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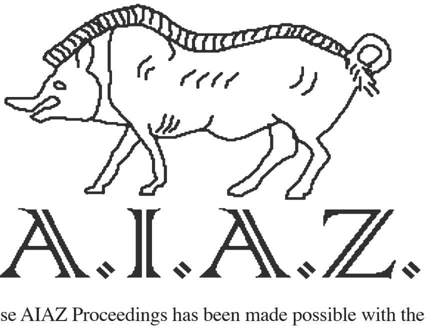

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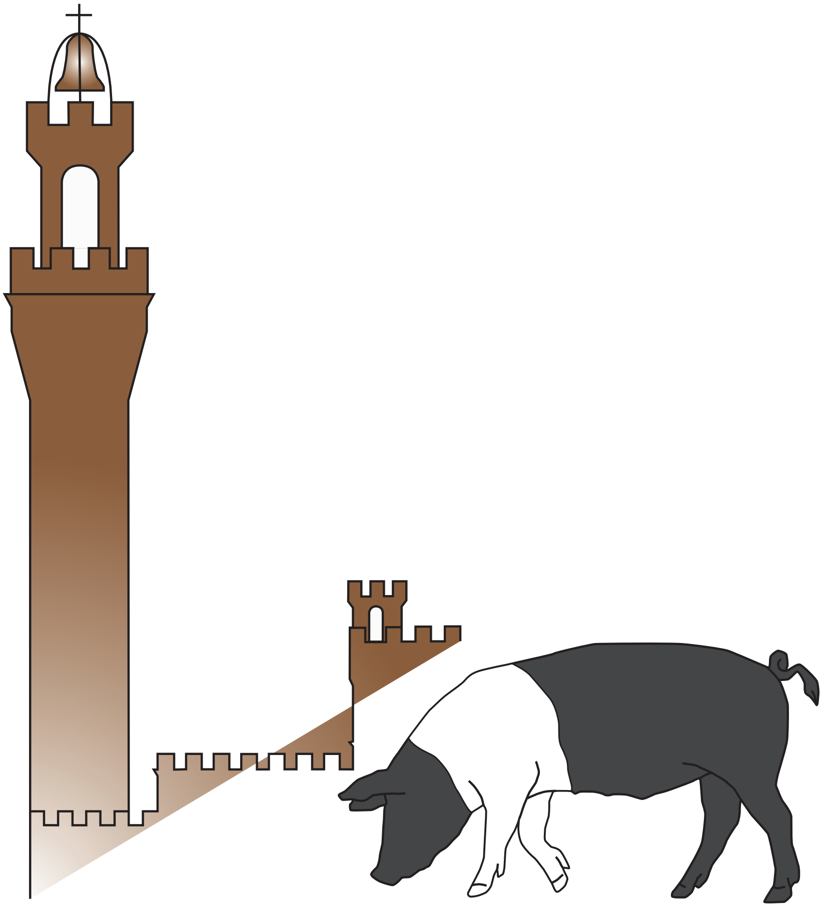

SIENA

Introducción / Introduction

To Elena Bedini, Jacopo De Grossi Mazzorin, Patrizia Farello,
Francesca Santini, and Claudio Sorrentino

This volume is dedicated to Elena Bedini, Jacopo De Grossi Mazzorin, Patrizia Farello, Francesca Santini, and Claudio Sorrentino, highly esteemed scholars, colleagues, and friends. With this book we want to honour their memory for their significant contribution to archaeozoological research, their deep scientific knowledge, and commitment to the Italian Association of Archaeozoology (AIAZ).

Nine national conferences of the Italian Association of Archaeozoology have traced the path that led to the important meeting held in Siena, the Proceedings of which are contained in this volume. Over the years, this long scientific and associative journey has led to a proliferation of studies on animal remains from archaeological sites located in Italy and abroad. This volume collects the oral and poster contributions presented at the 10th Meeting of the Italian Association of Archaeozoology, held in Siena from 3rd to 6th of November 2021 at the Santa Chiara Lab (University of Siena). Siena was chosen as venue because of the active interest in archaeozoological research shown by two academic departments of the University of this city: the Department of Physical Sciences, Earth and Environment, and the Department of History and Cultural Heritage. The collaboration between Prof. Giovanna Bianchi from the Department of History and Cultural Heritage, Prof. Enrico Zanini, who serves as the Director of the same department, the Santa Chiara Lab, and AIAZ itself, made the organisation of this event possible. We would like to express our gratitude to both departments for the trust placed in us and the support provided.

The 10th AIAZ Meeting had an hybrid format, combining both online and in-person participation, reflecting the circumstances of a period when the COVID-19 pandemic had not yet been completely solved. This choice allowed for broader and more diversified participation, enabling people who could not be physically present to contribute to the meeting's sessions remotely. Despite the challenges imposed by the pandemic, it was encouraging to see a strong participation of scholars and students: 94 participants from Italy and abroad, 91 of which presented the results of their research (51 oral presentations and 40 posters). On this occasion an innovative conference structure was adopted: the introduction of thematic rather than chronological sessions which aimed at promoting diachronic approaches and discussions. Session topics covered various fields, addressing themes such as the human-environment relationship, the integration of socio-economic, cultural, and environmental variables, the production and distribution of specific animal products, the study of faunal samples from high-status contexts, taphonomy, and the role of animals in ritual and funerary practices. Three of these sessions were dedicated to the memory of Elena Bedini, Francesca Santini, and Claudio Sorrentino.

The special thematic session of this 10th AIAZ Meeting was dedicated to the use of animals for recreational purposes and power display, with particular attention paid to the *Palio*, the historical horse racing event for which the hosting city is well-known. In this respect, we want to thank Dr Giovanni Mazzini, a historian of the city of Siena and its *contrade*, who led us through the history of the *Palio* with an engaging, fascinating and passionate presentation.

In addition to hosting oral presentation and poster sessions, the 10th AIAZ Meeting remained committed to its primary goal: facilitating active and constructive dialogue among scholars engaged in archaeological research, whether in the field or in the laboratory. This event, like previous AIAZ national Meetings, played a crucial role in bringing together the Italian community of archaeozoologists, providing the opportunity to meet colleagues and friends, and to consolidate a sense of scientific belonging after the long pause caused by the pandemic.

In this volume, archaeozoological research emerges as a key element for understanding the diverse relationships between humans, the environment, and animals through time, offering valuable insights into the history of human existence. The interdisciplinary approach showcased in these contributions, along with the diverse analyses that can be conducted on the same faunal samples, highlights the importance of archaeozoology not only in academia but also when planning archaeological material recovery strategies and long-term storage policies. It highlights the need for data collection protocols that can balance the demands of research with those of everyday emergency and rescue excavations, which are often hindered by limited time and funding. Through the collaborative efforts of researchers and the adoption of diverse approaches showcased in these pages, archaeozoological research emerges as a fundamental investigative tool. It does not merely explore the dietary habits of people in the past but offers an interpretative key to better understand the interactions between humans and the surrounding environment. In this scientific journey, the impact of archaeozoological analyses are not confined only to the past but extend to the present as well. Indeed, historical dynamics highlighted in some of the contributions in this volume provide valuable insights to address contemporary environmental challenges and develop critical understanding of our shared history and its implications for our present and future.

Despite its undeniable importance, however, archaeozoological research often struggles to obtain the recognition and attention it deserves in the Italian academic environment and beyond. This limitation is strongly connected to the difficulties of integrating such a multifaceted discipline within traditional academic structures, an achievement that is far from being fully accomplished. This delay is hard to justify, given the significant insights that archaeozoological research offers. Despite the significant progress made, there is still work to do to fully integrate archaeozoological research into the academic environment. In this context, the 10th AIAZ Meeting served a dual purpose: on the one hand, to celebrate past achievements and, on the other, to ensure that archaeozoology has its own place within the community of scholars dedicated to the reconstruction of human history.

Finally, we would like to express our deep gratitude to the Ministry of Culture (Direzione Generale Educazione, Ricerca e Istituti Culturali) for having financially supported the organization of the 10th AIAZ Meeting and the publication of the present Proceedings. We extend our gratitude to the scientific journal *Archaeofauna* for its important contribution to the publishing of this volume. Special mentions go to Prof. Arturo Morales Muñiz and Prof. Laura Llorente Rodriguez for their professional support during the entire publication process. We wish to renew our sincere thanks to Prof. Giovanna Bianchi for her valuable contribution. Her choice to support the conference, not only financially but also through her active participation, represents a tangible sign of her confidence in this scientific initiative and in the archaeozoological research.

We would also like to extend our gratitude to all those who made this event possible: from the researchers who presented their studies to the technicians and all members of staff who worked tirelessly behind the scenes.

We look to the future with renewed enthusiasm and inspiration, confident that our commitment to research will continue to bear positive fruits for our scientific community and to society as a whole. Thank you everyone for your contributions in making this conference an unforgettable moment of growth and collaboration.

The Organising and Editorial Committee

In alphabetical order:
Claudia Abatino, Veronica Aniceti, Francesco Boschin, Jacopo Crezzini,
Mauro Rizzetto, Lenny Salvagno e Umberto Tecchiati (President of AIAZ)

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Índices/Contents ON LINE

IN MEMORIAM

KNUD ROSENLUND

(March 8th,1946 – Vedbaek/Hørsholm January 25th, 2024)

Knud Rosenlund (Photo: Geert Brovad).

On January 25th, 2024, Knud Rosenlund, one of the pioneers in the field that is nowadays alternatively known as archaeozoology/zooarchaeology, passed away in Hørsholm. It was probably his pioneer condition in the birth of this discipline what explains why, in stark contrast with other scholars who entered academia through the "conventional" academic venues, Knud Rosenlund reached his status as a scientist joining the scientific community through a humbler route.

Knud Rosenlund arrived at the Zoological Museum (ZM hereafter), today a part of the Natural History Museum of Denmark, University of Copenhagen, on September 1st, 1963, where he began a five-year master's apprenticeship with taxidermist Ulrik Møhl at the ZMK's Quaternary Zoological Laboratory. Despite his professional expertise, U. Møhl was also a brilliant zoologist and a gifted teacher, with a holistic idea of what the Natural Sciences ought to be. Knud profited greatly from Møhl's naturalistic view who also proved instrumental in the decision to hire him as a laboratory technician and curation assistant in that same research unit upon completing his training on August 31st, 1968. During the ensuing 43 years, and until his retirement in 2011, Knud remained associated with the ZM's Quaternary Zoological Collections, and he continued with registration work of those collections until a few months before his death.

Knud excelled in his tasks as a laboratory technician and curation assistant. To paraphrase Kim Aaris-Sørensen's words on Knud Rosenlund's ZM obituary note: "*A natural born museum man, with a prodigious memory that could remember names of locations, the location of finds in the collection, the location of books in the museum's libraries, names of submitters, of authors, of previous visitors to the department, etc., it soon became the case that, when all hope was lost, people said:* "Have you asked Knud?".

But such a prodigious memory did more than just being of help to others. Indeed, despite his contractual work being so time-demanding, Knud found its way to become a skilled zoologist who took advantage of his job as a collection manager of the ZMK's vertebrate collections to develop into an eminent osteologist. He also demonstrated exceptional skills as a naturalist and a field archaeologist, the latter by virtue of he being embedded in the Quaternary Zoology tradition. Ever since the nineteenth century, Quaternary Zoology had been a Scandinavian specialty without parallels in other parts of the world. This discipline proceeded well beyond zoology and did not make clear-cut distinctions between disciplines from the natural and the socio-historical sciences. That conceptual scope bolstered collaboration amongst a wealth of specialists, including geologists, paleontologists, anthropologists, ethnographers, prehistorians, archaeologists and, eventually, when the discipline became established, archaeozoologists. In other words, multi-disciplinarity, in the proper sense of the term, and well before it was coined. No wonder that one of Knud's most repeated mottos to all of us, his students, was: "*remember that an archaeozoologist must simply know about everything*".

Kim Aaris-Sørensen and Knud Rosenlund sorting faunal remains from late glacial Allerød layers during field work in Nørre Lyngby, Northern Jutland, on one of the several fieldtrips that took place during the 1990's. Knud always smoked his pipe while on fieldwork, and as he stated when excavating in SE Greenland in 1992: "I only smoke to keep the mosquitoes away" (Photo: ©Zoological Museum).

All the synergies from such an enriching and far-sighted environment fell on fertile ground because, despite his entrance into science as a technician and collection manager, Knud Rosenlund also became a polymath of sorts. Indeed, in addition to scientific and museum skills, he was a superb scientific artist, capable of producing all kinds of infographics. He also had an innate ability to understand all computer-based things that came his way, and also in this domain, he became a pioneer archaeozoologist. Knud had also a great interest in art, literature, music, film and philosophy, being particularly fond of opera, Spinoza and, not surprisingly, Kirkegaard. As Kim Aaris Sørensen noted on his obituary note: "*His humor often led him …..to the concept of "practical jokes" – a discipline where a lot can go wrong*", and this explains his fondness for films such as Stanley Kubrick's *Dr. Strangelove,* and Joseph Mankiewicz's *Sleuth*. He was also a fan of the first *Star Wars* trilogy (the second one he considered "videogames"), bookbinding (a specialty in which he also became a "supervisor" for some of us), and cooking, being a very decent *chef* who eventually came to distrust one of us (AMM) for praising his excellent food once he discovered his inability to tell apart a *Bordeaux* from a *Chianti*!....not to mention the icy glance he sent to another one of us (ABG), an unexperienced wine *connoisseur*, when she started washing the wine glasses with dishwasher soap!

Copenhagen, July 18th, 1975: A young Knud Rosenlund, standing with a girlfriend and Arturo Morales, at the whale warehouse in the basement of the Zoological Museum.

Nørre Lyngby, Northern Jutland, 1997: a sweet tooth if there ever was one, Knud was particularly fond of cakes, as reflected by this most typical of all his smiles (Photo: Anne Birgitte Gotfredsen).

Within archaeozoology, Knud was best known for the pivotal role he played in the development of archaeoichthyology, the study of fish remains from archaeological sites. His most notable contributions in this discipline were the 1979 monograph *Fish Bone Measurements* he co-authored with one of us, and his role as founder and promoter of ICAZ's (International Council for Archaeozoology) Fish Remains Working Group in 1981. Already by that time, Knud had studied several Danish fish bone collections, spanning from Mesolithic (Ertebølle) to Viking Age times, something he essentially carried out while building up the superb fish bone reference collection the ZM presently harbors. In this early stage (mid-1970s) of his career, he received help from two outstanding ZM ichthyologists, Drs. Erik Berthelsen and Jørgen Nielsen, and from Prof. Dr. Johannes Lepiksaar from the Gothenburg Natural History Museum, another key figure in the development of archaeoichthyological research in the 1970s and 1980s. Knud's contact with leading fish systematists from these museums made him familiar with the relevance of cladistic classification and how much that helped archaeoichthyologists in their work with the identification of fish, and other vertebrates' bones (Knud was not only a keen fish bone specialist but over the years also acquired great skills in mammalian osteology, both of domestic and wild forms).

Retrospectively, it was a pity that Knud had to put aside his competence in fish and was not given more time to work with ichthyological problems because of his contractual conditions at the ZM.

Reykjavik, 2008: Knud Rosenlund, arriving at the surprise cake party Icelandic archaeologists organized for him on the occasion of his 62nd birthday (Photo: Kim Aaris-Sørensen).

However, as was so often the case with him, Knud's enormous generosity and legendary helpfulness helped him overcome that contractual "shortcoming" by funneling his expertise to help young students getting kickstarted on their careers. That help went beyond solving doubts and/or re-directing students to researchers, bibliography, etc. Indeed, to the very end, Knud was a true and supportive mentor, who, albeit busy, was always determined to offer time for you and your questions and always able to help you solve them. He placed students under his all-encompassing "umbrella" and, beyond specifics, taught us how science is carried out all the way from data gathering to interpretation and theory building. In a discipline like archaeozoology, where archaeological, historical and socio-cultural phenomena have too often taken priority over biological and osteological issues, Knud's cladistic view became an inspiration to those of us who learned to "understand" characters in bone morphology as evidence of how groups of species are interrelated in hierarchies because of their evolutionary trajectories and biomechanical constraints. Knud's way approach to instruction was kind, supportive and, when necessary, extremely polite. Shortly before he retired, two female students from one of us (ABG) informed me how Knud whom, as usual, had taken over helping them with logistics and nailing "enigmatic bones" during my absence, had told them in his most typical understated and subtle way, that that mysterious bone they were unable to identify, was, in fact, the penis bone of a grey seal. A superb instructor, and a mentor for generations of students frequenting the Quaternary Zoological Collections, this only became evident when a memorial arrangement took place shortly after Knud passed away – and many of the old students came to honor him. His decisive role in our careers, to which all of us owe an immense debt, grants him the title of a *Magister*, for many an outdated term which we feel best describes the man and his doings.

This contrasting combination as actor of a holistic, essentially now gone, legacy in the Natural Sciences and of an equally gone type of personalized training, while at the same time a pioneer of archaeo-ichthyology and of computer science in archaeozoology, with Knud's death, the ZM bade goodbye to a 60 years long-standing employee who meant a lot to the museum's development and reputation, and his students, colleagues and friends goodbye to a kind, honest an outstanding person, whose companionship was cherished by all who knew him.

We fondly remember Knud, and his absence will be deeply felt by everyone. May this issue on Italian archaeozoology stand as a humble reminder to the memory of our dear friend and mentor. Paraphrasing his *Stars Wars* motto, we would only wish to add: "*may the force be with you!*"

Anne Birgitte Gotfredsen

Leif Jonsson

Arturo Morales-Muñiz

Knud Rosenlund, Vedbaek, 1983 (Photo: Arturo Morales Muñiz).

REFERENCES

AARIS-SØRENSEN, K. (20-02-2024) *Knud Rosenlund (8. marts 1946 – 25. januar 2024) - en af museets skattede medarbejdere - er død efter kortere tids sygdom*. Nyhedsrum, Statens Naturhistoriske Museum.

MORALES, A. & ROSENLUND, K. 1979: *Fish Bone Measurements. An Attempt to standardize the Measuring of Fish Bones from Archaeological Sites. Steenstrupia*, Copenhaguen.

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Elite consumption practices in the Early Bronze Age: faunal evidence from the Palace of the Copper Axes at Khirbet al-Batrawy (Jordan)

Usi e consumi d’élite nel Bronzo antico: le evidenze faunistiche dal Palazzo delle Asce di Rame di Khirbet al-Batrawy (Giordania)

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ABSTRACT: The study of the faunal assemblage retrieved during the excavations carried out between 2009 and 2012 by Prof. Lorenzo Nigro (Sapienza University of Rome) in the so-called Palace of the Copper Axes in Khirbet al-Batrawy (Jordan) provides information on the exploitation of animal resources in an Early Bronze Age elite context, along with the last stages of the life of this settlement. The animal economy was based on sheep/goat, although the frequency of equids suggests that the town was an important hub along the trade routes. In addition to transport, equids were also consumed, a dual use also documented for cattle. Suids, including wild boar, were very rare. Hunting represented only a minor contribution to human diet. Remarkable is the presence of two remains of a bear paw which, considering the context, may constitute a luxury proxy. The comparison with other coeval sites from the Southern Levant evidences that the Batrawy faunal assemblage conforms with many of the expectations for an “urban” context. Indeed, that the destruction of the city follows a trend similar to that of many settlements from this region.

KEYWORDS: ZOOARCHAEOLOGY, TAPHONOMY, ELITE CONSUMPTION, EARLY BRONZE AGE, SOUTHERN LEVANT

RIASSUNTO: Lo studio del campione faunistico raccolto durante gli scavi condotti tra il 2009 e il 2012 dal Prof. Lorenzo Nigro (Sapienza Università di Roma) nel cosiddetto Palazzo delle Asce di Rame di Khirbet al-Batrawy (Giordania) permette di avere indicazioni sullo sfruttamento delle risorse animali in un contesto d’élite riferito al Bronzo Antico, come pure sulle ultime fasi di vita di questo insediamento. In generale l’economia appare basata sui caprovini, mentre l’alta frequenza di equidi suggerisce come questa città rappresentasse un importante snodo lungo le vie del commercio; tuttavia, questi animali venivano sfruttati non solo per il trasporto, ma anche a scopo alimentare; analogo duplice uso avevano pure i bovini. I suidi, tra cui è presente anche il cinghiale, sono molto rari. La caccia rappresentava comunque solo una fonte secondaria di cibo. Inaspettata è la presenza di due resti di una zampa di orso che, dato il contesto, può essere considerato un indicatore di lusso. Il confronto con altri siti coevi del Levante meridionale mostra come il campione di Batrawy rispetti molte delle aspettative di un contesto “urbano” e che la distruzione della città segue un destino analogo a quello di molti altri insediamenti della regione.

PAROLE CHIAVE: ZOOARCHEOLOGIA, TAFONOMIA, CONSUMI D’ÉLITE, ETÀ DEL BRONZO ANTICO, LEVANTE MERIDIONALE

http://www.doi.org/10.15366/archaeofauna2025.34.1.001

RESUMEN: El estudio del conjunto faunístico recuperado durante las excavaciones realizadas entre 2009 y 2012 por el Prof. Lorenzo Nigro de la Universidad Sapienza (Roma) en el denominado Palacio de las Hachas de Cobre de Khirbet al-Batrawy (Jordania) proporciona información sobre la explotación de los recursos animales. en un contexto elitista de la Edad del Bronce Antiguo y las últimas etapas de la ocupación de este asentamiento. La economía animal se basaba en ovejas y cabras, si bien la alta frecuencia de équidos sugiere que la ciudad fue un importante centro comercial donde confluyeron distintas rutas.

Además de como acémilas, los équidos fueron también consumidos, un doble uso que también se documenta en el vacuno. Los suidos, incluido el jabalí, son muy infrecuentes. La caza representaba una contribución muy secundaria a la dieta animal. Destaca la presencia de dos restos de una zarpa de oso que, dentro el contexto documentado, podría ser un indicador de lujo. La comparación con yacimientos coetáneos del Levante meridional evidencia que las asociaciones de fauna de Batrawy coincide con muchos de los patrones documentados en contextos "urbanos". Ello también parece extrapolable a la trayectoria de la ciudad cuya destrucción repite un destino similar al de muchos otros asentamientos de la región.

PALABRAS CLAVE: ZOOARQUEOLOGIA, TAFONOMIA, DIETAS DE ÉLITE, TEMPRANA EDAD DEL BRONCE, LEVANTE MERIDIONAL

INTRODUCTION

The site of Khirbet al-Batrawy (Jordan), located in the Zarqa river valley, has been investigated since 2005 by an archaeological expedition led by Lorenzo Nigro (Sapienza University of Rome). The settlement was occupied mainly during the Early Bronze Age (EBA) from about 3300 BCE to 2000 BCE with several phases of rise and fall until its final abandonment. During the EBA IIIB (2500-2300 BCE) the site was an important urban center with a large building known as the "Palace of the Copper Axes". The different halls and spaces of this building yielded, besides a hoard with five copper axes, large storage containers (*pithoi*) filled with selected cereals, abundant prestige goods showing long-distance exchanges, as well as evidence of craft activities. The Palace was devastated by a fire at the end of the EBA IIIB when the whole city was destroyed (Nigro *et al*., 2020 and references therein).

MATERIAL AND METHODS

The faunal assemblage presented in this paper was collected during the excavations carried out between 2009 and 2012 in the Palace of the Copper Axes. The sample is referred to the final destruction of the building at the end of the Early Bronze IIIB and provides interesting information regarding the use of the animals in this high-status context as well as hints about the final events occurring in this building.

The estimate of the age at death of the main domestic animals was based on the relevant literature (Payne, 1973; Barone, 1981, 1995; Bull & Payne, 1982; Grigson, 1982).

The preservation of bone surfaces is relatively good and all specimens, including the unidentifiable ones, were inspected to identify human, animal, and other natural modifications.

RESULTS AND DISCUSSION

The assemblage includes a total of 1689 specimens recovered in different contexts of the Palace with an uneven distribution (Table 1).

Ovis vel Capra always represents the main *taxon*, with a slight prevalence of sheep over goat (Table 1) while previous studies on other areas and periods of this site (Alhaique 2008, 2012 a, b) evidenced somewhat higher frequencies of goats, similarly to other settlements in the region (e.g., Clutton-Brock, 1979; Horwitz, 1997; Alhaique, 2000, 2005), and more in line with the environmental location of the city.

In five of the nine contexts described, equids are the second *taxon* as number of specimens (Table 1). Two types have been identified: a more frequent smaller one, presumably a donkey, and a larger one either an onager, a horse or a crossbreed. The high frequency of equids has been already documented at Batrawy (Alhaique, 2008, 2012a, b) and seems to be peculiar to relatively few sites in this region during

Species	**Yard L.936**		**Eastern Pavillion L.1046**		**Passageway L.1050**		**Western Pavillion**										**Entrance Hall L.1100**		**Peri-pomerial street L.1060**		**Total**			
							Pillared Hall L.1040		**Hall L.1110**		**Storeroom L.1120**		**Room L.1230**		**Court L.1250**									
	NISP	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP**	**MNI**	**NISP%**	**MNI%**
Pisces									1	1											**1**	**1**	**0,1**	**0,7**
Aves			1	1					3	2											**4**	**3**	**0,2**	**2,0**
Rodentia									26	3											**26**	**3**	**1,5**	**2,0**
Homo sapiens							23	1	1	1											**24**	**2**	**1,4**	**1,3**
Canis familiaris					3	1			1	1											**4**	**2**	**0,2**	**1,3**
Ursus arctos							1	1											1	1	**2**	**2**	**0,1**	**1,3**
Equus sp.	1	1	10	2	42	4	9	3	23	4	5	1					11	2	4	1	**105**	**18**	**6,2**	**11,9**
Sus domesticus	2	1					2	1	21	3	1	1					2	1	1	1	**29**	**8**	**1,7**	**5,3**
Sus scrofa					2	1	1	1	1	1							1	1	1	1	**6**	**5**	**0,4**	**3,3**
Cervidae					1	1															**1**	**1**	**0,1**	**0,7**
Ovis aries	4	1	2	1	6	2	1	1	6	3	4	3			1	1	1	1	6	2	**31**	**15**	**1,8**	**9,9**
Capra hircus	2	2			11	4			2	2	5	1			1	1	3	1	3	2	**27**	**13**	**1,6**	**8,6**
Ovis vel *Capra*	33	5	9	2	182	9	48	4	97	6	12	3			6	2	34	3	37	6	**458**	**40**	**27,1**	**26,5**
Capra aegagrus	3	1			8	3	1	1	1	1	1	1					1	1	1	1	**16**	**9**	**0,9**	**6,0**
Gazella gazella	2	1	1	1	3	1	1	1			2	1									**9**	**5**	**0,5**	**3,3**
Bos taurus	8	3	5	1	38	5	5	2	6	2	1	1			1	1	13	3	19	4	**96**	**22**	**5,7**	**14,6**
Bos primigenius			1	1	1	1															**2**	**2**	**0,1**	**1,3**
Medium mammal	29		10		82		28		60		21				4		15		22		**271**		**16,0**	
Large mammal	4		11		76		13		24		6		1		1		26		11		**173**		**10,2**	
Unidentifiable	17		10		139		63		100		14				4		37		21		**405**		**24,0**	
Total	**105**	**15**	**60**	**9**	**594**	**32**	**196**	**16**	**373**	**30**	**72**	**12**	**1**		**18**	**5**	**144**	**13**	**127**	**19**	**1690**	**151**	**100**	**100**

TABLE 1

Faunal sample from the Palace of the Copper Axes (NISP= Number of Identified Specimens; MNI= Minimum Number of Individuals).

the Bronze Age [e.g., Ashquelon-Afridar (Whitcher-Kansa, 2004); Azor (Horwitz, 1999); Tel Erani (Ducos, 1968); En Shadud (Horwitz, 1985)].

Cattle are the third species in number of specimens in five contexts and the second one in four (Table 1). The very few aurochs specimens have been easily identified by their very large size compared to the corresponding domestic *taxon* which is quite small. The aurochs is documented in the Southern Levant at least until the Iron Age (Tsahar *et al*., 2009; Bar-Oz & Weissbrod, 2017).

Suids, both wild boar and domestic pig, are in general rare but have been recovered in almost all the analyzed contexts (Table 1). Pigs were found also in many other coeval sites of the Southern Levant (Ducos, 1968; Lernau, 1978; Clutton-Brock, 1979; Hellwing, 1988-89; Wapnish & Hesse, 1991; Horwitz, 1996, 1999; Horwitz *et al*., 1996; Whitcher-Kansa, 2004), while they are absent at Tel Yarmouth (Davis, 1988). The presence of such *taxon*, especially the wild boar, suggests that probably relatively near the settlement there were at least some more wooded and humid areas.

The dog is very rare in the faunal assemblage (Table 1); however, carnivore gnaw marks have been identified in almost all contexts, suggesting the presence of this species even when skeletal elements are missing. The rarity of dog elements in the faunal assemblages of this and other sites in the region may be related to the fact that this species was not commonly used as food during the BA.

Hunted animals, as in many other settlements of the Southern Levant, always provided only a limited contribution to the diet of the people living and/or working in the Palace. In contrast to the previous faunal studies on this site (Alhaique, 2008, 2012a, b) bezoar goat is more abundant than gazelle, followed by the already mentioned wild boar and aurochs. Furthermore, the presence of the onager among the equid specimens cannot be completely excluded. A novelty in this assemblage is the presence of a cervid.

Among the exceptional finds of the Palace, there are the two bear specimens recovered in the Pillared Hall (L. 1040) of the Western Pavilion and the Peri-Pomerial street (L.1060). These are two right metatarsal fragments (Supplementary Figure 1) referable, on biogeographic bases, to a subspecies of brown bear (*Ursus arctos syriacus*), that during the Bronze age was still living in the mountain areas of the Levant. The animal became extinct in the region only in the 19th century (Bar-Oz & Weissbrod, 2017).

This *taxon* had not been previously identified at Batrawy and was only occasionally recovered at a few other EBA sites as well as sporadically also in later periods (Allentuck, 2013 and references therein). Considering the extreme rarity and peculiarity of this *taxon* it is very likely that the two specimens, although recovered in different contexts, may belong to the same foot of a single individual, possibly of old age as suggested by a slight pathology identified on one of the specimens (Supplementary Figure 1). Combustion, probably accidentally produced by the violent fire that destroyed the Palace, affects both specimens although with different intensities. Furthermore, the two elements display clear cut and chop marks produced by metal tools.

Considering the anatomical elements identified and the location of the cuts it is possible to suggest that among the goods deposited in the Pillared Hall there was probably the pelt of a bear still with distal limb elements attached or a bear paw. The finding of this plantigrade is particularly relevant also because this animal was held in high esteem and always had a strong symbolic role in many cultures. Still in the following millennium, as it is possible to see from the paintings in the tomb of Rekhmire (TT100), vizier of Thutmose III (1479-1425 ca. BCE) and Amenhotep II (1427-1401 ca. BCE), a bear was among the tributes offered to the Pharaoh by the Syrian legates (Supplementary Figure 2).

Finally, the faunal assemblage includes also a few bird remains, one of them belonging to a diurnal raptor, a single small fish vertebra and some rodent bones; the latter are very likely intrusive animals, while for the other *taxa* the absence of human modifications did not allow to assess the agent responsible for their accumulation.

The analysis of the age at death of the sheep/goat (Figure 1) suggests that this *taxon* was used primarily for secondary products (e.g., milk and wool) before being exploited for meat, but there is not the strong focus on milk evidenced in the EBA IVB village (Alhaique, 2012b). Mortality data for cattle (Figure 1) suggest that they were used both as a source of meat and for traction. Interestingly, the culling pattern evidenced for the equids (Figure 1) appears to indicate a use similar to cattle; therefore, not only as pack animals or means for transportation, but also as food; the latter use is also supported by taphonomic evidence. The few

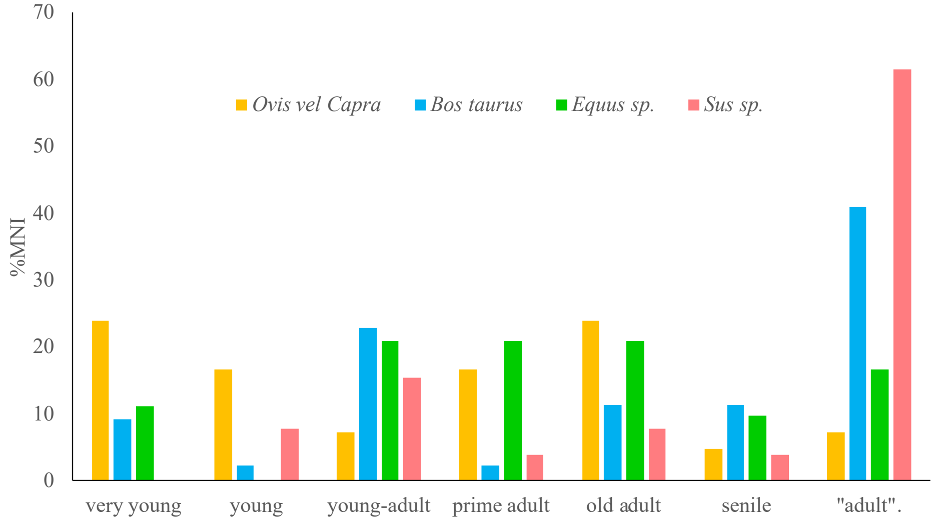

FIGURE 1

Age at death of the main taxa from the Palace of the Copper Axes (*Ovis* vel *Capra* MNI= 42; *Bos taurus* MNI= 22; *Equus* sp. MNI =18; *Sus* sp. MNI=13)

age data on the suids (Figure 1) suggest, as expected, a focus on meat.

The taphonomic analysis indicates the presence of modifications produced by humans during butchery, as well as in bone tool manufacturing and use. All stages of carcass processing, from skinning to marrow extraction, were identified on all the main species including equids and on most skeletal elements. The frequency of butchery marks on the most abundant *taxa* appears strongly related to the size of the animals (i.e., larger animals displaying higher frequencies of traces).

As mentioned before in the case of the bear, the morphology of the cut marks (Walker & Long, 1977; Olsen, 1988; Greenfield, 1999, 2002) suggests in many cases the use of metal tools rather than stone artifacts during butchery, as indicated also at other EBA sites in the area (Greenfield, 2005; 2006). In the context of Batrawy, such use is possibly also related to the high status of the Palace.

Human modifications referred to butchery are unevenly distributed in the different areas of the Palace (Figure 2), possibly in relation to the various activities taking place in the different halls and spaces.

Worked bones have been recovered in six out of nine contexts (Figure 2), such artifacts were not only used in these contexts, but also likely manufactured. The presence of two lightweight bone spindle whorls points to the production of fine textiles (see Gleba, 2008, Laurito *et al*., 2014 for experimental and archaeological data on this topic).

The distribution of burned specimens in the different halls and spaces as well as the intensity of the combustion damage on the bones may be helpful in reconstructing the fire that destroyed this area of the Palace. Combustion appears particularly high (Figure 2) in two adjacent spaces, namely the Pillared Hall and the Entrance Hall; however, it is much more intense in the former context than in the latter one, with many completely burnt or calcined specimens. It is possible that, although this whole part of the Palace was affected by the fire, the goods stored in the Pillared Hall together with the furniture and the wooden architectural elements (Nigro, 2017) favored the fire that was, therefore, able to spread and reach higher temperatures in this room. The relatively high frequency of burned bones in the Yard L.936 may have been instead related to the presence of an oven. Since localized burning traces are lacking in this assemblage, none of the burned elements can be positively identified as resulting from cooking practices.

Gnaw damage on the bones (Figure 2), likely produced by dogs, has been documented in all contexts even when actual specimens of this *taxon* are lacking, suggesting a strict relationship between humans and this species; however, the high frequency

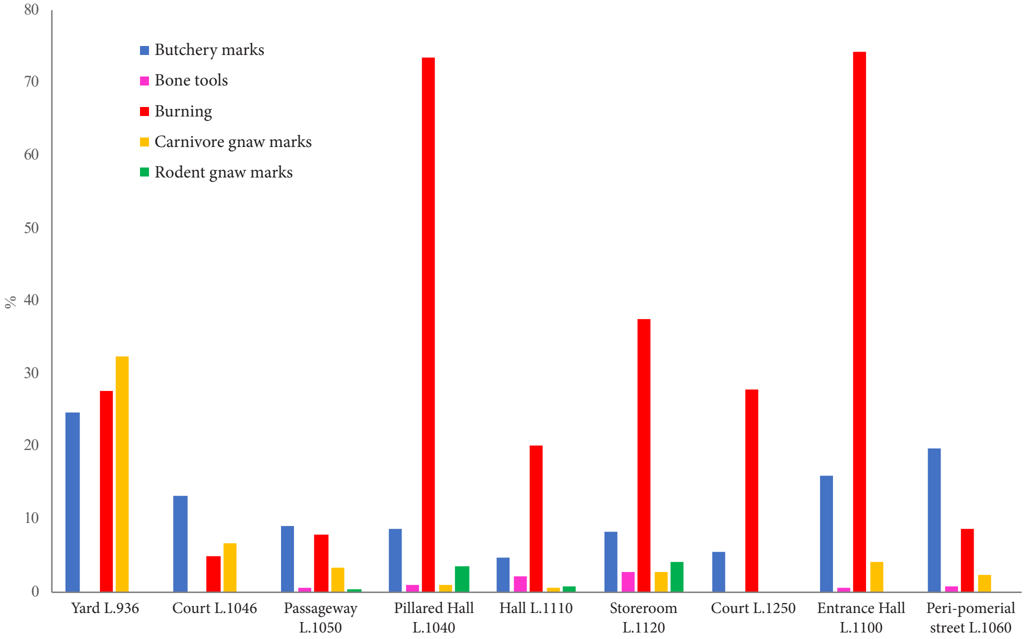

FIGURE 2

Frequencies of bone modifications in the different contexts of the Palace.

of tooth marked bones in the yard may suggest a place where these animals were staying or at least the fact that they did not have equal access to all the spaces in this area. However, it should also be remembered that humans and suids too may inflict damage on the bones with their teeth (e.g., Greenfield, 1988; Domínguez-Solera & Domínguez-Rodrigo, 2009; Fernández-Jalvo & Andrews, 2011; Saladié *et al*., 2013) therefore they cannot be completely ruled out as possible agents of bone modification, although, for environmental reasons, pig and wild boar are quite improbable.

The concentration of rodent gnaw marks only in some contexts of the Palace (Figure 2), even unexpected ones such as the Pillared Hall, may suggest that these pests may have been preferentially attracted by the edible goods stored there (e.g., the cereals contained in the large *pithoi*).

CONCLUSIONS

The overall pattern evidenced in the Palace of the Copper Axes at Batrawy indicates that the animal economy of the city was based on sheep/goat that were exploited primarily as a source of milk and wool and only secondarily for meat. The slight prevalence of sheep over goat could be related to the higher status context, where *Ovis* would have been more valuable as a producer not only of meat and milk, but also wool.

The high incidence of the equids suggests their economic importance at this site both as pack animals for trading and as a source of meat and other products; given the presence of animals in different age classes, including very young ones, it is possible that equids were also bred locally. The long-term exploitation of this *taxon* at Batrawy may indicate the possible role of the site as a trading hub, and maybe also as a specialized breeding center that continued through time possibly favored by the geographic location and environmental conditions of the surrounding area. Cattle too had been probably employed as animal power and as a food source. Suids, both pigs and wild boar, are very rare as expected in an arid environment. Notwithstanding the elite context, hunting represented only a minor source of food. However, the bear may be considered a luxury item that fits well with the palatial context where also other prestigious and exotic goods have been discovered (Nigro *et al*., 2020 and references therein) evidencing trade connections with Egypt, as well as with other regions.

The use of metal tools may be a further element related to the elite nature of this building.

In the Palace, craft activities were also carried out including fine thread spinning possibly used in the production of high-quality textiles.

The general information on the fauna agrees with the data obtained from previous excavations at Khirbet al-Batrawy (Alhaique, 2008, 2012a, b), and the differences may be related to intra-site variations, as well as economic changes through time during the different occupational phases.

A comparison with the coeval sites of the Southern Levant (Gaastra *et al*., 2020 and references therein for an overview), shows that the Batrawy faunal assemblage meets many of the expectations of the "urban" pattern of the animal economy, and the destruction of the town follows a destiny of many other settlements in the region (Nigro, 2017).

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_001

REFERENCES

ALHAIQUE, F. 2000: Faunal remains of the 1998 excavation campaign at Jericho. In: Marchetti, N. & Nigro, L. (eds.): *Excavations at Jericho, 1998. Preliminary Report on the Second Season of Excavations and Surveys at Tell es-Sultan, Palestine*: 297-317. Quaderni di Gerico 2.

— 2005: Schlepp effect intra-sito: un esempio dai livelli del Bronzo Antico di Gerico (Palestina). In: Fiore I., Malerba G., Chilardi S. (eds.): *Atti del 3° Convegno Nazionale di Archeozoologia*. Studi di Paletnologia N.S. I: 71-80.

— 2008: Appendix A: Faunal Remains. In: Nigro, L. (ed.): *Khirbet al-Batrawy II. The EB II city-gate, the EB II-III fortifications, the EB II-III temple. Preliminary report of the second (2006) and third (2007) seasons of excavations*: 327-358. ROSAPAT 6.

— 2012a: Appendix A: Faunal Remains. In: Nigro, L. (ed.): *Khirbet al-Batrawy III. The EB II-III triple fortification line, and the EB IIIB quarter inside the city-wall. Preliminary report of the fourth (2008) and fifth (2009) seasons of excavations*: 333-364. ROSAPAT 8.

— 2012b: Sfruttamento delle risorse animali a Khirbet al-Batrawy (Giordania) durante il Bronzo Antico IVB. In: De Grossi Mazzorin, J.; Saccà, D. & Tozzi, C. (eds.): *Atti del 6° Convegno Nazionale di Archeozoologia*: 365-368.

ALLENTUCK, A. 2013: *Human–Livestock Relations in the Early Bronze Age of the Southern Levant*. Unpublished PhD dissertation, University of Toronto.

BARONE, R. 1981: *Anatomia comparata dei mammiferi domestici*, vol. 3. Bologna.

— 1995: *Anatomia comparata dei mammiferi domestici*, vol. 1. Bologna.

BAR-OZ, G. & WEISSBROD, L. 2017: The Kaleidoscope of Mammalian Faunas during the Terminal Pleistocene and Holocene in the Southern Levant. In: Enzel, Y. & Bar-Yosef, O. (eds.): *Quaternary of the Levant: Environments, Climate Change, and Humans*: 363-368. Cambridge University Press, Cambridge. doi:10.1017/9781316106754.042

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphyseal fusion in pigs and wild boar. In: Wilson B.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing Animal Bones from Archaeological Sites*: 55-71. B.A.R. (British Series) 109. Oxford.

CLUTTON-BROCK, J. 1979: The mammalian remains from the Jericho Tell. *Proceedings of the Prehistoric Society* 45:135-157.

DAVIS, S.J. 1988: The mammal bones: Tel Yarmuth 1980-1983. In: de Miroschedji, P. *et al*. (eds.): *Yarmouth 1. Rapport sur les trois premières campagnes de fouilles à Tel Yarmouth (Israël) (1980-1982)*: 143-149. Éditions Recherche sur les Civilisations, Mémoire 76. Paris.

DOMÍNGUEZ-SOLERA, S.D. & DOMÍNGUEZ-RODRIGO, M. 2009: A taphonomic study of bone modification and of tooth-mark patterns on long limb bone portions by suids. *International Journal of Osteoarchaeology* 19: 345–363.

DUCOS, P. 1968: *L'origine des animaux domestiques en Palestine*, Publications de l'Institut de Préhistoire de l'Université de Bordeaux. Mémoire N° 6, Bordeaux.

FERNÁNDEZ-JALVO, Y. & ANDREWS, P. 2011: When humans chew bones. *Journal of Human Evolution* 60(1): 117-123.

Gaastra, J.S.; Greenfield, T.L. & Greenfield, H.J. 2020: There and back again: A zooarchaeological perspective on Early and Middle Bronze Age urbanism in the southern Levant. *PLOS ONE* 15(3): e0227255. https://doi.org/10.1371/journal.pone.0227255

Gleba, M. 2008: *Textile production in pre-roman Italy*. Ancient Series 4. Oxbow Books, Oxford.

Greenfield, H.J. 1988: Special Studies: Bone Consumption by Pigs in a Contemporary Serbian Village: Implications for the Interpretation of Prehistoric Faunal Assemblages. *Journal of Field Archaeology* 15(4): 473-479.

— 1999: The origins of metallurgy: distinguishing stone from metal cut marks on bones from archaeological sites. *Journal of Archaeological Scienc*e 26: 797-808.

— 2002: Distinguishing metal (steel and low-tin bronze) from stone (flint and obsidian) tool cut marks on bone: an experimental approach. In: Mathieu, J.R. (ed.): *Experimental archaeology. Replicating past objects, behaviors, and processes*: 35-54. B.A.R. (International Series) 1035. Oxford.

— 2005: The origins of metallurgy at Jericho (Tel es Sultan) a preliminary report on distinguishing stone from metal cut marks on mammalian remains. In: Buithenhuis, H.; Choyke, A.M.; Martin, L.; Bartosiewicz, L. & Mashkour, M. (eds.): *Archaeozoology of the Near East IV*: 178-186. ARC-Publicaties 123. Groningen.

— 2006: Report on the butchered faunal remains from the Afridar suburb (Area G) of Ashkelon (License 1963). *'Atiqot* 45: 243-261.

Grigson, C. 1982: Sex and age determination of some bones and teeth of domestic cattle: a review of literature. In: Wilson B.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing Animal Bones from Archaeological Sites*: 7-24. B.A.R. (British Series) 109. Oxford.

Hellwing, S. 1988-1989: Faunal remains from the Early Bronze and Late Bronze Ages at Tel Kinrot. *Tel Aviv* 15-16: 212-220.

Horwitz, L.K. 1985: The En-Shadud faunal remains. In: Braun, E. (ed.): *En-Shadud: Salvage Excavations at a Farming Community in the Jezrael Valley Israel*: 168-177. B.A.R. (International Series) 249. Oxford.

— 1996: The faunal remains from Me'ona. *'Atiqot* 28: 37-39.

— 1997: Faunal remains. In: Braun, E. (ed.): *Yiftah'el. Salvage and rescue excavations at a prehistoric village in Lower Galilee*: 155-171. Israel Antiquities Authority Reports 2. Jerusalem.

— 1999: The fauna of Early Bronze Age IA settlement of Azor. *'Atiqot* 38: 1-50.

Horwitz, L.K.; Hellwing, S. & Tchernov, E. 1996: Patterns of animal exploitation at Early Bronze Age Tel Dalit. In: Gophna, R. (ed.): *Excavations at Tel Dalit: An Early Bronze Age Walled Town in Central Israel*: 193-216. Tel Aviv.

Laurito, R.; Lemorini, C. & Perilli, A. 2014: Making Textiles at Arslantepe in the 4th and 3rd Millennia BCE. Archaeological Data and Experimental Archaeology. In: Breniquet, C. & Michel, C. (eds.): *Wool Economy in the Ancient Near East and the Aegean: From the Beginnings of Sheep Husbandry to Institutional Textile Industry*: 151-168. Nanterre.

Lernau, H. 1978: Faunal remains, Strata III-I. In: Amiran, R. *et al*. (eds.): *Early Arad. The Chalcolithic settlement and the Early Bronze Age city* Vol. I: 83-113. Jerusalem.

Nigro, L. 2017: The end of the Early Bronze Age in the Southern Levant. Urban Crisis and Collapse seen from two 3rd Millennium BC-Cities: Tell es-Sultan/Jericho and Khirbet al-Batrawy. In: Cunningham, T. & Driessen, J. (eds.): *Crisis to Collapse. The Archaeology of Social Breakdown*: 149-172. AEGIS 11. Louvain.

Nigro, L.; Gallo, E.; Gharib, R.; Mura, F.; Macrì, M. & Rinaldi, T. 2020: An Egyptian green schist palette and an amazonite gemstone from the "Palace of the Copper Axes" at Batrawy, Jordan. *Vicino Oriente* XXIV: 1-26.

Olsen, S.L. 1988: The identification of stone and metal tool marks on bone artifacts. In: Olsen, S.L. (ed.): *Scanning electron microscopy in archaeology*: 337-360. B.A.R. (International Series) 452. Oxford.

Payne, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Aşvan Kale. *Anatolian Studies* 23: 281-303.

Saladié, P.; Rodríguez-Hidalgo, A.; Díez, C.; Martín-Rodríguez, P. & Carbonell, E. 2013: Range of bone modifications by human chewing. *Journal of Archaeological Science* 40(1): 380-397.

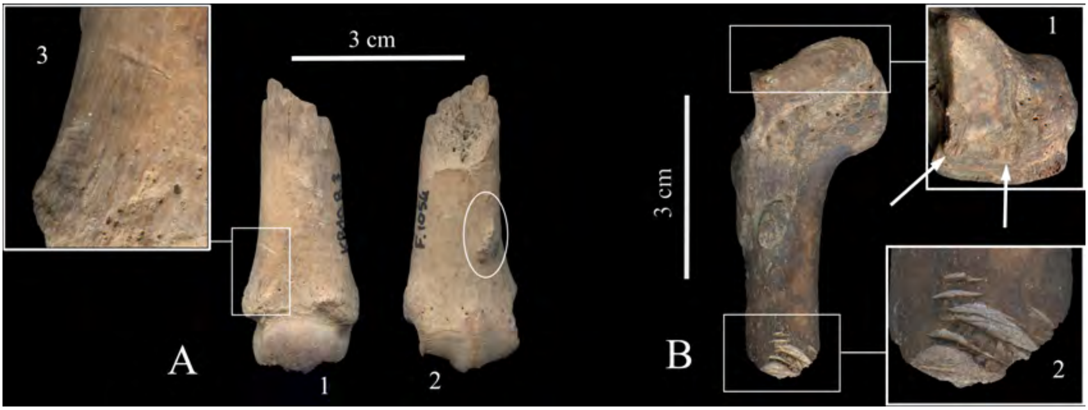
Tsahar, E.; Izhaki, I.; Lev-Yadun, S. & Bar-Oz, G. 2009: Distribution and extinction of ungulates during the Holocene of the Southern Levant. *PLOS ONE* 4(4): e5316. doi:10.1371/journal.pone.0005316.

Walker, P.L. & Long, J.C. 1977: An experimental study of the morphological characteristics of tool marks. *American Antiquity* 42: 605-616.

Wapnish, P. & Hesse, B. 1991: Faunal remains from Tel Dan: perspectives on animal production at a village, urban and a ritual center. *Archaezoologia* 4: 1-98.

Whitcher-Kansa, S. 2004: Animal exploitation at Early Bronze Age Ashqelon, Afridar: what the bone tell us – initial analysis of the animal bones from Areas E, F and G. *'Atiqot* 45: 279-297.

SUPPLEMENTARY MATERIAL



SUPPLEMENTARY FIGURE 1

1. Bear elements: A) distal metatarsal; 1. dorsal face with location of the cut mark; 2. plantar face with location of the possible pathology (circled); 3. Detail of the cut mark on the dorsal face. B) proximal portion of the fifth metatarsal; 1. Cranial view of the proximal epiphysis with location of the cur marks; 2. detail of the chop marks on the shaft.

SUPPLEMENTARY FIGURE 2

Syrians bringing an elephant and a bear, facsimile copy; detail from a scene of foreigners bringing offerings in the tomb of Rekhmire (TT 100) (Metropolitan Museum of Art, public domain).

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“Inertial culture” and pastoral traditions. Continuity and discontinuities in animal breeding patterns at Arslantepe and Zeytinli Bahçe (Turkey).

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ABSTRACT: What was the impact on animal breeding practices of large-scale social, economic, and/or political changes taking place in ancient settlements? The cases of two south-eastern Anatolian sites with stratigraphic sequences lasting millennia, are compared in this paper from the standpoint of those previous questions. Arslantepe, was a powerful political, economic, and administrative centre from the Chalcolithic to the Iron Age, and Zeytinli Bahçe a small rural village. Their long stratigraphic sequences highlight substantial discontinuities across time, marking cultural, social and economic changes. However, many aspects of the animal production strategies, especially those relating to husbandry practices, once acquired and adaptively embedded in a people’s tradition, tended to persist. Despite changes, at times dramatic, the rural world tended to resist innovative pressures, in some instances showing a tendency to greater conservatism than other aspects of the economy and material culture as evidenced by archaeological analyses. Paraphrasing one definition physics provides for ‘inertial mass’: the inertial culture expressed by the rural world tends to oppose innovative impulses with all the greater strength the more deeply rooted its traditions are.

KEYWORDS: SOUTH-EASTERN ANATOLIA, PASTORAL TRADITIONS, BRONZE AGE, IRON AGE

RIASSUNTO: Quali erano le ripercussioni sulla sussistenza legata allo sfruttamento degli animali che si osservano in seguito ad un evento sociale, economico o politico di grande portata che interessa un antico centro abitativo? Vengono presi in considerazione e confrontati i casi di due siti dell’Anatolia sud-orientale, entrambi con una lunga sequenza stratigrafica millenaria: Arslantepe, un potente centro egemone dal Calcolitico all’età del ferro e Zeytinli Bahçe, piccolo borgo rurale. La loro lunga sequenza stratigrafica evidenzia sostanziali discontinuità nel tempo, segnando cambiamenti culturali, sociali ed economici. Tuttavia, molti aspetti delle produzioni animali, in particolar modo quelli legati agli allevamenti, una volta acquisiti e integrati in modo adattivo nella tradizione di un popolo, tendono a radicarsi in modo persistente. Nonostante cambiamenti, a volte epocali, il mondo rurale tende ad opporsi alle spinte innovative mostrando in alcuni casi una tendenza ad un maggiore conservatorismo rispetto ad altri aspetti dell’economia e della cultura materiale evidenziati dall’analisi archeologica. Parafrasando una delle definizioni che la fisica dà della ‘massa inerziale’, la “*cultura inerziale*” espressa dal mondo rurale, anche se sottoposta a notevoli spinte di rinnovamento, tende a resistere ai cambiamenti, modificandosi tanto più lentamente quanto più numerosa è la popolazione e quanto più radicate le sue tradizioni.

PAROLE CHIAVE: ANATOLIA SUD-ORIENTALE, TRADIZIONI PASTORALI, ETÀ DEL BRONZO, ETÀ DEL FERRO

http://www.doi.org/10.15366/archaeofauna2025.34.1.002

RESUMEN: ¿Cuál habrá sido el impacto sobre las prácticas pecuarias de los cambios sociales, económicos y/o políticos a gran escala que tuvieron lugar en los asentamientos antiguos? En este artículo se comparan, atendiendo a las preguntas previas, las faunas de dos yacimientos de Anatolia sud-oriental con secuencias estratigráficas que abarcan milenios. Arslantepe fue un poderoso centro político, económico y administrativo desde el Calcolítico hasta la Edad del Hierro, mientras que Zeytinli Bahçe, un pequeño pueblo rural. Sus largas secuencias estratigráficas resaltan discontinuidades sustanciales a través del tiempo, marcando cambios culturales, sociales y económicos. Sin embargo, muchos aspectos de las estrategias de producción, especialmente aquellas relacionadas con las prácticas pecuarias, una vez son adquiridas e integradas adaptativamente en las tradiciones de un pueblo, tienden a persistir. A pesar de los cambios, a veces dramáticos, operados en ambos asentamientos, el mundo rural parece haberse resistido a estas presiones innovadoras, mostrando tendencias a un mayor conservadurismo que otros aspectos de la economía y la cultura material, como lo demuestran los análisis arqueológicos. Parafraseando una definición física sobre la "masa inercial": la cultura inercial, expresada por el mundo rural, tiende a oponerse a los impulsos innovadores con tanta mayor fuerza cuanto más arraigadas se encuentran sus tradiciones.

PALABRAS CLAVE: SURESTE ANATOLIA, TRADICIONES PASTORALES, EDAD DEL BRONCE, EDAD DEL HIERRO

INTRODUCTION

Between the end of the 4th and the beginning of the 3rd millennium BCE the process of centralization, both economic and political, which spread in the Mesopotamian world with the culture of Uruk, suffered an evident standstill in eastern Anatolia. A number of events in many analogous respects occurred in the following millennium with the rise and fall of the Hittite hegemony. This article discusses the repercussions on the animal economy following the aforementioned events, taking as examples some stratigraphic discontinuities present in two sites in south-eastern Anatolia: Arslantepe and Zeytinli Bahçe Höyük. Currently, both are artificial hills created by the uninterrupted superimposition (Frangipane, 2018) of the settlements that followed one another for millennia.

In the 4th millennium BCE, although small in comparison with Syro-Mesopotamian sites, Arslantepe became a very powerful political and economic centre in the Malatya plain, in eastern Anatolia (Frangipane, 2010a, 2012a, 2018).

Zeytinli Bahçe was instead a small rural village NW of the Jazira, where the north Syrian steppe plateau extends into the Taurus Mountains, on the right bank of the Euphrates, almost in correspondence with the current Turkish-Syrian border in the province of Urfa (Frangipane *et al.*, 2002; Frangipane, 2004, 2007, 2008, 2010a, b). The long stratigraphic sequences of the tells show phases of discontinuity that often reflect structural and radical changes in the social organization.

While these transformational processes from one culture or society into another reveal the maintenance of the cultural and ethnic identity of the Euphrates peoples, they also highlight the structural and radical changes in the social organizations.

RESULTS AND DISCUSSION

TRANSITION

Transition periods are precisely the periods during which these changes occur without completing themselves (see Frangipane, 2012b). In other words, they indicate the transitions from one situation to another and at the same time the links between one period and the next. Transition periods are generally associated with continuity and involve progressive alterations that entail slow change flows rather than abrupt substitutions. I have used the term 'inertial culture', paraphrasing one of the definitions that physics gives of 'inertial mass', or resistance to any event that might alter the relatively static condition of social organization. That is the passive force exercised by all the rules that make up the traditions of a people, acquired and rooted over time. 5,000 years ago in all of Anatolia, pastoral communities firstly raised flocks consisting of sheep and goats, followed by cattle and pigs. This configuration of the pastoral economy was so widespread and consolidated that any substantial modification of their structure must have been extremely difficult.

1) Continuity within the discontinuity:
Arslantepe (Period VIB, 3100-2750 BC; EBA I)

Around 3000 BCE a devastating fire put an end to the early-state organization of the Late Chalcolithic society. A radical crisis overwhelmed the central institutions, changing the course of Arslantepe's history forever. In the first phase of the Early Bronze Age I period (VI B1) the areas previously occupied by the public and élite buildings were abandoned (Frangipane, 2012a). This discontinuity is highlighted by a blanket of sediments on which seasonal settlements were built (Siracusano & Palumbi, 2014). In short, some catastrophic event had occurred, but the faunal data seem to tell the same story in a different way.

In fact, the livestock economy did not appear to show any immediate repercussions caused by the upheavals that occurred between the 4th and 2nd millennium BCE in that region. During the most prosperous period, the production of food provided by domestic animals, and the development, management and orientation of pastoral practices were closely linked to the main managers and consumers, represented by the ruling élites of the time. The bones of sheep and goats represented up to 80% of the remains of the livestock and constituted the main animal foodstuff. In some places (the so-called "redistribution rooms") the remains of caprines, almost exclusively sheep, were much more numerous (Bartosiewicz, 2010). The foodstuffs were probably redistributed in these particular places in the form of meals for the workers employed by the central élites (Frangipane, 1993) These animals therefore acted as a sort of currency through which transactions and exchanges were managed. If we exclude the substantial disappearance of pigs and the decrease in cattle numbers, which is entirely expected in nomadic communities, the pastoralists who settled in Arslantepe on the ruins of the palaces, showed no signs of any radical changes in the animal economy (Siracusano, 2024a; Figure 1). At the beginning of the 3rd millennium, the pastoral model showed no particular preferences or specializations, and sheep and goat meat continued to play a primary role in eating habits (Siracusano, 2024a; Supplementary material 1: Figure 3). While the pastoralists who frequented the area of the Malatya plain autonomously managed their means of production, due to a long-term drag effect, they continued along the path already traced by the previous economic system (Frangipane, 2014). They were the same ones who

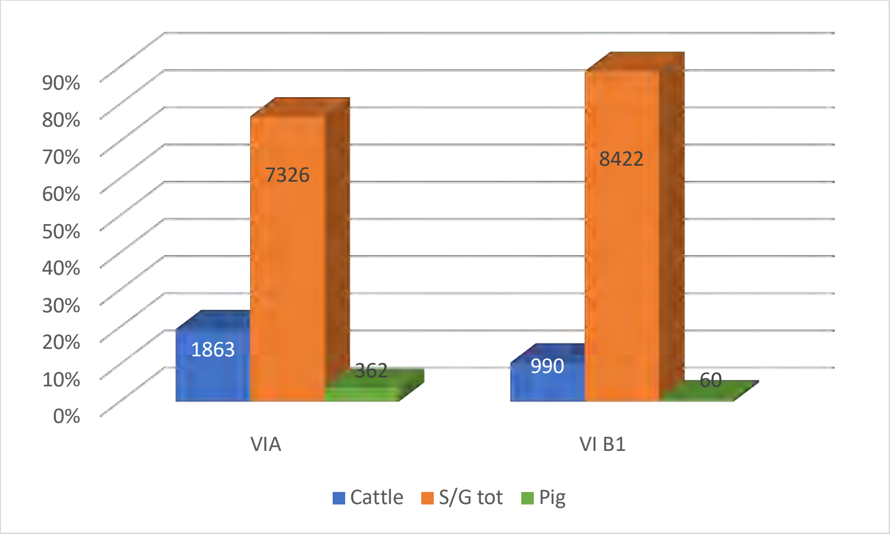

FIGURE 1

Arslantepe – Comparison based on NISP between the last phase of the late Chalcolithic (VIA, Late Uruk) and the first of the Ancient Bronze I (VIB1).

the shared traditions and cultural models of the so-called "Kura-Araks" culture and who supplied the élites when it was in vogue (Palumbi, 2008, 2010; Greenberg & Palumbi 2014). This would suggest that the food production system developed in order to maintain the centralized structure connecting the large and small communities was very stable (Gaastra *et al*., 2019).

2) Changes within discontinuity: Arslantepe (VIC period, 2750-2500 BC; EBA II)

At the end of the following three centuries, a period in which the community had acquired a more sedentary structure and moderate agricultural development, a period of great instability and conflict began. A new and more radical fracture occurred. Once again, devastating fires destroyed the town and put an end to the EBA I. After a temporary abandonment of the site between 2750 and 2500 BCE (VI C, EBA II) new communities settled seasonally, leaving non-permanent structures, as in the previous period VI B1 (Frangipane, 2012a). At first glance, judging from the livestock composition it would seem to have been a replica of what had happened three centuries earlier, without any major variations (Supplementary material 1: Figure 4). But this period marked the largest cultural split recorded in the history of Arslantepe and the Malatya region, marking the beginning of a new age. The new people from the surrounding hills were small mobile groups based on very small autonomous communities with different traditions (Di Nocera, 2005, 2008; Frangipane, 2012a; Siracusano, 2024a). Although their animal husbandry patterns were in line with the trend of the pastoral economy of the whole region, based fundamentally on the breeding of caprine flocks, the subsistence economy appears to have had certain distinctive traits compared to the previous ones. All the measurements taken clearly indicate that the sizes of both the sheep and the cattle of the newcomers were smaller than the previous ones (see Siracusano, 2024a, b; Supplementary material 1: Figure 5; Measurements domestic ungulates). The improvements in the quality and efficiency of breeding with respect to feed regimes or livestock care were often linked to the volume of exchanges, and the frequency of contacts between pastoral communities. The isolation of these villages meant that trade was reduced and that their economy was limited to mere subsistence. The size was markedly reduced for both cattle and sheep (Siracusano, 2024a). In this context, the best animals for these communities were the smaller, more frugal ones that could feed on marginal land. Small livestock have less value, but they also require less effort to maintain them. No increase in the size of goats, on the other hand, has been evidenced. In general, goats represented a heritage shared by a very small circle of people, who were therefore less involved in the livestock market, unlike sheep and cattle.

3) Resilience: Zeytinli Bahçe Höyük (3000-2600 BC; EBA 1)

In the second half of the 3rd millennium the western part of Upper Mesopotamia, between Urfa and Carchemis was affected by urbanization (Hauptmann, 1993; Matney & Algaze 1995; Wattenmaker, 1996; Matney *et al*., 1999). Nevertheless, the small size of Zeytinli Bahçe together with this animal breeding pattern retained a basic rural and village-like character. Before the Uruk wave came, the animal economy of Zeytinli showed "balanced" farming patterns, with caprines accounting for just over 45% followed by cattle and pigs in a substantial numerical balance.

The impact of socio-economic innovations and the increase in connectivity under Uruk influence was gradually assimilated and pastoral practices remodelled and readapted. The frequent interactions between the local populations favoured a hybridization of the common cultural background and similar organisational patterns. Significant changes were introduced by modifying many of the local traditions, including those relating to animal husbandry (Frangipane, 2010b). In this village, where the breeding of pigs had become very rooted since the Neolithic and played important role, the breeding of sheep and goats underwent a marked increase, until these animals became by far the most frequent among domestic livestock for generations (Siracusano, 2004; Figure 2). When the Uruk culture and the network of its commerce ended, the consequences of the dissolution of the centralized societies of the Mesopotamian type had repercussions over a vast territory.

At Zeytinli Bahçe no particular changes compared to the Late Chalcolithic occurred, at least until the second phase of the Early Bronze Age I (Siracusano, 2004).

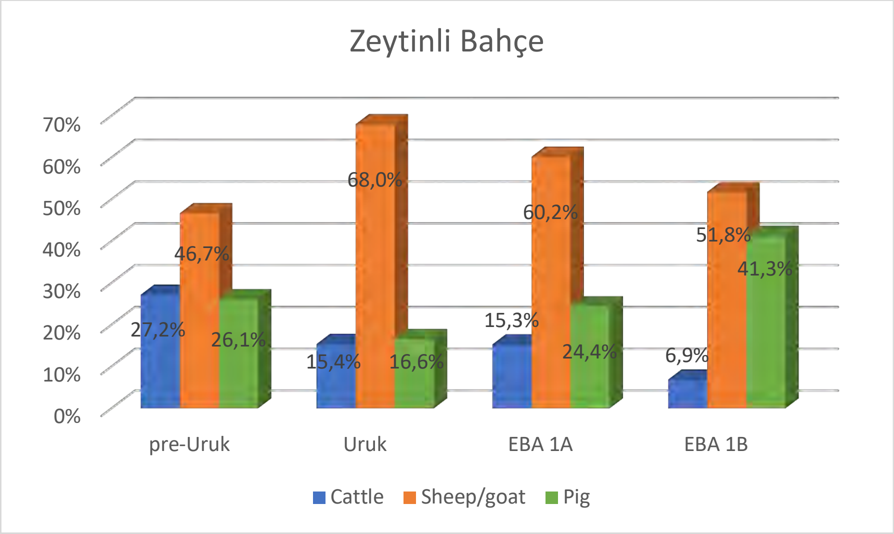

FIGURE 2

Diachronic distribution of domestic sheep and goat, cattle and pigs from the Late Chalcolitic to the Early Bronze Age at Zeitynli Bahçe; U=Uruk.

As at Zeytinli Bahçe, other secondary centres such as Hacinebi (Stein *et al*., 1996: 258-59; Bigelow, 1999), the so-called "colonies" of the middle and late Uruk period, a full return to ancient traditions (such as pig rearing) does not appear to have taken place immediately. Starting from this period, a sharp decrease in caprines and cattle has been observed and pig breeding increased dramatically, to become the second taxon raised in Zeytin. All this suggests a return to a more self-sufficient economy. The village once again came to depend almost exclusively on its own resources, as had been the case in the phases leading up to the Middle and Late Chalcolithic, restoring some of the ethnic and food production traditions present in the pre-Uruk period.

4) Changes within continuity: Arslantepe (Periods IIIA-IIIB, 1250-850 BC; LBA-Iron Age)

The Hittite expansion, which began on the upper Euphrates territories during the second quarter of the 2nd millennium BCE, also involved Arslantepe which became an important centre close to the eastern border. The most noticeable consequence on animal husbandry was the decrease in goats and sheep. The increased number of pigs, previously rare (1%) to reach 9% of the livestock, was probably linked to the production of meat (Bartosiewicz *et al*., 2013: 276-280, fig. VI.1) for the provision of garrisons.

The presence of military garrisons justified by the geopolitical position as an outpost in a frontier territory that guaranteed the safety of the peasants and their villages, probably led to a limitation on the free movement of people and animals. Although the number of the remains of equids does not exceed 3% of the domestic animals (but the result was expected, as they were not strictly part of the diet), the presence of horses in particular, and donkeys, was the most innovative element of the breeding patterns. Their expansion since the Late Bronze Age was favoured by the need to facilitate connections and the transport of people and goods.

The fact that horses outnumbered donkeys was probably due to the key role of horses in the patrolling and surveillance of the territory that had become a frontier, as well as for their use in war. The increase in cattle breeding, rising from 10% to as high as 37-47%, was also significant in the context of the agricultural and pastoral activities (Bartosiewicz *et al*., 2013). The political vacuum created by the disappearance of the Hittite power (Manuelli & Siracusano, 2022) starting in 1250 BCE in the Syro-Anatolian region, the so-called "Dark Age" (Fischer *et al*., 2003), led to dramatic conflicts which led to evident social, economic, and cultural changes. One of the consequences of the changes in the geopolitical equilibrium of Anatolia was a rearrangement of the regional socio-economic situations and the greater autonomy of the more distant and peripheral centres such as those in south-eastern Anatolia. In Arslantepe, as in other emerging Iron Age societies, the union between local and external cultures combined aspects of the Bronze Age culture but with the introduction of elements of total innovation in a blend of continuity and change (Manuelli, 2018, 2020). In the transition period that took place at the end of the Late Bronze-Early Iron Age (XIV century BCE, period IIIA), compared to the Late Bronze II (Arslantepe IV) and immediately following the Hittite decline, Arslantepe once again did not see any major changes. The breeding of sheep and the far more numerous goats remained fairly limited, a sign of persistent limited mobility. The slight increase in cattle could have been linked to a greater dependence on local agriculture. Instead, the decrease in pigs continued and almost disappeared, reaching less than 2%. At the end of the transition (IIIB), in the full Iron Age, there was an increase in caprines (Supplementary material 1: Figure 6), as had been the case in the Bronze Age, but the sheep:goat ratio dropped significantly to about 2:1 (from 4:1) (Manuelli & Siracusano, 2022). The increase in goats implies less manoeuvrability in the movement of the flocks (goats are more difficult to control than sheep and tend to refuse to wade across waterways). Consequently, the increase in goats as a whole may not have corresponded to a parallel increase in the extent of trade, but only their lower mobility. Horse and donkeys bone remains did not reach 0.5%, but in the early stages, horses were still prevalent by far, constituting 4/5 (horse:donkey ratio: 4:1) in the IIIB, while equids were almost exclusively donkeys. Horses, which had played an important role in the military border garrisons, therefore gave way to donkeys. This would suggest a return to a more limited rural economy.

CONCLUSIONS

In south-eastern Anatolia, one of the pivotal areas of civilization, over a period ranging from the fourth to the 2nd millennium BCE, large-scale events occurred, with the advent, followed by the subsequent decline, of the first centres of power. Many events took place, symbols of power, palaces and temples were built and then destroyed with the power itself. Apparently silent, but firm, the pastoralists were always there, true masters of the highlands. They were people with strong roots and solid traditions consolidated over centuries of animal husbandry practices whose pillars were mainly sheep and goat rearing, followed by cattle and pig. These communities were apparently at the mercy of events. However long-lasting, influential and coercive they may have been, they could not completely erase the deepest traditions. At the end of each event these tended to resurface. But even if traditions obstinately persisted, and history seemed to repeat itself, there was never a complete return to pre-existing situations. The examples reported on the Arslantepe and Zeytinli Bahçe sites, do not claim to have investigated the complex dynamics in which aspects of local behaviour overlapped and merged with external influences through intercultural contacts, but are limited to illustrating the repercussions on subsistence linked to the exploitation of animals. The proposed schematization seeks to emphasize the normalizing role of peasant civilizations and their traditions in the evolution of human history, with these large-scale upheavals being slowly absorbed and subsequently, and equally slowly, the ancient traditions resurfaced to restore a new equilibrium once the disturbing event had ended. The force of cultural inertia resisted by traditions cushioned the effects of the upheavals, even epochal changes, due to the birth and then to the collapse of the centres of power. Rural communities seem to have been the substratum on which historical events leave their mark. Domination left their traces on these peoples, but without completely erasing the deepest traditions. It was a kind of semi-conservative system showing how changes can quickly lead to both great progress and catastrophic destruction at the macroscopic level, while at the microscopic level, these changes turned out to be slower, more gradual and long-lasting.

SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_002

NOTES

[1] Measurements (in millimetres) follow Driesch (1976) and are listed in the Supplementary material.

REFERENCES

BARTOSIEWICZ, L. 2010: Herding in Period VIA in comparison with Period VIII. In: Frangipane, M. (ed.): *Economic Centralisation in Formative States. The Arcaeological reconstruction of the economic system in 4th Millennium Arslantepe*: 119-148. Sapienza Università di Roma, Roma.

BARTOSIEWICZ, L.; BÖKÖNYI, S. & SIRACUSANO, G. 2013: Animal Husbandry. In: Manuelli, F. (ed.): *Arslantepe Late Bronze Age Hittite influence and local traditions in an Eastern Anatolian community*, Chapter VI, Scavi e ricerche ad Arslantepe-Malatya Excavations and Research at Arslantepe-Malatya M. Frangipane ed. Sapienza Università di Roma Vol. IX: 275-284.

BIGELOW, L. 1999: Zooarchaeological investigations of economic organization and ethnicity at Late Chalcolithic Hacinebi: a preliminary report. *Paleorient* 25: 83-9.

DI NOCERA, G.M. 2005: Mobility and stability: preliminary observations on the Early Bronze Age settlement organisation in the Malatya Plain. *Archäologische Mitteilungen aus Iran und Turan* 37: 3-69.

— 2008: Settlements, population and landscape on the Upper Euphrates between V and II millennium B.C. Results of the Archaeological Survey Project 2003-2005 in the Malatya Plain. In: Cordoba, J.M.; Molist, M.; Pérez, C.M.; Rubio, I. & Martinez, S. (eds.): *Proceedings of the 5th International Congress on the Archaeology of the Ancient Near East,* Madrid: 633-646. Ediciones Universidad Autónoma de Madrid, Madrid.

DRIESCH, A. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Bullettin 1, Peabody Museum of Archaeology and Ethnology, Cambridge, MA.

FISCHER, B.; GENZ, H.; JEAN, E. & KORÜGLU¨, K. 2003: Identifying the transition from Bronze to Iron Ages in Anatolia and its neighboring regions. *Proceedings of International Workshop Istanbul*, November 8-9, 2002. Türk Eskiçag Bilimerli Enstitüsu¨, Istanbule.

FRANGIPANE, M. 1993: Local components in the development of centralized societies in Syro-Anatolian regions. In: Frangipane, M.; Hauotman, H. & Liverani, M. (eds.): *Between the Rivers and over the Mountains*: 133-161. Roma.

— 2004: The 2001 Excavation Campaign at Zeytinli Bahçe Hoyük: Preliminary Results. In: Tuna, N.; Öztürk, J. & Velibeyoÿlu, J. (eds.): *Salvage Project of the Archaeological Heritage of the Ilisu and Carchemish Dam Reservoirs. Activities in 2001*: 20-56. Ankara.

— 2007. The establishment of a Middle/Upper Euphrates Early Bronze I culture from the fragmentation of the Uruk world. New data from Zeytinli Bahçe Höyük (Urfa, Turkey). In: Peltenburg, E. (ed.): *Euphrates River Valley Settlement. The Carchemish Sector in the Third Millennium BC*.: 122-141. Euphrates River Valley Settlement. The Carchemish sector in the third millennium BC. Vol.5. Oxbow books, Oxford.

— 2008: Establishment of a Middle/Upper Euphrates Early Bronze I culture from the fragmentation of the Uruk world. New data from Zeytinli Bahçe Höyük (Urfa, Turkey) Euphrates River Valley Settlement. In: Peltenburg, E. (ed.): *The Carchemish sector in the third millennium BC Levant*: 122-141. Supplementary Series Volume 5. Oxbow Books, Oxford.

— 2010a: Arslantepe. Growth and Collapse of an Early Centralized System: The Archaeological Evidence. In: Frangipane, M. (ed.): *Economic Centralization in the Formative States. The Archaeological Reconstruction of the Economic System in 4th Millennium Arslantepe*: 23–42. Rome.

— 2010b: Late Chalcolithic developments and the transition to EB I in the Turkish Middle Euphrates Valley, as seen from the recent excavations at Zeytinli Bahçe H. (Urfa). Proceedings of the 6th ICAANE Conference, Rome, May 2008. *Harrasowicz Verl., Wiesbaden*: 186-203.

— 2012a: The collapse of the 4th Millennium Centralised system at arslantepe and the far-reaching changes in 3rd Millennium Societies. In: *Fifty years of excavations and research at Arslantepe-* Malatya (Turkey). A contribution to the study of the Earliest *Centralised Societies*: 237-260. Origini XXXVI.

— 2012b: "Transitions" as an Archaeological Concept. Interpreting the Final Ubaid–Late Chalcolithic Transition in the Northern Periphery of Mesopotamia. In: Marro, C. (ed.): *After the Ubaid: Interpreting Changes from the Caucasus to Mesopotamia at the Dawn of the Urban Civilization (4500–3500 BC)*: 39-63. Papers from The Post-Ubaid Horizon in the Fertile Crescent and Beyond. International Workshop Held at Fosseuse, 29th June–1st July 2009 (Varia Anatolica XXVII), Paris.

— 2014: After collapse: continuity and disruption in the settlement by Kura-Araxes-linked pastoral groups at Arslantepe- Malatya (Turkey). New data. *Paléorient* 40(2):169–182.

— 2018: Arslantepe. The rise and development of a Political Centre: from temple to palace to a fortified citadel. In: Durak, N. & Frangipane, M. (eds.): *Proceedings of the International Archaeology Symposium*: 71-104. Edited by IAAS.

FRANGIPANE, M.; ALVARO, C.; BALOSSI, F. & SIRACUSANO, G. 2002: The 2000 Campaign at Zeytinli Bahçe

Hoyük. In: Tuna, N.; Öztürk, J. & Velibeyoÿlu, J. (eds.): *Salvage Project of the Archaeological Heritage of the Ilisu and Carchemish Dam Reservoirs*: *Activities in 2000*: 57-99. Ankara.

Gaastra, J.S.; Greenfield, T.L. & Greenfield, H.J. 2019: Constraint, complexity and consumption: Zooarchaeological meta-analysis shows regional patterns of resilience across the metal ages in the Near East. *Quaternary International*. https://doi.org/10.1016/j.quaint.2019.03.013.

Greenberg, R. & Palumbi, G. 2014: Corridors and Colonies: Comparing Fourth–Third Millennia BC Interactions in Southeast Anatolia and the Levant. In: Knapp, B. & van Dommelen, P. (eds.): *The Cambridge Prehistory of the Bronze and Iron Age Mediterranean Cambridge*: 111-138. Cambridge University Press, Cambridge.

Hauptmann, H. 1993: Vier Jahrtausende Siedlungsgeschichte am mittleren Euphrat. *Archaeologie in Deutschland* 1: 10–15.

Manuelli, F. 2018: Drifting Southward? Tracing Aspects of Cultural Continuity and Change in the Late 2nd Millennium BC Syro-Anatolian Region. In: Matthiae, P. (ed.): *Studia Eblaitica Studies on the Archaeology, History, and Philology of Ancient Syria*: 139-186.

— 2020: The Regeneration of the Late Bronze Age Traditions and the Formation of the Kingdom of Malizi. In: Sollee, A.E. (ed.): *Formation, Organisation and Development of Iron Age Societies. A Comparative View*: 109-130. Proceedings of the Workshop held at the 10th ICAANE in Vienna, April 2016. Volume 15. Austrian Academy of Sciences, Vienna Oriental and European Archaeology.

Manuelli, F. & Siracusano, G. 2022: Economies in Transformation: A Zooarchaeological Perspective from Early Iron Age Arslantepe (Southeastern Türkiye). *Adalya*: 1.

Matney, T. & Algaze, G. 1995: Urban development at mid-late Early Bronze Age Titris Hoyük. in Southeastern Anatolia. *Bulletin of the American Schools of Oriental Research* 299/300: 33-52.

Matney, T.; Algaze, G. & Rosen, S.A. 1999: Early Bronze Age urban structure at Titris Hoyük, Southeastern Turkey: the 1998 season. *Anatolica* 25: 185–201.

Palumbi, G. 2008: *The Red and Black. Social and Cultural Interaction between the Upper Euphrates and Southern Caucasus Communities in the Fourth and Third Millennium BC* (*Studi di Preistoria Orientale* 2). Rome.

— 2010: Pastoral models and Centralized Animal Husbandry. The case of Arslantepe. In: Frangipane M. (ed.): *Economic Centralisation in Formative States. The Archaeological Reconstruction of the Economic System in 4th Millennium Arslantepe*: 149-163. Studi di Preistoria Orientale (SPO) 3, Roma.

Siracusano, G. 2004. Animal husbandry and centralized cultures. How social and political factors can influence rural lifestyle. *In:* Van Neer, W. & Ervynk, A. (eds.): *Behaviour Behind Bones: The zooarchaeology of ritual, religion, status and identity. Proceedings of the 9th ICAZ Conference, Durham 2002, Vol. 1: 190-197. Oxbow Books, Oxford.*

— 2024a: Pastori nel tempo. La pioggia li bagna, il vento li asciuga. *Atti 9° Convegno Nazionale Di Archeozoologia Ravenna* Novembre - Dicembre 2018.

— 2024b: From sheperds to farmers at Arslantepe (Eastern Turkey) during Early Bronze Age II and III, from 2750 to 2000 BC. *Proceedings of the ASWA meeting in Barcelona 2019*. Universitat Autònoma de Barcelona, Bellaterra, Barcelona, June 3-7, 2019.edito da Alcàntara Fors R., Saña Seguí M., Tornero Dacasa C. ISBN 9781407360614 British Archaeological Reports (Oxford) Ltdn.S3171, May 31, 2024.

Siracusano G, Palumbi G. 2014 -“Who'd be Happy, Let Him Be so: Nothing's Sure about Tomorrow” Discarded Bones in Early Bronze I Elite Area at Arslantepe (Malatya, Turkey): Remains of Banquets? Proceedings of the 8th ICAANE 30 April – 4 May 2012, P. Bieliński, M. Gawlikowski, R. Koliński, D. Ławecka, A. Sołtysiak and Z. Wygnańska (eds), University of Warsaw Vol. 3 Harrassowitz Verlag · Wiesbaden, 342-348

Stein, G.J.; Bernbeck, R.; Coursey, C.; Mcmahon, A.; Miller, N.F.; Misir, A.; Nicola, J.; Pittman, H.; Pollock, S. & Wright, H. 1996: Colonies and Anatolian Communities: An Interim Report on the 1992-93 Excavation at Hacınebi, Turkey. In: Bieliński, P.; Gawlikowski, M.; Koliński, R.; Ławecka, D.; Sołtysiak, A. & Wygnańska, Z. (eds.): Uruk. *American Journal of Archaeology* 100: 205-260.

Wattenmaker, P. 1996: Kazane Höyük, 1995: Excavations at an early city. *Kazi Sonuçlari Toplantisi* 18: 81–92.

SUPPLEMENTARY MATERIAL (1)

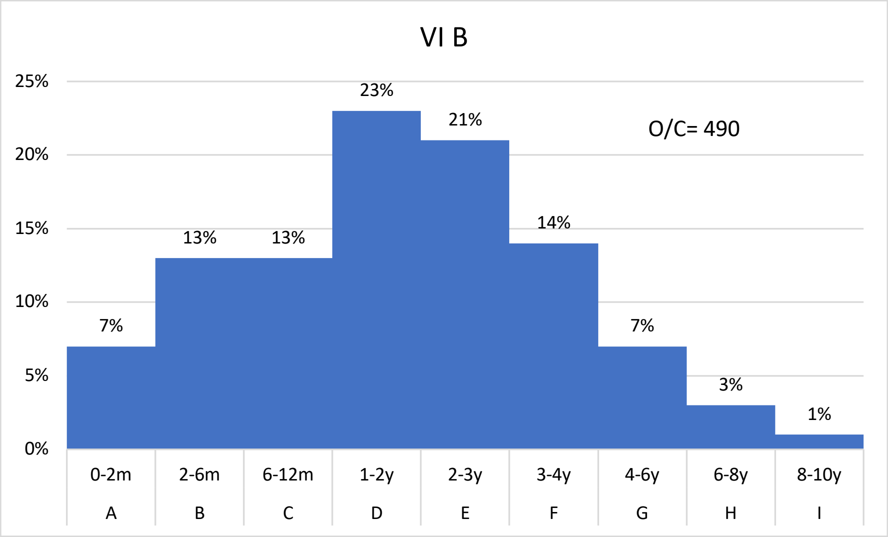

FIGURE 3

Caprines kill-off pattern histogram, age-at-death attributed according to Payne (1973); The ages are estimated based on the reduction of tooth crown heights, which also includes the upper teeth, recommended by Ducos (1968) and revised by Helmer *et al*. (2007: figure 2).

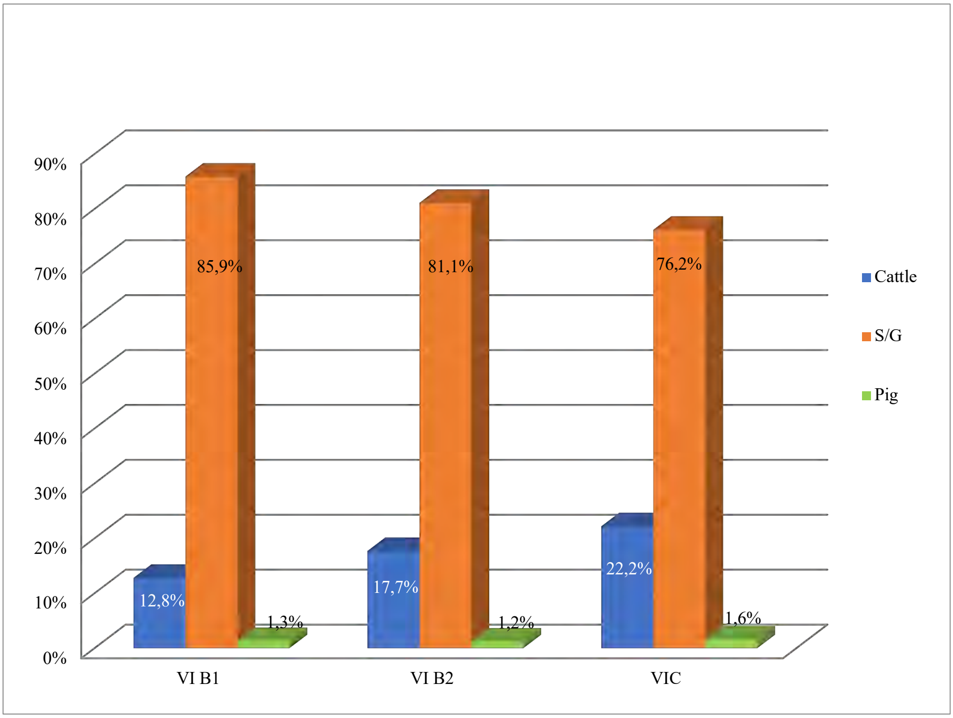

FIGURE 4

Arslantepe: Histograms (based on NISP) comparing cattle/ sheep/goat and pig frequencies between EBAI (VIB) and EBAII (VIC).

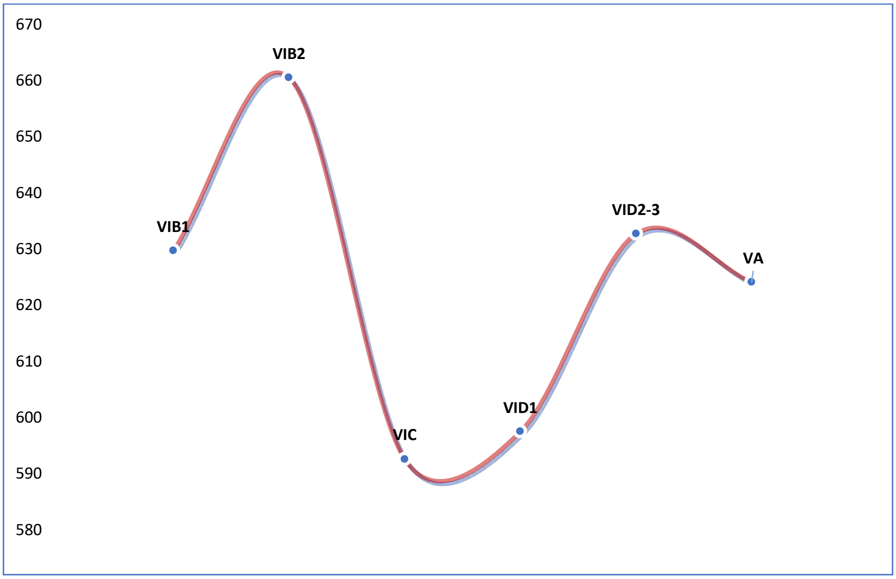

FIGURE 5

Withers height of *Ovis aries* in the EBAI (VIB1 and VIB2), EBA II (VIC) and EBA III (VID1 VID2-3) periods.

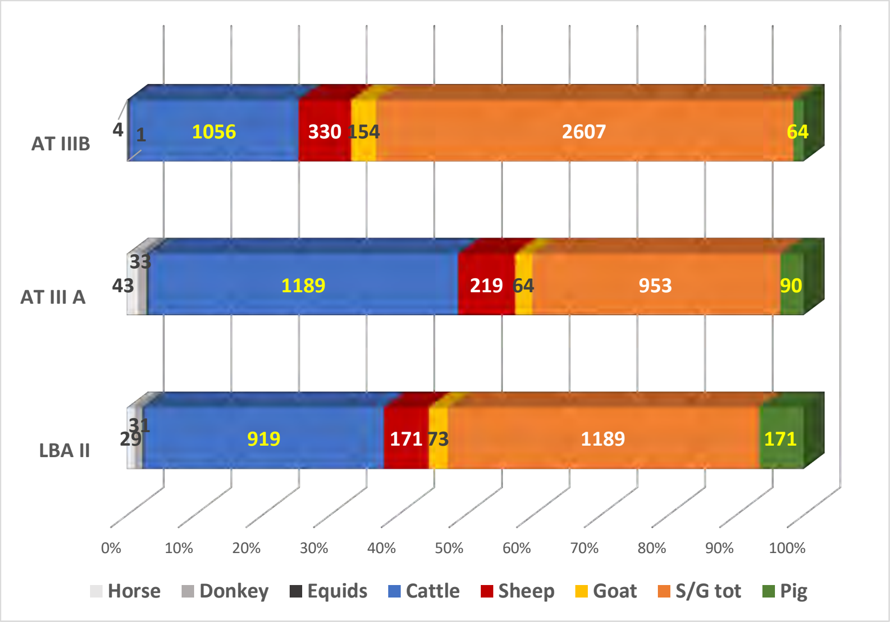

FIGURE 6

Diachronic distribution of domestic ungulates (NISP) from Arslantepe LBAII: 1400-1250 BC to.IIIB (EIAII: 1000-850 BC) at Arslantepe.

SUPPLEMENTARY MATERIAL 2

MEASUREMENTS DOMESTIC UNGULATES (DRIESCH, 1976)

± = rough measurement

PERIOD	**Horn core**	**Lf (43)**	**Cf (40)**	**A-O dm**	**L-M dm**
EBA II VI C	*Bos taurus*	119	38,5	33,5	110±
IA IIIA	*Bos taurus*		31,8	28,0	
IA IIIB	*Bos taurus*		45,2	47,5	141,0
EBA I VIB1	*Capra hircus*	66,0	24,5	13,4	30±
EBA I VIB1	*Capra hircus*	71,0	29,5	13,8	61,0
EBA I VIB1	*Capra hircus*	92,0	38,8	20,6	
EBA I VIB1	*Capra hircus*	95,0	36,0	25,0	
EBA I VIB2	*Capra hircus*	74,0	25,6	19,3	
EBA I VIB2	*Capra hircus*	81,0	32,0	17,4	130,0
EBA I VIB2	*Capra hircus*	123,0	45,7	25,0	
EBA I VIB2	*Capra hircus*	88,0	31,4	18,0	75,0
EBA I VIB2	*Capra aegagrus*		75,6	39,6	
EBA II VI C	*Capra hircus*	62,0	40,0	22,0	
EBA II VI C	*Capra hircus*	76,0	26,0	17,0	
EBA II VI C	*Capra hircus*	85,0	35,0	20,0	
EBA II VI C	*Capra hircus*	89,0	34,0	22,0	79,0
EBA II VI C	*Capra hircus*	98,0	34,0	24,0	
EBA II VI C	*Capra hircus*	33,5	91	20,8	
IA IIIA	*Capra hircus*	49,4	20,5		
IA IIIB	*Capra hircus*		30,9	22,5	135,0
IA IIIB	*Capra hircus*		22,8	34,9	
IA IIIB	*Capra hircus*		24,3	19,9	23,1
EBA I VIB1	*Ovis aries*	62,2	21,2	24,5	
EBA I VIB1	*Ovis aries*	70,0	22,6	16,0	
EBA I VIB2	*Ovis aries*	137,0	51,0	30,4	
EBA I VIB2	*Ovis aries*	84,0	31,7	18,0	
EBA I VIB2	*Ovis aries*	64,0	22,7	11,8	
IA IIIB	*Ovis aries*		55,0	19,0	14,1

PERIOD	***Mandible***	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**10*[1]**	**11**	**12**	**13**	**14**	**15a**	**15b**	**15c**
EBA I VIB1	*Bos taurus*										35,2	15,0							
EBA I VIB2	*Bos taurus*										39,0	17,1							
EBA I VIB2	*Bos taurus*							85,1			38,4	16,7							
EBA II VI C	*Bos taurus*										39,0	17,8							
IA IIIA	*Bos taurus*										31,1	14,7							
IA IIIA	*Bos taurus*										35,6	15,6							
IA IIIA	*Bos taurus*										32,4	13,0							
IA IIIA	*Bos taurus*										36,1	16,3							
VI C	*Bos taurus*										39,0	17,8							
IA IIIB	*Bos taurus*						127,5	82,8	43,4		37,0	17,0					51,7	33,6	
IA IIIB	*Bos taurus*										15,3								
IA IIIB	*Bos taurus*										36,1								
IA IIIB	*Bos taurus*						141,4	96,7	48,2							75,4	58,9	43,7	
IA IIIB	*Bos taurus*										36,1	15,5							
IA IIIB	*Bos taurus*										38,3								
IA IIIB	*Bos taurus*										31,6	13,0							
IA IIIB	*Bos taurus*										38,2	17,2							
IA IIIB	*Bos taurus*										35,4	14,5							
IA IIIB	*Bos taurus*										35,8	15,7							
IA IIIB	*Bos taurus*										34,6	12,0							
IA IIIB	*Bos taurus*										31,1	14,7							
IA IIIB	*Bos taurus*										35,6	15,6							
EBA I VIB1	*Ovis aries*										23,2	8,2							
EBA I VIB1	*Ovis aries*							73,9	49,4	24,0	23,6	8,9		36,2					
EBA I VIB1	*Ovis aries*										25,4	9,7							
EBA I VIB1	*Ovis aries*										25,8	9,2							
EBA I VIB1	*Ovis aries*							78,3	54,7	22,9	26,2	9,7		42,5					
EBA I VIB1	*Ovis aries*										27,3	9,8							
EBA I VIB1	*O/C*										21,6	7,5							
EBA I VIB1	*O/C*										22,5	9,0							
EBA I VIB1	*O/C*										23,0	8,8							
EBA I VIB1	*O/C*										23,6	9,0							
EBA I VIB1	*O/C*										24,0	9,5							
EBA I VIB1	*O/C*										24,0	8,8							
EBA I VIB1	*O/C*										24,2	8,9							
EBA I VIB1	*O/C*										24,5	9,0							
EBA I VIB1	*O/C*										25,0	8,9							
EBA I VIB1	*O/C*								54,2		25,3	9,7							
EBA I VIB1	*O/C*										26,5	9,0							
EBA I VIB1	*O/C*									25,0	19,1								
EBA I VIB1	*O/C*									25,0	19,1								

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[1] Measurements 10 and 10* represent, respectively, the width and length (occlusal) of M3.

EBA I VIB1	*O/C*										26,2	9,7							
EBA I VIB2	*Capra hircus*							77,0	51,0	26,3	22,0	8,6							
EBA I VIB2	*Capra hircus*							70,5			22,6	8,0					37,5	17,1	
EBA I VIB2	*Capra hircus*							76,9			22,8	8,5					39,0	14,5	
EBA I VIB2	*Ovis aries*							74,5	49,0	24,5	22,0	9,0							
EBA I VIB2	*Ovis aries*										22,3	8,8							
EBA I VIB2	*Ovis aries*							73,7			23,0	9,3					38,2	17,5	
EBA I VIB2	*Ovis aries*										23,4	9,0							
EBA I VIB2	*Ovis aries*							78,0	51,5	26,5	23,5	9,0						19,0	
EBA I VIB2	*Ovis aries*							76,3	51,0	23,8	23,9	9,1		40,4				17,0	
EBA I VIB2	*Ovis aries*							71,0	49,5	21,3	25,2	9,5							
EBA II VI C	*Ovis aries*							61±	40,0	20,0	19,0	8,2							
EBA II VI C	*Ovis aries*							74,6	38,6	34,7	23,2	7,2		31,0					
EBA II VI C	*O/C*										23	8,1							
EBA II VI C	*O/C*										23,5	8,5							
EBA II VI C	*O/C*								47,5		23,7	8,2							
EBA II VI C	*O/C*										25,0	8,7							
EBA II VI C	*O/C*										27,4	10,0							
EBA II VI C	*O/C*							82,0			28,8	9,3							
IA IIIA	*Capra hircus*							77,2	52,3	24,4	24,9	8,5							
IA IIIA	*Capra hircus*							78,4	50,6	23,6									
IA IIIB	*Capra hircus*							74,0	47,8	25,0	21,3	7,5							
IA IIIB	*Capra hircus*							79,6	57,5	26,5	23,2	7,7							
IA IIIB	*Capra hircus*							73,0	49,5	23,8	25,3	9,4							
IA IIIA	*Capra hircus*										24,9	8,9							
IA IIIA	*Ovis aries*							74,4	50,4	23,0	25,1	9,8							
IA IIIA	*Ovis aries*										22,0	7,8							
IA IIIA	*Ovis aries*							75,5	54,2		25,2	9,7							
IA IIIA	*Ovis aries*							71,8	50,4		22,4	8,6							
IA IIIA	*Ovis aries*								53,8		9,2								
IA IIIA	*Ovis aries*							75,8	52,2	21,8	9,3								
IA IIIA	*Ovis aries*								48,9		9,0								
IA IIIA	*Ovis aries*								52,0		8,0								
IA IIIA	*Ovis aries*										8,9								
IA IIIA	*O/C*										9,4								
IA IIIA	*O/C*										10,1								
IA IIIA	*O/C*								50,4		25,1	9,1							
IA IIIA	*Ovis aries*	178,0		52,8	123,0		137,5	70,1	49,5		21,0			37,0	20,8	16,2			
IA IIIA	*Ovis aries*										25,1	9,7							
IA IIIB	*Ovis aries*							75,0	50,2	24,5	22,7	8,5							
IA IIIB	*Ovis aries*							75,0	49,7	23,1	22,8	8,0		41,5	25,9	21,0			
IA IIIB	*Ovis aries*	173,0	180,0	52,4	121,0	123,0	141,5	71,8	50,4	21,6	23,6	10,0		39,0			23,0	17,4	
IA IIIB	*Ovis aries*								54,7	26,2	9,5						28,6		
IA IIIB	*Ovis aries*							80,0	54,4	25,2	22,0	8,4							
IA IIIB	*Ovis aries*							75,7	50,3	23,8	22,4	8,3		42,9	26,9	18,5			

IA IIIB	*Ovis aries*							72,0	50,8	21,6	22,5	8,4							
IA IIIB	*Ovis aries*							75,7	52,0	23,1	23,3	9,0							
IA IIIB	*Ovis aries*							65,7	45,0	20,2	22,0	8,5				19,1		16,0	
IA IIIB	*Ovis aries*								47,5		23,6								
IA IIIB	*Ovis aries*							68,2	47,0	21,1	24,5								
IA IIIB	*Ovis aries*										25,3								
IA IIIB	*Ovis aries*							72,0	49,4	21,4	24,7				24,4	19,7			
IA IIIB	*Ovis aries*							71,8	50,7	18,5	25,5			38,1	24,0	15,3			
IA IIIB	*Ovis aries*	185,0	196,3	66,9	122,8	141,2	162,6	73,6	50,9	20,8	24,7	9,7							
IA IIIB	*Ovis aries*								50,0			8,1							
IA IIIB	*Ovis aries*								51,1	21,9	23,1	8,4							
IA IIIB	*O/C*										24,1	8,7							
IA IIIB	*O/C*										25,0	9,1							
IA IIIB	*O/C*										25,0								
IA IIIB	*O/C*										22,1								
IA IIIB	*O/C*										22,7								
IA IIIB	*O/C*										21,9								
IA IIIB	*O/C*										22,9								
IA IIIB	*O/C*										25,4								
IA IIIB	*O/C*										23,6	7,8							
IA IIIB	*O/C*										22,2	8,9							
IA IIIB	*O/C*									51,4	25,3	9,4							

	Atlas	**GB**	**GL**	**BFcr**	**BFcd**	**GLf**	**Lad**	**H**	
EBA I VIB2	*O/C*			39,6	47,5				
IA IIIA	*O/C*	67,3	46,5	52,4		36,8			
IA IIIB	*Bos taurus*		80,0		85,0	53,0	42,7	58,0	
IA IIIB	*Capra hircus*			53,2	54,6	36,8		26,3	42,9
IA IIIB	*Ovis aries*			48,0	54,0	51,4	36,7	26,5	39,2
IA IIIB	*Ovis aries*		66,4	51,7	43,6	49,7	44,8		
IA IIIB	*O/C*			42,3	47,6	49,9	41,0	21,3	34,5
IA IIIB	*Sus domesticus*			40,0	49,0	52,0	22,0	24,0	47,0

	Epistrophaeus	**LCDe**	**LAPa**	**BFcr**	**BPacd**	**BPtr**	**SBV**	**BFcd**	**H**	**Dtd**
VI C	*Ovis*	**32**	48,6	42,0	40,0			22,2	20,5	
IA IIIB	*Bos taurus*			70,4			42,2			
IA IIIB	*Bos taurus*	90,3	60,0				39,1	32,5		
IA IIIB	*O/C*			46,4			26,6	61,1		
IA IIIB	*Sus domesticus*			43,2	30,3	35,5	29,4	27,0		

	Cervical vertebra	PL	GLPa	Bpacr	BPacd	BPtr	BPcr	BPcd	HFcr	HFcd	H
EBA I VIB2	*O/C*	25,5	25,5	54,0	41,4		17,0	31,0	19,5	19,4	
EBA I VIB2	*O/C*	34,8	35,0	36,8			37,9	45,0	15,0	20,8	16,6
EBA I VIB2	*O/C*	36,5	39,0		38,5		16,6	22,3	40,6		
IA IIIA	*O/C*	32,7	42,5	47,7	25,7	28,4	22,1	24,8			
IA IIIB	*Sus domesticus*	21,4	31,8	38,8	35,9			16,5	18,5	13,7	12,6

	Torachal vertebra		GLPa	Bpacr	BPacd	BPtr	BPcr	BPcd	HFcr	HFcd	H
IA IIIA	*O/C*		32,5	25,7			16,5	16,6	13,7	14,6	
IA IIIB	*O/C*	48,3				22,7		28,4	18,3	17,2	
IA IIIB	*O/C*	27,3			38,2		24,9	21,1		17,0	14,3

	Lumbar vertebra	PL	GLPa	Bpacr	BPacd	BPtr	BPcr	BPcd	HFcr	HFcd	H
EBA I VIB1	*Ovis aries*	50,0	38,0				26,0	30,0	19,8	17,2	
EBA I VIB1	*O/C*	44,0	34,0				26,2	23,2		19,0	21,0
EBA II VI C	*O/C*	34,0	43,9	25,0	30,0				27,0	24,5	
EBA II VI C	*O/C*	45,3	35,4			21,5	23,7	17,8	14,5		
IA IIIA	*O/C*	33,0					21,1	23,4	16,8	14,7	
IA IIIA	*O/C*	29,5	39,5	17,5	25,2	26,8	23,2	15,1	15,8		

	Scapula	SLC	GLP	LG	BG
EBA I VIB1	*Bos primigenius*		81,5	71,9	59,2
IA IIIA	*Bos taurus*		71,4	57,3	49,3
IA IIIB	*Bos taurus*	46,7	62,8	53,0	45,6
IA IIIB	*Bos taurus*	48,2	68,1	56,7	45,2
IA IIIB	*Bos taurus*	51,5	63,4	54,7	44,5
IA IIIB	*Bos taurus*	60,5		50,7	41,8
IA IIIB	*Bos taurus*	43,0	67,0	50,1	49,2
IA IIIB	*Bos taurus*	40,5	58,0	50,5	42,7
EBA I VIB1	*Capra hircus*	18,6	30,0	23,8	21,3
EBA I VIB1	*Capra hircus*	19,0	30,0	24,5	21,0
EBA I VIB1	*Capra hircus*	20,0	33,0	28,0	23,0
EBA I VIB1	*Capra hircus*	18,6	33,7	26,8	21,5
EBA I VIB1	*Capra hircus*	19,8	34,9	28,1	23,3
EBA I VIB1	*Capra hircus*		35,8	28,0	24,3
EBA I VIB1	*Capra hircus*	20,3	36,0	30,0	24,9
EBA I VIB1	*Capra hircus*		38,0	28,9	23,7
EBA I VIB1	*Capra hircus*	24,0	39,3	32,0	27,8
EBA I VIB1	*Capra hircus*	16,4		24,0	19,5
EBA I VIB1	*Capra hircus*	22,2		24,0	23,9
EBA I VIB1	*Capra hircus*	22,2		24,0	23,9
EBA I VIB2	*Capra hircus*		26,7	22,0	19,5

EBA I VIB2	*Capra hircus*	16,3	28,2	22,5	21,3
EBA I VIB2	*Capra hircus*	17,0	29,2	23,8	19,2
EBA I VIB2	*Capra hircus*	17,3	29,5	24,5	19±
EBA I VIB2	*Capra hircus*	18,0	30,7	25,1	
EBA I VIB2	*Capra hircus*	15,9	31,6	25,8	18,4
EBA I VIB2	*Capra hircus*	18,9	33,4	28,3	23,9
EBA I VIB2	*Capra hircus*	19,6		21,6	21,8
EBA II VI C	*Capra hircus*	17,7	31,8	27,0	19,8
EBA II VI C	*Capra hircus*	17,5	29,0	24,0	19,1
EBA II VI C	*Capra hircus*		29,6	24,7	20,7
VI B3-VIC	*Capra hircus*	17,5	29,0	24,0	19,1
IA IIIA	*Capra hircus*	24,1		30,1	27,8
IA IIIB	*Capra hircus*	18,8		24,1	23,7
IA IIIB	*Capra hircus*	19,7		28,0	23,7
IA IIIB	*Capra hircus*	19,6			21,8
IA IIIB	*Capra hircus*	22,2		26,8	22,7
IA IIIB	*Capra hircus*	33,7	24,6		20,4
IA IIIB	*Capra hircus*	18,3		21,4	21,1
EBA I VIB1	*Ovis aries*	19,0	24,0	27,0	22,5
EBA I VIB1	*Ovis aries*	19,0	33,5	26,0	21,2
EBA I VIB1	*Ovis aries*		36,0	27,5	22,2
EBA I VIB1	*Ovis aries*		29,3	23,5	20,8
EBA I VIB1	*Ovis aries*	20,0	30,2	27,2	22,0
EBA I VIB1	*Ovis aries*	20,2	30,5	25,7	20,9
EBA I VIB1	*Ovis aries*	20,0	30,6	24,2	21,0
EBA I VIB1	*Ovis aries*	19,5	31,0	24,0	19,9
EBA I VIB1	*Ovis aries*	18,3	32,7	25,8	22,2
EBA I VIB1	*Ovis aries*	20,0	33,3	26,3	22,0
EBA I VIB1	*Ovis aries*	20,3	34,0	27,0	23,2
EBA I VIB1	*Ovis aries*		34,0	27,0	22,6
EBA I VIB1	*Ovis aries*	20,4	34,4	27,0	22,0
EBA I VIB1	*Ovis aries*	20,4	34,4	27,0	22,0
EBA I VIB1	*Ovis aries*	21,0	34,6	26,5	22,4
EBA I VIB1	*Ovis aries*	20,3	34,8	27,3	23,0
EBA I VIB1	*Ovis aries*	20,3	34,8	27,3	23,0
EBA I VIB1	*Ovis aries*	25,0	35,0	30,0	27,4
EBA I VIB1	*Ovis aries*	21,4	36,0	30,0	
EBA I VIB1	*Ovis aries*		36,0	30,3	23,5
EBA I VIB1	*Ovis aries*	24,8	36,5	30,0	24,4
EBA I VIB1	*Ovis aries*	25,0	37,2	32,4	
EBA I VIB1	*Ovis aries*	20,0	37,4	31,0	23,6
EBA I VIB1	*Ovis aries*	23,0	37,5	28,7	24,0
EBA I VIB1	*Ovis aries*		38,0	31,1	25,5
EBA I VIB1	*Ovis aries*	23,8	38,1	31,0	24,0
EBA I VIB1	*Ovis aries*	24,4	38,3	30,0	24,0

EBA I VIB1	*Ovis aries*	24,9	38,5	30,0	26,0
EBA I VIB1	*Ovis aries*	23,4	39,0	29,0	25,5
EBA I VIB1	*Ovis aries*	26,8	40,2	30,5	25,0
EBA I VIB1	*Ovis aries*	22,7		30,0	25,1
EBA I VIB1	*Ovis orientalis*		44,5	37,3	31,3
EBA I VIB1	*O/C*	18,3	30,6	25,5	20,0
EBA I VIB1	*O/C*		32,5	26,8	19,7
EBA I VIB1	*O/C*		33,1	26,0	21,5
EBA I VIB1	*O/C*		33,8	26,6	22,0
EBA I VIB1	*O/C*		35,9	26,5	22,5
EBA I VIB1	*O/C*		35,9	26,5	22,5
EBA I VIB1	*O/C*		36,0	29,0	23,0
EBA I VIB1	*O/C*		36,0	29,0	23,0
EBA I VIB1	*O/C*		36,3	29,2	23,6
EBA I VIB1	*O/C*		36,5	28,0	23,2
EBA I VIB1	*O/C*		37,3	29,5	25,0
EBA I VIB2	*Ovis aries*	23,3	34,2	27,8	23,2
EBA I VIB2	*Ovis aries*	22,0	36,0	29,4	24,4
EBA I VIB2	*Ovis aries*	22,0	36,0	28,7	22,5
EBA I VIB2	*Ovis aries*	20,7	36,6	29,0	24,3
EBA I VIB2	*Ovis aries*	22,2	37,7	30,0	26,0
EBA I VIB2	*Sus s.ferus*	31,2	46±	43±	32±
VI B3-VIC	*Ovis aries*	19,4	30,2	24,0	18,6
VI B3-VIC	*Ovis aries*	17,4	28,6	21,1	16,4
EBA II VI C	*Ovis aries*	19,7	31,9	25,4	18,6
EBA II VI C	*Ovis aries*	16,2	30,0	27,9	
IA IIIA	*Ovis aries*	19,1		26,5	20,5
IA IIIA	*Ovis aries*	22,9		27,8	24,5
IA IIIA	*Ovis aries*	23,5	36,6	32,3	23,5
IA IIIB	*Ovis aries*	22,5			25,0
IA IIIB	*Ovis aries*	24,3	34,4	30,0	26,0
IA IIIB	*Ovis aries*	22,9	33,0	28,6	22,5
IA IIIB	*Ovis aries*	22,0	38,3	31,6	23,5
IA IIIB	*Ovis aries*		31,7	28,4	22,5
IA IIIB	*Ovis aries*	21,1	32,7	26,3	20,1
IA IIIB	*Ovis aries*	24,1	36,3	29,7	22,4
IA IIIB	*Ovis aries*	31,2		25,7	19,9
IA IIIB	*Ovis aries*			24,7	22,2
IA IIIB	*Ovis aries*	24,1		27,6	22,0
IA IIIB	*Ovis aries*		36,8	26,8	20,6
IA IIIB	*Ovis aries*	27,9	22,6	23,8	

	Humerus	**GL**	**GLC**	**Bp**	**DAPp**	**SD**	**Bd**	**BT**	BFT	HT	HTC
EBA I VIB1	*Bos taurus*						75,8	75,0	67,9		
EBA I VIB2	*Bos taurus*		58,0		16,3		73,3	61,8			
EBA I VIB2	*Bos taurus*						59,4	56,5			
EBA I VIB2	*Bos taurus*						72,0	67,2			
EBA I VIB2	*Bos taurus*		58,0		16,3		73,3	61,8			
EBA I VIB2	*Bos taurus*						59,4	56,5			
EBA I VIB2	*Bos taurus*						72,0	67,2		25,3	
EBA I VIB2	*Bos primigenius*						93,0	81,8			
IA IIIA	*Bos taurus*						76,0	65,6			
IA IIIA	*Bos taurus*						67,8	60,5	60,2		
IA IIIA	*Bos taurus*						70,4	67,5	62,8		
IA IIIA	*Bos taurus*						85,0	76,0			
IA IIIA	*Bos taurus*						67,7	59,0	59,6		
IA IIIB	*Bos taurus*						72,5	67,4			
IA IIIB	*Bos taurus*						81,0	76,6	74,7		
IA IIIB	*Bos taurus*						74,4	68,0			
IA IIIB	*Bos taurus*						70,6	61,2			
IA IIIB	*Bos taurus*						66,2	68,6	57,3		
EBA I VIB1	*Capra hircus*						27,0	26,0		22,6	
EBA I VIB1	*Capra hircus*						28,8	27,6	24,0	27,5	
EBA I VIB1	*Capra hircus*						29,7	28,3	24,2		
EBA I VIB1	*Capra hircus*						29,8	29,0	24,1		
EBA I VIB1	*Capra hircus*						30,0	26,5	28,9		
EBA I VIB1	*Capra hircus*					13,7	30,2	24,2	27,7		
EBA I VIB1	*Capra hircus*						30,5	29,4	26,1		
EBA I VIB1	*Capra hircus*						30,5	29,4	26,1		
EBA I VIB1	*Capra hircus*						31,7	30,9	17,6		
EBA I VIB1	*Capra hircus*						32,5	31,2	28,0		
EBA I VIB1	*Capra hircus*						33,3	30,5	28,0		
EBA I VIB1	*Capra hircus*						34,4	32,0	29,0		
EBA I VIB1	*Capra hircus*						34,5	33,1	28,0		
EBA I VIB1	*Capra hircus*						35,5	33,8			
EBA I VIB1	*Capra hircus*						36,9	31,0	35,3		
EBA I VIB1	*Capra hircus*						37,0	34,8	3,3		
EBA I VIB1	*Capra hircus*						37,2	34,9	30,4		
EBA I VIB1	*Capra hircus*						38,3	35,8	29,5		
EBA I VIB2	*Capra hircus*					16,3	29,2	29,0	25,3		
EBA I VIB2	*Capra hircus*						31,3	28,5	25,3		
EBA I VIB2	*Capra hircus*						31,6	29,3	24,4		
EBA I VIB2	*Capra hircus*						31,7	29,7	28,2		
EBA I VIB2	*Capra hircus*						32,3	30,4	25,5		
EBA I VIB2	*Capra hircus*						28,8	24,1			
EBA I VIB2	*Capra hircus*						30,8	28,8			
EBA II VI C	*Capra hircus*	143,0	129,0		46,6		22,4	27,5			

EBA II VI C	*Capra hircus*						28,1	27,8	22,6		
IA IIIB	*Capra hircus*						13,6	29,5	28,8		
IA IIIB	*Capra hircus*				63,0	16,7	32,0	31,4			
IA IIIB	*Capra hircus*						34,3	32,5	29,1		
IA IIIB	*Capra hircus*						33,2	21,8			
IA IIIB	*Capra hircus*					16,4	30,1	28,5	25,1		
IA IIIB	*Capra hircus*					16,9	37,5	33,7	32,3	10,0	8,4
IA IIIB	*Capra hircus*					17,2	29,5	28,1		6,8	7,2
EBA I VIB1	*Ovis aries*						32,2	30,1	27,9		
EBA I VIB1	*Ovis aries*						32,4	30,7	27,0		
EBA I VIB1	*Ovis aries*						32,5	31,0			
EBA I VIB1	*Ovis aries*						33,0	32,4	29,0		
EBA I VIB1	*Ovis aries*						33,0	30,5	28,8		
EBA I VIB1	*Ovis aries*						33,6	31,4			
EBA I VIB1	*Ovis aries*						34,0	31,2			
EBA I VIB1	*Ovis aries*						34,2	33,2	29,4		
EBA I VIB1	*Ovis aries*						34,8	32,1	30,7		
EBA I VIB1	*Ovis aries*						34,8	32,0	29,0		
EBA I VIB1	*Ovis aries*						35,0	32,0	29,7		
EBA I VIB1	*Ovis aries*						35,5	33,8	31,0		
EBA I VIB1	*Ovis aries*						35,7	34,0	29,5		
EBA I VIB1	*Ovis aries*						36,8	34,6	30,9		
EBA I VIB1	*Ovis aries*						36,9	34,6	31,4		
EBA I VIB1	*Ovis aries*						37,0	33,7	31,8		
EBA I VIB1	*Ovis aries*						37,2	34,7	30,6		
EBA I VIB1	*Ovis aries*						37,5	33,7	33,6		
EBA I VIB1	*Ovis aries*						38,0	35,4	30,6		
EBA I VIB2	*Ovis aries*						29,0	28,4	25,0		
EBA I VIB2	*Ovis aries*						32,3	29,8	27,0		
EBA I VIB2	*Ovis aries*						32,9	30,6	27,0		
EBA I VIB2	*Ovis aries*						32,9	30,3	25,3		
EBA I VIB2	*Ovis aries*						34,5	33,9	30,9		
EBA I VIB2	*Ovis aries*						36,0	33,7			
EBA I VIB1	*Ovis aries*						38,8	36,3			
EBA I VIB1	*Ovis orientalis*					18,6	38,6	35,2			
EBA I VIB2	*Ovis orientalis*						40,0	37,0	38,0		
IA IIIA	*Ovis aries*						40,9	37,3	34,7		
IA IIIA	*Ovis aries*					17,3	35,3	30,6			
IA IIIA	*Ovis aries*						30,8	27,2			
IA IIIA	*Ovis aries*						34,7	30,9			
IA IIIA	*Ovis aries*						41,8	36,7			
IA IIIA	*Ovis aries*						34,4	34,0			
IA IIIA	*Ovis aries*						32,8	29,8	25,9		
IA IIIA	*Ovis aries*						34,3	31,1			
IA IIIB	*Ovis aries*						31,0	30,6	28,0		

IA IIIB	*Ovis aries*						32,0	31,0	27,0		
IA IIIB	*Ovis aries*					16,3	33,2	31,0	27,9		
IA IIIB	*Ovis aries*					15,5	33,6	33,2	29,8		
IA IIIB	*Ovis aries*						33,7	29,5			
IA IIIB	*Ovis aries*						36,0	33,8			
IA IIIB	*Ovis aries*						35,4	32,3			
IA IIIB	*Ovis aries*						31,1	30,6	28,3		
IA IIIB	*Ovis aries*						37,5	33,6			
IA IIIB	*Ovis aries*						31,6	27,7			
IA IIIB	*Ovis aries*						34,0	31,1			
IA IIIB	*Ovis aries*						39,8	36,5			
IA IIIB	*Ovis aries*						34,8	31,9			
IA IIIB	*Ovis aries*						33,3	29,5	26,1		
IA IIIB	*Ovis aries*						32,1	29,2			
IA IIIB	*Ovis aries*					16,9	41,1	34,4		8,6	9,4
IA IIIB	*Ovis aries*					19,9	32,5	29,3		8,2	8,2
IA IIIB	*Ovis aries*						29,4	27,7	25,4		
EBA I VIB1	*O/C*						29,0	26,6			
EBA I VIB1	*O/C*						29,2	28,0			
EBA I VIB1	*O/C*						30,0	28,3			
EBA I VIB1	*O/C*						30,0	28,3			
EBA I VIB1	*O/C*						30,0	28,9			
EBA I VIB1	*O/C*						30,0	28,9			
EBA I VIB1	*O/C*						30,2	28,7			
EBA I VIB1	*O/C*						31,5	29,0			
EBA I VIB1	*O/C*						31,5	30,5			
EBA I VIB1	*O/C*						31,5	30,5			
EBA I VIB1	*O/C*						32,0	30,0			
EBA I VIB1	*O/C*						32,2	30,0			
EBA I VIB1	*O/C*						33,4	31,5			
EBA I VIB1	*O/C*						33,5	30,7			
EBA I VIB1	*O/C*						33,5	32,2			
EBA I VIB1	*O/C*						34,0	31,8			
EBA I VIB1	*O/C*						34,4	31,8			
EBA I VIB1	*O/C*						34,6	31,0			
EBA I VIB1	*O/C*						35,3	34,6			
EBA I VIB1	*O/C*						37,8	34,5			
EBA I VIB1	*O/C*					19,9	38,0	34,2			
EBA I VIB1	*O/C Wild*						39,8	38,0			
EBA I VIB2	*O/C*						30,5	28,5	26,5		
EBA I VIB2	*O/C*						34,6	32,8			
EBA I VIB2	*O/C*						35,5	32,3			
EBA I VIB2	*O/C*						39,3	35,5			
EBA II VI C	*O/C*					15,3	31,6	29,8	26,1		
EBA II VI C	*O/C*						31,2	29,1			

EBA II VI C	*O/C*						31,5	29,8			
EBA II VI C	*O/C*						33,0	29,0			
IA IIIB	*O/C*						36,0	33,0	29,0		
IA IIIB	*O/C*			40,8	48,3						
IA IIIB	*O/C*						34,2	33,7			
IA IIIB	*Sus domesticus*						33,9	26,9			

	Radius	**GL**	**PL**	**BP**	**BFp**	**DAPp**	**SD**	**CD**	**Bd**	**BFd**	**DAPd**
EBA I VIB1	*Bos primigenius*			90,0		46,0					
EBA I VIB1	*Bos taurus*								88,9	62,0	49,0
EBA I VIB2	*Bos taurus*								63,7	59,2	
EBA I VIB2	*Bos taurus*			86,4	79,5	40,0					
EBA I VIB2	*Bos taurus*			87,7	80,5	45,3					
EBA II VI C	*Bos taurus*								57,5	42,8	
EBA II VI C	*Bos taurus*								61,5		39,8
IA IIIB	*Bos taurus*			73,0	67,7	36,0					
IA IIIB	*Bos taurus*			65,0	59,6	34,0					
IA IIIB	*Bos taurus*			69,7	64,8	34,7					
IA IIIB	*Bos taurus*			86,5	78,8	42,0					
IA IIIB	*Bos taurus*								53,2	50,7	
IA IIIB	*Bos taurus*								70,0	54,0	
IA IIIB	*Bos taurus*								80,2	62,3	45,0
IA IIIB	*Bos taurus*								53,2	49,4	32,9
IA IIIB	*Bos taurus*			75,6	66,0	35,4					
IA IIIB	*Bos taurus*			79,7	73,0						
EBA I VIB1	*Capra hircus*			27,3	26,8	15,0					
EBA I VIB1	*Capra hircus*			27,3	26,5	14,2					
EBA I VIB1	*Capra hircus*			27,7	27,2	14,4					
EBA I VIB1	*Capra hircus*								26,7	22,8	17,4
EBA I VIB1	*Capra hircus*				34,0	17,6					
EBA I VIB1	*Capra aegagrus*			41,0	37,6	22,4					
EBA I VIB2	*Capra hircus*			27,8	27,5	16,2					
EBA I VIB2	*Capra hircus*			27,9	25,6	14,2					
EBA I VIB2	*Capra hircus*			28,0	27,7	16,0					
EBA I VIB2	*Capra hircus*			28,5	27,5	14,4					
EBA I VIB2	*Capra hircus*			28,5	27,0	15,6	18,7				
EBA I VIB2	*Capra hircus*			29,8	29,3	15,0					
EBA I VIB2	*Capra hircus*			31,4	29,4	15,6					
EBA I VIB2	*Capra hircus*			31,5	30,4	17,7	19,0				
EBA II VI C	*Capra hircus*	140,0	139,0	26,0	25,1		15,6	35,5	19,8	18,0	17,6
EBA II VI C	*Capra hircus*			29,0	28,0		14,9				
EBA II VI C	*Capra hircus*			29,2	27,0	15,5					
EBA II VI C	*Capra hircus*			29,7	29,4		17,1				
EBA II VI C	*Capra hircus*								29,0	28,6	18,4

EBA II VI C	*Capra aegagrus*			44,0	18,7						
IA IIIA	*Capra hircus*			29,2	27,2	16,0					
IA IIIA	*Capra hircus*			28,7	28,3	16,1					
IA IIIB	*Capra hircus*			36,9	33.7						
EBA I VIB1	*Ovis aries*			31,9	17,0						
EBA I VIB1	*Ovis aries*			32,3	29,2	16,0					
EBA I VIB1	*Ovis aries*			32,5	31,0	15,5					
EBA I VIB1	*Ovis aries*			33,7	32,2	18,5					
EBA I VIB1	*Ovis aries*			34,3	31,8	18,0					
EBA I VIB1	*Ovis aries*			35,5	34,6	16,6					
EBA I VIB1	*Ovis aries*			35,7	32,4	19,5					
EBA I VIB1	*Ovis aries*			35,8	32,0	17,2					
EBA I VIB1	*Ovis aries*			36,9	29,0	16,5					
EBA I VIB1	*Ovis aries*			37,5	34,8	19,0					
EBA I VIB1	*Ovis aries*			37,8	33,7	18,0					
EBA I VIB1	*Ovis aries*			38,0	34,5	19,3					
EBA I VIB1	*Ovis aries*			38,8	34,9	20,0					
EBA I VIB1	*Ovis aries*			39,3	35,0	20,5			30,0	25,1	19,0
EBA I VIB1	*Ovis aries*								35,0	29,0	22,5
EBA I VIB1	*Ovis aries*								35,0	34,6	24,0
EBA I VIB1	*Ovis orientalis*									29,8	21,0
EBA I VIB2	*Ovis aries*										
EBA I VIB2	*Ovis aries*			35,2	31,2	17,8					
EBA I VIB2	*Ovis aries*			30,0	28,3	15,8	15,0	40,0			
EBA II VI C	*Ovis aries*			27,5	25,0		18,8				
EBA II VI C	*Ovis aries*			28,2	26,0	13,5			27,6	23,0	17,8
EBA II VI C	*Ovis aries*	146,1	143,9	28,6	26,1	14,6	14,4	42,0	27,8	24,8	18,9
EBA II VI C	*Ovis aries*	135,4	132,0	30,0	28,0	15,4	13,6	44,0			
EBA II VI C	*Ovis aries*			36,7	32,5	20,0	20,5		25,4		
IA IIIA	*Ovis aries*			37,8	35,3	19,5					
IA IIIA	*Ovis aries*			32,0	29,4	17,1					
IA IIIA	*Ovis aries*			46,9	39,0	20,3					
IA IIIA	*Ovis aries*			36,7	32,5	18,0					
IA IIIA	*Ovis aries*			34,3	32,6	17,3					
IA IIIA	*Ovis aries*			32,1	31,4				36,5	32,2	24,6
IA IIIA	*Ovis aries*			32,7	28,7	15,2					
IA IIIA	*Ovis aries*								31,7	26,9	20,5
IA IIIB	*Ovis aries*			31,0	28,2	15,6					
IA IIIB	*Ovis aries*			31,5	28,6	16,1					
IA IIIB	*Ovis aries*			31,3	28,1	15,6					
IA IIIB	*Ovis aries*			35,2	32,0	17,0	19,6				
IA IIIB	*Ovis aries*								30,0	22,2	
IA IIIB	*Ovis aries*			35,0	30,9	17,5	18,5				
IA IIIB	*Ovis aries*			34,7	32,4	19,0					
IA IIIB	*Ovis aries*			33,8	33,1	18,0	17,5				

IA IIIB	*Ovis aries*			33,7	18,7						
IA IIIB	*Ovis aries*			34,6	31,6	17,2					
IA IIIB	*Ovis aries*			32,3	29,3	16,5					
IA IIIB	*Ovis aries*			35,7	31,0	18,6					
IA IIIB	*Ovis aries*			36,0	32,4						
EBA I VIB1	*O/C*								30,5	25,5	18,5
EBA I VIB1	*O/C*								30,0	28,8	18,6
EBA I VIB1	*O/C*			34,7					28,8	25,7	19,0
EBA I VIB1	*O/C*								30,0	23,8	
EBA I VIB1	*O/C*			36,7		19,1			30,0	25,4	20,0
EBA I VIB1	*O/C*								30,3	26,2	20,3
EBA I VIB1	*O/C*								30,5	27,6	21,0
EBA I VIB1	*O/C*								30,5	25,3	19,5
EBA I VIB1	*O/C*								30,8	27,8	21,2
EBA I VIB1	*O/C*								31,0	27,2	19,5
EBA I VIB1	*O/C*								31,6	27.5	19,0
EBA I VIB1	*O/C*								31,6	27.5	19,0
EBA I VIB1	*O/C*								32,0	27,5	19,9
EBA I VIB1	*O/C*								32,0	26,0	21,0
EBA I VIB1	*O/C*								32,3	27,0	20,1
EBA I VIB1	*O/C*								34,4	30,8	20,3
EBA I VIB1	*O/C*								36,3	29,2	23,5
EBA I VIB1	*O/C*										
EBA I VIB2	*O/C*			26,5	25,1	18,5			33,5	28,1	23,0
EBA I VIB2	*O/C*										
IA IIIA	*O/C*								34,1	26,6	
IA IIIA	*O/C*								32,8	28,0	21,4
IA IIIB	*O/C*				26,0	16,0					
IA IIIB	*O/C*			36,8	33,9	17,8					
IA IIIB	*O/C*				33,1				32,4	30,0	
IA IIIB	*O/C*								32,5	25,8	
IA IIIB	*O/C*					18,2			30,7	24,8	

	Metacarpus	**GL**	**GL 1**	**L1**	**Bp**	**Dp**	**SD**	**CD**	**DD**	**Bd**	**Dd**	**BFd**	**WCM**
EBA I VIB1	*Bos taurus*				67,0	40,5							
EBA I VIB2	*Bos taurus*				60,0	35,3							
EBA I VIB2	*Bos taurus*	218,3	215,0	206,7	67,3	39,0	34,5	101,0	25,7	67,0	36,2		
EBA I VIB2	*Bos taurus*								21,1	56,4	33,7		
IA IIIA	*Bos taurus*				52,1	31,0							
IA IIIA	*Bos taurus*				56,3	33,8							
IA IIIA	*Bos taurus*				52,4	31,7							
IA IIIB	*Bos taurus*				48,5	29,0							
IA IIIB	*Bos taurus*								19,7	48,4	28,7		
IA IIIB	*Bos taurus*				50,0	28,7							

IA IIIB	*Bos taurus*									49,2	28,6		
IA IIIB	*Bos taurus*									64,3	35,2	21,9	
IA IIIB	*Bos taurus*									52,0	27,5		
IA IIIB	*Bos taurus*				47,2	31,5							
IA IIIB	*Bos taurus*									50,0	27,2		
IA IIIB	*Bos taurus*				56,7	35,6							
IA IIIB	*Bos taurus*								21,1	62,0	31,0		
IA IIIB	*Bos taurus*				50,0	29,0							
IA IIIB	*Bos taurus*									58,8	30,3		
IA IIIB	*Bos taurus*				54,9	31,2							
IA IIIB	*Bos taurus*				55,7	34,9							
IA IIIB	*Bos taurus*				57,8	35,3							
IA IIIB	*Bos taurus*									60,6			
IA IIIB	*Bos taurus*								20,7	56,6	28,4		
IA IIIB	*Bos taurus*								21,8	60,0	31,8		
IA IIIB	*Bos taurus*				61,0	34,1							
IA IIIB	*Bos taurus*				60,8	35,0							
IA IIIB	*Bos taurus*						30,1	87,0	19,6	53,4			
IA IIIB	*Bos taurus*				57,0	35,1							
IA IIIB	*Bos taurus*									53,7	28,6		
IA IIIB	*Bos taurus*	194,7	191,0		62,4	35,9	36,5	96,0		61,0	33,8		
IA IIIB	*Bos taurus*				48,3	31,1							
IA IIIB	*Bos taurus*				57,3	32,9							
IA IIIB	*Bos taurus*				44,4	27,1							
IA IIIB	*Bos taurus*								19,0	52,6	27,5		
IA IIIB	*Bos taurus*				52,8	33,7							
IA IIIB	*Bos taurus*				47,3	29,2							
IA IIIB	*Bos taurus*								18,1	54,0	28,2		
IA IIIB	*Bos taurus*								19,2	52,5	25,7		
IA IIIB	*Bos taurus*								15,0	45,4	24,4		
IA IIIB	*Bos taurus*				50,6	29,8							
IA IIIB	*Bos taurus*				52,1	33,5							
IA IIIB	*Bos taurus*				48,9	29,8	22,1	72,0					
IA IIIB	*Bos taurus*									53,7	28,6		
IA IIIB	*Bos taurus*				60,7	37,0							
IA IIIB	*Bos taurus*					61,0							
IA IIIB	*Bos taurus*					48,2							
IA IIIB	*Bos taurus*					46,5							
IA IIIB	*Bos taurus*									68,3	36,1		
IA IIIB	*Bos taurus*				54,0	33,3							
IA IIIB	*Bos taurus*									49,5	28,7		
IA IIIB	*Bos taurus*				52,8	34,0							
IA IIIB	*Bos taurus*				51,7	30,9							
IA IIIB	*Bos taurus*									56,6			
IA IIIB	*Bos taurus*				55,2	31,3							

IA IIIB	*Bos taurus*									55,6			
IA IIIB	*Bos taurus*									54,6	30,0		
IA IIIB	*Bos taurus*				51,3	28,0							
IA IIIB	*Bos taurus*								20,6	56,9	30,5		
IA IIIB	*Bos taurus*	190,5			66,0	41,8	22,4	71,0			35,4		
IA IIIB	*Bos taurus*					29,9				64,8	33,0		
IA IIIB	*Bos taurus*				59,9	35,2							
IA IIIB	*Bos primigenius*				67,0	40,1				48,5	27,0		
EBA I VIB1	*Capra hircus*					14,9		44,0	9,2	24,3	14,5		
EBA I VIB1	*Capra hircus*					14,9		44,0	9,2	24,3	14,5		
EBA I VIB1	*Capra hircus*	107,2	105,5	102,7	23,1	16,5	15,3	47,0	10,3	26,6	16,3		
EBA I VIB1	*Capra hircus*									27,4	18,9		
EBA I VIB1	*Capra hircus*									28,7	19,0		
EBA I VIB1	*Capra hircus*						14,0			29,1	19,4		
EBA I VIB1	*Capra hircus*						11,3			29,7	18,3		
EBA I VIB1	*Capra hircus*									29,8	18,5	27,0	
EBA I VIB1	*Capra hircus*									30,0	19,8		
EBA I VIB1	*Capra hircus*									30,2	17,7	28,7	
EBA I VIB1	*Capra hircus*									30,6	16,6		
EBA I VIB1	*Capra hircus*	117,8	116,3	113,4	24,4	18,0	16,5	51,0	10,7	31,6	17,3		
EBA I VIB1	*Capra hircus*				25,2	18,4							
EBA I VIB1	*Capra hircus*				22,4	15,8							
EBA I VIB1	*Capra hircus*				27,4	19,8							
EBA I VIB1	*Capra hircus*				28,3	19,7							
EBA I VIB2	*Capra hircus*				25,8	17,6	18,4						
EBA I VIB2	*Capra hircus*				25,8	17,6	18,4						
EBA I VIB2	*Capra hircus*									26,0	9,2		
EBA I VIB2	*Capra hircus*								10,4	27,0	17,5		
EBA II VI C	*Capra hircus*			25,3	17,4								
EBA II VI C	*Capra hircus*								15,0	25,8	25,4		
IA IIIA	*Capra hircus*			29,7	20,6	11,0							
IA IIIB	*Capra hircus*				24,2	15,6	15,4	49,0	10,0				
IA IIIB	*Capra hircus*				22,2	16,0	14,9	43,0					
IA IIIB	*Capra hircus*				25,3	16,7							
IA IIIB	*Capra hircus*				26,5	19,0							
IA IIIB	*Capra hircus*								10,2	28,7	17,3		
IA IIIB	*Capra hircus*				26,3	18,1							
IA IIIB	*Capra hircus*				23,0	16,4	15,7	46,0	9,6				
IA IIIB	*Capra hircus*				19,2	18,2	55,0						
IA IIIB	*Capra hircus*				24,8	18,4							
IA IIIB	*Capra hircus*				21,1	15,9	14,3	46,0					
IA IIIB	*Capra hircus*				25,0								
IA IIIB	*Capra hircus*				21,9	14,8	14,3	42,0					
IA IIIB	*Capra hircus*				25,2	17,8							
IA IIIB	*Capra hircus*				28,0	20,0							

IA IIIB	*Capra hircus*				22,8	15,5							
IA IIIB	*Capra hircus*				27,8	18,4	18,2		10,9				
IA IIIB	*Capra hircus*				22,6	15,6							
EBA I VIB1	*Ovis aries*				20,0	14,0							
EBA I VIB1	*Ovis aries*				21,2	14,7							
EBA I VIB1	*Ovis aries*				22,4	16,5							
EBA I VIB1	*Ovis aries*				22,7	15,7							
EBA I VIB1	*Ovis aries*				24,6	18,4							
EBA I VIB1	*Ovis aries*				24,6	18,4							
EBA I VIB1	*Ovis aries*				24,9	18,2							
EBA I VIB1	*Ovis aries*				24,9	18,2							
EBA I VIB1	*Ovis aries*				28,6	20,4	16,6	55,0					
EBA I VIB1	*Ovis aries*									25,9	18,0		
EBA I VIB1	*Ovis aries*									26,7	16,3		
EBA I VIB1	*Ovis aries*								11,4	29,3	19,8		
EBA I VIB1	*Ovis aries*								11,4	29,4	18,7		
EBA I VIB1	*Ovis aries*						16,4	55,0	12,0	29,7	19,3		
EBA I VIB1	*Ovis aries*								11,4	29,9	20,2		
EBA I VIB1	*Ovis aries*									32,6	21,0		
EBA I VIB2	*Ovis aries*				23,3	16,2							
EBA I VIB2	*Ovis aries*				26,6	19,5							
EBA I VIB2	*Ovis aries*				31,0	20,6	16,3						
EBA I VIB2	*Ovis aries*									23,7	16,4	23,7	
EBA I VIB2	*Ovis aries*								10,8	27,8	18,6		
EBA I VIB1	*O/C*									25,0	16,0		
EBA I VIB1	*O/C*									25,5	16,0		
EBA I VIB1	*O/C*									25,5	16,0		
EBA I VIB1	*O/C*									31,3	29,7	27,8	
EBA I VIB1	*O/C*				28,0	19,6							
EBA I VIB1	*O/C*									25,0	16,0		
EBA I VIB1	*O/C W*									33,4	20,0		
IIIA	*Ovis aries*				22,4	15,9	14,9	45,0					
IA IIIA	*Ovis aries*				27,6	19,1							
IA IIIA	*Ovis aries*				26,5	18,6							
IA IIIA	*Ovis aries*				23,6	17,7							
IA IIIA	*Ovis aries*				28,7	19,1							
IA IIIA	*Ovis aries*									26,9	18,5		
IA IIIB	*Ovis aries*				29,5	19,0							
IA IIIB	*Ovis aries*				26,0	17,4							
IA IIIB	*Ovis aries*				25,0	17,2	14,2		10,0				
IA IIIB	*Ovis aries*				27,5	20,0							
IA IIIB	*Ovis aries*	118,9	116,5	114,4	23,9	16,8	13,3	43,0	9,1	25,8	15,7		
IA IIIB	*Ovis aries*				26,0	17,6							
IA IIIB	*Ovis aries*				24,9	17,8							
IA IIIB	*Ovis aries*									27,1	17,7		

IA IIIB	*Ovis aries*				25,5	18,5							
IA IIIB	*Ovis aries*								9,9	27,1	18,0		
IA IIIB	*Ovis aries*				25,5	17,7	14,7	48,0					
IA IIIB	*Ovis aries*				22,8	17,9							
IA IIIB	*Ovis aries*				26,5	19,5							
IA IIIB	*Ovis aries*				24,6	17,2							
IA IIIB	*Ovis aries*				27,2	17,8							
IA IIIB	*Ovis aries*				23,4	16,8							
IA IIIB	*Ovis aries*				23,4	16,2	13,3	48,0					
IA IIIB	*Ovis aries*				23,5	16,4							
IA IIIB	*Ovis aries*				24,5	18,3							
IA IIIB	*Ovis aries*									26,8	18,1		
IA IIIB	*Ovis aries*				24,0	17,6							
IA IIIB	*Ovis aries*				23,3	16,9							
IA IIIB	*Ovis aries*				23,2	16,2							
IA IIIB	*Ovis aries*				23,2	16,2							
IA IIIB	*Ovis aries*				28,1	17,9							
IA IIIB	*Ovis aries*				27,4	19,2							
IA IIIB	*Ovis aries*				22,1	15,0							
IA IIIB	*Ovis aries*				27,3	19,1							
IA IIIB	*Ovis aries*				24,3	16,5							
IA IIIB	*Ovis aries*				25,3	18,3							
IA IIIB	*O/C*				27,0	18,0							
IA IIIB	*O/C*				17,0	11,1							
IA IIIB	*O/C*				18,8	10,9							
IA IIIB	*O/C*				18,7	12,6							
IA IIIB	*O/C*				24,4	14,1							
IA IIIB	*O/C*				22,9	12,9							
IA IIIB	*O/C*				24,7	19,1							
	Metacarpus V		**GL**	**LeP**	**Bp**	**B**	**Bd**						
EBA I VIB2	Sus domesticus		54,0	50,0	8,4	7,0	11,5						

	Pelvis		**GL**	**LA**	**LAR**
IA IIIA	*Bos taurus*			60,5	61,2
EBA I VIB1	*O/C*	Pelvis		29,8	26,0
EBA I VIB1	*O/C*	Pelvis		29,8	26,0
EBA I VIB1	*O/C*	Pelvis		30,0	27,0
EBA I VIB1	*O/C*	Pelvis		35,0	31,5
EBA I VIB1	*O/C*	Pelvis		19,9	27,0
EBA II VI C	*O/C*	Pelvis	167,2	29,8	25,3
EBA II VI C	*O/C*	Pelvis		31,2	27,0
EBA II VI C	*O/ C W?*	Pelvis		32,3	26,0
IA IIIA	*O/C*			28,2	26,3

	Patella	Patella	**GL**	**GB**
EBA I VIB1	*Bos taurus*	Patella	60,0	42,0
EBA I VIB1	*O/C*	Patella	26,4	21,0
EBA I VIB1	*O/C*	Patella	35,0	26,5

	Femur	**Bp**	**BTr**	**DC**	**SD**	**DAPD**	**CD**	**Bd**	**DAPd**
IA IIIA	*Bos taurus*	117,0		50,6					
IA IIIA	*Capra hircus*	50,7		25,9					
IA IIIB	*O/C*		34,3	40,0					
IA IIIB	*O/C*	47,0	25,9	27,9					
IA IIIB	*Sus domesticus*							32,3	37,4

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The management and consumption of animals in the Early Middle Ages: the faunal remains of the Torba tower, Castel Seprio (Varese)

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ABSTRACT:This paper reports the early medieval faunal assemblage retrieved during four excavation campaigns which took place in the Torba tower on the *castrum* of Castel Seprio (Varese). The study outlines the faunal composition and management of animals in this area of the *castrum*, itself a part of the larger defensive system from Castel Seprio. Most remains represent domestic species with high frequencies of pigs, sheep, goats, cattle, and roosters, and lower values for horses and dogs. Wild animals account for only a small part of the assemblage. The presence of most anatomical portions in the main livestock species and butchery marks suggest that these remains reflect preparation and consumption practices. The disarticulated remains of a male horse were found on the external margin of the tower in what appears to be a burial whose perimeter, along with some bones which are missing on our sample were described in the 1978 excavation report by Alessandro Dejana.

KEYWORDS: FORTIFIED SITE, DIET, ANIMAL BUTCHERING, EARLY MIDDLE AGES

RIASSUNTO: Si presentano i risultati dello studio archeozoologico condotto sul campione faunistico altomedievale recuperato durante le quattro campagne di scavo nella torre di Torba. Esso ha fornito un quadro sulla composizione faunistica e in generale sul rapporto uomo-animale in questo specifico settore del *castrum*, facente parte del più ampio sistema difensivo di Castel Seprio (Varese). La maggior parte dei resti è riconducibile a specie domestiche con un'alta percentuale di maiali, caprovini, bovini e polli; meno attestati sono invece il cavallo e soprattutto il cane, presente con soli due denti. Gli animali selvatici rappresentano una piccolissima percentuale del lotto faunistico indagato. L'attestazione di quasi tutti i distretti anatomici delle principali specie di bestiame e le diverse tracce di macellazione suggeriscono che i resti siano il risultato della preparazione e del consumo di cibo. In prossimità della soglia d'ingresso si sono rinvenuti i resti di un cavallo di sesso maschile, privo di connessione anatomica, sepolto all'esterno della torre; i limiti della fossa nella quale è stato deposto e i resti ossei mancanti sono descritti nella relazione di scavo di Alessandro Dejana del 1978.

PAROLE CHIAVE: CASTRUM, ALIMENTAZIONE, MACELLAZIONE, ALTO MEDIOEVO

RESUMEN: Este trabajo detalla el conjunto faunístico altomedieval recuperado en cuatro campañas de excavación realizadas en la torre Torba del *castrum* de Castel Seprio (Varese). El estudio describe la composición faunística y la gestión animal en esta área del recinto fortificado, que forma parte del más amplio sistema defensivo de Castel Seprio. La mayoría de los restos representan

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especies domésticas con altas frecuencias de cerdos, ovejas, cabras, ganado vacuno y gallos, y valores más bajos para los caballos y perros. Los animales salvajes representan sólo una pequeña parte del conjunto. La presencia de la mayoría de las porciones anatómicas en las principales cabañas ganaderas y las marcas de despiece indican que los restos de las mismas reflejan prácticas de preparación y consumo. Los restos desarticulados de un caballo macho fueron encontrados en el margen externo de la torre en lo que parece ser un enterramiento cuyo perímetro, junto con algunos huesos que faltan en nuestra muestra, fueron descritos en 1978 en el informe de excavación de Alessandro Dejana.

PALABRAS CLAVE: TORBA, DIETA, DESPIECE ANIMAL, ALTA EDAD MEDIA

INTRODUCTION

The early medieval fortified settlement of Castel Seprio (Varese, Italy), is located between the valleys of the Olona river and the Tenore stream. At the southern edge of the site stands the Torba complex with the only surviving standing tower of the ancient fortification. Between 2017 and 2019, in agreement with the *FAI - Fondo Ambiente Italiano* and the *Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Como, Lecco, Sondrio e Varese*, four excavation campaigns were conducted under the direction of Alexandra Chavarría Arnau, full Professor of Medieval Archeology at the University of Padua. The aim was to understand the origins, evolution and characteristics of this area of the settlement in two specific moments of its history: in the VII century AD when it was part of the *castrum* and was equipped with a small funerary church and the subsequent transformation of the tower into part of a monastery (Brogiolo & Chavarría Arnau, 2021). The research team excavated different areas of the site including the tower (area 4000), the monastery basement, a cemetery attached to the northern wall of the church (area 1000) and a large building outside the fortification (area 2000) and the area west of the tower front of the facade of the building (area 6000), expanding the area investigated in 1978 towards the courtyard and going down to the natural ground and, finally, in the basement of the monastery (area 5000) to check the construction plan of

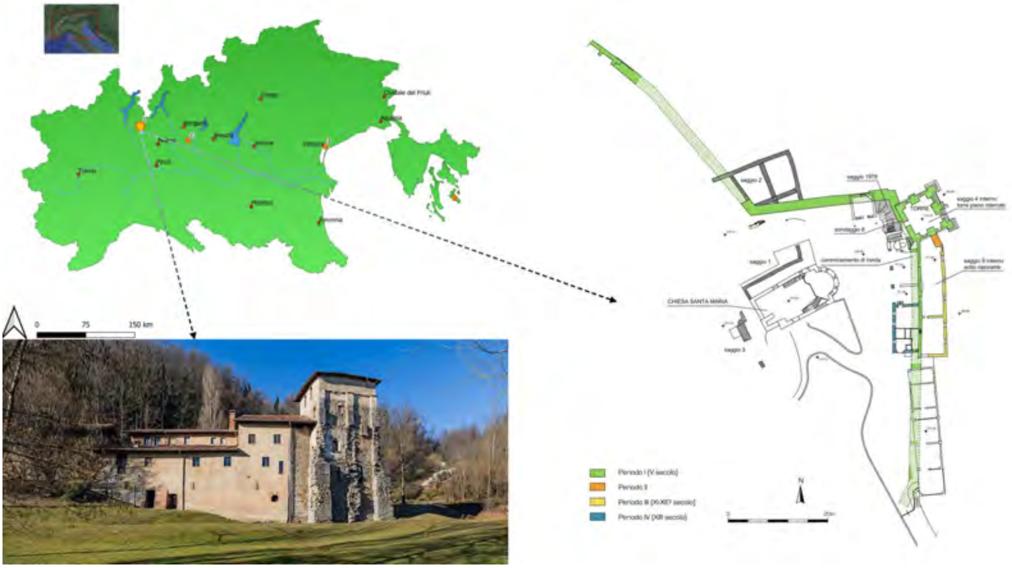

FIGURE 1

Location of the site and general plan of the excavation areas with indications of the main chronological phases.

the wall (Figure 1). Archeozoological analysis (in combination with archaeobotanical and stable isotope study of human remains) was undertaken in order to understand the exploitation of animals and in particular the consumption of meat between the sixth and eighth centuries, an era characterized by significant social, economic, and climatic changes. Furthermore, with the results of the present study, compared with other castra of northern Italy, we want to analyze the human-animal relationship in the fortified sites.

MATERIALS AND METHODS

In the four excavation campaigns, a total of 1423 animal remains were recovered including bones, teeth, and horns/antlers found in layers dating back to the Early Middle Ages (6th-8th century). The vast majority of the remains (84%) come from the area inside the building with a total of 1196 finds. This was followed by area 6000, which returned 177 fragments (12.5%), 21 of which are referable to a horse burial, and by area 5000 with only 50 animal bones (3.5%). The distribution of the remains in the different stratigraphic units of the area 4000 is particularly uneven – an anthropic layer (US 4080) linked to the existence of different hearths stands out in terms of quantity, while other stratigraphic units (USS 4024, 4077, 4106) had only very few fragments. The excavation of the US 4050 anthropic layer and the US 4051 filling of a hole (US 4052) have returned numerous bones, many of which are intact and in an exceptional state of conservation.

The taxonomic determination was carried out by using the modern reference collection of the Educational Museum of Veterinary Medicine of the University of Padua and specific atlases of comparative anatomy and archaeozoology including Schmid (1972), Habermehl (1975) and Barone (2017). For the more complex discrimination of goat and sheep, the rules dictated by Boessneck *et al*. (1964) were taken into consideration, while the study conducted by Cohen & Serjeantson (1964) was fundamental for the recognition of domestic and wild avifauna. The data were systematically collected and managed in a spreadsheet of the Microsoft Excel program, where the generic categories of large-size or small-medium size herbivores comprise the bones of mammals for which the determination of the precise taxonomic species was not possible due to the absence of sufficient diagnostic elements. The first category includes fragments of long bones diaphysis, ribs without joint facets, and vertebrae probably referable to cattle, although some may belong to individuals of similar size such as horses or deer. The second category includes the same anatomical parts referring to small ruminants (goat, sheep, or roe deer) and in some cases pigs. In addition to recording any pathologies, a careful taphonomic analysis was conducted to identify the natural and cultural processes that led the bones to become part of the archaeological record (signs of combustion, gnawing by other animals, traces of slaughter, etc.) in the moments before and after their burial (De Grossi Mazzorin, 2008). To determine the sexual dimorphism in the different animal species, both osteometric criteria, such as the Nobis indices (Nobis, 1954) on the bovine metacarpals, and morphological criteria such as the presence/absence of the spur in the *Gallus gallus* tarsometatarsus or the shape and size of the canines in the *Sus domesticus* were applied. For an estimate of the mortality patterns of the main domestic species, the fusion of the epiphyses to the diaphyseal body of long bones and the eruption, replacement, and dental wear have made it possible to obtain various information on the age of slaughter of the animals. The studies by Payne (1973) and Grant (1982), which are commonly used in archaeozoology, were only comparisons for the methodology currently used by us by observing the state of wear of the occlusal surface of the teeth (Tecchiati, 2023). To make observations about the management of the animal in the Torba site, several data quantification techniques were applied: after counting the Number of Remains (NR), the Minimum Number of Individuals (MNI) was deduced for each species certified in the site by counting the laterality of the different bones and the state of wear of the dP4 and M3. Finally, in addition to estimating the meat-producing capacity of the main domestic species following the method of Flannery (1969), the measurements of all the well-preserved bones of unburnt and disease-free adult individuals were acquired according to the prescriptions of Driesch (1976).

RESULTS AND DISCUSSION

The faunal material counts a total of 1423 bone fragments, among which 918 remains (65%) were determined while for the remaining 505 (35%) it was not possible to identify the animal species they belonged to (this set includes the undetermined, defined as N.D., and the bones assigned to the category of large and small-medium sized herbivorous). All the bones are in a good state of conservation, especially those found in the layers of 2018. The only exceptions are the faunal finds from the stratigraphic unit 4080 which returned very fragmented and mostly burnt bones. 83 burned elements (6%) were identified, for some of which it was still possible to identify the species or anatomical element, for others the modification of the bone prevented their recognition. 90% of these are burnt and the remaining 10% are calcined, a sign that these finds have been subjected to very high temperatures for a long period. Three remains have a hole on the surface attributable to the bite of carnivores while six are the traces attributable to gnawing by small rodents.

Precisely, 158 elements (11%) show signs of anthropogenic action caused by cutting tools: based on their type (clean or superficial cut) it is possible to understand whether the affected bone had been slaughtered, stripped, or disjointed. In the case of Torba, the signs were mostly present in the three main classes of domestic animals and in four cases also on *Gallus gallus* bones; no signs of killing or skinning were found in wild species (except for a superficial cut observed on a bone of *Lepus europaeus*); this is not because these animals were not hunted, killed and their meat treated, but rather because the class of remains of this faunal record did not provide a sufficient number of bones to verify the phenomenon.

The zooarchaeological analysis and the subsequent deduction of the Minimum Number of Individuals made it possible to ascertain that the pig is the most attested species on the site, followed in quantity by sheep and goats, and cattle (Table 1). 12% are bones of domestic avifauna (*Gallus gallus*), 5% of horses while the rest are attributable to some mammals and wild birds.

During the 2017 excavation inside the tower (area 4000; US 4057) a forequarter of a cow in anatomical connection was found in an exceptional state of conservation. In total there are, for this specimen, 241 fragments and complete bones that inevitably overestimate the number of remains referable to this species in the site, a parameter which was then corrected in the deduction of the Minimum Number of Individuals, considering it as a single individual. The individual has clear butchery marks, in particular a clean-cut transversal to the third cervical vertebra (C3) for the elimination of the head and along the thoracic vertebrae for the half-carcass of the animal (Figure 2) - all of which are evident traces of a first butchery of the animal. Superficial signs of cut marks are present both externally and internally on the ribs, the vertebrae, and the mandibles. By observing the occlusal surface of the teeth still inserted in the jaw and the mandible it is possible to affirm that it is a completely adult individual that has abundantly exceeded 24-28 months of life when the complete eruption of the third molar takes place. Due to the absence of a pelvis, the size and structure of the horns were relied upon in determining the sex, suggesting that it was a female example - this is also confirmed by the application of the Nobis index (Bp*100/GL, 5,1*100/18,06 = 27,41 cm).

The presence of all the skeletal elements (Table 2) suggests that the breeding of livestock (sheep and goats, pigs, and cattle) probably took place near the *castrum*, also considering that, for domestic species, the population counted exclusively on wild pastures without any type of forced fattening, a typical practice of the Roman period (Montanari, 1992). However, this does not exclude that there may have been stables and shelters for animals.

Thanks to the remains of teeth and the sporadic discovery of complete mandibles and jaws, it was

	Bos taurus	***Ovis* vel *Capra***	***Sus domesticus***	***Equus caballus***	***Gallus gallus***	***Cervus elaphus***	***Lepus europaeus***	***Mustelidae***	***Mus musculus***	***Canis familiaris***	***Galliformes***
NR	343	293	163	47	35	1	4	3	20	2	7
% NR	37,3	32,3	17,7	5,1	3,8	0,1	0,4	0,3	2,1	0,2	0,7
NMI	8	10	11	2	5	1	1	2	2	1	-
% NMI	18,6	23,2	25,9	4,6	11,6	2,3	2,3	4,6	4,6	2,3	-

TABLE 1

Number of Remains and Minimum Number of Individuals, with relative percentage, of domestic and wild species and determined in the site.

FIGURE 2
Cervical vertebrae of the cow in anatomical connection (US 4057) found inside the tower with evident traces of slaughter.

possible to estimate the age at death from the state of eruption, replacement, and dental wear for sheep and goats, pigs, and cattle. The first and second molars were also used to determine the age at death, deducing the state of wear of the third molar originally associated with them (Fecchio & Tecchiati, 2021). By observing the mortality curves (Figure 3), which are broadly confirmed by those obtained from the state of fusion of the epiphyses with the diaphyseal body of the long bones, considerations have been made about the management of the animal in the site, in particular for the early medieval phase. Most of the sheep and goats, whose carcasses were treated on the spot, were slaughtered in adulthood (58%) but a good percentage of young individuals (14%) and some very young (confirmed for the discovery of two tibias, a radius and a humerus) was attested: it is deduced that, in general, animals were mostly exploited for secondary products such as milk and wool. On the other hand, young individuals were occasionally killed for their lamb meat, which was definitely more valuable. Furthermore, a too high number of unweaned animals in the flock would have affected the production of milk, which had to be used for human consumption also in the form of derived products. Usually, the ratio between goats and sheep within an archaeological fauna of the Early Middle Ages is 1:5 (Salvadori, 2015). Therefore, it is interesting to see how the difference between the two species, in the case of Torba, is minimal: as a matter of fact, it can be assumed that the flocks were equally composed of both sheep and goats, which, despite belonging to the same taxonomic subfamily, have a different ability to adapt to the surrounding habitat and, basically, a different type of diet.

The analysis of the deciduous fourth premolar and the third molar and their state of wear allowed us to count a minimum of eleven individuals of *Sus domesticus*. The same result was obtained based on the laterality of the bone most present in the fauna sample under examination. The mortality curve shows how, even in this case, the higher percentages are to be associated with sub-adult individuals (18%) or just adults (24%) due to the advanced state of wear of the deciduous fourth premolar (dP4+++) or due to the absent or slight wear of the third molar (M3+/-, M3+).

	Bos taurus	*Ovis aries*	*Capra hircus*	*Ovis vel Capra*	*Sus domesticus*	*Equus*	*Gallus gallus*	*Cervus elaphus*	*Lepus europaus*	*Mustelidae*	*Mus musculus*	*Canis familiaris*	*Galliformes*	**Piccola taglia**	**Grande taglia**	**ND**
Calvaria	3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
Cranium	44	-	2	17	16	-	-	-	-	-	4	-	-	8	-	24
Maxilla	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Dentes	11	-	-	3	18	4	-	1	-	-	1	2	-	-	-	-
Mandibula	14	2	-	3	18	8	-	-	-	-	2	-	-	1	1	-
Costae	145	-	-	67	15	5	1	-	-	-	2	-	-	144	37	17
Vertebrae	43	4	1	47	15	5	-	-	-	-	-	-	-	-	1	6
Sternum	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Os coracoide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Furcula	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Scapula	7	-	-	4	15	3	1	-	-	-	1	-	-	1	1	-
Humerus	6	3	2	17	7	-	5	-	1	2	1	-	2	-	-	-
Radius	3	4	-	11	4	2	4	-	1	-	3	-	-	-	-	-
Ulna	1	1	-	4	7	-	4	-	-	1	-	-	1	-	-	-
Carpalia	7	-	-	3	2	-	-	-	-	-	-	-	-	-	-	1
Metacarpus	5	3	2	3	4	-	-	-	-	-	-	-	-	-	-	-
Pelvis	2	1	1	14	4	2	-	-	-	-	-	-	-	-	-	1
Femur	5	-	2	13	7	1	7	-	1	-	4	-	-	-	-	-
Tibia	5	1	1	22	11	2	-	-	1	-	2	-	1	-	2	1
Patella	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Os sesamoide	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tibiotarsus	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-
Fibula	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Talus	1	-	-	-	3	2	-	-	-	-	-	-	-	-	-	-
Os sacrum	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Calcaneus	4	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Tarsalia	1	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Tarsometatarsus	-	-	-	-	-	-	7	-	-	-	-	-	1	-	-	-
Metatarsus	1	2	2	5	10	1	-	-	-	-	-	-	-	-	-	-
Metapodia	1	-	-	8	1	2	-	-	-	-	-	-	-	-	-	-
Phalanges	14	2	5	5	2	4	-	-	-	-	-	-	-	-	-	-
Diaphyses		-	-	-	-		-	-	-	-	-		-	17	8	4
ND	9	-	-	-	-	-	-	-	-	-	-	-	2	-	1	229
Totale	**343**	**25**	**21**	**247**	**163**	**47**	**35**	**1**	**4**	**3**	**20**	**2**	**7**	**171**	**51**	

TABLE 2

Animal remains of the entire faunal assemblage of Torba.

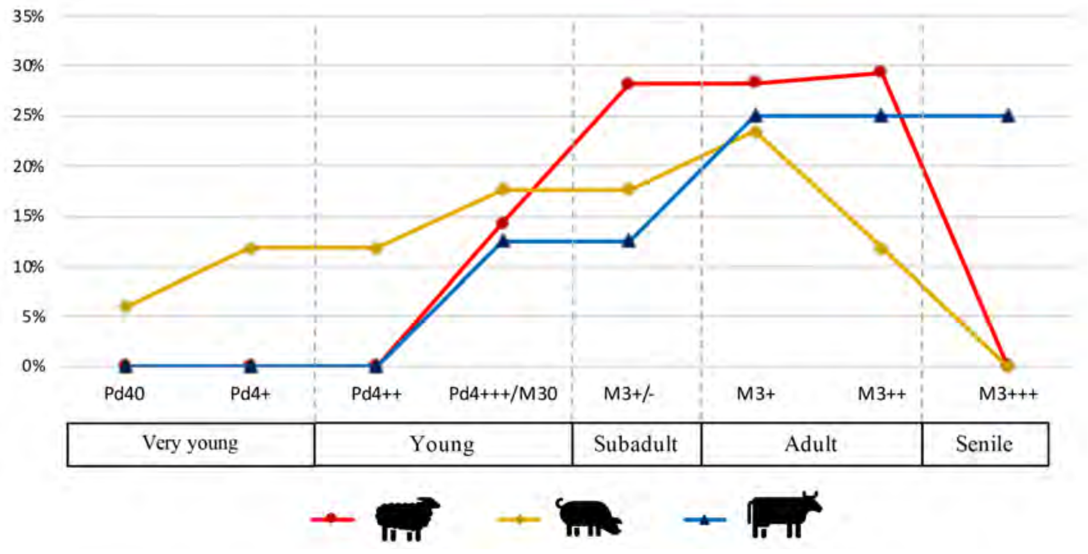

FIGURE 3

Mortality curves for the main domestic species obtained from the analysis of the state of wear, replacement, and dental eruption.

If we exclude the cow remains in anatomical connection, the incidence of the ox in the faunal sample is quite modest even if the remains of slaughter in this species are very significant of the practice in ancient times. The cuts were made along the main joints and along the bones where there was the least amount of meat and the analysis of the age at death of the individuals allowed us to identify a high percentage of adults (50%) and senile individuals (25%), whereas sub-adults and young specimens are much less attested. Furthermore, from the osteometric analysis, we obtain an average height at the withers of 110 cm of (a small-medium-sized ox), a parameter compatible with those obtained for other early medieval faunas in northern Italy (Salvadori, 2011). The generic adult/senile age of a large part of the cattle found in the faunal lot suggests that they were widely exploited as a primary resource and, despite the absence of pathologies attributable to biomechanical stresses, most likely also as workforce in agricultural activity.

Immediately outside and near the entrance to the Torba tower, several skeletal elements of horses were found, part of which had already been excavated in 1978 by Alessandro Dejana. The remains, coming from US 6019, were not in anatomical connection and include a right mandible (Figure 4), a left tibia and fibula, a left scapula and, always referable to the left hind limb, an astragalus, a calcaneus, a metatarsal, the first and second phalanx and the tarsal bones (cuboid, navicular and large cuneiform bone). In 2018 in the same excavation and layer, but slightly further north, a pelvis and femur of a horse had been discovered and in 1978 a significant amount of horse bone remains (neurocranium, radius, metacarpus, and thoracic vertebrae and ribs) were found, of which, however, we only obtained a survey and detailed documentation that testify the horse was buried in a trapezoidal pit (1.80x1.25/1.80 m). By observing the fusion of the epiphyses with the diaphyseal body of the long bones (in particular the complete left femur and tibia), it was possible to say that the individual was an adult, certainly older than 42 months (Barone, 2017). The data is confirmed if we observe the occlusal surface of the permanent teeth, whose dental wear and the height of the crown suggest that it was an adult individual. The size of the canines and the morphology of the pelvis (compared with a reference collection) lead to the hypothesis

FIGURE 4

Complete right mandible of the horse found outside the tower near the entrance threshold.

that it was a male horse. Considering the presence of a complete tibia, it was possible to deduce that the height of the animal at the withers was about 140 cm - a biometric piece of data that allows us to conclude that this individual had an average height for its species in the Italian Early Medieval period (Salvadori, 2016). Unfortunately, in the case of Torba, the possible owner of this horse has not yet been found; as evidenced in many studies for the Moncalieri burial ground or the Spilamberto cemetery (Fedele, 2017), the horse did not necessarily have to be laid down near the owner's tomb. The presence of only a few bones remains, even if in a good state of conservation, and the impossibility of analyzing the bones found in 1978 does not allow us to make more detailed observations. Considering the absence of traces of slaughter and flesh-eating, we can safely affirm that the animal was not slaughtered to be consumed, and, considering its state of health, it most likely did not make such big efforts in its life as to become visible at a paleopathological level.

A study of the stable isotopes of carbon (δ13C) and nitrogen (δ15N) was combined with the zooarchaeological, taphonomic, and osteometric analysis of the animal remains, aimed at calibrating the local trophic line for the same analyzes carried out on some skeletons found inside of the northern annex of the church of Santa Maria di Torba (Va), a few tens of meters from the tower of the fortification under consideration. This also allowed us to make considerations about the forage system and the environment in which the animals lived.

For the fauna material we tried to take into account only bone fragments and the highest *taxa* variability; therefore, both herbivores (cattle and sheep and goats), omnivores (pigs), and carnivores (mustelids) datable to the early medieval (4 samples) and late medieval (4 samples) phases of occupation of the tower were taken into account (for more details on the methodology employed, see Marinato & Rigo, 2021). From the comparison between the collagen values of the fauna with the stratigraphic and chronological data of the material, an increase in the isotope ratio of nitrogen over time is observed for all the species considered: from the early medieval to the late medieval period, an increase of δ15N of about 1.0‰ is observed for cattle, goats, and mustelids, while the gap is greater for pigs - 2.0‰. This variation in the isotope ratio of nitrogen could be due to a change in the environmental resources present in the area and to a change in the diet and forage of these animals between the early and late Middle Ages.

In addition, the pig sample relating to the Early Middle Ages phase has low nitrogen values similar to those of other herbivores (2.95‰), indicating a greater consumption of plant resources by this individual (Marinato & Rigo, 2021). This data, associated with those of the remaining fauna that demonstrate how the basic ecosystem was mainly C3 plants, suggests that the animals were bred in the wild in the woods near the *castrum*. In this habitat not only did the pig find food such as roots, acorns, etc., but it also had frequently the chance to breed with its wild equivalent, the wild boar. This would account for the large size of *Sus domesticus,* which, according to the osteometric data collected for the site, must have been around 79 cm at the withers.

CONCLUSION

The analysis of the faunal remains of the Torba tower made it possible to obtain, at least in part, a whole series of historical information on this military *castrum* which was most likely inhabited by troops of soldiers who presided over the place. The high incidence of pigs, the meat animals par excellence as well as an undisputed reference unit of forestry-pastoral production, and sheep and goats, the protagonist in early medieval farming, suggests that in the settlement, or at least in a part of it, there was a production of meat destined for the local community. The very scarce presence of wild species in the faunal assemblage investigated is ambiguous: the analyzes of post-classical faunas in northern Italy show low percentages of remains referable to wild species; the data is in clear contradiction with the written sources, in particular the Edict of Rotari (643 AD), which instead present hunting as common practice for all social classes focused mostly on the killing of deer and waterfowl. Furthermore, in the case of Torba, archaeobotanical analysis confirmed that, after the initial deforestation of the area, there was the presence of chestnut and walnut trees around the castrum (Proserpio & Rottoli, 2021). Despite the proximity of the Olona river which could be exploited for fishing, fish remains are not documented, contrary to what one might expect.

This study represents a starting point for future insights into the human-animal relationship in the *castrum* in the broader framework of northern Italy in the Early Middle Ages. New excavation campaigns, developed at this moment in the area of Castel Seprio, will predictably lead to an increase in data, and also compare them with other analyses which is being conducted mostly on the burial contexts of the church of San Giovanni (stable isotopes and DNA analysis of burial soils) to track dietary and healthy signals linked to the microbiome from the burial environment.

SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_003

BIBLIOGRAFIA

BARONE, R. 2017: *Anatomia comparata dei mammiferi domestici. Osteologia*. Volume I. Edagricole, Bologna.

BOESSNECK, J.; MÜLLER, H.H. & TEICHERT, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf und Ziege. *Kvehn – Archiv* 78: 1-129.

BROGIOLO, G.P. & CHAVARRÍA ARNAU, A. 2021: Le difese: le mura e la grande torre. In: Chavarría Arnau, A. & Brogiolo, G.P. (eds.): *Torba (VA). Scavi 2013-2019*: 21-54. SAP Società Archeologica s. r. l., Mantova.

COHEN, A. & SERJEANTSON, D. 1996: *A manual for the identification of bird bones from archaeological sites*. Archetype publications, London.

DE GROSSI MAZZORIN, J. 2008: *Archeozoologia: lo studio dei resti animali in archeologia*. Editori Laterza, Bari.

DRIESCH, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Cambridge University Press, Cambridge. MA.

FECCHIO, M. & TECCHIATI, U. 2021: I resti faunistici altomedievali della torre. In: Chavarría Arnau, A. & Brogiolo, G.P. (eds.): *Torba (VA). Scavi 2013-2019*: 203-225. SAP Società Archeologica s. r. l., Mantova.

FEDELE, A. 2017: La deposizione del cavallo nei cimiteri longobardi: dati e prime osservazioni. In: Giostra, C. (eds.): *Archeologia dei Longobardi: dati e metodi per nuovi percorsi di analisi*: 59-82. SAP Società Archeologica s. r. l., Mantova.

FLANNERY, K.V. 1969: Origins and ecological effects of early domestication in Iran and near Est. In: Ucko, P.J. & Dimbleby, G.W. (eds.): *The domestication and exploitation of plants and animals*: 27-66.

GRANT, A. 1982: *The use of tooth wear as a guide to the age of domestic ungulates*. B.A.R. Publishing London, Oxford.

HABERMEHL, K.H. 1975: *Die Altersbestimmung bei Haus – und Labortieren*. Berling – Hamburg.

MARINATO, M. & RIGO, M. 2021: La paleodieta degli inumati dell'annesso nord: i dati isotopici. In: Chavarría Arnau, A. & Brogiolo, G.P. (eds.): *Torba (VA). Scavi 2013-2019*: 187-194. SAP Società Archeologica s. r. l., Mantova.

MONTANARI, M. 1992: *Alimentazione e cultura nel Medioevo*. Editori Laterza, Roma.

NOBIS, G. 1954: Zur Kenntnis der ur- und frühgeschichtlichen Rinder Nord- und Mitteldeutschlands. *Zeitschrift* für *Tierzüchtung und Züchtungsbiologie* 63: 155-194.

PAYNE, S. 1973: Kill–off Patterns in Sheep and Goat: The Mandibles from Aşvan Kale. *Anatolian Studies* 23: 281-303.

PROSERPIO, B. & ROTTOLI, M. 2021: Le analisi archeobotaniche. In: Chavarría Arnau, A. & Brogiolo, G.P. (eds.): *Torba (VA). Scavi 2013-2019*: 195-201. SAP Società Archeologica s. r. l., Mantova.

SALVADORI, F. 2011: Zooarcheologia e controllo delle risorse economiche locali nel medioevo. *Post Classical Archeologies* I. SAP Società Archeologica s. r. l., Mantova.

— 2015: *Uomini e animali nel Medioevo: Ricerche archeozoologiche in Italia tra analisi di laboratorio e censimento dell'edito*. Edizioni Accademiche Italiane, Rome.

— 2016: I rinvenimenti di cavallo (*Equus caballus* L., 1758) nei depositi di età medievale. In: Thun Hohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Annali dell'università di Ferrara. Sezione: Museologia scientifica e naturalistica* 11/2: 327-336. Ferrara.

SCHMID, E. 1972: *Atlas of Animal Bones, for Prehistorians, Archaeologists and Quaternary Geologists*. Elsevier Publishing Company, London.

TECCHIATI, U. 2023: I resti faunistici di età bassomedievale e moderna. In: Magrini, C. & Zenarolla, L. (eds.): *A tavola e in cucina tra Medioevo e Rinascimento nel castello di San Vito al Tagliamento* (PN): 130-132. All'Insegna del Giglio, Firenze.

The results presented in this volume stem from activities carried out under excavation permits granted by the Ministry of Culture (permit details: 2013, Prot. 3566 del 10.04.2013; 2014, Prot.1706 del 03.03.2014; 2016, Prot. 2067 del 03.03.2016; 2017, Prot. 5723 del 24.02.2017; 2018-2020, Prot.10236 del 12.04.2018)

SUPPLEMENTARY MATERIAL

Mandibula							
Specie	**Catalogo**	**M3-Ca**	**M3-P2**	**M3-M1**	**P2-I3**		
Sus domesticus	534	114,7	94,9	60,2	39,0		
	1305	112,3	92,8	57,8	39,8		
Specie	**Catalogo**	**Cr-Gov**	**Cr-Id**	**Id-Goc**	**Goc-M3**	**P2-M3**	**M1-M3**
Bos taurus	89	182,4	343,7	338,8	100,4	135,7	83,3
	90	184,3	349,9	340,6	105,0	136,2	82,8
Specie	**Catalogo**	**Cr-Gov**	**Cr-Id**	**Id-Goc**	**Goc-M3**	**P2-I3**	**M1-M3**
Equus caballus	1379 (US 6019)	323,2	541,2	503,1	165,9	111,8	99,4
Dentes							
Specie	**Catalogo**	**Dentes**	**B**	**L**			
Sus domesticus	3	M3 inf.	13,4	27,1			
Bos taurus	369	M3 sup.	14,6	34,7			
Equus caballus	776 (US 4079)	P2 inf.	17,8	32,2			
	780 (US 4079)	P3 inf.	19,1	27,7			
	781 (US 4079)	P4 inf.	19,5	27,3			
	782 (US 4079)	M1 inf.	25,1	17,5			
	783 (US 4079)	M2 inf.	25,2	16,2			
Atlas							
Specie	**Catalogo**	**H**	**BFcr**				
Sus domesticus	714	45,9	52,8				
Specie	**Catalogo**	**GB**	**GLF**	**GL**	**BFcd**		
Bos taurus	270	133,2	76,7	88,0	83,2		
Axis							
Specie	**Catalogo**	**LAPa**	**H**	**LCDe**			
Bos taurus	271	67,9	102,9	103,9			
Scapula							
Specie	**Catalogo**	**GLP**	**LG**	**BG**			
Bos taurus	292	62,4	53,6	46,8			
	293	62,5	53,3	45,8			
Equus caballus	1364 (US 6019)	94,1	62,0	49,5			
Specie	**Catalogo**	**GL**	**Dic**				
Galllus gallus	681	62,8	7,4				
Humerus							
Specie	**Catalogo**	**Bd**	**BT**	**Bp**	**SD**	**GL**	
Ovis aries	607	30,3	29,6	-	-	-	
Capra hircus	81	-	-	37,6	-	-	
	416	28,5	28,0	-	-	-	
Sus domesticus	650	38,7	-	-	16,2	-	
Bos taurus	294	69,2	63,3	92,1	30,9	262,8	
	305	66,3	-	90,9	30,6	260,5	
Radius							
Specie	**Catalogo**	**Bd**	**BFd**	**Bp**	**SD**	**BFp**	**GL**
Ovis aries	399	31,3	27,9	-	-	-	-
	403	-	-	33,1	17,8	-	-
	509	-	-	31,5	18,0	-	-
Bos taurus	295	61,3	-	67,7	34,5	62,5	250,7
	306	61,7	-	68,2	34,3	63,5	249,5

Specie	**Catalogo**	**Bp**	**SD**
Sus domesticus	910	28,1	16,4
	1119	30,3	19,9

Specie	**Catalogo**	**CD**	**Bd**	**BFd**
Equus caballus	400	40,6	74,8	61,7

Specie	**Catalogo**	**GL**	**SC**	**Bd**
Gallus gallus	20	54,0	2,8	6,3

Ulna

Specie	**Catalogo**	**GL**	**SC**	**Did**
Gallus gallus	381	55,9	3,5	7,8

Metacarpus

Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GL**
Ovis aries	424	24,6	25,7	19,4	122,4
	454	22,6	-	12,3	-
Capra hircus	452	22,7	-	-	-
	508	25,5	27,3	15,6	120,2
Bos taurus	296	51,2	53,1	27,8	185,9
	309	50,5	52,9	27,0	183,4

Pelvis

Specie	**Catalogo**	**LA**	**LAR**
Sus domesticus	1338	34,1	30,7
Equus caballus	595 (US 6019)	70,3	65,7

Femur

Specie	**Catalogo**	**Bp**	**SD**
Capra hircus	715	40,3	14,9

Specie	**Catalogo**	**Bp**	**GL**	**SC**	**Bd**	**Lm**
Gallus gallus	350	-	-	6,8	12,8	-
	662	-	-	6,3	12,5	-
	695	13,6	71,4	6,7	13,0	66,7

Tibia

Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GL**
Ovis aries	533	42,9	-	-	-
Capra hircus	404	43,5	28,0	15,2	216,4
Ovis vel *Capra*	34	-	26,9	-	-
	415	-	26,5	-	-
	510	-	26,7	-	-
Bos taurus	402	-	63,3	-	-

Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GL**	**Dd**
Equus caballus	1365 (US 6019)	96,1	76,2	42,7	353,3	47,3

Tibiotarsus

Specie	**Catalogo**	**GL**	**La**	**Dd**	**Bd**
Gallus gallus	31	109,1	104,7	11,6	10,2
	353	-	-	10,8	9,0

Talus

Specie	**Catalogo**	**GLl**	**GLm**
Sus domesticus	4	48,7	44,6
	428	38,5	35,2

Specie	**Catalogo**	**GH**	**LmT**	**GB**	**BFd**

Equus caballus	558	55,5	56,7	58,2	50,8
	1367 (US 6019)	58,9	61,6	62,4	51,2
Calcaneus					
Specie	**Catalogo**	**GL**	**GB**		
Bos taurus	786	111,5	36,9		
Equus caballus	1368 (US 6019)	111,6	53,3		
Tarsalia					
Specie	**Catalogo**	**GB**			
Equus caballus	1373 (US 6019)	49,4			
	1374 (US 6019)	49,2			
Metatarsus					
Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GL**
Capra hircus	30	21,9	24,7	13,2	123,7
Bos taurus	1204	45,1	53,5	26,0	236,6
Specie	**Catalogo**	**Bp**	**CD**		
Equus caballus	1366 (US 6019)	52,4	34,1		
Metatarsus III					
Specie	**Catalogo**	**Bp**	**B**		
Sus domesticus	43	14,2	-		
	83	12,9	10,5		
	1125	13,8	11,6		
Tarsometatarsus					
Specie	**Catalogo**	**Bp**	**GL**	**SC**	**Bd**
Gallus gallus	355	12,6	-	6,4	-
	666	-	-	6,8	11,3
	710	14,5	94,5	7,7	16,0
	883	-	-	6,7	12,9
Phalanx 1					
Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GLpe**
Ovis aries	80	12,0	10,2	9,4	35,4
Capra hircus	465	13,7	11,6	11,2	34,9
	924	12,6	10,4	10,1	41,5
Bos taurus	297	25,0	23,5	22,9	50,9
	308	27,8	24,1	23,0	50,5
	450	25,2	24,8	22,2	50,1
	700	33,3	30,0	28,4	53,1
	740	33,7	30,9	28,5	57,6
	1302	24,5	24,1	23,6	52,5
Specie	**Catalogo**	**SD**	**Bd**	**BFd**	**GL**
Equus caballus	1377 (US 6019)	35,2	48,0	42,4	82,6
Phalanx 2					
Specie	**Catalogo**	**Bp**	**Bd**	**SD**	**GL**

Capra hircus	461	12,0	9,7	9,0	20,5		
	920	11,6	10,5	8,8	26,5		
Bos taurus	298	25,9	21,5	21,8	34,9		
	299	25,5	21,6	21,6	34,6		
Specie	**Catalogo**	**Bp**	**Dp**	**BFp**	**SD**	**GL**	**Bd**
Equus caballus	1378 (US 6019)	55,9	33,6	45,6	44,1	47,9	49,0
Phalanx 3							
Specie	**Catalogo**	**DLS**	**Ld**	**MBS**			
Capra hircus	463	30,4	22,8	6,1			

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The transition from Late Antiquity to the early Middle Ages in Northern Italy: an Environmental Archaeology Approach

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ABSTRACT: This paper focuses on the agricultural and animal husbandry practices in Northern Italy between the 5th and 11th c. CE. The aim is to define the modes of land exploitation, human adaptability, and subsistence patterns in the transition from Late Antiquity to the Early Middle Ages. Selected archaeobotanical data and zooarchaeological assemblages were compared through correspondence analysis to explore correlations in an integrated botanical and faunal dataset. The results show a high degree of variation in agriculture during this temporal window, with the introduction of more resilient and short-cycled grains to minimize food shortage risks caused by climatic, political, and social change. Meat consumption appear to have increased, with pig-breeding being the most frequent practice, followed by caprines, supporting the early medieval preference for raising smaller sized ungulates. Cattle decreases at this time, becoming less useful as a working animal, its increase only coinciding with the postulated agricultural revival of the medieval climatic optimum (10th–11th c. CE). Overall, these environmental and archaeological frames evidence that peasant autonomy during the Early Middle Ages resulted in a highly diversified exploitation of wild and domesticated resources alike.

KEYWORDS: LATE ANTIQUITY, EARLY MIDDLE AGES, ENVIRONMENTAL ARCHAEOLOGY, MULTIVARIATE STATISTICS

RIASSUNTO: Il presente contributo è incentrato sulle pratiche agricole e di allevamento in Nord Italia dal V all'XI sec. d.C. L'obiettivo è di delineare i modelli di sfruttamento della terra, di adattabilità umana e di sussistenza alla transizione dall'antichità all'Alto Medioevo. Lo studio mette a confronto dati archeobotanici e archeozoologici da 35 contesti selezionati. I risultati delle analisi di corrispondenza, effettuate per la ricerca di correlazioni in un dataset integrato, illustrano un alto grado di variazione nell'agricoltura di questo periodo. Al fine di minimizzare il rischio di carestia, causata da cambiamenti climatici, politici e sociali, furono introdotti grani più resilienti a ciclo breve. Il consumo di carne sembra incrementare, in particolare da allevamento suino e caprino. Ciò dimostra la preferenza in questo periodo per animali di piccola taglia. La popolazione bovina diminuisce almeno fino al presunto revival agricolo dei sec. X-XI d.C. Il fine di questa ricerca è la valorizzazione del ruolo dell'archeologia ambientale nella comprensione del fenomeno dell'autonomia contadina altomedievale, rappresentata da uno sfruttamento altamente diversificato delle risorse selvatiche e domestiche.

PAROLE CHIAVE: TARDA ANTICHITÀ, ALTO MEDIOEVO, ARCHEOLOGIA AMBIENTALE, STATISTICA MULTIVARIATA

RESUMEN: Este artículo se centra en las prácticas agrícolas y ganaderas del norte de Italia entre los siglos V y XI. CE. Su objetivo es definir los modos de explotación de la tierra, la adaptabilidad humana y los patrones de subsistencia en la transición de la Antigüedad Tardía a la Alta Edad Media. Se compararon datos arqueo-botánicos y conjuntos zooarqueológicos seleccionados a través de los análisis de correspondencia para explorar correlaciones entre los datos botánicos y

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los faunísticos. Los resultados muestran un alto grado de variación en la agricultura durante este lapso temporal, con la introducción de granos más resilientes y de ciclo corto que minimizarían el riesgo de escasez de alimentos causado por los cambios climáticos, políticos y sociales. El consumo de carne parece haber aumentado con el tiempo, siendo la cría del cerdo la práctica más frecuente, seguida por la de caprinos, lo que respalda la preferencia en el Medioevo temprano por criar los ungulados de menor tamaño. El vacuno disminuye en estos momentos, volviéndose menos útil como animal de trabajo, y su aumento solo vuelve con el renacimiento agrícola propiciado por el óptimo climático medieval (siglos X-XI d.C.). En general, estos marcos ambientales y arqueológicos evidencian que la autonomía campesina durante la Alta Edad Media generó una explotación sumamente diversificada de recursos, tanto los silvestres como los domésticos.

PALABRAS CLAVE: ANTIGÜEDAD TARDÍA, EDAD MEDIA TEMPRANA, ARQUEOLOGÍA AMBIENTAL, ESTADÍSTICA MULTIVARIANTE

INTRODUCTION

Scholarly debate on the dynamics of human-nature interaction in Northern Italy during the transition from Late Antiquity to the Early Middle Ages still leaves today some open questions. Were the former Roman economic structures and farming practices completely abandoned or did they find continuity during this turbulent time? Which agricultural strategies did peasants develop to cope with political, demographic and climatic change? This study is part of the research framework on peasant autonomy, a concept introduced by Wickham (2005), who claimed that after the 5th c. peasants operated in small circles of subsistence economy, although acquiring more autonomy and responsibilities in farming production than in Roman times. Peasants were liberated of former farming priorities, such as generating a surplus for taxation, and thus they did not need to meet external demands any longer. This autonomy was weakened in the 8th c. by the full implementation of the manor system. Verhulst (1966) had already demonstrated the late origins of the manor system in France, but Wickham (2005) argued for the presence of manors in Northern Italy and Tuscany as well. Overall, past archaeological and historical literature has contributed to our understanding of the early medieval rural dynamics, but the integration with different types of archaeological sources can improve this picture. The integration of different sources is fundamental to casting new light on peasants' lifeways, which may be obscured in the textual records, privileging elite contexts and high-status transactions. Bioarchaeological evidence can help visualise the early medieval Northern Italian landscape in which new agrarian strategies were taking place (Figure 1).

MATERIALS AND METHODS

This study focuses on 27 archaeobotanical and 39 zooarchaeological assemblages from a total of 35 sites (Tables 1, 5, Supplementary Material). These consist of 11 rural sites, 16 urban contexts, and 8 high-status sites (2 religious, 6 *castra*/castles). I will quantitatively analyse the archaeobotanical and zooarchaeological samples.

The choice of the upper and lower chronological boundary for this research depended on the historical events framing the period. The 5th c. was chosen as the date marking the political end of the Roman Empire, while the 11th c. is related to the phenomenon of *incastellamento* (the creation of castles encompassing the villages) and the medieval agricultural revival (described in Toubert, 1973). In addition to political events, the period was also marked by two climatic anomalies that conditioned landscape use and, consequently, the economy: the Late Antique Little Ice Age (LALIA, 536-660 CE ca.) and the Medieval Warm Period (MWP, 900-1300 CE ca.). The most problematic phase is the 7th - 8th c., which lacked a substantial amount of pre-existing data. The southern geographical boundary for the research area is the imaginary line drawn from the region of Emilia-Romagna (including San Marino) to northern Tuscany. Some of the regions under consideration are entirely missing or lacking data (Figure 1). The area encompasses three ecological zones that are considered in the examination – coast, inland and mountains.

Another issue affecting the quantifications of samples is chronological fuzziness. Dating plant and animal remains using radiocarbon is very rare, at least for the samples in the database. The dating parameters mostly rely on ceramics, thus chronologies can range between one and several centuries. Taking this into account, I assigned a weight to each sample (Supplementary Material, Sect. 3). Weights can be used for weighted means/medians, with samples with larger chronologies (hence less precise) having a lower impact on the computations.

Several quantifications have been performed on the archaeobotanical dataset. Ubiquity (Supplementary Material, 4.2) is a presence/absence analysis providing a score based on presence of species in the samples considered (Wright, 2010) and has the advantage of not being biased by overrepresented taxa. In order to facilitate comparison between samples, the raw data was converted into relative ranks, which assigns increasing ranks to the count values (excluding zeros) on a scale of 0 to 1, thus minimizing the impact of extreme outliers and reducing the effects of large differences in values. Weighted proportions were computed from the relative ranks, incorporating both sample size and chronological uncertainty. The resulting proportions were then used to calculate the Shannon diversity index (H') for each sample and century in the region. A value of 0 indicates a completely uneven distribution of taxa, where one taxon dominates all others, while a value of 1 indicates perfect evenness. It is however important to stress that different sample sizes affect the outcome (Faith & Du, 2018). The quantifications on the zooarchaeological dataset use NISP as a parameter, the information that reports provide the most. NISP data has also been converted to relative rank proportions, to compare samples and different time phases (Means: Table 6, Supplementary Material). Effective sample sizes for both datasets can be consulted in Tables 4 (Supplementary Material) and 9 (Supplementary Material).

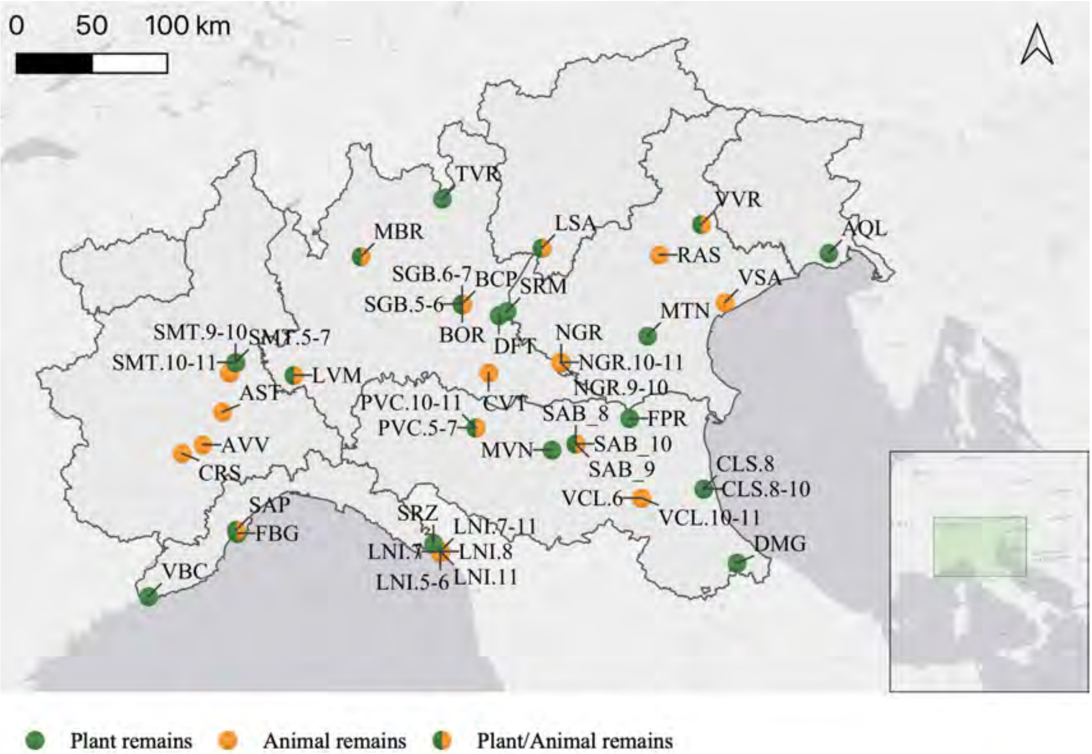

FIGURE 1

The sites under examination. Refer to the Supplementary Materials for the legend codes.

Research in the past has considered archaeobotanical and zooarchaeological studies mostly independently, for pragmatic reasons. The integrated examination of these dataset types can be challenging, because of the risk of not comparing like with like. A strategy proposed by VanDerwarker (2010) guided the development of this integrated methodology. First, I created a joint table with the weighted means of the proportions of relative ranks of both plant and animal remains. To ensure comparability, I normalized this table by dividing each cell by the total of rows and columns, so that all cells in the table sum up to one. I later performed a correspondence analysis (CA) on the table. CA allows the reduction of the dimensionality of multivariate nominal data to visualize it on a two-dimensional plot (Shennan, 1997). It is appropriate for exploring non-negative data (e.g. percentages or counts) in a table, and examining the relationships between cells in a row (e.g. the assemblage of a particular century), in a column (e.g. a group of taxa/species through different centuries), and their interrelationship (Baxter, 2015). Please refer to the Supplementary Materials for a more in-depth breakthrough of the process with the R scripts and tables. A Quarto markdown file is also provided to allow code reproducibility.

RESULTS

ARCHAEOBOTANY

Cereals represented the major component of early medieval cultivation in Northern Italy. The most popular Roman crops, bread wheat/durum (*Triticum aestivum/durum*) and barley (*Hordeum vulgare*), continued to be cultivated in most sites in every century, with ubiquity values of >70% for wheat and >50% for barley. The use of grains such as oats (*Avena* sp.), millets, rye (*Secale cereale*) and sorghum (*Sorghum bicolor*) increased, in addition to emmer (*Triticum dicoccum*) and einkorn wheat (*Triticum monococcum*). Oat, used in porridge and as animal fodder, is difficult to identify (the caryopsis alone is insufficient) (Renfrew, 1973); however, it seems more ubiquitous in the 5th and 6th c. (58-60%) than later. Among the millets, foxtail millet (*Setaria italica*), was most prevalent and abundant in the 5th–7th c., declining in the later centuries. Broomcorn millet (*Panicum miliaceum*) was abundant (rank proportion means ranging between 0.07-0.18 if calculated on the total of cereals) and diffused between the 5th and 11th c. Rye consumption (mean ubiquity 50%) also peaked during this time period, declining in the 11th c. Relative rank proportions for the total of cereals (Table 5, Supplementary Material) indicate a mean of 0.10 in the 5th and 6th c., and 0.07-0.05 in the 10th and 11th c. Sorghum became popular in the 10th and 11th c., with 50-71% ubiquity values. Emmer and einkorn wheat, also used for soups, were still cultivated in the Early Middle Ages. Despite Castiglioni & Rottoli (2013) reporting a gradual decrease of emmer in Northern Italy, the data used in this study show continuity, especially in Emilia-Romagna.

ZOOARCHAEOLOGY

The analysis of faunal remains showed that the rank proportions of cattle (*Bos taurus*), still high in the 5th c., rapidly decreased from the 6th c. In the 7th and 8th c., cattle proportions are at their lowest point (means: 0.12-0.09). Proportions slowly increase again from the 9th c. onwards, although never equalling the 5th c. peak (0.31). Cattle were mostly diffused on lowlands from the 5th to the 7th c., and on mountains from the 9th c., probably for the greater availability of pastures. In general, in every century cattle were chiefly found in rural sites. Concurrently with the decline in cattle, pig (*Sus domesticus*) becomes the predominant mammal taxon, although decreasing in cities after the 5th c. in favour of rural sites. Pig rank proportions only slightly decline in the 9th and 10th centuries, when caprines (*Ovis aries vel capra*) become more common, especially in urban sites as S. Giulia di Brescia. Caprine rank proportions rise in the centuries under examination peaking in the 9th c. (0.44), being more diffused on mountains in the earlier centuries (5th–6th c.), and later at lower altitudes. The proportions of pigs exhibit more consistency across different altitudes, whereas cattle rank proportions tend to increase in mountainous sites. From the CA graph (Figure 2), it is possible to see how the reliance on game is more strongly associated with the 9th and 10th centuries. Another source of protein was domestic poultry, which could be raised even in small plots: chicken (*Gallus domesticus*) and geese (*Anser sp.*) are common in the assemblages, with relative rank proportions between 0.01 and 0.13.

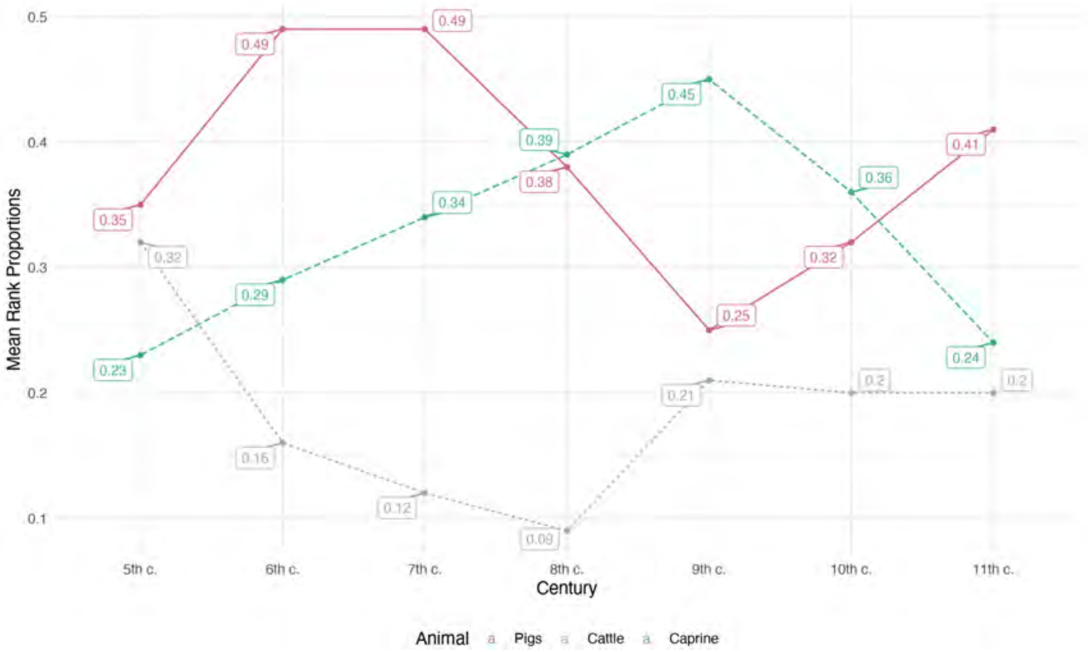

FIGURE 2

Trends in domestic animals relative ranks proportions. Effective sample sizes can be consulted in Table 9, S.M.

DISCUSSION

FROM THE ROMAN MONOCULTURE TO THE MEDIEVAL POLYCULTURE

One compelling question is at the forefront of this research: what caused the shift from a mostly monoculture system in Roman times to the medieval polyculture? Several factors must be considered. I described earlier how peasants, now liberated of constraints, became more autonomous in their farming practices, at least until the 8th c. Additionally, climate instability between the 5th and 11th c. might have also played a role. According to Hoffmann (2014), the climate during this period alternated between warmer and cooler phases, and the onset of the LALIA brought increased rainfalls and cooler temperatures. Even if early medieval climatic anomalies are widely accepted today, medieval peasants would not be aware of long-term climate patterns. They could, however, consider short-term weather instabilities and select their cultivations to minimize economic and famine risks. Montanari (2006) argues that medieval polyculture was a way to compensate for poor yields. Two possible methods that farmers could have used to fight climatic instability are choosing short-cycle crops that v2ried in sowing/harvesting times and utilizing taxa that could be planted twice a year (e.g. broomcorn millet). In Italy, broomcorn millet has been cultivated since the Bronze Age. It is a good option in times of climatic uncertainty because it can be ripened fast and twice annually, although it is tender to frost (Renfrew, 1973). In the 5th and 6th centuries, it seems more diffused in the countryside and *castra*, although the ubiquity of these contexts is difficult to calculate in the next centuries with the information available. The cultivation of barley and rye in the 5th and 6th centuries might be related to climatic factors and, in the case of rye, also to Germanic dietary customs, although it might be simplistic to ethnicize this grain (see Squatriti, 2019). These crops can both sustain cool climates (although not the heat), and rye is extremely resistant to moisture. In low temperatures, it can grow quicker than wheat (Renfrew, 1973). The MWP made possible the introduction of Mediterranean plants in the North (e.g. figs), also allowing more climatic security for plant selection. This climatic anomaly coincided also with the advent of castle building, which asserted new forms of direct control in the surrounding territory. As humans increased their control over the landscape, they cleared land and replaced wild forests with fields and domesticated trees (Wickham, 1994). In this period, diversity levels decreased (Figure 4, Supplementary Material) and bread wheat/durum and barley were again the most common cereals (perhaps mirroring a revival of the market system). Interestingly, minor cereals were not completely abandoned. In tangent with the rise of temperatures, sorghum became more abundant due to its ability to thrive in hot temperatures and tolerate drought.

The popularity of minor cereals in the Early Middle Ages, according to Montanari (1979), can also be potentially explained by their exemption from taxation. One of the consequences of this popularity is that bread, the main meal for the masses in antiquity, became secondary or reserved for the upper class. Late Antique northern peasants had to be content with rye bread and soups made from cereals and pulses, especially after the nullification of the *annona* system (the Roman state distribution of wheat) (Giovannini, 2001; Hoffmann, 2014).

ANIMAL HUSBANDRY IN THE EARLY MIDDLE AGES

Salvadori (2019) relates cattle husbandry to an economy based on cereal production. In Roman times, either in rural or urban sites, cattle were butchered at an older age (after 3.5 years), suggesting that they were used as working animals or for milk production (MacKinnon, 2004). The early medieval mixed production aimed to maximize yields from smaller plots, and thus likely required less workforce than Roman extensive agriculture. The slow reduction in cattle size supports this hypothesis of a diminishing importance of cattle in agricultural works, although does not necessarily imply economic decline: smaller cows produce more milk and require less water and fodder (Kreiner, 2020). When the importance of cattle eventually declined, pigs became the predominant mammal species. One of the novelties of the Early Middle Ages was the raising of pigs in woodlands, where they could be fed on acorns of oak groves (Montanari, 2015a). Pig rank proportions are high in every type of site and are particularly dominant in 5th c. urban contexts (mean: 0.39) and 9th-11th c. rural sites (mean 0.40). The swine popularity of this period is unprecedented— pigs are in every cookbook, they appear in laws, forests were measured by the number of pigs they could host, and the swineherd became one of the most respected Lombard serfs (Montanari, 1988). Germanic tribes placed significant cultural importance on pigs, which may have influenced patterns of pig rearing and consumption in northern Italian culture. Pig also becomes a Christian marker in this time, contrasting the Jewish and Muslim diets (Montanari, 2015b). The early medieval preference for raising smaller-sized animals is also supported by the popularity of caprines. Sheep and goats could graze in forests, wetlands and pastures, which were more common after the 6th c., as some palynological analyses from the period demonstrate (Mercuri *et al*., 2009; Marchesini *et al*., 2011; Bosi *et al*., 2019). The woodland encroachment is consistent with the farming collapse following the Gothic Wars (535-554 CE) (Christie, 2006). Coinciding with the increase of uncultivated land, caprine rank proportions slowly increase, peaking in the 9th c. (0.45), and declining afterwards. The dataset reports generalised culling practices because these animals held different functions. Caprines culled within their first year of age were raised for meat production; the samples show that these younger animals are often found in cities. Alternatively, they could be kept to produce milk and wool. Overall, caprines were common domestic animals in the Early Middle Ages, but their popularity in Northern Italy never equalled that in Byzantine Southern Italy (Kroll, 2012).

Wild animals are always present in the selected assemblages, although the proportions of red deer, roe deer and hare rise from the 9th c. The increase can be best noted in urban and *castra* sites (Figure 6, Supplementary Material). However, due to the limited number of samples available, there is some uncertainty about the accuracy of these findings. In the 11th c., the frequencies of wild animals are lower in cities: the reason might relate to legality, with hunting rights beginning to be restricted to nobility from the 7th c. and increasingly in the 9th and 10th c. (Wickham, 1994). *Castra*, centres of aristocratic (and military) power, became the first consumers of venison.

INTEGRATING ARCHAEOBOTANY AND ZOOARCHAEOLOGY

One of the aims of this research has been to develop a strategy to integrate the study of faunal and botanical remains. Using a joint table of relative rank proportions of taxa and species (Tables 3, 8, Supplementary Material), I grouped the main categories of remains into a new table and normalised it with a 0-1 range as outlined in the SM (Table 12, Supplementary Material). According to the CA (Figure 3), the consumption of common wheat, barley, and pulses was more significant during the 7th–8th c., while millets, einkorn, rye, and sorghum were more commonly consumed during the 5th and 11th c. In addition to these cereals, cattle was more prevalent during the 5th and 11th c., while the 6th c. was associated with pigs, domestic fowl, and oats. The 9th and 10th centuries had stronger similarities in terms of fruits (both domestic and spontaneous) and game, whereas caprines and emmer showed little variation. The graph also reveals similarities between three groups of centuries: the 7th–8th c., the 9th and 10th c., and the 5th and 11th c. While the first two groups suggest temporal continuity in bioarchaeological assemblages, the closeness between the 5th and 11th c. suggest similar agricultural practices at the beginning and the end of the period under consideration. It is possible that such practices may also have been fostered by similar climatic conditions between the Roman Warm Period and the MWP. The elements of continuity are accompanied by several changes in crop and livestock husbandry, diet, and subsistence. The mixed production of cereals was most suitable for peasants who could not count on a large workforce. Choosing spring and winter cultures allowed farmers to concentrate their efforts on smaller plots, and to be safeguarded in times of bad harvest. The early medieval polyculture also affected livestock raising. Cattle, the main Greek and Roman working animal, became less frequent and smaller in size in northern Italian sites. Uncultivated lands, forests, and marshes (all synonyms of barbarianism in the Roman age) became resources. Crop and animal selection appeared to be following the economic logic of cost and energy saving. The early medieval people were able to adapt efficiently to changes, relying both on wild and domesticated resources for their diet (which became very diverse), exploiting and taking advantage of their new environment, and eventually domesticating forests with fruit trees (such as chestnuts), where animals could graze.

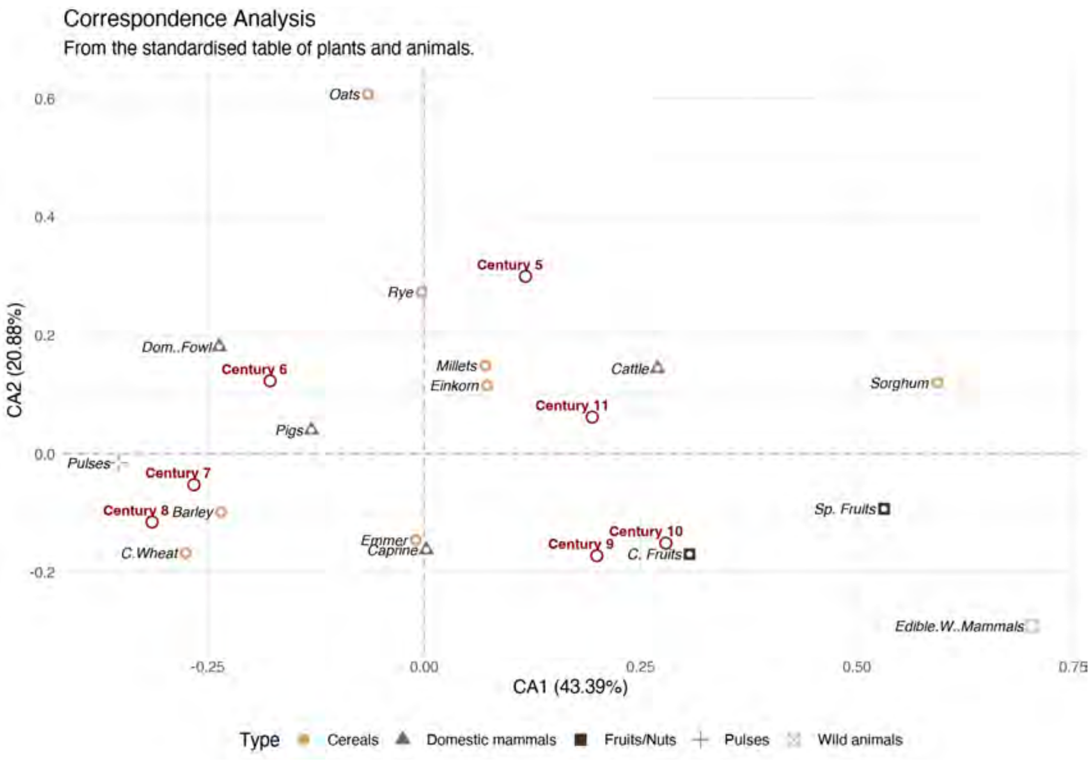

FIGURE 3

CA of the integrated botanical and faunal datasets.

CONCLUSION

My study demonstrates how bioarchaeological sources can be valuable for the historical reconstruction of early medieval farming practices, human diet, and economy. Twenty-seven archaeobotanical case studies allowed the identification of the most common and frequent plants in these periods. The most typical cereals of Roman times (bread wheat, durum, and barley) continued to be ubiquitous, but in the 5th and 6th centuries, these taxa compete with broomcorn millet, rye and foxtail millet. The selection of more resilient taxa must be considered in relation to harsh and wet winters at the time of the LALIA and to simpler ways of processing/storing the grains (Squatriti, 2019). By the 10th and 11th centuries, barley, bread wheat/durum, broomcorn millet and sorghum became the most frequent crops. The study of 39 zooarchaeological assemblages proved the growing importance of pigs at the expense of cattle. Cattle were primarily used for traction and became rarer in early medieval contexts. This working animal was bred in specialized farms, described by post-7th c. literary sources as *casae bubulcariciae* (Fumagalli, 1985). On the other hand, pig breeding was much more versatile and required less space. In this period, cereals and legumes were cultivated in smaller (even urban) plots (Goodson, 2021), supporting the preference for smaller animals.

This study has outlined an early medieval subsistence economy in which dietary resources originated close to the site in which they were consumed. These resources were diversified, in conformity with an increased peasant autonomy in farms and, in the case of plant selection, with their adaptability to climatic fluctuations. Peasants were able to acquire more autonomy since the mid-6th c., when there was less centralized power and taxation over the countryside, in contrast to Byzantine Italy, where the taxation system was preserved (Wickham, 1994). An economy based on subsistence does not necessarily reflect a poor diet. Conversely, the study of plant and animal assemblages shows that early medieval nutrition was complete and diversified. Osteological analyses confirm the good balance between cereal and meat proteins (Giovannini, 2001; Marinato, 2019). It is hard to detect whether an early medieval market system was in place using plants/animals proxy counts, thus further work is necessary for example using more targeted biometric measures as a proxy. The economy of this period adapted efficiently to new climatic and environmental situations. People relied both on wild and domestic resources. Forests hosted pigs, uncultivated lands were often used as pastures for animal grazing, wild species could be hunted by everyone (at least until the time of the first hunting bans) and the collection of spontaneous fruits was common practice. This ambivalence between wild and domestic resources, and the choice of farming practices that required less human labour, are typical of this phase of transition and characterize its economy.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_004

REFERENCES

Baxter, M.J. 2015: *Exploratory multivariate analysis in archaeology, Foundations of archaeology*. Percheron Press, New York.

Bosi, G.; Labate, D.; Rinaldi, R.; Montecchi, M.C.; Mazzanti, M.; Torri, P.; Riso, F.M. & Mercuri, A.M. 2019; A survey of the Late Roman period (3rd-6th century AD): Pollen, NPPs and seeds/fruits for reconstructing environmental and cultural changes after the floods in Northern Italy. *Quaternary International* 499: 3–23.

Castiglioni, E. & Rottoli, M. 2013: Broomcorn millet, foxtail millet and sorghum in North Italian Early Medieval sites. *PCA* 3: 131–144.

Christie, N. 2006: *From Constantine to Charlemagne: an archaeology of Italy, AD 300-800*. Routledge, Abingdon-on-Thames.

Faith, J.T. & DU, A. 2018: The measurement of taxonomic evenness in zooarchaeology. *Archaeology and Anthropology Science* 21: 1419–1428.

Fumagalli, V. 1985: Gli animali e l'agricoltura. In: CISAM (ed.): *L'uomo di fronte al mondo animale Nell'alto Medioevo* 31: 579–609. CISAM, Spoleto.

GIOVANNINI, F. 2001: *Natalità, mortalità e demografia dell'Italia medievale sulla base dei dati archeologici*. Archaeopress, Oxford.

GOODSON, C. 2021: *Cultivating the City in Early Medieval Italy*. Cambridge University Press, Cambridge.

HOFFMANN, R. 2014: *An Environmental History of Medieval Europe*. Cambridge University Press, Cambridge.

KREINER, J. 2020: *Legions of pigs in the early medieval West*. Yale University Press, New Haven.

KROLL, H. 2012: Animals in the Byzantine Empire: an overview of the archaeozoological evidence. *Archeologia Medievale* 39: 93–121.

MACKINNON, M.R. 2004: Production and consumption of animals in Roman Italy: Integrating the zooarchaeological and textual evidence. *Journal of Roman archaeology* 54.

MARCHESINI, M.; MARVELLI, S.; GOBBO, I. & BIAGIONI, S. 2011: Paesaggio vegetale e antropico circostante l'abitato altomedievale di Nogara (Verona): risultati delle indagini archeopalinologiche. In: Saggioro, F. (ed): *Nogara: archeologia e storia di un villaggio medievale (scavi 2003-2008)*: 159–183. Bretschneider, Roma.

MARINATO, M. 2019: *Alimentazione, salute e mobilità della popolazione in Italia settentrionale tra IV e VIII secolo: approcci bioarcheologici*. SAP, Mantova.

MERCURI, A.M.; ACCORSI, C.; MAZZANTI, M.; BIGI, P.; BOTTAZZI, G.; BOSI, G.; MARCHESINI, M.; MONTECCHI, M.C. & PEDINI, D. 2009: From the "Treasure of Domagnano" to the Archaeobotany of a Roman and Gothic settlement in the Republic of San Marino. In: Morel, J.-P. & Mercuri, A.M. (eds.): *Plants and Culture: Seeds of the Cultural Heritage of Europe*: 69-91. Edipuglia, Bari.

MONTANARI, M. 1979: *L'alimentazione contadina nell'alto Medioevo*. Liguori, Naples.

— 1988: *Alimentazione e cultura nel Medioevo*. Laterza, Rome.

— 2006: *Food is culture*. Columbia University Press, New York.

— 2015a: *Medieval tastes: food, cooking, and the table*. Columbia University Press, New York.

— 2015b: *Mangiare da cristiani: diete, digiuni, banchetti, storie di una cultura*. Rizzoli, Milan.

RENFREW, J.M. 1973: *Palaeoethnobotany: the prehistoric food plants of the Near East and Europe*. Columbia University Press, New York.

SALVADORI, F. 2019: The transition from late antiquity to early Middle Ages in Italy. A zooarchaeological perspective. *Quaternary International*, *Food Production and Land Use* 499: 35–48.

SHENNAN, S. 1997: *Quantifying Archaeology*. Edinburgh University Press, Edinburgh.

SQUATRITI, P. 2019: Rye's Rise and Rome's Fall: Agriculture and Climate in Europe during Late Antiquity. In: Izdebski, A. & Mulryan, M. (eds.): *Environment and Society in the Long Late Antiquity*: 342-351. Brill, Leiden.

TOUBERT, P. 1973: *Les structures du Latium médiéval: le Latium méridional et la Sabine du IXe siècle à la fin du XIIe siècle*. École francaise de Rome, Rome.

VANDERWARKER, A.M. 2010: Simple Measures for Integrating Plant and Animal Remains. In: VanDerwarker, A.M. & Peres, T.M. (eds.): *Integrating Zooarchaeology and Paleoethnobotany: A Consideration of Issues, Methods, and Cases*: 65-74. Springer, New York.

VERHULST, A.E. 1966: La genèse du régime domanial classique an France au haut moyen âge, *Studia historica Gandensia*: 135–160.

WICKHAM, C. 1994: *Land and power: studies in Italian and European social history, 400 - 1200*. British School at Rome, London.

— 2005: *Framing the early Middle Ages: Europe and the Mediterranean 400 - 800*. Oxford University Press, Oxford.

WRIGHT, P.J. 2010: Methodological Issues in Paleoethnobotany: A consideration of Issues, Methods, and Cases. In: VanDerwarker, A.M. & Peres, T.M. (eds.): *Integrating Zooarchaeology and Paleoethnobotany: A Consideration of Issues, Methods, and Cases*: 37-64. Springer, New York.

Supplementary Material

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1 Materials

This study focuses on 27 archaeobotanical assemblages and 39 zooarchaeological assemblages from a total of 35 sites. The map in Figure 1 shows the spatial and typological distribution of the samples.

MAP.png

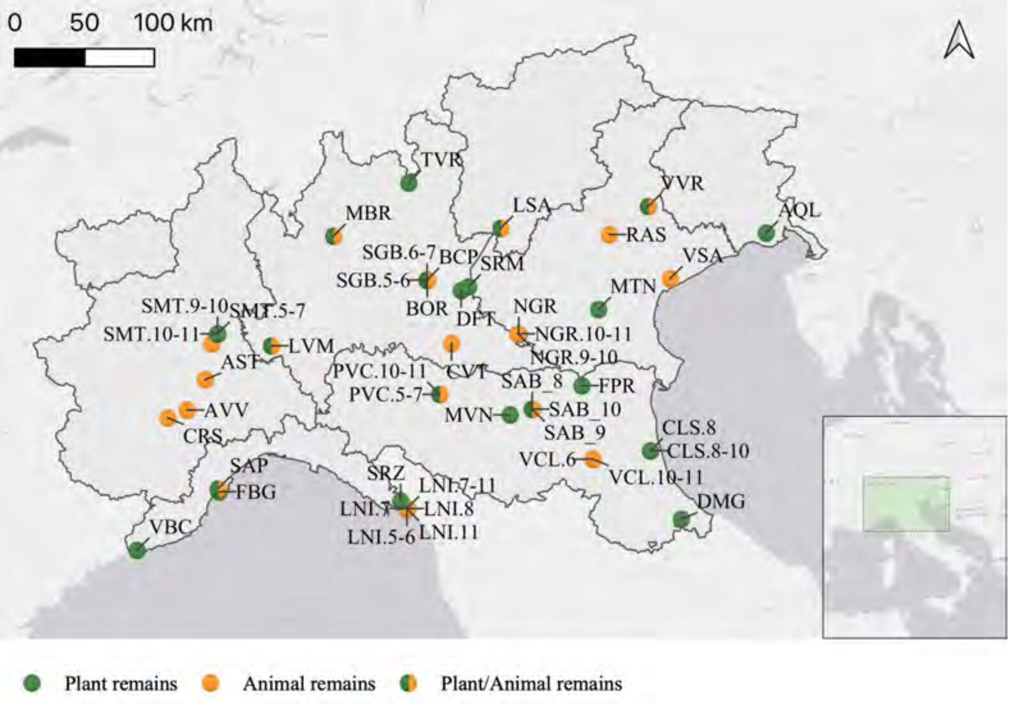


Figure 1: Sites under examination. Some points might be obscured at this scale, because of too many overlaps. The full list, along with the code legend can be read in Table 1 and Table 7.

2 Requirements

The graphs and computations presented in this document require to load some libraries and to create custom functions as a first step.

2.1 Libraries

The following R scripts require to load some libraries already available or downloadable in the R Studio **Packages** tab.

Weighted means/medians:

```
library(spatstat)
```

Statistical Analysis:

```
library(FactoMineR)
library(vegan)
```

Graphics/Data handling:

```
library(tidyverse)
library(here)
library(stringr)
library(knitr)
library(kableExtra)
library(ggrepel)
library(ggpubr)
library(reshape2)
library(patchwork)
```

2.2 Custom functions

Several custom functions have been specifically created to perform calculations, data handling, etc.

Bot_Rel_Prop_per_Century

Relative proportions of plants (site based). Requires the exported table of plants raw counts from the project's database.

```
# Calculate the relative proportion of botanical data by site and century
Bot_Rel_Prop_per_Century <- function(data, century) {

  # Replace NAs with zeroes
  data[is.na(data)] <- 0

  # Subset the data by the selected century
  data <- subset(data, data_valid_start <= century & data_valid_end >= century)

  # Calculate relative proportions
  total_per_site <- rowSums(data[,14:ncol(data)])
  rel_prop_per_site <- round(
    (
```

```
        (data[14:ncol(data)]/total_per_site)*100
        ),
      digits=2
      )

    # Combine the site, species, and relative proportion data into a single data frame
    result <- data.frame(
      site_name = data$site_name,
      type_name = data$type_name,
      data_valid_start = data$data_valid_start,
      data_valid_end = data$data_valid_end,
      weight = data$weight,
      culture_type = data$culture_type,
      x = data$x,
      y = data$y,
      rel_prop_per_site
    )

    return(result)
  }
```

Bot_Mean_fun

This function creates weighted means for a single century. Requires a table of relative proportions created with the previous function.

```
Bot_Mean_fun <- function(df, century) {
  library(spatstat)

  # Store a tmp proportions table
  proportions_century <- Bot_Rel_Prop_per_Century(df, century)
  # Make 0s NAs for 'safer' calculations of the means
  proportions_century[proportions_century== 0] <- NA

  # Apply the weighted means function
  mean_century <- t(apply(
    proportions_century[9:ncol(proportions_century)],
    2,
    weighted.mean,
    #weightedMedian,
    w=proportions_century[,5],
    na.rm=TRUE,
    ties="weighted"
    ))
```

```r
  mean_century <- data.frame(Century=century, mean_century)

  return(mean_century)
}
```

Bot_Mean_table

This function iterates Bot_Mean_fun to create a table of medians for each century

```r
Bot_Mean_table <- function(df) {

  # If the index in the for cycle is 0 skip to the next index
  # We do not want a century "0".
  mean_tot <- data.frame()
  for (i in 5:11){
    if (i==0) {next}
    mean_cent <- data.frame(Bot_Mean_fun(df,i))
    mean_tot <- rbind(mean_tot,mean_cent)
  }
  return (mean_tot)
}
```

archaeobotany_tables

This function is used to create a table of ubiquity, relative proportions or to subset the dataframe for a particular century.

```r
archaeobotany_tables <- function(x, century) {

  # Convert NAs to 0
  x[is.na(x)] <-0

  # Subset by century
  x <- subset(x, data_valid_start <= century & data_valid_end >= century)

  # Create a total
  Total <- rowSums(x[,14:ncol(x)])

  plants <- data.frame(x$site_name,
                       x$type_name,
                       x$data_valid_start,
                       x$data_valid_end,
                       x$culture_type,
                       x[14:ncol(x)],
```

```
                       Total
  )

  Rel_Prop <- round(
    ((x[14:ncol(x)]/Total)*100),
    digits=2)

  # Ubiquity:
  # Number of sites where the plant is present / Tot. sites (num rows - header)

  Pres_Abs <- Rel_Prop
  Pres_Abs[Pres_Abs > 0] <- 1               # Replace with 1
  Tot_sites_present <- colSums(Pres_Abs)
 # Tot_sites_present # This row will be added at the end of the Pres_Abs table
  # to calculate Ubiquity

  Ubiquity <- (Tot_sites_present / nrow(Pres_Abs))*100

  return(list(
    Ubiquity_exp = Ubiquity,
    Rel_Prop_exp = Rel_Prop,
    Raw_Counts = plants
    ))
}
```

2.3 Import the tables

> ℹ Note
>
> The package `here` is used for reproducible file paths. To reproduce the script, the folder `R_Tables` has to be in the same directory as your R project.

The tables containing the raw botanical and faunal data have been imported using the functions `read.csv()`. Below, the list of columns of the imported files:

```
names(faunal_condensed)
```

```
 [1] "ID"                    "Site"                  "Culture"
 [4] "Type"                  "Geo"                   "weight"
 [7] "Region"                "Macroregion"           "From.Century"
[10] "To.Century"            "Reference"             "X"
[13] "Y"                     "Pigs"                  "Cattle"
```

```
[16] "Caprine"                "Dom..Fowl"               "Edible.W..Mammals"
[19] "Fish"                   "Mollusca"                "Unedible.Dom..Mammals"
[22] "Unedible.Wild.Mammals"
```

```r
names(bot_condensed)
```

```
 [1] "site_code"                 "site_name"
 [3] "type_name"                 "region_name"
 [5] "data_valid_start"          "data_valid_end"
 [7] "weight"                    "sampling_notes"
 [9] "extra_notes"               "short_ref"
[11] "culture_type"              "x"
[13] "y"                         "Triticum.aestivum.durum"
[15] "Triticum.dicoccum"         "Triticum.monococcum"
[17] "Avena.sp"                  "Hordeum.vulgare"
[19] "Panicum.milliaceum"        "Secale.cereale"
[21] "Setaria.italica"           "Sorghum.bicolor"
[23] "Cerealia.ind"              "Leguminosae"
[25] "Lens.culinaris"            "Pisum.sativum"
[27] "Vicia.faba"                "Vicia.sativa"
[29] "Vicia.sp"                  "Lathyrus.cicera.sativus"
[31] "Cicer.aretinum"            "Cornus.mas"
[33] "Corylus.avellana"          "Ficus.carica"
[35] "Fragaria.vesca"            "Juglans.regia"
[37] "Castanea.sativa"           "Malus.domestica"
[39] "Olea.europaea.L"           "Prunus.cerasus"
[41] "Prunus.avium"              "Prunus.sp"
[43] "Prunus.persica"            "Prunus.domestica"
[45] "Prunus.spinosa"            "Rubus.fruticosus"
[47] "Pyrus.communis"            "Sambucus.nigra"
[49] "Cucumis.melo"              "Vitis.vinifera"
[51] "Linum.usatissimus"         "Sorbus.sp"
```

The `.csv` files are included in the **Supplementary Materials** for reproducibility.

3 Weights

An issue affecting the quantifications of samples is chronological fuzziness. The dating parameter is mostly ceramics, thus chronologies can range between one century or several. Taking this into account, I weighted each sample as follows:

$$W = \frac{1}{(C_{end} - C_{start} + 1)}$$

Where:

- C_end is the terminus ante quem.
- C_start is the terminus post quem.
- 1 has been summed to the denominator to avoid 0 values.

The imported tables already contain a column of weights, as this operation has been performed on the database prior the export. A diachronic table of means for both datasets has been generated using the code snippets in Section 4.3 (archaeobotany) and Section 5.2 (zooarchaeology).

4 Archaeobotany

4.1 List of sites with carpological remains

Table 1: BOT - List of sites and sample biases

Code	Site	Type	Chronology	Region	Notes.Biases
AQL	Aquileia, northern insulae	Urban	5th-6th c.	Friuli-Venezia Giulia	small sample size; only counts for cereals and pulses
BCP	Brescia, Capitolium	Urban	7th c.	Lombardy	2 samples, from a latrine and a deposit
BOR	Brescia, Kitchen Garden (Ortaglia) domus	Urban	6th-7th c.	Lombardy	
SGB	Brescia, S. Giulia	Religious, Monastery	5th-7th c.	Lombardy	storage area: high number of charred seeds
CRG	Campi di Riva del Garda, Monte S. Martino	Urban	4th-6th c.	Trentino-Alto Adige	only counts for cereals and pulses
CLG	Cislago	Rural	4th-5th c.	Lombardy	storage area: high number of bread wheat/durum remains; only counts for cereals and pulses
CLS	Classe	Urban	8th-10th c.	Emilia-Romagna	storage area: large number of barley/lentil seeds
DFT	Desenzano, loc. Faustinella	Rural	5th-6th c.	Lombardy	grape overrepresented
DMG	Domagnano	Rural	5th-6th c.	San Marino	samples from a Gothic well, used later as a wastepit. Grape, olive and fig overrepresented.
FPR	Ferrara, corso Porto Reno	Urban	10th-11th c.	Emilia-Romagna	
FBG	Finalborgo	Urban	10th-11th c.	Liguria	fig overrepresented
LVM	Lomello, villa Maria	Rural	5th-6th c.	Lombardy	only counts for cereals
LSA	Loppio, isola S. Andrea	Castrum	5th-6th c.	Trentino-Alto Adige	
LNO	Luni, loc. Ortonovo	Urban	8th c.	Liguria	flotation (unspecified mesh size)
MVN	Modena, via Nonantolana	Rural	5th-6th c.	Emilia-Romagna	only counts for cereals and pulses
MBR	Monte Barro	Castrum	5th-6th c.	Lombardy	storage area: large number of bread wheat/durum
MTN	Montegrotto Terme, via Neroniana	Rural	11th c.	Veneto	from a silos; remains mostly mineralised
NGR	Nogara, Mulino di Sotto	Rural	9th-11th c.	Veneto	grape overrepresented
PVC	Parma, piazza Garibaldi/via Cavestro	Urban	10th-11th c.	Emilia-Romagna	from wastepit and cesspit; grape and fig (mostly waterlogged) overrepresented
SAP	S. Antonino di Perti	Castrum	6th-7th c.	Liguria	small sample size
SAB	Sant'Agata Bolognese	Castrum	10th-11th c.	Emilia-Romagna	
SRZ	Sarzana, Pieve S. Andrea	Religious, Pieve	11th c.	Liguria	craft area (furnace). Small sample size (5 charred seeds/8 imprints on terracotta slabs)
SRM	Sirmione, via Antiche Mura	Rural, villa	5th-6th c.	Lombardy	storage area: mostly broomcorn millet and foxtail millet
TVR	Teglio, via Roma	Urban	5th-6th c.	Lombardy	visual sampling; small sample size
TRZ	Trezzo sull'Adda, Cascina S. Martino	Rural	3rd-6th c.	Lombardy	waterlogged; samples collected from Roman well used later as a wastepit. Grape, wild/sour cherry, fig overrepresented. The pit contained human excrements.
VBC	Ventimiglia, Cathedral baptistery	Urban	6th-7th c.	Liguria	bread wheat/durum overrepresented
VVR	Vittorio Veneto, loc. S. Rocco	Urban	5th c.	Veneto	suburban townhouse

4.2 Ubiquity

Ubiquity is a presence/absence analysis providing a score (0-100%) based on taxa's presence percentage in the samples considered and has the advantage of not being biased by overrepresented taxa. The ubiquity can be calculated with the custom function `archaeobotany_tables`. The results can be read in Table 2 and visualized in Figure 3.

```
Ubiquity_table <- data.frame(
  "V CE" = archaeobotany_tables(bot_condensed, 5)$Ubiquity_exp,
  "VI CE" = archaeobotany_tables(bot_condensed, 6)$Ubiquity_exp,
  "VII CE" = archaeobotany_tables(bot_condensed, 7)$Ubiquity_exp,
  "VIII CE" = archaeobotany_tables(bot_condensed, 8)$Ubiquity_exp,
  "IX CE" = archaeobotany_tables(bot_condensed, 9)$Ubiquity_exp,
  "X CE" = archaeobotany_tables(bot_condensed, 10)$Ubiquity_exp,
  "XI CE" = archaeobotany_tables(bot_condensed, 11)$Ubiquity_exp
  )
```

It is possible to visualize ubiquity using a heatmap (Figure 3, a), where darker cells represent higher ubiquity values.

```
Ubiquity_mat <- as.matrix(Ubiquity_table) # Create a matrix with the table

# Renaming the centuries for better visualization
colnames(Ubiquity_mat) <- c("5th c. CE", "6th c. CE", "7th c. CE",
                            "8th c. CE", "9th c. CE", "10th c. CE",
                            "11th c. CE")

Ubiquity_melt <- reshape2::melt(Ubiquity_mat) # Melting df to use ggplot2
colnames(Ubiquity_melt) <- c("Taxon", "Century", "Ubiquity")

#Creating the heatmap
Ubiquity_HM <- ggplot(Ubiquity_melt, aes(Century, Taxon, fill=Ubiquity)) +
  geom_tile(colour="white") +
  scale_alpha(range=c(0,1)) +
  scale_x_discrete("", expand = c(0, 0)) +
  scale_y_discrete("", expand = c(0, 0)) +
  theme_grey(base_size = 9) +
  theme(legend.position = "right",
        axis.ticks = element_blank(),
        axis.text.x = element_text(angle = 90, hjust = 0)
        ) +
  theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank())+
  labs(
    title="Ubiquity",
```

Table 2: BOT - Ubiquity table

	V.CE	VI.CE	VII.CE	VIII.CE	IX.CE	X.CE	XI.CE
Triticum.aestivum.durum	75.00	80.00	80	100.00	100	100.00	71.43
Triticum.dicoccum	33.33	46.67	60	66.67	100	83.33	57.14
Triticum.monococcum	58.33	60.00	60	33.33	50	50.00	42.86
Avena.sp	58.33	60.00	40	33.33	0	50.00	42.86
Hordeum.vulgare	58.33	73.33	100	100.00	100	83.33	85.71
Panicum.milliaceum	58.33	66.67	60	66.67	100	83.33	71.43
Secale.cereale	50.00	53.33	60	0.00	50	50.00	42.86
Setaria.italica	66.67	73.33	80	0.00	50	50.00	57.14
Sorghum.bicolor	33.33	26.67	20	0.00	50	50.00	71.43
Cerealia.ind	66.67	66.67	80	66.67	100	50.00	42.86
Leguminosae	16.67	26.67	60	0.00	0	0.00	0.00
Lens.culinaris	41.67	53.33	80	66.67	100	66.67	42.86
Pisum.sativum	25.00	26.67	20	0.00	50	66.67	57.14
Vicia.faba	41.67	40.00	20	100.00	100	66.67	71.43
Vicia.sativa	33.33	46.67	60	0.00	50	16.67	14.29
Vicia.sp	16.67	20.00	20	100.00	50	33.33	14.29
Lathyrus.cicera.sativus	25.00	33.33	40	66.67	100	50.00	28.57
Cicer.aretinum	0.00	0.00	0	66.67	50	16.67	0.00
Cornus.mas	16.67	26.67	40	0.00	50	66.67	57.14
Corylus.avellana	16.67	26.67	40	0.00	50	83.33	71.43
Ficus.carica	8.33	6.67	0	33.33	0	66.67	57.14
Fragaria.vesca	16.67	13.33	0	0.00	0	33.33	28.57
Juglans.regia	50.00	46.67	60	33.33	50	50.00	42.86
Castanea.sativa	16.67	20.00	20	0.00	50	33.33	28.57
Malus.domestica	8.33	6.67	0	0.00	50	33.33	28.57
Olea.europaea.L	8.33	6.67	0	33.33	0	0.00	0.00
Prunus.cerasus	8.33	6.67	0	0.00	0	50.00	42.86
Prunus.avium	8.33	6.67	0	0.00	0	33.33	28.57
Prunus.sp	8.33	13.33	20	33.33	50	33.33	28.57
Prunus.persica	16.67	33.33	60	0.00	50	66.67	57.14
Prunus.domestica	8.33	13.33	20	0.00	50	83.33	71.43
Prunus.spinosa	0.00	0.00	0	0.00	50	50.00	42.86
Rubus.fruticosus	0.00	0.00	0	0.00	50	66.67	57.14
Pyrus.communis	8.33	6.67	0	0.00	0	16.67	14.29
Sambucus.nigra	0.00	0.00	0	0.00	50	66.67	57.14
Cucumis.melo	0.00	0.00	0	0.00	0	16.67	14.29
Vitis.vinifera	50.00	60.00	100	66.67	50	66.67	71.43
Linum.usatissimus	8.33	6.67	0	0.00	0	16.67	28.57
Sorbus.sp	0.00	0.00	0	0.00	50	50.00	57.14

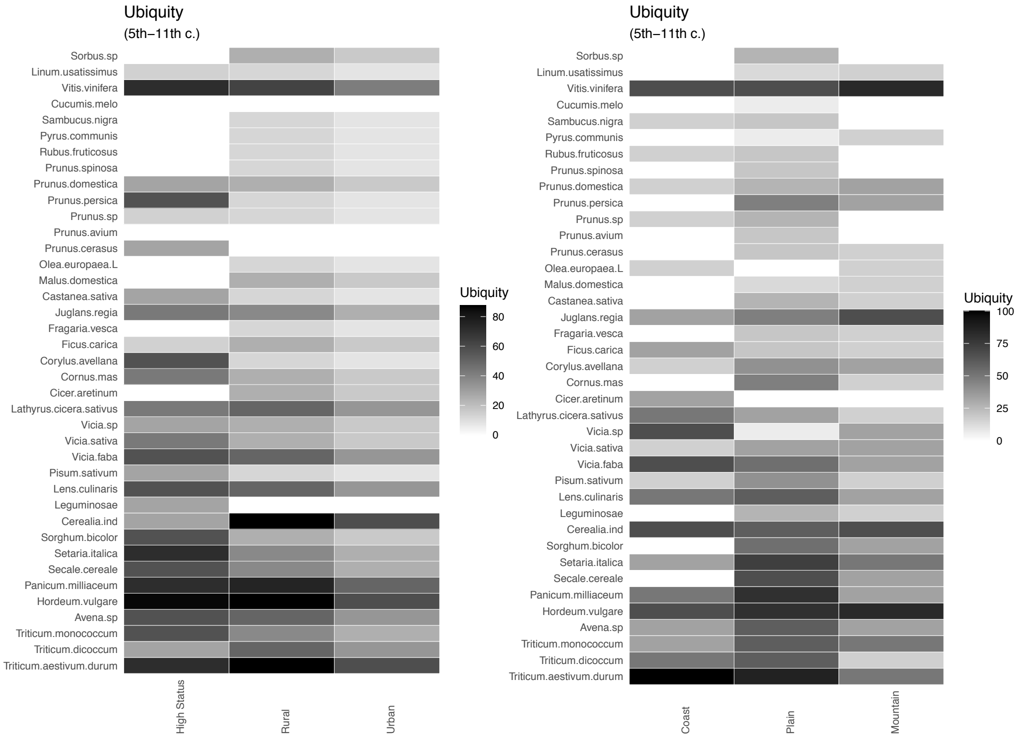
```
    subtitle="Diachronical heatmap of recorded plant species"
  ) +
  scale_fill_gradient(low = "white", high = "black")
```

4.2.1 Ubiquity by site type

The size of the archaeobotanical dataset does not allow in-depth statistics concerning the distribution of particular taxa in different site types. However, it is possible to make generalised observations about the entire period. The heatmap in Figure 2 shows the ubiquity of taxa distributed by site type.

4.2.2 Ubiquity by geography

As stated above, the size of the archaeobotanical dataset only allows generalised observations about the entire period. The heatmap in Figure 2 shows the ubiquity of taxa distributed by the geographical features of the sites.



(a) distributed by site type.

(b) distributed by geography.

Figure 2: Ubiquity of plants (5^{th} to 11^{th} c.)

4.3 Weighted means

As some samples presented some biases, data were first converted into relative ranks with the function `decostand(method="rrank")` in the package `vegan`. This function rearranges row counts into ranks, flattening huge differences in rows by assigning ordered values ranging from 0 (lowest rank) to 1 (highest rank). For instance, the site of (ID 33) *Sirmione, via antiche Mura* has two taxa that are skewing the distribution: *Setaria italica* (count: 255600) and *Panicum miliaceum* (count: 90000). Treating these values as outliers and removing them would ignore the importance of these two plant remains in the sample: these are in fact extreme values, but still suggest that the plant was stored in high quantities. When the sample is standardised with the relative ranks, Setaria italica has a value of 1 and Panicum miliaceum has a value of 0.75. The other plant remains found in this sample, Triticum aestivum/durum, has a value of 0.25 (original count = 13). The weighted means of the proportions of ranked plants are calculated in this way:

1. We subset the botanical dataset by century using a for loop.
2. Inside the for loop, we calculate the total of ranks from each sample (sample size) and multiply it by sample weight (the arbitrary weighting value described earlier, that gives more credibility to samples that are shorter in time).
3. We multiply all the rows in the columns by their sample weight, then sum all the rows so that we also get the weighted total rank for each plant in that century. This allows to have means that take into account both sample sizes and the credibility weight.
4. We can calculate the effective century sample size by summing all the sample sizes of that century. In this way, we get a weighted century total ranks (Table 4).
5. Finally, we can calculate the rank proportions by dividing the weighted total plant ranks by the weighted total samples ranks, for each century.

Table 3 reports the weighted means of the proportions of ranks by century. To visualise the frequency of each plant, refer to the heatmap Figure 3, b. The code to build the heatmap is not included here as it is the same as the one in the section above. In addition to information about the means, it might be also informative to check the effective sample sizes before and after the weighting process and conversion to ranks.

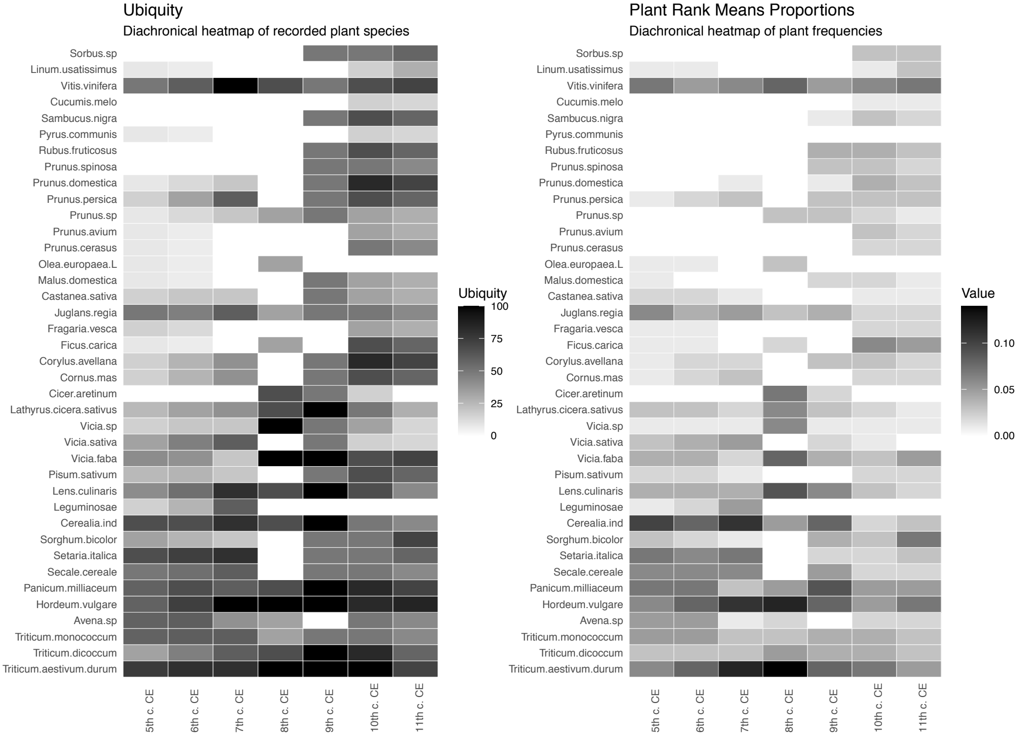
```r
# Create a copy of the original dataframe
# Convert the seeds counts to relative ranks (0-1)
bot_condensed.rank <- bot_condensed
bot_condensed.rank[,14:52] <- decostand(bot_condensed.rank[,14:52], method = "rrank")

# Create empty matrices to store results of the for loops
# 39 is the number of plants
# 7 is the number of centuries
results_bot <- matrix(NA, nrow = 7, ncol  = 39)

# Data frames to store extra informations
results_bot_sample_size <- matrix(NA, nrow = 7, ncol = 1)
results_bot_sample_size_noweight <- matrix(NA, nrow = 7, ncol = 1)
```

```r
# loop over each century
for (i in 5:11) {
  # subset the data for the current century
  d <- bot_condensed.rank[bot_condensed.rank$data_valid_start <= i
                          & bot_condensed.rank$data_valid_end >= i, ]

  # calculate the sample size for each row
  sample_size <- rowSums(d[, 14:52] * d$weight, na.rm = TRUE)
  sample_size_noweight <- rowSums(d[, 14:52], na.rm = TRUE)

  # calculate the total weight for each plant
  plant_totals <- colSums(d[, 14:52] * d$weight, na.rm = TRUE)

  # calculate the total sample size
  total_sample_size <- sum(sample_size, na.rm = TRUE)

  # calculate the proportions for each plant and store them in the results matrix
  results_bot[i - 4, ] <- plant_totals / total_sample_size
  results_bot_sample_size[i - 4, ] = total_sample_size
  results_bot_sample_size_noweight[i - 4, ] = sum(sample_size_noweight, na.rm = TRUE)
}

# Set the names in the matrices
row.names(results_bot) <- paste0("Century ", 5:11)
colnames(results_bot) <- colnames(bot_condensed.rank[,14:52])

# Create a table that provides information about samples and ranks
row.names(results_bot_sample_size) <- paste0("Century ", 5:11)
colnames(results_bot_sample_size) <- "Effective_Size"

results_bot_sample_size <- as.data.frame(results_bot_sample_size)
results_bot_sample_size_noweight = as.data.frame(results_bot_sample_size_noweight)
results_bot_sample_size$Size_Unweighted = results_bot_sample_size_noweight$V1

# Let's add to this table also the original seeds counts per century
tot_sample_size_seeds <- matrix(NA, nrow = 7, ncol = 1)
for (i in 5:11) {
  # subset the data for the current century
  tmp <- bot_condensed[bot_condensed$data_valid_start <= i
                          & bot_condensed$data_valid_end >= i, ]
  sample_size_seeds <- rowSums(tmp[, 14:52], na.rm = TRUE)

  tot_sample_size_seeds[i - 4, ] <- sum(sample_size_seeds, na.rm=T)
```

```
}
tot_sample_size_seeds = as.data.frame(tot_sample_size_seeds)
results_bot_sample_size$Tot_Seeds = tot_sample_size_seeds$V1

# Let's now round the results
results_bot = round(results_bot,2)
results_bot_sample_size = round(results_bot_sample_size,2)
```

4.3.1 Weighted means on the total of cereals

In addition to calculating the weighted means of the proportions of ranks using as a total seeds from every category (cereals, pulses, fruits and nuts), it can also be informative to explore relative trends in the cereals category. To do so, the process is exactly the same as the one described before, but the total of seeds is updated with the total of cereals. Table 5 reports the weighted means of the proportions of ranks by century.



Ubiquity

Diachronical heatmap of recorded plant species

Plant Rank Means Proportions

Diachronical heatmap of plant frequencies

(a) Ubiquity of plants

(b) Weighted means of plant frequencies.

Figure 3: Heatmaps

Table 3: BOT - Weighted mean proportions of ranked plants, printed by century.

	V.CE	VI.CE	VII.CE	VIII.CE	IX.CE	X.CE	XI.CE
Triticum.aestivum.durum	0.06	0.08	0.12	0.14	0.08	0.07	0.05
Triticum.dicoccum	0.03	0.03	0.03	0.05	0.04	0.04	0.03
Triticum.monococcum	0.05	0.05	0.03	0.03	0.04	0.04	0.03
Avena.sp	0.05	0.05	0.01	0.02	0.00	0.02	0.02
Hordeum.vulgare	0.06	0.08	0.11	0.12	0.08	0.05	0.07
Panicum.milliaceum	0.07	0.07	0.03	0.05	0.09	0.05	0.05
Secale.cereale	0.06	0.06	0.06	0.00	0.05	0.02	0.02
Setaria.italica	0.07	0.06	0.07	0.00	0.02	0.02	0.03
Sorghum.bicolor	0.03	0.02	0.01	0.00	0.04	0.03	0.07
Cerealia.ind	0.10	0.08	0.11	0.05	0.08	0.02	0.03
Leguminosae	0.01	0.02	0.05	0.00	0.00	0.00	0.00
Lens.culinaris	0.04	0.04	0.04	0.09	0.06	0.03	0.02
Pisum.sativum	0.02	0.02	0.01	0.00	0.00	0.02	0.02
Vicia.faba	0.04	0.04	0.02	0.08	0.04	0.03	0.05
Vicia.sativa	0.03	0.04	0.05	0.00	0.02	0.01	0.00
Vicia.sp	0.01	0.01	0.01	0.06	0.01	0.01	0.01
Lathyrus.cicera.sativus	0.03	0.03	0.02	0.06	0.03	0.02	0.01
Cicer.aretinum	0.00	0.00	0.00	0.07	0.02	0.00	0.00
Cornus.mas	0.01	0.02	0.03	0.00	0.00	0.02	0.02
Corylus.avellana	0.01	0.02	0.02	0.00	0.03	0.03	0.02
Ficus.carica	0.01	0.01	0.00	0.02	0.00	0.06	0.05
Fragaria.vesca	0.01	0.01	0.00	0.00	0.00	0.02	0.02
Juglans.regia	0.06	0.04	0.05	0.03	0.04	0.02	0.02
Castanea.sativa	0.02	0.02	0.01	0.00	0.00	0.01	0.01
Malus.domestica	0.01	0.00	0.00	0.00	0.02	0.02	0.01
Olea.europaea.L	0.01	0.01	0.00	0.03	0.00	0.00	0.00
Prunus.cerasus	0.00	0.00	0.00	0.00	0.00	0.02	0.02
Prunus.avium	0.00	0.00	0.00	0.00	0.00	0.03	0.02
Prunus.sp	0.00	0.00	0.00	0.03	0.03	0.02	0.01
Prunus.persica	0.01	0.02	0.03	0.00	0.03	0.03	0.03
Prunus.domestica	0.00	0.00	0.01	0.00	0.01	0.04	0.03
Prunus.spinosa	0.00	0.00	0.00	0.00	0.03	0.03	0.02
Rubus.fruticosus	0.00	0.00	0.00	0.00	0.04	0.04	0.03
Pyrus.communis	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sambucus.nigra	0.00	0.00	0.00	0.00	0.01	0.03	0.02
Cucumis.melo	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Vitis.vinifera	0.07	0.05	0.06	0.08	0.05	0.06	0.07
Linum.usatissimus	0.01	0.01	0.00	0.00	0.00	0.01	0.03
Sorbus.sp	0.00	0.00	0.00	0.00	0.00	0.03	0.03

Table 4: BOT - Sample sizes of rank proportions by century, weighted and unweighted. Original total seeds counts are also provided in the column Tot_Seeds. This column is unweighted as the weighting has been applied to ranks.

	Effective_Size	Size_Unweighted	Tot_Seeds
V.CE	35.50	68.0	394789
VI.CE	47.50	95.0	397601
VII.CE	20.00	35.0	3254
VIII.CE	13.83	17.5	1956
IX.CE	6.50	19.5	2211
X.CE	27.50	61.5	43495
XI.CE	32.67	63.0	43238

Table 5: Cereals - Weighted mean proportions of ranked cereals, printed by century.

	V.CE	VI.CE	VII.CE	VIII.CE	IX.CE	X.CE	XI.CE
Triticum.aestivum.durum	0.11	0.14	0.20	0.31	0.19	0.22	0.15
Triticum.dicoccum	0.04	0.05	0.04	0.10	0.05	0.11	0.07
Triticum.monococcum	0.10	0.08	0.05	0.08	0.08	0.10	0.08
Avena.sp	0.09	0.08	0.02	0.03	0.00	0.08	0.06
Hordeum.vulgare	0.11	0.15	0.19	0.27	0.14	0.12	0.18
Panicum.milliaceum	0.12	0.12	0.07	0.13	0.18	0.14	0.11
Secale.cereale	0.10	0.10	0.09	0.00	0.10	0.07	0.05
Setaria.italica	0.11	0.11	0.11	0.00	0.01	0.04	0.07
Sorghum.bicolor	0.05	0.03	0.03	0.00	0.07	0.07	0.16
Cerealia.ind	0.17	0.14	0.19	0.08	0.18	0.05	0.07

Table 6: Cereals - Sample sizes of rank proportions by century, weighted and unweighted. Original total seeds counts are also provided in the column Tot_Seeds. This column is unweighted as the weighting process has been applied to ranks.

	Effective_Size	Size_Unweighted	Tot_Seeds
V.CE	21.00	40.0	377093
VI.CE	26.75	53.5	379541
VII.CE	10.75	18.5	2857
VIII.CE	6.50	8.5	1290
IX.CE	2.67	8.0	559
X.CE	9.92	22.5	1874
XI.CE	13.42	24.0	1656

4.4 Diversity

The Shannon-Wiener index (H’) is a common index to calculate the diversity of species in a community, calculated as follows:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

Where p_i is the proportion of the entire site made up of species i. The higher the value of H’, the higher the diversity of species in a particular site. The lower the value of H’, the lower the diversity. A value of H = 0 indicates a site that only has one species.

Using the `R` package `vegan`, I ran the `diversity()` function (with the parameters: `index = Shannon` and `base = exp(1)`) on the sites filtered by century. The calculation has been done both on raw frequencies and on the relative ranks proportions. The code is not reported below, as the calculation is very straightforward with the package.

Figure 4 shows a temporal trend line of diversity in the plant samples, excluding the 8th and 9th centuries which did not provide enough data. The results are very similar when using ranks or raw frequencies. It is important to stress that sample sizes affect this index, and it has been used only for exploratory purposes.

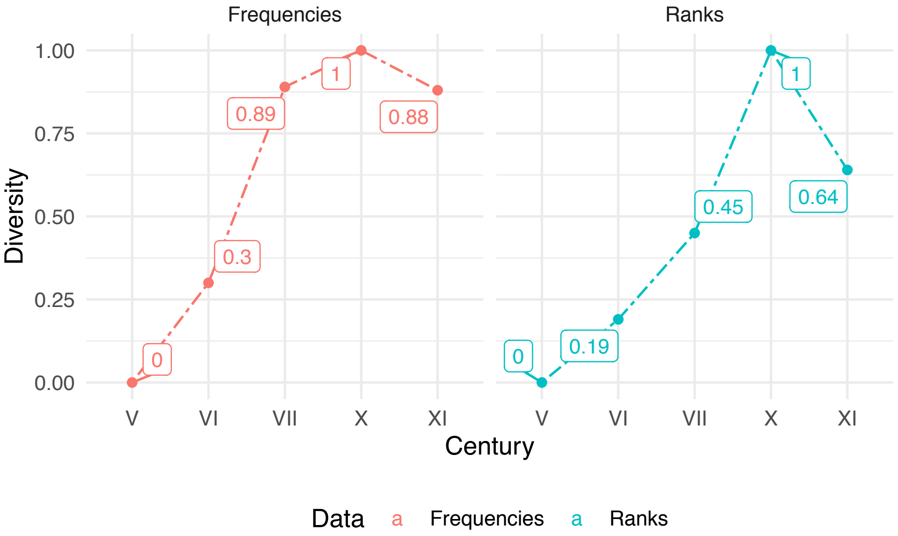


Figure 4: Diversity of the plant samples across the centuries under examination. The 8th and 9th centuries are missing as data was not sufficient for the calculation. The values have been normalised from 0 to 1 to allow comparability between graphs. Sample sizes are in Table 4.

5 Zooarchaeology

5.1 List of sites

Table 7: ZOO - List of sites and sample biases

Code	Site	Type	Chronology	Region	Sieved	Fragmentation	Notes.Biases
APR	Alba, Piazza Risorgimento	Urban	11th-12th c.	Piedmont	na	na	
AVV	Alba, via Vernazza	Urban	5th-7th c., 11th-12th c.	Piedmont	yes	na	
RAS	Asolo (Rocca)	Castrum	7th-13th c.	Veneto	no	high (22% id.)	
AST	Asti, via dei Varroni	Urban	4th-6th c.	Piedmont	no	na	
SGB	Brescia, Santa Giulia	Monastery	9th-10th c.	Lombardy	na	na	caprine overrepresented
CVT	Calvatone	Rural	4th-5th c.	Lombardy	na	na	cattle overrepresented (butchered in loco)
CRS	Cherasco, castello di Manzano	Castle	11th-13th c.	Piedmont	partially	na	
VCL	Imola, villa Clelia	Rural	6th c., 10th-11th c.	Emilia-Romagna	no	fair (43% id.)	
LVM	Lomello, villa Maria	Rural	5th-6th c.	Lombardy	yes	na	
LSA	Loppio, isola S. Andrea	Castrum	5th-6th c.	Trentino-Alto Adige	na	na	cattle and caprine raised in loco
LNO	Luni	Urban	4th-13th c.	Liguria	partially	na	
MFR	Mombello Monferrato	Rural	5th-8th c.	Piedmont	no	na	
MBR	Monte Barro	Castrum	5th-6th c.	Lombardy	partially	na	
NGR	Nogara	Urban	9th-11th c.	Veneto	na	na	
PVC	Parma, via Cavestro	Urban	5th-7th c.	Emilia-Romagna	na	good (80% id.)	
SMT	San Michele di Trino	Urban	5th-7th c., 10th-11th c.	Piedmont	no	na	small sample size
SAB	Sant'Agata Bolognese	Castrum	9th-11th c.	Emilia-Romagna	no	na	
SAP	Sant'Antonino di Perti	Castrum	6th-7th c.	Liguria	no	na	butchering in loco: domestic mam. overrepresented
TCB	Teglio, Combolo	Urban	1st-6th c.	Lombardy	na	na	wide chronology
TRZ	Trezzo sull'Adda, Cascina San Martino	Rural		Lombardy	no	high (24% id.)	
VSL	Venezia, San Lorenzo di Ammiana	Urban	6th-7th c.	Veneto	no	fair (44.5% id.)	

5.2 Weighted means

The animal NISP counts have been converted to relative ranks proportions as for the archaeobotanical dataset. The weighted means of the proportions of ranked animals are calculated in this way:

1. We subset the faunal dataset by century using a for loop.
2. Inside the for loop, we calculate the total ranks of the NISP of each sample (sample size) and multiply it by sample weight (the arbitrary weighting value described earlier, that gives more credibility to samples that are shorter in time). Note that fish and mollusca are excluded by the total, as they might bias the results.
3. We multiply all the rows in the columns by their sample weight, then sum all the rows so that we also get the weighted total ranks for each animal in that century. This allows to have means that take into account both sample sizes and the credibility weight.
4. We can calculate the effective century sample size by summing all the sample sizes of that century. In this way, we get a weighted century total (Table 9).
5. Finally, we can calculate the rank proportions by dividing the weighted total ranks by the weighted total samples, for each century.

```
faunal_condensed.rank <- faunal_condensed
faunal_condensed.rank[,14:18] <- decostand(faunal_condensed.rank[,14:18],
                                           method = "rrank"
                                           )


# 5 is the number of animals
```

```
# 7 is the number of centuries
results_zoo <- matrix(NA, nrow = 7, ncol = 5)
results_zoo_century_sample_size <- matrix(NA, nrow = 7, ncol = 1)
results_zoo_century_sample_size_unweighted <- matrix(NA, nrow = 7, ncol = 1)


# loop over each century
for (i in 5:11) {
  # subset the data for the current century
  d <- faunal_condensed[faunal_condensed.rank$From.Century <= i
                        & faunal_condensed.rank$To.Century >= i, ]

  # calculate the sample size for each row
  sample_size <- rowSums(d[, 14:18] * d$weight, na.rm = TRUE)
  sample_size_noweight <- rowSums(d[, 14:18], na.rm = TRUE)

  # calculate the total weight for each animal
  animal_totals <- colSums(d[, 14:18] * d$weight, na.rm = TRUE)

  # calculate the total sample size
  total_sample_size_animals <- sum(sample_size, na.rm = TRUE)

  # calculate the proportions for each animal and store them in the results matrix
  results_zoo[i - 4, ] <- animal_totals / total_sample_size_animals
  results_zoo_century_sample_size[i - 4, ] <- total_sample_size_animals
  results_zoo_century_sample_size_unweighted[i - 4, ] = sum(sample_size_noweight, na.rm =
}

# set the names of the results matrix
row.names(results_zoo) <- paste0("Century ", 5:11)
row.names(results_zoo_century_sample_size) <- paste0("Century ", 5:11)
colnames(results_zoo) <- colnames(faunal_condensed.rank[,14:18])

results_zoo_century_sample_size = as.data.frame(results_zoo_century_sample_size)
results_zoo_century_sample_size_unweighted=as.data.frame(results_zoo_century_sample_size_

results_zoo_century_sample_size$Size_Unweighted= results_zoo_century_sample_size_unweighte

# Let's add to this table also the original NISP counts per century
results_zoo_century_NISP_size <- matrix(NA, nrow = 7, ncol = 1)
for (i in 5:11) {
  # subset the data for the current century
  tmp <- faunal_condensed[faunal_condensed$From.Century <= i
                          & faunal_condensed$To.Century >= i, ]
```

Table 8: ZOO - Weighted mean proportions of ranked animals, printed by century

	V.CE	VI.CE	VII.CE	VIII.CE	IX.CE	X.CE	XI.CE
Pigs	0.35	0.49	0.49	0.38	0.25	0.32	0.41
Cattle	0.32	0.16	0.12	0.09	0.21	0.20	0.20
Caprine	0.23	0.29	0.34	0.39	0.45	0.36	0.24
Dom..Fowl	0.07	0.05	0.04	0.14	0.02	0.02	0.10
Edible.W..Mammals	0.03	0.01	0.01	0.00	0.07	0.10	0.04

```
  sample_size_NISP <- rowSums(tmp[, 14:18], na.rm = TRUE)

  results_zoo_century_NISP_size[i - 4, ] <- sum(sample_size_NISP, na.rm=T)
}
results_zoo_century_NISP_size = as.data.frame(results_zoo_century_NISP_size)

results_zoo_century_sample_size$Tot_NISP = results_zoo_century_NISP_size$V1

colnames(results_zoo_century_sample_size) = c("Effective Size",
                                              "Unweighted Size",
                                              "Total Nisp (unweighted)")

results_zoo = round(results_zoo,2)
results_zoo_century_sample_size = round(results_zoo_century_sample_size,2)
```

Table 9: ZOO - Weighted and unweighted sample sizes for each century.

	Effective Size	Unweighted Size	Total Nisp (unweighted)
Century 5	2455.40	5066	5066
Century 6	10398.05	13500	13500
Century 7	8209.76	10863	10863
Century 8	12194.95	3570	3570
Century 9	1329.86	3702	3702
Century 10	2107.36	5257	5257
Century 11	6748.86	9353	9353

5.3 Weighted means by site type

The weighted means of the proportions of ranked animals are calculated in this way:

1. We subset the faunal dataset by century using a for loop.

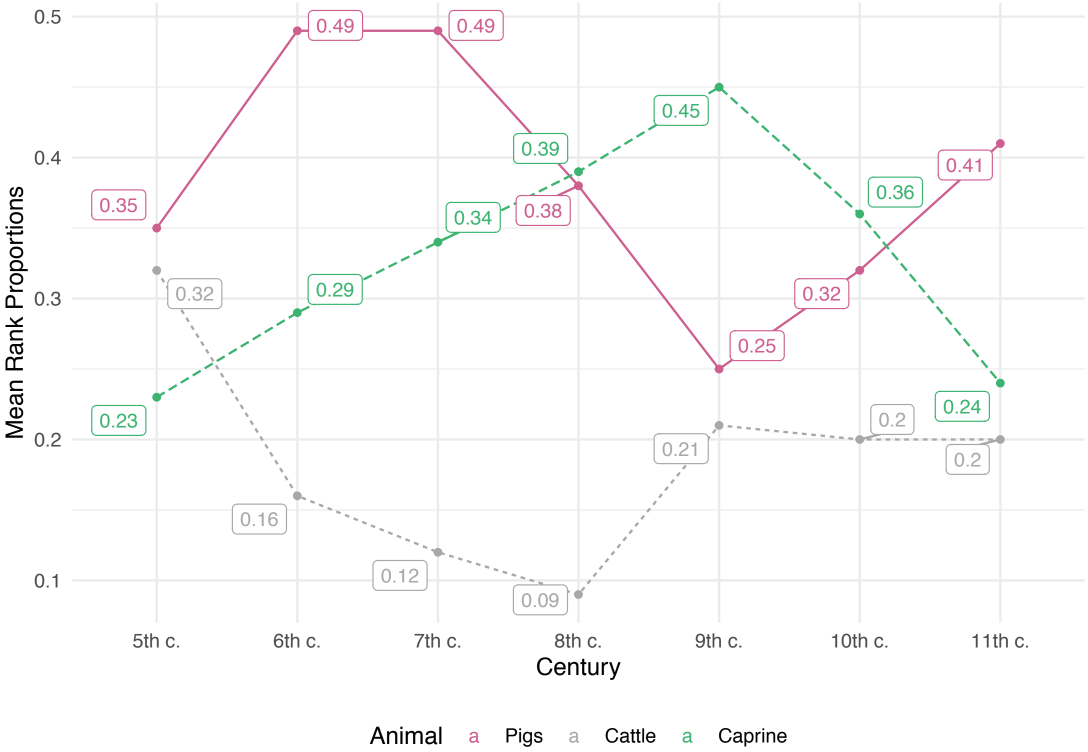


Figure 5: Rank proportions of main domesticates.

2. Inside the for loop, we nest another for loop to subset the century table by each site type.
3. As before, we calculate the total NISP of each sample (sample size) and multiply it by sample weight (the arbitrary weighting value described earlier, that gives more credibility to samples that are shorter in time).
4. We multiply all the rows in the columns by their sample weight, then sum all the rows so that we also get the weighted total NISP for each animal in that century and site type. This allows to have means that take into account both sample sizes and the credibility weight.
5. We can calculate the effective century sample size by summing all the sample sizes of that century and site type. In this way, we get a weighted century-type total NISP (Table 11).
6. Finally, we can calculate the rank proportions by dividing the weighted total animal NISP by the weighted total samples NISP, for each century and site type.

The plots (Figure 6) have been stacked together using the package `patchwork`. To avoid taking up too much space, the script only shows how to build the plot for pigs. The plots for the other animals are completely identical, and only the variable for the animal type changes.

```
#Simplify the categories
faunal_condensed.rank$Type <-
  str_replace(faunal_condensed.rank$Type,
              "Religious, monastery",
              "High status")
faunal_condensed.rank$Type <-
  str_replace(faunal_condensed.rank$Type,
              "Castle", "High status")
faunal_condensed.rank$Type <-
  str_replace(faunal_condensed.rank$Type,
              "Castrum", "High status")

site_types <- unique(faunal_condensed.rank$Type)

# create a matrix to hold the results for each combination of century and site type
results_zoo_type_temp <-
  matrix(
    NA,
    nrow = 7 * length(site_types),
    ncol = ncol(faunal_condensed.rank[, 14:18]) + 2
  )
results_zoo_type_samplesize <-
  matrix(NA, nrow = 7 * length(site_types), ncol = 3)
row_counter = 1

#faunal_condensed.rank[is.na(faunal_condensed.rank)] <- 0

# loop over each century
for (i in 5:11) {
```

```
  for (j in 1:length(site_types)) {
    # subset the data for the current century and site type
    d <-
      faunal_condensed.rank[faunal_condensed.rank$From.Century <= i &
                              faunal_condensed.rank$To.Century >= i &
                              faunal_condensed.rank$Type == site_types[j],]
    # calculate the sample size for each row
    sample_size <- rowSums(d[, 14:18] * d$weight, na.rm = TRUE)

    # calculate the total weight for each animal
    animal_totals <- colSums(d[, 14:18] * d$weight, na.rm = TRUE)

    # calculate the total sample size
    total_sample_size_animals <- sum(sample_size, na.rm = TRUE)

    # calculate the proportions for each animal and store them in the results matrix
    results_zoo_type_temp[row_counter,] <-
      c(paste0("Century ", i),
        site_types[j],
        animal_totals / total_sample_size_animals)
    results_zoo_type_samplesize[row_counter,] <-
      c(paste0("Century ", i),
        site_types[j],
        total_sample_size_animals)
    row_counter <- row_counter + 1
  }
}

# set the names of the results matrix
row.names(results_zoo_type_temp) <- NULL
colnames(results_zoo_type_temp) <-
  c("Century", "Type", colnames(d[, 14:18]))
row.names(results_zoo_type_samplesize) <- NULL
colnames(results_zoo_type_samplesize) <-
  c("Century", "Type", "Effective_Size")

# reshape the results
results_zoo_type_temp_df <- as.data.frame(results_zoo_type_temp)
results_zoo_type_df <- results_zoo_type_temp_df %>%
  mutate_at(vars(3:7), as.numeric)
results_zoo_type_df[, 3:7] <- round(results_zoo_type_df[, 3:7] , 3)
results_zoo_type_df$Century = as.factor(results_zoo_type_df$Century)
levels(results_zoo_type_df$Century) = c(10, 11, 5, 6, 7, 8, 9)
```

Table 10: ZOO - Weighted mean proportions of ranked animals, printed by century and site type.

Century	Type	Pigs	Cattle	Caprine	Dom..Fowl	Edible.W..Mammals
5	Urban	0.391	0.218	0.272	0.097	0.022
5	High status	0.333	0.167	0.267	0.167	0.067
5	Rural	0.321	0.385	0.256	0.038	0.000
6	Urban	0.304	0.284	0.192	0.170	0.050
6	High status	0.333	0.178	0.267	0.156	0.067
6	Rural	0.321	0.313	0.267	0.079	0.021
7	Urban	0.277	0.208	0.316	0.123	0.077
7	High status	0.314	0.238	0.248	0.133	0.067
7	Rural	0.333	0.267	0.200	0.133	0.067
8	Urban	0.274	0.139	0.332	0.191	0.064
8	High status	0.267	0.333	0.200	0.133	0.067
8	Rural	0.333	0.267	0.200	0.133	0.067
9	Urban	0.300	0.200	0.400	0.100	0.000
9	High status	0.256	0.280	0.243	0.080	0.142
9	Rural	0.400	0.300	0.200	0.000	0.100
10	Urban	0.326	0.200	0.243	0.100	0.130
10	High status	0.256	0.280	0.243	0.080	0.142
10	Rural	0.400	0.300	0.200	0.000	0.100
11	Urban	0.328	0.206	0.266	0.129	0.071
11	High status	0.322	0.222	0.219	0.133	0.104
11	Rural	0.400	0.300	0.200	0.000	0.100

```r
results_zoo_type_samplesize_df <-
  as.data.frame(results_zoo_type_samplesize)
results_zoo_type_samplesize_df <-
  results_zoo_type_samplesize_df %>%
  mutate_at(vars(3), as.numeric)
results_zoo_type_samplesize_df[, 3] <-
  round(results_zoo_type_samplesize_df[, 3] , 3)
results_zoo_type_samplesize_df$Century = as.factor(
  results_zoo_type_samplesize_df$Century
  )
levels(results_zoo_type_samplesize_df$Century) = c(10, 11, 5, 6, 7, 8, 9)
```

```r
pigs_by_type <-
  ggplot(data = results_zoo_type_df, aes(
    fill = factor(Century, levels = c(5, 6, 7, 8, 9, 10, 11)),
```

```
    x =Type,
    y = Pigs
  )) +
  geom_bar(position = "dodge", stat = "identity") +
  theme_pubclean() +
  theme(legend.position = "none") +
  scale_fill_grey() +
  labs(title = "Pigs",
       x = "",
       y = "%",
       fill = "Chronology")
```

Table 11: ZOO - Effective weighted sample sizes for each century and site type.

Century	Type	Effective_Size
5	Urban	33.333
5	High status	3.000
5	Rural	3.250
6	Urban	65.000
6	High status	4.500
6	Rural	3.250
7	Urban	36.166
7	High status	2.100
7	Rural	1.000
8	Urban	32.834
8	High status	0.600
8	Rural	1.000
9	Urban	0.834
9	High status	3.100
9	Rural	1.250
10	Urban	3.833
10	High status	3.100
10	Rural	2.500
11	Urban	36.584
11	High status	3.600
11	Rural	2.083

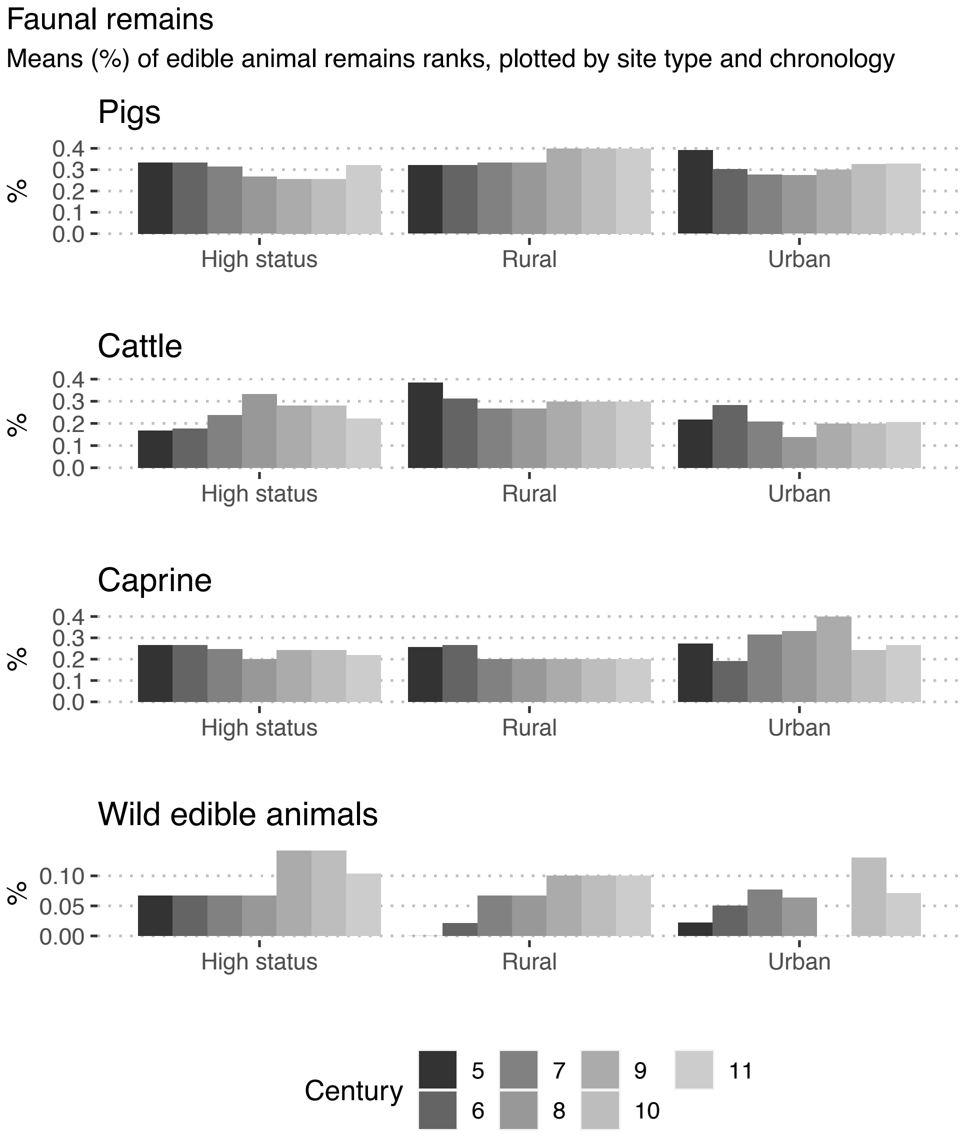


Figure 6: Means of faunal remains ranks by site type. Rural site data is scarcer from the 8th c. and the results might not be reliable.

5.4 Weighted means by geography

The process of calculating weighted means of animal remains ranks proportions by site geography and chronology is identical as the one described above for site type. The only change is in the variable name, and the code has hence been omitted.

6 Proxy integration

6.1 Method overview

Research in the past has considered archaeobotanical and zooarchaeological studies mostly independently for pragmatic reasons. The integrated examination of these dataset types can be challenging, because of the risk of not comparing like with like. A strategy proposed by Amber VanDerwarker (2010) guided the development of this integrating methodology. Firstly, I created a list of species and taxa of interest for this analysis. The botanical assemblage has been converted into relative ranks proportions as shown earlier in this document. The faunal assemblage did not present major biasing problems, but was converted in relative ranks for comparability. Further, the results were the same as a simple conversion into relative frequencies. The fish category has been excluded because it was not possible to determine if every excavation reported it. After the conversion to ranks, some plant taxa has been merged together (grouped by means) so to facilitate the reading of the results. For instance, all domestic fruits have been grouped into the category `Domestic fruits`. Subsequently, the rank tables were subset by century, so that it was possible to calculate centuries rank averages. The averages were calculated dividing the sum of all the seeds/NISP remains of a particular plant/taxa by the total of all seeds/bones in the century of interest. Plants and animals were then combined by each century. Finally, after VanDerwarker and Peres (2010, 88) the table was standardised so that the sum of each cell equalled 1. To obtain this, each cell in the table was divided by the rows and columns totals. This standardisation provides a measure of “how one unit of mass is distributed across the cells” (Ibid., 87). Using the normalised table, I performed a correspondence analysis (CA) using the package `FactoMineR` on R Studio (visualized using the package `ggplot2`). CA allows the reduction of the dimensionality of multivariate nominal data to visualize it on a two-dimensional plot (Shennan 1997, 308). It is appropriate for exploring non-negative data (e.g. percentages or counts) in a table, and examining the relationships between cells in a row (i.e. the assemblage of a particular century), in a column (i.e. a group of taxa/species through different centuries), and their interrelationship (Baxter 2015, 101).

6.2 Correspondence analysis

Before running the correspondence analysis, it is necessary to pre-process the data as explained above.

```
# PRE-PROCESSING

```

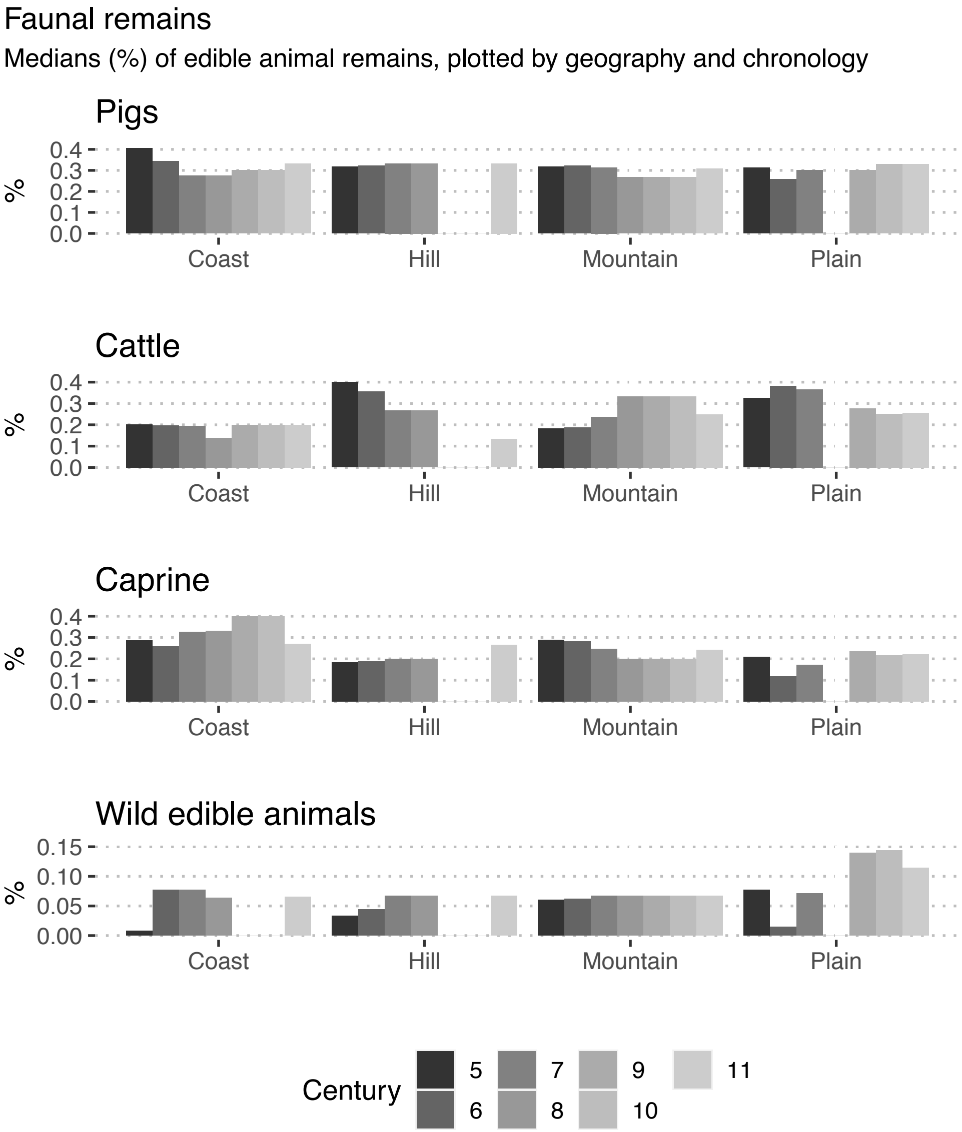


Figure 7: Medians of faunal remains by geographical feature. Rural site data is scarcer from the 8th c. and the results might not be reliable.

```
test <- cbind(results_zoo,results_bot)
test <- as.data.frame(test)

# Cleaning the dataframe

Millets <- rowMeans(test[,c(11,13)])
Pulses <- rowMeans(test[,16:23])
C.Fruits <- rowMeans(test[,c(25,26,28,30:36,39,41,42,43)]) # Cultivated fr.
Sp.Fruits <- rowMeans(test[,c(24,27,29,37,38,40,44)]) # Spontaneous fr.


test.simplified <- cbind.data.frame(
  test[,c(1:5)],
  "C.Wheat" = test$Triticum.aestivum.durum,
  "Barley"=test$Hordeum.vulgare,
  "Emmer" = test$Triticum.dicoccum,
  "Einkorn" = test$Triticum.monococcum,
  "Oats" = test$Avena.sp,
  "Sorghum" = test$Sorghum.bicolor,
  "Millets"= round(Millets, 2),
  "Rye" = test$Secale.cereale,
  "Pulses" = round(Pulses, 2),
  "C. Fruits" = round(C.Fruits, 2),
  "Sp. Fruits" = round(Sp.Fruits, 2)
)

# Normalising the table
test.simplified = test.simplified/sum(test.simplified)
```

When the normalised table is ready, it is finally possibly to perform a correspondence analysis using the function `CA` from the package `FactoMineR`.

```
test.cca <- FactoMineR::CA(test.simplified, graph = T)
```

After performing the CA, it is good practice to check the scree plot to choose the most appropriate dimensions that explain most variance.

We can then choose the first two dimensions.

	eigenvalue	percentage of variance	cumulative percentage of variance
dim 1	0.0593446	43.66458	43.66458
dim 2	0.0346213	25.47364	69.13822

Table 12: Normalised table of botanical and faunal rank mean proportions. The table has been transposed so that it would fit the page.

	V.CE	VI.CE	VII.CE	VIII.CE	IX.CE	X.CE	XI.CE	Total
Pigs	0.0349650	0.0489510	0.0489510	0.0379620	0.0249750	0.0319680	0.0409590	0.2687313
Cattle	0.0319680	0.0159840	0.0119880	0.0089910	0.0209790	0.0199800	0.0199800	0.1298701
Caprine	0.0229770	0.0289710	0.0339660	0.0389610	0.0449550	0.0359640	0.0239760	0.2297702
Dom..Fowl	0.0069930	0.0049950	0.0039960	0.0139860	0.0019980	0.0019980	0.0099900	0.0439560
Edible.W..Mammals	0.0029970	0.0009990	0.0009990	0.0000000	0.0069930	0.0099900	0.0039960	0.0259740
C.Wheat	0.0059940	0.0079920	0.0119880	0.0139860	0.0079920	0.0069930	0.0049950	0.0599401
Barley	0.0059940	0.0079920	0.0109890	0.0119880	0.0079920	0.0049950	0.0069930	0.0569431
Emmer	0.0029970	0.0029970	0.0029970	0.0049950	0.0039960	0.0039960	0.0029970	0.0249750
Einkorn	0.0049950	0.0049950	0.0029970	0.0029970	0.0039960	0.0039960	0.0029970	0.0269730
Oats	0.0049950	0.0049950	0.0009990	0.0019980	0.0000000	0.0019980	0.0019980	0.0169830
Sorghum	0.0029970	0.0019980	0.0009990	0.0000000	0.0039960	0.0029970	0.0069930	0.0199800
Millets	0.0069930	0.0059940	0.0049950	0.0029970	0.0059940	0.0039960	0.0039960	0.0349650
Rye	0.0059940	0.0059940	0.0059940	0.0000000	0.0049950	0.0019980	0.0019980	0.0269730
Pulses	0.0019980	0.0029970	0.0019980	0.0039960	0.0019980	0.0009990	0.0009990	0.0149850
C. Fruits	0.0009990	0.0009990	0.0009990	0.0009990	0.0019980	0.0019980	0.0019980	0.0099900
Sp. Fruits	0.0009990	0.0009990	0.0009990	0.0000000	0.0009990	0.0029970	0.0019980	0.0089910
Total	0.1448551	0.1478521	0.1458541	0.1438561	0.1438561	0.1368631	0.1368631	1.0000000

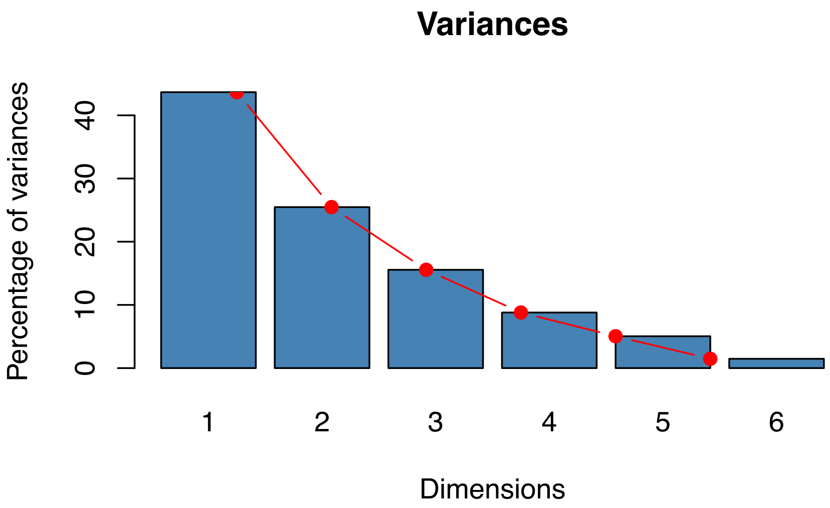


Figure 8: Screeplot of the CA.

To interpret the results, we can plot them using the standard `plot()` function or the companion package `FactoExtra`. To obtain a custom data visualization, it is possible to extract the coordinates of the CA. The coordinates will then be used to create a scatterplot using the package `ggplot2`.

```
species_data.CA <- test.cca$col %>%
  as.data.frame()

phases_data.CA <- test.cca$row %>%
  as.data.frame()

# Creating a dataframe with a column of 'Types'. I will then merge this column
# to my species dataframe to color the points in the scatterplot

CA_Types <- data.frame(Type=1:16)
CA_Types$Type[6:13] <- "Cereals"
CA_Types$Type[14] <- "Pulses"
CA_Types$Type[15:16] <- "Fruits/Nuts"
CA_Types$Type[1:4] <- "Domestic mammals"
CA_Types$Type[5] <- "Wild animals"

# Merge the type column to the species data
species_data.CA <- cbind.data.frame(species_data.CA, CA_Types)
# Create a palette with the colors for CA_Types
Palette <- c("#dda15e", "#582f0e", "#bc4749", "#92CF93", "#606c38")

# PLOT

CA.plot <- ggplot(species_data.CA) +
  geom_vline(xintercept = c(0), color = "grey70", linetype = 2) +
  geom_hline(yintercept = c(0), color = "grey70", linetype = 2) +
  # SPECIES
  geom_point(
    aes(
      x=coord.Dim.1,
      y=coord.Dim.2,
      color=Type,
      shape=Type),
    size=3)+
  annotate(geom = "point",
           x = species_data.CA$coord.Dim.1,
           y = species_data.CA$coord.Dim.2,
           color= "white",
           size = 1) +
  annotate(geom = "text",
```

```
         x = species_data.CA$coord.Dim.1-0.01,
         y = species_data.CA$coord.Dim.2,
         label=rownames(species_data.CA),
         fontface=3,
         hjust = "right",
         size = 3) +
# CENTURIES
annotate(geom = "text",
         x = phases_data.CA$coord.Dim.1+0.02,
         y = phases_data.CA$coord.Dim.2+0.02,
         label=rownames(phases_data.CA),
         hjust = "top",
         colour="red4",
         fontface=2,
         size = 3) +
annotate(geom = "point",
         x = phases_data.CA$coord.Dim.1,
         y = phases_data.CA$coord.Dim.2,
         colour="red4",
         size = 3) +
annotate(geom = "point", # Just to create a bicolor point
         x = phases_data.CA$coord.Dim.1,
         y = phases_data.CA$coord.Dim.2,
         colour="white",
         size = 2) +
theme_minimal()+
scale_color_manual(values = c("#dda15e","#8B6969","#582f0e","#606c38","#92CF93")) +
theme(legend.position = "bottom")+
labs(title = "Correspondence Analysis",
     x="CA1 (43.66%)",
     y="CA2 (25.47%)"
)
```

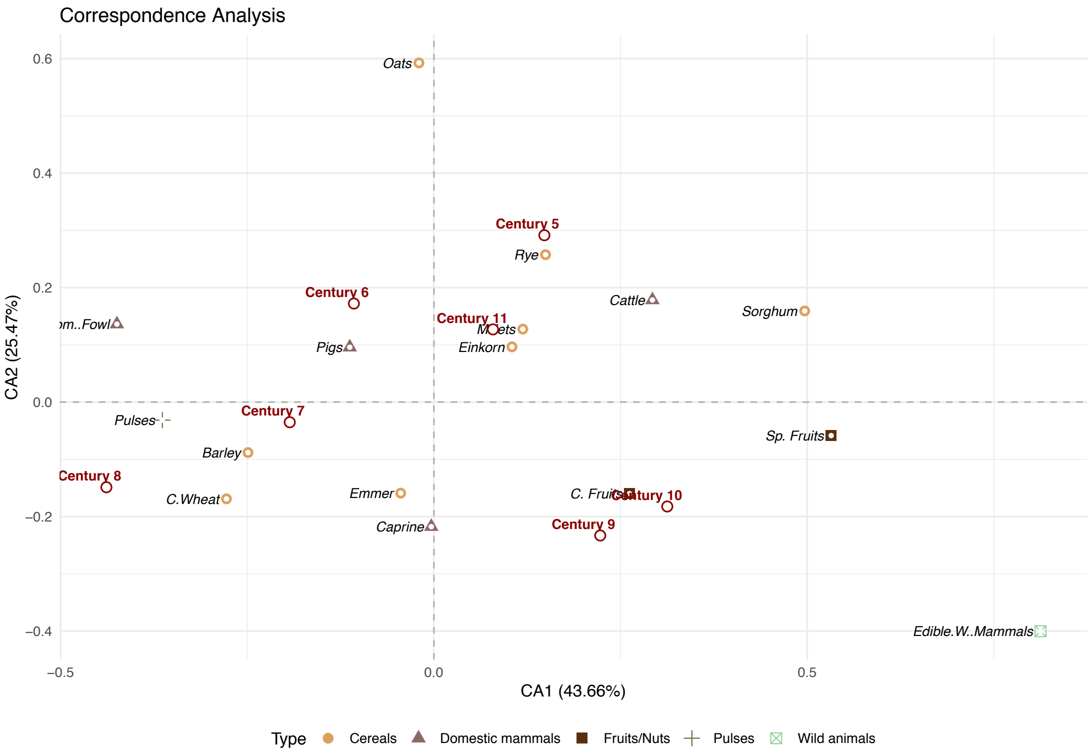


Figure 9: CA of the integrated botanical and faunal datasets.

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Late Pleistocene faunal remains from new investigations at Grotta Guattari (San Felice Circeo, Latium): preliminary considerations on climate and environment

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ABSTRACT: Grotta Guattari (San Felice Circeo, central Italy) is best known for the discovery of a Neanderthal skull in 1939. New researches in an area never previously investigated (i.e., the so-called *Antro del Laghetto*), have been recently carried out by the *Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina* with the collaboration of archaeologists from "Tor Vergata" University, Rome. At least 25 *taxa* distributed in two layers have been recognized. The most abundant species are *Cervus elaphus*, *Crocuta spelaea* and *Bos primigenius*, followed by *Sus scrofa*, *Equus ferus* and other *taxa*, including *Felis silvestris*, *Panthera spelaea*, *Equus hydruntinus* and *Rupicapra* sp., first reported in this cave. The faunal remains were probably accumulated by the cave hyena. The dominance of the red deer, together with the presence of chamois, ibex and *Megaloceros giganteus*, suggests that the bone deposit accumulated during a climate stage colder than today. The ecological features of the *taxa* indicate that the environment around the cave was forested though featuring large open spaces, wetlands and rocky areas. The mammal assemblage from Layer 2 also suggests that the environment was probably less forested and the climate slightly colder than on Layer 3.

KEYWORDS: QUATERNARY, CENTRAL ITALY, MAMMALS, PALEOCLIMATE, PALAEOENVIRONMENT

RIASSUNTO: Grotta Guattari (San Felice Circeo, Italia centrale) è nota soprattutto per il ritrovamento di un cranio di Neanderthal nel 1939. Recentemente sono state condotte nuove indagini effettuate dalla Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina con la collaborazione di archeologi dell'Università degli Studi di Roma "Tor Vergata" in un'area mai indagata precedentemente, il cosiddetto Antro del Laghetto. Sono stati riconosciuti almeno 25 *taxa* distribuiti in due strati. Le specie più abbondanti sono *Cervus elaphus*, *Crocuta spelaea* e *Bos primigenius*, seguite da *Sus scrofa*, *Equus ferus* e altri *taxa* tra cui *Felis silvestris*, *Panthera spelaea*, *Equus hydruntinus* e *Rupicapra* sp. mai trovati in precedenza. I resti faunistici furono probabilmente accumulati dalla iena delle caverne. La predominanza del cervo unitamente alla presenza di camoscio, stambecco e *Megaloceros giganteus*, suggerisce che il deposito osteologico si sia accumulato durante una fase climatica più fredda di quella attuale. Le caratteristiche ecologiche dei *taxa* presenti indicano che l'ambiente circostante la grotta era

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prevalentemente boschivo con ampi spazi aperti, zone umide e aree rocciose. L'associazione di mammiferi dello Strato 2 suggerisce che probabilmente l'ambiente era meno boscoso e il clima era un po' più freddo dello Strato 3.

PAROLE CHIAVE: QUATERNARIO, ITALIA CENTRALE, MAMMIFERI, PALEOCLIMA, PALEOAMBIENTE

RESUMEN: Grotta Guattari (San Felice Circeo, centro de Italia) es más conocida por el descubrimiento de un cráneo de neandertal en 1939. Recientes investigaciones en un área nunca antes investigada (el llamado Antro del Laghetto). Han sido emprendidas por la *Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina* con la colaboración de arqueólogos de la Universidad "Tor Vergata" de Roma. Se han reconocido al menos 25 taxones distribuidos en dos niveles. Las especies más abundantes son *Cervus elaphus*, *Crocuta spelaea* y *Bos primigenius*, tras las que vienen *Sus scrofa*, *Equus ferus* y otros taxones que incluyen a *Felis silvestris*, *Panthera spelaea*, *Equus hydruntinus* y *Rupicapra* sp., taxones reportados por vez primera en la cueva. Los restos de fauna probablemente fueron acumulados por la hiena de las cavernas. La dominancia del ciervo, junto con la presencia de rebecos, cabras montesas y *Megaloceros giganteus*, sugiere que el depósito óseo se acumuló durante una etapa climática más fría que la actual. Las características ecológicas de los taxones indican que el entorno de la cueva era boscoso con grandes espacios abiertos, humedales y zonas rocosas. El conjunto de mamíferos del nivel 2 también sugiere que el ambiente probablemente fue menos boscoso y el clima ligeramente más frío que en el nivel 3.

PALABRAS CLAVE: CUATERNARIO, ITALIA CENTRAL, MAMÍFEROS, PALEOCLIMA, PALEOAMBIENTE

INTRODUCTION

Grotta Guattari (San Felice Circeo, Latium, central Italy; Figure 1) is a prehistoric site well known since the fortuitous discovery in 1939 of the third Neanderthal skull of Italian history after those from Saccopastore in Rome (Blanc, 1939a, 1942; Salari *et al*., 2019a). Afterwards, also two Neanderthal mandibles were found (Blanc, 1939a; Sergi & Ascenzi, 1955). Several archaeological excavations were carried out inside and outside the cave in the following years collecting a large assemblage of vertebrates and a few Mousterian artifacts (Blanc & Segre, 1953; Taschini, 1979). The studies on Guattari's fauna allowed to recognize 17 genres of large mammals (i.e., Lagomorphs, Carnivores, Proboscideans, Perissodactyls and Artiodactyls), 4 *taxa* of small mammals, as many birds and one of amphibians and reptiles (Blanc & Segre, 1953). In these studies, *Cervus elaphus* prevailed over *Bos primigenius* and *Equus ferus* (Blanc & Segre, 1953; Taschini, 1979; Stiner, 1991a, b; Alhaique & Tagliacozzo, 2000). Subsequently, Piperno & Giacobini (1991) analysed over 600 bone remains from the paleosurface of the two main rooms of the cave (i.e., *Antro dell'Uomo* and *Vano Principale*, literally Chamber of the Man and Main Chamber) belonging to 12 taxonomic groups and identified the cave hyena as the main agent of bone accumulation.

The construction works of a new visiting route of the cave by the *Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Frosinone e Latina* led to additional archaeological investigations carried out with the collaboration of archaeologists of the "Tor Vergata" University of Rome.

The project began in 2018 with the cleaning of the existing sections of the cave and a sounding within the so-called *Antro del Laghetto* (i.e., Chamber of the small lake, see Piperno & Giacobini, 1991), described for the first time by Blanc (1939b), that opens in front of *Antro dell'Uomo* (Figure 1) and was never investigated before. The *Antro del Laghetto* has a maximum length of 9.93 m along the NE-SW axis and is narrow in width, from 0.75 to 3.60 m. The excavation, divided in seven "areas", brought back to light a paleosurface (Layer 1), correlatable with that investigated elsewhere since the 1939s, followed by two layers (Layer 2 and Layer 3) and a further layer with several lithic artifacts, although it has only been partially investigated at present (ongoing study by Rolfo and colleagues). The *Antro dell'Uomo* and *Vano Principale* paleosurface was dated 52 ± 12 ky BP (Belluomini *et al*., 1990) and 51 ± 3 ky BP

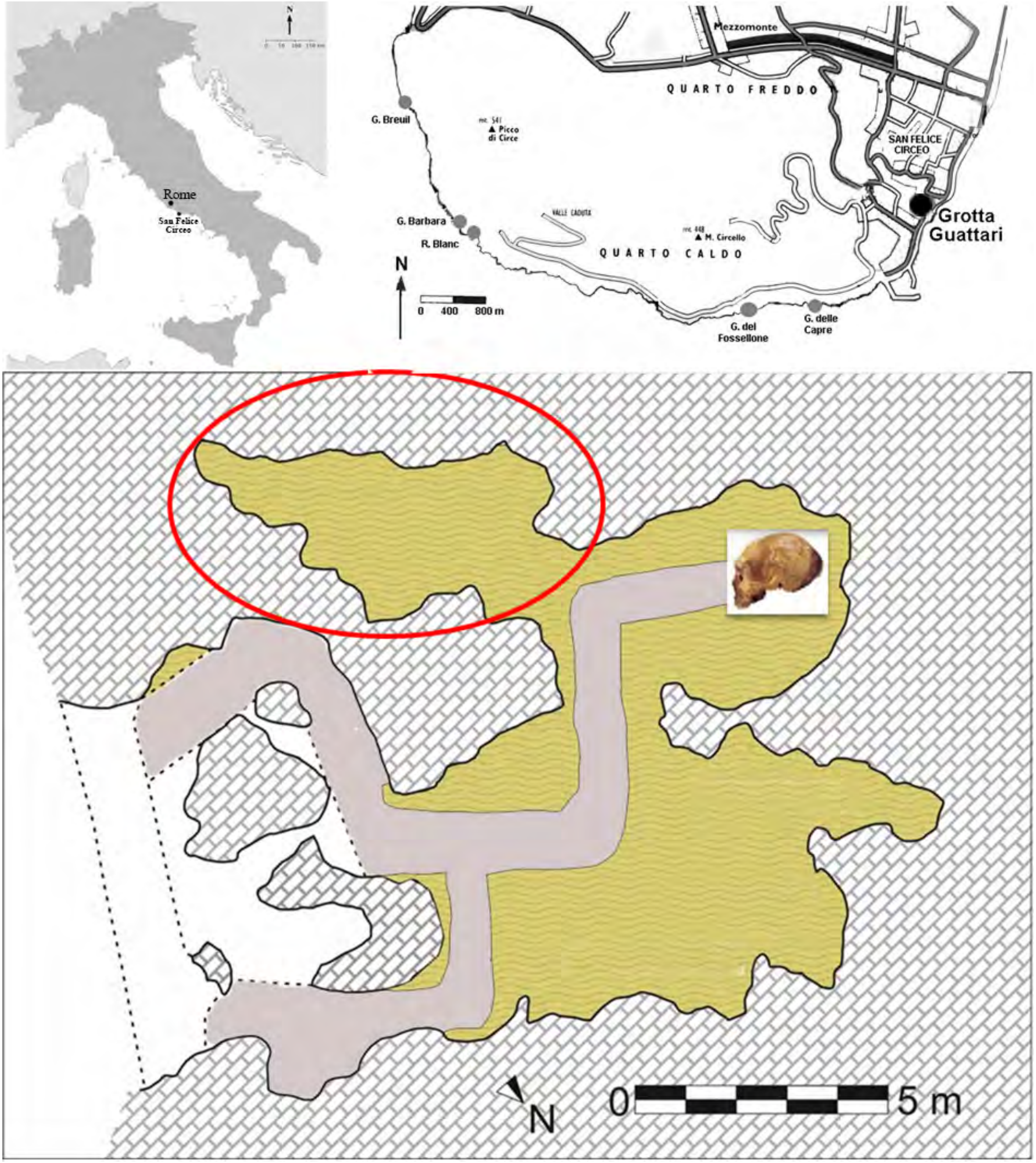

FIGURE 1

Geographical location of the site (up) and plan of Grotta Guattari (down; after Blanc, 1939, modified). In ocher the paleosurface today (the little skull indicates the position of the Neanderthal cranium discovered in 1939), in gray the archaeological trenches by A.C. Blanc and L. Cardini; the red ellipse highlights the *Antro del Laghetto*.

(Schwarcz *et al*., 1991). Therefore, the two hyena layers of *Antro del Laghetto* should be a little older and referable to the final stages of the Marine Isotope Stage (MIS) 4 (as supported by geological studies and radiometric dating; Rolfo *et al*., 2023). The paleosurface contained only a few fossil remains. The two underlying layers have yielded a large amount of faunal remains, of which over 1300 have been taxonomically determined, and around one hundred hyena coprolites. Moreover, several bones and teeth of *Homo neanderthalensis* have been identified. Layer 2 is 30 to 80 cm thick and is predominantly sandy with small rounded limestone pebbles and many faunal remains; Layer 3 is on average 20 cm thick and it is characterized by a greater presence of clasts, patches of greyish compact sediment, calcareous concretions and very fragmented faunal finds (ongoing study by Rolfo and colleagues).

The aim of this work is to describe the new faunal data from Layer 2 and Layer 3 of the *Antro del Laghetto* at Grotta Guattari, and discuss in a preliminary way its climate and environmental implications.

MATERIAL AND METHODS

The faunal remains are stored within a warehouse-laboratory in the town-hall building of San Felice Circeo. A large percentage of the fossil remains is covered by carbonate concretion, particularly on the bones close to the paleosurface but also on many of those recovered from the lower part of the deposit. This did not hinder the anatomical and taxonomic classification but sometimes prevented accurate measurements and taphonomic observations (see Fiore *et al*., this volume). Fragments of ribs and vertebrae and many fragments of long bones, although anatomically identified but not taxonomically determined, were counted among the indeterminate. The ages of death were estimated according to the stage of fusion of the long bone epiphyses, and tooth eruption, replacement and wear stages; the tables and observations of Barone (1974, 1981) and Grant (1982) for present-day domestic cattle and horses (as a proxy for *B. primigenius* and *E. ferus*), Bull & Payne (1982) for *Sus scrofa*, Mariezkurrena (1983) for *C. elaphus* and Brugal *et al*. (1997) for *Crocuta spelaea*, were taken into account. The Minimum Number of Individuals (MNI) was calculated following Bökönyi (1970); fallen antlers and fragment antlers of cervids were not considered. The measurements were taken with a standard calliper according to Driesch (1976). The wither heights were estimated by the coefficients of Kiesewalter (1888) for horse, Teichert (1969) for wild boar, Matolcsi (1969) for auroch and those reported by Wilkens (1989) for red deer.

The environmental reconstruction is based on the ecology and biogeographical distribution of the species found (see below). Moreover, this work tentatively proposes the habitat weighting method, already used for detailed environmental reconstructions based on small mammals (e.g., López-García *et al*., 2014; Salari *et al*., 2019c).

RESULTS AND DISCUSSION

Over 9000 fossil remains were examined of which about 14.5% were taxonomically determined (Table 1). The most frequent species is *C. elaphus*, followed by *C. spelaea* and *B. primigenius*, both in terms of number of identified specimens and MNI (Tables 1 and 2). Both *E. ferus* and *S. scrofa* are also abundant, while the other *taxa* are less represented and some, that occur only with 1-5 remains, can be considered rare. All the *taxa* described in previous studies have been found, with the exception of the hippopotamus and the European polecat. Moreover, a few species never identified before, such as *Felis silvestris*, *Panthera spelaea*, *Equus hydruntinus* and *Rupicapra* sp. have also been discovered (Petronio *et al*., 2021; Supplementary material: Table 4).

Most of the remains refer to adult individuals, while young individuals are very scarce. However, it can be noted that *C. spelaea* is also represented by an important percentage of old individuals, while *Palaeoloxodon antiquus* occurs only with a few cubs or very young individuals (Table 2).

The wither heights were calculated whenever possible. These were found to be between 140.2 and 151.4 cm (mean 145.1 cm) for *E. ferus*, 102.7 cm for *S. scrofa*, between 112.6 and 124.2 cm (mean 119.4 cm) for *C. elaphus*, and between 143.9 and 179.3 cm (mean 159.1 cm) for *B. primigenius* (Supplementary material: Table 5). These wither heights are among the greatest for these species in the Late Pleistocene of Italy (Conti *et al*., 2010; Pandolfi *et al*., 2011; Di Stefano *et al*., 2015; Salari *et al*., 2019b). Even *C. spelaea* from Grotta Guattari is represented by large-size specimens. The length of the upper carnassial (P4) is between 37.6 and 44.0 mm (mean 40.6 mm), that of the lower carnassial (m1) is between 29.2 and 34.2 mm (mean 31.1 mm), generally larger than the living spotted hyena and the Late Pleistocene cave hyena from nearby sites such as Cava Muracci and La Sassa and among the largest of Western Europe (Testu, 2006; Gatta *et al*., 2019, 2022; Iannucci *et al*., 2021; Lewis & Werdelin, 2022).

A large part of the examined remains shows signs of gnawing by a large carnivore, plausibly the cave hyena, including some human bones and of the

Taxon	L. 2		L. 3		Total	
	NR	%	NR	%	NR	%
Testudinata			1	0,2	1	0,1
Aves	3	0,4			3	0,2
Lepus sp.	5	0,6	1	0,2	6	0,4
Canis lupus	7	0,9	3	0,6	10	0,7
Vulpes vulpes	15	1,8	7	1,3	22	1,6
Ursus spelaeus			3	0,6	3	0,2
Ursus arctos	11	1,3	19	3,7	30	2,2
Mustelidae	1	0,1			1	0,1
Felis silvestris	2	0,2			2	0,1
Panthera spelaea	1	0,1	1	0,2	2	0,1
Panthera pardus	3	0,4			3	0,2
Crocuta spelaea	163	19,9	125	24,0	288	21,5
Palaeoloxodon antiquus	2	0,2	5	1,0	7	0,5
Elephantidae	8	1,0			8	0,6
Stephanorhinus cf. S. *hemitoechus*	2	0,2	1	0,2	3	0,2
Rhinoceratidae	5	0,6			5	0,4
Equus ferus	55	6,7	25	4,8	80	6,0
Equus hydruntinus			8	1,5	8	0,6
Sus scrofa	55	6,7	39	7,5	94	7,0
Megaloceros giganteus	37	4,5	14	2,7	51	3,8
Cervus elaphus	230	28,1	113	21,7	343	25,6
Dama dama	40	4,9	20	3,8	60	4,5
Capreolus capreolus	2	0,2	4	0,8	6	0,4
Cervidae	30	3,7	33	6,3	63	4,7
Bos primigenius	135	16,5	98	18,8	233	17,4
Capra ibex	3	0,4			3	0,2
Rupicapra sp.	1	0,1			1	0,1
Caprinae	3	0,4			3	0,2
Total identified specimens	819	100	520	100	1339	100
Identified specimens	819	18,9	520	10,5	1339	14,4
Indeterminate bones	3513	81,1	4443	89,5	7956	85,6
TOTAL	4332	100	4963	100	9295	100

TABLE 1

Grotta Guattari (San Felice Circeo, Latium, Italy): number of remains (NR); L.: Layer.

same *C. spelaea*, and several fallen cervid antlers are severely crunched (Fiore *et al*., this volume). This evidence, together with the high taxonomic diversity with most of the adult individuals among the ungulates and abundant *C. spelaea* remains and the occurrence of numerous cave hyena coprolites (see Stiner, 1990; Piperno & Giacobini, 1991; Diedrich, 2012; Gatta *et al*., 2019, 2022), suggest that *C. spelaea* was the main agent of bone accumulation.

The distribution of skeletal elements of the main ungulates (Table 3) shows that most belong to the extremities (carpal and tarsal bones, metacarpus, metatarsus and phalanges) followed by the skull. This, particularly for the teeth and the small bones of the carpus and tarsus, can be attributed to their compact and resistant structure and consequently to their recognizability (see Marean 1991). However, the limb bones are also well represented, particularly the forelimb. These distributions of skeletal elements, together with the abundance of cervid fallen antlers and the low survival rate, except for the humerus of *S. scrofa* and the metatarsus

Taxon	Layer 2							Layer 3						
	MNI	%	vy	y	ya	a	o	MNI	%	vy	y	ya	a	o
Lepus sp.	2	2,4				2		1	1,7				1	
Canis lupus	1	1,2				1		1	1,7				1	
Vulpes vulpes	3	3,6				3		1	1,7				1	
Ursus spelaeus								1	1,7				1	
Ursus arctos	3	3,6		1		2		2	3,4				2	
Mustelidae	1	1,2				1								
Felis silvestris	1	1,2				1								
Panthera spelaea	1	1,2				1		1	1,7				1	
Panthera pardus	1	1,2				1								
Crocuta spelaea	14	16,7	1		1	7	5	12	20,3	1	1		7	3
Palaeoloxodon antiquus	1	1,2	1					2	3,4	2				
Elephantidae	1	1,2				1								
Stephanorhinus cf. S. *hemitoechus*	2	2,4		1		1		1	1,7				1	
Rhinoceratidae	1	1,2				1								
Equus ferus	6	7,2		1		5		3	5,2		1	1	1	
Equus hydruntinus								2	3,4				2	
Sus scrofa	7	8,4		2		4	1	5	8,6	1	1		3	
Megaloceros giganteus	4	4,8				4		1	1,7				1	
Cervus elaphus	15	18,1		3	1	9	2	13	22,4		2		10	1
Dama dama	4	4,8				4		2	3,4				2	
Capreolus capreolus	1	1,2				1		2	3,4				2	
Bos primigenius	11	13,3	1	2		7	1	8	13,8		1	1	5	1
Capra ibex	1	1,2				1								
Rupicapra sp.	1	1,2				1								
Caprinae	1	1,2	1											
TOTAL	83	100	4	10	2	58	9	58	100	4	6	2	41	5

TABLE 2

Grotta Guattari (San Felice Circeo, Latium, Italy): minimum number of individuals (MNI); vy: very young; y: young; ya: young-adult; a: adult; o: old.

of *C. elaphus* (Supplementary material: Table 6), suggest that the cave hyena has mainly introduced portions of carcasses or single anatomical elements of preyed or scavenged animals within the cave.

Although there has been a selection by the cave hyena, the ecological features of the *taxa* found and their percentages, particularly of the ungulates (Tables 1 and 2), provide some useful indications to preliminary reconstruct the environmental landscape and the climate of Circeo Promontory during the final phases of MIS 4.

Among the ungulates, the wild boar prefers woods and wetlands, the red deer is particularly common in open woods with large grassy clearings, the fallow deer preferably lives in sparse woods or Mediterranean scrub, the roe deer is a typically woody species preferring hardwood forests rich of brushwood and clearings, while *M. giganteus* and *P. antiquus* seem to have frequented different environments with a predilection for woods and forests near water bodies (Boitani *et al.*, 2003; Petronio *et al.*, 2014; Callaway, 2016). The chamois attend coniferous and hardwood woody areas with rich brushwood spaced by rocky walls and stony zones, alpine prairies, bare patches and grassy ledges, the ibex prefers open and arid spaces and rocky mountain areas, while the aurochs preferred open forest or grasslands with woods rich of glades (Boitani *et al.*, 2003; Pandolfi *et al.*, 2011). *Equus ferus*, *E. hydruntinus* and *Stephanorhinus hemitoechus* prefer open environments like steppes and grassland (Conti *et al.*, 2010; Pandolfi *et al.*, 2011; Salari & Masseti, 2016). The Italic hare is a species adapted to

Skeletal elements	*Crocuta spelaea*		*Equus ferus*		*Sus scrofa*		*Cervus elaphus*		*Bos primigenius*	
	L. 2	L. 3	L. 2	L. 3	L. 2	L. 3	L. 2	L. 3	L. 2	L. 3
Horn/Antler							47	23	2	3
Skull	12	6	2				5	3	1	
Maxillary	5	6	2		4	1		2		
Upper teeth	39	37	8	5	9	7	11	10	9	12
Mandible	17	9			4	3			5	3
Lower teeth	52	51	9	8	10	16	16	4	5	7
Indeterminate teeth	3	2								
Atlas	4									
Axis	1	2							2	
Vertebrae	8	3					7	6	10	2
Scapula					1		2	3	7	4
Humerus	1				13	7	12	1	12	7
Radius			1		3		17	7	15	5
Ulna	9	1	2			1	2	1	3	2
Carpal bones			1	3		1	4	2	5	6
Metacarpus		3	6	2	2	1	16	9	10	11
Pelvis		1			1		2		1	3
Femur	3		1			1	2	1	5	4
Patella		2								1
Tibia	2		1		1		14	7	6	1
Fibula										
Malleolar bone							1			2
Talus			2	1		1	8	3	6	6
Calcaneus			3	1			10	5	6	4
Tarsal bones	1		2				5	6	6	4
Metatarsus	2	1	6	1			28	12	9	7
Metapodial bones			5	2	1		18	5		2
Sesamoids							1			
Phalanx I	1		3	1	3		1	2	6	1
Phalanx II	3	1		1	2		1	1	4	1
Phalanx III			1		1					
TOTAL	163	125	55	25	55	39	230	113	135	98

TABLE 3

Grotta Guattari (San Felice Circeo, Latium, Italy): distribution of anatomical elements of *Crocuta spelaea* and the main ungulates; L.: Layer.

live in several environments but seems to prefer shrubby dry areas and prairie alternated to hardwood forest with large grassy clearings; instead, the European hare has rather open habitats like grassland and steppe (Amori *et al*., 2008). About the carnivores, wild cat and brown bear prefer woodland areas near water sources, while wolves and foxes are animals adapted to a variety of environments generally settling the den in woodlands with gorges and stony zones (Boitani *et al*., 2003). Cave lion and cave hyena seem to have frequented different environments, with a predilection for open spaces, like the extant lion and spotted hyena of the savannah, while the leopard adapts to evergreen forests, savannas, woods, rocky hills and swamps (Dorst & Dandelot, 1988).

Therefore, it is plausible that the landscape surrounding the cave was mostly covered with wood and forests with large clearings alternating to open spaces with steppe and grassland, marginal rocky areas in the highest part of the promontory and probably coastal wetlands.

The habitat weighting method can be useful to reconstruct the environmental variations of the Circeo Promontory during the final stages of MIS 4.

Taking into account the weighted partition of the habitats frequented by the ungulates (Supplementary material: Table 7) and their percentage variations in the two layers (Supplementary material: Table 8), it seems that between Layer 2 and Layer 3 there were only small differences in the landscape. Indeed, it can be seen that when Layer 2 was deposited the environment was less wooded and with a little more wetlands and rocky areas than at the time of Layer 3 (Figure 2).

Although sporadic, the occurrence of chamois and ibex, together with the clear dominance of the red deer over the fallow deer and the occurrence of *M. giganteus*, that reached central and southern Italy only in the colder phases of the Late Pleistocene (Petronio *et al*., 2014), suggests that the faunal deposit of Grotta Guattari was accumulated in colder conditions than the present, as confirmed by pollen analyses and radiometric dating (Rolfo *et al*., 2023). Given that ibex and chamois appear only in Layer 2 and that *M. giganteus* occurs in this same layer with a higher percentage than in Layer 3, it can be assumed that at the time of deposition of Layer 2 the climate was a little colder than at the time of Layer 3.

CONCLUSIONS

The recent excavation of the *Antro del Laghetto* in Grotta Guattari confirmed the widespread presence of *H. neanderthalensis* in the Circeo Promontory. About 9300 faunal remains, of which over 1300 taxonomically determined, have been analyzed. At least 25 *taxa* have been recognized, including some (i.e., *Felis silvestris*, *Panthera spelaea*, *Equus hydruntinus* and *Rupicapra* sp.) not identified during previous investigations of the site. The cave hyena was probably the main accumulation agent of faunal remains. The most abundant species are *C. elaphus*, *C. spelaea* and *B. primigenius*, followed by *S. scrofa* and *E. ferus*; all these species were relatively large in size. The ecological features of the *taxa* suggest that the environment surrounding the cave plausibly was mainly forested with large open spaces, wetlands and steep rocky areas. The occurrence of chamois, ibex and *M. giganteus* and the clear dominance of the red deer over the fallow deer suggest that the faunal remains were accumulated in colder times than the present day. Finally, the analysis of the faunal remains made it possible to record a cold oscillation in the final stages of MIS 4. The mammal assemblage from Layer 2 indicates

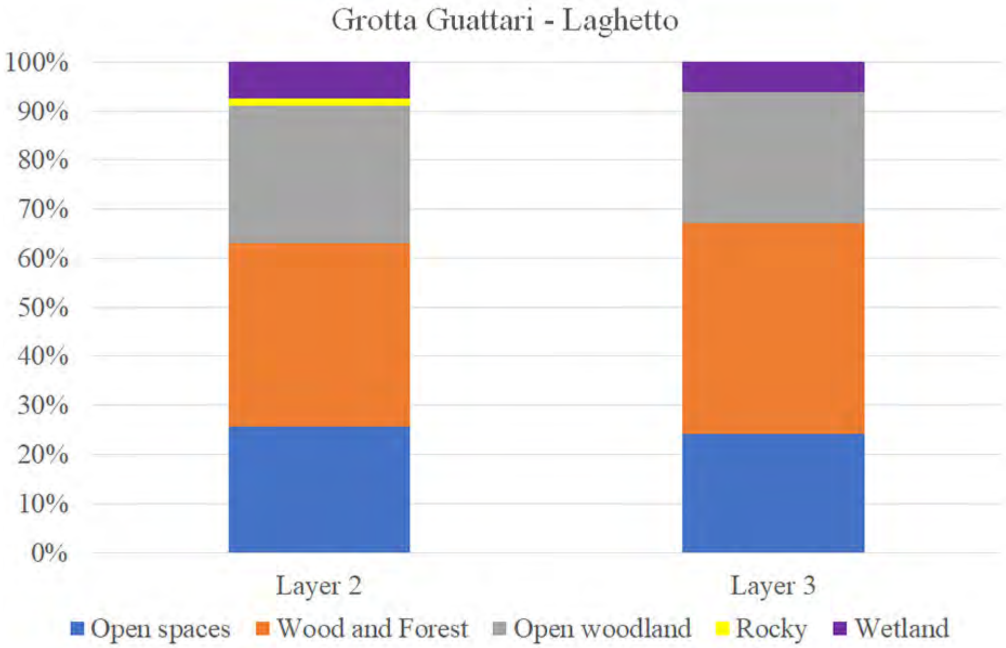

FIGURE 2

Grotta Guattari (San Felice Circeo, Latium, Italy): percent ratio of the ungulates from Layer 2 and Layer 3 according to the partition of the habitats (see Supplementary material: Tables 7 and 8).

that probably the climate was a little colder and the environment less forested in the Circeo Promontory than at the time of Layer 3.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_005

REFERENCES

ALHAIQUE, F. & TAGLIACOZZO, A. 2000: L'interpretazione dei dati faunistici nella ricostruzione delle strategie di sussistenza nel Paleolitico medio: l'esempio del Lazio. *Atti del 2° Convegno Nazionale di Archeozoologia, Asti 1997*: 111-124, Forlì.

AMORI, G.; CONTOLI, L. & NAPPI, A. 2008: *Fauna d'Italia. Mammalia II*. Calderini de Il Sole 24 Ore, Milano.

BARONE, R. 1974: *Anatomia comparata dei Mammiferi domestici. 1, Osteologia* (ed. it. a cura di R. Bortolami). Edagricole, Bologna.

— 1981: *Anatomia comparata degli Mammiferi domestici. 3, Splancnologia*. (ed. it. a cura di R. Bortolani). Edagricole, Bologna.

BELLUOMINI, G.; BRANCA, M. & CARTONI, G. 1990: Amino acid racemization dating of Guattari Cave and its underlying marine deposit. In: AA.VV.: *The Circeo 1 Neanderthal skull. Studies and documentations. Museo Nazionale Preistorico Etnografico Pigorini*: 495-500. Roma.

BLANC, A.C. 1939a: L'uomo fossile del Monte Circeo: un cranio neandertaliano nella Grotta Guattari a S. Felice Circeo. *Rivista di Antropologia* 32: 287-308.

– 1939b: I giacimenti pleistocenici le grotte e l'uomo fossile del Monte Circeo. *Materie Prime d'Italia e dell'Impero* 7-8: 2-23.

– 1942: I Paleantropi di Saccopastore e del Circeo. I giacimenti, le industrie, correlazione geocronologica. *Quartär* 4 : 1-37.

BLANC, A.C. & SEGRE, A.G. 1953 : *Excursion au Mont Circé*. Livret-guide au IV^e Congrès International INQUA, Roma/Pisa.

BOITANI, L.; LOVARI, S. & VIGNA TAGLIANTI, A. 2003: *Fauna d'Italia. Mammalia III. Carnivora - Artiodactyla*. Calderini, Bologna.

BÖKÖNYI, S. 1970: A new method for the determination of the number of individuals in animal bones material. *American Journal of Archaeology* 74: 291-292.

BRUGAL, J.P.; FOSSE, P. & GUADELLI, J.L. 1997: Comparative study of bone assemblages made by recent and Pleistocene Hyenids. *Proceeding of the 1993 Bone Modification Conference Hot Springs, South Dakota*: 158-187.

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphysal fusion in Pigs and Wild Boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-71. B.A.R. (British Series) 109. Oxford.

CALLAWAY, E. 2016: Elephant history rewritten by ancient genomes. *Nature* 2016-09-16. doi:10.1038/nature.2016.20622.

CONTI, N.; PETRONIO, C. & SALARI, L. 2010: The Late Pleistocene equids from "Tana delle Iene" (Ceglie Messapica, Brindisi, Southern Italy). *Bollettino della Società Paleontologica Italiana* 49: 227-236.

DIEDRICH, C. 2012: An Ice Age spotted hyena *Crocuta crocuta spelaea* (Goldfuss 1823) population, their excrements and prey from the Late Pleistocene hyena den of the Sloup Cave in the Moravian Karst, Czech Republic. *Historical Biology* 24: 161-185.

DI STEFANO, G.; PANDOLFI, L.; PETRONIO, C. & SALARI, L. 2015: Considerations on the morphometry and the occurrence of *Cervus elaphus* (Mammalia, Cervidae) from the Late Pleistocene of the Italian Peninsula. *Rivista Italiana di Paleontologia e Stratigrafia* 121: 1-18.

DORST, J. & DANDELOT, P. 1988: *A field guide to the large mammals of Africa*. Collins, London.

DRIESCH, A. von den 1976: A guide to the measurement of animal bones from archaeological sites. *Peabody Museum Bulletin* 1. Harvard University, Cambridge, Massachusetts.

FIORE, I.; CERULEO, P.; DI MARIO, F.; FERRACCI, A.; GATTA, M.; PETRONIO, C.; SALARI, L. & ROLFO, M.F. this volume: Nuovi scavi a Grotta Guattari. Uomo e carnivori: le prede e le tracce sulle superfici ossee. *Atti del 10° Convegno Nazionale di ArcheoZoologia*, Siena, 3-6 novembre 2021.

GATTA, M.; KOTSAKIS, T.; PANDOLFI, L.; PETRONIO, C.; SALARI, L.; ACHINO, K.F.; SILVESTRI, L. & ROLFO, M.F. 2019: The Late Pleistocene faunal assemblage from Cava Muracci (Latium, Italy): Palaeoecological implications for coastal central Italy during MIS 3. *Comptes Rendus Palevolution* 18: 51-71.

GATTA, M.; FIORILLO, A.; SALARI, L.; ACHINO, K.F.; ROLFO, M.F. & ALESSANDRI, L. 2022: The faunal assemblage from La Sassa cave (Latium, Italy): Environmental perspective of a Late Pleistocene cave hyena – brown bear den. *Journal of Archaeological Science: Reports* 46(103691): 1-15.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

IANNUCCI, A.; MECOZZI, B.; SARDELLA, R. & IURINO, D.A. 2021: The extinction of the giant hyena *Pachycrocuta brevirostris* and a reappraisal of the Epivillafranchian and Galerian Hyaenidae in Europe: Faunal turnover during the Early-Middle Pleistocene Transition. *Quaternary Science Reviews* 272(107240): 1-22.

KIESEWALTER, L. 1888: *Skelettmessungen an Pferden als Beitrag zur theoretischen Grundlage der Beurteilungslehre des Pferdes*. Diss. Leipzig.

LEWIS, M.E. & WERDELIN, L. 2022: A revision of the genus *Crocuta* (Mammalia, Hyaenidae). *Palaeontographica, Abteilung A: Palaeozoology - Stratigraphy* 322: 1-115.

LÓPEZ-GARCÍA, J.M.; BERTO, C.; COLAMUSSI, V.; DALLA VALLE, C.; LO VETRO, D.; LUZI, E.; MALAVASI, G.; MARTINI, F. & SALA, B. 2014: Palaeoenvironmental and palaeoclimatic reconstruction of the latest Pleistocene-Holocene sequence from Grotta del Romito (Calabria, southern Italy) using the small-mammal assemblages. *Palaeogeography, Palaeoclimatology, Palaeoecology* 409: 169-179.

MAREAN, C.W. 1991: Measuring the post-depositional destruction of bone in archaeological assemblages, *Journal of Archaeological Science* 18: 677-694.

MARIEZKURRENA, K. 1983: Contribución al conocimiento del desarollo de la dentici*ón y el esqueleto postcraneal de Cervus elaphus*. *Munibe* 35: 149-202.

MATOLCSI, J. 1969: Historesche Erforschung der Köpergrösse des Rindes auf Grund von ungarischen Knochen Material. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 87: 89-137.

PANDOLFI, L.; PETRONIO, C. & SALARI, L. 2011: *Bos primigenius* Bojanus, 1827 from the Early Late Pleistocene Deposit of Avetrana (Southern Italy) and the Variation in Size of the Species in Southern Europe: Preliminary Report. *Journal of Geological Research* 2011, ID 245408, doi:10.1155/2011/245408

PETRONIO, C.; DI STEFANO, G.; PANDOLFI, L. & SALARI, L. 2014: The Late Pleistocene mammal fauna from Montemerano - Manciano (Grosseto, central Italy). *Bollettino del Museo Civico di Storia Naturale di Verona* 38 (Geologia Paleontologia Preistoria): 103-116.

PETRONIO, C.; ROLFO, M.F.; CERULEO, P.; DI MARIO, F.; FERRACCI, A.; FIORE, I.; GATTA, M. & SALARI, L. 2021: Preliminary report on the new faunal remains from Grotta Guattari (Late Pleistocene, San Felice Circeo, Latium). *Bulletin of Regional Natural History* 1(4): 29-38.

PIPERNO, M. & GIACOBINI, G. 1991: A taphonomic study of the paleosurface of Guattari Cave (Monte Circeo, Latina, Italy). *Quaternaria Nova* 1 (1990/91): 143-161.

ROLFO, M.F.; BINI, M.; DI MARIO, F.; FERRACCI, A.; GIACCIO, B.; HSUN-MING, H.; ISOLA, I.; SADORI, L; SHEN, C.C.; VIGNOLA, C. & ZANCHETTA, G. 2023: Neanderthal bones collected by hyena at Grotta Guattari, central Italy, 66-65 ka: U/Th chronology and paleoenvironmental setting. *Quaternary Science Reviews* 311 (108132): 1-15. DOI: https://doi.org/10.1016/j.quascirev.2023.108132.

SALARI, L. & MASSETI, M. 2016: Attardamenti olocenici di *Equus hydruntinus* Regalia, 1907 in Italia. In: Thun Hohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Convegno Nazionale di Archeozoologia*, Annali dell'Università degli Studi di Ferrara - Museologia Scientifica e Naturalistica, 12(1): 313-320.DOI: http://dx.doi.org/10.15160/1824-2707/1310.

SALARI, L.; CERULEO, P.; PANDOLFI, L.; PETRONIO, C. & MARRA, F. 2019a: Una nuova età nel MIS 7 per la fauna di Saccopastore (bassa valle dell'Aniene, Roma). In: De Grossi Mazzorin, J.; Minniti, C. & Fiore, I. (eds.): *Atti dell'8° Convegno Nazionale di Archeozoologia, Lecce 11-14 novembre 2015*: 13-20.

SALARI, L.; PETRONIO, C.; KOTSAKIS, T.; DI STEFANO, G.; GROSSI, F.; MAIORINO, L.; PANDOLFI, L.; ROLFO, M.F.; RUIU, F.D.; SANSALONE, G. & TAGLIACOZZO, A. 2019b: Reassessing the faunal assemblages of the Late Pleistocene stratified karst filling from Avetrana (Apulia, southern Italy): the bed 8, palaeoenvironment and biochronology. *Alpine and Mediterranean Quaternary* 32: 101-115.

SALARI, L.; ROLFO, M.F. & SILVESTRI, L. 2019c: I micromammiferi di Grotta Mora Cavorso (alta valle dell'Aniene, Lazio) tra Pleistocene Superiore e Olocene. Nota preliminare. In: De Grossi Mazzorin, J.; Minniti, C. & Fiore, I. (eds.): *Atti dell'8° Convegno Nazionale di Archeozoologia, Lecce 11-14 novembre 2015*: 37-44.

SCHWARCZ, H.P.; BUHAY, W.; GRÜN, R.; STINER, M.; KUHN, S. & MILLER, G.H. 1991: Absolute dating of sites in coastal Lazio. *Quaternaria Nova* 1 (1990/91): 51–67.

SERGI, S. & ASCENZI, A. 1955: La mandibola neandertaliana Circeo III (mandibola B). *Rivista di Antropologia* 42: 337-403.

STINER, M.C. 1990: The use of mortality patterns in Archaeological studies of hominid predatory adaptations. *Journal of Anthropological Archaeology* 9: 305-351.

— 1991a: The Guattari faunas then and now. *Quaternaria Nova* 1 (1990/91): 163-192.

— 1991b: The faunal remains from Grotta Guattari: a taphonomic perspective. *Current Anthropology* 32: 103-117.

TASCHINI, M. 1979 : L'industrie lithique de Grotta Guattari au Mont Circé (Latium): définition culturelle, typologique et chronologique du Pontinien. *Quaternaria* 21: 179-247.

TEICHERT, M. 1969: Osteometrische Untersuchumgen zur Berechnung der Widerristhöhe bei vor- und frühgeschichtlichen Schweinen. *Kühn-Archiv* 83: 237-292.

TESTU, A. 2006 *: Etude paléontologique et biostratigraphique des Felidae et Hyaenidae pléistocènes de l'Europe méditerranéenne*. Université de Perpignan, France.

WILKENS, B. 1989: Il cervo dal Mesolitico all'Età del Bronzo nell'Italia centro-meridionale. *Rassegna di Archeologia* 8: 63-95.

SUPPLEMENTARY MATERIAL

Previous works	*Antro del Laghetto*
Lepus europaeus	*Lepus* sp.
Canis lupus	*Canis lupus*
Vulpes vulpes	*Vulpes vulpes*
Ursus spelaeus	*Ursus spelaeus*
Ursus sp. cf. arctos	*Ursus arctos*
Putorius putorius	
	Mustelidae
	Felis silvestris
	Panthera spelaea
Felis pardus	*Panthera pardus*
Hyaena crocuta spelaea	*Crocuta spelaea*
Elephas antiquus	*Palaeoloxodon antiquus*
Rhinoceros Merckii	*Stephanorhinus* cf. *S. hemitoechus*
	Rhinoceratidae
Equus caballus	*Equus ferus*
	Equus hydruntinus
Hippopotamus amphibius	
Sus scropha	*Sus scrofa*
Giant deer	*Megaloceros giganteus*
Capreolus capreolus	*Capreolus capreolus*
Cervus elaphus	*Cervus elaphus*
Dama dama	*Dama dama*
	Cervidae
Bos primigenius	*Bos primigenius*
Capra ibex	*Capra ibex*
	Rupicapra sp.
	Caprinae

TABLE 4

Large mammals (Lagomorphs, Carnivores, Proboscideans, Perissodactyls and Artiodactyls) from Grotta Guattari (Latium, Late Pleistocene) according to Blanc & Segre (1953), Stiner (1994) and this work (by Petronio *et al*. 2021, updated).

n.	skeletal element species	wither height
	Equus ferus	
862	metatarsus III	140.2
931	metacarpus III	141.7
995	metacarpus III	141.7
2347	metacarpus III	142.3
892	metacarpus III	144.2
2138	metacarpus III	148.7
US 20	metacarpus III	150.6
824	metatarsus III	151.4
	mean	145.1
	Sus scrofa	
2304	metacarpus IV	102.7
	Cervus elaphus	
485	metatarsus	112.6
592	metatarsus	115.5
US 20	calcaneus	117.6
871	calcaneus	117.6
2176	metacarpus	120.1
916	metacarpus	121.9
2478	calcaneus	122.1
846	calcaneus	122.6
US 54	calcaneus	124.2
	mean	119.4
	Bos primigenius	
525	metatarsus	143.9
542	metatarsus	146.6
530	metacarpus	151.4
4037	metacarpus	152.6
4014	metacarpus	154.5
840	metatarsus	156.4
2154	metatarsus	156.4
3775	metacarpus	157.6
606	metatarsus	161.9
711	metacarpus	166.9
2449	metatarsus	167.4
548	radius	172.9
660	radius	179.3
	mean	159.1

TABLE 5

Grotta Guattari (Latium, Late Pleistocene): Wither height of the main ungulates, according to the coefficients of Kiesewalter (1888) for horse, Teichert (1969) for wild boar, Matolcsi (1969) for auroch and those reported by Wilkens (1989) for red deer.

	Equus ferus		*Sus scrofa*		*Cervus elaphus*		*Bos primigenius*	
	L. 2	L. 3	L. 2	L. 3	L. 2	L. 3	L. 2	L. 3
Humerus	0,00	0,00	0,93	0,70	0,40	0,04	0,55	0,44
Radius	0,08	0,00	0,21	0,00	0,57	0,27	0,68	0,31
Ulna	0,17	0,00	0,00	0,10	0,07	0,04	0,14	0,13
Metacarpus	0,50	0,33	0,07	0,05	0,53	0,35	0,45	0,69
Femur	0,08	0,00	0,00	0,10	0,07	0,04	0,23	0,25
Tibia	0,08	0,00	0,07	0,00	0,47	0,27	0,27	0,06
Metatarsus	0,50	0,08	0,00	0,00	0,93	0,46	0,41	0,44

TABLE 6

Grotta Guattari (Latium, Late Pleistocene): Survival rate (minimum number of elements / number of expected elements) of the main ungulate long bones; L.: Layer.

Taxon	Open spaces	Wood and forest	Open woodland	Rocky	Wetland
P. antiquus	0.20	0.40	0.20		0.20
S. hemitoechus	0.70	0.10	0.20		
E. ferus	1.00				
E. hydruntinus	1.00				
S. scrofa		0.30	0.30		0.40
M. giganteus	0.20	0.20	0.30		0.30
C. capreolus		1.00			
C. elaphus		0.75	0.25		
D. dama		0.25	0.75		
B. primigenius	0.40	0.30	0.30		
C. ibex	0.50			0.50	
Rupicapra sp.	0.33	0.33		0.33	

TABLE 7

Grotta Guattari (Latium, Late Pleistocene): Distribution by habitat of the ungulates. Data from Dorst & Dandelot (1988), Boitani *et al.* (2003), Amori *et al.* (2008), Conti *et al.* (2010), Pandolfi *et al.* (2011), Petronio *et al.* (2014), Callaway (2016), Salari & Masseti (2016) and references therein.

Taxon	Layer 2		Layer 3	
	MNI	%	MNI	%
P. antiquus	1	1.89	2	5.13
S. hemitoechus	2	3.77	1	2.56
E. ferus	6	11.32	3	7.69
E. hydruntinus			2	5.13
S. scrofa	7	13.21	5	12.82
M. giganteus	4	7.55	1	2.56
C. capreolus	1	1.89	2	5.13
C. elaphus	15	28.30	13	33.33
D. dama	4	7.55	2	5.13
B. primigenius	11	20.75	8	20.51
C. ibex	1	1.89		
Rupicapra sp.	1	1.89		
Total	53	100	39	100

TABLE 8
Grotta Guattari (Latium, Late Pleistocene): Percent ratio among the ungulates, according to the minimum number of individuals (MNI).

REFERENCES

AMORI, G.; CONTOLI, L. & NAPPI, A. 2008: *Fauna d'Italia. Mammalia II*. Calderini de Il Sole 24 Ore, Milano.

BLANC, A.C. & SEGRE, A.G. 1953 : *Excursion au Mont Circé*. Livret-guide au IV^e Congrès International INQUA, Roma/Pisa.

BOITANI, L.; LOVARI, S. & VIGNA TAGLIANTI, A. 2003: *Fauna d'Italia. Mammalia III. Carnivora - Artiodactyla*. Calderini, Bologna.

CALLAWAY, E. 2016: Elephant history rewritten by ancient genomes. *Nature* 2016-09-16. doi:10.1038/nature.2016.20622.

CONTI, N.; PETRONIO, C. & SALARI, L. 2010: The Late Pleistocene equids from "Tana delle Iene" (Ceglie Messapica, Brindisi, Southern Italy). *Bollettino della Società Paleontologica Italiana* 49: 227-236.

DORST, J. & DANDELOT, P. 1988: *A field guide to the large mammals of Africa*. Collins, London.

KIESEWALTER, L. 1888: *Skelettmessungen an Pferden als Beitrag zur theoretischen Grundlage der Beurteilungslehre des Pferdes*. Diss. Leipzig.

MATOLCSI, J. 1969: Historesche Erforschung der Köpergrösse des Rindes auf Grund von ungarischen Knochen Material. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 87: 89-137.

PANDOLFI, L.; PETRONIO, C. & SALARI, L. 2011: *Bos primigenius* Bojanus, 1827 from the Early Late Pleistocene Deposit of Avetrana (Southern Italy) and the Variation in Size of the Species in Southern Europe: Preliminary Report. *Journal of Geological Research* 2011, ID 245408, doi:10.1155/2011/245408

PETRONIO, C.; DI STEFANO, G.; PANDOLFI, L. & SALARI, L. 2014: The Late Pleistocene mammal fauna from Montemerano - Manciano (Grosseto, central Italy). *Bollettino del Museo Civico di Storia Naturale di Verona* 38 (Geologia Paleontologia Preistoria): 103-116.

PETRONIO, C.; ROLFO, M.F.; CERULEO, P.; DI MARIO, F.; FERRACCI, A.; FIORE, I.; GATTA, M. & SALARI, L. 2021: Preliminary report on the new faunal remains from Grotta Guattari (Late Pleistocene, San Felice Circeo, Latium). *Bulletin of Regional Natural History* 1(4): 29-38.

SALARI, L. & MASSETI, M. 2016: Attardamenti olocenici di *Equus hydruntinus* Regalia, 1907 in Italia. In: Thun Hohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Convegno Nazionale di Archeozoologia*, Annali dell'Università degli Studi di Ferrara - Museologia Scientifica e Naturalistica, 12(1): 313-320.DOI: http://dx.doi.org/10.15160/1824-2707/1310.

STINER, M.C. 1994: *Honor among thieves. A zooarchaeological study of Neandertal ecology*. NJ Princeton University Press, Princeton.

TEICHERT, M. 1969: Osteometrische Untersuchumgen zur Berechnung der Widerristhöhe bei vor- und frühgeschichtlichen Schweinen. *Kühn-Archiv* 83: 237-292.

WILKENS, B. 1989: Il cervo dal Mesolitico all'Età del Bronzo nell'Italia centro-meridionale. *Rassegna di Archeologia* 8: 63-95.

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Non solo per cavalieri.
Ruoli e valenze del cavallo sui semata attici di età classica

Not just for knights.
Roles and symbolism of the horse in the Attic semata of Classical Age

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RIASSUNTO: La produzione di monumenti funerari (*semata*) in marmo costituisce una delle più alte espressioni della scultura attica di periodo classico. Al di là di una possibile influenza delle iconografie partenoniche, le immagini di cavalli in questo contesto mostrano particolari combinazioni di fenotipi che, alla luce del riesame delle antiche trattazioni, sembrano trovare un puntuale riscontro nelle prescrizioni lasciateci da Senofonte e Simone di Atene. Sempre nell'ambito dei *semata* attici, la prospettata possibilità di identificare i cavalieri grazie alla sola presenza del cavallo, sulla base della lettura di alcuni autori, sembra essere complicata dalla scarsità di indicazioni che vengono dall'epigrafia e dalla prosopografia dei defunti. Proprio un'attenta analisi iconografica permette invece di identificare al fianco di questi animali un'ampia serie di figure sociali, che concorrono a mostrare l'importante simbolismo attribuito al cavallo, inteso come elemento aristocratico e bene di lusso.

PAROLE-CHIAVE: CAVALLO, CAVALIERI, *SEMATA*, ATENE, ETÀ CLASSICA

ABSTRACT: The production of marble funerary monuments (*semata*) represents one of the highest expressions of Attic sculpture in Classical Antiquity. Beyond the influence of the sculptures of the Parthenon, horse representations show here a particular combination of phenotypes, which seem to fit precisely the prescriptions left by Xenophon and Simon of Athens. As suggested by some authors, among the *semata* from Attica, the identification of Athenian knights through only the presence of horses seems very difficult to confirm due to the lack of epigraphic and prosopographic data. Thanks to a careful iconographic analysis, one can nevertheless recognize on the flanks of these animals a wide range of social figures which evidence the rich symbolism of this animal, both as an aristocratic element and a luxury good.

KEYWORDS: HORSE, HORSEMEN, *SEMATA*, ATHENS, CLASSICAL ANTIQUITY

RESUMEN: La producción de monumentos funerarios de mármol (semata) representa una de las más altas expresiones de la escultura ática en la Antigüedad clásica. Más allá de la influencia de las imágenes del Partenón, las representaciones de caballos muestran aquí una particular combinación de fenotipos, que parecen ajustarse con precisión a las prescripciones dejadas por Jenofonte y Simón de Atenas. Como sugieren algunos autores, entre los semata del Ática, la identificación de los caballeros atenienses a través de la sola presencia de caballos parece muy

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difícil de confirmar debido a la falta de datos epigráficos y prosopográficos. Gracias a un cuidadoso análisis iconográfico, se puede reconocer sin embargo en los flancos de estos animales una amplia gama de figuras sociales que evidencian el rico simbolismo de este animal, tanto como elemento aristocrático como bien de lujo.

PALABRAS CLAVE: CABALLO, JINETE, *SEMATA*, ATENAS, ANTIGÜEDAD CLÁSICA

IL CAVALLO NELLA SOCIETÀ ATENIESE DI ETÀ CLASSICA: UN SIMBOLO ESCLUSIVO?

Nel descrivere le classi sociali dell'Atene a lui contemporanea, il filosofo Aristotele – o più probabilmente uno dei suoi allievi – tramanda i criteri con cui, oltre due secoli prima, il celebre legislatore Solone aveva suddiviso la popolazione dell'Attica su base censitaria (*Res. Publ.* 7, 4): al primo posto sono ricordati i *pentacosiomedimni*, ossia coloro che in un anno riescono a trarre dalle loro proprietà 500 misure di prodotto fra aridi e liquidi; a questi seguono poi i *cavalieri* (ἱππεῖς), con una rendita di 300 misure annue, e ancora gli *zeugiti*, con 200 misure, per arrivare infine ai *teti* (fra i quali sono compresi anche i nullatenenti). Unica deroga alla rigida ripartizione soloniana è segnalata per la classe dei cavalieri, i quali sembrano essere qualificati come tali anche in forza della capacità di mantenere a proprie spese un cavallo. A riprova di ciò, l'autore dell'opera adduce il caso della statua di un certo Anthemion figlio di Diphilos, eretta sull'acropoli di Atene e consistente nell'immagine di un giovane uomo al fianco di un cavallo: Anthemion era infatti riuscito a passare dalla classe dei teti a quella dei cavalieri, e per tale motivo aveva scelto di offrire in dono questo particolare gruppo scultoreo, dal momento che il cavallo costituiva il simbolo dell'appartenenza a questa specifica categoria sociale. Le implicazioni della vicenda di Anthemion e della sua scultura votiva sembrano tuttavia incontrare una serie di ostacoli non irrilevanti: da un lato, infatti, la veridicità di questo assunto non sembra convincere del tutto lo stesso Aristotele, che preferisce dar credito alla sola possibilità di una suddivisione dei cittadini sulla base del censo; dall'altro, gli studi più recenti hanno suggerito come, da un punto di vista iconografico, almeno nella sfera della scultura funeraria attica di periodo classico il cavallo sembri costituirsi quale attributo di personaggi che non sempre appaiono qualificabili con sicurezza come cavalieri (Margariti, 2019: 136).

IL MONDO DEI *SEMATA* ATTICI: CRONOLOGIA, CLASSI TIPOLOGICHE E METODO DI INDAGINE

Proprio il variegato mondo dei *semata* (monumenti funerari) di matrice attica rappresenta, per omogeneità di linguaggio e ricchezza di documentazione, un'eccezionale lente attraverso cui analizzare il riflesso dell'antica società ateniese, fra l'ultimo trentennio del V e (quasi) tutto il IV secolo a.C. (Marchiandi, 2011: 29-34). Questo genere di produzioni, realizzate con il largo impiego di pregiati marmi locali, inizia infatti a fare la sua comparsa ad Atene intorno al 430-420 a.C., conoscendo poi nell'arco del IV secolo una strepitosa fioritura; tale fenomeno va tuttavia ad esaurirsi rapidamente già dopo il 317-307 a.C., anche in forza del drastico freno alle manifestazioni del lusso imposto da un decreto del governatore locale, Demetrio di Falero (Cic. *De leg.* 2, 64-65).

Per tentare di esplorare al meglio la figura e le possibili implicazioni del cavallo nei *semata* attici di periodo classico, dal duplice punto di vista dei fenotipi etnici dell'animale e della sua associazione con alcune categorie sociali, è stato preso in esame un campionario di 73 monumenti (pubblici e privati), su cui sono rintracciabili rappresentazioni di destrieri (Tanganelli, 2019). I monumenti considerati si caratterizzano per differenti forme, dimensioni e significati (Marchiandi, 2011: 52-60): si va infatti dalle stele funerarie con decorazioni a basso e altorilievo, sulle quali il defunto con il cavallo può essere effigiato singolarmente oppure in compagnia di altri individui, fino ai piccoli e grandi vasi funerari monoansati con scene a bassorilievo (*lekythoi*), spesso presenti in numero maggiore delle stele figurate e non di rado impiegati come elementi decorativi dei recinti funerari. A questi fanno seguito alcuni particolari vasi marmorei con doppia ansa (*loutrophoroi*), che sembrano aver marcato le sepolture dei soli defunti maschi, morti senza aver contratto matrimonio.

Infine, si aggiungono all'elenco le sculture cosiddette "accessorie" (statue a carattere decorativo), e ancora le eventuali basi per *semata* decorate in rilievo.

Prima di entrare nel vivo della discussione sui *semata* dei cavalieri, potrà essere utile portare all'attenzione una questione di carattere squisitamente terminologico, in relazione alla definizione di questa particolare categoria sociale: gioverà infatti ricordare come con il termine ἱππεῖς si indicassero ad Atene, ad uno stesso tempo, sia i cavalieri intesi come membri del ceto equestre, sia i cavalieri nell'accezione di militari combattenti a cavallo. Se tuttavia, come anche Senofonte ricorda (*Mag. Eq.* 9, 5), l'appartenenza di un cittadino maschio adulto al ceto equestre non sempre si traduceva meccanicamente nella sua partecipazione alle attività militari, si deve altresì rilevare come, a partire dall'età di Pericle, la progressiva apertura dei ranghi della cavalleria ateniese anche a cittadini di classi inferiori – disposta per supplire alla cronica carenza di nuove reclute, ben esemplificata dalla storia di Anthemion – dovette portare alla formazione di un esercito la cui composizione ormai non risultava più omogenea per estrazione sociale dei suoi componenti (Pischedda, 2015: 78). In questo senso, occorre quindi stabilire quale genere di ἱππεύς ci si possa aspettare di rintracciare sui *semata* attici, al fianco dei cavalli. Dal momento che gran parte dei monumenti si limita a tramandare scarsissime informazioni biografiche sul conto dei relativi proprietari – attraverso una ricorrente e stringata sequenza onomastica, articolata nella formula *nome proprio + patronimico + etnico* – l'analisi epigrafica e prosopografica non aiuta a ricostruire (se non in rarissimi casi) le famiglie di origine dei differenti individui (Tanganelli, 2019). Per tale motivo, sembra quindi preferibile indagare la presenza dei cavalieri nel mondo dei *semata* attici solo in un'ottica militare, attraverso un'indagine di carattere iconografico che tenga conto non soltanto della presenza dei cavalli, ma anche dell'indicazione data dalla panoplia; per contro, la semplice foggia delle vesti dei defunti appare in sé troppo generica, e per questo non sufficiente a qualificare da sola un membro dell'esercito ateniese (Spence, 1993: 29).

L'ICONOGRAFIA DEI CAVALLI SUI *SEMATA* ATTICI

Per quanto concerne le rappresentazioni di cavalli nell'ambito dei *semata* attici d'età classica, come premesso, esse possono essere rintracciate, tramite i *corpora* disponibili, su poco più di settanta esemplari (Woysch-Méautis, 1982; Clairmont, 1993). È stato sostenuto come queste iconografie zoomorfiche sembrino essere in una certa misura debitrici degli splendidi cavalli fidiaci presenti sul Partenone di Atene (Markman, 1969: 88-91). Questa rilevazione può essere in buona sostanza condivisa, tanto più che, con la chiusura del cantiere partenonico, le locali maestranze, perfezionatesi nella lavorazione del marmo, potrebbero essersi verosimilmente orientate verso una nuova committenza, di carattere privato, mettendo a frutto la decennale esperienza maturata sull'Acropoli sotto la direzione di Fidia. Occorre tuttavia sottolineare fin da subito come, contrariamente alle altre immagini di animali presenti nelle necropoli dell'Attica – come ad esempio i cani (Tanganelli & Masseti, 2019) – i cavalli sui *semata* funerari appaiano raffigurati solo sui monumenti a rilievo. Mentre infatti fra i *semata* attici di periodo arcaico risultano attestate (seppur in numero esiguo) vere e proprie statue di defunti a cavallo (Eaverly, 1955), le necropoli attiche di età classica non sembrano aver mai restituito, fino ad oggi, alcuna traccia di statue funerarie di carattere equestre. Similmente, anche il monumento osservato dal periegeta Pausania in prossimità della Porta del Dipylon, descritto come ἐπίθημα e attribuito alla mano dello scultore Prassitele (*Graec. Descr.* 1, 2, 3), potrebbe essere inteso tanto nell'accezione di statua, quanto in quella di stele.

A partire dall'analisi dei soli *semata* in rilievo, si pone dunque il problema di una definizione del tipo di immagini equestri così come rappresentate dagli scultori attici. Tentando di superare in questa sede il concetto di razza – difficilmente applicabile alle iconografie antiche, soprattutto in assenza di puntuali indicazioni più sicure – la moderna scienza zoologica definisce per la classificazione dei cavalli due principali tipologie (Masseti, 2018: 155-158): sulla base dei fenotipi etnici, si possono infatti distinguere un tipo di cavallo convenzionalmente detto "orientale" (o arabo) e uno detto "occidentale" (o berbero). Nel primo tipo, l'animale mostra in generale un profilo del muso dritto, semi-concavo o concavo, un'incollatura snella e arcuata, un fisico nel suo complesso slanciato e un'attaccatura della coda alta; nel secondo tipo, invece, si rileva un profilo del muso dritto, semi-convesso o convesso, una poderosa incollatura di forma tronco-piramidale, un fisico più massiccio e un'attaccatura della coda bassa. Con l'ovvia premessa che l'arte classica mantiene sempre un certo livello di idealizzazione, senza la pretesa di rappresentare la realtà in un'ottica che potremmo definire "scientifica", l'analisi dei destrieri sui *semata* attici si mostra comunque di grande interesse dal punto di vista dei fenotipi di questi animali. Infatti, al netto di alcune rappresentazioni eccessivamente danneggiate o lacunose, una considerevole parte degli esemplari esaminati (67%) appare qualificata da specifiche caratteristiche ricorrenti, che sembrano avvicinare maggiormente i cavalli attici al tipo "orientale" (Tanganelli, 2019): si evidenziano, in particolare, un profilo del muso spesso dritto o lievemente concavo, una corporatura solida ma al contempo slanciata e un'attaccatura della coda alquanto alta. L'unica eccezione per questo tipo iconografico è rappresentata dall'incollatura dei destrieri, che sui *semata* si mostra di solito decisamente massiccia – e dunque più affine, come detto, a quella caratteristica dei cavalli di tipo "occidentale". In rapporto alle figure umane, infine, si rileva come le dimensioni degli esemplari raffigurati non sembrino essere mai particolarmente elevate: questo dato potrebbe far pensare alla rappresentazione di un tipo di cavallo affine al cd. "cavallo baio dell'Egeo", una delle più antiche razze ancora oggi osservabili in taluni ambienti insulari della Grecia, la cui altezza al garrese si aggira attorno ai 100-120 cm (Masseti, 2018: 158-160).

La possibilità che i destrieri effigiati sui *semata* attici rappresentino in molti casi un tipo specifico di cavallo, forse non casualmente tratteggiato in questo modo, sembra essere suggerita da alcuni frammenti superstiti dell'opera di Simone di Atene. Autore, intorno alla metà del V secolo a.C., di un rinomato trattato – oggi in gran parte perduto – sulle caratteristiche fisiche dei cavalli, e ritenuto da Senofonte una vera e propria autorità in questo campo (*De re eq*. 1, 1), Simone offre una descrizione assai dettagliata di quelle che, a suo dire, sono le caratteristiche del miglior tipo di cavallo: "(…) *bisogna che il cavallo sia corto in alto e piccolo in basso; ossia, la zona che va dal garrese alla groppa deve essere corta, quella che va dalle cosce posteriori alle anteriori deve essere il più piccola possibile*. (…) *Deve avere l'incollatura dritta dalla parte della testa, non ricurva nel suo sviluppo, e più spessa e larga possibile dalla parte del garrese. Ma all'altezza delle ganasce l'incollatura deve essere sottile, elastica* (…); *la testa deve essere molto appariscente e leggera. Le narici devono essere il più grandi possibile* (…) *gli occhi grandi, il più possibile sporgenti e brillanti a vedersi, le orecchie piccole* (…). *Le cosce non devono essere carnose* (…). *Deve avere la coda alta e, a partire dalla groppa, folta e lunga*" (Sestili, 2006: 33-34). Sorprendentemente, la descrizione offerta nei pochi frammenti di trattato giunti fino a noi sembra trovare una notevole corrispondenza con i caratteri del tipo iconografico rintracciabile sulla maggior parte dei monumenti funerari attici fra V e IV secolo a.C. Data la fama di cui Simone e la sua opera godettero nell'Atene di età classica, potrebbe allora essere interessante chiedersi se e fino a che punto le iconografie equestri presenti sui *semata* delle necropoli locali (ed eventualmente le immagini partenoniche prima di loro) possano essere considerate debitrici del modello di cavalcatura da questi tratteggiato – se non addirittura rappresentative di una specifica razza diffusa e apprezzata in territorio attico, e oggi non meglio identificabile.

UOMINI E CAVALLI SUI *SEMATA* ATTICI: ANALISI E INTERPRETAZIONE DEI SOGGETTI

La presenza del cavallo sembra contribuire a conferire molteplici valenze ai proprietari dei *semata* attici, quando letta alla luce delle sue associazioni con le differenti categorie sociali che fanno la loro comparsa all'interno di questo genere di produzioni. È indubbio che, in primo luogo, il cavallo si costituisca quale inseparabile compagno dei cavalieri che hanno combattuto nell'esercito ateniese. Uno dei casi più celebri – e certo fra i più spettacolari offerti dai *semata* ateniesi – è rappresentato dalla stele funeraria di Dexileos (Figura 1), oggi conservata nel Museo del Ceramico di Atene. Qualificato dalla sua iscrizione commemorativa (IG II^2 6217) come uno dei cinque cavalieri caduti a Corinto nel 394/3 a.C., il giovane Dexileos, prematuramente scomparso, è raffigurato in sella al suo destriero rampante, eretto sulle zampe posteriori, mentre si appresta a scagliare la sua lancia contro un nemico caduto a terra. Questo schema iconografico, in apparenza più vicino all'immagine di un guerriero vincitore, è stato qui verosimilmente impiegato per celebrare il valore del cavaliere caduto, dal momento che in realtà fu proprio Dexileos a perire sul campo di battaglia (Hurwit, 2007: 41-44). Si è rilevato come circa un terzo dei cavalieri rintracciati sui *semata* attici appaia effigiato in questo stesso schema ico-

FIGURA 1

Stele di Dexileos. Atene, Museo Archeologico del Ceramico (P 1130). © Hellenic Ministry of Culture and Sports / Hellenic Organization of Cultural Resources Development nografico (Tanganelli, 2019), il quale potrebbe esser stato adottato sui monumenti privati a partire da un possibile modello – ben più "democraticamente anonimo" – presente su cenotafi e sepolcri statali (*demosia semata*), secondo un'opinione che tuttavia non trova ancora concordi gli studiosi (cfr. Goette, 2009: 192-196; *contra* Arrington, 2015: 100-104). La tradizione di raffigurare cavalieri caduti nello schema di combattenti deve essere in ogni caso ritenuta alquanto più antica del *sema* di Dexileos, se si considera la descrizione offerta da Pausania (*Graec. Descr*. 1, 29, 6) in merito alla stele eretta alla memoria di Melanopo e Macartato, morti a Tanagra nel 457 a.C. e già rappresentati su di essa come cavalieri impegnati nella lotta. Non mancano tuttavia variazioni su questo stesso schema, che meritano parimenti un'attenta riflessione. Una grande *lekythos* funeraria del Museo Nazionale di Atene mostra infatti, a sua volta, un cavaliere dotato di corsetto, in sella a un cavallo eretto sulle zampe posteriori, il quale tuttavia appare caratterizzato da un atteggiamento alquanto pacato, senza che si rilevi la presenza di alcuna arma fra le sue mani, né quella del tipico avversario caduto a terra (Clairmont, 1993: 4.650). In questo caso la scena sembra acquistare un valore assai differente da quello propriamente militare, e può forse trovare una spiegazione nelle parole di Senofonte: descrivendo alcuni esercizi di alta scuola, destinati ai cavalli da parata, questi asserisce infatti che i cavalieri che riescano a insegnare ai propri destrieri ad alzarsi sulle zampe posteriori, mantenendo il proprio padrone sulla schiena e mostrando al pubblico il ventre e i genitali, riscuotano un grande successo fra giovani e anziani, poiché ricordano da vicino le immagini equestri degli dèi e degli eroi rappresentati sui grandi cicli pittorici della città (*De re eq*. 11, 1-5). La proiezione di questo anonimo cavaliere defunto fuori da un contesto di carattere marcatamente bellico potrebbe dunque trovare una giustificazione in una sua esaltazione postuma, di carattere eroico. A tale riguardo potrà essere utile ricordare come i soldati caduti in battaglia non sembrino comunque essere mai stati tributari di un vero e proprio culto eroico in seno alla comunità di Atene, venendo unicamente qualificati, sul duplice livello iconografico e sociale, come uomini valorosi (ἄνδϱες ἀγαθοί), allo scopo forse di offrire un esempio di virtù per le nuove generazioni di combattenti (Woysch-Méautis, 1982: 28-38).

Una sicura identificazione dei cavalieri sui *semata* attici, come premesso, non sembra essere tuttavia genericamente estendibile a tutte le figure maschili dotate di un cavallo, rivelandosi valida per appena il 49% dei casi esaminati. Un gruppo di almeno 5 *semata* appare ad esempio dedicato a individui che sembrano presentarsi come cacciatori (Tanganelli, 2019): in aggiunta ai cavalli si possono infatti individuare ulteriori attributi che spingono verso questa lettura, come accade nel caso della *lekythos* di Hegemon Epikephisios (Clairmont, 1993: 2.867a). In questo come in altri *semata*, la presenza di due cani – assimilabili per fenotipi a moderni podenchi (Tanganelli & Masseti, 2019: 309-310) – deve essere univocamente considerata come indicatore dell'attività di caccia praticata dal defunto, non solo per via della tipologia canina adottata (di norma impiegata nell'inseguimento della selvaggina), ma anche in forza del fatto che l'esercito ateniese non sembra aver mai fatto ricorso all'uso di cani come ausilio in battaglia, contrariamente a quanto testimoniato dagli scrittori greci e latini per altri popoli antichi (es. per i Lidi: Polyaen. *Strat*. 7, 1; per i Macedoni: Plut. *Arat*. 24, 1; per i Tessali e gli Epiroti: Aen. *Polior*. 21, 32-33; per i Colofoni e i Castabalensi: Plin. *Nat. Hist*. 8, 40). L'inserimento del cavallo nella costruzione di iconografie legate al mondo della caccia sembra dunque riscuotere un certo apprezzamento anche sui *semata* attici, i quali tramandano in questo modo il valore di una pratica che – proprio come la partecipazione alla vita militare – rientrava fra quelle caratterizzanti il modello educativo tipico del ceto aristocratico (Schnapp, 1979).

Oltre alla guerra, l'attività venatoria non è comunque la sola in cui i cavalli potevano essere impiegati, come ricorda il retore Giulio Polluce (*Onom*. 1, 181) e come mostra anche una *lekythos* attica anepigrafe (Figura 2), appartenuta a un ignoto sepolcro inquadrabile nell'ambito del IV secolo a.C., sulla quale si può ancora apprezzare la rappresentazione di un auriga posto alla guida di una quadriga (Clairmont, 1993: 1.383). La perdita dei dati relativi al contesto di rinvenimento del *sema* e l'assenza di formule onomastiche non aiutano a ricostruire l'identità del suo proprietario; tuttavia, potrebbe forse non essere azzardato immaginare di ricondurre questo manufatto al sepolcro di una delle (poche) famiglie ateniesi legate alla pratica dell'allevamento di cavalli (*hippotrophia*). Un'ipotesi non dissimile è stata più volte proposta per il sepolcro di famiglia di Philopeites Prospaltios, dal quale proviene una stele iscritta dedicata alla memoria di Euxenides Amphidexios: pur non mostrando iconografie equestri, essa registrava infatti le vittorie da

FIGURA 2

Lekythos con auriga e *tethrippos*. Atene, Museo Archeologico Nazionale (3940). © Hellenic Ministry of Culture and Sports / Hellenic Organization of Cultural Resources Development questi conseguite nelle corse con il carro ai giochi panellenici di Nemea e Istmia (Marchiandi, 2011: N.Arch.7). Alla guida di una quadriga (*tethrippos*) aveva inoltre vinto nei giochi Pitici del 374 a.C. Chabrias figlio di Ktesippos, il cui nome rientra fra quelli delle famiglie legate sempre al mondo equestre (Spence, 1993: 292). Da Aristotele sappiamo che gli allevatori di cavalli da corsa appartenevano alle classi più elevate della società ateniese (*Pol*. 4, 1289b), e fra il 600 e il 300 a.C. sono appena quattordici i nomi di famiglie ateniesi legate all'*hippotrophia*, che risultano aver conseguito vittorie con il carro in ambito panellenico, grazie ai destrieri usciti dalle proprie scuderie (Marchiandi, 2011: 131). Se il legame di questa *lekythos* con una famiglia di *hippotrophoi* fosse confermato, avremmo dunque una nuova testimonianza di questa antica e dispendiosa pratica fra i *semata* marmorei conservati presso il Museo Archeologico Nazionale di Atene.

Più complesso – e per certi versi intrigante – appare invece il caso di una stele funeraria appartenuta ad un tale Antipatros, conservata oggi alla Ny Carlsberg Glyptotek di Copenhagen (Clairmont, 1993: 1.472). Del defunto in questione è noto solo il nome, in quanto il suo *sema* non ne riporta il patronimico, né l'etnico; unico elemento aggiuntivo è il saluto formulare «*chaire*» (χαῖϱε), indicativo del congedo nella sfera del lutto (IG II^2 10692). Da un punto di vista iconografico, Antipatros è rappresentato come un giovane uomo vestito con un abito corto (*exomis*), tipico delle figure dedite al lavoro. Effigiato nell'atto di muoversi verso sinistra, il defunto trattiene con una mano le redini di una coppia di cavalli, mentre con l'altra porta appoggiato sulla spalla uno strumento dalla forma sottile e allungata, identificato come una frusta o una verga. La presenza del doppio cavallo è stata talvolta ricollegata all'*hippotrophia*, anche se non si può escludere una possibile indicazione del ruolo di scudiero (*hippokomos*), il quale avrebbe dovuto in teoria provvedere ad almeno due cavalcature – di cui una per sé – al fine di poter adeguatamente accompagnare il proprio padrone sul campo di battaglia (Marchiandi, 2011: 65). Stalliere di un ricco *hippotrophos*, oppure scudiero di un cavaliere, Antipatros sembra comunque essere inquadrabile come una figura di rango servile, non solo in forza delle osservazioni di carattere prettamente iconografico, ma anche per la presenza della formula di congedo χαῖϱε, che in epoca classica risulta attestata proprio sulle stele di meteci e servitori (Nielsen *et al*., 1989: 419). Una conferma in questo senso arriva da una seconda stele attica, dedicata a Menes figlio di Kallias, il quale è indicato come "Argivo" (Ἀϱγεῖος) nell'iscrizione funeraria, e ancora una volta salutato con la formula χαῖϱε (IG II^2 8370). In questo caso, la qualifica di meteco è resa evidente dall'origine alloctona di Menes, dichiarata sulla sua stessa stele, la quale fu rinvenuta all'interno di uno dei periboli funerari della necropoli del Ceramico, sottintendendo per questo un possibile legame del defunto con la famiglia che ne deteneva la proprietà (Marchiandi, 2011: 302-303). Varrà la pena sottolineare come l'iconografia del meteco Menes – raffigurato come un uomo barbato e ammantato, armato di lancia e seduto in sella a un destriero rampante – appaia perfettamente assimilata a quella di un cavaliere ateniese, nonostante fino almeno verso il 360 a.C., stando alle parole di Senofonte (*Mag. Eq*. 9, 6), l'ingresso nei ranghi della cavalleria ateniese sembri esser rimasto precluso ai meteci dell'Attica.

Da ultimo, può essere interessante segnalare il caso di almeno una *lekythos* funeraria in marmo oggi perduta, la cui memoria si è tuttavia fortunatamente conservata attraverso una riproduzione grafica (Clairmont, 1993: 2.387d). Questo manufatto doveva essere ancora visibile come elemento di reimpiego agli inizi del Settecento, all'interno di una chiesa situata forse nel territorio dell'odierna Maroussi, alla periferia settentrionale di Atene. Nulla si conosce del defunto effigiato sulla *lekythos*, il cui nome, giuntoci incompleto, potrebbe forse essere integrato come [Eud]emippos. Raffigurato come un uomo d'età matura, con il corpo avvolto in un lungo mantello, che ne lascia scoperto solo il braccio destro con la spalla e parte del petto, il soggetto si mostra nell'atto di incedere verso destra, in direzione di una donna seduta, che porta il nome di Demostrate. L'uomo conduce accanto a sé un cavallo, dai tratti più vicini a quelli del tipo "occidentale" – anche se lo stile grafico del documento, nel suo complesso, lascia spazio a qualche dubbio circa l'attendibilità della riproduzione. Nell'assoluta impossibilità di qualificare su base prosopografica questo defunto – il cui nominativo può al massimo ricordare la moda, criticata da Strepsiade (Arist. *Nub*. 60-64), di imporre troppo spesso ai figli degli Ateniesi nomi contenenti "*-hippos*" – quello che maggiormente interessa in questo caso è la sua scelta di presentarsi, sul piano iconografico, come un semplice cittadino ateniese, ma con il dettaglio (non irrilevante) di un cavallo raffigurato al suo fianco.

Non potendo stabilire un più sicuro status o un ruolo sociale per questo individuo (e per altri presenti sui *semata* attici), tutto ciò che possiamo asserire è che, a livello iconografico, il cavallo possa esser stato inserito di volta in volta al fianco di alcuni defunti almeno con lo scopo di celebrare idealmente la loro ricchezza (e/o quella delle rispettive famiglie di provenienza), in accordo con le parole del *Prometeo incatenato* di Eschilo, che poco prima della metà del V secolo a.C. aveva riconosciuto questo animale come simbolo del "lusso più sfarzoso" (v. 466). A conferma di questo giudizio, si può ricordare come dall'analisi dei documenti d'archivio relativi alla cavalleria ateniese, rinvenuti negli scavi dell'Agorà del Ceramico, sia emerso come ad Atene, sul finire del IV secolo a.C., il prezzo di un buon cavallo potesse oscillare fra le 100 e le 700 dracme – con una spesa media che doveva aggirarsi intorno alle 400 dracme – mentre nella prima metà del secolo successivo non mancano esemplari pagati addirittura fino a 1200 dracme (Kroll, 1977: 89).

CONCLUSIONI

Alla luce dei dati esposti in questa sede, l'analisi delle rappresentazioni di cavalli sui *semata* attici di periodo classico sembra porre una interessante serie di considerazioni preliminari, oltre a quesiti ancora irrisolti e prospettive per futuri approfondimenti. Una parte delle novità emerse riguarda la definizione del tipo iconografico di cavallo ricorrente con maggiore frequenza sui rilievi funerari, il quale presenta fenotipi che sembrano corrispondere, con una notevole precisione, all'ideale di cavalcatura teorizzato da Simone di Atene nei frammenti superstiti del suo trattato. Oltre a ciò, le soluzioni adottate nell'inserimento del cavallo al fianco di particolari categorie umane permettono di andare contro una generale (e talvolta eccessiva) associazione di questo animale con il mondo dei cavalieri attici, qualificandolo da un lato come elemento dalla forte valenza eroizzante, che contribuisce a testimoniare con la sua presenza le virtù e le buone pratiche del cittadino aristocratico, e dall'altro come un indicatore di lusso, in grado di trasmettere all'osservatore (anche implicitamente) un chiaro messaggio circa lo status economico del suo proprietario.

BIBLIOGRAFIA

Arrington, N.T. 2015: *Ashes, images and memories: the presence of the war dead in the fifth-century Athens*. Oxford University Press, New York.

Clairmont, C.W. 1993: *Classical Attic Tombstones*. Akanthus, Kilchberg.

Eaverly, M.A. 1995: *Archaic Greek equestrian sculpture*. The University of Michigan Press, Ann Arbor.

Goette, H.R. 2009: Images in the Athenian 'Demosion Sema'. In: Palagia, O. (ed.): *Art in Athens during the Peloponnesian War*: 188-206. Cambridge University Press, New York.

Hurwit, J.M. 2007: The problem with Dexileos: heroic and other nudities in Greek art. *American Journal of Archaeology* 111(1): 35-60.

Kroll, J.H. 1977: An archive of the Athenian cavalry. *Hesperia* 46(2): 83-140.

Marchiandi, D. 2011: *I periboli funerari nell'Attica classica: lo specchio di una 'borghesia'*. Pandemos, Atene-Paestum.

Margariti, K. 2019: Funerary sculpture: women on Attic grave reliefs. In: Palagia, O. (ed.): *Handbook of Greek Sculpture*: 123-159. Volume 1. De Gruyter, Berlin.

Markman, S.D. 1969: *The horse in the Greek art*. Biblo and Tanner, New York.

Masseti, M. 2018: Il cavallo, *Equus przewalskii* Poliakov, 1881, fra Antichità e Alto Medioevo. In: Camin, L. & Paolucci, F. (eds.): *A cavallo del tempo. L'arte di cavalcare dall'Antichità al Medioevo*: 155-177. Catalogo della mostra (Firenze, 2018), Sillabe, Livorno.

Nielsen, T.H.; Bjertrup, L.; Hansen, M.H.; Rubinstein, L. & Vestergaard, T. 1989: Athenian grave monuments and social class. *Greek, Roman and Byzantine Studies* 30: 411-420.

Pischedda, E. 2015: La cavalleria ateniese nel IV secolo. Un lusso utile? *Annuario della Scuola Archeologica di Atene e delle Missioni Italiane in Oriente* 91(2013): 77-87.

Schnapp, A. 1979: Pratiche e immagini di caccia nella Grecia antica. *Dialoghi di Archeologia* 1: 36-59.

Sestili, A. 2006: *L'equitazione nella Grecia antica. I trattati equestri di Senofonte e i frammenti di Simone*. Firenze Atheneum, Firenze.

Spence, I.G. 1993: *The cavalry of Classical Greece. A social and military history*. Clarendon Press, Oxford.

Tanganelli, F. 2019: *Non solo cavalieri: polisemia del cavallo sui* sémata *attici di età classica*, Università degli Studi di Firenze. (Unpublished).

Tanganelli, F. & Masseti, M. 2019: A fianco del padrone: tipologie e simbolismi del cane sui monumenti funerari attici di età classica. *Atti dell'8° Convegno Nazionale AIAZ:* 307-312. Lecce 2015.

Woysch-Méautis, D. 1982: *La représentation des aimaux et des êtres fabuleux sur les monuments funéraires grecs. De l'époque archaïque a la fin du IV^e siècle av. J.-C.*. Bibliothèque historique vaudoise, Lausanne.

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The Holocene faunal assemblage from La Sassa Cave (Sonnino, central Italy): the importance of zooarchaeological and taphonomic analyses for the interpretation of a funerary context

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ABSTRACT: La Sassa Cave, located near Sonnino (Latina, Latium) was systematically excavated by the Groningen Institute of Archaeology, in collaboration with the University of Rome "Tor Vergata" since 2016. This paper covers the Copper Age and Bronze Age occupation layers, as well as, secondarily, the Late Medieval-Renaissance phase. The Protohistoric evidence is characterised by disturbed human burials and possible ritual activities, whereas the Late Medieval-Renaissance phase features an unusually high concentration of dog remains. The zooarchaeological study is integrated by the analysis of the taphonomic processes which influenced the deposit's formation. We show that La Sassa Cave, although having a similar burial use with most of the coeval archaeological caves of central Italy, is characterised by peculiar ritual patterns. Regarding the faunal remains, there were residues of ritual meals and animal offerings, and an unusual abundance of wild species.

KEYWORDS: CAVE ARCHAEOLOGY, CAVE TAPHONOMY, ZOOARCHAEOLOGY, ITALIAN PROTOHISTORY, BURIAL AND RITUAL CAVE

RIASSUNTO: Grotta La Sassa, situata presso Sonnino (Latina, Lazio), è stata oggetto di scavi sistematici fin dal 2016 da parte del Groningen Institute of Archaeology, in collaborazione con l'Università degli Studi di Roma "Tor Vergata". Le fasi di occupazione prese in esame dal presente lavoro sono quelle dell'Età del Rame e del Bronzo, e secondariamente del Tardo Medioevo-Rinascimento. L'evidenza protostorica è caratterizzata da sepolture umane sconvolte e possibili attività rituali, mentre i livelli moderni mostrano una presenza eccezionalmente elevata di resti di cane. L'analisi archeozoologica viene affrontata contestualmente a quella dei processi tafonomici, che hanno determinato la formazione del deposito. Ne emerge che Grotta La Sassa, pur rivelando un uso funerario comune alla maggior parte delle coeve cavità centro-italiane, è caratterizzata da pratiche rituali piuttosto peculiari. È stato infatti possibile ipotizzare che i resti animali appartenessero a pasti ed offerte rituali, riconoscendo inoltre un'inaspettata abbondanza di specie selvatiche.

PAROLE CHIAVE: ARCHEOLOGIA DI GROTTA, TAFONOMIA DI GROTTA, ZOOARCHEOLOGIA, PROTOSTORIA ITALIANA, GROTTA RITUALE E FUNERARIA

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RESUMEN: La cueva de La Sassa, situada cerca de Sonnino (Latina, Lacio), ha sido excavada sistemáticamente desde 2016 por el Instituto de Arqueología de Groningen, en colaboración con la Universidad de Roma "Tor Vergata". Este artículo cubre los niveles de ocupación de la Edad del Cobre y la Edad del Bronce, así como, secundariamente, el nivel de la Baja Edad Media-Renacimiento. La evidencia protohistórica se caracteriza por enterramientos humanos perturbados con posibles actividades rituales, mientras que la fase de la Baja Edad Media-Renacimiento presenta una concentración inusualmente alta de restos de perros. El estudio zooarqueológico se integra con el análisis de los procesos tafonómicos que influyeron en la formación del yacimiento. Mostramos que la cueva, aunque presenta un uso funerario similar al de la mayoría de las cuevas arqueológicas coetáneas del centro de Italia, se caracteriza por patrones rituales peculiares. Por lo que se refiere a los restos de fauna, se encontraron residuos de comidas rituales y ofrendas animales, así como una inusual abundancia de especies silvestres.

PALABRAS CLAVE: ARQUEOLOGIA EN CUEVA, TAFONOMIA EN CUEVA, ZOOARQUEOLOGÍA, PROTOHISTORIA ITALIANA, CUEVA DE ENTIERRO Y RITUALES

INTRODUCTION

La Sassa, a karst cave located in Southern Latium's Ausoni Mountains (Sonnino, LT) (Figure 1), was first explored by local speleological groups in 2014 and excavated from 2016 to 2019 by the Groningen Institute of Archaeology (Netherlands), in collaboration with the University of Rome "Tor Vergata" (Italy) (Alessandri *et al*. 2020; Alessandri *et al*., 2021; Gatta *et al*., 2022; Romboni *et al*., 2023). A vertical opening leads into the large and naturally illuminated Room 1 (Figure 1), followed by a smaller Room 2; these chambers yielded most of the faunal, human and ceramic finds retrieved at the site, with a further two pits found in Room 2. Unfortunately, the stratigraphic integrity of

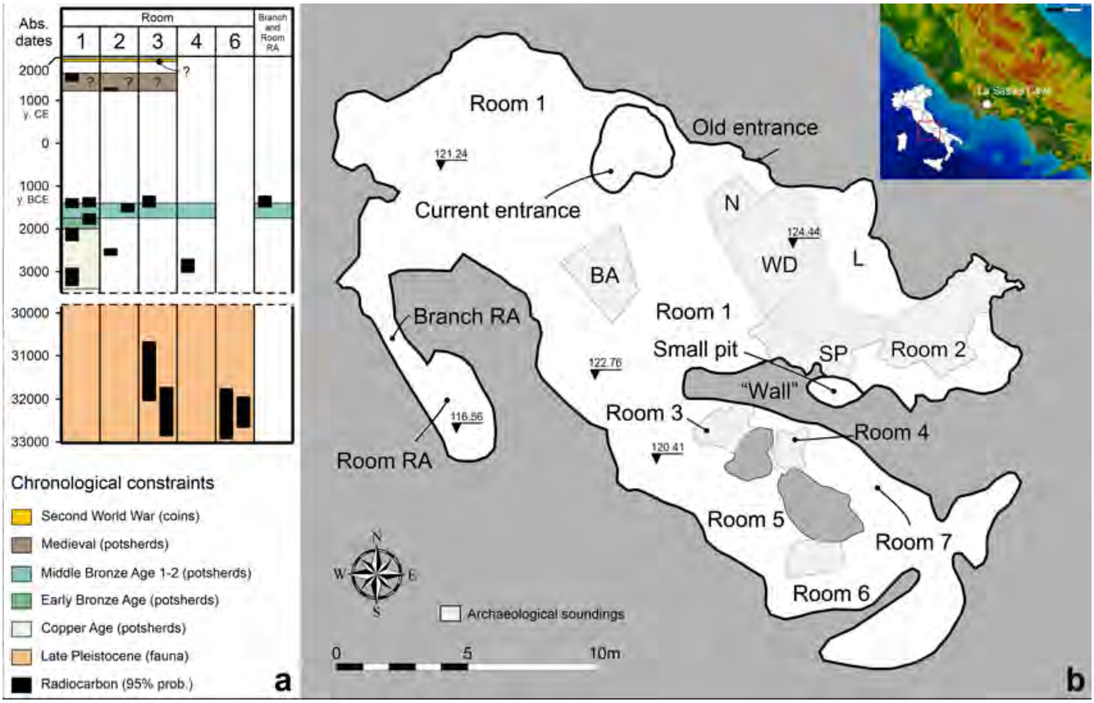

FIGURE 1

La Sassa Cave: chronological constraints (a); location in central Italy and map with indication of the excavated Rooms (b). Background of Italy: TINITALY hillshade (Tarquini *et al*., 2023).

both areas was compromised by sheltering refugees during World War II. Radiocarbon analyses of the human bones place La Sassa's funerary occupation in the 3rd and 2nd millennia BCE, i.e., in the Copper and Early Bronze Ages, with most of the significant ceramic finds belonging to the Early and Middle Bronze Age (Alessandri *et al*., 2021). Of the remaining seven chambers explored (Figure 1), Rooms 3 and 4 yielded more faunal, human and Middle Bronze Age ceramic remains, although these were sometimes mixed with a few Roman and Modern potsherds, as well as Pleistocene bones. Such evident disturbance of the stratigraphy did not allow for the incorporation of this chronologically uncertain faunal material into the analysed Protohistoric assemblage. In a recently identified branch of the cave ("RA") (Figure 1), further Protohistoric finds, including likely coeval faunal remains and an intact baby-bottle, were recovered (Supplementary material: Figure 2) (Alessandri *et al*., 2021).

MATERIALS AND METHODS

Faunal remains were taxonomically identified with the help of Tor Vergata University's comparative collection and of Schmid (1972), Barone (1974, 1981) and Wilkens (2003). Other analyses included Minimum Number of Individuals (MNI) (Bökönyi, 1970), side and skeletal part distribution, and age kill-off patterns estimation (Payne, 1973, 1985; Bull & Payne, 1982; Grant, 1982; Mariezkurrena, 1983), measurements (Driesch, 1976), withers height (wolf: Harcourt, 1974; Clark, 1995; sheep: Teichert, 1975), sheep/goat, wolf/dog, dog/fox and pig/wild boar distinction (Wagner, 1930; Boessneck, 1969; Payne, 1985; Prummel & Frisch, 1986; Tagliacozzo, 1993; Albarella *et al*., 2009; Johnson, 2015; Salari *et al*., 2017) and taphonomic features identification (Lyman, 1994). One of the peculiar traits of La Sassa Cave is the presence of hundreds of bone remains attributable to *Canis familiaris*, belonging to several individuals, in almost all the investigated rooms. The quantity of dog bone finds is inversely proportional to the age of the deposit. Three ^{14}C data, carried out on as many dog remains from different stratigraphic layers, revealed all three finds to be late Medieval (Figure 1); these were representative of a larger undated dataset with similar taphonomic features (e.g., yellowish patina, peculiar porosity and weight). It was therefore assumed that all such dog remains found in the Protohistoric deposit were intrusive. This proved to be a useful instrument to validate the stratigraphic reliability of each layer, representing a marker of their disturbance. Therefore, layers showing a percentage of dog bones greater than 50% were excluded from the Protohistoric stratigraphic sequence. Faunal remains were divided into three Protohistoric horizons: Copper Age (CA, number of identified specimens – NISP: 314), Bronze Age (BA, NISP: 333), and Generic Protohistory (GP, NISP: 128, where neither radiocarbon dating, nor pottery chrono-typology allowed for a more detailed definition). Despite the limited NISP for the three horizons, valuable information and interpretations could be drawn from the study of the assemblages (Schmölcke, 2013).

RESULTS

Domestic caprines are overall the predominant faunal finds. Red deer and wild boar are, rather surprisingly, among the most represented species in two of the three identified Protohistoric horizons (Table 1). Micromammals, avifaunal and reptile remains are quite rare in all three contexts. With regard to the kill-off patterns (Table 2), as expected, all the carnivores belong to the adult age class. Other taxa mostly show an equal presence of adult and young individuals; exceptions are the mostly adult domestic caprines from the CA, while among the BA and GP phases the young and very young classes are predominant. This ratio is also found for pig and wild boar. Among the skeletal elements of the main species (Supplementary material: Table 3), teeth and the autopod region are overall overrepresented compared to the limbs. This could be because small and compact skeletal elements tend to be better preserved, whereas long bones might have suffered a higher fragmentation degree, also considering the trampling activities in recent times. On the other hand, especially in the case of cattle, this evidence could be related to the introduction of hides into the cave rather than the entire, cumbersome, carcass. Red deer's skeletal element distribution in the CA shows a quantitative homogeneity of teeth/autopod region and stylopod/zeugopod's ratio. This might indicate that these bones, all retrieved in a circumscribed, rather secluded area of Room 2, and often bearing cutmarks and firemarks, were related to an intentional accumulation, possibly consisting of the waste of a meal. The analysis of marks on the surfaces of

	Copper Age				Bronze Age				Generic Protohistory			
	NISP	NISP%	MNI	MNI%	NISP	NISP%	MNI	MNI%	NISP	NISP%	MNI	MNI%
Reptilia	**35**	**1.7**										
Aves	**4**	**0.2**			**4**	**0.4**			**1**	**0.3**		
Micromammals	**58**	**2.8**			**7**	**0.7**						
Canis familiaris	62	19.7	1	5.3	211	63.4	5	29.4				
Sus domesticus	21	6.7	3	15.8	25	7.5	3	17.6	67	52.3	3	20
Bos taurus	9	2.9	2	10.5	3	0.9	1	5.9	13	10.2	2	13.3
Ovis vel *Capra*	142	45.2	7	36.8	32	9.6	3	17.6	14	10.9	1	6.7
Ovis aries	15	4.8			2	0.6						
Capra hircus	5	1.6										
Domestic Mammals	254	80.9	13	68.4	273	82	12	70.6	94	73.4	6	40
Lepus sp.					1	0.3	1	5.9	1	0.8	1	6.7
Canis lupus	6	1.9	1	5.3	51	15.3	2	11.8				
Vulpes vulpes	3	1	1	5.3					5	3.9	1	6.7
Martes sp.									4	3.1	1	6.7
Sus scrofa	3	1	1	5.3	5	1.5			11	7.1	3	20
Cervus elaphus	48	15.3	3	15.8	3	0.9	2	11.8	13	11.8	3	20
Wild Mammals	60	19.1	6	31.6	60	18	5	29.4	34	26.8	9	60
Determinate L. Mammals	**314**	**15.8**	**19**	**100**	**333**	**33**	**17**	**100**	**128**	**26.3**	**15**	**100**
Medium-Large Ribs	43	2.6			73	10.8			23	6.4		
Small-Medium Ribs	186	11.1			178	26.3			54	15.1		
Medium-Large Vertebrae	41	2.5			18	2.7			4	1.1		
Small-Medium Vertebrae	156	9.3			85	12.6			20	5.6		
Undetermined fragments	1245	74.5			323	47.7			257	71.8		
Undetermined Large Mammals	**1671**	**84.2**			**677**	**67**			**358**	**73.7**		
Tot. Large Mammals	**1985**	**95.3**			**1010**	**98.9**			**486**	**99.8**		
Final total	**2082**	**100**			**1021**	**100**			**487**	**100**		

TABLE 1

Faunal remains identified in the three Protohistoric deposits of La Sassa Cave by NISP (Number of Identified Specimens), MNI (Minimum Number of Individuals) and related percentages.

	MNI Copper Age					MNI Bronze Age					MNI Generic Protohistory				
	S	A	Y-A	Y	VY	S	A	Y-A	Y	VY	S	A	Y-A	Y	VY
Canis familiaris		1					4		1						
Sus domesticus		1		1	1			1	2			1		1	1
Bos taurus		1	1				1					1		1	
Ovis aries vel Capra hircus		4		2	1		1		1	1				1	
Lepus sp.							1					1			
Canis lupus		1					2								
Vulpes vulpes		1										1			
Martes sp.												1			
Sus scrofa				1								1		1	1
Cervus elaphus		1	1	1			1		1		1	1		1	

TABLE 2

Age classes of the taxa identified in the three Protohistoric deposits of La Sassa Cave (VY= Very Young; Y= Young; Y-A= Young Adult; A= Adult; S= Senile).

identified and undetermined mammal bones from each period (Supplementary material: Table 4) has revealed a large presence of cutmarks and a modest occurrence of firemarks. The CA assemblage, with the highest concentration of marks, shows (more) cuts and (less) burnings on an almost equal amount of meaty and non-meaty sheep/goat bones, while marks on red deer remains are mainly on meaty elements, and pig and wild boar are found only on meaty bones. The few cutmarks and firemarks recorded in the BA belong to non-meaty elements in both cattle and wolf. Finally, in the GP, where only cutmarks were observed, both meaty and non-meaty bones are equally accounted for in cattle, pig, and wild boar, while the fox bones had a single mark on a meaty element. Gnawing marks are extremely rare in all Protohistoric layers; this occurrence might suggest that the intact or partial carcasses were deposed in a relatively protected environment, where secondary consumers could not reach them.

DISCUSSION

ENVIRONMENTAL OBSERVATIONS

The presence of red deer, wild boar and marten indicate the existence of extended, partly humid woodlands, while the identification of hare suggests the presence of clearings, in the surrounding area of the cave. Conversely, today's Amaseno Valley is featured by wide open areas and artificial dry terraces, with sparse groves. Pastures for cattle grazing and domestic caprines, provided that grazing areas existed in the immediate vicinity of the cave (since pollen analyses are not available to confirm this hypothesis) complete the Protohistoric palaeoenvironmental reconstruction. Similar habitats have been inferred for several other central Italian contexts, such as Grotta Mora Cavorso (Silvestri *et al*., 2016), and Grotta dei Cocci (Salari & Tagliacozzo, 2019).

ECONOMIC OBSERVATIONS

While the faunal record of a funerary cave, most likely selectively introduced in the site, cannot fully mirror their occupants' subsistence strategies (see Silvestri *et al*., 2019a and references therein), some economic inferences can still be made. The predominance of domestic mammals suggests an unsurprising central role of breeding and herding activities. The important presence of red deer and wild boar shows that such domesticated activities were still integrated by significant hunting activities – a rare occurrence that finds some parallels with Grotta Mora Cavorso (Silvestri *et al*., 2016) and the pile-dwelling settlement of Villaggio delle Macine in Latium (Achino *et al*., 2021 and references therein). Sheep/goat farming, however, was still crucial for this community's subsistence. Based on withers height (Supplementary material: Table 5), La Sassa's *Ovis aries* falls within the size range of nearby coeval sites (see Salari &Tagliacozzo, 2019 and references therein). The prevalence of sheep over goats follows the overall trend of most of Protohistoric contexts (Minniti, 2012 and references therein). In the CA, the breeding strategy seems to be aimed at both secondary products and meat exploitation. The absence of individuals younger than three months may be due to a more intensive frequentation of the site outside of the spring season, similarly to Grotta del Fontino (Vigliardi & Bachechi, 2002). The breeding of cattle and pig was certainly well developed, which can be particularly noted for the BA, with *Sus domesticus'* values very close to sheep and/or goat. As expected, kill-off patterns of *S. domesticus* show that the majority of these individuals were conveniently slaughtered within their first year of life, such as in Grotta Beatrice Cenci (Agostini *et al*., 1991), Grotta di Pastena (Silvestri *et al*., 2019a, b) and Grotta dei Cocci (Salari & Tagliacozzo, 2019). Pig mortality differences between the above-mentioned sites and the few available coeval settlements (e.g., Minniti, 2012; Achino *et al*., 2021;) are not striking, excluding those cave contexts with clear sub-juvenile pigs' ritual slaughtering (Silvestri *et al*. 2019a, b and references therein); however, aside of those obvious exceptions, a slight prevalence of younger individuals can still be noted in caves over settlements. The mortality curve of the cattle, on the contrary, shows a majority of adult individuals in all three levels, such as Grotta del Fontino (Vigliardi & Bachechi, 2002). This suggests that *Bos taurus* could have been used mainly as a labour force for local agricultural activities and for their raw materials and secondary products. In addition, the remains of a calf and a ceramic baby-bottle (Alessandri *et al*., 2021) respectively indicate meat and milk exploitation. Finally, taxa such as *Canis lupus* (similar in size to the late Italian Pleistocene wolves and larger than the extant Apennine wolf, Salari *et al*., 2017; Supplementary material: Table 5) and *Vulpes vulpes* could have been killed to protect the livestock; at the same time, these species, along with marten and hare, may have been exploited for their fur, tendons and teeth, as indicated by the presence of cutmarks.

CULTURAL OBSERVATIONS

La Sassa, like many other Protohistoric central Italian caves, was a ritual and burial site with faunal evidence reflecting this use (Silvestri *et al*., 2019a). The two preserved pits in Room 2 were most likely of a ritual nature (Grifoni Cremonesi, 1996), one of which contained both human and faunal remains – especially pig and wild boar. In the same room, the unusual position and features of the CA red deer's bones and teeth might suggest a symbolic deposition of meal remains, closely linked to the human depositions. Due to the poorer preservation condition of the BA layers, it cannot be stated whether the absence of peculiar features can be attributed to post-depositional reasons or to an actual change in practices at the site. The better preservation of some juvenile – and thus more fragile – limb bones in the BA of Room 2, however, suggests that trampling and soil accumulations must have almost fully destroyed what was likely a much more complex situation. Overall, it seems possible that La Sassa's Protohistoric faunal remains were deposited in association with the funerary rituals. The deposition of non-meaty carcass portions with limited manipulation – indicated by the scarcity of butchery marks and the NISP/MNI ratio – seems to be the primary animal-related symbolic practice- The paucity of gnawing marks probably indicates that the animal body portions, left in the cave as offerings, were protected from secondary consumers. Observing the high percentage of autopod region's elements, it may be that hides of different animals were used to contain the offerings (e.g., Grotta Mora Cavorso, Silvestri *et al*., 2016) or to wrap the deceased. Despite the overall prevalence of non-meaty bones, a further hypothesis that meals were consumed in the cave cannot be fully ruled out, as half of the cut-marked bones belong to meaty skeletal elements. However, the small number of firemarks identified even in areas where charcoal was detected, suggests that the animals were not cooked inside the cave, in contrast with the nearby Grotta di Pastena (Silvestri *et al*., 2019b). It must be noted, however, that other cooking methods, such as boiling, do not leave such evident traces of food processing.

DOGS AT LA SASSA CAVE – CASE CLOSED?

Depositions of dogs began to appear in funerary contexts of the Italian peninsula around the CA (Wilkens, 2006). However, ^{14}C dating shows us that this did not occur at La Sassa Cave. Further hypotheses for their presence may be that 1) stray dogs used the cave as a den during the 15th century, thus disturbing the deposit – this, however, is rather improbable, given the absence of gnaw marks on bones and evidence of holes dug in the deposit, or 2) the dogs simply fell into the cave opening and later died of starvation – but this can also be excluded since such a fate would have surely befallen other species as well, for which there is no evidence. The remaining theory, therefore, is that the dog carcasses may have been thrown into the well-like entrance of the cave by the community living in the settlement probably connected to the nearby abandoned church of Madonna della Misericordia. During World War II, the use and rearrangement of the cave by refugees likely caused the dog remains to commingle, even lower down, resulting in the disturbance of most of the stratigraphy. This hypothesis finds a precise parallel with a rustic farmhouse located in Vittorio Veneto (Treviso, Italy), where, inside a late-republican well reused in the Middle Ages, the almost complete remains of 24 dogs were found (Reggiani *et al*., 2016).

CONCLUSIONS

La Sassa Cave presents a complex stratigraphic and archaeological deposit, with disturbed Protohistoric layers attributed to the CA and the BA. The disturbance caused by the discarding of dog carcasses in the 15th century and by sheltering refugees during World War II has compromised the integrity of this context, however, it remains of great archaeological interest. Zooarchaeological analyses have shed light on the symbolic practices undertaken in this burial cave, while clarifying the post-depositional processes that have altered the deposit through time. In summary, it seems that ritual animal offerings, especially in the form of non-meaty portions of domestic and of unusually numerous wild animals, were deposited in the same context as the burials, while ritual cooking and meals might also have been performed on a more limited scale. These features fit well in the framework of central Italian coeval burial and ritual caves. Taphonomic analyses have also allowed for the recognition of some relevant post-depositional changes that occurred here, and thus, demonstrate that carrying out accurate zooarchaeological work can clarify a wide range of archaeological issues even in a disturbed site such as La Sassa Cave.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_007

REFERENCES

Achino, K.F.; Angle, M.; Barcelò, J.A.; Salari, L. & Silvestri, L. 2021: Assessing the human-animal relationship at Villaggio delleMacine (Latium, central Italy): a contextual zooarchaeological approach for Bronze Age Italian lakeside settlements. *Journal of Archaeological Science: Reports* 36(102831): 1-17.

Agostini, S.; Coubray, S.; De Grossi Mazzorin, J. & D'ercole, V. 1991: Cappadocia (L'Aquila), località Oveto. Indagini preliminari nella Grotta Beatrice Cenci. *Bollettino di Archeologia* 8: 61–71.

Albarella, U.; Dobney, K. & Rowley-Conwy, P. 2009: Size and shape of the Eurasian wild boar (*Sus scrofa*), with a view to the reconstruction of its Holocene history. *Environmental Archaeology* 14: 103-136.

Alessandri, L.; Baiocchi, V.; Del Pizzo, S.; Di Ciaccio, F.; Onori, M.; Rolfo, M.F. & Troisi, S. 2020. A flexible and swift approach for 3D image–based survey in a cave. *Applied Geomatics*. https://doi.org/10.1007/s12518-020-00309-4

Alessandri, L.; Cardello, G.L.; Attema, P.A.J.; Baiocchi, V.; De Angelis, F.; Del Pizzo, S.; Di Ciaccio, F.; Fiorillo, A.; Gatta, M.; Monti, F.; Onori, M.; Rolfo, M.F.; Romboni, M.; Sottili, G. & Troisi, S. 2021: Reconstructing the Late Pleistocene – Anthropocene interaction between the neotectonic and archaeological landscape evolution in the Apennines (La Sassa cave, Italy). *Quaternary Science Review* 265(107067): 1-24.

Barone, R. 1974: *Anatomia comparata dei Mammiferi domestici. 1, Osteologia*. Edagricole, Bologna.

— 1981: *Anatomia comparata dei Mammiferi domestici 3, Splancnologia*. Edagricole, Bologna.

Boessneck, J. 1969: Osteological Difference Between Sheep (*Ovis aries* Linné) and Goat (*Capra hircus* Linné). In: Brothwell, D.R. & Higgs, E.S. (eds.): *Science in Archaeology: A comprehensive survey of progress and research*: 331-358. Thames and Hudson, London.

Bökönyi, S.1970: A new method for the determination of the number of individuals in animal bones material. *American Journal of Archaeology* 74: 291-292.

Bull, G. & Payne, S. 1982. Tooth eruption and epiphyseal fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing animal bones from archaeological sites*: 55-71. B.A.R. (International Series) 109. Oxford.

Clark, K.M. 1995. The later prehistoric and protohistoric dog: the emergence of canine diversity. *Archaeozoologia* 7: 9-32.

Driesch, A. von den 1976: *A guide to the measurements of animal bones from archaeological sites*. Peabody Museum Bulletins 1. Peabody Museum Press, Cambridge. MA.

Gatta, M.; Fiorillo, A.; Salari, L.; Francesca Achino, K.; Federico Rolfo, M. & Alessandri, L. 2022. The faunal assemblage from La Sassa cave (Latium, Italy): Environmental perspective of a Late Pleistocene cave hyena – Brown bear den. *Journal of Archaeological Science*: Reports 46, 103691. https://doi.org/10.1016/j.jasrep.2022.103691

Grant, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing animal bones from archaeological sites*: 91-108. B.A.R. (International Series) 109. Oxford.

Grifoni Cremonesi, R. 1996: Osservazioni sulle buche e sulla problematica dei culti. In: Di Fraia, T. & Grifoni Cremonesi, R. (eds.): *La Grotta di S. Angelo sulla montagna dei Fiori (Teramo) e il problema delle frequentazioni cultuali in grotta*: 305-307. Istituti editoriali e poligrafici internazionali, Pisa.

Harcourt, R.A. 1974: The Dog in Prehistoric and Early Historic Britain. *Journal of Archaeological Science* 1: 151-175.

JOHNSON, E. 2015: *A skeletal comparison of Domestic Dog (*Canis familiaris*), Red Fox (*Vulpes vulpes*), Badger (*Meles meles*) and Domestic Cat (*Felis catus*)*. Open access article, University of Exeter – available online at https://ifeelitinmybones.files.wordpress.com/2015/09/a-skeletal-comparison-of-dog-fox-badger-and-cat.pdf.

LYMAN, R.L. 1994: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

MARIEZKURRENA, K. 1983: Contribución al conocimiento del desarrollo de la dentición y el esqueleto postcraneal de *Cervus elaphus*. *Munibe* 35: 149-202.

MINNITI, C. 2012: *Ambiente, sussistenza e articolazione sociale nell'Italia centrale tra Bronzo medio e Primo Ferro*. B.A.R. (International Series) 2394. Oxford.

PAYNE, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Aşvan Kale. *Anatolian Studies* 23: 281-303.

— 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, Ovis, and Goats, Capra. *Journal of Archaeological Science* 12: 139-147.

PRUMMEL, W. & FRISCH, H.J. 1986: A guide for the distinction of species, sex and body side in bones of sheep and goat. *Journal of Archaeological Science* 13(6): 567-577.

REGGIANI, P.; GHEZZO, E. & POSSENTI, E. 2016: Resti di cane provenienti dal sito di età altomedievale di Via Malanotti a Vittorio Veneto (Treviso). In: ThunHohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Convegno Nazionale di Archeozoologia (Ferrara 2012)*: 285-294. Annali dell'Università degli Studi di Ferrara, Ferrara.

ROMBONI, M.; ARIENZO, I.; DI VITO, M.A.; LUBRITTO, C.; PIOCHI, M.; DI CICCO, M.R.; RICKARDS, O.; ROLFO, M.F.; SEVINK, J.; DE ANGELIS, F. & ALESSANDRI, L. 2023. La Sassa cave: Isotopic evidence for Copper Age and Bronze Age population dynamics in Central Italy. *PLOS ONE* 18, e0288637. https://doi.org/10.1371/journal.pone.0288637

SALARI, L. & TAGLIACOZZO, A. 2019: Le faune. Considerazioni ambientali, economiche e culturali. In: De Angelis, M.C. (ed.): *La Grotta dei Cocci di Narni. Scavi 1989-2001*: 75-91. All'Insegna del Giglio, Sesto Fiorentino.

SALARI, L.; ACHINO, K.F.; GATTA, M.; PETRONIO, C.; ROLFO, M.F.; SILVESTRI, L. & PANDOLFI, L. 2017: The wolf from Grotta Mora Cavorso (Simbruini mountains, Latium) within the evolution of *Canis lupus* L., 1758 in the Quaternary of Italy. *Palaeogeography, Palaeoclimatology, Palaeoecology* 476: 90–105.

SCHMID, E. 1972: *Atlas of animal bones: For prehistorians, archaeologists and Quaternary geologists. Knochenatlas. Für Prähistoriker, Archäologen und Quartärgeologen*. Elsevier, Amsterdam.

SCHMÖLCKE, U. 2013: Once More: Sample Size Estimation in Archaeozoology. *Offa* 69/70: 239-247.

SILVESTRI, L.; SALARI, L. & ROLFO, M.F. 2016: La fauna della media età del Bronzo di Grotta Mora Cavorso (Jenne, RM). In: ThunHohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Convegno Nazionale di Archeozoologia (Ferrara 2012)*: 119-126. Annali dell'Università degli Studi di Ferrara, Ferrara.

SILVESTRI, L.; ROLFO, M.F.; ANGLE, M.; SKEATES, R. & SALARI, L. 2019a: Il potenziale interpretativo dell'archeofauna: alcuni esempi da grotte rituali e funerarie dell'età del Bronzo medio in Italia Centrale. In: De Grossi, J.; Fiore, I. & Minniti, C. (eds.): *Atti dell'8° Convegno Nazionale di Archeozoologia*: 101-108. Lecce, Novembre 2015. Università del Salento, Lecce.

SILVESTRI, L.; ROLFO, M.F.; ACHINO, K.F.; GATTA, M. & ANGLE, M. 2019b: How to detect ritual in Middle Bronze Age Central Italy? A contextual approach at Pastena Cave. In: Buster, L.; Warmenhol, E. & Mlekuž, D. (eds.): *Between worlds: Understanding ritual cave use in later prehistory*: 87-112. Springer, Berlin.

TAGLIACOZZO, A. 1993: L'Archeozoologia: problemi e metodologie relativi all'interpretazione dei dati. *Origini* 17: 7-93.

TARQUINI, S.; ISOLA, I.; FAVALLI, M.; BATTISTINI, A. & DOTTA, G. (2023). *TINITALY*, a digital elevation model of Italy with a 10 meters cell size (Version 1.1). Istituto Nazionale di Geofisica e Vulcanologia (INGV).

TEICHERT, M. 1975: Osteometrische Untersuchungen zur Berechnung der Widderisthöhe bei Schafen. In: Clason, A.T. (ed.): *Archaeozoological Studies*: 51-69. North Holland & American Elsevier, Amsterdam.

VIGLIARDI, A. & BACHECHI, L. 2002: *La grotta del Fontino: una cavità funeraria eneolitica del Grossetano*. Edifir, Firenze.

WAGNER, K. 1930: Rezente Hunderassen: eine osteologische Untersuchung SkriftenutgittavDet Norske Videnskaps. Akademi i Oslo. *Mathematisk-Naturvidenskapeligklasse* 9: 1-157.

WILKENS, B. 2003: *Archeozoologia. Manuale per lo studio dei resti faunistici dell'area mediterranea*. Schio, CD Rom.

— 2006: The sacrifice of dogs in ancient Italy. In: Snyder, L. (ed.): *Dogs and People in Social, Working, Economic or Symbolic Interaction*: 131-136. Oxbow Books, Oxford.

SUPPLEMENTARY MATERIAL

FIGURE 2

Excavation and finds. (a) and (c) Human bones from the Copper Age layers, in Room 1. (b) Collecting the potsherds in Branch RA. (d) The baby-bottle found in Room RA. (e) The pyx lid and some burial-related potsherds from Branch RA. (Pictures by A. Ferracci and M. F. Rolfo) (After Alessandri *et al*., 2021: fig. 8).

Skeletal elements	***Bos taurus***			***Ovis aries* vel *Capra hircus***			***Sus domesticus***			***Canis familiaris***		***Cervus elaphus***			***Sus scrofa***			***Lepus* sp.**		***Canis lupus***			***Vulpes vulpes***		***Martes* sp.**
	CA	**BA**	**GP**	**CA**	**BA**	**GP**	**CA**	**BA**	**GP**	**CA**	**BA**	**CA**	**BA**	**GP**	**CA**	**BA**	**GP**	**BA**	**GP**	**CA**	**BA**	**GP**	**CA**	**GP**	**GP**
Cranial																									
Horn				2	1																				
Maxilla				1			1	2	1		4	1		2											
Mandible			1	6	3		3	2	2		3	1											1		
Upper tooth	2			16	2	1	2	2	7	8	24	4		3			1			1	4				
Lower tooth	1	1	2	19	8	1	1	1	6	6	17	6		3							2				
Undet. Tooth	2	1	3	9	2	1	1	1	7	6	15	3		3							3			1	
Atlas				1							2	1													
Axis				3										1											
Vertebra							1	1		3		1													
Rib												2													
Scapula				1	1		1	1	1			1													
Humerus	1		2	6	2	1	1	1	1			5											1	1	
Radius				7	1		2	1	2		4	3									1				
Ulna		1		1	1		1	1	2		4	3					2							1	
Coxal			1	1		1					2	2													
Femur	1			7	2	1	1	3				1												1	2
Patella				2					1		7														
Tibia				5		1		2	2	1	1	1			1										
Fibula																									
Carpal				4	7			1			6	3				4	2				2				
Tarsal				3		2			1	1	3														
Sesamoid										1	6	1													
Astragalus			1	8			1	2		1	5	1				1	1				3				
Calcaneus				1					2	2	1	1	1	1							2				
Metacarpal	1			6			1		3	2	12	2					1	1			5				
Metatarsal				5	2			1	4	2	8	1					1			1	7			1	
Metapodial			1	7			2	1	3	2	5	1			1		3						1		
Phalanx I				22	2	3		1	10	9	38	2	1		1				1	1	10				1
Phalanx II	1		1	11		2	1		8	11	17	1	1							2	12				1
Phalanx III			1	8			1	1	4	7	27									1					
Total	**9**	**3**	**13**	**162**	**34**	**14**	**21**	**25**	**67**	**62**	**211**	**48**	**3**	**13**	**3**	**5**	**11**	**1**	**1**	**6**	**51**		**3**	**5**	**4**

TABLE 3

Skeletal elements of the identified taxa in the three Protohistoric deposits of La Sassa Cave. CA: Copper Age; BA: Bronze Age; GP: Generic Protohistory.

	NISP	**Cutmarks**	**%Cutmarks**	**Firemarks**	**% Firemarks**	**Gnawing marks**	**%Gnawing marks**
Canis familiaris CA	62	-	-	-	-	-	-
Canis familiaris BA	213	-	-	-	-	-	-
Sus domesticus CA	21	-	-	1	4.8%	-	-
***Sus domesticus* BA**	25	-	-	1	4.0%	1	4.0%
***Sus domesticus* GP**	67	2	3.0%	-	-	-	-
Bos taurus CA	9	-	-	-	-	-	-
***Bos taurus* BA**	3	-	-	1	33.3%	-	-
***Bos taurus* GP**	14	3	21.4%	-	-	-	-
***Ovis* vel *Capra* CA**	160	7	4.4%	2	1.3%	4	2.5%
Ovis vel *Capra* BA	32	-	-	-	-	-	-
***Ovis* vel *Capra* GP**	12	2	16.7%	-	-	1	8.3%
Canis lupus CA	6	-	-	-	-	-	-
***Canis lupus* BA**	49	1	7.1%	-	-	-	-
Vulpes vulpes CA	3	-	-	-	-	-	-
***Vulpes vulpes* GP**	5	1	20.0%	-	-	-	-
***Sus scrofa* CA**	3	1	33.3%	-	-	-	-
***Sus scrofa* GP**	9	2	22.2%	-	-	-	-
***Cervus elaphus* CA**	46	6	13.0%	2	4.3%	3	6.5%
Cervus elaphus BA	3	-	-	-	-	-	-
Cervus elaphus GP	15	-	-	-	-	-	-
M-L ribs CA	43	1	2.3%	-	-	-	-
S-M ribs CA	186	1	0.5%	-	-	-	-
Undetermined CA	1242	5	0.4%	54	4.3%	4	0.3%
M-L ribs BA	73	1	1.4%	-	-	-	-
S-M vertebrae BA	85	1	1.2%	-	-	-	-
Undetermined BA	323	1	0.3%	8	2.5%	1	0.3%
Undetermined GP	156	-	-	1	0.6%	1	0.6%

TABLE 4

Cutmarks, firemarks and gnawing marks identified on the main taxa and undetermined mammal bones of the three Protohistoric deposits of La Sassa Cave. Percentages are calculated on the NISP. CA: Copper Age; BA: Bronze Age; GP: Generic Protohistory. M-L: Medium-Large; S-M: Small-Medium.

	Taxon	Phase	Measurements in mm (Driech 1976)	Withers height in cm
Astragalus	*Ovis aries* vel *Capra hircus*	Copper Age	GLl= 25.5	
Astragalus	*Ovis aries* vel *Capra hircus*	Copper Age	GLl= 25.5	
Axis	*Ovis aries* vel *Capra hircus*	Copper Age	BF cr= 35.0	
Humerus	*Ovis aries* vel *Capra hircus*	Copper Age	Bd= 25.5; SD= 11.5	
Humerus	*Ovis aries* vel *Capra hircus*	Copper Age	SD= 12.5	
Humerus	*Ovis aries* vel *Capra hircus*	Bronze Age	GL= 145.0; SD= 10.2	
Lower M3	*Ovis aries* vel *Capra hircus*	Bronze Age	L= 21.0; B= 7.5	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 32.0; Bd= 9.0; Bp= 10.5; SD= 8.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 34.0; Bd= 10.5; SD= 9.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 33.0; Bp= 11.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 34.0; Bp= 11.0; SD= 9.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 33.0; Bd= 9.0; Bp= 10.0; SD= 8.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Bd= 8.5; SD= 8.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 32.0; Bd= 9.0; Bp= 11.0; SD= 8.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Bd= 9.0; Bp= 10.0; 8.0= SD	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Bd= 10.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Bp= 9.5; SD= 7.5	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 31.0; Bd= 10.0; Bp= 10.5; SD= 9.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Gl= 33.5; Bd= 11.0; Bp= 12.0; SD= 10.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	SD= 10.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 35.5; Bd= 10.5; Bp= 11.0; SD= 9.0	
Phalanx I	*Ovis aries* vel *Capra hircus*	Copper Age	Bp= 10.5	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 20.5; Bd= 8.0; Bp= 10.0	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 20.0; Bd= 8.0; SD= 8.5	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 19.0; Bd= 8.0; Bp= 10.0; SD= 7.0	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 24.0; Bd= 8.0; Bp= 10.0; SD= 8.0; Glpe= 23.5	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 17.0; Bd= 8.0; Bp= 10.5; SD= 8.0	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 19.0; Bd= 8.0; Bp= 10.5; SD= 8.0	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	GL= 36.5; Bd= 11.0; Bp= 11.0; SD= 9.0	
Phalanx II	*Ovis aries* vel *Capra hircus*	Copper Age	Bp= 10.5; SD= 8.0	
Astragalus	*Ovis aries*	Copper Age	Bd= 15.5; GLl= 26.0; GLm= 24.0; Dm= 14.0; Dl= 14.5	59
Astragalus	*Ovis aries*	Copper Age	Bd= 15.5; GLl= 25.0; GLm= 24.0; Dm= 15.0; Dl= 14.0	56,7
Lower M3	*Ovis aries*	Copper Age	L= 16.5; B= 6.5	
Lower M3	*Ovis aries*	Copper Age	L= 19.0; B= 7.5	
Metacarpal	*Ovis aries*	Copper Age	SD= 11.0	
Metacarpal	*Ovis aries*	Copper Age	GL= 104.0; Bd= 20.5; SD= 11.0	50,9
Metacarpal	*Ovis aries*	Copper Age	Bp= 20.0	
Metatarsal	*Ovis aries*	Copper Age	Bp= 18.0; SD= 10.0	
Radius	*Ovis aries*	Copper Age	Bd= 26.0	
Astragalus	*Capra hircus*	Copper Age	Bd= 15.5; GLl= 25.5; GLm= 24.0; Dm= 14.5; Dl= 14.0	
Metatarsal	*Capra hircus*	Copper Age	SD= 13.0	
Phalanx I	*Lepus* sp.	Generic Protohistory	GL= 25.0; Bd= 6.0; Bp= 5.0; SD= 3.5	
II Metacarpal	*Canis lupus*	Bronze Age	GL= 74.0; Bd= 11.0; Bp= 14.5	68
II Metacarpal	*Canis lupus*	Bronze Age	GL= 75.5; Bd= 11.0	69,4
IV Metacarpal	*Canis lupus*	Bronze Age	Bd= 10.5	
III Metatarsal	*Canis lupus*	Bronze Age	GL= 95.5; Bd= 12.0; Bp= 12.0; SD= 10	71,3
IV Metatarsal	*Canis lupus*	Copper Age	GL= 97.3; Bd= 12.0	70,3
IV Metatarsal	*Canis lupus*	Bronze Age	Bd= 10.5	
V Metatarsal	*Canis lupus*	Bronze Age	GL= 86.0; Bd= 10.0; Bp= 9.0	
Phalanx I	*Canis lupus*	Bronze Age	GL= 34.5; Bd= 8.5; Bp= 10.5; SD= 6.5	

Phalanx I	*Canis lupus*	Bronze Age	GL= 39.0; Bd= 10.0	
Phalanx I	*Canis lupus*	Bronze Age	GL= 34.5; Bd= 9.5; Bp= 11.0	
Phalanx I	*Canis lupus*	Bronze Age	GL= 34.0; Bd= 10.0; Bp= 11.5; SD= 8.0	
Phalanx I	*Canis lupus*	Bronze Age	GL= 34.0; Bd= 10.0; Bp= 11.5; SD= 8.0	
Phalanx I	*Canis lupus*	Bronze Age	GL= 34.5; BD= 9.5; Bp= 11; SD= 7.5	
Phalanx I	*Canis lupus*	Bronze Age	GL= 28.5; Bd= 10.0; Bp= 11.5; SD= 8.0	
Phalanx I	*Canis lupus*	Bronze Age	BD= 9.5	
Phalanx I	*Canis lupus*	Bronze Age	GL= 35.0	
Phalanx I	*Canis lupus*	Copper Age	GL= 29.0; Bd= 9.0; Bp= 10.5; SD= 7.0	
Phalanx II	*Canis lupus*	Copper Age	GL= 22.0; Bd= 10.0; Bp= 10.5; SD= 8.0	
Phalanx II	*Canis lupus*	Copper Age	GL= 18.0; Bd= 10.0; Bp= 10.0; SD= 8.5	
Phalanx II	*Canis lupus*	Bronze Age	GL= 21.5; Bp= 9.0; SD= 9; SD= 6.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 18.0; BD= 8.5; Bp= 9.0; SD= 7.5	
Phalanx II	*Canis lupus*	Bronze Age	GL= 23.0; BD= 9.5; Bp= 9.5; SD= 7.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 23.5; Bd= 8.5; Bp= 9.5; SD= 6.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 17.0; Bd= 10.0; Bp= 10.0; SD= 8.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 22.0; Bd= 10.5; Bp= 10.5; SD= 8.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 23.0; Bd= 9.5; Bp= 10.0	
Phalanx II	*Canis lupus*	Bronze Age	GL= 23.0; Bp= 10.0; SD= 7.5	
Radius	*Canis lupus*	Bronze Age	GL= 213.5; Bd= 31.0; Bp= 23.0; SD= 17.5	69,8
Femur	*Vulpes vulpes*	Generic Protohistory	Bp= 28.5; DC= 13.5	
Humerus	*Vulpes vulpes*	Generic Protohistory	Bp= 21.0	
Mandible	*Vulpes vulpes*	Copper Age	1= 34; 12= 31; 13= 14.5; 14= 14	
Femur	*Martes* sp.	Generic Protohistory	Bd= 11.0	
Femur	*Martes* sp.	Generic Protohistory	Bp= 11.0; DC= 6.0	
Phalanx I	*Martes* sp.	Generic Protohistory	GL= 16.0; Bd= 5.0; Bp= 5.0; SD= 3.5	
Astragalus	*Cervus elaphus*	Copper Age	GLm= 44.5; Dl= 20.5	
Lower M3	*Cervus elaphus*	Copper Age	L= 28.0; B= 11.0	
Metacarpal	*Cervus elaphus*	Copper Age	SD= 20.5	
Metacarpal	*Cervus elaphus*	Copper Age	Bp= 35.0; SD= 20.5	
Metatarsal	*Cervus elaphus*	Copper Age	Bd= 38.0	
Phalanx I	*Cervus elaphus*	Copper Age	Bd= 16.5; SD= 13.5	
Phalanx I	*Cervus elaphus*	Copper Age	Bp= 14.0; SD= 16.5	
Phalanx II	*Cervus elaphus*	Copper Age	GL= 37.0; Bd= 15.0; Bp= 17.5; SD= 12.5	

TABLE 5

Measurements and withers heights of the main Protohistoric taxa found in La Sassa Cave.

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Monkeys in ancient Rome

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ABSTRACT: Despite the popularity that monkeys enjoyed in the ancient Roman *oecumene* as curious pets, frequently artistically evoked, it is not easy to encounter their osteological remains in coeval archaeozoological contexts. Together with the Barbary macaque, *Macaca sylvanus* (L., 1758), the best known and most widespread monkey in the Roman world, few other species live – or lived - within the boundaries of the Western Palaearctic. These are essentially represented by olive or Anubis baboon, *Papio anubis* (Lesson, 1827), hamadryas or sacred baboon, *P. hamadryas* (L., 1758), green monkeys of the genus *Chlorocebus* Gray, 1870, and patas or red monkeys, *Erythrocebus patas* (Schreber, 1775). There is also the case of an artistic representation that suggests the ancient Romans' knowledge of exotic primates from the Middle East and/or the Indian subcontinent, such as the rhesus macaque, *Macaca mulatta* (Zimmermann, 1780).

KEYWORDS**:** BARBARY MACAQUE, GRIVET, RHESUS MACAQUE, ARTISTIC ICONOGRAPHY, OSTEOLOGICAL REMAINS OF PRIMATES

RIASSUNTO: Nonostante la popolarità di cui le scimmie hanno goduto presso l'antica ecumene romana anche come animali da compagnia che venivano spesso raffigurati artisticamente, non è facile incontrarne i resti osteologici nei contesti archeozoologici coevi. Insieme alla bertuccia berbera, *Macaca sylvanus* (L., 1758), la scimmia più conosciuta e diffusa nel mondo romano, poche altre specie vivono - o hanno vissuto - entro i confini del Paleartico occidentale. Questi sono rappresentati essenzialmente dal babbuino oliva o Anubis, *Papio anubis* (Lesson, 1827), dall'amadriade o babbuino sacro, *P. hamadryas* (L., 1758), dalle scimmie verdi del genere *Chlorocebus* Gray, 1870, e dalle scimmie patas o scimmie rosse, *Erythrocebus patas* (Schreber, 1775). C'è anche il caso di una raffigurazione che fa ipotizzare la conoscenza da parte degli antichi Romani di primati esotici provenienti dal Medio Oriente e/o dal subcontinente indiano, come il macaco rhesus, *Macaca mulatta* (Zimmermann, 1780).

PAROLE CHIAVE: BERTUCCIA BERBERA, CERCOPITECO GRIGIOVERDE, MACACO RESO, ICONOGRAFIA ARTISTICA, RESTI OSTEOLOGICI DI PRIMATI

RESUMEN: A pesar de la popularidad de los monos en la antigua Roma como singulares animales de compañía, frecuentemente evocados artísticamente, no resulta fácil encontrar restos osteológicos de ellos en contextos arqueozoológicos coetáneos. Junto con el macaco de Berbería, *Macaca sylvanus* (L., 1758), el mono más conocido y más extendido en el mundo romano, pocas otras especies viven -o vivieron- dentro de los límites del Paleártico occidental. Estas están representadas fundamentalmente por el babuino oliva o de Anubis, *Papio anubis* (Lesson, 1827), el babuino hamadryas o sagrado, *P. hamadryas* (L., 1758), los monos verdes del género *Chlorocebus* Gray, 1870, y los monos patas o rojos, *Erythrocebus patas* (Schreber, 1775). También existe el caso de una representación artística que sugiere el conocimiento por parte de los antiguos romanos de primates exóticos de Oriente Medio y/o del subcontinente indio, como el macaco rhesus, *Macaca mulatta* (Zimmermann, 1780).

PALABRAS CLAVE: MACACO DE BERBERÍA, CERCOPITECO VERDE, MACACO RHESUS, ICONOGRAFÍA ARTÍSTICA, RESTOS OSTEOLÓGICOS DE PRIMATES

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INTRODUCTION

At the time of its greatest territorial extension, the Roman Empire covered a geographical range that spanned from the Near East and North Africa to Great Britain and the Canary Islands (McEvedy, 1992). In this large geographical area, monkeys were not uncommon as novelties and curiosities (King, 2002), often being also popular pets (McDermott, 1938; Toynbee, 1973). Thus, it is not difficult to find Roman artistic productions depicting these animals in a variety of poses.

The best-known primate in the western oecumene of Roman times was the Barbary macaque, *Macaca sylvanus* (L., 1758) (McDermott, 1938; Rolfe & Grigson, 2006). This animal is also ordinarily referred to as "Barbary ape", due to a unique feature of its morphology that is the absence of a tail, as in "true apes" (Garcia, 1979). It was the *pithekos* of Aristotle, which gave rise to a general model portrait of the tailless "apes" of Africa and Asia (Spencer, 1995; Masseti, 2019). The Barbary macaque is the only primate indigenous to the Western Palaearctic, where it occurs further north than any other non-human species, also being the only macaque found in Africa (Waters *et al*., 2007). It figures among the medium sized mammals endemic to the western Mediterranean zoogeographical unit (Masseti, 2002). Perhaps for this very reason, the Romans' provisioning of this species was easier than that of other, more exotic primates. Barbary macaques are confined to fragmented populations throughout their current natural range, western North Africa, where they are discontinuously distributed in the subtropical mountainous areas of Morocco and Algeria, while they have long been considered extinct in both Tunisia and Libya (Cabrera, 1932; Richard *et al*., 1989; Fa, 1999). The present distribution of this monkey comprises a European enclave coinciding with the boundary of the promontory of Gibraltar, a British possession in the Iberian Peninsula since 1704 (Zeuner, 1952). The anthropochorous origin of this population is beyond all doubt (Cabrera, 1914; Hill, 1966; Fa, 1981, 1999; Groves, 2001). Few other species of primates live – or lived - within the boundaries of the Western Palaearctic (Figure 1). These are essentially represented by olive or Anubis baboon, *Papio anubis* (Lesson, 1827), hamadryas or sacred baboon, *P. hamadryas* (L., 1758), green monkeys of the genus *Chlorocebus* Gray, 1870, and patas or red monkeys, *Erythrocebus patas* (Schreber, 1775) (Masseti & Bruner, 2009; Masseti, 2012).

ICONOGRAPHY

Being the best-known primates of the ancient western world, Barbary macaques were often represented in the artistic Roman productions, perhaps more than baboons themselves, which were the other best-known monkeys of the time, thanks mainly to their popularity in Egypt. Among the oldest Roman depictions of *M. sylvanus* we can recall a polychrome terracotta shown in the collections of the National Archaeological Museum of Taranto (MArTA), in southern Italy (inv. 196937-196938). It is a *Nike* ("victory"), a winged female figure, seated on a chest with a crouched monkey, dated to the 4th century BC. The artefact appears to depict a sub-adult Barbary macaque. A monkey similar to the latter species is also portrayed in the sculptural group with *Pan and Silenus* from the excavation of the *Ara Pacis* (Rome) in 1937-1938, which does not find typological comparisons and could therefore be a Hellenistic original (Termini, 2009). Another juvenile macaque is evoked in a marble group which is part of the cinerary altar of Caius Julius Saecularis, found in the Villa of Julius III (second half of the 1st century AD) (Rome, Terme di Diocleziano, Museo Nazionale Romano) (Caruso, 2021). The animal is evoked at the feet of the deceased, standing in a tall shell-shaped niche. Another marble relief from Ostia (first half of the 3rd century AD) shows a vegetable seller with a large basket and a stall made up of a wooden trestle table. On the counter are two Barbary macaques to attract and entertain customers (Ostia, Antiquarium inv. 198c) (Toynbee, 1973; Parisi Presicce & Rossini, 2015). Other Barbary monkeys seem to have been portrayed respectively in a terracotta lamp of the 1st - 2nd century AD, a bronze ring with the head of a monkey (2nd - 4th century AD), and the magnificent specimen of the mosaics that decorate the northeastern hall of the imperial palace of Byzantium (register I, sector C, panel Co), Istanbul (Turkey). Here a clothed macaque is attempting to catch a bird from the top of a tall tree, using a lime-twig (Jobst *et al*., 1997). The production of these mosaics dates to the first half of the 6th century AD. Vespa (2022) recalls further examples of Roman artistic representations inspired by the image of Barbary macaques. We have already noted that these North African monkeys were probably more accessible to Roman hunters and trappers than other species, due to their range being less distant than from Rome than that of other monkeys. But this

FIGURE 1
Skull bones and parts of the skeleton of a subadult Barbary macaque, *Macaca sylvanus* (L., 1758), dated between the 50 BC-140 AD (^{14}C) (courtesy Parco Archeologico di Pompei).

does not rule out the importation of other primates from more far-flung areas, such as sub-Saharan Africa or, even, the Indian subcontinent. A case of the latter could be the Roman marble relief with a crouching monkey (2nd century AD), on display at the Thorvaldsens Museum in Copenhagen. It may in fact be the representation of an individual of rhesus macaque, *Macaca mulatta* (Zimmermann, 1780), still dispersed in the Indian subcontinent and adjacent territories (Masseti & Veracini, in press, and references therein). I would, however, have misgivings about accepting the identification in a specimen of Patas monkey proposed by Vespa (2022) for the same second-century AD marble relief.

FAUNAL REMAINS

Representations of monkeys occur in Roman artifacts of Egyptian production (or inspiration). From the Roman-dominated land of the Nile come various depictions of baboons, especially hamadryades (Osborn & Osbornova, 1998). In fact, the production of monkey-shaped artefacts continued in Egypt under Roman rule, as in previous times.

Apart, however, from the Nile country, where it is not difficult to find osteological remains of baboons, representatives of the genus *Chlorocebus*, patas monkeys, and at times even Barbary macaques (Osborn & Osbornova, 1998; Masseti & Veracini, 2024), in the remaining ancient Roman oecumene monkey bones are rather rare in archaeological contexts. No more than nine specimens from the European subcontinent could be documented during the present study, and were only attributed to two species: *M. sylvanus* and *Chlorocebus* cf. *aethiops* (L., 1758). As can be seen from the data in Table 1, some of these remains come from three French archaeological sites. Osteological fragments of *M. sylvanus* were recovered at Cutry (Meurthe-et-Moselle) (first half of the 2nd century AD) (Poplin, 1986; Liéger *et al*., 1997; Gerber & Baudry-Dautry, 2012), and Clos de la Lombarde (Narbonne) (end of the 2nd-beginning of the 3rd century AD) (Sabriè, 2011; Gerber & Baudry-Dautry, 2012), while fragments of the skull of a *Chlorocebus* cf. *aethiops* came from Poitiers (Gerber & Baudry-Dautry, 2012; Gerber, 2019). The new radiocarbon dating placed the remains of the latter specimen between 550 and 620 A.D. (Frédéric Gerber, 2020: pers. comm.). From the United Kingdom come the bones of four other Barbary macaques: from Wroxeter baths (Shropshire) (*c*. 150 AD) (Armour-Chelu, 1997; Albarella, 2007), from the Roman levels of Catterick (Hodgson, 1990, 2002; Armour-Chelu, 1997) and Dunstable (Hodgson, 1990), and from the Northern Ireland site of Navan (150+/-70 BP) (Groves, 2008). Osteological fragments of an individual of the same

Species	**site**	**datation**	**sex**	**Bone remains and age**	**References**
*Macaca sylvanus**	Navan (Northern Ireland, UK)	150+/-70 BP (14C)	-	skull	Groves 2008
Macaca sylvanus	Pompeii (Naples, I)	50 BC-140 AD (14C)	-	Juvenile – skull bones and parts of the skeleton	Henneberg 1997; Bailey *et al.* 1999; Ciarallo 1999; King 2002;
Macaca sylvanus	Cutry (Meurthe-et-Moselle, FR)	first half of the 2nd century AD	♀	very old specimen	Poplin 1986; Liéger *et al.* 1997; Gerber & Baudry-Dautry 2012;
Macaca sylvanus	Wroxeter baths (Shropshire, UK)	c 150 AD	-	phalanx	Armour-Chelu 1997; Albarella 2007
Macaca sylvanus	Clos de la Lombarde (Narbonne, FR)	end of the 2nd-beginning of the 3rd century AD	-	-	Sabriè 2011; Gerber & Baudry-Dautry 2012;
Macaca sylvanus	Llívia, Cerdanya (Empúries, SP)	5th - 6th century AD	♂	subadult – skeleton with the skull	Guardia & Maragall, 2004; Guardia *et al.* 2005; Aquilué 2007
Macaca sylvanus	site 433, Catterick (UK)	Roman levels	-	fragment of skull	Hodgson 1990; Armour-Chelu 1997; Hodgson 2002
Macaca sylvanus	Dunstable (UK)	Roman levels	-	-	Hodgson 1990
Chlorocebus cf. *aethiops*	Poitiers (FR)	550 - 620 AD	-	adult - fragment of skull	Gerber & Baudry-Dautry 2012; Gerber 2019

TABLE 1

Monkey bones from Roman times found in the European subcontinent.

species come from Catalonia (Llívia, Cerdanya: 5th - 6th century AD) (Guardia & Maragall, 2004; Guardia *et al*., 2005; Aquilué, 2007) and Pompeii, southern Italy (50 BC-140 AD) (Henneberg, 1997; Bailey *et al*., 1999; Ciarallo, 1999; King, 2002) (Figure 1), respectively. The latter case constitutes the only Barbary macaque find so far returned by archaeological investigation conducted on Italian territory in Roman contexts. At this point, it is logical to ask why monkey bones are so rare in Roman archaeological contexts in Italy, when artistic depictions of the same subjects are anything but uncommon there? Could this have happened due to sampling biases or to the fact that primate bones were not recognised? Sheet 30, for example, of the *Homo faber* catalogue of the namesake exhibition (Ciarallo & De Carolis, 1999) describes the osteological remains of a primate whose "*exact species attribution is apparently not possible because the skeleton is incomplete*" and for which taxonomic attribution to a young macaque is assumed (Ciarallo, 1999). The problem, however, is that the just given description contained on page 2 of the catalogue *Homo faber* does not correspond to the image of a monkey but rather to that of the bones of a representative of the Soricidae family, rather far from the taxonomic position of primates. However, as we have seen, other authors such as Henneberg (1997), Bailey *et al*. (1999) and King (2002), were in no doubt in referring the monkey to the species *M. sylvanus*.

CONCLUDING REMARKS

Such a gross error would, however, lean more towards a justification to be found in an oversight of the editorial package rather than a problem of another nature. Nor, however, can it be ruled out that the fact that primate burials, especially those of subadult macaques, are occasionally associated with those of humans, may have been mistaken for the remains of subadult individuals of the latter and therefore not included in the archaeozoological record. The bones of the macaque of Pompeii were recovered during a survey conducted back in 1966 among the human skeletal remains stored in Terme di Sarno. The latter material was provided by early excavations of Pompeii in the 19th century (Nicolucci, 1882). According to Henneberg (1997), it is possible that the bones of the monkey were recovered at the same time because skeletons of some domestic animals were excavated together with human remains: "*Since hitherto it has not been known that ancient inhabitants of Pompeii kept per monkeys the skeleton described here was probably mistaken for a skeleton of a human baby and not given any significance by early excavators*" (Henneberg, 1997). We should not forget that the remains of Barbary macaques have also been recovered in human funerary contexts. Suffice it to recall in this regard the already mentioned inhumation of a subadult individual from the ancient Roman necropolis of Iulia Livica (5th-6th centuries AD) at Empúries, in Catalonia. This animal was inhumated with military decorations (belt buckles and bronze plaquettes), suggesting it may have been a military mascot (Guardia *et al*., 2005). And, therefore, invested with a significance that shifted its purely animal dimension towards a decidedly more 'humanoid' perception of it.

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REFERENCES

Albarella, U. 2007: Companions of our travel: the archaeological evidence of animals in exile. In: Hartmann, S. (ed.): *Fauna and Flora in the Middle Ages. Studies of the medieval environment and its impact on the human mind*: 133-154. Verlag Peter Lang, Frankfurt am Main.

Aquilué, X. 2007: Els animals de companyia a l'antiguitat. In: Aquilué, X. & Monturiol, J. (eds.): *Animals d'Empúries. La Fauna i l'Home a l'Antiguitat*: 32-35. Ajuntament de l'Escala/Museu d'Arqueologia de Catalunya-Empuries.

Armour-Chelu, M. 1997: Appendix 8: Faunal remains. In: Barker, P.; White, R.; Pretty, H.; Bird, K. & Corbishley, M. (eds.): *The Bath Basilica Wroxeter. Excavations 1966-90*: 350-364. English Heritage Archaeological Report, 8.

Bailey, J.F.; Henneberg, M.; Colson, I.B.; Ciarallo, A.; Hedges, R.E.M. & Sykes, B. 1999: Monkey business in Pompeii - Unique find of a juvenile Barbary Macaque skeleton in Pompeii identified using osteology and ancient DNA techniques. *Molecular Biology and Evolution* 16(10): 1410-1414.

Cabrera, A. 1914: *Fauna ibérica*. Museo Nacional de Ciencias Naturales, Madrid.

— 1932: Los mamíferos de Marruecos. *Trabajos del Museo Nacional de Ciencias Naturales, Serie Zoologica* 57: 1-362.

Caruso, C. 2021: Altare funerario di C. Julius Saecularis. In: Camin, L. & Paolucci, F. (eds.): *A Misura di Bambino*. *Crescere nell'Antica Roma*: 192. Gallerie degli Uffizi, Firenze/Sillabe, Livorno.

Ciarallo, A. 1999: 30. Scheletro di scimmia. In: Ciarallo, A. & De Carolis, E. (eds.): *Homo Faber. Natura, Scienza e Tecnica nell'Antica Pompei*: 71. Napoli, Museo archeologico Nazionale. Electa, Milano.

Ciarallo, A. & De Carolis, E. (eds.) 1999: *Homo faber. Natura, scienza e tecnica nell'antica Pompei*. Electa, Milano.

Fa, J.E. 1981: Apes on the rock. *Oryx* 16: 73-76.

— 1999: *Macaca sylvanus* (L., 1758). In: Mitchell-Jones, A.J.; Amori, G.; Bogdanowicz, W.; Kryštufek, B.; Reijnders, P.J.H.; Spitzenberger, F.; Stubbe, M.; Thissen, J.B.M.; Vohralik, V. & Zima, J. 1999 (eds.): *The Atlas of the European Mammals*: 158-159. Academic Press, London.

Garcia, J. 1979: *The famous rock apes of Gibraltar*. Mediterranean Sun Publishing Co Ltd, Gibraltar.

Gerber, F. (ed.) 2019: *De la nécropole antique aux jardins des Filles de Notre-Dame*. Inrap NA&OM, Bègles.

Gerber, F. & Baudry-Dautry, A. 2012: La mode de l'animal exotique dans la haute société gallo-romaine. Sépulture d'un singe dans la nécropole de la rue des Caillons à Poitiers. *Archéopages*. *Archéologie et société* 35: 42-47.

Groves, C.P. 2001: *Primate taxonomy*. Smithsonian Institution Press, Washington DC.

— 2008: *Extended family: long lost cousins. A personal look at the history of primatology*. Conservation International, Arlington (USA).

Guardia, J. & Maragall, M. 2004: Periodització del jaciment de les Colomines, Zona A (Llívia, Cerdanya). Fase constructives i seqüencia cronologica. *Setenes Jornades d'Arqueologia de les Comarques de Girona*: 247-252.

Guardia, J.; Maragall, M.; Mercadal, O.; Olesti, O.; Galbany, J. & Nadal, J. 2005: Enterrament d'època tardoromana corresponnent a un macaco amb aixovar al jaciment de les Colomines (Llívia). *Ceretania* 4: 66-106.

Henneberg, M. 1997: *Skeleton of a monkey from ancient Pompeii*. Unpublished manuscript.

Hill, W.C.O. 1966: *Primates. Comparative anatomy and taxonomy*. Volume 6. Catarrhini Cercopithecoidea Cercopithecinae. Edinburgh University Press, Edinburgh.

Hodgson, G.W.I. 1990: *Catterick 433: animal bone report*. AML rep no 2404.

— 2002: A barbary ape from the 1958-9 bypass excavations (Site 433). In: Wilson, P.R. (ed.): Cataractonium: *Roman Catterick and its Hinterland. Excavations and Research, 1958–1997*. Part II: 415. Council for British Archaeology Research Report 129. Oxford.

Jobst, W.; Erdal, B. & Gurtner, C. 1997: *Istanbul. The great palace mosaic*. Arkeoloji ve Sanat Yayinlari, Istanbul.

King, A. 2002: Mammals. Evidence from wall paintings, sculpture, mosaics, faunal remains, and ancient literary sources. In: Feemster Jashemski, W. & Meyer, F.G. (eds.): *The Natural History of Pompeii*: 401-450. Cambridge University Press, Cambridge.

Liéger, A.; Cussenot, O.; Poulain, TH. & Steinbach, D. 1997: *La nécropole gallo-romaine de Cutry (Meurthe-et-Moselle)*. Études Lorraines d'Archéologie Nationale 3. Presses Universitaires de Nancy, Nancy.

Masseti, M. 2002: *Uomini e (non solo) topi. Gli animali domestici e la fauna antropocora*. Firenze University Press/Università di Firenze, Firenze.

— 2012: *Atlas of terrestrial mammals of the Ionian and Aegean islands*. De Gruyter, Berlin.

— 2019: Monkeys in the Ancient Greek World (2000-500 B.C.). In: Veracini, C.; Casanova, C. & Scalfari, F. (eds.): *History of Primatology: yesterday and today. The Mediterranean Tradition*: 21-51. Aracne editrice, Canterano, Rome.

Masseti, M. & Bruner, E. 2009: The primates of the western Palaearctic. A biogeographical, historical, ethnozoological and archaeozoological review. *Journal of Anthropological Sciences* 87: 33-91.

Masseti, M. & Veracini, C. 2024: Europe from the Bronze Age (mid-third millennium BCE) to Greco-Roman times. In: Veracini, C. & Wood, M. (eds.): *Primates in history, myth, art and science*: 103-133. Taylor & Francis, London.

McDermott, W.C. 1938: The ape in Antiquity. *The Johns Hopkins University Studies in Archaeology* 27: vii + 338.

McEvedy, C. 1992: *The new Penguin atlas of medieval history*. Penguin Books, London.

Nicolucci, G. 1882: Crania pompeiana. *Archivio per l'Antropologia e per l'Etnologia* 12: 148-178.

Osborn, D.J. & Osbornova, J. 1998: *The mammals of ancient Egypt*. Aris & Phillips Ltd, Warminster, Oxford.

Parisi Presicce, C. & Rossini, O. (eds.) 2015: *Nutrire l'impero. Storie di alimentazione da Roma a Pompei*. Catalogue of the exhibition in Rome (Museo dell'Ara Pacis, 2 luglio-15 novembre 2015). L'Erma di Bretschneider, Roma.

Poplin, F. 1986: Introduction aux animaux et aux végétaux du séjour des morts. In: Duday, H. & Masset, C. (eds.): *Actes du Colloque Anthropologie Physique et Archéologie, Méthodes d'Étude des Sépultures*: 281-287. C.N.R.S., Toulouse.

Richard, A.F.; Goldstein, S.J. & Dewar, R.E. 1989: Weed macaques: evolutionary implications of macaque feeding ecology. *Int. J. Primatol.* 10: 569-591.

Rolfe, W.D.I. & Grigson, C. 2006: Stubbs's "Drill and albino hamadryas baboon" in conjectural historical context. *Arch. Nat. History* 33: 18-41.

Sabriè, R. 2011: La Maison au Grand Triclinium du Clos de la Lombarde à Narbonne. *Archéologie et Histoire Romaine* 19 (Dremil-Lafage): 1-396.

Spencer, F. 1995: *Pithekos* to *Pithecanthropus*: an abbreviated review of changing scientific views on the relationship of the anthropoid apes to Homo. In: Corbey, R. & Theunissen, B. (eds.): *Ape, Man, Apeman: Changing Views since 1600: Evaluative Proceedings of the Symposium* (28 June-1 July 1993): 13-27. Department of Prehistory, Leiden University, Leiden.

Termini, C. 2009: Gruppo scultoreo con Pan e Sileno, proveniente dallo scavo dell'Ara Pacis del 1937-1938, raffigurante un satiro e una testa barbata di Dioniso. In: Rossini, O. (ed.): *Ara Pacis*: 9. Electa, Milano.

Toynbee, J.M.C. 1973: *Animals in Roman life and art*. Cornell University Press, Ithaca-New York.

Vespa, M. 2022: The place of nonhuman primates in ancient Roman culture: narratives and practices. In: Urbani, B.; Youlatos, D. & Antczak, A.T. (eds.): *World Archaeoprimatology Interconnections of Humans and Nonhuman Primates in the Past*: 201-224. Cambridge University Press, Cambridge.

Waters, S.S.; Aksissou, M.; El Harrad, A.; Hobbelink, M.-E. & FA, J.E. 2007: Holding on the Djebela: Barbary macaque *Macaca sylvanus* in northern Morocco. *Oryx* 41: 106-108.

Zeuner, F.E. 1952: Monkeys in Europe. Past and present. *Oryx* 1: 265-273.

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La fotogrammetria come strumento di documentazione di giacimenti osteologici complessi: il caso della Grotta dei Pietrazzi (Si/Pa 182) Sicilia, Palermo

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RIASSUNTO: Durante le operazioni di rilievo topografico della Grotta dei Pietrazzi (Si/Pa 182), sita all'interno della RNO "Grotta della Molara", sono stati rinvenuti in diversi settori della cavità depositi osteologici a faune. Dalle prime analisi *in situ* e grazie al riconoscimento di alcune peculiari caratteristiche anatomiche, è stato possibile determinare l'appartenenza di tali reperti alla famiglia dei cervidi. I reperti si trovano sia affioranti che sub affioranti da depositi fangosi; si presentano frequentemente veicolati dall'azione delle acque percolanti all'interno della cavità e in alcuni casi inglobati dalle concrezioni calcitiche. Poiché non tutti i resti hanno subito gli stessi processi tafonomici (seppellimento, rimaneggiamento o trasporto) su una piccola aliquota di essi è stato possibile rilevare parziali connessioni anatomiche. Tuttavia, le particolari condizioni tafonomiche e di conservazione rendono questi reperti estremamente fragili. Constatata la quasi impossibilità di lavorare direttamente in grotta sui reperti, si è scelto di utilizzare il rilievo fotogrammetrico per poter analizzarli in maniera assolutamente non invasiva. Attraverso questa tipologia di indagine è stato quindi possibile rilevare il giacimento ottenendo dei modelli tridimensionali sui quali sono state effettuate analisi, misure, confronti morfologici e restituzioni bidimensionali in scala.

PAROLE CHIAVE: GROTTA DEI PIETRAZZI, DEPOSITI OSTEOLOGICI, CERVIDAE, FOTOGRAMMETRIA, MODELLI 3D

ABSTRACT: During the topographical survey activities in the Grotta dei Pietrazzi (Si/Pa 182; Grotta della Molara Natural Reserve – Palermo), an osteological faunal deposit was found in different sectors of the cave. Since the first *in situ* investigations, was possible to assign most part of the remains to cervids. The finds were found both laying on the surface or partially covered by a muddy deposit. The remains had been largely washed away by the water percolating action, and in some cases covered by a thin crust of calcitic flowstone. Although the bones appeared extremely fragile due precarious preservation conditions, part of the osteological deposit it evidenced varying degreesof of anatomical connection. Due to the fragility of the samples and the difficult underground environment, it was decided to analyze the samples adopting photogrammetric methods. Through this type of investigation, it was possible to obtain three-dimensional models on which measurements, morphological comparisons and two-dimensional scale representations were carried out.

KEYWORDS: GROTTA DEI PIETRAZZI, OSTEOLOGICAL DEPOSITS, CERVIDAE, PHOTOGRAMMETRY, 3D MODELS

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RESUMEN: Durante el desarrollo de actividades de levantamiento topográfico en la Grotta dei Pietrazzi (Si/Pa 182; Reserva Natural Grotta della Molara – Palermo), se encontró un depósito faunístico osteológico en diferentes sectores de la cueva. Las primeras investigaciones *in situ* permitieron asignar la mayor parte de los restos a los cérvidos. Los hallazgos aparecian tanto dispersos en superficie como parcialmente cubiertos por un depósito fangoso. Los restos habían sido mayoritariamente arrastrados por percolación hídrica agua y, en algunos casos, cubiertos por una fina costra de roca caliza. Aunque los huesos parecían extremadamente frágiles debido a las precarias condiciones de conservación, una parte de las osamentas mostraba distintos grados de conexiones anatómicas. Debido a la fragilidad de las muestras y al difícil contexto subterráneo, se decidió analizar las muestras adoptando métodos fotogramétricos. A través de éstos se logró obtener modelos tridimensionales sobre los cuales se realizaron mediciones, comparaciones morfológicas y representaciones bidimensionales a escala.

PALABRAS CLAVE: GROTTA DEI PIETRAZZI, DEPÓSITOS OSTEOLÓGICOS, CERVIDAE, FOTOGRAMETRÍA, MODELOS 3D

INTRODUZIONE

La Grotta dei Pietrazzi (Si/Pa 182) ubicata ad ovest della piana di Palermo, (Figura 1a), è una delle tre cavità presenti all'interno della RNO "Grotta della Molara" insieme alla Grotta della Molara (Si/Pa 53) e la Grotta degli Spiriti (Si/Pa 181) (Di Maggio *et al*., 2012). Dal punto di vista storico-archeologico l'area è conosciuta nel panorama antropologico per la presenza di sepolture risalenti al periodo Mesolitico, rinvenute presso Grotta della Molara, mentre la documentazione inerente Grotta degli Spiriti si limita ad un'unica segnalazione di materiale paleontologico pleistocenico, rappresentato da un piccolo frammento di difesa di elefante *Palaeoloxodon* sp. Grotta dei Pietrazzi è conosciuta sin dai primi anni del secolo scorso; durante le prime esplorazioni, mosse da un interesse prettamente speleologico, furono segnalati sporadici reperti riguardanti alcune faune pleistoceniche: *Palaeoloxodon falconeri* e *Crocuta crocuta spelaea* (Mannino, 2007). Le esplorazioni si avvicendarono fino ai primi anni Settanta perlustrando interamente la grotta, caratterizzata da complesse morfologie, ma si limitarono alla realizzazione di semplici ed incomplete topografie della cavità. Durante le operazioni di rilievo topografico della cavità, effettuate durante il biennio 2015/2016 come da incarico del GRE Sicilia - Gruppi di ricerca Ecologica Sicilia ODV, ente gestore della RNO Grotta della Molara, fu rinvenuto un consistente deposito osteologico a faune, fino a quel momento inedito. Il giacimento è ubicato nei pressi della zona centrale della cavità e dall'analisi di alcune peculiari caratteristiche anatomiche delle ossa degli arti e del cranio è stato possibile determinare l'appartenenza di tali reperti alla famiglia dei cervidi di piccola taglia. La Sicilia durante il pleistocene medio annovera diverse specie di cervidi di piccola taglia, oggi estinte, le quali, avvicendandosi fra i diversi complessi faunistici pleistocenici, contraddistinsero l'isola dal punto di vista paleo faunistico (Abazzi *et al*., 2001). Da una prima analisi qualitativa il materiale osteologico, sub-fossile, si conserva con colore e consistenza strutturale differente e risulta evidente come il giacimento sia stato sottoposto a diversi processi tafonomici (come trasporto, seppellimento e successivo sconvolgimento) da attribuire a dinamiche naturali (come acque circolanti, movimenti tettonici) e cause legate a frequentazioni animali e/o antropiche. Inoltre, fra i numerosi i reperti che compongono il giacimento, costituito quasi esclusivamente da cervidi, durante alcuni confronti effettuati *in situ* è stato possibile identificare due specie di carnivori che hanno caratterizzato i complessi faunistici tardo pleistocenici (Bonfiglio *et al*., 2002; Marra, 2013) come la iena delle caverne, *Crocuta crocuta spelaea* e il leone delle caverne *Panthera spelaea*. Durante gli anni successivi la scoperta del deposito sono state condotte diverse ricognizioni mirate al posizionamento topografico dello stesso e, dove le condizioni tafonomiche dei reperti lo hanno permesso, sono state effettuate in via preliminare delle analisi morfometriche, tramite misurazioni biometriche direttamente sui reperti. Una caratteristica che contraddistingue il deposito osteologico della Grotta dei Pietrazzi è rappresentata dai diversi processi tafonomici sopra citati.

Questi hanno agito sui resti rendendoli particolarmente stabili o estremamente fragili, tanto che alcuni possono essere definiti effimeri rendendo impossibile ogni operazione; a tal proposito le analisi biometriche sono state acquisite sfruttando alcune nuove tecnologiche innovative come il rilievo digitale fotogrammetrico attraverso il quale è stato possibile effettuare una mappatura di dettaglio delle singole aree che compongono il deposito osteologico e successivamente, tramite l'utilizzo del software Agisoft Metashape (Agisoft PhotoScan, 2016), sono stati generati dei modelli tridimensionali e le relative restituzioni bidimensionali in scala delle singole aree interessate dal deposito sui quali, in maniera del tutto non invasiva, è stato possibile effettuare alcune analisi morfometriche, come confronti e misurazioni di dettaglio, senza rimuovere o asportare alcun reperto.

MATERIALI E METODI

GROTTA DEI PIETRAZZI: MAPPATURA E TAFONOMIA DEL GIACIMENTO OSTEOLOGICO

La cavità si apre ad una quota di 170 m s.l.m. nei calcari di margine di piattaforma carbonatica (calciruditi e calcareniti) della formazione Calcare di Piano Battaglia del Giurassico superiore-Cretacico inferiore (Catalano *et al*., 2013). La grotta è riccamente concrezionata ed è caratterizzata da una serie di ambienti inclinati ostruiti da grossi blocchi di crollo in assetto caotico. Questi depositi rendono il percorso estremamente accidentato e percorribile tramite l'ausilio della tecnica di progressione speleologica, la quale prevede l'utilizzo di corde ed attrezzature specifiche. La grotta si estende per circa 500 metri e vasti ambienti più profondi presentano un andamento in prevalenza orizzontale raggiungendo la profondità dall'ingresso di circa 90 m (Figura 1b). Il giacimento osteologico è ubicato nella porzione centrale della cavità dove i grossi blocchi di crollo rendono articolato il percorso generando diversi camminamenti attraverso i quali è possibile raggiungere il fondo dell'ipogeo. Durante le operazioni di rilievo topografico e restituzione grafica finale, tutta l'area interessata da materiale osteologico affiorante in superficie, denominata “La via della Ossa”, è stata evidenziata sulla topografia e contrassegnata tramite l'apposita simbologia dell'Unione Internazionale di Speleologia (UIS) che indica il deposito osteologico (Figura 2). La porzione della cavità in cui affiora parte del giacimento coincide parzialmente con il camminamento principale utilizzato da sempre dagli speleologi per transitare verso le zone profonde della grotta; questo implica che molti dei resti rinvenuti su questa via presentano evidenti tracce di calpestio (*cross-trampling*). Le ossa dei cervidi si trovano sia affioranti che sub affioranti dai depositi fangosi, presentandosi in gran parte veicolate dall'azione delle acque percolanti all'interno della cavità. Presentano una colorazione che va dal bianco tendente al giallo-ocra ed in alcuni casi punteggiate di nero, acquisita durante i processi

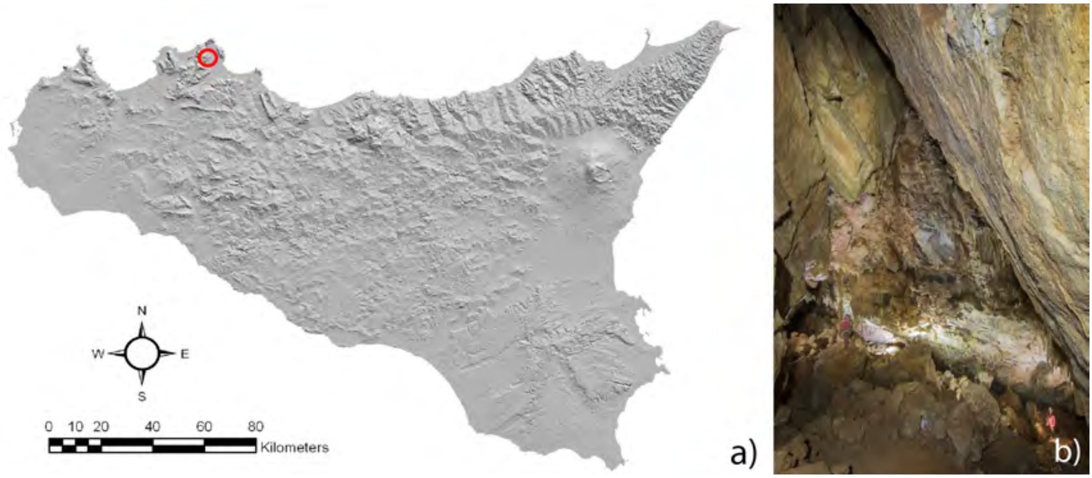


FIGURA 1
a) Ubicazione RNO Grotta della Molara, b) ambienti terminali Grotta dei Pietrazzi.

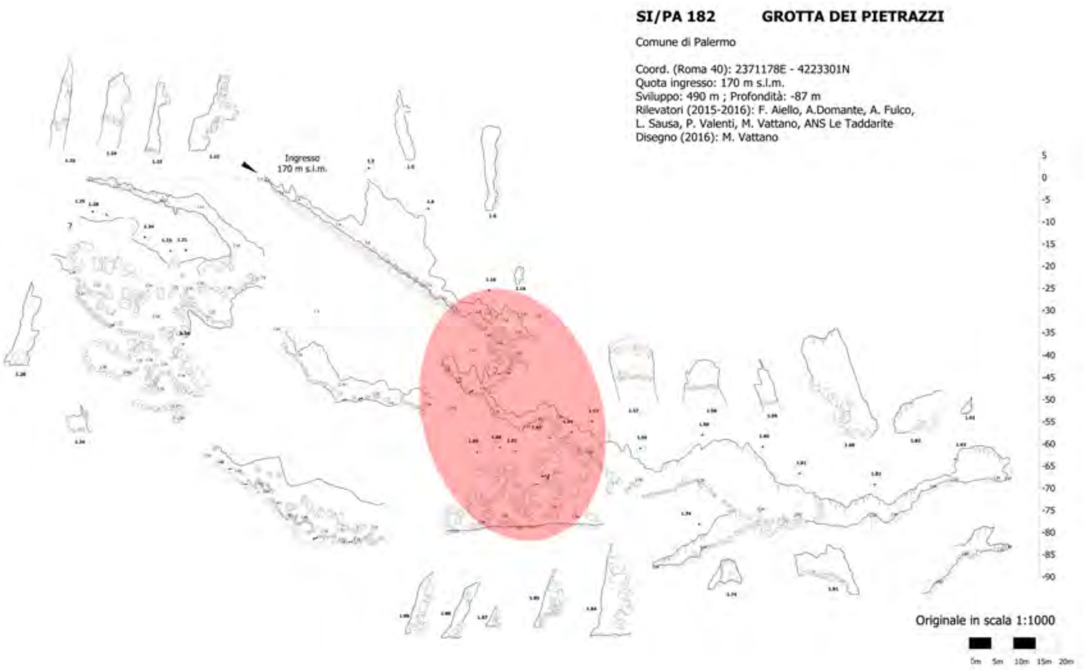


FIGURA 2
Sezione longitudinale estesa della cavità, in rosso evidenziata la “via della ossa”.

tafonomici ad opera degli ossidi di ferro manganese presenti nel terreno (Figura 3a). Tuttavia, non tutto il deposito ha subito un processo di seppellimento, rimaneggiamento e trasporto da parte delle acque percolanti. Questo è dimostrato da alcuni reperti riconducibili a singoli individui, rinvenuti sia in superficie che parzialmente inglobati da concrezioni carbonatiche, che preservano parziali connessioni anatomiche (Figura 3b).

Risulta però evidente che alcuni reperti sono venuti alla luce dalla matrice argillosa per mano dell’uomo come dimostrato dal rinvenimento effettuato in una delle zone più prossime all’ingresso dove, una piccola porzione del giacimento, presenta una chiara azione di disturbo. Alcuni reperti, infatti, dopo essere stati manipolati sono stati posizionati su di un masso adiacente al punto da cui affioravano. Grotta dei Pietrazzi, prima dell’istituzione della RNO, è stata meta abituale non solo per gli speleologi locali ma anche per avventurieri occasionali (Figura 3c). Circa la metà del deposito si trova lungo un percorso che dalla sala immediatamente sotto l’ingresso della grotta raggiunge la zona centrale della cavità. Muovendosi tra grossi blocchi di crollo, il deposito si estende in direzione degli ambienti più profondi della grotta e risulta distribuito sul piano di calpestio in modo caotico (Figura 2). È possibile identificare la genesi del giacimento in diversi momenti: la caduta e accumulo delle carcasse degli animali lungo il piano inclinato che separa l’ambiente sotto l’ingresso con la zona centrale e successivamente il trasporto ad opera delle acque d’infiltrazione. Sulla restante porzione del giacimento osteologico, rappresentata dai reperti che non hanno subito trasporto da parte dell’acqua, sono state rilevate connessioni anatomiche di alcuni distretti come arti e rachide cervicale. Da tali evidenze è stato possibile attribuire l’appartenenza dei reperti a singoli individui e determinare il sesso e l’età degli animali. Una particolarità che contraddistingue questi depositi è quella di non presentare la tipica colorazione rossastra dovuta agli ossidi ferro che accomuna la quasi totalità del giacimento (Figura 4a). Ad avvalorare l’ipotesi che questi animali siano arrivati in completa o parziale connessione anatomica all’interno della cavità e veicolati ad opera esclusivamente della gravità, vi sono ad esempio lo scheletro integro di un giovane individuo di sesso maschile ed i resti del quarto anteriore destro di un giovane individuo di sesso femminile con le vertebre cervicali,

FIGURA 3
a) Porzione di deposito affiorante dai sedimenti, b) elementi scheletrici in connessione anatomica inglobati da concrezione calcitiche, c) reperti decontestualizzati.

dalla II alla VI, in connessione anatomica e cranio semi integro (Figura 4b). In merito alle condizioni qualitative del deposito ubicato lungo la "Via delle Ossa" è possibile fare delle distinzioni alquanto considerevoli. Per quanto riguarda i reperti affioranti e sub affioranti dal fango, questi risultano moderatamente ricoperti da uno strato di carbonato di calcio, molto probabilmente generato dell'azione di seppellimento, la quale ha favorito l'inizio del processo di mineralizzazione. Ciò non vale per un'abbondante aliquota di reperti anch'essi sub affioranti dal fango, i quali apparentemente si presentano come i resti descritti poco sopra, ma risultano estremamente fragili, probabilmente per l'esposizione all'atmosfera della cavità, estremamente satura in anidride carbonica, che ha compromesso la stabilità strutturale di parte del giacimento osteologico (Figura 4a). Gli elementi anatomici in connessione anatomica che non hanno subito né trasporto né seppellimento presentano diversi gradi di alterazione. Le ossa hanno le superfici fortemente alterate, con fratture e macchie attribuibili probabilmente all'azione di diversi fattori come l'alto tenore di umidità, l'azione di batteri endogeni del terreno, ecc. La presenza sporadica di faune pleistoceniche come la iena ed il leone, la sostanziale differenza tafonomica fra questi reperti, nonché la condizione sub fossile dei reperti appartenenti ai cervidi, hanno destato non pochi interrogativi sull'età dell'intero giacimento. A tal proposito è stato sottoposto ad analisi radiometrica un reperto proveniente dal punto in cui sono state registrati evidenti segni di disturbo antropico (Figura 3c). La datazione radiometrica al ^{14}C, effettuata da Laboratorio Circe con sede a Caserta, ha rivelato un'età radiocarbonica di ca 23.313 – 22.491 BC. Questo dato ci premette di posporre in avanti la presenza di più specie di cervidi di piccole dimensioni come *Cervus elaphus siciliae e Dama carburangelensis* nel medesimo periodo sul territorio siciliano dal complesso faunistico pleistocenico (CF) denominato "Grotta di San Teodoro-Pianetti" (Interpleniglaciale del tardo Pleistocene superiore, cfr Bonfiglio *et al*., 2008) almeno al complesso faunistico più tardo denominato denominato"Fauna di Castello" (Pleniglaciale superiore e Tardo glaciale, Petruso *et al*., 2011). In via del tutto preliminare, sono state condotte alcune analisi dirette solamente su quei reperti strutturalmente stabili, prelevando alcune misure biometriche in accordo con Driesch (1976). L'estrema fragilità di numerosi elementi scheletrici, rappresentante l'aliquota del giacimento che non ha subito un processo di seppellimento, ha reso estremamente rischiose, ed in molti casi impossibili, anche la più semplice analisi diretta come l'acquisizione di misure biometriche. A tal proposito l'applicazione della

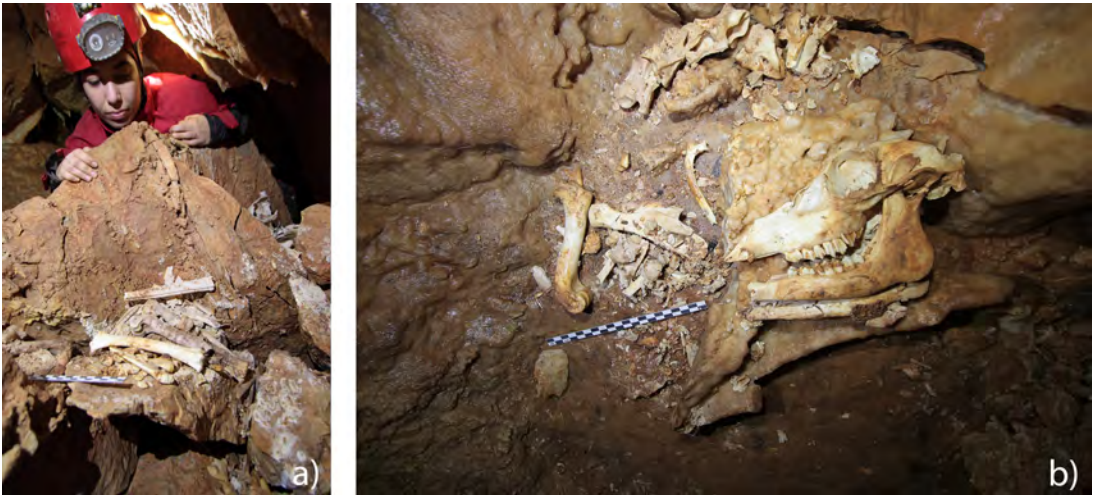


FIGURA 4

a) Reperti fragili che non hanno subito seppellimento dai sedimenti, b) elementi scheletrici cranio e rachide cervicale in parziale connessione anatomica di un giovane cervide di sesso femminile.

tecnica fotogrammetrica ha permesso di studiare il deposito nella maniera meno invasiva possibile.

La fotogrammetria applicata alla documentazione del giacimento

I nuovi strumenti per la documentazione, la salvaguardia e la valorizzazione di contesti difficilmente raggiungibili di interesse comunitario, caratterizzati da un patrimonio naturale e culturale, permettono di garantire la loro sopravvivenza e la trasmissione alle generazioni future. Nel programma di conoscenza, studio e intervento nella Grotta dei Pietrazzi, il rilievo ha rappresentato l'azione preliminare e indispensabile alla conoscenza, tutela, conservazione digitale e monitoraggio del giacimento, da estendere successivamente anche ad altre aree del deposito. La "conservazione digitale" sfrutta le più avanzate tecnologie informatiche per custodire, attraverso la registrazione, classificazione e archiviazione dei dati, il deposito osteologico in quel determinato momento storico senza intaccare la fisicità dei reperti, preservandoli nel tempo, almeno a livello virtuale (Carmassi, 2001). La necessità di effettuare una documentazione tridimensionale del deposito non deriva solo dall'esigenza di studiare un sito ubicato in un ambiente ipogeo ad alto rischio, ma anche di preservare digitalmente il sito stesso, che potrebbe subire danni da agenti esogeni, endogeni o antropici. La documentazione tridimensionale rappresenta uno strumento fondamentale per la comprensione dello stato di conservazione del sito e per monitorarne l'evoluzione nel tempo (Agapiou *et al*., 2016), data la fragilità dei reperti presi in esame. L'integrazione delle tecniche tradizionali di rilievo con le tecnologie digitali avanzate nella ricerca paleontologica, consentono la restituzione 3D da immagini digitali 2D delle aree prese in esame mediante la definizione di modelli numerici scalati sulla base di misure reali prese sul campo (Lo Brutto *et al*., 2014). Per documentare in maniera puntuale la distribuzione dei numerosi resti osteologici presenti è possibile raccogliere il massimo delle informazioni utilizzando le ortofoto, uno strumento unico e versatile anche per la realizzazione di rappresentazioni iconografiche. Considerando le problematicità riconducibili al contesto (accessibilità, assenza di luce, umidità, ambienti angusti e mobilità/spazio), è stato necessario individuare una tecnica di 3D *surveying* che offrisse il miglior rapporto tra precisione del rilievo, area da rilevare, economicità dell'intervento (sia per costi che per peso/spazio delle attrezzature da impiegare) e garanzia del risultato finale. Pertanto, soppesando le differenti possibilità di rilievo e le differenti soluzioni oggi disponibili, si è impiegata la *photo modelling*, detta anche fotogrammetria 3D, eseguita attraverso l'*Image Based in Camera Scan-*

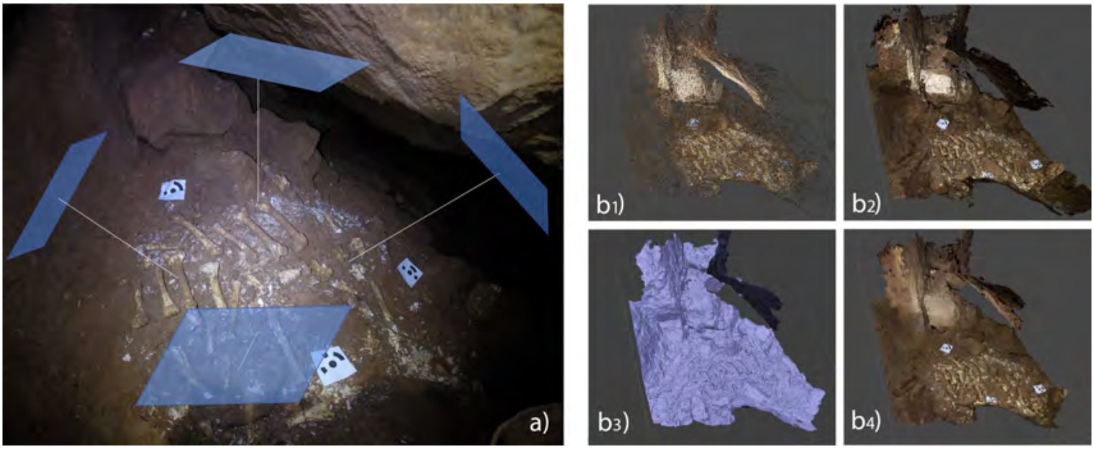


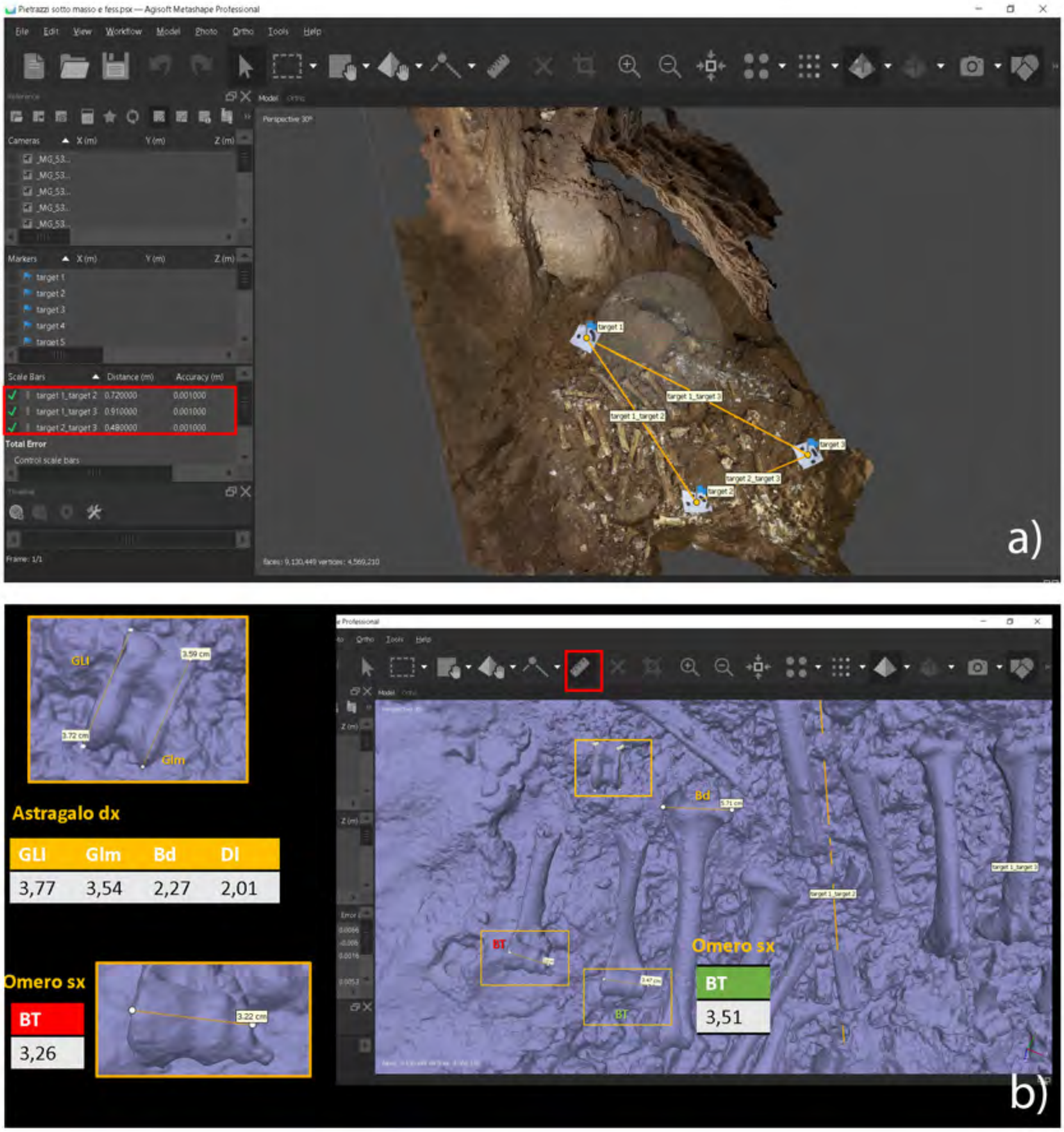
FIGURA 5

a) Posizionamento delle fotografie e dei target per la scalatura del modello tridimensionale, b) realizzazione del modello 3D attraverso l'allineamento delle immagini (1), la nuvola densa (2), la mesh (3) e la texture (4).

ner che consente la restituzione metrica tridimensionale delle superfici eterogenee senza disporre di attrezzature complesse (Limoncelli & Schepis, 2020). Infatti, il rilievo fotogrammetrico 3D è stato realizzato da tre operatori con un set di faretti, una fotocamera DSRL Canon 5D Mark II dotata di obiettivo grandangolare (17-40mm f/4) ed una action-cam Go-Pro Hero 9 per l'acquisizione di fotografie in ambienti ristretti. La tecnica dell'*Image Based in Camera Scanner* utilizza come input le immagini prodotte dalle fotocamere digitali e come output i modelli 3D metrici attraverso la proiezione, in uno spazio tridimensionale, di punti rilevati in maniera automatizzata con alta precisione e fedeltà al reale (Bianchini, 2009) (Figura 5). Per orientare in maniera corretta le fotografie in un sistema di coordinate spaziali è stato necessario impiegare dei punti di controllo omologhi (*matching*) tra le varie immagini, indicati da *target* (numerati, generati e stampati dal software di elaborazione Agisoft Metashape) che successivamente vengono ricondotti all'interno di uno spazio tridimensionale e perfettamente scalati grazie alle misure delle distanze tra i *target* prese sul campo. Il risultato finale è la restituzione di un modello tridimensionale metrico in scala 1:1 sul quale è possibile effettuare misurazioni biometriche. Per confermare la veridicità e l'accuratezza della metodologia impiegata sono state effettuate un set di misurazioni *in situ* con l'ausilio di un calibro digitale e confrontate con misurazioni ottenute in maniera digitale sul modello 3D ottenendo uno scarto di 0,001mm di differenza che conferma la precisione della tecnica impiegata (Figura 6). Dal modello tridimensionale ottenuto è stata inoltre possibile generare un'elaborazione grafica in ambiente vettoriale CAD di due aree sottoposte a rilievo fotogrammetrico in scala consentendo di localizzare tutti gli elementi presenti nella scansione ed evidenziare i dettagli del deposito (Figura 7). La tecnica del *camera scanner* è stata preferita alla scansione laser per velocità di acquisizione del rilievo e di elaborazione dati; per la maggiore libertà di scelta dei punti di ripresa che consente un miglior campionamento delle superfici (con conseguente riduzione dei coni d'ombra e dei sottosquadri); per la praticità dei movimenti in ambiente grotta e per l'economicità delle attrezzature. Sfruttando la possibilità di poter effettuare misure direttamente sui modelli tridimensionali in scala di quelle porzioni del giacimento osteologico particolarmente fragili è stata condotta, in via del tutto preliminare, una prima indagine morfometrica.

RISULTATI DISCUSSIONI

L'applicazione del rilievo fotogrammetrico come strumento per la documentazione ha ridotto al minimo il rischio di compromettere la stabilità dei reperti. I dati biometrici di questi ultimi, prelevati con l'ausilio del programma di elaborazione dei modelli tridimensionali (Agisoft Metashape 1.7), risultano estremamente affidabili e precisi. Confrontando i dati con le misure dei medesimi



Scale Bars	Distance (m)	Accuracy (m)
✓ target 1_target 2	0.720000	0.001000
✓ target 1_target 3	0.910000	0.001000
✓ target 2_target 3	0.480000	0.001000

Astragalo dx

GLl	Glm	Bd	Dl
3,77	3,54	2,27	2,01

Omero sx

BT
3,26

Omero sx

BT
3,51

FIGURA 6

a) Scalatura del modello tridimensionale, b) misurazioni biometriche dei reperti.

reperti rilevate direttamente con l'ausilio di un calibro digitale, è emerso che le misure si discostano soltanto di alcuni decimi di millimetro, uno scarto equiparabile alle misurazioni manuali effettuate da due diversi operatori. L'analisi morfometrica è stata condotta comparando alcune misure, registrate su alcuni astragali, con un dataset di misure disponibili in bibliografia (Tagliacozzo, 1993), confermando le piccole dimensioni degli animali. In merito a tale evidenza, consapevoli che sia il cervo che il daino hanno caratterizzato la Sicilia pleistocenica con diversi *taxon* endemici (*Cervus elaphus siciliae e Dama carburangelensis*, Gliozzi & Malatesta, 1983) e in mancanza dei palchi, la posizione tassonomica dei reperti rimane incerta. Non si può infatti escludere la presenza di differenti specie di cervidi all'interno del giacimento preso in esame. La datazione radiometrica ci permette di poter approfondire un importante scenario d'indagine implementando la conoscenza attuale sul tur-

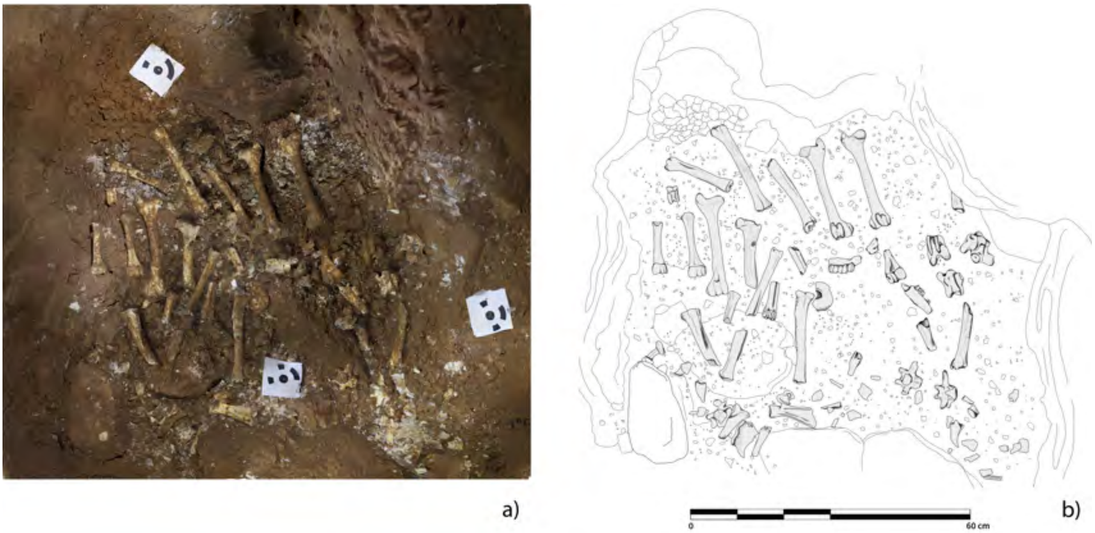


FIGURA 7
a) Ortofoto di una parte del deposito estrapolata dal modello tridimensionale, b) elaborazione grafica in ambiente vettoriale cad.

nover delle specie di mammiferi che caratterizzano i depositi faunistici quaternari rinvenuti presso le cavità del palermitano.

CONCLUSIONI

Il nuovo approccio metodologico applicato alle estreme condizioni operative del sito ipogeo indagato come la totale assenza di luce, i piccoli spazi di manovra, l'elevato tasso di umidità dell'aria, hanno reso le operazioni di acquisizione dei dati per nulla semplici, tuttavia, l'accuratezza delle misure biometriche ottenute dai modelli tridimensionali generate, i bassi costi di applicazione della fotogrammetria come strumento indiretto per la documentazione e lo studio biometrico di depositi osteologici ubicati in ambienti complessi come le cavita carsiche, si è rivelata una strategia vincente ed innovativa. La conferma di poter indagare, dal punto di vista biometrico, il nuovo giacimento nel modo meno invasivo possibile, ha aperto l'opportunità di proseguire gli studi con ulteriori analisi negli anni a venire. Inoltre, l'utilizzo della tecnica fotogrammetrica permette in maniera digitale la conservazione dei giacimenti attraverso la prototipazione e stampa tridimensionali dei reperti in scala, garantendo la musealizzazione di siti di difficile accesso. Nuove indagini mirate alla discriminazione morfologica e biometrica delle diverse specie di cervidi siciliani sono attualmente in corso e potranno chiarire le complesse dinamiche faunistiche tardo pleistoceniche di questa cavità.

REFERENCIAS

ABAZZI, L.; BONFIGLIO, L.; MARRA, A.C. & MASINI, F. 2001: A revision of medium and small sized deer from the middle and late Pleistocene of Calabria and Sicily. *Boll. Soc. Pal. It.* Modena 40(2): 115-126.

AGAPIOU, V.; LYSANDROU, K.; THEMISTOCLEOUS, D.G. & HADJIMITSIS 2016: Risk Assessment of Cultural Heritage Sites Clusters Using Satellite Imagery and GIS: The Case Study of Paphos District, Cyprus. *Journal of the International Society for the Prevention and Mitigation of Natural Hazards* 83/2: 1-15.

AGISOFT PHOTOSCAN 2016: *Manuale d'Uso*: Versione Professional, Versione 1.2. Copyright Agisoft LLC.

BIANCHINI, M. 2009: *Manuale di Rilievo Digitale in Archeologia*. Aracne, Roma.

BONFIGLIO, L.; MANGANO, G.; MARRA, A.C.; MASINI, F.; PAVIA, M. & PETRUSO, D. 2002: Pleistocene Bioprovince calabresi e siciliane. *Geobio. Spec. mem.* 24: 29–39.

BONFIGLIO, L.; ESU, D.; MANGANO, G.; MASINI, F.; PETROSO, D.; SOLIGO, M. & TUCCIMEI, P. 2008: Late Pleistocene vertebrate bearing deposits at San Teodoro Cave (North-Eastern Sicily): Preliminary data on fauna, diversification and chronology. *Quaternary International* 190: 26-37.

CARMASSI, M. 2001: Approcci Metodologici, Progetto di conservazione. In: Zevi, L. (ed.): *Il Manuale del Restauro Architettonico*. Mancuso, Roma.

CATALANO, R.; AVELLO, G.; BASILONE, L.; CONTINO, A. & AGATE, M. 2013: *Note Illustrative della Carta Geologica d'Italia* alla scala 1: 50.000 foglio 595. Palermo, ISPRA Istituto Superiore per la Ricerca Ambientale, Servizio Geologico D'Italia, Organo Cartografico dello Stato (legge n°68 del 2.2.1960).

DI MAGGIO, C.; MADONIA, G.; PARISE, M. & VATTANO, M. 2012: Karst of Sicily and its conservation. *Journal of Cave and Karst Studies* 74(2): 157–172.

DRIESCH, A. von den 1976: *A guide to the measurements of bones from archaeological sites*. Harvard University, Cambridge.

GLIOZZI, E. & MALATESTA, A. 1983: A Megacerine in che Pleistocene of Sicily. *Geo. Rom.* 21: 311-395.

LIMONCELLI, M. & SCHEPIS, L. 2020: Atlante topografico di Soknopaiou Nesos: 3D surveying della città: metodologie di acquisizione dei dati e sistemi di rilevamento per la documentazione archeologica (campagna 2019). In: Serra, F. (ed.): *Studi di egittologia e papirologia*: 17. Pisa.

LO BRUTTO, M.; GARRAFFA, A. & MELI, P. 2014: UAV Platforms for Cultural Heritage Survey: First Results. In: Remondino, F. & Menna F. (eds.): *ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences*: 227-234, vol. II-5. Riva del Garda.

MANNINO, G. 2007: *Guida alla Preistoria del palermitano: elenco dei siti preistorici della provincia di Palermo*. Istituto Siciliano degli studi Politici ed Economici, Palermo.

MARRA, E. 2013: Evolution of Endemic Species, Ecological Interactions and Geographical Changes in an Insular Environment: A Case Study of Quaternary Mammals of Sicily (Italy, EU). *Geosciences* 2013(3): 114-139.

PETRUSO, D.; SARÀ, M.; SURDI, G. & MASINI, F. 2011: Le faune a mammiferi della Sicilia tra il tardo glaciale e L'olocene. *Biogeographia* 30: 27-39.

TAGLIACOZZO, A. 1993: Archeozoologia della Grotta dell'Uzzo, Sicilia. *Bulletino di Paletnologia Italiana* 84.

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The development of husbandry strategies at Pisa between the 5th century BC and the 5th century AD

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ABSTRACT: The analysis of the animal remains from the 1985-1988 excavations in the eastern area of Piazza Duomo, near the Leaning Tower (saggio D) of Pisa is presented. The site was a central locus within the Etruscan-Roman city, situated on the northern edge of the urban area and bordered northwards by the now-extinct river Auser. The excavation highlighted a complex stratigraphy characterized by intense building activities from the mid-6th c. BC to the 6th c. AD. Domesticates (cattle, pig and caprines) constitute the bulk of the faunal samples, with red deer and roe deer being the most frequent wild species. The long chronological sequence allowed us to reveal changes in the animal exploitation strategies through time.

KEYWORDS: PISA, TUSCANY, ETRUSCAN, ROMAN, ZOOARCHAEOLOGY

RIASSUNTO: In questo lavoro vengono analizzati i resti faunistici recuperati durante le indagini archeologiche svolte negli anni 1985-1988 a Pisa nel settore orientale di Piazza del Duomo, a pochi metri dalla torre pendente (saggio D). L'area si colloca, come oggi, in un punto nevralgico della città etrusca e romana, ubicato ai limiti settentrionali dell'area urbana e lambito a nord da un fiume oggi scomparso, l'Auser. Lo scavo ha evidenziato una complessa stratificazione articolata in molteplici fasi di frequentazione, caratterizzate da un'intensa attività edilizia, databili senza soluzione di continuità tra la metà del VI a.C. e il V secolo d.C. I campioni analizzati sono composti dai resti riferibili alle principali categorie di animali domestici (bovini, ovicaprini e suini); le specie selvatiche sono presenti ma in minor numero. Tra queste, i più rappresentati risultano essere il cervo e il capriolo. La lunga sequenza cronologica ci permette di osservare come lo sfruttamento degli animali sia cambiato nel corso dei secoli.

PAROLE CHIAVE: PISA, TOSCANA, ETRUSCA, ROMANA, ZOOARCHAEOLOGIA

RESUMEN: Se presenta el estudio de los restos faunísticos de las excavaciones realizadas entre 1985-1988 en la zona este de la Piazza Duomo, cerca de la Torre Inclinada (saggio D) de Pisa. El contexto corresponde a un lugar central dentro de la ciudad etrusco-romana, ubicada en la margen norte del área urbana, bañada entonces por el hoy extinto río Auser. La excavación puso de relieve una estratigrafía compleja caracterizada por una intensa actividad constructiva que se desarrolló de forma ininterrumpida desde mediados del siglo VI. a.C, hasta el siglo VI. AD. Las cabañas domésticas (bovina, porcina y caprina) constituyen el grueso de la muestra, siendo el ciervo y el corzo las especies silvestres más frecuentes. La larga secuencia cronológica permitió asimismo evidenciar cambios en las estrategias de explotación animal a lo largo del tiempo.

PALABRAS CLAVE: PISA, TOSCANA, ETRUSCO, ROMANO, ZOOARQUEOLOGÍA

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INTRODUCTION

The current Piazza dei Miracoli in Pisa stands on a focal point of the Etruscan-Roman settlement, even if it is located in a peripheral area of the city (Bruni, 2022); at that time, the site was on a hillock, bordered by the western branch of the Auser river (Bini *et al.*, 2015: 205).

Fortuitous discoveries and systematic archaeological research brought to light materials dated between the Orientalizing and the Hellenistic period; however, only in some rare cases it was possible to identify reliable archaeological contexts after thorough stratigraphic excavations. The latter were carried out between the 1980s and the end of the 1990s, focusing on the eastern sector of the square, few steps away from the Leaning Tower (Maggiani, 1993: 57-60; Bruni, 1995: 181-185; Alberti *et al.*, 2015: 58, fig. 1).

The first interpretation suggested that during the Orientalizing period (around the end of the 8th century BC) aristocratic residences occupied the area (Bruni, 1998: 99-102); however, between the beginning of the Archaic period and the middle Hellenistic period (end of the 7th-last quarter of the 3rd century BC), archaeological evidences may hint to a ritual function of the site, even though monumental buildings have yet to be found (Bonamici, 2011). This last option is further confirmed by bronze figures and a golden plate, found in the same context (Maggiani, 1993: 58, fig. 8, 3; Maggiani, 2001: fig. 1, c). The recently discovered epigraphic repertoire and other findings may also indicate the presence of an artisanal and emporic sector inhabited by a diverse community; in this place, ritual activities were probably practised too (Bonamici & Taccola, 2022).

Despite the main function of the site remains unclear, a striking feature is that the orientation between the various structures remained unchanged for almost nine centuries–at least from the beginning of the 5th century BC: as a matter of fact, the structures often appear overlapped between the different phases. This spatial organisation was part of a regular urban network, aligned with the cardinal points. Between the different archaeological phases, flood events caused by the nearby Auser can be identified. One of these floods led to the abandonment and the consequent restoration of the area between the last quarter of the 3rd century BC and the first quarter of the 2nd century BC. After that, the site turned into a residential area for the upper class, then maintaining this vocation for the whole Roman period (Taccola, 2020: 17-18).

The aim of this work is to discuss the preliminary zooarchaeological analysis carried out on the materials recovered from Area D, the only area excavated between 1985 and 1988. This area was inhabited from the Archaic period until the Late Antiquity and was characterised by an intense construction activity. A thorough reconstruction of the stratigraphic sequence and a detailed analysis of the archaeological materials concerned the Hellenistic period, between the middle of the 4th century BC and the beginning of the 1st century BC (Taccola, 2019).

MATERIALS AND METHODS

The animal remains were identified throught direct comparison with the references collection of the Laboratory of Zooarchaeology of the University of Pisa, but the works of different scholars were also used as reference: Schmid (1972) and Barone (1980) for the mammals, and Cohen & Serjeanston (1996) for the avifauna. The distinction between sheep and goat was carried out with the criteria described in Boessneck *et al.* (1964) and Zeder & Lapham (2010) for long bones, Payne (1985) and Halstead *et al.* (2002) for mandibles and teeth.

Data from the epiphyseal fusion of long bones were recorded using the works of Silver (1969) for cattle, Bullock & Rackham (1982) for caprines and Bull & Payne (1982) for pigs. In accordance with these works, the age stages are defined as follows: juvenile when the animal was killed before 12 months, subadult when it was killed between 12 and 35 months and, lastly, adult when it was killed later than 35 months. Tooth wear stages were recorded following Grant (1982) and Bull & Payne (1982) for pig and Payne (1973) for caprines.

The faunal sample was divided into two chronological phases: Pre-Roman period (550-175 BC) and Roman period (175 BC-400 AD). This division was made to observe changes in animal exploitation during a large chronological period in the same context.

As shown in Table 1, it was possible to identify 1016 bone remains (35.9% of the whole faunal record), while 547 remains (19.3%) are ribs and vertebrae and the remaining (44.7%) are unidentified bone fragments. The majority of animal bones

Period	**Pre-Roman**			**Roman**			**Total Sample**		
Taxon	**NISP**	**%**	**MNI**	**NISP**	**%**	**MNI**	**NISP**	**%**	**MNI**
Domestic species									
Equids - *Equus* sp.	1	0,1	1				1	0,1	2
Cattle - *Bos taurus* L.	126	15,1	1 SA, 3 A	27	14,7	2 A	153	15,1	6
Sheep or Goat - *Ovis* vel *Capra*	210	25,2		38	20,7		248	24,4	
Sheep - *Ovis aries* L.	47	5,6	2 J, 4 SA, 7 A	5	2,7	2 SA, 1A	52	5,1	16
Goat - *Capra hircus* L.	16	1,9		3	1,6		19	1,9	
Pig - *Sus domesticus* Erx.	389	46,8	4 J, 3 SA, 4 A	96	52,2	2 J, 2 SA, 1A	485	47,7	16
Dog - *Canis familiaris* L.	3	0,4	1 SA	2	1,1	1 J	5	0,5	2
Cat - *Felis catus* L.	1	0,1	1 A				1	0,1	1
Domestic fowl - *Gallus gallus* L.	2	0,2	1 A	1	0,5	1 A	3	0,3	
Wild Species									
Roe deer - *Capreolus capreolus* L.	12	1,4	1 SA, 1A	1	0,5	1 A	13	1,3	3
Red deer - *Cervus elaphus* L.	6	0,7	1 SA				6	0,7	1
Fox - *Vulpes vulpes* L.	1	0,1	1 A				1	0,1	1
Tortoise - *Testudo hermanni* Glm.	2	0,2	1				2	0,2	1
Wood pigeon - *Columba palumbus* L.				2	1,1	1 A	2	0,2	
Bird - Aves ind.	11	1,3		4	2,2	1	15	1,5	
Fish - Pisces ind.	3	0,4	2	2	1,1	1	5	0,5	3
Mollusca ind.	2	0,2	1	3	1,6	2	5	0,4	3
Total identified	**832**	**100**	**37**	**184**	**100**	**15**	**1016**	**100**	**52**
Vertebrae	119			24			143		
Ribs	361			43			404		
Unidentified fragments	1081			184			1265		
Total	**2393**			**435**			**2828**		

TABLE 1

Numbers of identified animal remains (NISP), percentage and minimum number of individuals (MNI) divided between Pre-Roman phase (550-175 BC) and Roman phase (175 BC – 400 AD). (J=Juvenile, SA=Subadult, A=Adult).

come from the Pre-Roman context (2393 bone fragments, corresponding to 84.6% of the total), while the Roman period is less rapresented (435 remains, corresponding to 15.4%). In both phases, the main domestic animals predominate, alongside a small number of dogs, cats, and domestic fowl. Wild species are also present, and among them, roe deer predominating, followed by deer; other species (fox, bird, tortoise, marine shells, and fish) are present in negligible quantities. As can be seen in the chart (Figure 1), the faunal remains analysed were divided among the different archaeological periods; a striking feature is that almost half of the bone remains (47%) were found in the 3rd century period, during the Hellenistic phase (Pre-Roman period).

RESULTS: THE PRE-ROMAN PERIOD

As mentioned above, the sample is mainly composed of domestic species (95.7%), with pigs being the most predominant *taxon* (46.8%). The most recurrent anatomical elements (see Table 1 in Supplementary materials) are teeth, cranium, forelimb, and hindlimb; however, the extremities of the limbs (carpal, tarsal and phalanges) are poorly represented. Pigs' mortality data (see Table 2 in Supplementary materials, Figure 2), calculated using epiphyseal fusion, indicates that juveniles and adult animals are present with similar numbers (37.8% and 36.2% respectively), while subadult individuals are less prominent (26%). However, tooth wear stage data-which are more reliable-indicate as follows: 13% of the animals were killed before 12 months-with 10% under the 7 months; 73% were slain between 12 and 35 months-with more than 35% of animals butchered between 24 and 30 months and, finally, 14% were slaughtered over 35 months. Lastly, 8% of the pig bones showed butchery marks, mainly located on humerus, ulna, pelvis, and tibia, while 50% of the limb bones had burn marks.

Caprines are the second most represented category (32.7%), with sheep prevailing over goats at a

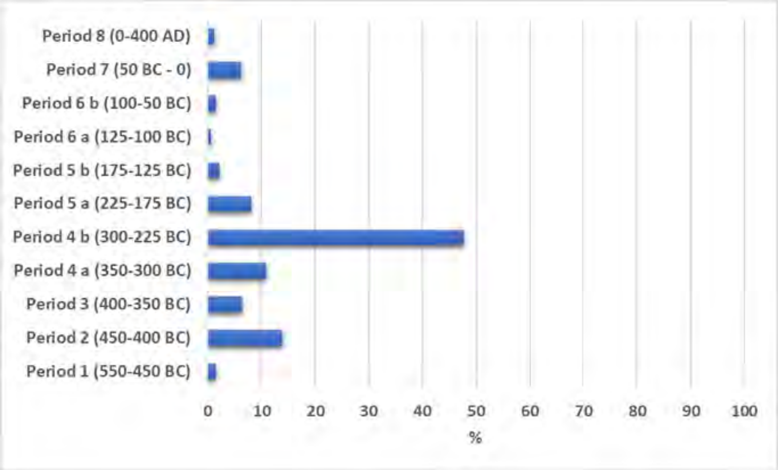

FIGURE 1

Percentage of faunal remains divided between the different archaeological periods described in Taccola (2019).

ratio of 3:1. As with pigs, the most recurrent skeletal elements (see Table 1 in Supplementary materials) are teeth, cranial, and limbs elements, with a slight prevalence of forelimb; except for metacarpals and metatarsals, the extremities of the limbs are under-represented. Epiphyseal fusion data (see Table 3 in Supplementary materials, Figure 2) show that adult individuals represented almost half of the killed flock (48.9%), which are followed by young caprines (32.4%), while subadult individuals are less present (18.7%). Tooth wear data provide contrasting results: 11,3% of the animals were slaughtered between 6 and 12 months (with no killings under 6 months), while most of the killing ocurred between 12 and 35 months (62.4%); lastly, 26.3% of the caprines were killed off in later stages of life, but before their sixth year. Around 12% of caprine bones showed butchery marks, especially atlas, axis, forelimb, and hindlimb elements. Almost half (46%) of the caprine bones had burning marks, mainly localised on scapula, humerus, pelvis, femur and tibia.

Cattle remains are mainly represented (see Table 1 in Supplementary materials) by teeth, while all limb elements occur in similar numbers. The mortality data (see Table 4 in Supplementary materials, Figure 2) calculated using epiphyseal fusion shows that adult individuals predominated (88.4%), followed by a small number of subadult individuals (11.6%) and no juveniles. For cattle, we observe the same pattern found in other domestic species, where the percentage of burned bones (54.2%) is higher than that of bones with butchery marks (15.6%).

RESULTS: THE ROMAN PERIOD

During this phase, domestic animals remain the predominant category (93.5%), with pigs still prevailing (52.2%), followed by caprines (25%) and cattle (14.7%). All pig skeletal elements (see Table 1 in Supplementary materials) apart from the atlas and patella are present, with metacarpals and femurs slightly predominating. The mortality data (see Table 2 in Supplementary materials, Figure 3) calculated using epiphyseal fusion indicates that piglets predominated (60%), followed by adult individuals (34%), while subadults are almost absent (6%). Anthropogenic modifications on pig bones in this period are similar to those observed in the previous phase, with burning marks (37%) ocurring more than butchery marks (6%).

Different caprine elements were found without any selection (see Table 1 in Supplementary materials). The mortality data calculated using epiphyseal fusion (see Table 3 in Supplementary materials, Figure 3) suggests that the animals were mainly slaughtered during their subadult age (70%), with a good representation of adult individuals (30%) and with no killing carried out in their first years. Butchery marks were observed on 13% of caprine bones, while burning marks were present on 30% of them.

Lastly, almost all cattle anatomical elements are sporadic (see Table 1 in Supplementary materials), except for teeth, humerus, and the 2nd phalanges. The mortality data, calculated using epiphyseal fusion (see Table 4 in Supplementary materials, Figure 3) show that individuals were killed is their adult stage. Burning and butchery marks were found only on 6 cattle bones.

DISCUSSION

Zooarchaeological analysis carried out in urban contexts primarily provides information regarding animal consumption and farming practices, which are strongly related to the market's demand for meat. These products consumed in the city were usually brought from extra-urban areas where breeding and farming were practised (De Grossi Mazzorin & Minniti, 2010: 52).

Between the beginning of the Archaic Age (end of the 7th century BC) and the Middle Hellenistic Age (last quarter of the 3rd century BC), this area was occupied by structures and preparations that may refer to ritual practices, as confirmed by different votive findings (bronzes and a golden plate). The faunal record analysed does not show any ritual features, except for a dog humerus and femur with butchery marks. In fact, dogs are often associated with rituals (De Grossi Mazzorin, 2008), however this finding may also refer to the exploitation of hides. The presence of a worked deer antler also suggests processing activities of animal hard materials in the area.

During the Roman period, the area was rebuilt as a residential quarter inhabited by the upper class. The high presence of piglets in this phase may reflect an elite diet, since they refer to fine and tender cuts of meat; this feature was observed in other contemporary contexts (King *et al.,* 1985; De Grossi Mazzorin & Minniti, 2010: 53-54; Alhaique *et al.,* 2011).

As a matter of fact, the faunal sample analysed is mainly composed by the main domestic animals in both phases. Pig is the predominant *taxon*, which increases in number during the Roman period while caprines become less important. Mortality data from the Pre-Roman period show that pigs were killed in almost all life stages with similar numbers, while in the Roman period piglets were preferred.

In both phases, sheep prevail over goats; epiphyseal fusion data suggest that caprines were slaughtered at different life stages, with adults prevailing in the Pre-Roman period and subadults in the Roman period.

Tooth wear stage data for the Roman period were not discussed due to the low occurrence of teeth remains. On the other hand, for the Pre-Roman period, we observe that tooth wear data for both caprines and pigs are not consistent with epiphyseal fusion data. Tooth wear data indicate that pigs were mainly killed between the first and the third year (especially in the 24-30 months period), when the animals reached their maximum yield; we can observe similar data for caprines. A certain selection of body parts can be perceived for both pigs and caprines: the terminal part of the limbs (carpal, tarsal and phalanges) is poorly represented, while other limb elements are more recurrent. Furthermore, burning and butchery marks are mainly localised on shoulder and leg portions. These data may indicate that butchering activities, such as meat division, were partly carried out on the site. Cattle adult individuals, which predominate in the faunal record, were probably exploited as well.

Wild species are attested by few bone remains, among which deer and roe deer are predominant;

FIGURE 4
Deer antler with cuts and detail of manufacture marks.

while roe deer remains refer to different anatomic elements, two antlers and two phalanges attest the presence of deer. Moreover, a deer antler shows manufacture marks (Figure 4); different cuts can be observed on the antler, which may indicate either that it is an unfinished worked object or that the removed part was used.

CONCLUSION

In this preliminary study, the faunal sample was divided between the two main chronological phases; the next ideal step will be to examine the distinct occupation levels levels to better understand how animal exploitation strategies changed through time. Those results will be further discussed in the PhD dissertation of the project titled "Animal consumption and exploitation strategies on the coastal portion of Tuscany between the Etruscan period and the Middle Ages".

Zooarcheological analysis was pivotal for the interpretation of the examined context. In the Pre-Roman phase, an interest in meat for both caprines and pigs was demonstrated. However, we must remark that different activities probably occurred in the area, as suggested by the worked deer antler.

Most of the animal remains were found in Pre-Roman levels; this sample shows a high consumption of pigs, followed by sheep and goats, which were killed at all age stages. On the other hand, cattle were mainly killed in their adult stage. The difference between the mortality data obtained from epiphyseal fusion and tooth wear stage may indicate that animal portions were prepared outside the context, then transported to this site to be consumed or sold. Finally, wild species are also occasionally attested, including roe deer, deer, birds, land tortoise, marine mollusks and fish.

The Roman period faunal record consists of fewer bone remains, making it a less reliable sample. Zooarchaeological analysis still shows a common trend in animal exploitation, with a slight increase in pig husbandry. Wild species in this phase are less represented than the previous one.

SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_010

REFERENCES

Alberti, A.; Gualandi, M.L.; Lo Giudice, F.; Raffo, O.; Rizzitelli, C.; Siclari, P. & Sorrentino, G. 2015: Pisa, Piazza dei Miracoli: materiali dagli scavi del 1998. ΑΓΩΓΗ 8-9: 57-97.

Alhaique, F.; De Bernardis, D. & Fortunato, M.T. 2011: Attività produttive legate allo sfruttamento delle risorse animali tra età romana e medioevo, il caso di Ferento. In: De Minicis, E. & Pavolini C. (eds.): Risorse naturali e attività produttive, Ferento a confronto con altre realtà, Atti del 2° Convegno di studi in memoria di Gabriella Maetzke, Viterbo, 27-28 April 2010, *Daidalos* 12: 195-208. DISBEC, Viterbo.

Barone, R. 1980: *Comparative anatomy of domestic mammals. Tome 1, Osteologia*. Italian edition by R. Bortolani. Edagricole, Bologna.

Bini, M.; Rossi, V.; Amorosi, A.; Pappalardo, M.; Sarti, G.; Noti, V.; Capitani, M.; Fabiani, F. & Gualandi, M.L. 2015: Palaeoenvironments and palaeotopography of a multilayered city during the Etruscan and Roman periods: early interaction of fluvial processes and urban growth at Pisa (Tuscany, Italy). *Journal of Archaeological Science* 59: 197-210.

Boessneck, J.; Müller, H.H. & Teichert, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries*) und Ziege (*Capra hircus*). *Kühn Archiv* 78: 1-129.

Bonamici, M. 2011: Actorerio a disco da Pisa, piazza del Duomo. *Studi Etruschi* 74: 39-47.

Bonamici, M. & Taccola, E. 2022: PISAE: piazza del Duomo. *Studi Etruschi* 84: 210-237.

Bruni, S. 1995: Prima dei Miracoli. Aspetti e problemi dell'insediamento antico nell'area della Piazza del Duomo. In: Storia ed Arte nella Piazza del Duomo: Conferenze 1992-1993, in *Quaderni dell'Opera della Primaziale* Pisana 4: 163-196. Vigo Cursi, Pisa.

— 1998: *Pisa etrusca. Anatomia di una città scomparsa*. Longanesi, Milan.

— 2022: The Origins: The Etruscan Polis and Roman Civitas. In: Mathews, K.R.; Orvietani Busch, S. & Bruni, S. (eds.): *A Companion to Medieval Pisa*: 59-77. Brill, Leiden.

Bull, G. & Payne, S. 1982: Tooth Eruption and Epiphysial Fusion in Pigs and Wild Boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (British Series) 109. Oxford.

Bullock, D. & Rackam, J. 1982: Epiphysial Fusion and Tooth Eruption of Feral Goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones* *from Archaeological Sites*: 73-80. B.A.R. (British Series) 109. Oxford.

COHEN, A. & SERJEANSTON, D. 1996: *A manual for the identification of bird bones from archaeological sites*. Revised edition. Archetype Publications, London.

DE GROSSI MAZZORIN, J. 2008. L'uso dei cani nei riti di fondazione, purificazione e passaggio nel mondo antico. In: D'Andria, F.; De Grossi Mazzorin, J. & Fiorentino, G. (eds): Uomini piante e animali nella dimensione del sacro. Atti del seminario di studi di Bioarcheologia, Cavallino (Lecce), 28-29 giugno 2002, in *Beni Archeologici- Conoscenze e Tecnologie*, 6: 71-81. Edipuglia, Bari.

DE GROSSI MAZZORIN, J. & MINNITI, C. 2010: L'utilizzo della documentazione Archezoologica a Roma e nel Lazio dalla preistoria recente all'età classica. In: Drago Troccoli, L. (ed.): *Il Lazio dai Colli Albani ai Monti Lepini tra preistoria ed età moderna*: 39-67. Ed. Quasar, Roma.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

HALSTEAD, P.; COLLINS, P. & ISAAKIDOU, V. 2002: Sorting the Sheep from the Goats: Morphological Distinction between the Mandibles and the Mandibular Teeth of Adult Ovis and Capra. *Journal of Archaeological Science* 29: 543-545.

KING, A.C.; PHODES, P.A.; RIELLEY, K. & THOMAS, K.D. 1985: I resti animali. In: Carandini, A. & Ricci, A. (eds.): *Settefinestre. Una villa schiavistica nell'Etruria romana*. 3. *La villa e i suoi reperti*: 278-305. Panini, Modena.

MAGGIANI, A. 1993: Pisa in età classica. In: Letta, C. (ed.): *Archeologia di Pisa, Atti della giornata di studio, Pisa, 16 aprile 1988*: 57-62. Tipografia comunale, Pisa.

— 2001: Elementi etrusco-italici nei santuari del Veneto. In: Cresci Marrone, G. & Tirelli, M. (eds.): Orizzonti del sacro. Culti e santuari antichi in Altino e nel Veneto orientale, Atti del convegno, Venezia, 1-2 Dicembre 1999, in *Altinum*: 121-138. Quasar, Rome.

PAYNE, S. 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, *Ovis*, and, Goats, *Capra*. *Journal of Archaeological Science* 12: 139-147.

— 1973: Kill-off Patterns in Sheep and Goats: the Mandibles from Asvan Kale. *Anatolian Studies* 33: 281-303.

SCHMID, E. 1972: *Atlas of animal bones. For prehistorians, archaeologists and quaternary geologists*. Elsevier Publishing Company, Amsterdam.

SILVER, I.A. 1969: The Ageing of Domestic Animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. Thames & Hudson, London.

TACCOLA, E. 2019: *Uno sguardo su Pisa ellenistica da piazza del Duomo. Lo scavo del saggio D 1985-1988*. Archaeopress, Oxford.

— 2020: La nascita di un quartiere residenziale: le domus ai piedi della Torre tra II e I secolo a.C. In: Cantini, F.; Fabiani, F.; Gualandi, M.L. & Rizzitelli, C. (eds.): Le case di Pisa. Edilizia privata tra Età romana e Medioevo, Atti del convegno, Pisa, 7-8 Maggio 2019, in *Dialoghi sul Medioevo*: 17-28. All'Insegna del Giglio, Sesto Fiorentino.

ZEDER, M.A. & LAPHAM, H.A. 2010: Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905.

SUPPLEMENTARY MATERIAL

Taxon	**Pig**		**Sheep and goat**		**Cattle**	
	Pre-Roman	**Roman**	**Pre-Roman**	**Roman**	**Pre-Roman**	**Roman**
Skeletal Element	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**	**NISP**
Horn core			2	1	1	1
Cranium	24	2	4		5	
Maxila	24	3	6	1	1	
Max. Teeth	23	3	21	4	17	4
Mandible	45	5	26	4	6	2
Mand. Teeth	50	7	26	2	10	2
Teeth ind.	2	4			1	
Atlas	3		4		1	
Axis			5	1	1	
Scapula	22	6	10	2	3	1
Humerus	28	7	18	8	5	4
Radius	21	4	21	4	3	
Ulna	16	5	11		5	1
Carpal	3				3	
Metacarpal	20	13	13	5	8	1
Pelvis	23	5	22	4	7	1
Femur	18	9	14		7	
Patella	2					
Tibia	21	2	34	5	5	1
Fibula	5	1				
Calcaneus	7	3	6	2	1	
Astragalus	3	1	4	1	7	1
Tarsal						
Metatarsal	16	5	17	1	7	1
Metapodial	7		3	1	2	2
Phalanx 1	5	6	5		9	1
Phalanx 2	1	2	1		3	4
Phalanx 3					8	
TOTAL	**389**	**93**	**273**	**46**	**126**	**27**

TABLE 1

NISP per skeletal element for the main domestic *taxa* divided the two chronological periods, Pre-Roman (550-175 BC) and Roman (175 BC - 400 AD).

Period		**Pre-roman**		**Roman**	
	age	**U**	**F**	**U**	**F**
scapula a.	7-11 months	7	9	4	1
pelvis a.	7-11 months	2	4	2	0
humerus d.	+11 months	5	8	0	2
radius p.	+ 11 months	3	7	0	1
phalanx 2 p.	12-18 months	0	1	1	1
tibia d.	19-23 months	0	11	1	0
phalanx 1 p.	19-23 months	3	2	2	4
metacarpal d.	+23 months	7	4	5	4
metatarsal d.	+23 months	5	4	3	2
metapodial d.	+23 months	3	4	0	1
humerus p.	+35 months	7	2	2	0
radius d.	+35 months	9	2	3	0
ulna p.	+35 months	4	1	1	0
femur d.	+35 months	8	2	6	0
tibia p.	+35 months	7	1	1	0
calcaneum p.	+35 months	7	0	0	1

TABLE 2

Frequencies of unfused (U) and fused (F) bones of pigs per period, Pre-Roman (550-175 BC) and Roman (175 BC - 400 AD).

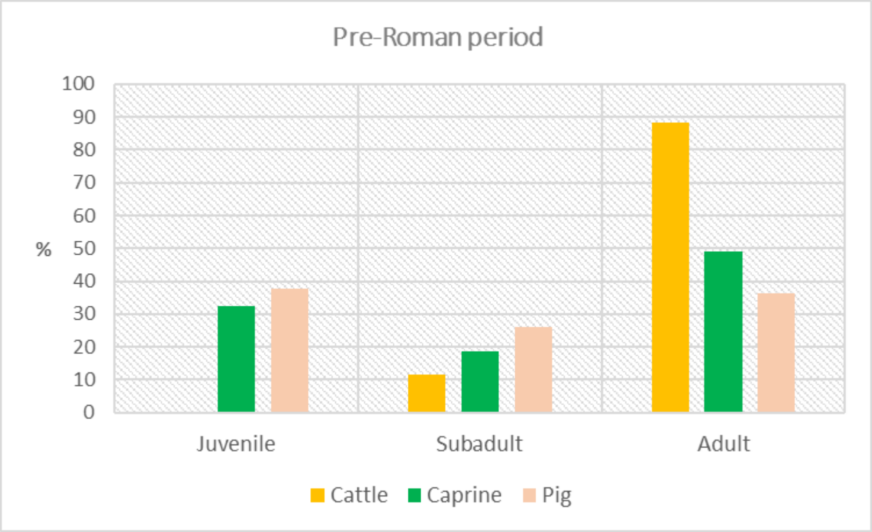

FIGURE 2

Chart showing the mortality data calculated using epiphyseal fusion for cattle (NISP=45), caprines (NISP=122) and pigs (NISP=139) in the Pre-Roman period (550-175 BC).

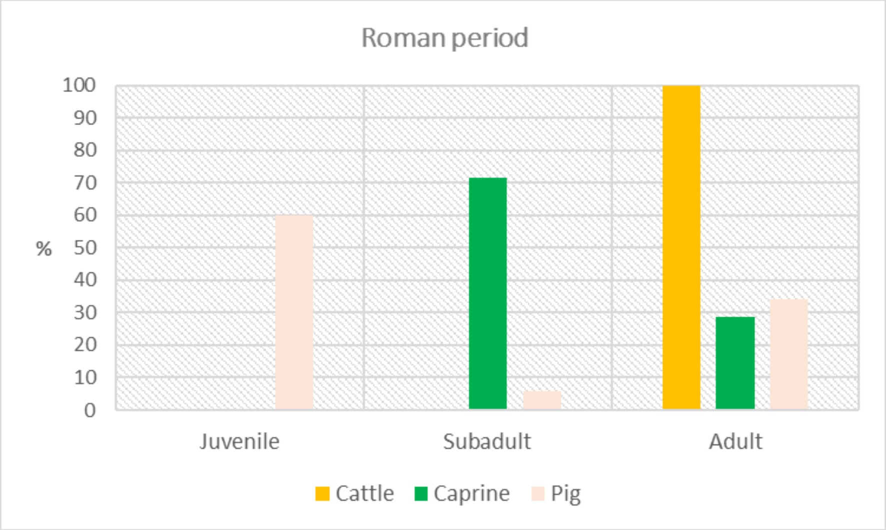

FIGURE 3

Chart showing the mortality data calculated using epiphyseal fusion for cattle (NISP=13), caprines (NISP=19) and pigs (NISP=48) in Roman period (175 BC - 400 AD).

Period		**Pre-roman**		**Roman**	
	age	**U**	**F**	**U**	**F**
humerus d.	-12 months	3	9	0	3
radius p.	-12 months	2	8		
pelvis a.	-12 months	4	2		
scapula d.	12 months	2	4	0	2
phalanx 1 p.	14-35 months	1	3		
phalanx 2 p.	14-35 months	1	0		
tibia d.	35 months	5	16	0	2
femur p.	35 months	2	0		
metacarpal d.	48 months	4	3	1	1
femur d.	48 months	6	4		
metatarsal d.	48 months	4	4		
metapodial d.	48 months	2	1		
tibia p.	48 months	11	1	3	0
humerus p.	48-60 months	4	2	2	0
radius d.	48-60 months	2	4	4	0
ulna p.	48-60 months	1	2		
calcaneum p.	48-60 months	2	3	0	1

TABLE 3

Frequencies of unfused (U) and fusing (F) bones caprines per period, Pre-Roman (550-175 BC) and Roman (175 BC - 400 AD).

Period		**Pre-roman**		**Roman**	
	age	**U**	**F**	**U**	**F**
scapula d.	7-10 months	0	2		
pelvis a.	7-10 months				
humerus d.	12-18 months	0	4	0	3
radius p.	12-18 months	0	3		
phalanx 1 p.	18 months	0	9	0	1
phalanx 2 p.	18 months	0	3	0	4
metacarpal d.	24-30 months	0	6		
tibia d.	24-30 months	0	2	0	1
metapodial d.	24-30 months	0	1	0	1
metatarsal d.	30-36 months	1	3	0	1
calcaneum p.	36 months	0	1		
femur p.	42 months	2	2		
ulna p.	42-48 months			0	1
femur d.	42-48 months	0	2		
tibia p.	42-48 months	2	1	0	1

TABLE 4
Frequencies of unfused (U) and fusing (F) bones of cattles per period, Pre-Roman (550-175 BC) and Roman (175 BC - 400 AD).

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Le risorse legate agli ambienti dulciacquicoli della valle dell'Adige nel Mesolitico: Riparo Romagnano Loc III e Riparo Pradestel (TN)

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RIASSUNTO: Questo contributo si propone di analizzare in modo critico i dati relativi allo sfruttamento delle risorse dulciacquicole dei ripari sottoroccia mesolitici della Valle dell'Adige, Romagnano Loc III e Pradestel (TN). Viene proposta una stima delle potenzialità informative delle faune di ambiente dulciacquicolo (pesci e testuggini palustri) di questi siti, mentre vengono analizzati quantitativamente e qualitativamente i resti riconducibili ai mammiferi legati alle zone umide, quali il castoro (*Castor fiber*) e la lontra (*Lutra lutra*). Per quanto riguarda il castoro, vengono anche esposti i risultati ottenuti dall'analisi tafonomica e, nello specifico, i dati relativi alle tracce di intervento antropico per l'approvvigionamento delle risorse e lo sfruttamento delle carcasse.
L'obiettivo di questa ricerca è l'ottenimento di nuovi dati riguardanti tafonomia e stagionalità e il riesame di quelli già esistenti così da meglio delineare scenari e comportamenti legati allo sfruttamento di determinate nicchie ecologiche da parte dei gruppi umani di cacciatori-raccoglitori e pescatori che frequentarono la valle durante l'Olocene antico.

PAROLE CHIAVE: MESOLITICO, VALLE DELL'ADIGE, RISORSE DULCIACQUICOLE, CASTORO, TAFONOMIA

SUMMARY: This paper critically analyses data related to the exploitation of freshwater resources in the Mesolithic rock shelters of Riparo Romagnano Loc III and Riparo Pradestel (TN), in the Adige valley. An estimate of the informative potential of the samples is proposed for fish and terrapenes, whereas the remains of mammal species related to aquatic ecosystems, such as beaver (*Castor fiber*) and otter (*Lutra lutra*), are quantitatively and qualitatively analysed. In the case of the beaver, we present the results of a taphonomic analysis focusing on anthropic marks that provide information on the exploitation of the carcasses. This information on taphonomy and seasonality has allowed us to assess published data to better define the scenarios and behaviours related to the subsistence practices of Mesolithic hunter-gatherers and fishermen of the Adige valley during the Early Holocene.

KEY WORDS: MESOLITHIC, ADIGE VALLEY, FRESHWATER RESOURCES, BEAVER, TAPHONOMY

RESUMEN: Este artículo valora los datos relativos a la explotación de los recursos dulceacuícolas en los abrigos rocosos mesolíticos de Riparo Romagnano Loc III y Riparo Pradestel (TN), en el valle del Adigio. Se presenta una estimación del potencial informativo de las muestras de

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peces y galápagos, mientras que los restos de dos especies de mamíferos ripícolas, como son el castor (*Castor fiber*) y la nutria (*Lutra lutra*) se analizan cuantitativa y cualitativamente. En el caso del primero, se presentan asímismo los resultados de un análisis tafonómico centrado sobre marcas antrópicas que aportan información sobre la explotación del animal. Esta información ha permitido evaluar datos publicados para mejor caracterizar los entornos y comportamientos relacionados con las prácticas de subsistencia de los cazadores-recolectores y pescadores del Mesolítico del valle del Adigio durante el Holoceno temprano.

PALABRAS CLAVE: MESOLÍTICO, VALLE DEL ADIGE, RECURSOS DULCEACUÍCOLAS, CASTOR, TAFONOMÍA

INTRODUZIONE

Con l'inizio dell'Olocene (11.400 anni cal BP; Ravazzi *et al*., 2007) l'ambiente fisico dell'attuale Trentino viene contrassegnato da un rapido miglioramento climatico, iniziato già nel Tardoglaciale (Angelucci, 2016), che portò rilevanti modificazioni ambientali. Il ritiro dei ghiacciai nelle vallate alpine causò un fenomeno erosivo che portò alla creazione, nelle valli alpine, delle caratteristiche morfologie sospese note come terrazzi fluviali (Bassetti, 2018). È proprio in questo primo momento dell'Olocene che le popolazioni umane iniziano ad abitare sistematicamente la valle e ad usufruire delle ricche risorse fornite dal nuovo assetto ambientale. Le aree lacustri, formatesi a seguito della deglaciazione, erano popolate da pesci, molluschi, testuggini, castori e lontre mentre nei pianori soprastanti facilmente raggiungibili, era possibile cacciare stambecchi e camosci (Broglio, 1980; Dalmeri, 1998; Thun Hohenstein *et al*., 2016; Wierer *et al*., 2018).

Da una lettura dell'edito dedicato alle faune mesolitiche dei siti di fondovalle dislocati lungo l'asta dell'Adige, risulta da subito evidente una interessante presenza di fauna legata agli ambienti di acqua dolce che, tuttavia, è stata indagata in maniera dettagliata solo per il sito di Galgenbühel (Bazzanella & Wierer, 2001; Wierer & Boscato, 2006; Wierer *et al*., 2018). Al contrario, per la maggior parte dei siti di cui disponiamo di studi archeozoologici, la fauna legata ad ambienti dulciacquicoli, se presente, non viene investigata: tra questi si ricordano Riparo Gaban (Kozlowski & Dalmeri, 2000; Thun Hohenstein *et al*., 2016); Riparo Vatte di Zambana, Riparo Pradestel e Riparo Romagnano loc. III (Boscato & Sala, 1980).

In questo contributo vengono presentati i risultati delle analisi paleoeconomiche e tafonomiche effettuate sui resti delle faune legate ad ambienti umidi e di acqua dolce, con particolare riferimento al castoro e alla lontra, dei siti di Romagnano Loc III (d'ora in poi nominato RLoc), e di Riparo Pradestel (d'ora in poi nominato RP). Tali indicazioni andranno ad integrare i dati di tipo paleoecologico pubblicati da Boscato & Sala (1980).

Le descrizioni dei due siti, vengono presentate nel contributo "Strategie di sussistenza e mobilità dei gruppi di cacciatori-raccoglitori-pescatori nella Val d'Adige: tafonomia e stagionalità a Riparo Romagnano Loc III e Riparo Pradestel (TN)" presente in questo stesso volume (Dipino *et al*., 2025).

MATERIALI E METODI

L'analisi archeozoologica è stata effettuata utilizzando le collezioni osteologiche del MUSE e del Laboratorio di Archeozoologia e Tafonomia dell'Università di Ferrara. L'analisi tafonomica è stata effettuata sia tramite lenti a piccolo ingrandimento sia con uno stereomicroscopio Leica M 165C con ingrandimenti da 0.75 a 124X; quando necessario sono state acquisite immagini tramite microscopico elettronico a scansione ZEISS EVO XVP, Carl Zeiss SMT Ltd.. Castoro e lontra sono stati analizzati dal punto di vista quantitativo: numero dei reperti determinati totalmente (NRDt; Grayson, 1984) e numero minimo di individui (NMI; Lyman, 1994). Per il *Castor fiber* sono stati registrati anche gli indici di rappresentatività degli elementi scheletrici: numero minimo degli elementi (NME; Marean *et al*., 2001; Lyman, 2008), numero degli elementi attesi (NEA) e indice di fratturazione, dato dal rapporto tra NME e numero dei resti determinati (NISP) (Binford, 1981; Grayson, 1984; Lyman, 1994).

Le alterazioni di origine antropica sono state registrate e descritte qualitativamente sulla base della bibliografia: Binford, 1981; Bunn, 1981; Giacobini *et al*., 1992; Aimar *et al*., 1995; Blumenshine, 1995; Malerba & Giacobini, 1995; Romandini *et al*., 2012; Fernández-Jalvo & Andrews, 2016).

RISULTATI

COMPOSIZIONE DELLA FAUNA DULCIACQUICOLA

Il campione faunistico preso in esame per il sito RLoc è costituito complessivamente da 6.099 reperti, con una percentuale di determinazione dell'87% (NR 5.311).

L'insieme dei resti faunistici rinvenuti nel corso degli scavi a RP si compone di 16.400 reperti dei quali solo il 24,5% (NR 4.014) è stato determinato tassonomicamente ed anatomicamente.

In entrambi i depositi la fauna legata agli ambienti di acqua dolce (ittiofauna, tartaruga palustre, lontra e castoro) ammonta circa al 50% della totalità della fauna determinata (NISP).

La fauna ittica è rappresentata da 2.443 resti provenienti da RLoc e da 1.000 resti provenienti da RP. In generale è stata osservata la presenza di scaglie, vertebre, denti e frammenti di cranio. Dei reperti è stata fatta solo una stima quantitativa in quanto l'ittiofauna sarà oggetto di studio da parte di una delle scriventi (N. Dipino). Ulteriori analisi saranno necessarie per indagare meglio quali specie fossero presenti nei due depositi archeologici, quale potesse essere il reale impatto dell'ittiofauna sulla sussistenza delle popolazioni di cacciatori-raccoglitori-pescatori ed infine per dettagliare meglio la stagionalità di occupazione dei siti di fondovalle (vedi Dipino *et al*., 2025, in questo stesso volume).

Nell'insieme faunistico dei due ripari è presente anche la testuggine palustre, *Emys orbicularis*. Sono 251 i reperti ritrovati a RLoc che si concentrano principalmente nei tagli 1 e 2 dello strato AB del Castelnoviano (NR 142). I reperti presenti a RP sono 415, trovati soprattutto nello strato L, Sauveterriano recente, Boreale. Sono presenti quasi esclusivamente elementi di piastrone e carapace senza caratteri diagnostici, e pochissimi post-craniali; risulta pertanto difficile fare qualsiasi considerazione in merito al numero minimo degli individui presenti. Dall'analisi tafonomica non risultano presenti tracce di sfruttamento o modificazione antropica.

La lontra, *Lutra lutra*, rinvenuta solo a RLoc, è rappresentata da 10 resti appartenenti a 2 individui: 5 resti dal Castelnoviano (NMI 1) e 5 resti dal Sauveterriano (NMI 1). L'analisi tafonomica dei resti non mostra segni di modificazione antropica. Presenti falangi e metapodiali.

Il castoro, *Castor fiber,* è l'animale legato agli ambienti di acqua dolce chiaramente più abbondante. I resti attribuibili al castoro provenienti da RLoc sono 49, la maggior parte dei quali ritrovati nei livelli sauveterriani (NR 43; NMI 9). A RP è maggiormente documentato: i resti rinvenuti sono 378 e si distribuiscono in tutta la stratigrafia mesolitica con una maggiore concentrazione nel livello L attribuibile al Sauveterriano medio. Il maggior numero di individui (NMI 14) si riscontra nei tagli più alti del Sauveterriano, riferibili ad un primo momento del Boreale. In entrambi i depositi, le porzioni anatomiche meglio rappresentate sono falangi, metapodiali, arti superiori e vertebre.

RAPPRESENTATIVITÀ DELLA CARCASSA DI CASTOR FIBER

Vista l'abbondante presenza di resti di castoro provenienti da RP si è ritenuto utile calcolare indici per la stima della rappresentatività delle carcasse. Tale operazione di quantificazione è stata effettuata non per singoli livelli stratigrafici ma per raggruppamenti di livelli che dessero un'indicazione cronologica, sebbene più ampia, più attendibile, dal punto di vista quantitativo. I raggruppamenti effettuati sono i seguenti: Castelnoviano recente (D), Castelnoviano antico (E), Sauveterriano recente-finale (F-G-H) e Sauveterriano medio (L_{1-6}). I livelli A, B ed L preboreale non sono stati presi in considerazione perché i reperti risultavano troppo scarsi per qualsiasi valutazione.

Dalla Tabella 1 si evince che gli elementi più presenti nel sito sono gli arti superiori ed inferiori, con valori tra 10% e 40% per gli arti superiori (omero, radio, ulna) e dal 33% al 50% per gli arti inferiori (femore, tibia, fibula). Meno rappresentato o addirittura assente è il mascellare e il cinto scapolare. Gli elementi anatomici rinvenuti mostrano la presenza nel sito di gran parte dell'apparato scheletrico del castoro senza evidenziare marcate differenze tra uno strato e l'altro.

Castor fiber	**CASTELNOVIANO**										**SAUVETERRIANO**									
	Castelnoviano recente (D)					Castelnoviano antico (E)					Sauveterriano recente-finale (F, G, H,)					Sauveterriano medio ($L_{boreale}$)				
ELEMENTO ANATOMICO	NISP	NME	NEA	indice soprav. (%)	indie fratturaz. NME/NR	NISP	NME	NEA	indice soprav. (%)	indie fratturaz. NME/NR	NISP	NME	NEA	indice soprav. (%)	indie fratturaz. NME/NR	NISP	NME	NEA	indice soprav. (%)	indie fratturaz. NME/NR
calvaria	-	-	-	-	-	5	3	10	%30	0,6	3	1	18	%6	0,3	4	4	28	%14	1,0
maxilla	-	-	-	-	-	1	1	10	%10	1,0	-	-	-	-	-	-	-	-	-	-
emimandibula	-	-	-	-	-	1	1	10	%10	1,0	3	2	18	%11	0,7	9	8	28	%29	0,9
dentes	6	-	-	-	-	10	-	-	-	-	23	-	-	-	-	55	-	-	-	-
atlas	1	1	3	%33	1,0	-	-	-	-	-	1	1	9	%11	1,0	1	1	14	%7	1,0
axis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
scapula	1	1	6	%17	1,0	-	-	-	-	-	-	-	-	-	-	2	2	28	%7	1,0
clavicola	-	-	-	-	-	1	1	10	%10	1,0	-	-	-	-	-	1	1	28	%4	1,0
sternum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
os sacrum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
humerus	2	2	6	%33	1,0	1	1	10	%10	1,0	1	1	18	%6	1,0	5	5	28	%18	1,0
radius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	8	28	%29	0,8
ulna	1	1	6	%17	1,0	4	4	10	%40	1,0	3	3	18	%17	1,0	8	8	28	%29	1,0
carpalia	1	1	64	%2	1,0	1	1	80	%1	1,0	5	5	144	%3	1,0	2	2	224	%1	1,0
metacarpus	6	4	60	%7	0,7	3	3	100	%3	1,0	14	14	180	%8	1,0	3	3	280	%1	1,0
coxalis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	28	%11	1,0
femur	2	2	6	%33	1,0	1	1	10	%10	1,0	-	-	-	-	-	2	2	28	%7	1,0
patella	1	1	6	%17	1,0	1	1	10	%10	1,0	-	-	-	-	-	2	2	28	%7	1,0
tibia	3	3	6	%50	1,0	-	-	-	-	-	1	1	18	%6	1,0	2	2	28	%7	1,0
fibula	3	3	6	%50	1,0	1	1	10	%10	1,0	1	1	18	%6	1,0	-	-	-	-	-
os malleolare	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
calcaneus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	28	%4	1,0
talus	1	1	6	%17	1,0	-	-	-	-	-	1	1	18	%6	1,0	1	1	28	%4	1,0
tarsalia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	6	196	%3	1,0
metatarsus	5	5	60	%8	1,0	7	6	100	%6	0,9	3	3	180	%2	1,0	5	5	280	%2	1,0
phalanx 1	12	11	60	%18	0,9	6	6	100	%6	1,0	24	22	180	%12	0,9	29	29	280	%10	1,0
phalanx 2	9	9	60	%15	1,0	2	2	100	%2	1,0	17	17	180	%9	1,0	12	12	280	%4	1,0
phalanx 3	1	1	60	%2	1,0	4	4	100	%4	1,0	11	11	180	%6	1,0	8	8	280	%3	1,0
TOTALE	55	46	415	%11	0,8	49	36	670	%5	0,7	111	83	1179	%7	0,7	171	113	2198	%5	0,7
	NMI				4	NMI				5	NMI				9	NMI				14

TABELLE 1

Indici di quantificazione del castoro a Riparo Pradestel. In tabella sono indicati: numero dei reperti determinati (NISP), numero minimo degli elementi (NME), numero degli elementi attesi sulla base del numero minimo di individui (NEA), indice di sopravvivenza (NME/NEA), indice di fratturazione (NME/NISP) e il numero minimo di individui (NMI).

TAFONOMIA: MODIFICAZIONI DI ORIGINE ANTROPICA SU CASTOR FIBER

Da RLoc provengono solo 2 reperti con tracce di taglio e, in entrambi i casi, le tracce sono posizionate su prime falangi, vicino all’epifisi prossimale; questo tipo di tracce può essere ricondotto ad azioni di spellamento della carcassa. Le due falangi provengono da strati del Sauveterriano medio. Al contrario a RP, il castoro risulta, insieme al cervo, l’animale sul quale sono stati riscontrati più segni di modificazioni antropiche. I resti con tracce sono 14, cinque dallo strato D del Castelnoviano recente, due dal Castelnoviano antico (strato E), un solo resto dallo strato H del Sauveterriano recente – finale e sei dallo strato Sauveterriano medio (L). La maggior parte di queste tracce (NR 7) sono riconducibili alla disarticolazione degli elementi ossei e sono collocate sull’epifisi laterale della clavicola, sull’epifisi distale dell’omero (Figura 1b), sull’ulna sopra al processo anconeo e sotto le superfici articolari per il radio e, infine, sul collo del femore (Figura 1c).

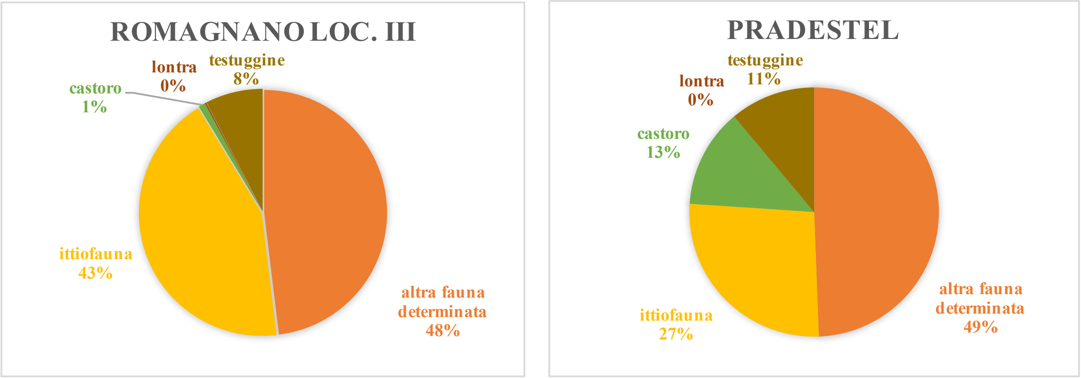
Strie dovute al depezzamento sono state riscontrate su una vertebra cervicale la cui posizione farebbe pensare alla decapitazione, e su una vertebra caudale forse per la rimozione della coda (stria perpendicolare all’asse dell’osso).

Sul processo laterale di una vertebra caudale è stato trovato un *cut-mark* compatibile con la scarnificazione, azione che avrebbe causato anche le strie trovate sul corpo di due coste.

Infine, risultano di dubbia attribuzione le tracce ritrovate sul corpo di due clavicole. In letteratura non esistono confronti con altri resti di castoro; gli unici due casi italiani confrontabili, riguardano tracce su clavicole di marmotta (Gurioli *et al*., 2011; Romandini, 2012; Romandini *et al*., 2012). Nel primo caso si tratta di tracce su reperti provenienti dal sito epigravettiano delle Grotte di Pradis, interpretate come tacche incise senza scopo utilitaristico. Nel secondo caso, si tratta di tracce trovate sulle clavicole di marmotte provenienti dal sito di Clusantin e compatibili con la macellazione dell’animale.

A Pradestel le strie sulla superficie delle clavicole non sono interpretabili come tacche incise (Figura 1a) ma potrebbero essere state prodotte durante lo spellamento dell’animale; attività di archeologia sperimentale potranno in un futuro confermare o meno questa ipotesi.

Alcuni reperti di castoro sono stati osservati al microscopio a scansione elettronica (SEM) al fine di evidenziare le micro-caratteristiche dei *cut-marks* ed identificarli con certezza.



Romagnano loc III	
altra fauna det.	2637
ittiofauna	2374
castoro	49
lontra	10
testuggine	415

Pradestel	
altra fauna det.	1853
ittiofauna	1000
castoro	483
lontra	0
testuggine	415

FIGURA 1

Composizione della fauna. Nel grafico sono riportate le percentuali di reperti determinati per specie (NISP) sulla totalità dei reperti determinati.

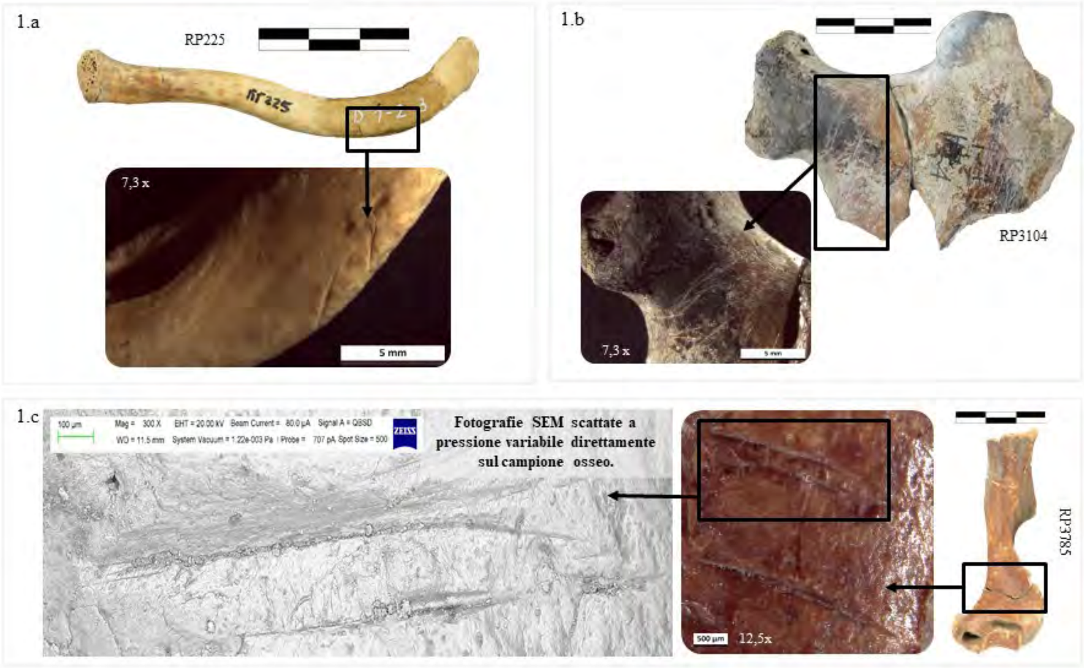
DISCUSSIONE E CONCLUSIONI

Lo studio dei resti faunistici dei depositi di Riparo Romagnano Loc III e Riparo Pradestel, ha fornito numerose informazioni sull'economia dei gruppi di cacciatori-raccoglitori-pescatori che popolavano la valle dell'Adige durante il Mesolitico (Dipino *et al*., 2025, in questo volume). Inoltre, la grande abbondanza di fauna strettamente legata agli ambienti dulciacquicoli ha confermato uno sfruttamento specializzato dell'ecosistema umido che caratterizzava la Valle dell'Adige nella prima parte dell'Olocene. I dati ambientali desunti da questi due siti trovano conferma anche nei ritrovamenti del sito di Galgenbhüel, più a nord nella valle dell'Adige (Bazzanella & Wierer, 2001; Wierer & Boscato, 2006; Wierer *et al*., 2018). Questo ha restituito resti faunistici che evidenziano un quadro ambientale di fondovalle preciso: un'area umida popolata da castori, lontre, testuggini palustri e da una variegata fauna acquatica.

La buona conservazione del campione di Romagnano Loc III e Pradestel ha permesso uno studio approfondito dei resti di castoro e lontra mentre è stato fatto solo uno studio preliminare per testuggine palustre e fauna ittica. I resti di pesce sono al momento in studio da parte di una degli scriventi (N. Dipino) nell'ambito del XVIII Ciclo di Dottorato dell'Università di Ferrara in Sostenibilità ambientale e Benessere. Tale progetto è volto ad indagare le interazioni tra l'uomo ed il complesso mosaico ecologico che ha caratterizzato il Trentino durante il Mesolitico, con particolare attenzione allo sfruttamento delle risorse dulciacquicole.

Di notevole interesse l'abbondante presenza del castoro a Pradestel, dove è rappresentato da oltre 300 reperti appartenenti ad individui di tutte le età. Il castoro è un animale che si riscontra comunemente nei depositi mesolitici, sia a nord delle Alpi che in Europa orientale (Salari *et al*., 2020).

Per il castoro, proveniente da Pradestel, sono stati calcolati gli indici di rappresentatività della carcassa che hanno evidenziato oscillazioni quantitative nel numero di resti delle singole ossa o nelle regioni anatomiche interpretabili in vario modo: potrebbero essere frutto di un trattamento selettivo dell'uomo o della diversa risposta ai processi pre- e post-deposizionali. È però necessario tener



Fotografie SEM scattate a pressione variabile direttamente sul campione osseo.

FIGURA 2

Alcuni frammenti ossei di castoro con tracce di intervento antropico: 1.a clavicola con tracce lineari nella porzione distale palmare; 1.b tracce lineari sul collo del femore; 2.c omero con tracce insistite nella porzione distale (dettaglio fotografato al SEM, fotografie scattate a pressione variabile direttamente su campione osseo: Mag= 62X, EHT = 20.00 kV, Beam Current = 80.0 μ, Signal A = QBSD, WD = 11.5 mm; System VACUUM = 1.15e-003, Probe = 707 pA, Spot Size = 500).

presente che la posizione del sito non ha favorito la conservazione in estensione della stratigrafia e pertanto anche del materiale in essa contenuto. Il riparo, infatti, ha subito, fin dalla prima occupazione, l'azione di colate detritiche laterali; inoltre, buona parte del deposito esterno alla volta è stato asportato da lavori di sbancamento del conoide detritico per la realizzazione di una cava. In generale però si nota come tutti gli elementi scheletrici siano presenti; dunque è lecito pensare che l'intera carcassa venisse introdotta nell'accampamento e completamente trattata, dallo spellamento alla scarnificazione.

Le tracce antropiche meglio rappresentate sono i *cut-marks* da strumento litico. I tagli, nella maggior parte dei casi, si presentato insistiti e in corrispondenza di epifisi distali e prossimali o di ossa vicine alla superficie corporea riferibili a disarticolazione e spellamento. Nel caso del castoro, risultano significative le tracce di taglio attribuibili con disarticolazione, riscontrate sulle ossa lunghe in corrispondenza delle epifisi, ma sono altresì significative le tracce in corrispondenza delle vertebre che indicano il depezzamento della testa e della coda dell'animale. In generale, le tracce sono compatibili con la macellazione del roditore per il consumo alimentare e per la pelliccia; di particolare rilievo sono i *cut-marks* per il depezzamento e per la scarnificazione della coda. La coda, piatta e semirigida, è costituita da un materiale corneo al di sotto della quale vi è il prolungamento della spina dorsale, i tendini e il grasso che l'animale immagazzina per l'inverno (Zahner *et al*., 2020). Inoltre, alla base della coda, si trovano due ghiandole anali che producono una sostanza chiamata *castoreum* conosciuta fin dall'antichità per le sue proprietà benefiche. Le più antiche testimonianze di uso del *castoreum* risalgono all'epoca romana: Plinio il vecchio scrisse sull'uso medicinale della sostanza nel suo *Naturalis Historia* (Salari *et al*., 2020).

BIBLIOGRAFIA

AIMAR, A.; CILLI, C.; MALERBA, G. & GIACOBINI, G. 1995: L'étude au microscope électronique à balayage des surface osseuses. Le problème de l'identification des traces d'action anthropiques sur les objects archéologiques en matière dure animale. In: *1st international congress on "Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin"*, Siracusa.

ANGELUCCI, D.E. 2016: La Valle dell'Adige: genesi e modificazione di una grande valle alpina come interazione tra dinamiche naturali e fattori antropici. *Memorie dell'Accademia Roveretana degli Agiati* 4: 9-43.

BAZZANELLA, M. & WIERER, U. 2001: Die mesolithische Fundstelle am Galgenbühel in Salurn, Südtirol. Eine Sauveterrienstation im Etschtal. *Der Schlern* 75/2: 116-128.

BASSETTI, M. 2018: "L'acqua disfa li monti e riempie le valle...". Il ruolo dei processi fluviali nell'evoluzione del paesaggio urbano di Trento. In: Nicolis, F. & Oberosler, R. (a cura di): *Archeologia delle Alpi. Studi in onore di Gianni Ciurletti* 2018: 79-132.

BINFORD, L.R. 1981: *Bones, Ancient Men and Modern Myths*. Academic Press, New York.

BLUMENSCHINE, R.J. 1995: Percussion marks, tooth marks, and experimental determinations of the timing of hominid and carnivore ace to long bones at FLK Zinjanthropus, Olduvai Gorge, Tanzania. *Journal of Human Evolution* 27: 197-213.

BOSCATO, P. & SALA, B. 1980: Dati paleontologici, paleoecologici e cronologici di 3 depositi epipaleolitici in Valle dell'Adige (Trento). *Preistoria Alpina* 16: 45-61.

BROGLIO, A. 1980: Culture e ambienti della fine del Paleolitico e del Mesolitico nell'Italia nordorientale. *Preistoria Alpina* 16: 7-29.

BUNN, H.T. 1981: Archaeological evidence for meat-eating by Plio-Pleistocene hominids from Kooby and Olduvai Gorge. *Nature* 291: 574-577.

DALMERI, G. 1998: Il percorso della più antica preistoria: la Valle dell'Adige nel Mesolitico. *Natura Alpina* 3: 8-9.

DIPINO, N.; CHIACCHIO, G.; FONTANA, A.; FLOR, E.; FONTANA, F. & THUN HOHENSTEIN, U. 2025: Strategie di sussistenza e mobilità dei gruppi di cacciatori-raccoglitori-pescatori nella Val d'Adige: tafonomia e stagionalità a Riparo Romagnano e Riparo Pradestel (TN). *Archaeofauna* 34(1) (2025): 00-00.

FERNÁNDEZ-JALVO, Y. & ANDREWS, P. 2016: *Atlas of Taphonomic Identifications. 1001+ Images of Fossil and Recent Mammal Bone Modification*. Springer, Amsterdam.

GIACOBINI, G.; AIMAR, A. & MALERBA, G. 1992: Lo studio delle tracce di macellazione sui resti faunistici preistorici. In: *Atti del Colloquio, Sepolture preistoriche nelle Dolomiti e primi insediamenti storici*: 109-124. Belluno 1992.

GRAYSON, D.K. 1984: *Quantitative zooarchaeology. Topics in the analysis of archaeological faunas*. Accademic Press, New York.

GURIOLI, F.; BARTOLOMEI, G.; NANNINI, N.; PERESANI, M. & ROMANDINI, M. 2011: Deux clavicules de marmotte epigravettiennes incisées, provenant des Grottes Verdi de Pradis (Alpes Italiennes). *Paléo* 22: 311–318.

KOSZLOWSKI, S.K. & DALMERI, G. 2000: Riparo Gaban: the Mesolithic layers. *Preistoria Alpina* 36: 3-42.

LYMAN, R.L. 1994: Quantitative units and terminology in zooarchaeology. *American Antiquity* 59: 36-71.

— 2008: *Quantitative paleozoology*. University Press, Cambridge.

MALERBA, G. & GIACOBINI, G. 1995: Analisi delle tracce di macellazione in un sito paleolitico. L'esempio del Riparo di Fumane (Valpolicella, Verona). In: *Atti del I Convegno Nazionale di Archeozoologia*: 97-108. Rovigo 1993.

MAREAN, C.W.; ABE, Y.; NILLSEN, P.J. & STONE, E.C. 2001: Estimating the minimum number of skeletal elements (MNE) in zooarchaeology: a review and new image-analysis GIS approach. *American Antiquity* 66.2: 333-348.

RAVAZZI, C.; PERESANI, M.; PINI, R. & VESCOVI, E. 2007: Il Tardoglaciale nelle Alpi e in Pianura Padana. Evoluzione stratigrafica, storia della vegetazione e del popolamento antropico. *Il Quaternario* 20: 163-184.

ROMANDINI, M. 2012: *Analisi archeozoologica, tafonomica, paleontologica e spaziale dei livelli Uluzziani e tardo-Musteriani della Grotta di Fumane (VR). Variazioni e continuità strategico comportamentali umane in Italia Nord-Orientale: i casi di Grotta del Col della Stria (VI) e Grotta del Rio Secco (PN)*. Dottorato di ricerca in Scienze e Tecnologie per l'Archeologia e i Beni Culturali, ciclo XXIV, Università di Ferrara, Ferrara.

ROMANDINI, M.; PERESANI, M.; GURIOLI, F. & SALA, B. 2012: Marmota marmota, the most common prey species at Grotta del Clusantin: Insights from an unusual case-study in the Italian Alps. *Quaternary International* 252: 189-194.

SALARI, L.; MASSETI, M. & SILVESTRI, L. 2020: Late Pleistocene and Holocene distribution history of the Eurasian beaver in Italy. *Mammalia* 84(3): 259–277.

THUN HOHENSTEIN, U.; BERTOLINI, M.; VALVERDE, I.; DALMERI, G. & PEDROTTI, A. 2016: Exploitation of faunal resources at Riparo Gaban (Trento, Italy) during the Late Mesolithic period: preliminary results of archaeozoological and taphonomical analysis. *Preistoria Alpina* 48: 53-62.

WIERER, U. & BOSCATO, P. 2006: Lo sfruttamento delle risorse animali nel sito mesolitico di Galgenbühel-Dos de la Forca, Salorno (BZ): la macrofauna. In: Tecchiati, U. & Sala, B. (eds.): *Studi di archeozoologia in onore di Alfredo Riedel*: 85-98.

WIERER, U.; BETTI, L.; BOSCATO, P.; BAZZANELLA, M.; BOSCHIN, F.; CREZZINI, J.; GALA, M.; GIROD, A. & TAGLIACOZZO, A. 2018: Vivre près de l'eau. Environnement, économie du milieu humide y techniques de pêche du site mésolithique Galgenbühel/Dos de la Forca dans la vallée de l'Adige (Tyrol du Sud, Italie). In: Cupillard, C.; Séara, F. & Griselin, S. (Dir.): *Au cœur des sites mésolithiques: Entre processus taphonomiques et données archéologiques, Actes de la table-ronde internationale de Besançon (Doubs, France) « Hommages au Professeur André Thévenin » 29–30 octobre 2013*: 241–257.

ZAHNER, V.; SCHMIDBAUER, M.; SCHWAB, G. & ANGST, C. 2020: *Der Biber. Baumeister mit Biss*. SüdOst-Verlag.

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Skinned and defleshed horses. Clues to sacrifice on horse remains from the necropolis of Este-Nuova Casa di Ricovero (Padova, Italy)

Cavalli scuoiati e scarnificati. Indizi di sacrificio sui resti di cavallo della necropoli di Este-Nuova Casa di Ricovero (Padova, Italia)

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ABSTRACT: The use of horses in sacrificial rites in northern Italy has been documented since the Early Iron Age and includes the burial of whole horses or the deposition of parts of them in tombs and sanctuaries. The discovery of 34 horse burials from the Nuova Casa di Ricovero site of Este, dated between the 6th and 4th centuries B.C., allowed us to implement a statistical analysis of biometric parameters and the study of butchering traces. The horses, buried without traces of harnesses, are predominantly adults, including many males, and their dimensions fall within the averages for horses from other coeval necropoles. The taphonomic study incorporates elements never reported in horse burials of the ancient Veneti. This is the case of butchering marks which demonstrate that horse carcasses were handled prior to burial. Many horses show the typical traces associated with skinning and defleshing. In some cases, cutmarks conform with carcasses being placed in too narrow pits. Our study provides relevant data on butchering traces to confirm or revise hypotheses on the nature of horse burials in the Veneto area.

KEYWORDS: ANCIENT VENETI, HORSE BURIAL, SACRIFICE, BUTCHERING MARKS, CONSERVATION PROCESSES

RIASSUNTO: L'utilizzo dei cavalli nei riti sacrificali nell'Italia centro-settentrionale è testimoniato sin dalla prima Età del Ferro e comprende la sepoltura di individui completi o la deposizione di parti di essi nelle tombe e nei santuari. Il rinvenimento di 34 sepolture di cavallo nel sito di Nuova Casa di Ricovero di Este, datate tra VI-IV sec. a.C., ha consentito l'analisi statistica delle caratteristiche biometriche e lo studio delle tracce di macellazione. I cavalli, sepolti senza elementi di bardatura, sono in prevalenza adulti, tra i quali molti maschi, e per le dimensioni rientrano nelle medie dei cavalli di altre necropoli coeve. Lo studio tafonomico aggiunge elementi nuovi, mai riscontrati nelle sepolture di cavallo dei Veneti antichi, evidenziando per la prima volta che le carcasse dei cavalli sono state manipolate prima della sepoltura. Molti cavalli mostrano

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le tracce tipiche del recupero della pelle e altri anche della carne. In alcuni casi particolari le tracce sono da mettere in relazione con l'inserimento della carcassa in fosse troppo strette. Questo studio fornisce dati importanti sulle tracce di macellazione per confermare o ridiscutere le ipotesi interpretative sulla natura delle sepolture di cavalli in area veneta.

PAROLE CHIAVE: VENETI ANTICHI, SEPOLTURE DI CAVALLI, SACRIFICIO, TRACCE DI MACELLAZIONE, RESTAURO

RESUMEN: En el norte de Italia el uso del caballo en ritos sacrificiales está documentado desde la Edad del Hierro Temprana e incluye tanto enterramiento de animales completos como la deposición de porciones anatómicas en tumbas y santuarios. El descubrimiento de 34 enterramientos de caballos en el yacimiento de Nuova Casa di Ricovero en Este, datados entre los siglos VI y IV a.C., ha permitido implementar un análisis estadístico de parámetros biométricos y el estudio de huellas de despiece. Los caballos, enterrados sin rastros de arneses, son predominantemente adultos, incluidos muchos machos, y sus dimensiones se encuentran dentro de la media de los caballos de otras necrópolis coetáneas. El estudio tafonómico incluye elementos nunca antes reportados en los enterramientos de caballos de los antiguos Vénetos. Este es el caso de las marcas de despiece que demuestran que los cadáveres fueron manipulados antes de su enterramiento. Muchos caballos muestran las típicas huellas asociadas con el desollado y descarnado de las carcasas. En algunos casos, las marcas de corte corresponden a carcasas colocadas en fosas demasiado estrechas. Nuestro estudio proporciona datos relevantes sobre las huellas de despiece que permitirán confirmar o revisar las hipótesis avanzadas sobre la naturaleza de los enterramientos de caballos en el área del Véneto.

PALABRAS CLAVE: ANTIGUOS VÉNETOS, ENTERRAMIENTO EQUINO, SACRIFICIO, MARCAS DE DESPIECE, PROCESOS DE CONSERVACIÓN

INTRODUCTION

The centrality of the horse in Iron Age Veneto is an unequivocal fact on which literary and material sources converge: artifacts, images, and excavation contexts. Classical texts associate these people with the reputation of the horses they bred (Strabo V, 1-4; Alcmane frg. 1, 46-51; Alcmane frg. 3, 35-51; Voltan, 1989; Prosdocimi, 2001). The most original character of the Horse/ancient Veneti binomial is the high number of equine burials, both single and concentrated in groupings, found in the necropolises located in the territories of: Oppeano (VR), Adria (RO), Este (PD), Padua, Altino (VE), Oderzo (TV) (Bortolami, 2019 and the references therein).

These burials range from isolated inhumations to mixed necropolis with separate burials of men and horses, horse-only necropolis, and joint burials of man and horse, all of which assume a strong ritual valence. There is no agreement to consider horse-only burials as the result of sacrifices or ritual acts. Other interpretative hypotheses range from the simple burial of animals that died of natural causes to that of animals that died during combat.

Compared with other domestic animals used in various sacrificial rites, the horse seems to stand out in that its bones are not usually found in food offerings or in the remains of funeral banquets, indicating that its meat has always been of special importance (hippophagy) and that it was not consumed in all communities. Due to the poor preservation of butchering marks, it is often difficult to trace the different stages and modes of animal sacrifice and burial (e.g., choice of subject, mode of killing, treatment of the carcass, possible use of the skin or meat, mode of deposition, etc.).

In Este, in the area of the Nuova Casa di Ricovero (henceforth Este-NCR), during the 2003-2004 excavations, 34 equine burials (*Equus caballus*) deposited during three cycles of use between the late 6th and 4th centuries B.C. were aggregated according to 4 subcircular groups, indicating compliance with an order (Figures S1-S4) (Balista & Ruta Serafini, 2008).

Their study provided a better understanding of both the mode of burial and the treatment of the carcass before burial.

MATERIALS AND METHODS

The burials of Este-NCR, at the time of the excavation, were assigned a progressive pit number preceded by the abbreviation CV (horse in Italian, an abbreviation that is retained in the present work). Of the 34 burials, 33 have no grave goods, while in one (CV36) there is an impasto bowl, datable between the late sixth and fourth centuries B.C., deposited upside down between the skull and forelimbs of the horse, a position that reminds one of the libatory rituals frequent in funerary contexts (Balista & Ruta Serafini, 2008; Bortolami, 2019 and references therein). The burials were obtained in two phases alternated by alluvium. The arrangement of the horses shows no particular orientation. Many are deposed on their sides with their limbs fully extended (Figure S5), while others show the limbs strongly flexed and, in some cases, with the skull and neck strongly twisted (Figure S6). In one case, a horse was placed on its back with its limbs strongly flexed toward the chest and abdomen (Figure S7 CV6). In the eastern sector, there is a surveyed part called a "*tumulus*" in which there are burials referable to both phases (Figure S8). In this area, several individuals deposited one on top of the other were recognized in pit CV32. Most of the skeletal remains placed in the lower part were attributed to three individuals (CV32 inf A, CV32 inf B, CV32 inf C), while in the upper part a single horse was recognized (CV32 sup) (Figure S9).

In the necropolis there is (Figures S2; S10) the burial (UT20) of a pig (*Sus domesticus*) cutting through the grave of a human inhumation tomb (Tb inhumed), the interpretation of which is not deemed appropriate to carry out here.

The assignment of the skeletal remains to *E caballus* and not to *Equus asinus*, or their hybrids, was made both on the analysis of the morphology of the dental remains examined (Eisenmann, 1986; Bistolfi & De Grossi Mazzorin, 2005) and on the biometric analysis of the metapodials, based on the measurements proposed by Eisenmann & Beckouche (1986). In particular, the latter analysis shows that the metapodials of Este-NCR present measurements, both of maximum length and of the transverse and antero-posterior widths of the epiphysis and diaphysis, that are consistently higher than those of the donkey and the hinny, while they are lower, especially with regard to maximum length, than those of mules.

Of the 34 equine burials, 30 individuals were analyzed, of which only 26 had their appendicular bones in good condition. Statistical analysis of biometric characteristics was also conducted on the latter, which allowed a significant number of measurements. Some of the parameters, such as the metapodial slenderness index, were calculated only on a smaller number of skeletal elements.

To enable the study of the horses, a restoration project of part of the skeletons was initiated in the years 2008-2010. This restoration was carried out after a preliminary check for the presence of any traces of natural or anthropogenic modification to be preserved for subsequent taphonomic research. A total of 2 individuals were fully restored: CV22 (NISP 109) and CV24 (NISP 96) were used for study and prepared for possible museum display, and 298 other skeletal elements belonging to 24 other individuals were fully restored for study, focusing on the cranial vault, occipital area, dentition, ventral margin of the mandible, and complete elements of the postcranial skeleton (Figures S11-S13).

The ages of the horses at their deaths were estimated based on tooth eruption and wear and on the state of fusion of the axial and appendicular bones according to Barone (1981, 1995) and Martin (2005). Given the extreme heterogeneity of the state of preservation of the skeletons, the morphometric analysis was focused on the metapodial bones, which are the best preserved. For the same reason, it was not possible to conduct a multivariate analysis that included the entire sample, for which univariate and bivariate analyses were more useful.

The measurements were taken according to Driesch (1976). The wither heights were calculated on several anatomical elements of both sides when they were present, according to Kiesewalter (1888) and May (1985). From the values obtained, the minimum, mean, and maximum withers height were calculated for each individual.

The sex determination was based on the statistical analysis of the measures of metapodials compared with the presence/absence of the canines.

The Slenderness Index (GL x 100/SD) was calculated for the metapodials, the most preserved bones of the skeletons, in order to better define the morphological characteristics of horses.

Statistical analyses (univariate, bivariate, and multivariate) were executed employing PAST (PAlaeontologicalSTatistics) 3.20 software (Hammer *et al.*, 2001).

For comparison purposes, the population of horses buried in the necropolis of Le Brustolade (Altino, Italy) was selected, where 27 horse skeletons (Riedel, 1982) attributable to an interval between 450 and 350 B.C. were recovered (Tombolani, 1979).

The taphonomic analysis involved 503 horse bone elements referable to 24 skeletons. Two complete skeletons were analyzed; the girdle and limb bones of seven other skeletons, and only well-preserved limb bones of 15 skeletons were analyzed and used for morphometric study (Tables S6-S7).

Preliminary analysis of the bone surfaces was carried out by using low magnification lenses (10x-20x). More detailed observations were made with the Stereomicroscope (stereo NIKON SMZ 1000, 40x - 160x). Digital photographs of the remains and modification traces were taken with a Nikon Coolpix 4500 camera and then processed with Adobe CS4. To distinguish between the different types of traces reference was made to what has been described in the literature (Fisher, 1995; Greenfield, 1999; Fernández-Jalvo & Andrews, 2016 and references therein).

RESULTS

POPULATION ANALYSIS

Age of death determination was made possible for 27 individuals. There are numerous age classes, ranging from animals as young as 1-2 years old to individuals as old as even over 10 years, with adult individuals predominating (Table S1). In summary, 3 horses are between 1 and 2 years old, 5 are less than or slightly older than 42 months, 8 are older than 52 months, 1 is about 5 years old, 1 is between 9 and 11 years old, and 9 are 10 years old or older. For 5 horses, the age of death could not be determined. The distribution of age classes within the necropolis appears entirely random and shows no particular centralization (Figure S14).

The withers height calculated on 26 horses (Table S2) varies from 1159 mm to 1465 mm, with a mean of 1327.8 mm and a standard deviation comprised between 63.3838 (minimum height) and 61.9768 (maximum height), indicative of an extreme variability of calculated values.

The frequency histograms of the minimum, average and maximum horse heights (Figure S15), present a bimodal distribution of the minimum and maximum values and a unimodal one for the average values.

The Slenderness Index calculated on 12 metacarpals (Table S3) varies from 12.2 to 16.0 with a mean of 14.65 and a standard deviation of 1.063177, indicative of a not very wide dispersion of calculated values. The frequency histogram of the slenderness index for the metacarpal (Figure S16) shows a bimodal trend, indicative of the presence of both individuals with relatively slender metacarpals and individuals with slightly stubby metacarpals.

The Slenderness Index calculated on 13 metatarsals (Table S4) varies from 9.9 to 12.5 with a mean of 11.35 and a standard deviation of 0.675297, indicative of a dispersion of calculated values narrower than the metacarpals one. The frequency histogram of the slenderness index for metatarsus (Figures S17-S18) shows a unimodal pattern indicative of the presence of numerous individuals with relatively stubby metatarsus along with a smaller number of individuals with slender metatarsus. According to the classification proposed by Brauner (1916) on the basis of the Slenderness Index of the metapodials, and the classification proposed by Vitt (1952) based on the withers height regarding the metacarpals, most of the Este-NCR horses fall into the small withers height category and into the slender legged, semi-slender legged, and slender Slenderness Index categories, with most of the individuals with the canines included in the semi-slender legged category (Figure S19).

According to the same classification based on the metatarsals (Figure S20) most horses, including those with canines, fall into the below-medium and medium height categories, and into the slender Slenderness Index category.

In synthesis, the wide range of the values of the withers' height and of the Slenderness Index of the metapodials indicates a wide variety of individual types buried in the Este-NCR horse cemetery, although relatively medium-tall and slender individuals seem to prevail.

Distinguishing females from males in the buried horses is important to interpret the burial rituals and the human/horse relationships at the site.

At Este-NCR, not all horse skeletons preserved the coxal in a way that would allow observation and measurements (Nistelberger *et al.*, 2019 and references therein), then it was preferred not to consider this character. Regarding the presence of the canines, not all horse skulls allow viewing of the rostral portion of the maxilla and mandible. Therefore, the presence of canines was observed in only 8 individuals. Considering that the presence/absence of this tooth, with more robust morphological characters in males (Johnstone, 2004), is considered as a distinguishing characteristic of the male gender only on a statistical level and not as an unambiguous and discriminating parameter (De Grossi Mazzorin, 2008), this data is used only as a supplement to the observations made about the biometry of metapodials.

The biometric analysis of metapodials was conducted by processing the scatter plots of Greatest Length (GL) versus the Smaller Breath of the diaphysis (SD) (Figures S17-S18), and with the analysis of principal components of all measures (Figures S21-S22) (the details are illustrated in SM). Diagram analysis seems to be more effective for metacarpals than for metatarsals, with a good correlation with the presence/absence of canines, although there are exceptions, especially regarding the PCA of metatarsals.

From the comparison of the observations made on the dental characters (presence/absence of canines) and the bivariate and multivariate analysis of the biometric parameters of 27 individuals. To summarize, it would appear that the population of horses buried in the equine necropolis of Este-NCR consists of 2 females, 2 probable females, 12 males, 1 probable male and 10 individuals to be determined (Table S5).

TAPHONOMIC ANALYSIS

The analysis of the surfaces of the bone remains of horses from the Este-NCR was carried out to highlight through macro- and microscopic observation possible traces of killing and carcass treatment/manipulation (Table 1). 503 remains attributable to 24 individuals were analysed (Tables S6-S7). On almost all the horse remains analyzed, traces of different depths, lengths, widths, orientations, and with different locations on the anatomical elements were observed. Many *striae* refer to traces of root systems, and long straight grooves refer to vascular impressions. Analysis of the fracture margins and their course has allowed us to hypothesize that some parts of the fractures are due to post-depositional processes.

Butchery cuts with ancient patina are repeated, and sub-parallel, with small cleaves and deeper notches in some cases.

The evidence of carcass treatment prior to burying was found on 15 individuals of the 27 analyzed (Tables 1, S6-S8; Figures S31-S35).

Anatomical elements that show traces of cuts produced in antiquity are 46, accounting for 9.1 % of the remains analyzed. Of these, 26 are leg extremity bones (metacarpals, metatarsals, and phalanges I and II). The remaining elements refer to long leg bones and girdles.

- Typically, these are traces referable to skinning localized on the leg extremity bones (metapodials and phalanges) of 13 individuals (Figure 1). Only in one case were dubious striae from skinning found on the skull (CV33), unfortunately poorly preserved.
- The cuts found on other long bones such as the humerus, radius-ulna, femur, tibia, and some metapodials of eight individuals are most likely to deflesh.
- The small notches found on the coxals of individuals CV2, 33, and 35 could refer to defleshing, but it is complex to determine the butchering action. The cuts that would seem to refer to disarticulation as they are located near the joints, rather than refer to the recovery of the meat, probably to the insistent cutting of muscle insertions like those observed on the elements of the girdles of CV33. In fact, the carcass is shown in the connection (Table S8; Figure S34).
- Traces of disarticulation were found on the right metatarsal of CV11. A deep longitudinal cut was found on the distal condyle, documenting how there might have been partial detachment, although the skeleton appears to be in connection.
- Particularly interesting is the case of CV33. It refers to a young adult of 30/36 months, the skeleton of which is complete and in perfect connection, deposed on the right side with semiflexed legs. Cut traces were found on 12 elements. The position of the traces on the different elements corresponds to the main muscle insertions. The typology of the traces suggests the removal of shoulder and thigh muscle masses without disarticulation. The distribution of the different anatomical elements and the typology of the cuts note that this individual was skinned and entirely defleshed before being buried.

Individual CV	Age at death	Mean withers height (mm)	Gender Hypothesised determination	Butchering marks
2	++ 52 m	1342,7	M	S - DFL
6	+ 10 - 12 y	1325,7	F?	S
8	2,5-3,5 y			
9	++ 12 y	1229,0	?	
10	+ 52 m	1251,5	M?	S - DFL
11	adult	1380,0	F?	S - D
12	adult	1343,0	?	
13	1 y			
14	1y	1328,5	F	
15	++ 52 m	1407,1	M	S
16	++ 52 m	1380,4	M	S
17	+ 12 y	1430,1	M	
18	indet			
19	1 – 2 y	1324,0	?	
21	> 42 m	1414,2	?	
22	9 – 11 y	1330,9	M	DFL
24	10 – 12 y	1347,3	M	S - DFL
25	indet			
27	+ 10 - 12 y	1312,0	M	
28/29	10 – 12 y	1318,2	?	
30	5 years		?	
31	10 – 12 y	1347,2	M	S
32 sup	10 – 12 y	1288,8	M	
32 inf A	indet	1216,2	?	
32 inf B	3 y	1296,6	?	S
32 inf C	indet	1288,0	?	
32 inf A/B/C	indet	1266,8	M	
33	2,5 – 3,5 y	1305,9	?	S – D - DFL
34	++ 36 ms	1282,5	M	S
35	+ 10 y	1354,7	F	S - DFL
36	30 – 36 m	1351,3	M	S - DFL

TABLE 1

Ages at death, Withers Height, Gender and butchering marks of Este-Nuova Casa di Ricovero horses (m: months; y: years; S: skinning; D: disarticolation; DFL: defleshing).

Moreover, the grave is large enough to contain the entire carcass, so it cannot be assumed that some cuts were made to better fit it into the grave. Striae were found on practically all the long limb bones on both sides (Figure 2). Cuts also recur on the girdle bones. The cuts recur predominantly on the medial faces of the different anatomical elements, suggesting that the defleshed recovery actions occurred by intervening on the carcass disposed with its ventral side upward. The position of the skeleton within the pit with the coxal facing upward from its natural position further confirms the hypothesis of carcass manipulation (Table S6; Figure S35-S36).

– Currently, no traces have been identified that can be traced back to the killing of the animals. It could be done without affecting the bones by throat-slashing, drowning, or asphyxia.

The skinning traces, which are the most frequent ones, testify that horses were skinned. The defleshing cuts, on the other hand, testify that portions

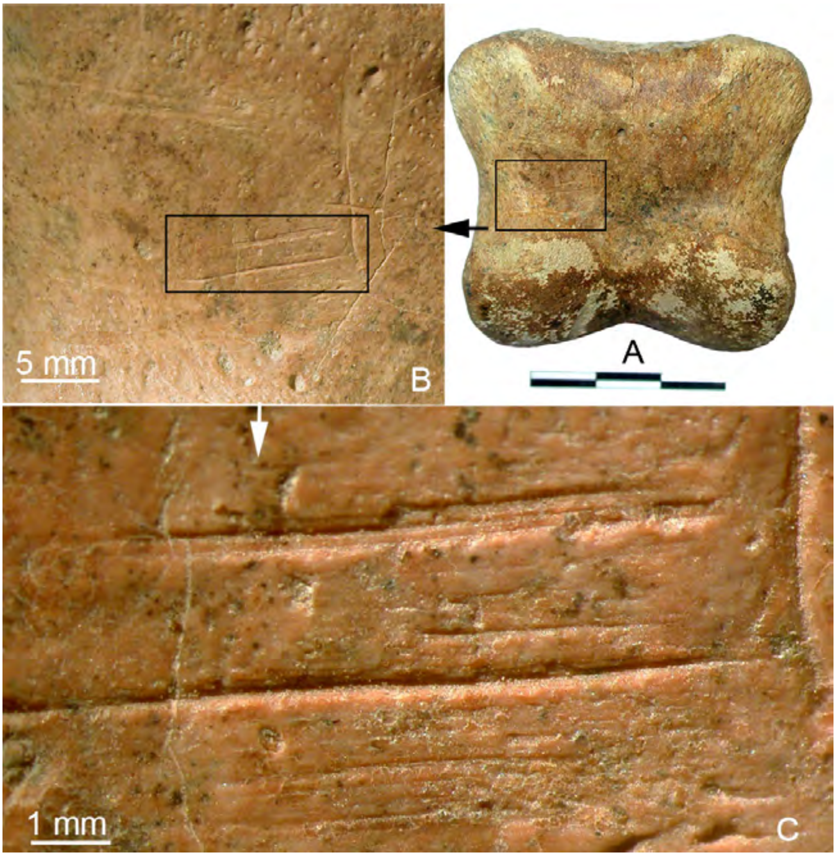


FIGURE 1

CV2, II phalanx with evidence of skinning, location and details of cuts.

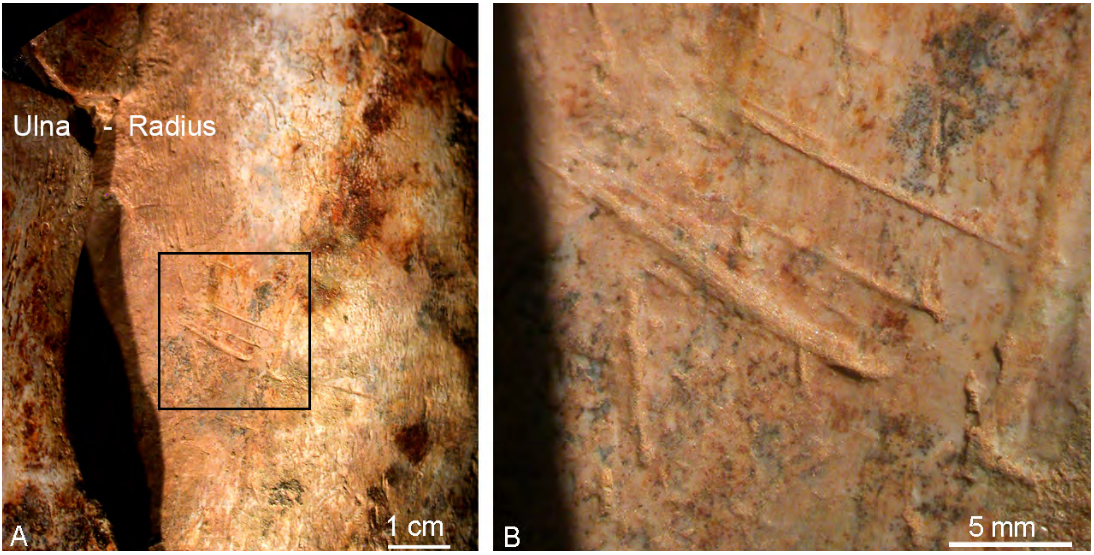


FIGURE 2

CV33, proximal radius-ulna with evidence of defleshing, location and details of cuts.

of meat were taken out, leaving the carcass in connection. In general, taphonomic data shows that mostly male animals were buried at Este-NCR. As a special note, it is highlighted that the horses buried in the tumulus were all skinned.

PATHOLOGIES

Part of anomalies due to pathology have been firmly established in six individuals. Some examples are the left humerus and coxal of CV24, which show appositions of bone tissue in different areas of the two anatomical elements and also anomalous wear was observed on the upper and lower P2 of CV24; this type of wear usually occurs with bit placement (Figure S37). The deformities found at the proximal joint of the left metatarsal of CV17 and the metatarsal of CV33 could be related instead to the activity carried out by the animal, such as riding or traction.

DISCUSSION

In the world of the ancient Veneti, the horse is a constant presence. There are numerous representations of it in religious and profane contexts; bronze figures of mounted warriors and horses are common. The ritual of horse burial, isolated or in connection with human and/or animal burials, is certainly a peculiarity of the Veneto world during the Second Iron Age; it is enough to mention the necropolis of Oppeano (VR), Adria (RO), Este (PD), Padua, Altino (VE), and Oderzo (TV). However, it is precisely because of this highly ritualistic character and the very diverse appearance of these depositions that it is not yet possible to provide an unambiguous interpretation of this practice, so widespread in the ancient Veneti context (Bortolami, 2019 and references therein).

A comparison of the dimensions of the horses from the Este-NCR necropolis (the withers height varies from 1159 mm to 1465 mm, with a mean of 1327.8 mm) with those of other Patavinian contexts verified that they correspond to those of the horses from Via S. Eufemia (Facciolo & Tagliacozzo, 2006) and are slightly smaller than those from the later necropolis of Via Belzoni (Rizzi Zorzi & Reggiani, 2010).

A more appropriate context type and chronology comparison is with the horses from Le Brustolade (Altino, Italy) (Riedel, 1982). Twenty-seven horse skeletons were recovered at this site, four of which retained their morsel or other ornaments. These burials are dated between 450 and 350 B.C. (Tombolani, 1979). At Le Brustolade the spatial disposition, lacking preferential orientation, the mode of deposition mostly on one side, show remarkable analogies with the Nuova Casa di Ricovero site at Este.

In summary (see Supplementary Materials for further discussion), the two horse populations of Este-NCR and Le Brustolade, from the point of view of height at withers, biometry of metapodials, but also for other elements of the appendicular skeleton, seem to be quite similar. Este has a narrower range of withers height than Le Brustolade (1050-1501 mm), but it is shifted toward lower values and has a strong discontinuity between individual values (Figures S23-S30).

It appears from the excavation data of Este-NCR that the absent skeletal parts can be attributed to later events, such as agricultural work. Only pit CV2, which is intact, contains the skeleton of a complete horse without the skull. This could represent a variation of an ancient Veneti ritual, reminiscent of practices in use in Rome, where the removal of some parts of the sacrificed horse (head and tail to be displayed) was also provided for (Devereux, 1970) or in later periods among the Lombards where burials of decapitated horses are frequent (Ceglia & Marchetta, 2012).

The skinning traces clearly indicate the recovery of the hide, which played a particular significance in sacrifices called ‘communion sacrifices’. Such type of sacrifice in the Mediterranean context involved a division of the sacrificed animal between offerers and priests. The parts of the carcass to be divided were well defined and usually the hides belonged to the priest and the temple (D’Andrea, 2018). The importance of the horse for the ancient Venetians, an animal that pervaded the material and religious spheres, probably excluded the consumption of its meat, except in exceptional occasions, while the hides perhaps had a special significance in the sacrifice.

Unlike the evidence at Este-NCR, where traces of butchering are frequent, there is little evidence in other contexts. Only two depositions are currently known in the area and in the period under consideration that show traces of slaughter, in both cases identified as marks of killing. One is burial No. 57 on Via San Massimo, dated between the 8th and 6th centuries B.C. which contains a horse in a crouched position with an obvious fracture on the skull (Gamba *et al.,* 2013). The other is a *bisoma* man-horse burial from the Piovego necropolis, where the horse shows a triangular-shaped blow that caused the skull to fracture (Leonardi, 2004).

CONCLUSIONS

The population of Este-NCR horses, based on morphological and biometric data, appears to be characterized by a fair amount of heterogeneity in terms of size. However, it was possible to put forward the hypothesis that a greater number of individuals show male-specific size characteristics than those with female-specific traits. The distribution of age classes at death also varies, although adults and senile individuals older than 10-12 years prevail. In some skeletons, pathologies related to the use of horses for pulling weights (plough?), for transport (chariot?) or for riding are evident. In only one case was abnormal wear of the front premolars found, most likely due to the use of the bit.

The pits vary in size, some are wide enough to contain the carcasses with the limbs extended and half-flexed, while others are narrower. The patterns of burial show the preferential choice of deposition on the side, with legs outstretched or flexed, although some individuals show very folded legs. In some cases, the possibility has been suggested that the horse was deposed on its dorsal side, with the limbs and belly facing upward. In terms of comparing the two phases of necropolis use, no significant differences are evident, either with respect to the number of animals buried or with respect to the age of death. In both phases, the frequency of individuals with butchering traces and the type of traces (with a preference for those from skinning) appear similar. The only different element is the prevalence in Phase 2 of depositions on the right side. Regarding the orientation of the pits, it appears quite variable. However, in Phase 1, there is a slight prevalence of E-W and N-S oriented individuals, while in Phase 2, there is a clearer prevalence of E-W oriented deposition (Figures S2–S4; Table S6).

No traces of the killing were found. How and why the animals died could not be determined. The taphonomic study reveals that the carcasses were generally skinned before burying, and that portions of meat were taken, leaving the carcass in connection. In some burials, the cutting traces should be interpreted not only as actions of butchering but also in relation to the dimension of the burial pits and the position of the carcasses within them. In fact, in some cases, due to the small size of the burials, the carcasses were laid on their backs and/or with the limbs strongly flexed. It is not excluded that some cuts or notches may be attributable to ligaments' cutting to better arrange the carcasses within the pits.

If we exclude pit CV2, which is intact but contains the skeleton of a complete horse without the skull, we can assume that we are dealing with complete carcass burials.

The study of the Este-NCR burials provides new elements inherent to the role of the horse in the world of the ancient Veneti. The practice of skinning, in more than half of the predominantly male animals, and the recovery of part of the meat could suggest that these were sacrificed animals, in which the animal's skin was recovered and the meat probably consumed at ritual banquets. It should be noted that ancient sources indicate that the ancient Veneti sacrificed a white horse to Diomedes (Strabo V, 8-9; Prosdocimi, 2003; Braccesi, 2013). Thus, the color of the skin played a special role in the choice of the animal to be sacrificed and, in some cases, could be recovered after the sacrifice. If, on the other hand, the animals died a natural death or in combat, such burials could be interpreted as utilitarian aimed at recovering valuable substances such as skin and meat.

ACKNOWLEDGEMENTS

The excavations at Este-Nuova Casa di Ricovero were carried out by Soprintendenza Archeologica del Veneto in cooperation with GEOARCHEOLOGI ASSOCIATI s.a.s. who produced the plan and photographic documentation of the necropolis.

SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_012

REFERENCES

Balista, C. & Ruta Serafini, A. 2008: Spazi urbani e spazi sacri ad Este. In: *I Veneti antichi. Novità e aggiornamenti*: 81-100. Atti del convegno di studio (Isola della Scala, 15 ottobre 2005). Verona.

Barone, R. 1981: *Anatomia comparata dei mammiferi domestici. 3, Splancnologia. (Italian edition by R. Bortolani)*. Edagricole, Bologna.

— 1995: *Anatomia comparata dei mammiferi domestici. 1, Osteologia. (Italian edition by R. Bortolani, E. Callegari)*. Il Sole 24 Ore – Edagricole, Bologna.

Bistolfi, F. & De Grossi Mazzorin, J. 2005: I resti equini rinvenuti nello scavo condotto sul Celio a Piazza Celimontana (Roma). In: Fiore, I.; Malerba, G. & Chilardi, S. (eds.): *Atti del 3° Convegno Nazionale di Archeozoologia* (Siracusa, 3-5 novembre 2000): 449-458. Istituto poligrafico e Zecca dello Stato, Roma.

Bortolami, F. 2019: Sepolture e sacrifici equini nel Veneto preromano. *Incontri di filologia classica* 17(2017-2018): 61-88.

Braccesi, L. 2013. Il mondo veneto e l'immaginario ellenico. In: Gamba, M.; Gambacurta, G.; Ruta Serafini, A.R.; Tinè, V. & Veronese, F. (eds.): *Venetkens: viaggio nella terra dei Veneti antichi*: 51-57. (Mostra, Padova, 6 aprile-17 novembre 2013). Marsilio, Venezia.

Brauner, A. 1916: The horse of the Tiraspol moulds, Kherson district. Materials on the knowledge of the domestic animals of Russia. *Zapiski obshchestva selskogo hozyaystva Yujnoy Rossii* 86(1): 49-85.

Ceglia, V. & Marchetta, I. 2012: Nuovi dati dalla necropoli di Vicenne a Campochiaro [A stampa in La trasformazione del mondo romano e le grandi migrazioni. Nuovi popoli dall'Europa settentrionale e centro-orientale alle coste del Mediterraneo. In: Ebanista, C. & Rotili, M. (eds): *Atti del Convegno internazionale di studi, Cimitile-Santa Maria Capua Vetere, 16-17 giugno 2011*: 217-238. Tavolario edizioni 2012. Distribuito in formato digitale da "Reti Medievali", www.retimedievali.it.

D'andrea, D. 2018: Sacrificare "alla maniera" fenicia? i sacrifici animali nel mondo fenicio e punico: caratteri e specificità. In: Celestino Pérez, S. & Rodríguez González, E. (eds.): *Un viaje entre el Oriente y el Occidente del Mediterráneo. Actas del IX Congreso Internacional de Estudios Fenicios y Púnicos 2018*: 149-165. Mytra 5, Mérida. halshs-02953352

De Grossi Mazzorin, J. 2008: *Archeozoologia. Lo studio dei resti animali in archeologia*. Manuali Laterza, vol. 255. Roma.

Devereux, G. 1970: The "Equus October" Ritual Reconsidered Devereux (1970) – George Devereux, "The Equus October Ritual Reconsidered". *Mnemosyne* IV(23) (1970): 297–301.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletins. Harvard University. MA.

Eisenmann, V. 1986: Comparative osteology of Modern and Fossil Horse, Half-Asses, and Asses. In: Meadow, R.H. & Uerpmann, H.-P. (eds.): *Equids in the Ancient World* I: 67-116. Dr Ludwig Reichert Verlag, Wiesbaden.

Eisenmann, V. & Beckouche, S. 1986: Identification and Discrimination of Metapodials from Pleistocene and Modern Equus, Wild and Domestic. In: Meadow, R.H. & Uerpmann, H.-P. (eds.): *Equids in the Ancient World* I: 117-163. Dr Ludwig Reichert Verlag, Wiesbaden.

Facciolo, A. & Tagliacozzo, A. 2006: Animal burials from via S. Eufemia in the Paleovenetian contexts– Padova (Italia). *Archaeozoological studies in honour of Alfredo Riedel. Bolzano*: 143-152.

Fernández-Jalvo, Y. & Andrews, P. 2016: *Atlas of Taphonomic Identifications. 1001+ Images of Fossil and Recent Mammal Bone Modification*. Springer, Amsterdam. https://doi.org/10.1007/978-94-017-7432-1

Fisher, W.J. 1995: Bone surface modifications in zooarchaeology. *Journal of Archaeological method and theory* 2: 7-68.

Gamba, M.; Gambacurta, G.; Ruta Serafini, A.; Tinè, V. & Veronese, F. (eds.) 2013: *Venetkens. Viaggio nella terra dei Veneti antichi*. (Mostra, Padova, 6 aprile-17 novembre 2013). Marsilio, Venezia.

Greenfield, H.J. 1999: The Origins of Metallurgy: Distinguishing Stone from Metal Cut Marks on Bones from Archaeological Sites. *Journal of Archaeological Science* 26: 797–808.

Hammer, Ø.; Harper, D.A.T. & Ryan, P.D. 2001: PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4(1): 1-9.

Johnstone, C.J. 2004: A Biometric Study of Equids in the Roman World. Thesis submitted for PhD University of York Department of Archaeology September 2004. York.

Kiesewalter, L. 1888: *Skelettmessungen an Pferden als Beitrag zur teoretischen Grundlage der Beurteilungslehre des Pferdes*. Dissert., Leipzig.

Leonardi, G. 2004: *La tomba bisoma di uomo e di cavallo nella necropoli del Piovego-Padova*. Marsilio, Venezia.

Martin, M.T. 2005: *Manuale per la determinazione dell'età nel cavallo*. American Associationof Equine Practitioners. College of Veterinary Medicine Texas A&M University.

May, E. 1985: Winderristhöhe und Langknochenmasse bei Pferden-ein immer noch actuelles Problem. *Z Säugertierkunde* 50: 368-382.

Nistelberger, H.M.; Pálsdóttir, A.H.; Star, B.; Leifsson, R.; Gondek, A.T.; Orlando, L.; Barrett, J.H.; Hallsson, J.H. & Boessenkool, S. 2019: Sexing Viking Age horses from burial and non-burial sites in Iceland using ancient DNA. *Journal of Archaeological Science* 101: 115-122. doi: 10.1016/j.jas.2018.11.007.

Prosdocimi, A.L. 2001: I riti dei Veneti antichi. Appunti sulle fonti. In: *Orizzonti del sacro, Culti e santuari antichi in Altino e nel veneto orientale*: 5-35. Edizioni Quasar, Roma.

— 2003: Sul sacrificio del cavallo in alcune fonti di tradizioni indoeuropee. In: Cresci, G.; Marrone & Tirelli M. (eds.): *Produzioni, merci e commerci in Altino preromana e romana*: 61-88. Atti del Convegno (Venezia, 12-14 dicembre 2001). Venezia.

Riedel, A. 1982: The Paleovenitian horse of Le Brustolade (Altino). *Studi Etruschi* 50: 227-256.

Rizzi Zorzi, J. & Reggiani, P. 2010: I cavalli della necropoli di Padova-Via Belzoni. Indagini istologiche preliminari sul terzo metacarpo di cavallo. In: Tagliacozzo, A; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del V Convegno Nazionale di Archeozoologia* (2010): 193-201. Edizioni Osiride, Rovereto.

Tombolani, M. 1979: Altino (Venezia): a) Loc. Le Brustolade. In: Colonna, G. (ed.): *Scavi e scoperte*. *Studi Etruschi* 47: 481-482.

Vitt, V.O. 1952: The horses of the Pazyryk moulds. *Sovetskaya Archeologia* 16: 161- 207.

Voltan, C. 1989: Le fonti letterarie per la storia della Venetia et Histria I: da Omero a Strabone. *Memorie classe di Scienze Morali, Lettere ed Arti*, vol. XLII. Ed. Zoppelli, Treviso.

SUPPLEMENTARY MATERIAL

THE SITE

Between the years 2000 and 2004, in the area of the Nuova Casa di Ricovero di Este (henceforth Este-NCR) several excavation fields were conducted (Figure S1).

A total of 34 intentional burials were uncovered, most of them equine (*Equus caballus*), which at the time of excavation was assigned a progressive grave number preceded by the initials CV (cavallo in Italian, an acronym retained in the present work). Of the 34 burials, 33 have no grave goods, while one (CV36) has an impasto bowl, that can be dated to the end of the 6th - 4th century B.C., placed upside down between the skull and the front legs of the horse, a position reminiscent of the libation rituals common in funerary contexts (Balista & Ruta Serafini, 2008; Bortolami, 2019).During the excavation, an *in situ* conservation intervention had been conducted by one of the authors (E.C.). A detailed map of each skeleton was made, and each skeletal element had been numbered and subsequently collected, with simultaneous preliminary documentation.

The burials appear to have been deposited in at least four clusters (Figure S2) and occured in two phases interspersed with alluvium leading to the deposition of sandy sediments (Figures S3-S4) (Balista & Ruta Serafini, 2008). The burials of phase 1 are deposited in the southwestern sector of the necropolis, while those of phase 2 are located in the northeastern sector. In the eastern sector, there is an elevated part called "tumulus". In this area there are some burials that refer to both phases. The arrangement of the horses does not show any particular orientation. Many lie on their side with the limbs fully extended (Figure S5), while in others the limbs are strongly flexed and, in some cases the skull and neck are strongly twisted, either toward the dorsal part of the shoulder or toward the sternum (Figure S6). In one case, a horse was lying on its back with the limbs strongly bent toward the chest and abdomen (Figure S7). Several burials are arranged in the tumulus area (Figure S8), with the horses laid down at approximately the same height, except in pit CV32. In the latter, several individuals deposited one on top of the other and next to each other were recognised: most of the skeletal remains placed in the lower part were attributed to three individuals (CV32 inf A, CV32 inf B, CV32 inf C), but some elements were not attributed with certainty to any of the latter (in the tables it is indicated as CV32 inf A/B/C), while in the upper part a single horse was recognised (CV32 sup). Furthermore, the excavation of the CV32 burial pit intercepted an earlier burial (CV34), destroying a large part of its skeleton (Figure S9).

In addition to the horse burials, the necropolis also contains (Figure S2; S10) the burial (UT20, Tb inhumate) of a pig (*Sus domesticus*) with the lower part of the skeleton of a human being (*Homo sapiens*).

MATERIALS

Of the 34 horse burials present in the Este- NCR necropolis, 30 individuals were analysed (Table S6). Among them, only 26 had their appendicular bones in a state of preservation that permitted effective morphological observation and the collection of a significant number of measurements. For this reason, the statistical analysis of the biometric characteristics of the horses was conducted on the 26 individuals for which the biometric parameters could be calculated. For the same reason, some of the parameters, such as the metapodial slenderness index, were only calculated on a smaller number of skeletal elements.

Taphonomic analysis involved 24 horse skeletons (Figure S31). However, no taphonomic data is found for three of them (CV8, CV18 and CV28/29). The following individuals were analised: two complete horses (CV22, CV24), consisting of 109 and 96 elements, respectively; the girdle and limb bones of 7 others (CV2, CV10, CV32b, CV33, CV34, CV35, CV36), a minimum of 13 to a maximum of 41 remains were observed, the quantity of elements being conditioned=by the preservation of body parts (Figures S31-32; Tables S7-S8). Of 15 horses, only well-preserved limb bones were analised and sampled for morphometric study. It should be noted that only a few elements were observed, ranging from a minimum of 3 to a maximum of 18. A total of 503 horse bone elements were analised (Tables S7-S8; Figure S33).

CONSERVATION AND RESTORATION

To enable the study of the horses buried in the necropolis of Este-NCR, a project to restore part of the horse skeletons was initiated in 2008-2010.

This restoration was made possible thanks to funding from the Arcus SpA - Società per lo sviluppo dell'arte, della cultura e dello spettacolo (a company established by a synergy between the Ministry of Economy and Finance, the Ministry of Culture and the Ministry of Sustainable Infrastructures and Mobility) and the scientific direction of the then Soprintendenza per i Beni Archeologici del Veneto (now Soprintendenza Archeologia Belle Arti e Paesaggio **per l'area metropolitana di Venezia e le province di Belluno, Padova e Treviso**) and the then Quaternary Palaeontology and Archaeozoology Section of the Soprintendenza al Museo Nazionale Preistorico Etnografico 'Luigi Pigorini' (now the Bioarchaeology Service of the Museum of Civilisations in Rome). The restoration was carried out by the Società Cooperativa ARX of Rome, by one of the authors (E.C.), applying the guidelines provided by this type of intervention (e.g., Carta CNR, 1987; Borselli *et al*., 1998), after a preliminary check for the presence of natural or anthropic modifications to be preserved for the subsequent taphonomic study, carried out by one of the authors (I.F.), and under the scientific direction of another of the authors (A.T.).A total of 2 individuals were fully restored: CV22 (NISP 109) and CV24 (NISP 96) used for study and prepared for possible museum display (Figures S11-S12), and a further 298 skeletal elements belonging to another 24 individuals were fully restored for study, focusing on the cranial vault, occipital area, dentition, ventral margin of the mandible and complete elements of the post-cranial skeleton.

The main stages of the restoration work were:

- the total or partial removal of the original packing in the area where the portions subject to the intervention were present;
- the removal of the gauze that had been applied during the first conservation work carried out during the sampling performed during the excavation (this first intervention had been partially carried out in 2004 by the same restoration operator, E.C.), by light soaking with water or acetone;
- the external, internal and fractured bone surfaces were cleaned; the sandy concretions (medium-fine quartzaceous-micaceous sand, slightly to averagely compact) were cleaned mechanically using wood tools to avoid interfering with the subsequent taphonomic analyses, by moistening the sediment with water or, where necessary due to the close proximity of particularly fragile bone parts, with acetone; cotton wool dampened with water or acetone was used for finishing;
- to prevent damage to the traces, after the first cleaning and before consolidation and assembly, initial taphonomic analyses were conducted, which also provided a qualitative check on the restoration work;
- the consolidation of bone tissue and the eventual consolidation of sediment present between the bone portions in fractures that are beating but full of sediment, in order to avoid subsequent displacements; consolidation was carried out by sprinkling consolidating solutions of Paraloid B72® in acetone (with concentrations varying from 3% to 5%), where the size of the specimen allowed it, consolidation was carried out by immersion;
- the assembly of the fragments that had detached or were in the process of detaching; the well-fitting fragments were assembled with acrylic adhesive (UHU extra®) or, where necessary due to the small size of the contact, with cyanacrylate adhesive (Super Attak®) after having applied a primer layer (Paraloid B72® 10% in acetone); in some cases, where the fractures were not perfectly matched due to the deformation of the fragments or the detachment of small portions, the assembly was carried out using fast epoxy resin (UHU plus fast®), mixed and sprinkled superficially with fine sediment to mask the resin, after the application of a primer layer (Paraloid B72® 10% in acetone); where gaps were present, which would have compromised the structural preservation, replacements were made using Polylla ® plaster or dental plaster finished with Polylla ® plaster, previously or subsequently coloured with pigments;
- in some cases, when the state of preservation of the skeletal elements made it necessary, especially regarding the skull, a layer of sediment, consolidated with a solution of Paraloid B72® 5% in acetone, was left to form a supporting base (Figure S13);
- upon completion, all restored elements were marked with Indian ink.

The restoration was carried out following the restoration principles outlined in the Carta CNR (1987) and in Borselli *et al*. (1998).

The restoration thus enabled the population study of the horses and the taphonomic analysis of the skeletal elements.

METHODS

The ages of the horses at their deaths were estimated on the basis of tooth eruption and wear and on the state of fusion of the axial and appendicular bones according to Barone (1981, 1995) and Martin (2005).

The measurements were taken according to Driesch (1976).

According to Kiesewalter (1888) and May (1985), withers heights were calculated on the humerus, radius, ulna, femur, tibia and metapodials of both sides when they were present. From the values obtained, the minimum, mean, and maximum wither heights were calculated for each individual.

The sex determination was based on the statistical analysis of the measures of metapodials compared with the presence/absence of the canines.

The Slenderness Index (GLx100/SD) was calculated for the metapodials, the most preserved bones of the skeletons, to better define the morphological characteristics of horses.

Statistical analyses (univariate, bivariate, and multivariate) were executed by means of the PAST (PAlaeontologicalSTatistics) 3.20 version software (Hammer *et al*., 2001).

RESULTS

AGE AT DEATH

The age at death was determined on 27 individuals. Numerous age classes were recognised, ranging from animals as young as 1-2 years old to individuals older than 10 years (tab. S1 age at death). In summary, 3 horses (CV 13, 14, 19) are between 1 and 2 years old, 5 horses (CV 8, 21, 32 inf B, 33, 36) are younger or slightly older than 42 months, 8 horses (CV 2, 10, 11, 12, 15, 16, 33, 34) are older than 52 months, 1 horse (CV30) is about 5 years old, 1 horse (CV22) is between 9 and 11 years old, 9 horses (CV 6, 9, 17, 24, 27, 28/29, 31, 32 sup, 35) are 10 years old or older. For 5 horses (CV 18, 25, 32 inf A, 32 inf B, 32 inf A/B/C) the age of death could not be determined. The distribution of the age classes within the necropolis appears completely random and does not show any particular accentuation (Figure S14).

WITHERS HEIGHT

The withers height calculated on 26 horses (Table S2) varies from 1159 mm to 1465 mm, with a mean of 1327.8 mm and a standard deviation comprises between 63.3838 (minimum height) and 61.9768 (maximum height), indicative of the extreme variability of calculated values.

The histograms of the frequency of the minimum, mean and maximum withers height of the horses (Figure S15), show a bimodal distribution of the minimum and maximum values and a unimodal distribution for the mean values. The highest frequency of the low values of the minimum withers height (MNI 4) is between 1229 and 1242 mm, while the highest frequency of the high values of the minimum withers height (MNI 7) is between 1318 and 1341 mm. The highest frequency of mean heights (MNI 12) is between 1312.0 and 1354.7 mm. The highest frequency of low values of maximum withers height (MNI 6) is between 1229 and 1242 mm, while the highest frequency of high values of maximum withers height (MNI 6) is between 1362 and 1384 mm.

METAPODIALS SLENDERNESS INDEX

The Slenderness Index calculated on 12 complete metacarpals (Table S3) varies from12.2 to 16.0 with a mean of 14.65 and a standard deviation of 1.063177, indicative of a not very wide dispersion of calculated values. The histogram of the Slenderness Index frequency for the metacarpus (Figure S16 b)) shows a bimodal trend, with the highest frequency classes (MNI 4 and 3) moving towards fairly high values (around 15.0 and 16.0), indicative of the presence of both individuals with a relatively slender metacarpus and individuals with a slightly stockier metacarpus, as can also be seen in the GL vs. SD scattergram (Figure S17).

The Slenderness Index calculated on 13 complete metatarsals (Table S4) varies from 9.9 to 12.5 with a mean of 11.35 and a standard deviation of 0.675297, indicative of a dispersion of calculated values narrower than the metacarpals. The histogram of the Slenderness Index frequency for the metatarsus (Figure S16 b) shows a unimodal trend, with the highest frequency classes (MNI 13) towards the highest values of the distribution range (between 11.42 and 11.92), indicative of the presence of numerous individuals with a relatively stubby metatarsus together with a smaller number of individuals with a slender metatarsus, as also visible in the GL vs. SD scatter plot (Figure S18).

According the classification proposed by Brauner (1916) based on the Slenderness Index of the metapodials, and the classification proposed by Vitt (1952) based on the withers height [for an accurate description of the values proposed by the two Authors and their application see e.g. also Bartosiewicz (2002) and Spassov *et al.* (2018)], regarding the metacarpals most of the Este-NCR horses fall in the small withers height category and in the slender legged, semi-slender legged and slender Slenderness Index categories, with most of the individuals with the canines included in the semi-slender legged category (Figure S19). In the same diagram, it is evident that for some metacarpals, especially in CV 31, there is an obvious bilateral asymmetry. Finally, one specimen (CV 14) appears particularly short and very slender legged, a feature highlighted also in the bivariate analysis of the GL and SD parameters of the same skeletal element (Figure S17).

According to the same classification based on the metatarsals (Figure S20), most horses, including those with canines, fall into the below-medium and medium height categories, and into the slender Slenderness Index category. Only CV 24, which has canines, has a below-medium height and a semi-slender metatarsus; while CV 10 is very short but with a Slenderness Index of the metatarsus close to the border between the categories of slender and semi-slender.

In synthesis, the wide range of the values of the withers height and of the Slenderness Index of the metapodials indicates a wide variety of individual types buried in the Este-NCR horse cemetery, although relatively medium-tall and slender individuals seem to prevail.

GENDER DETERMINATION

Distinguishing female from male in the buried horses is important to interpret the burial rituals and the human/horse relationships in the site. Traditionally, the skeletons of female and male horses have been distinguished based on the morphological characteristics of the pelvis and on the presence/absence of canine teeth (Nistelberger *et al.*, 2019, and references therein). At Este-NCR, not all horse skeletons kept the coxal in a state of preservation that would allow observations and measurements, so this skeletal element was not considered as a discriminating character between male and female individuals. Regarding the presence of canines, not all horse skulls are in a perfect state of preservation and allow the rostral portion of the maxilla and mandible to be seen. Therefore, the presence of canines was only observed in horses CV 19, 22, 24, 27, 30, 31, 23 inf_B and 33. Considering that the presence of this tooth, with morphological characters that are more robust in males (Johnstone, 2004), is considered as a distinguishing character of the male gender only at a statistical level and not as a univocal and discriminating parameter, while its absence is certainly indicative of the female gender (De Grossi Mazzorin, 2008), this data is considered only as a supplement to the observations made regarding the biometry of metapodials. The biometrical analysis of the metapodials was carried out by means of bivariate and multivariate methods.

The scatter plot of Greatest Length (GL) versus the Smaller Breath of the diaphysis (SD) of the metacarpals (Figure S17) identifies two areas of dispersion of the individuals: an upper one in which the horses with the canine are also present, and therefore attributable in the first analysis to male individuals, and a lower one, attributable in first analysis to female individuals. In the latter area is the metacarpal of CV14, which presents a pronounced slenderness (SI = 12.19), especially when compared, for example, to the right metacarpal of CV31 (SI = 15.09), which has a practically equal length.

The scatter plot of Greatest Length (GL) versus the Smaller Breath of the diaphysis (SD) of the metatarsals (Figure S18) also identifies two areas of dispersion of individuals, although less clearly separated than in the same graph for the metacarpus. Again, the upper area can be attributed to male horses, while the lower to female horses, with a good correlation with the presence of canines. The exception is the right metatarsal of CV 33 which, despite having the canine, has relatively slender proportions (SI = 10.43).

The scatter plot (Figure S21) of the first (Eigenvalue =91.4767; variance = 88.396%) and the second (Eigenvalue = 7.21522; variance = 6.9722%)

components of the Principal Component Analysis (matrix: variance-covariance) of the metacarpals (21 elements, 15 individuals) identifies four areas of individual dispersion. Two comprise most of the measurable metapodials. A large proportion of the metacarpals belonging to horses with canines are included in the dispersion area located in the upper quadrants, which would thus identify male horses, while the one at the bottom would identify female horses. In this last area is located the right metacarpal of horse CV 31, in which the canines are present. This metacarpal, being damaged, allowed for the detection of a few measurements and furthermore, has a slenderness index (15.1) significantly lower than the left metacarpal (16.0), reasons that would justify its graphical placement far from the corresponding left metacarpal. Also in this graph, the metacarpals of the CV32 upper and CV34 individuals are placed in the upper quadrants but detached from the set of presumed male horses. Similarly, the metacarpals of horses CV32 (A/B/C) and CV24, which have the canines, are placed in the lower quadrants but detached from the dispersal area of the presumed female horses. This separation could be attributable to the proportions of the relative metacarpals, which are relatively short and stubby.

The scatter plot (Figure S22) of the first (Eigenvalue =176.395; variance = 80.962%) and the second (Eigenvalue = 26.4733; variance = 12.152%) components of the Principal Component Analysis (matrix: variance-covariance) of the metatarsals does not appear to discriminate the gender as effectively as that of the metacarpals. Although placing the elements in two apparently separate areas, comparing this arrangement with the presence of the canines and the indications of the PCA analysis conducted on the metacarpals for several elements, the findings do not coincide.

In this scatter plot, the points representing the metatarsals of E-NCR CV10 are not depicted, as they are located in the negative value quadrant and they are widely separated from the remaining points. So, it was decided to depict only the scatter plot of the remaining points, which would otherwise have been too compressed and graphically indistinguishable. The horse CV10 is a short individual with a withers height mean of 1251.5 mm, a value that places it in the "small" category according to the classification proposed by Vitt (1952) and with a relatively slender metatarsus: the slenderness index of the left metatarsus is 11.92, a value that places it in the "slender legged" category according to the classification proposed by Brauner (1916).

From the comparison of the observations made on dental characters (presence of canines) and from the bivariate and multivariate analyses of the biometric parameters of 27 individuals, it would appear, in summary, that the population of horses buried in the equine necropolis of Este - NCR consists of 2 females (CV 14, 35), 2 probable females (CV 6, 11), 12 males (CV 2, 15, 16, 17, 22, 24, 27, 21, 32 sup, 32 inf A/B/C, 34, 36), 1 probable male (CV 10) and 10 individuals (CV 9, 12, 19, 21, 28/29, 30, 32 inf A, 32 inf B, 32 inf C, 33) to be determined (Table S5).

COMPARISONS

In order to make a more effective comparison, the data from the study of coeval horse populations, consisting of numerous specimens rather than isolated specimens was preferred. As a result, data from the study of horses at Le Brustolade (Altino, Italy) were used (Riedel, 1982). At this site, located not far from Venice, 27 horse skeletons were recovered in an area of approximately 200 square meters, four of which retained their morsels or other ornaments. These horse burials are chronologically assignable to an interval between 450 and 350 B.C. (Tombolani, 1979). At Le Brustolade the spatial arrangement, lacking preferential orientation, and the manner of deposition, mostly on one side, show remarkable similarities with the site of Este-NCR.

On the basis of the published biometric data (Riedel, 1982), for each individual providing useful biometric indications the minimum, mean, and maximum withers height were calculated according to the indices proposed by Kiesewalter (1888) and May (1985).

For the Le Brustolade too, the analyses of withers height and of biometrical features of the metapodials were conducted using univariate, bivariate, and multivariate methods.

Le Brustolade's horses (MNI 20) cover a wide range of withers height values between 1050 and 1501 mm, with a mean of 1341.0 mm (standard deviation 86.2376498799): a wider range than the E-NCR population and with a higher mean of 13.2 mm.

The frequency distribution of the Le Brustolade withers height (Figure S23) shows several similarities with the E-NCR one.

The frequency distribution of the minimum withers height is bimodal with a higher frequency of the low values (MNI 2) of 1128 mm, lower than that observed for E-NCR, and a higher frequency of the high values (MNI 9) between 1295 and 1355, a slightly wider range than E-NCR and relatively shifted towards higher values. The frequency distribution of the mean withers height is unimodal, with the highest frequency (MNI 5) between 1329.7 and 1342.7 mm, a less wide range than E-NCR and with slightly higher values. The frequency distribution of the maximum withers height is also unimodal, with the highest frequency (MNI 6) between 1406 and 1427 mm, a narrow range as for E-NCR, but shifted towards significantly higher values.

The frequency distribution of the Le Brustolade horses' metacarpal Slenderness Index (Figure S24 a) is bimodal, with the highest frequency classes corresponding to the value ranges 14.77 and 15.00 (NMI 6), and 15.69 and 16.00 (NMI 5), indicative of a wide range of metacarpal slenderness within the Le Brustolade population, an aspect that is also found at E-NCR with quite similar absolute values. In contrast, the frequency distribution of the metatarsal slenderness index (Figure S24 b) is, as in E-NCR, unimodal, but with the highest frequency class (NMI 7) between values of 11.12 and 11.41, indicating slenderer metatarsals than in E-NCR.

According to the classification proposed by Brauner (1916) (Spassov *et al*., 2018) and the classification proposed by Vitt (1952), most of the Le Brustolade male horses fall into the small, below medium and medium withers height categories and into the slender legged and semi-slender legged Slenderness Index categories, while fewer individuals fall into the slender category (Figure S25). In the same diagram, it is to be noticed that the metacarpals of the castrate fall in the below medium withers height category and in the slender Slenderness Index category, while the metacarpals of the male LB19 are very slender, even if they belong to a particularly tall horse. This diagram shows that the range of the Le Brustolade horses' withers height is wider than the E-NCR one, while the range of Slenderness Index is relatively less wide than the E-NCR one.The same arrangements can be seen in the analogous diagram for the metatarsal (Figure S26), with the most Le Brustolade male horses falling into the slender legged Slenderness Index category, as the E-NCR metatarsals.

In synthesis, the wide range of the withers height values and the Slenderness Index values of the Le Brustolade horses metapodials, indicates a wide variety of individuals as well as for E-NCR, with a wider range of height values.

The scatter plot of Greatest Length (GL) versus the Smaller Breath of the diaphysis (SD) of the Le Brustolade and E-NCR metacarpals (Figure S27) shows a certain coincidence in the areal dispersion of the representative points of the metacarpals distinguished according to the gender of the animal, although some exceptions represented by the metacarpals of a male (LB19) and a female (LB6) of Le Brustolade are present. The former is particularly tall and slender, the latter is shorter and stockier, but because of their proportions they fall within the areal assigned to the opposite gender. Obviously, the same dispersal characteristics can be observed in the s scatter plot of Greatest Length (GL) versus the Slenderness Index (Figure S28).

The scatter plot (Figure S29) of the first (Eigenvalue =217.083; variance = 95.814%) and the second (Eigenvalue = 3.72809; variance = 1.6455%) components of the Principal Component Analysis (matrix: variance-covariance) of the Le Brustolade and E-NCR horse metacarpals continues to show good agreement in the dispersion of the representative points of Le Brustolade males and females compared to those assumed for E-NCR, albeit with the exceptions noted above.

The scatter plot (Figure S30) of the first (Eigenvalue =294.503; variance = 89.53%) and the second (Eigenvalue = 18.4444; variance = 5.6072%) components of the Principal Component Analysis (matrix: variance-covariance) of the Le Brustolade and E-NCR horse metatarsals, as already observed for the E-NCR metatarsals, compared to the similar scatter plot for the metacarpals, does not seem to be significantly discriminating between the genders. This is probably due to the proportions of the metatarsals, which are already naturally longer and slenderer, even in the same individual, than the metacarpals.

Both scatter plots show, however, that the Le Brustolade horse population has a significantly greater variety in size and body proportions of individuals than the E-NCR population.

From a biometric point of view, the two populations of horses from Este-NCR and Le Brustolade present various similarities, although the Este-NCR one is characterised by a less wide range of withers height values (1159-1465 mm) than that of

Le Brustolade (1050-1501 mm), with a greater frequency of lower values and a slightly lower mean height (- 13.2 mm).

TAPHONOMIC ANALYSIS

Although the taphonomic study is based on selected portions of the skeleton, the skeletal elements are well represented (Figures S31-S34). Cuts were predominantly found on the bones of the extremities of the limbs (metapodials and phalanges). The cuts refer mainly to skinning by location and orientation, although fleshing is well documented, and disarticulation is rarer (carcasses are predominantly in anatomical connection) (Figures S34-S35). On many horses only traces of skinning have been found, but often in other individuals these are associated with fleshing and occasionally with disarticulation (Figure S35).

REFERENCES

Balista, C. & Ruta Serafini, A. 2008: Spazi urbani e spazi sacri ad Este. In: *I Veneti antichi. Novità e aggiornamenti*: 81-100. Atti del convegno di studio (Isola della Scala, 15 ottobre 2005). Verona.

Barone, R. 1981: *Anatomia comparata dei mammiferi domestici. 3, Splancnologia. (Italian edition by R. Bortolani)*. Edagricole, Bologna.

— 1995: *Anatomia comparata dei mammiferi domestici. 1, Osteologia. (Italian edition by R. Bortolani, E. Callegari)*. Il Sole 24 Ore – Edagricole, Bologna.

Bartosiewicz, L. 2002:

Borselli, V.; Confortini, F.; Dal Sasso, C.; Malanni, M.; Muscio, G.; Paganoni, A.; Simonetto, L. & Teruzzi, G. 1998: Carta del restauro dei fossili. *Museologia Scientifica* 15: 215-226.

Bortolami, F. 2019: Sepolture e sacrifici equini nel Veneto preromano. *Incontri di filologia classica* 17 (2017-2018): 61-88.

Brauner, A. 1916: The horse of the Tiraspol moulds, Kherson district. Materials on the knowledge of the domestic animals of Russia. *Zapiski obshchestva selskogo hozyaystva Yujnoy Rossii* 86(1): 49-85.

Carta C.N.R. 1987: Carta 1987 della conservazione e del restauro degli oggetti d'arte e di cultura. Roma, Consiglio Nazionale delle Ricerche. Rome.

De Grossi Mazzorin, J. 2008: *Archeozoologia. Lo studio dei resti animali in archeologia*. GLF Ed. Laterza, Bari.

Driesch, A. von den 1976: A guide to the measurement of animal bones from archaeological sites. Peabody Museum Bulletins. Harvard University. MA.

Hammer, Ø.; Harper, D.A.T. & Ryan, P.D. 2001: PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4(1): 1-9.

Johnstone, C.J. 2004: A Biometric Study of Equids in the Roman World. Thesis submitted for PhD University of York Department of Archaeology September 2004. York.

Kiesewalter, L. 1888: *Skelettmessungen an Pferden als Beitrag zur teoretischen Grundlage der Beurteilungslehre des Pferdes*. Dissert., Leipzig.

May, E. 1985: Winderristhöhe und Langknochenmasse bei Pferden-ein immer noch actuelles Problem. *Z Säugertierkunde* 50: 368-382.

Martin, M.T. 2005: *Manuale per la determinazione dell'età nel cavallo*. Traduzione di Roberto Busetto. American Association of Equine Practitioners. College of Veterinary Medicine Texas A&M University: 1-42.

Nistelberger, H.M.; Pálsdóttir, A.H.; Star, B.; Leifsson, R.; Gondek, A.T.; Orlando, L.; Barrett, J.H.; Hallsson, J.H. & Boessenkool, S. 2019: Sexing Viking Age horses from burial and non-burial sites in Iceland using ancient DNA. *Journal of Archaeological Science* 101: 115-122. doi: 10.1016/j.jas.2018.11.007.

Riedel, A. 1982: The Paleovenitian horse of Le Brustolade (Altino). *Studi Etruschi* 50: 227-256.

Spassov, N.; Iliev, N.; Hristova, L. & Ivanov, V. 2018: Typology of Thracian horses according to osteological analysis of skeletal remains and depictions from the antiquity. *Historia naturalis bulgarica* 25: 15-24.

Tombolani, M. 1979: Altino (Venezia): a) Loc. Le Brustolade. In: Colonna, G. (ed.): *Scavi e scoperte. Studi Etruschi* 47: 481-482.

Vitt, V.O. 1952: The horses of the Pazyryk moulds. *Sovetskaya Archeologia* 16: 161- 207.

FIGURE S1

Location of Este-Nuova Casa di Ricovero site.

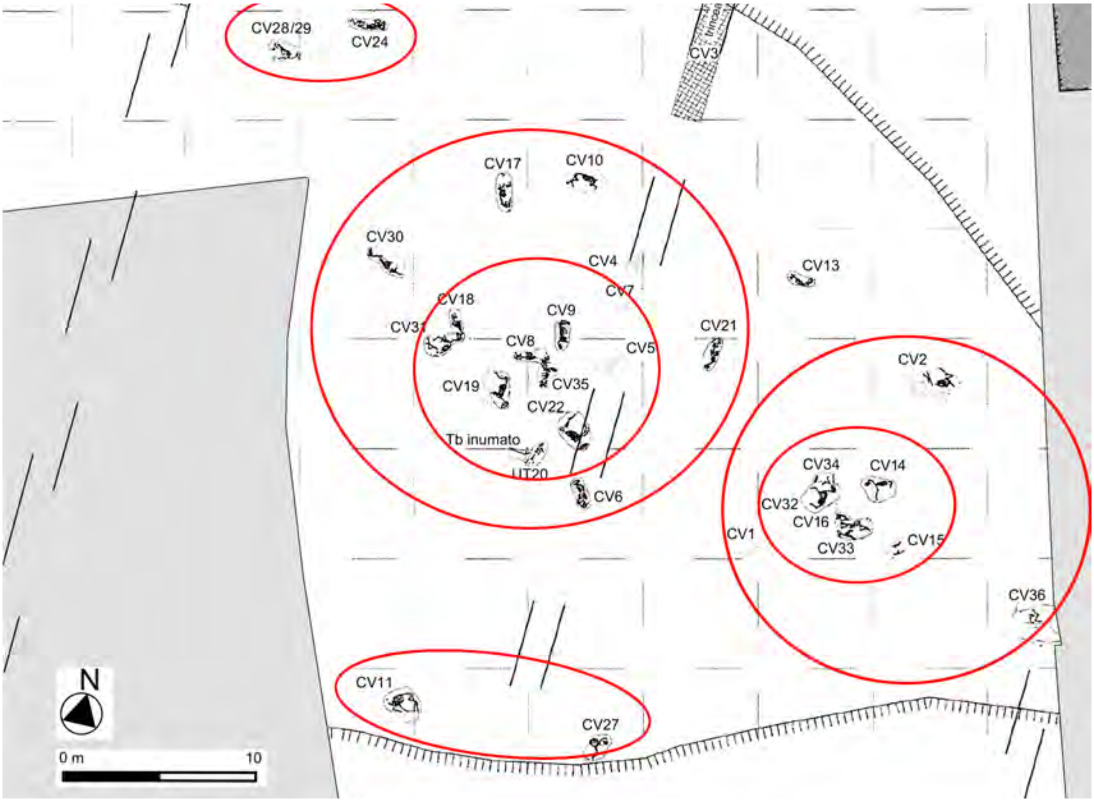


FIGURE S2

Map of the burials disposition.

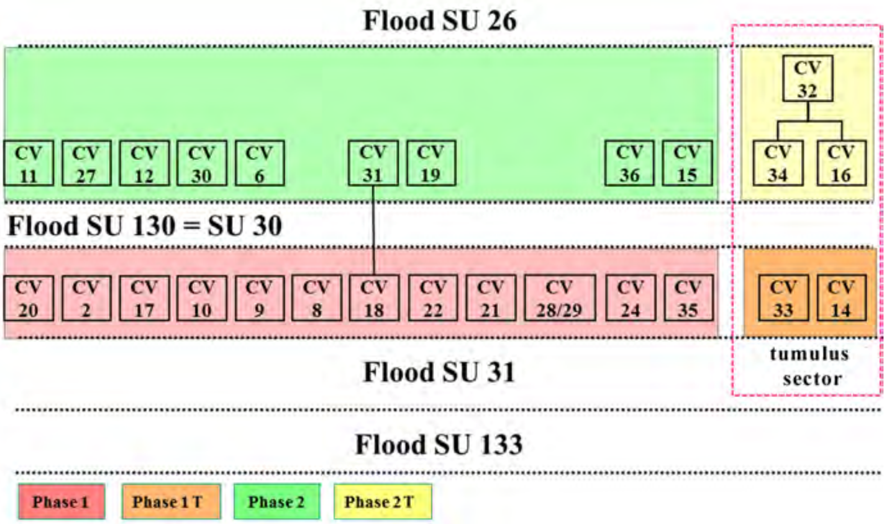


FIGURE S3

Sketch of the division of burials into stages.

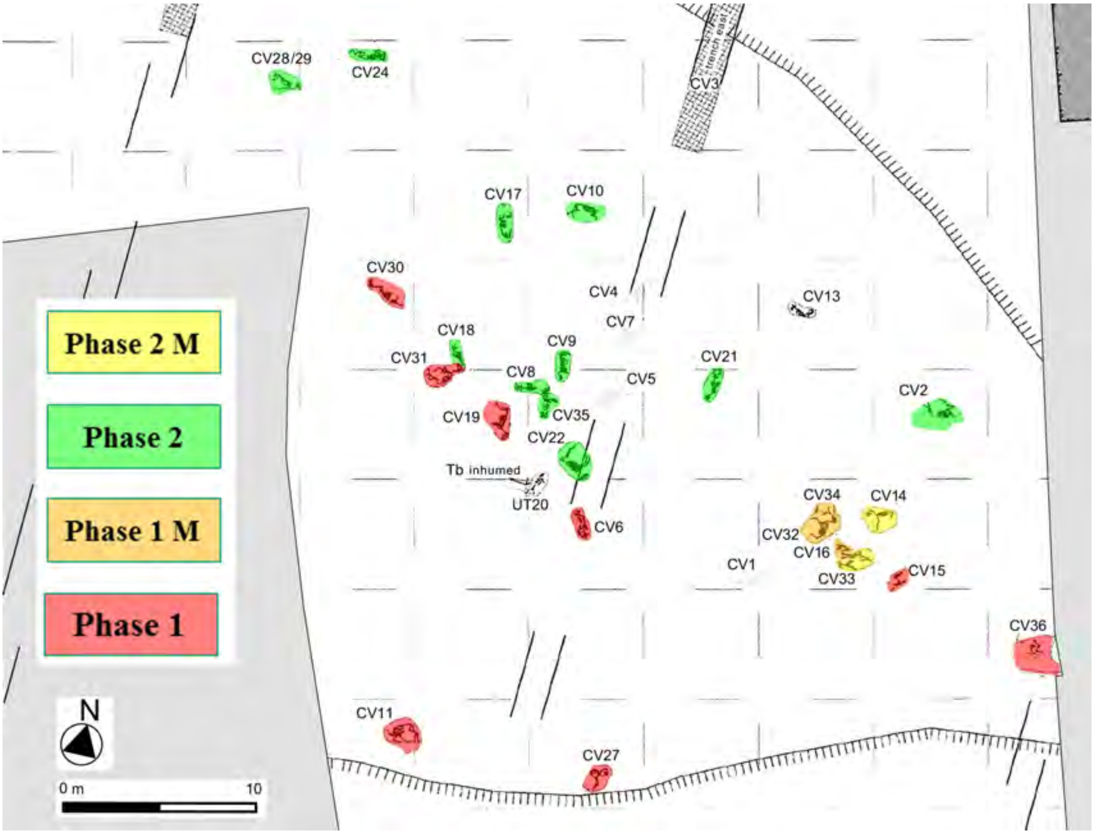


FIGURE S4

Map of the necropolis with the division of the burials into stages.

FIGURE S5
Horse CV22 during the excavation.

FIGURE S6
Horse CV24 during the excavation: anterior portion.

FIGURE S7
Horse CV6 during the excavation.

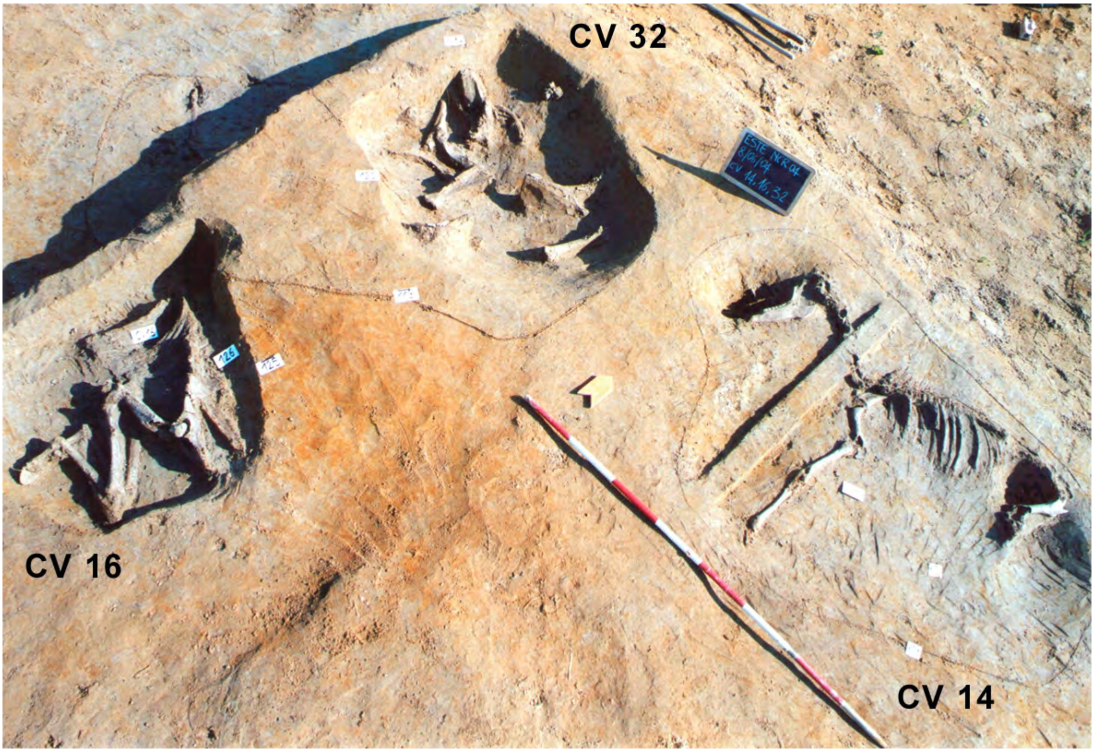


FIGURE S8
Part of the tumulus during the excavation with CV 14, 16, 32 burials.

FIGURE S9
Burials of CV32 and CV34 during the excavation, with CV32 sup. exposed.

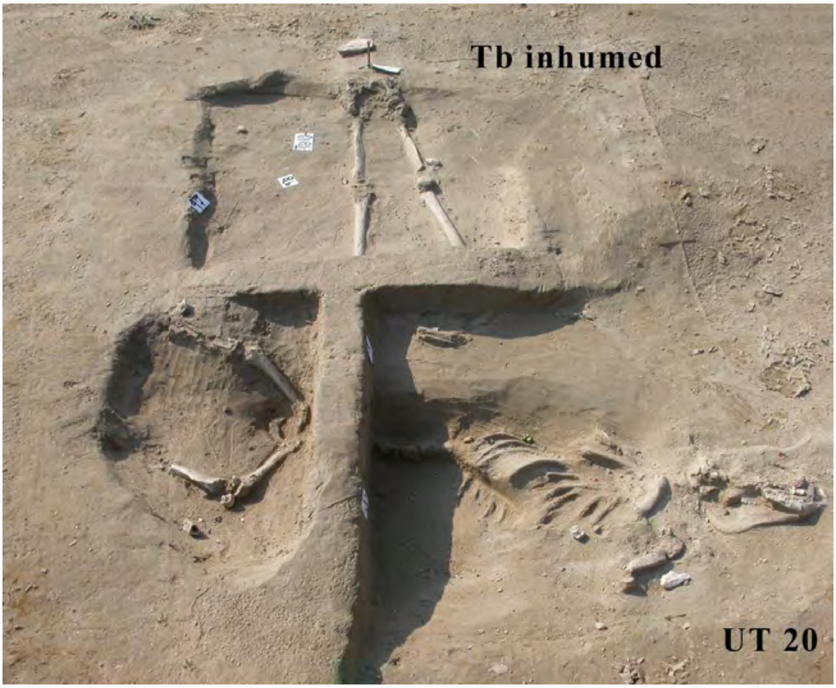


FIGURE S10
Burials of *Sus domesticus* (UT20 and *Homo sapiens* (Tb inhumed) during the excavation.

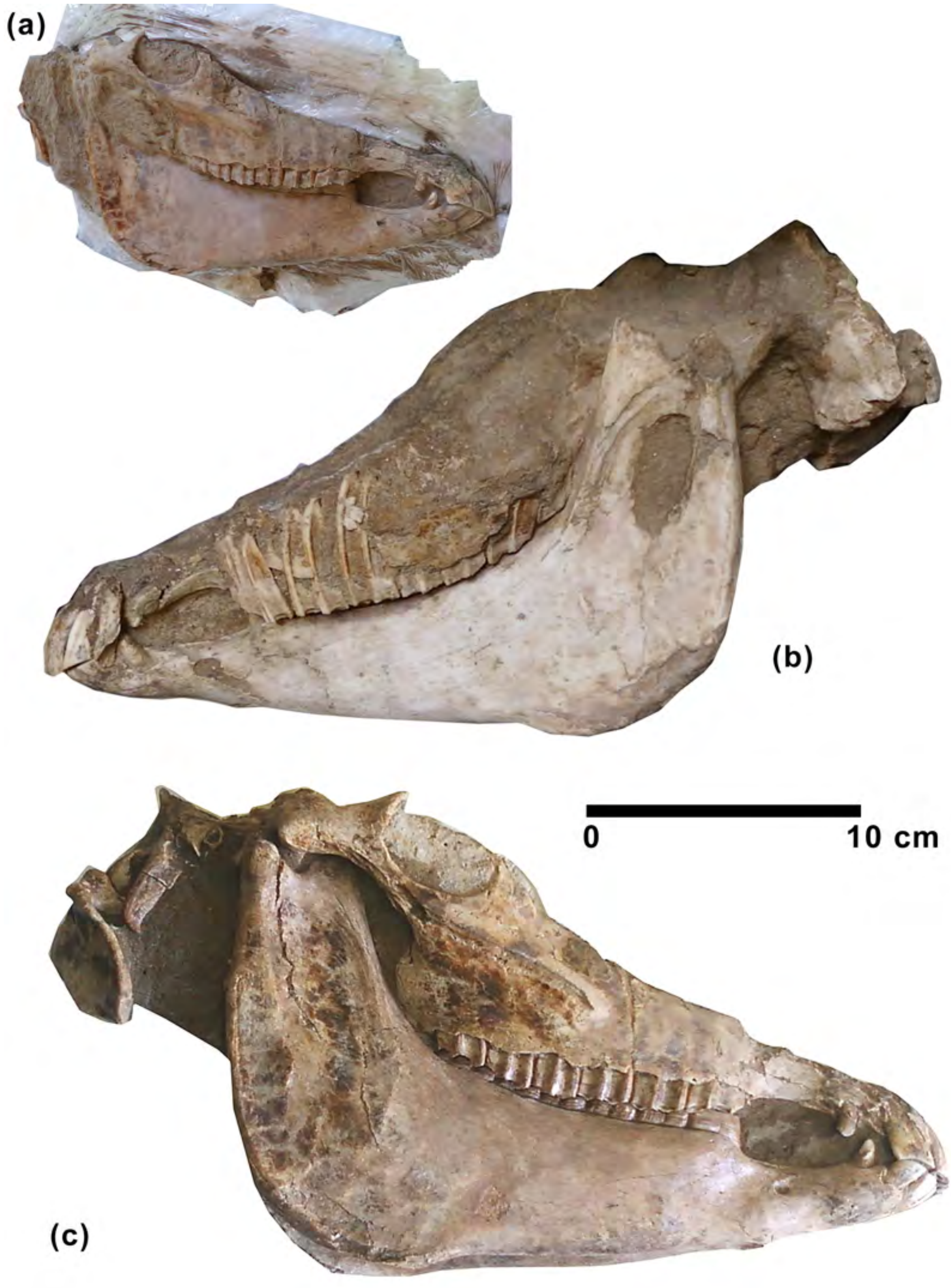


FIGURE S11

Cranium of horse CV22: a) right side during the restoration process, b) left side after the restoration, c) right side after the restoration.

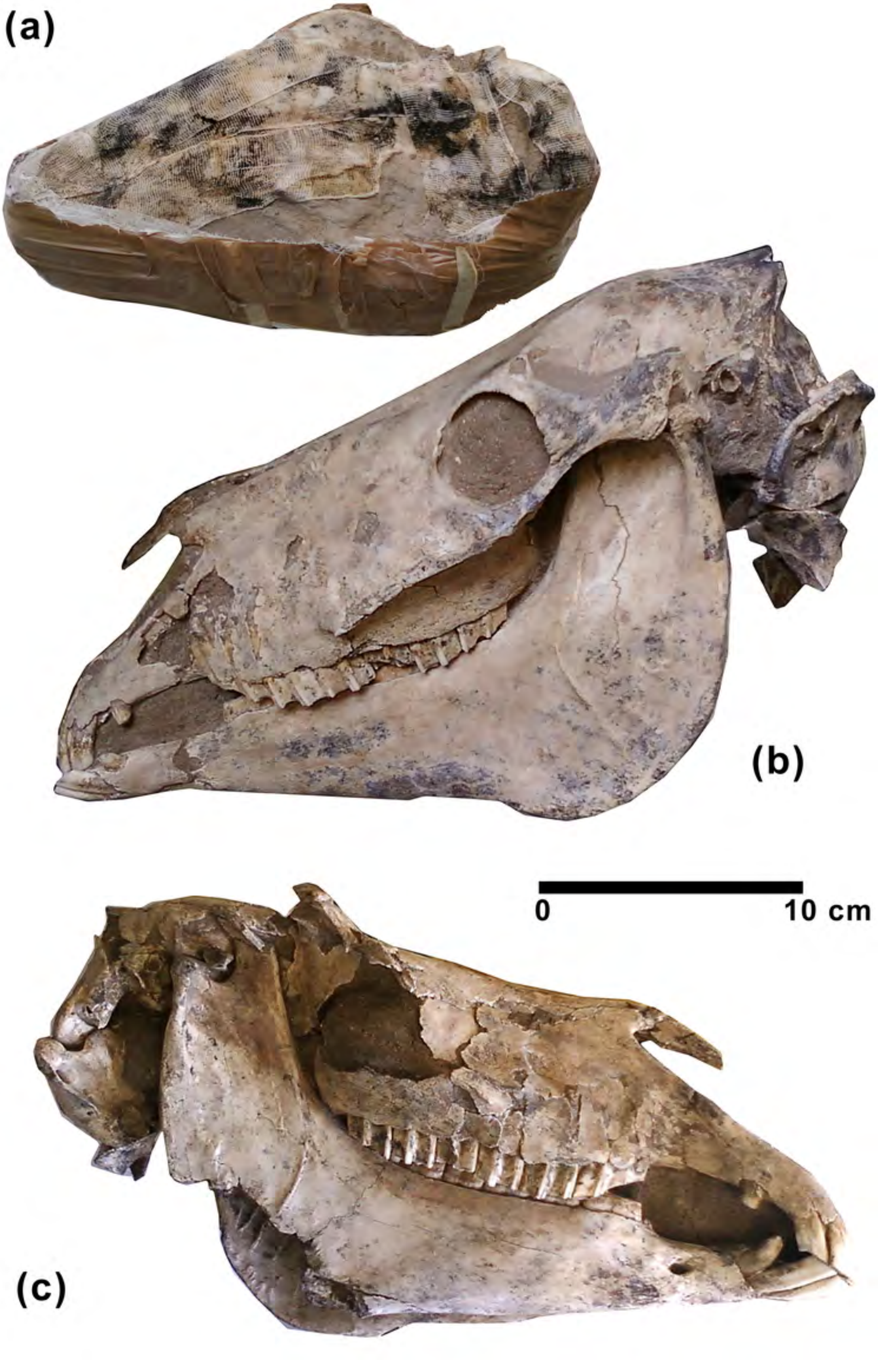


FIGURE S12
Cranium of horse CV24: a) right side during the restoration process, b) left side after the restoration, c) right side after the restoration.

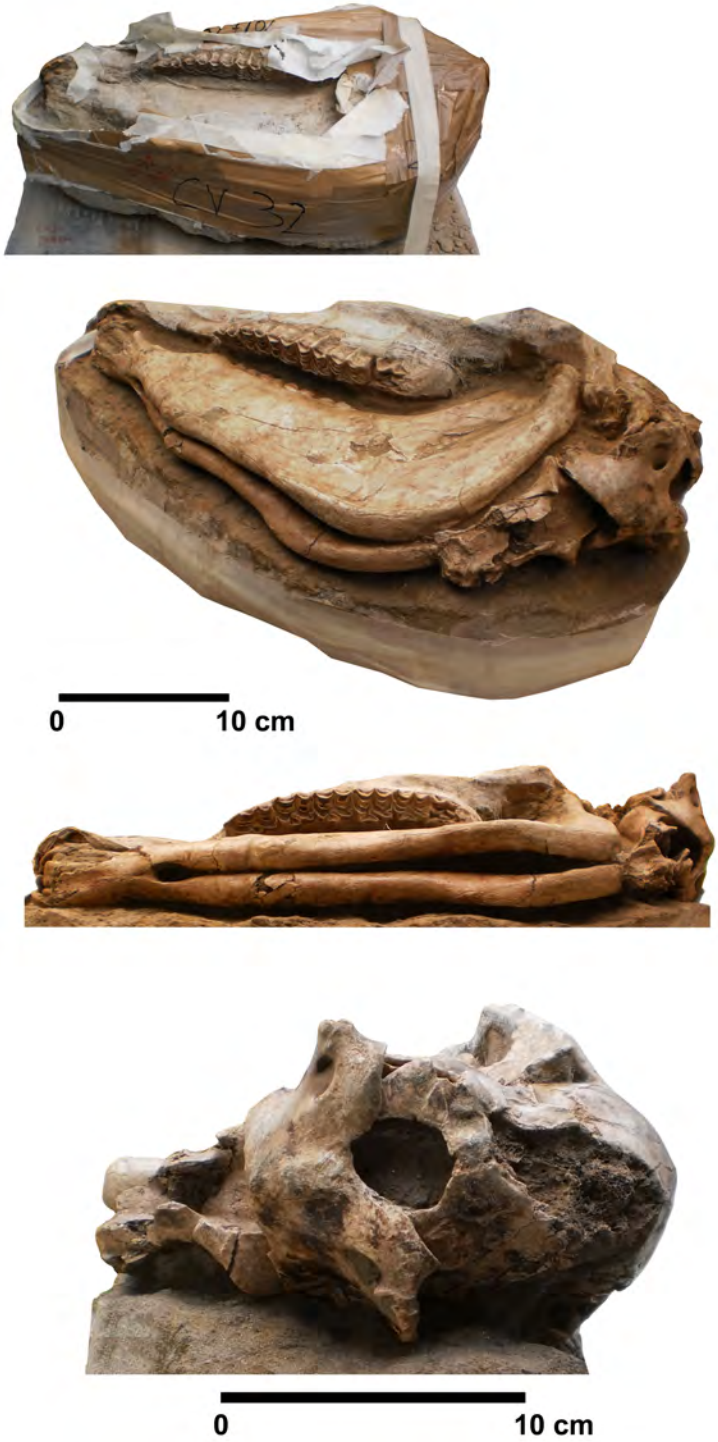


FIGURE S13

Cranium of horse CV32 inf. B: a) left side during the restoration process, b) left side after the restoration with part of the sediment preserved and consolidated to support the remain, c) ventral side after the restoration, d) nuchal side after the restoration.

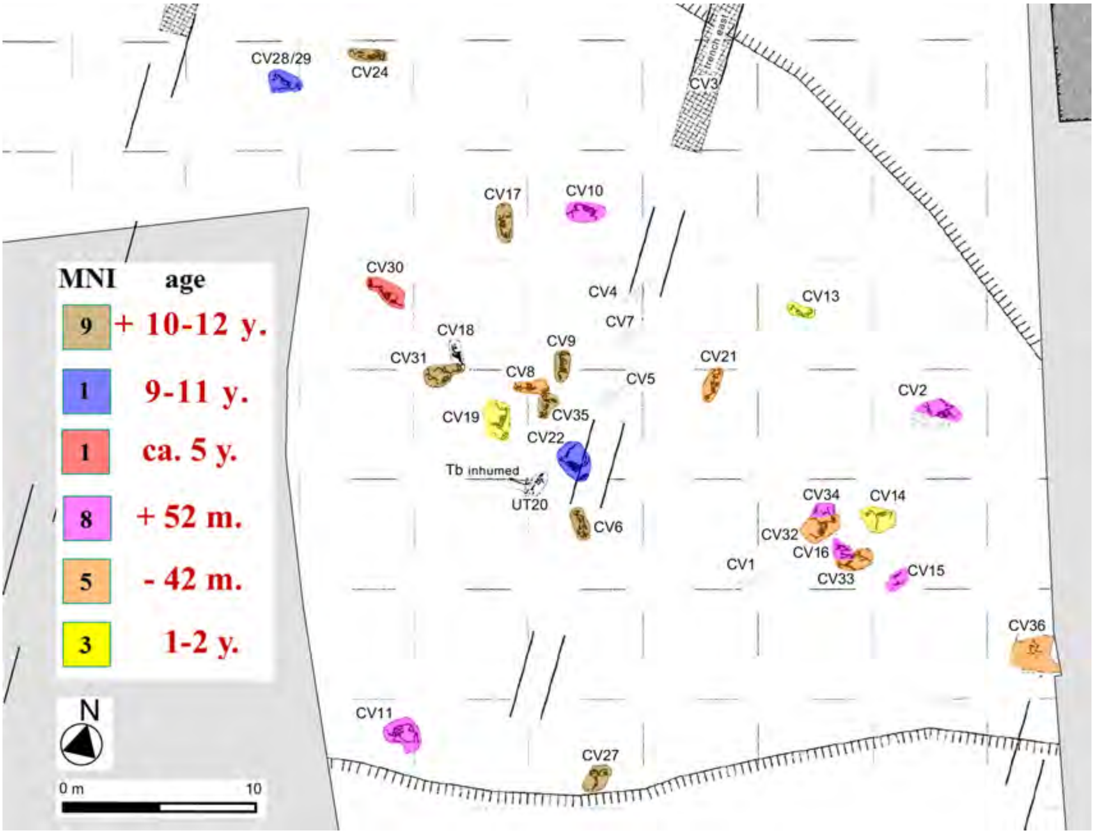


FIGURE S14

Map of the necropolis with ages at death distribution.

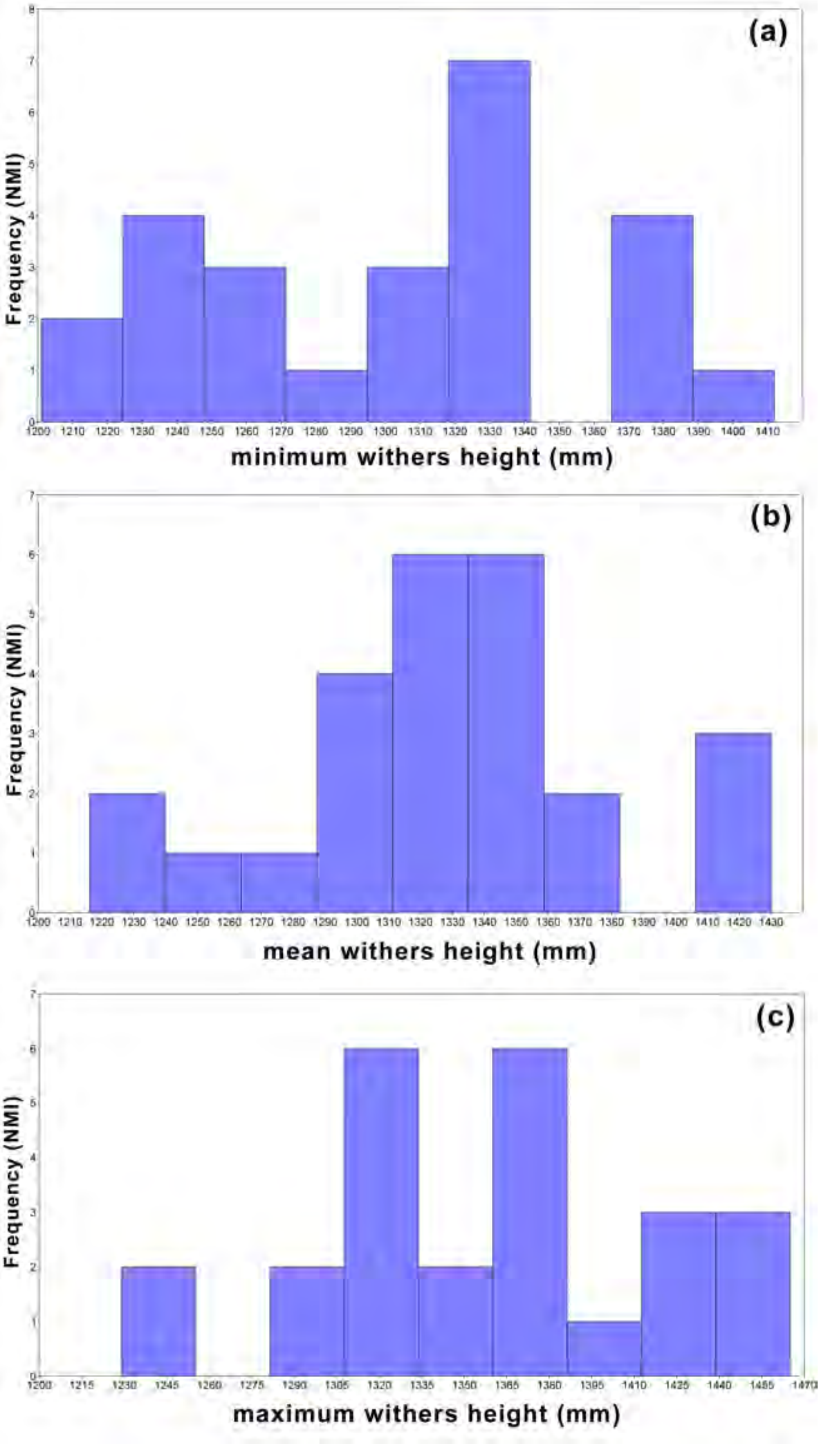


FIGURE S15

Minimum (a), mean (b) and maximum (c) withers height histogram of Este-Nuova Casa di Ricovero horses.

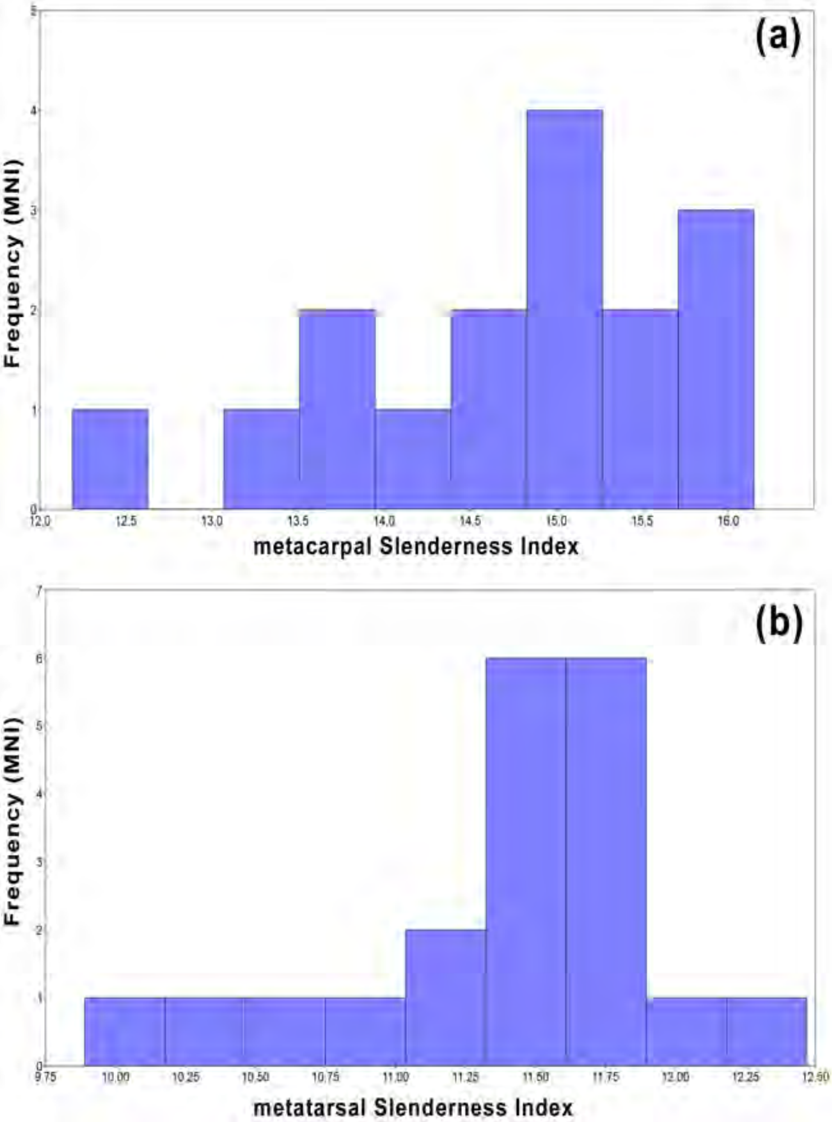


FIGURE S16

Slenderness index histogram of Este-Nuova Casa di Ricovero horses: a) metacarpals, b) metatarsals

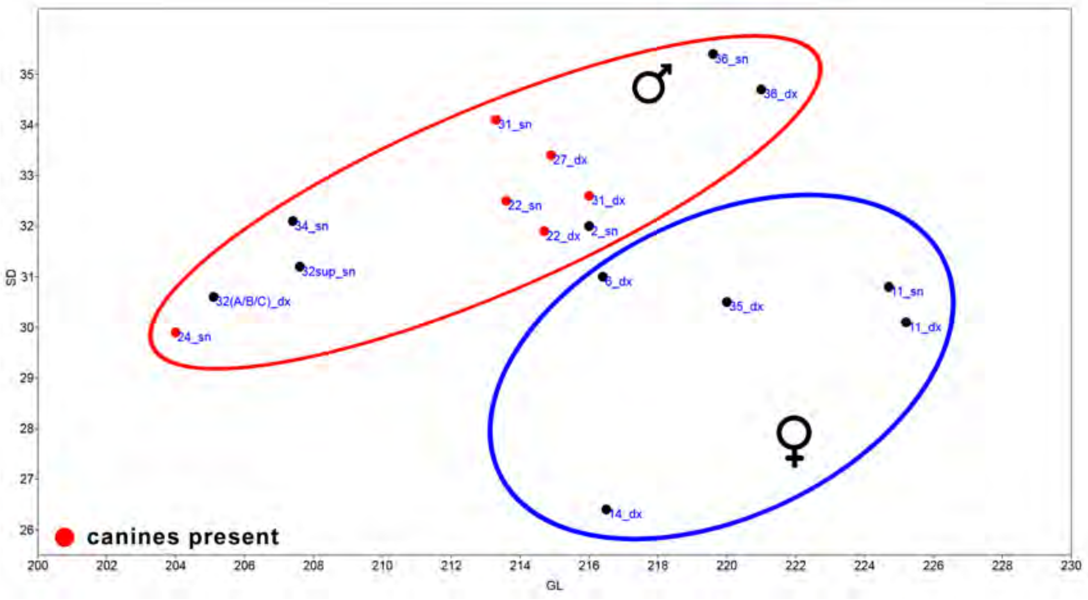


FIGURE S17

Scatter plot of greatest length (GL) versus small breath of diaphysis (SD) of Este-Nuova Casa di Ricovero metacarpals. In red the hypothesised male distribution area, in blue the hypothesised female distribution area.

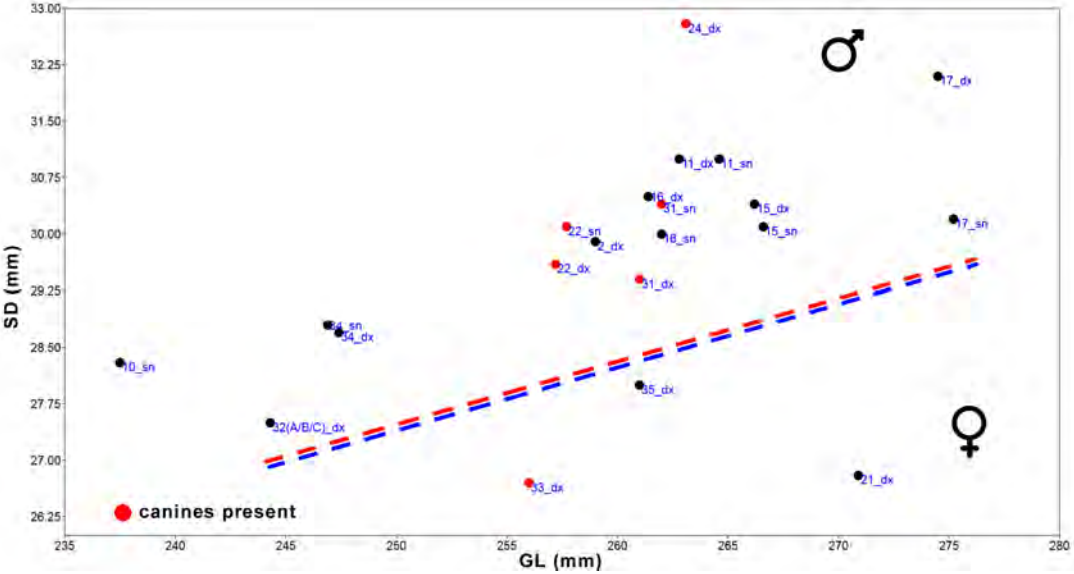


FIGURE S18

Scatter plot of greatest length (GL) versus small breath of diaphysis (SD) of Este-Nuova Casa di Ricovero metatarsals. In the upper part the hypothesised male distribution area, in lower part the hypothesised female distribution area.

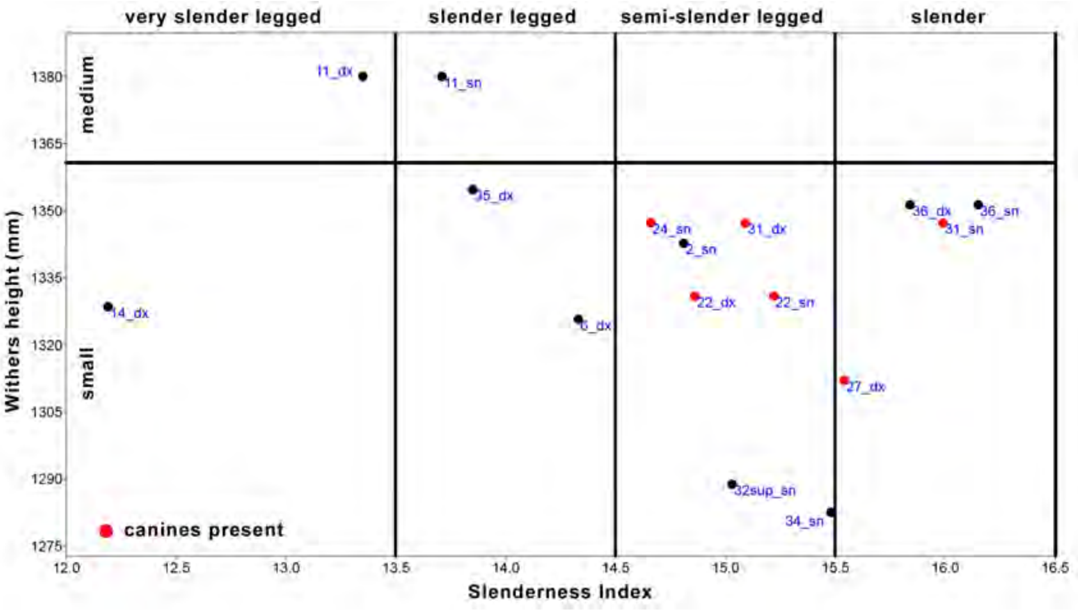


FIGURE S19

Scatter plot of Slenderness Index of metacarpals versus the Withers Heiht of Este-Nuova Casa di Ricovero horses, with the classifications proposed by Brauner (1916) (Spassov et al., 2018) and Vitt (1952).

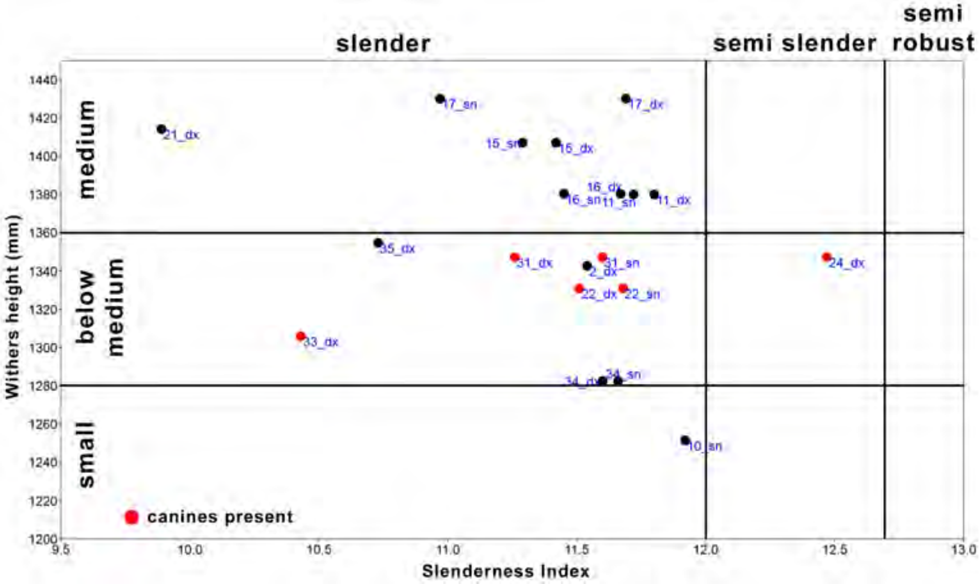
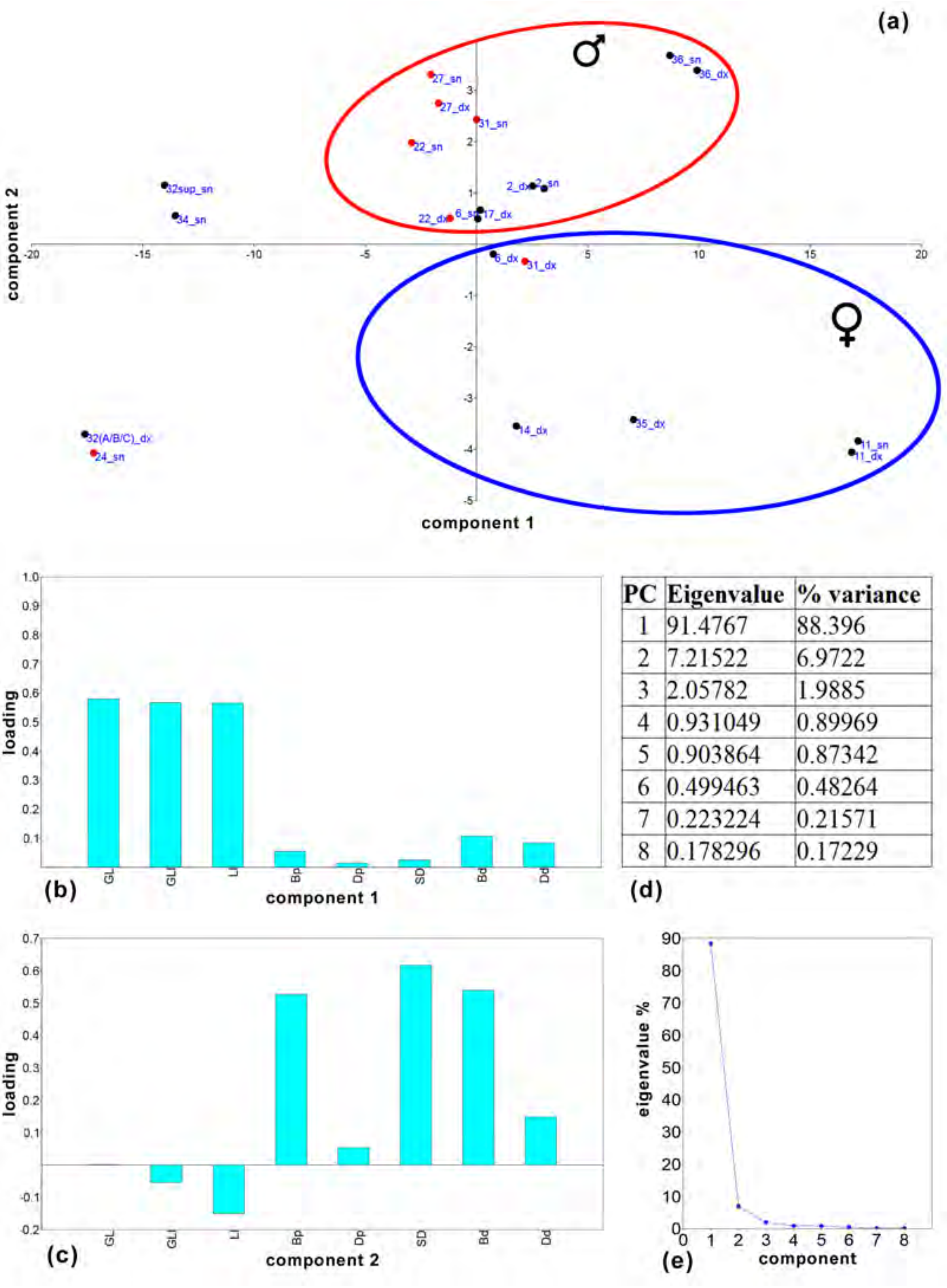


FIGURE S20

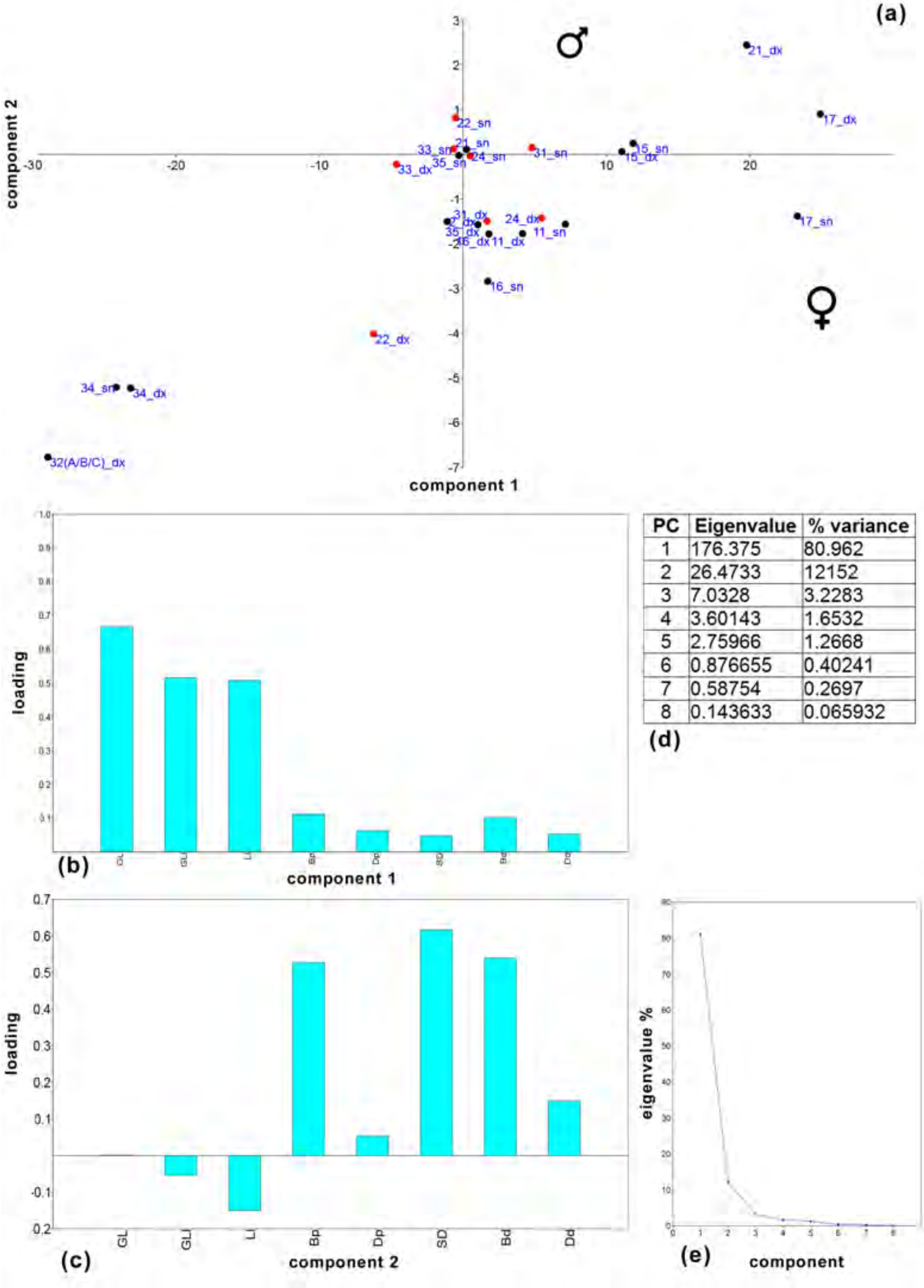
Scatter plot of Slenderness Index of metatarsals versus the Withers Heiht of Este-Nuova Casa di Ricovero horses, with the classifications proposed by Brauner (1916) (Spassov *et al*., 2018) and Vitt (1952).



PC	Eigenvalue	% variance
1	91.4767	88.396
2	7.21522	6.9722
3	2.05782	1.9885
4	0.931049	0.89969
5	0.903864	0.87342
6	0.499463	0.48264
7	0.223224	0.21571
8	0.178296	0.17229

FIGURE S21

(a) diagram resulting from the principal components analysis (PCA) computed by using all von den Driesch (1976) measures of the Este-Nuova Casa di Ricovero horses metacarpals with the he hypothesised male distribution area (in red) and he hypothesised female distribution area (in blue); (b) component loadings showing the degree to which the different original variables enter into the components 1; (c) component loadings showing the degree to which the different original variables enter into the components 2; (d) eigenvalue and variance percentage of the first eight components; (e) scatter plot of eigenvalue percentage of the first eight components.



PC	Eigenvalue	% variance
1	176.375	80.962
2	26.4733	12152
3	7.0328	3.2283
4	3.60143	1.6532
5	2.75966	1.2668
6	0.876655	0.40241
7	0.58754	0.2697
8	0.143633	0.065932

FIGURE S22

(a) diagram resulting from the principal components analysis (PCA) computed by using all von den Driesch (1976) measures of the Este-Nuova Casa di Ricovero horses metatarsals with the hypothesised male distribution area in the upper quadrants and the hypothesised female distribution area in the lower quadrants; (b) component loadings showing the degree to which the different original variables enter into the components 1; (c) component loadings showing the degree to which the different original variables enter into the components 2; (d) eigenvalue and variance percentage of the first eight components; (e) scatter plot of eigenvalue percentage of the first eight components.

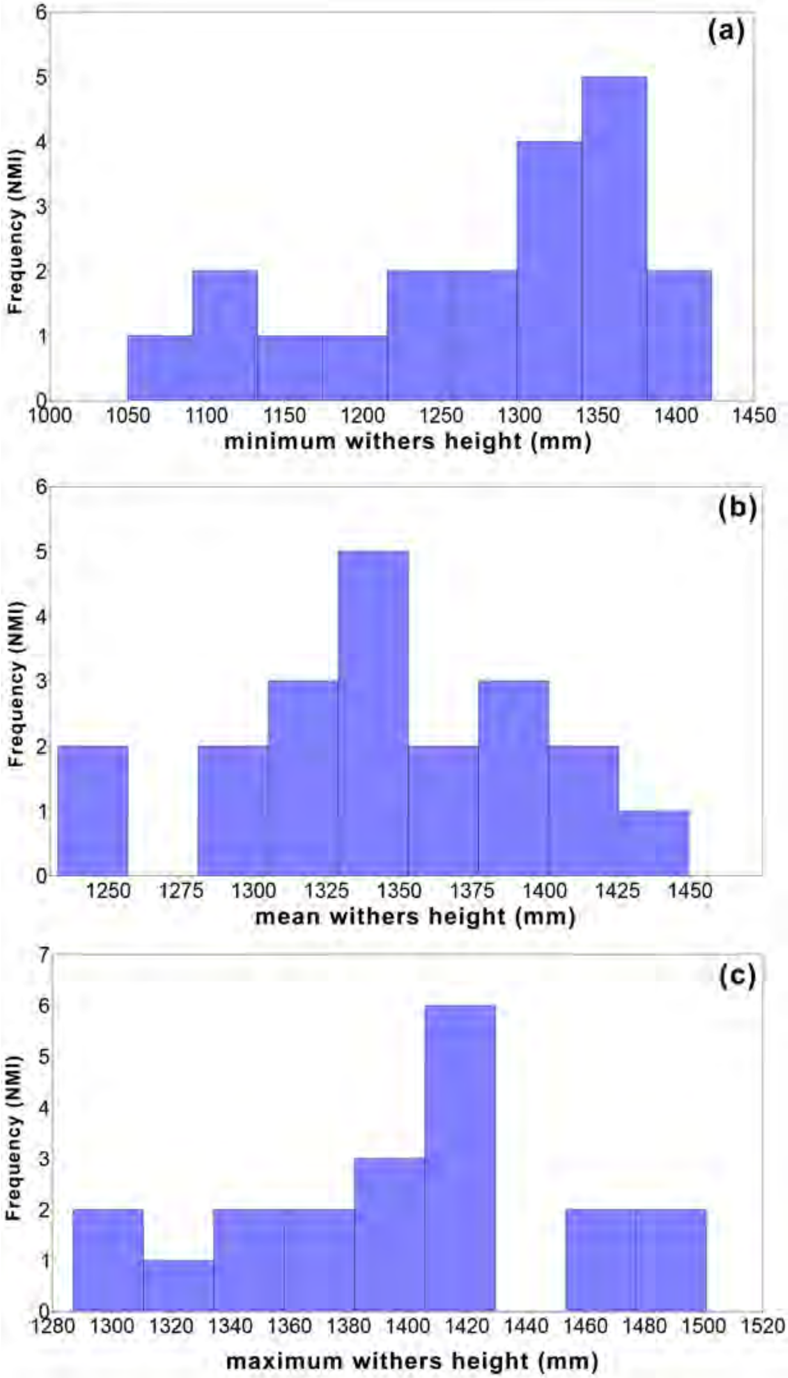


FIGURE S23

Minimum (a), mean (b) and maximum (c) withers height histogram of Este-Nuova Casa di Ricovero horses.

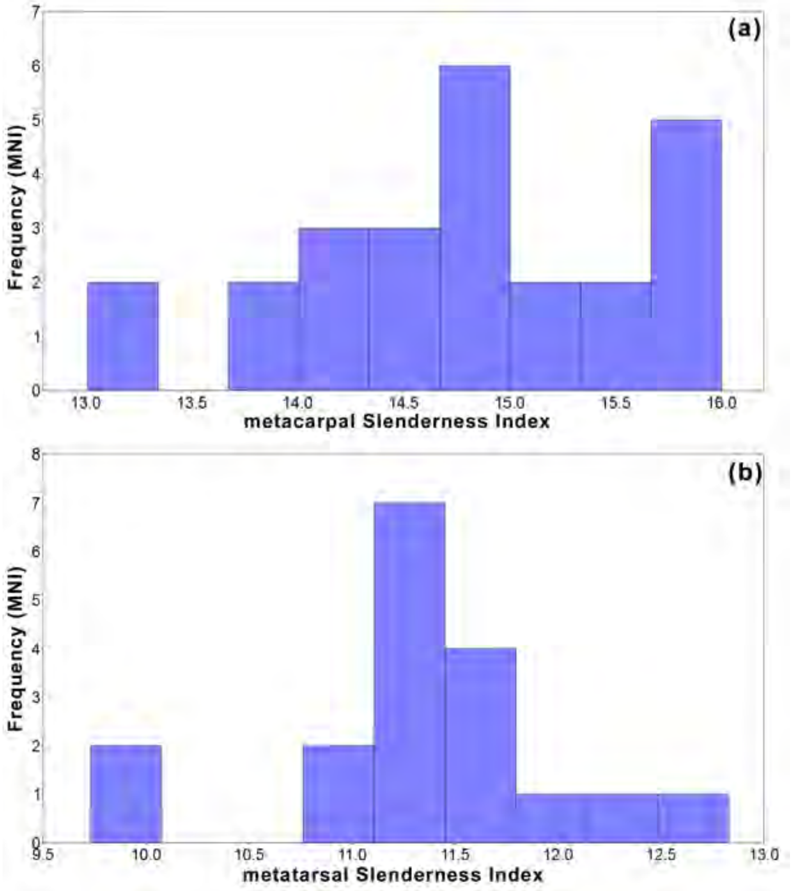


FIGURE S24
Slenderness index histogram of Le Brustolade horses: a) metacarpals, b) metatarsals.

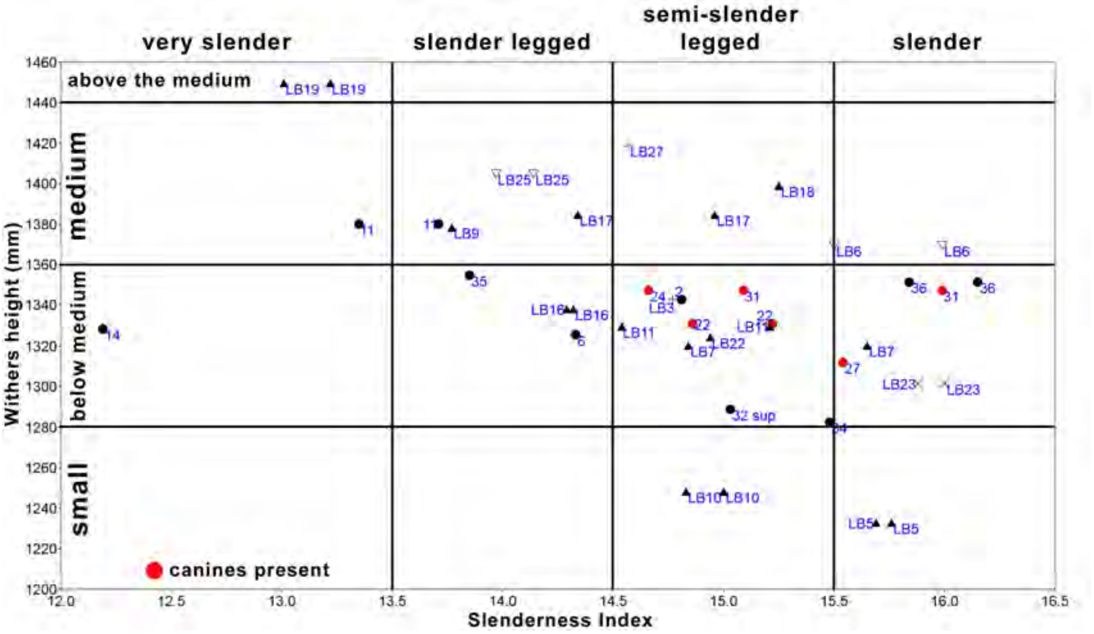


FIGURE S25

Scatter plot of Slenderness Index of metacarpals versus the Withers Heiht of Este-Nuova Casa di Ricovero and Le Brustolade horses, with the classifications proposed by Brauner (2016) (Spassov *et al*. 2018) and Vitt (1952).

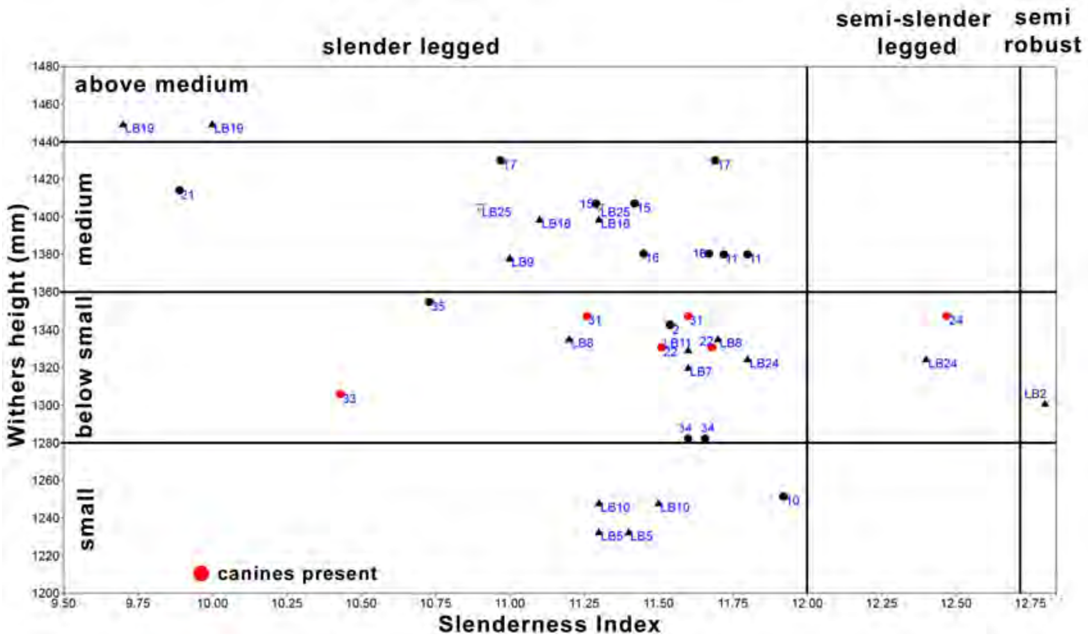


FIGURE S26

Scatter plot of Slenderness Index of metatarsals versus the Withers Heiht of Este-Nuova Casa di Ricovero and Le Brustolade horses, with the classifications proposed by Brauner (1916) (Spassov *et al*., 2018) and Vitt (1952).

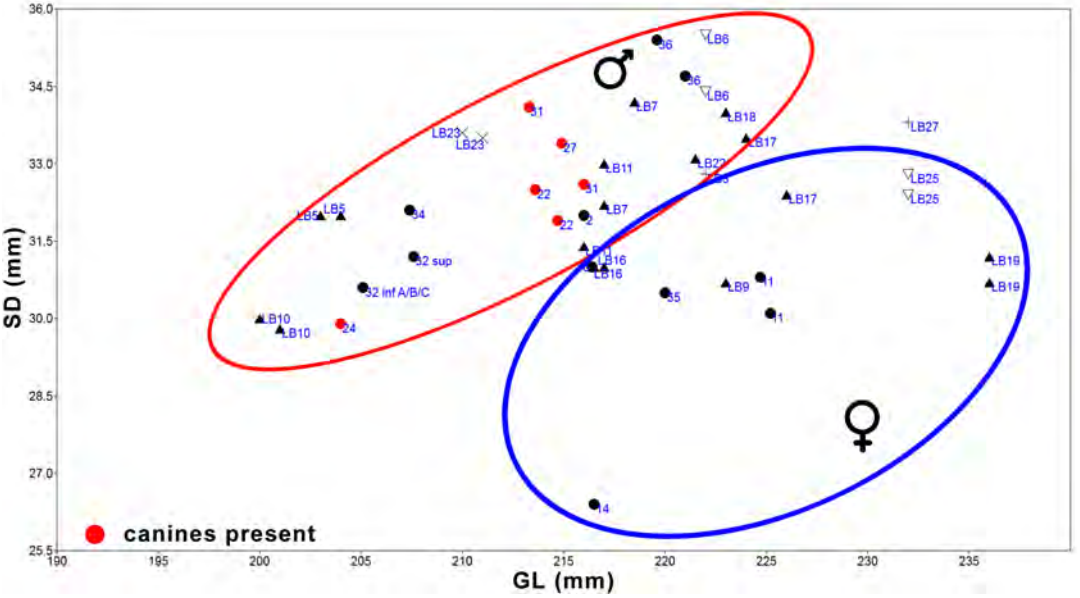


FIGURE S27

Scatter plot of greatest length (GL) versus small breath of diaphysis (SD) of Este-Nuova Casa di Ricovero and Le Brustolade metacarpals. In red the hypothesised male distribution area, in blue the hypothesised female distribution area.

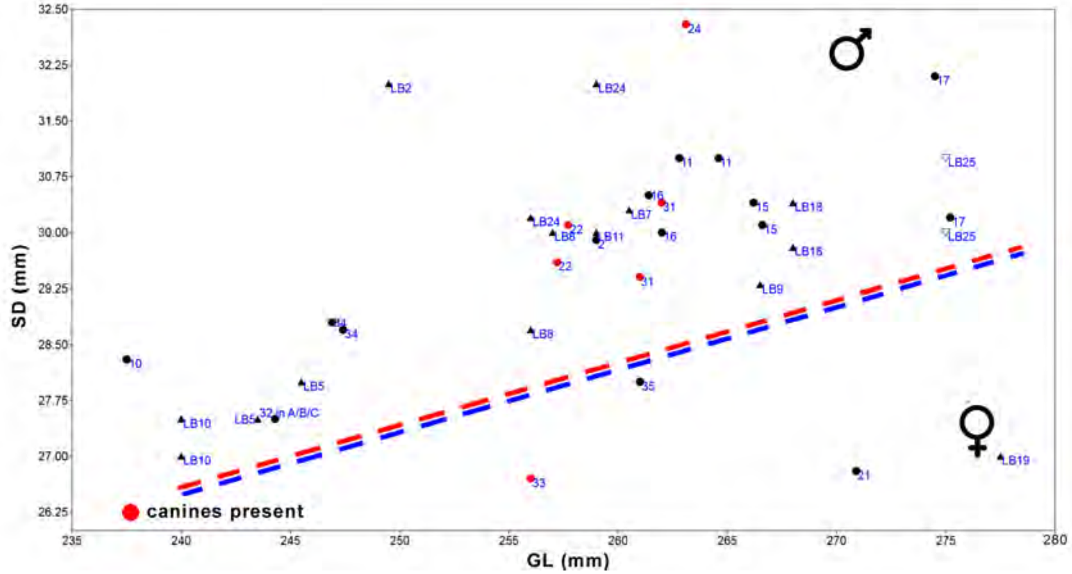
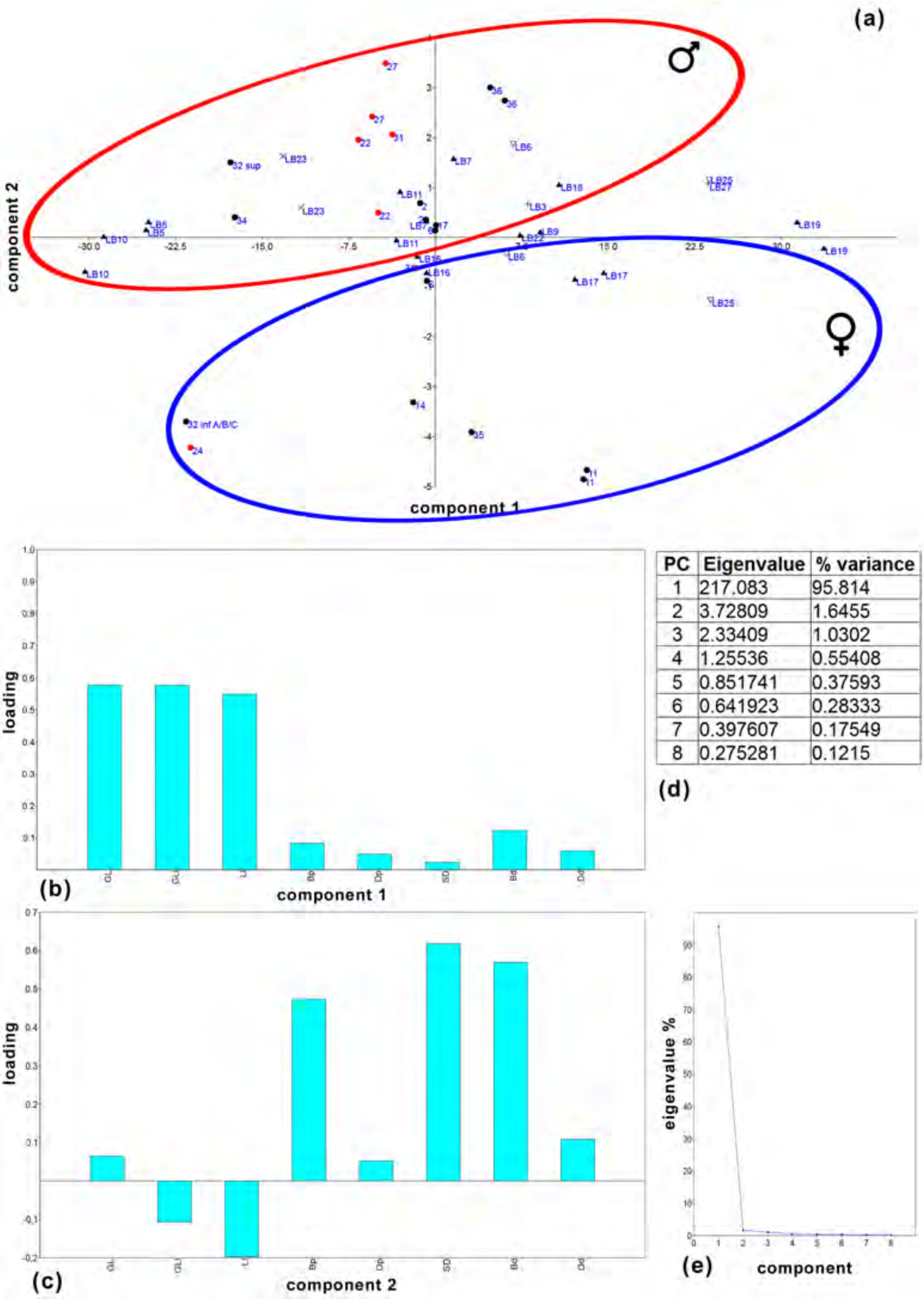


FIGURE S28

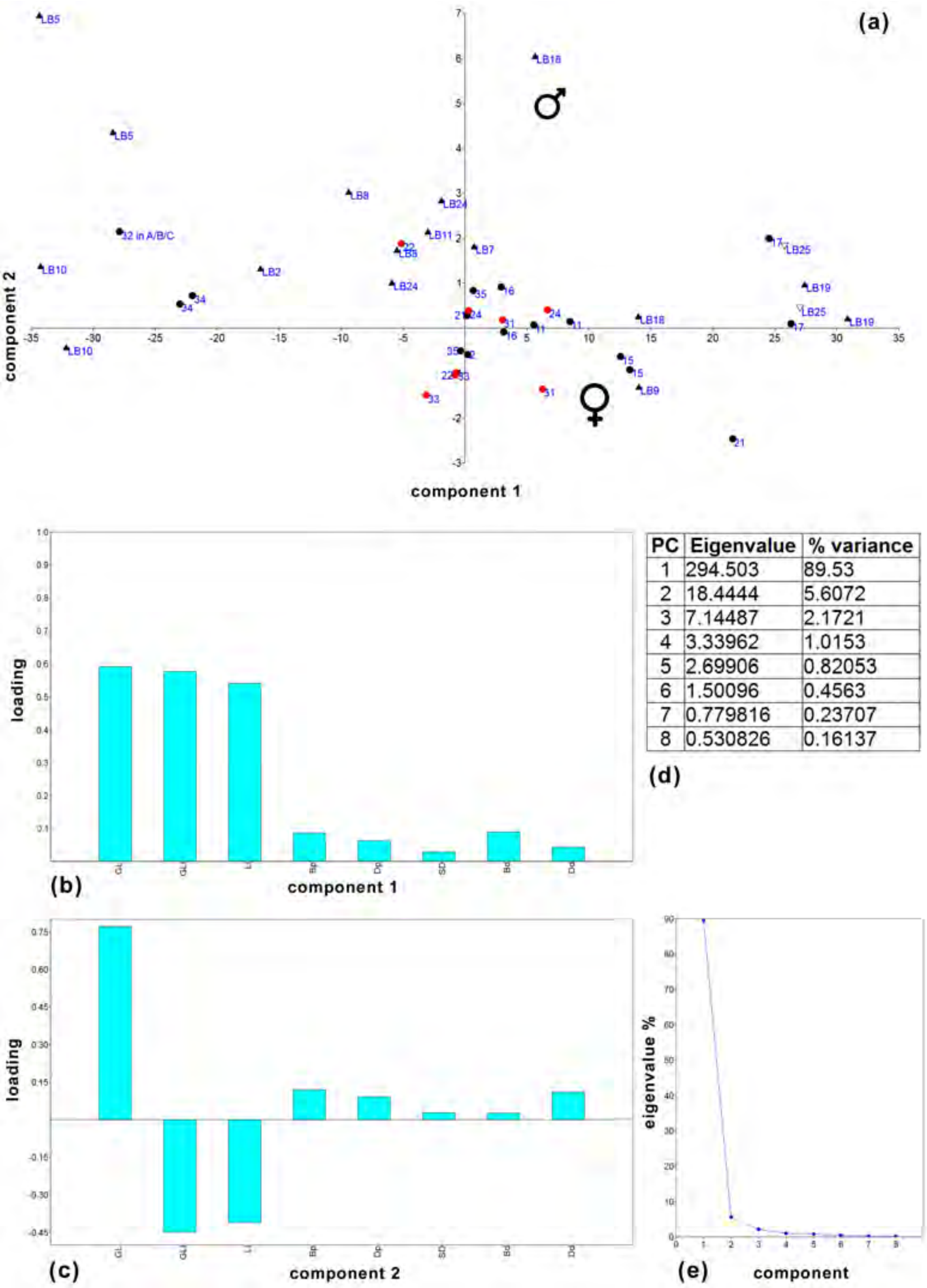
Scatter plot of greatest length (GL) versus small breath of diaphysis (SD) of Este-Nuova Casa di Ricovero and Le Brustolade metatarsals. In the upper part the hypothesised male distribution area, in lower part the hypothesised female distribution area.



PC	Eigenvalue	% variance
1	217.083	95.814
2	3.72809	1.6455
3	2.33409	1.0302
4	1.25536	0.55408
5	0.851741	0.37593
6	0.641923	0.28333
7	0.397607	0.17549
8	0.275281	0.1215

FIGURE S29

(a) diagram resulting from the principal components analysis (PCA) computed by using all von ven Driesch (1976) measures of the Este-Nuova Casa di Ricovero and Le Brustolade horses metacarpals with the he hypothesised male distribution area (in red) and he hypothesised female distribution area (in blue); (b) component loadings showing the degree to which the different original variables enter into the components 1; (c) component loadings showing the degree to which the different original variables enter into the components 2; (d) eigenvalue and variance percentage of the first eight components; (e) scatter plot of eigenvalue percentage of the first eight components.



PC	Eigenvalue	% variance
1	294.503	89.53
2	18.4444	5.6072
3	7.14487	2.1721
4	3.33962	1.0153
5	2.69906	0.82053
6	1.50096	0.4563
7	0.779816	0.23707
8	0.530826	0.16137

FIGURE S30

(a) diagram resulting from the principal components analysis (PCA) computed by using all Driesch (1976) measures of the Este-Nuova Casa di Ricovero and Le Brustolade horses metatarsals with the hypothesised male distribution area in the upper quadrants and the hypothesised female distribution area in the lower quadrants; (b) component loadings showing the degree to which the different original variables enter into the components 1; (c) component loadings showing the degree to which the different original variables enter into the components 2; (d) eigenvalue and variance percentage of the first eight components; (e) scatter plot of eigenvalue percentage of the first eight components.

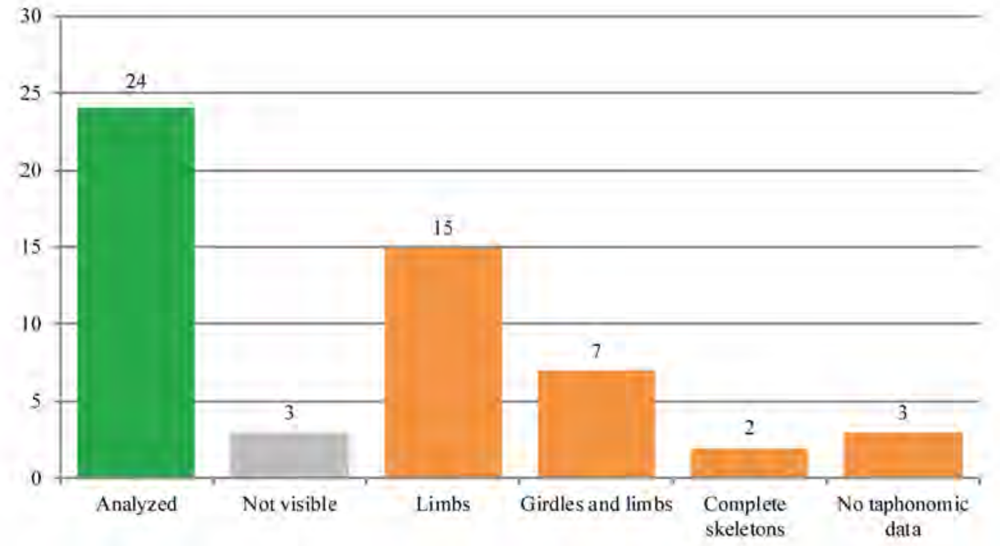


FIGURE S31

MNI of horses available for taphonomic study (MNI 27 green + grey). The difficulty of the restoration made it possible to analyse only some portions of the skeleton for the different individuals. In orange the different portions of the skeleton analysed by MNI / burials.

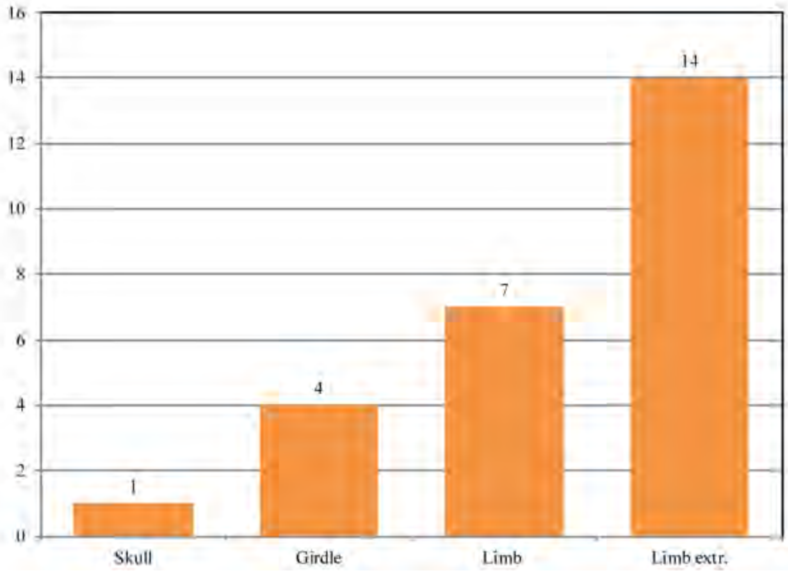


FIGURE S32

Portions of the skeleton analysed for MNI, observed predominantly limb bones compared to skull and girdle remains.

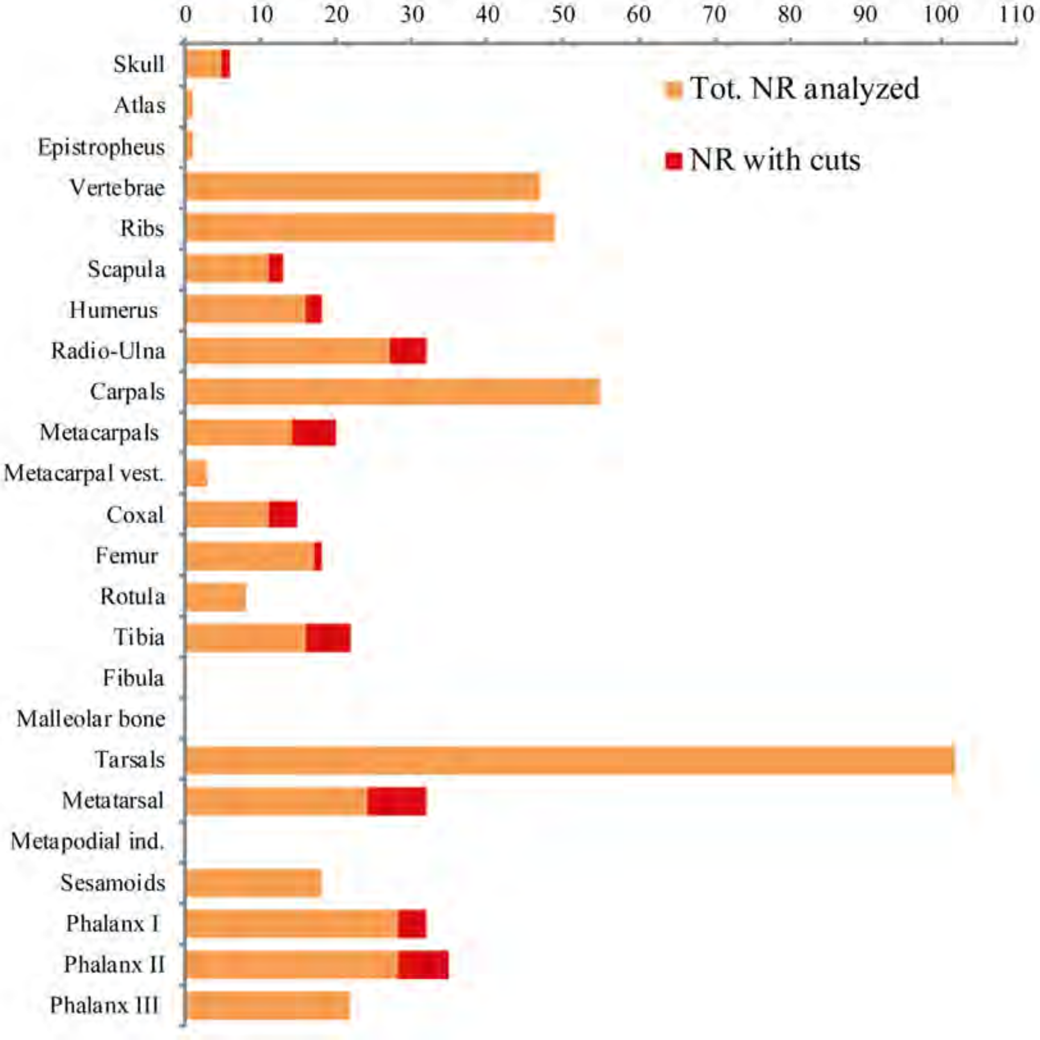
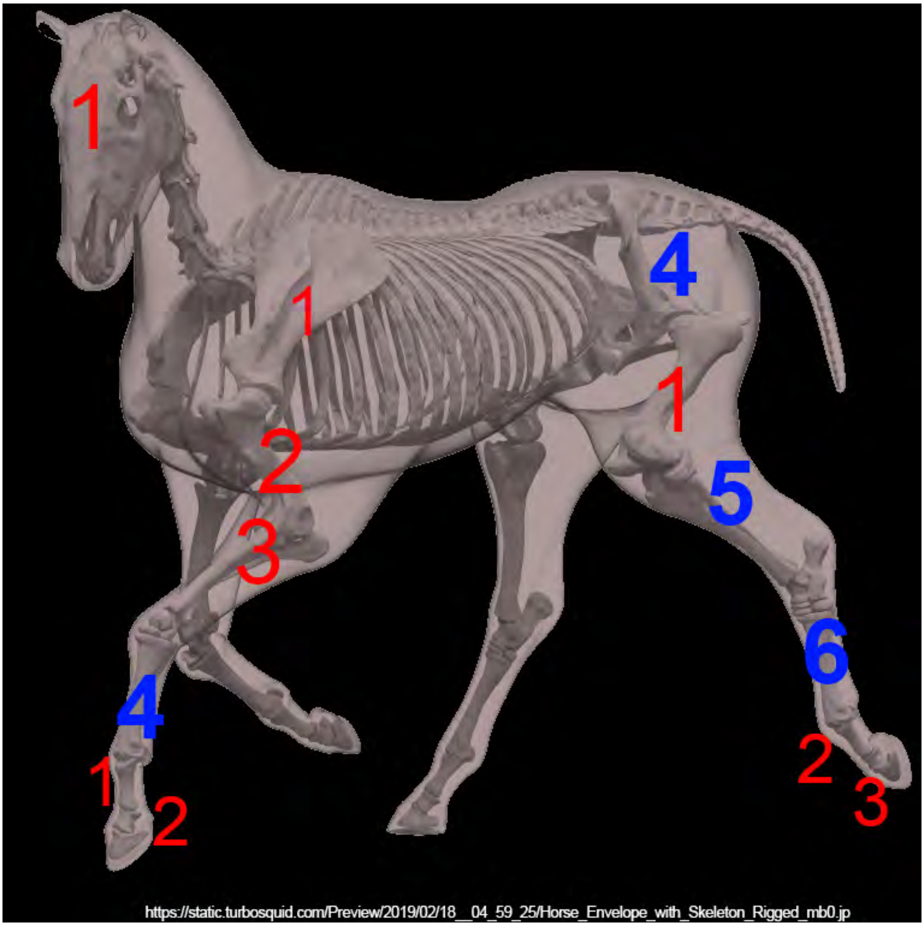


FIGURE S33

The ratio of anatomical elements analised (orange) to those with traces (red) of butchering.



https://static.turbosquid.com/Preview/2019/02/18__04_59_25/Horse_Envelope_with_Skeleton_Rigged_mb0.jp

FIGURE S34

Butchering traces distribution on different horse skeletal elements: blue indicates the highest number of MNI (e.g., six horses show cuts on metatarsals); red is for the lowest values (one skull shows grooves on the front; unfortunately, these traces are poorly preserved and that is why we attribute them with uncertainty).

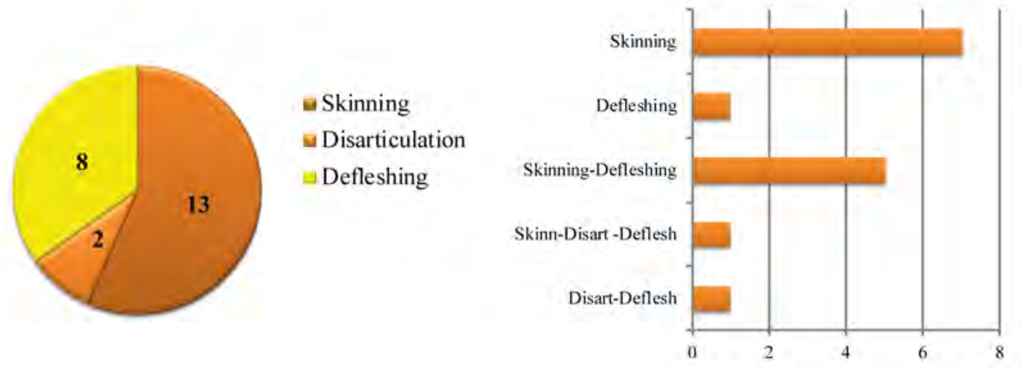


FIGURE S35

The distribution of different butchering actions, skinning is prevalent for 13 horses (left); the combination of butchering actions on various horse skeletons (right).

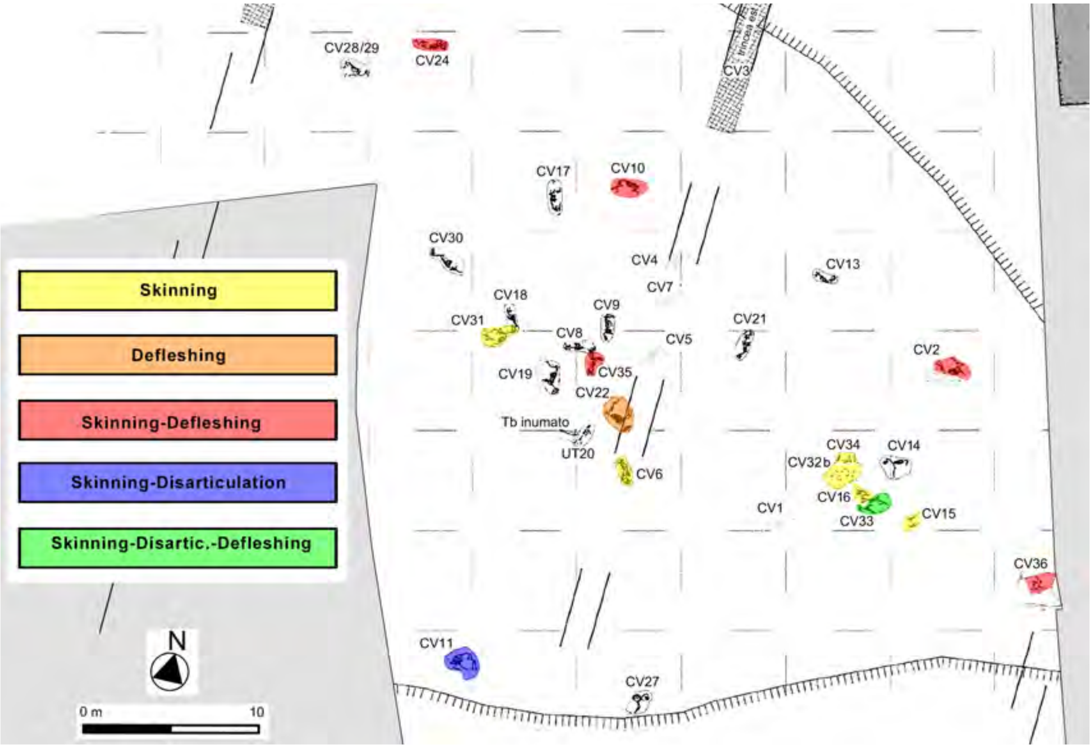


FIGURE S36

Map of the necropolis with the butchering marks distribution.

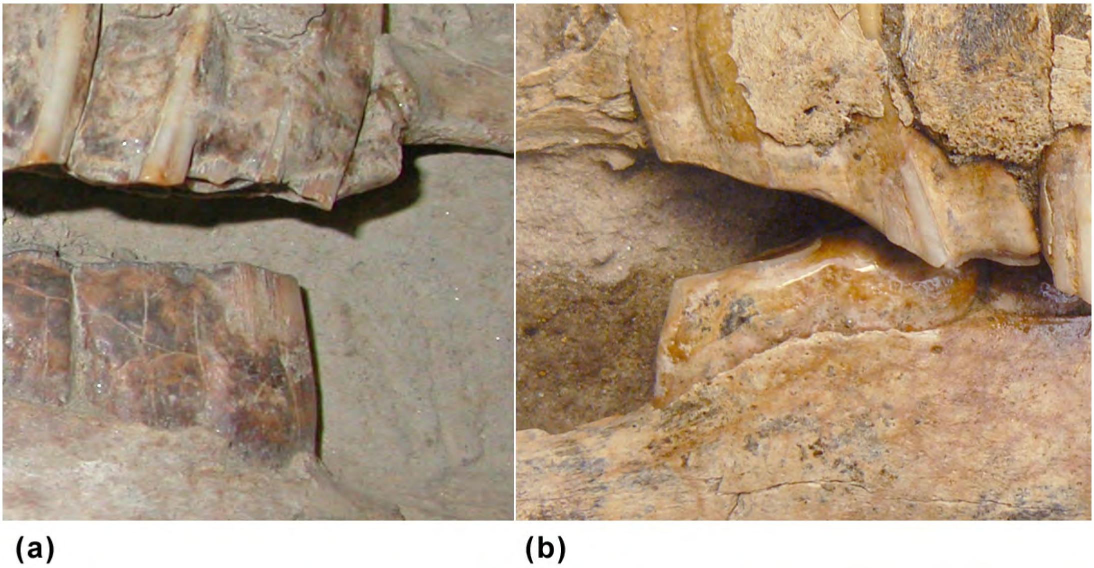


FIGURE S37

(a) particular of second premolars of CV27 with no anomalous wear, (b) particular of second premolars of CV24 with an anomalous wear usually due to morsel placement.

Individual	**Age at death**
2	++ 52 months
6	+ 10 - 12 years
8	2,5-3,5 years
9	++ 12 years
10	+ 52 months
11	adult
12	adult
13	1 year
14	1 year
15	++ 52 months
16	++ 52 months
17	+ 12 years
18	indet
19	1 – 2 years
21	> 42 months
22	9 – 11 years
24	10 – 12 years
25	indet
27	+ 10 - 12 years
28/29	10 – 12 years
30	5 years
31	10 – 12 years
32 sup	10 – 12 years
32 inf A	indet
32 inf B	3 years
32 inf C	indet
32 inf A/B/C	indet
33	2,5 – 3,5 years
34	++ 36 months
35	+ 10 years
36	30 – 36 months

TABLE S1

Ages at death of Este-Nuova Casa di Ricovero horses.

Este - Nuova Casa di Ricovero - withers heights (mm)

Individuals	**minimum**	**mean**	**maximum**
2	1318	1342,7	1384
6	1320	1325,7	1331
9	1229	1229,0	1229
10	1242	1251,5	1285
11	1366	1380,0	1392
12	1341	1343,0	1344
14	1321	1328,5	1331
15	1385	1407,1	1465
16	1333	1380,4	1450
17	1412	1430,1	1442
19	1324	1324,0	1324
21	1378	1414,2	1431
22	1201	1330,9	1418
24	1207	1347,3	1435
27	1307	1312,0	1322
28/29	1285	1318,2	1372
31	1302	1347,2	1374
32 sup	1267	1288,8	1326
32 inf A	1159	1216,2	1237
32 inf B	1267	1296,6	1349
32 inf C	1239	1288,0	1313
32 inf A/B/C	1252	1266,8	1280
33	1218	1305,9	1369
34	1266	1282,5	1296
35	1323	1354,7	1375
36	1336	1351,3	1362

	minimum	mean	maximum
minimum	1159	1216,2	1229
mean	1293,8	1327,81	1358,3
maximum	1412	1430,1	1465
standard dev.	63,3838446	52,9257161	61,9768218

TABLE S2

Minimum, mean and maximum Withers Height of Este-Nuova Casa di Ricovero horses.

Individuals CV	side	GL (mm)	SD (mm)	SI	Mean WH (mm)
2	lf	216.0	32.0	14.81	1342,7
2	rg	216.3			
6	lf				1325,7
6	rg	216.4	31.0	14.33	
11	lf	224.7	30.8	13.71	1380,0
11	rg	225.2	30.1	13.35	
14	rg	216.5	26.4	12.19	1328,5
17	rg				1430,1
22	lf	213.6	32.5	15.22	1330,9
22	rg	214.7	31.9	14.86	
24	lf	204.0	29.9	14.66	1347,3
27	lf		34.3		1312,0
27	rg	214.9	33.4	15.54	
31	lf	213.3	34.1	15.99	1347,2
31	rg	216.0	32.6	15.09	
32 sup	lf	207.6	31.2	15.03	1288,8
32 inf A/B/C	rg	205.1	30.6	14.9	1266,8
34	lf	207.4	32.1	15.48	1282,5
35	rg	220.0	30.5	13.85	1354,7
36	lf	219.6	35.4	16.15	1351,3
36	rg	221.0	34.7	15.84	

TABLE S3

Slenderness Index and mean Withers Height of the Este-Nuova Casa di Ricovero horse metacarpals; lf: left side, rg: right side; GL: greatest lengh; SD: small breath of diaphysis (following Driesch, 1976).

Individuals	side	GL (mm)	SD (mm)	SI	Medium WH (mm)
2	rg	259.0	29.90	11.54	1342.7
10	lf	237.5	28.30	11.92	1251.5
10	rg	237.0			
11	lf	264.6	31.00	11.72	1380.0
11	rg	262.8	31.00	11.80	
15	lf	266.6	30.10	11.29	1407.1
15	rg	266.2	30.40	11.42	
16	lf	262.0	30.00	11.45	1380.4
16	rg	261.4	30.50	11.67	
17	lf	275.2	30.20	10.97	1430.1
17	rg	274.5	32.10	11.69	
21	lf		26.50		1414.2
21	rg	270.9	26.80	9.89	
22	lf	257.7	30.10	11.68	1330.9
22	rg	257.2	29.60	11.51	
24	lf		31.80		1347.3
24	rg	263.1	32.80	12.47	
31	lf	262.0	30.40	11.60	1347.2
31	rg	261.0	29.40	11.26	
32 inf A/B/C	rg	244.3	27.5	11.26	1266.8
33	lf		26.20		1305.9
33	rg	256.0	26.70	10.43	
34	lf	246.9	28.80	11.66	1282.5
34	rg	247.4	28.70	11.60	
35	lf				1354.7
35	rg	261.0	28.00	10.73	

TABLE S4

Slenderness Index and mean Withers Height of the Este-Nuova Casa di Ricovero horse metatarsals; lf: left side, rg: right side; GL: greatest lengh; SD: small breath of diaphysis (following Driesch, 1976).

Este - Nuova Casa di Ricovero - gender determination				
Individuals CV	**Canines presence**	**metacarpal**	**metatarsal**	**Gender hypothesised determination**
CV 2		M	M	M
CV 6		F		F?
CV 9				?
CV 10			M	M?
CV 11		F	M	F?
CV 12				?
CV 14		F		F
CV 15			M	M
CV 16			M	M
CV 17			M	M
CV 19	x			?
CV 21			F	?
CV 22	x	M	M	M
CV 24	x	M	M	M
CV 27	x	M		M
CV 28/29				?
CV 30	x			?
CV 31	x	M	M	M
CV 32 sup		M		M
CV 32 inf_A				?
CV 32 inf_B	x			?
CV 32 inf_C				?
CV 32 inf A/B/C		M	M	M
CV 33	x		F	?
CV 34		M	M	M
CV 35		F	F	F
CV 36		M		M

TABLE S5

Gender hypothesised determination of Este-Nuova Casa di Ricovero horses, based on canines presence and biometrical analysis of metacarpals and metatarsals.

Individuals	**side**	**GL (mm)**	**SD (mm)**	**SI**	**Medium WH (mm)**
2	rg	259.0	29.90	11.54	1342.7
10	lf	237.5	28.30	11.92	1251.5
10	rg	237.0			
11	lf	264.6	31.00	11.72	1380.0
11	rg	262.8	31.00	11.80	
15	lf	266.6	30.10	11.29	1407.1
15	rg	266.2	30.40	11.42	
16	lf	262.0	30.00	11.45	1380.4
16	rg	261.4	30.50	11.67	
17	lf	275.2	30.20	10.97	1430.1
17	rg	274.5	32.10	11.69	
21	lf		26.50		1414.2
21	rg	270.9	26.80	9.89	
22	lf	257.7	30.10	11.68	1330.9
22	rg	257.2	29.60	11.51	
24	lf		31.80		1347.3
24	rg	263.1	32.80	12.47	
31	lf	262.0	30.40	11.60	1347.2
31	rg	261.0	29.40	11.26	
32 inf A/B/C	rg	244.3	27.5	11.26	1266.8
33	lf		26.20		1305.9
33	rg	256.0	26.70	10.43	
34	lf	246.9	28.80	11.66	1282.5
34	rg	247.4	28.70	11.60	
35	lf				1354.7
35	rg	261.0	28.00	10.73	

TABLE S4

Slenderness Index and mean Withers Height of the Este-Nuova Casa di Ricovero horse metatarsals; lf: left side, rg: right side; GL: greatest lengh; SD: small breath of diaphysis (following Driesch, 1976).

Phase	Individual	Conserved carcass	Type Deposition	Orientation	Grave type	Elements by Age	Age at death	Withersheights (min - mean - max)	Gender	Elements analizsed see Table S7	Butchering marks see Table S8
1	CV6	Incomplete. Skull, vert. column, and limbs present.	On back, paws saddened.	N/S	Narrow	Skull complete, premolars and molars worn. Visible upper teeth.	Adult (+ 10 - 12 years)	1320-1325.7-1331	F?	Only some elements.	Skinning
1	CV11	Incomplete. Carcass missing skull.	Right side bent and stretched out.	S/SW	Wide	Metapodial distal fused.	Adult	1366-1380-1392	F?	Only some elements.	Skinning -Disarticulation
1	CV12	Incomplete. Few remains of vertebrae and ribs, metapodial.	Upset.	Indet.	Indet.	Metapodial views, distal ends well fused	Adult	1341-1343-1344	Uncertain	Only some elements.	
1	CV15	Incomplete. Only portions of hind limb.	Right side legs bent.		Indet.	Tibia and femur fused.	Adult (++ 52 months)	1385-1407.1-1465	M	Only some elements.	Skinning
1 T	CV16	Incomplete. Only posterior half preserved: part ribcage and hind limbs.	Right side legs bent.	N/W	Narrow	Tibia and femur fused.	Adult (++ 52 months)	1333 -1380.4-1450	M	Only some elements.	Skinning
1	CV19	Incomplete. Skull, limbs, vert. column. Limbs extremities missing.	Left side, bent.	N/S	Wide	Complete skull visible sup. dx, M2 erupting	Young (1 – 2 years)	1324.0	Uncertain	Only some elements.	
1	CV27	Incomplete. Preserved forepart: skull, forelimbs, rib cage.	Left side, paws slightly bent.	E/W	Narrow	Skull complete, present sup. stagger, premolar and molar teeth very worn	Adult (+ 10 - 12 years)	1307-1312-1322	M	Only some elements.	
1	CV30	Incomplete. preserved spine and skull. Missing fore and hind limbs.	Left side.	W/E	Narrow	Skull complete, visible right side. Canine erupting M3 blunt.	Young adult (5 years)		Uncertain	Only some elements.	
1	CV31	Complete	Right side, paws slightly bent.	E/W	Narrow	Complete skull M3 not well visible - P3 -P4 low crown and canine worn. Visible left side.	Adult (10 – 12 years)	1302-1347.2-1374	M	Only some elements.	Skinning
1 T	CV 32 sup.	Incomplete. Skull, forelimb, vv. hind limb elements, vert. and ribs.	Upset.	N/S	Wide	Hemimandibula with complete dentition, M3 worn out	Adult (10 – 12 years)	1267-1288.8-1326	M	Only some elements.	
1 T	CV32b	Incomplete. Skull, right fore and hind limb elements, right vertebrae and ribs present.	Right side.	N/S	Wide	Skull complete, M3 erupting.	Young adult (3 years)	1267-1296.6-1349	Uncertain	Skull and limb elements present.	Skinning
1 T	CV34	Incomplete. anteriore hind limb extremities present.	Left side.	W/E	Wide	Calcaneum caput fused.	Adult (++ 36 months)	1266-1282.5-1296	M	Elements of limbs present.	Skinning
1	CV36	Incomplete. Skull frags., forelimbs and few frags. hind limbs present.	Right side, paws folded.	E/W	Wide	Deciduous and definitive incisors.	Young adult (30 – 36 months)	1336-1351.3-1362	M	Skull and elements of limbs present.	Skinning -Defleshing

TABLE S6

Summary table of characteristics of burials and horses of Este-Nuova Casa di Ricovero.

Phase	Individual	Conserved carcass	Type Deposition	Orientation	Grave type	Elements by Age	Age at death	Withersheights (min - mean - max)	Gender	Elements analizsed see Table S7	Butchering marks see Table S8
2	CV2	Incomplete. Missing skull and hind limb elements.	Right side, legs bent.	E/W	Wide	Fused long bones.	Adult (++ 52 months)	1318-1342.7-1384	M	Elements of limbs present.	Skinning-Defleshing
2	CV8	Incomplete. Skull, vert. column, proximal part limbs present.	On back.	E/W	Narrow	Complete skull. Crushed, visible lower D4.	Young adult (2.5-3.5 years)			Not analyzed.	
2	CV9	Incomplete. Skull frags., vert. column, and proximal part fore and hind limbs.	Right side.	S/N	Narrow	Skull missing anterior part. Visible very worn premolars and molars.	Adult (++ 12 years)	1229	Uncertain	Only some elements.	
2	CV10	Incomplete. Missing skull ends ant. and post. right limbs.	Left side, legs extended and bent.	E/W	Wide	Fused long bones.	Adult (+ 52 months)	1242-1251.5-1285	M?	Elements of limbs present.	Skinning-Fleshing
Indet.	CV13	Incomplete. Skull, vert. column and anterior limbs, posterior incomplete.	Left side.	Indet.	Indet.	Complete skull, D2-D4 M1 erupting. Visible upper teeth.	Young (1 year)		Uncertain	Only some elements.	
2 T	CV14	Incomplete. skull frr. mandibles, vert. column and anterior limbs, posterior incomplete.	Right side legs stretched out.	W/E	Wide	Right and left hemimandibula, right maxillary deciduous + M1 in eruption.	Young (1 year)	1321-1328.5-1331	F	Only some elements.	
2	CV17	Incomplete. Partial connection: teeth, skull, various ant. and post. limb elements. Vert. column.	Left side, prone decubitus, prob. legs bent.	N/S	Narrow	Incisors (I-III upper left; II upper right; I-II lower left) and canine very worn, pm2 upper right.	Adult (+ 12 years)	1412-1430.1-1442	M	Only some elements.	
2	CV18	Incomplete. Vert. column and girdles.	Probably on back.	N/S	Narrow	Indeterminate. To be verified diagnostic elements.	Indet.			Not analyzed.	
2	CV21	Incomplete. Missing forelimbs.	On back, saddened.	S/W	Narrow	Skull. Not visible. Tibia not fused.	Young adult (>42 monthsi)	1378-1414.2-1431	Uncertain	Only some elements.	
2	CV22	Complete.	Right side legs extended, forelegs slightly folded.	S/E	Wide	Complete skull. Present worn M3 and canine - worn canine.	Adult (9 – 11 years)	1201-1330.9-1418	M	COMPLETE.	Defleshing
2	CV24	Complete.	Right side paws very folded.	E/W	Narrow	Complete skull, complete dentition. M3 worn - canine worn.	Adult (10 – 12 years)	1207-1347.3 -1435	M	COMPLETE.	Skinning-Defleshing
2	CV28/29	Incomplete. Skull, vert. column, proximal limb elements present.	Left side.	E/W	Indet.	Skull complete, visible upper M3 worn.	Adult (10 – 12 years)	1285-1318.2-1372	Uncertain	Not analyzed.	
2 T	CV33	Incomplete. Skull, proximal forelimb elements present. Hind limb, various vert. and ribs.	Right side, paws extended and folded.	S/W	Wide	Skull complete with M3 in eruption.	Young adult (2.5 – 3.5 years)	1218-1305.9-1369	Uncertain	Skull and limb elements present	Skinning - Disarticulation - Defleshing
2	CV35	Incomplete. Skull frags., incomplete fore and hind limbs.	Right side, probab. supine.	N/S	Narrow	Complete skull. Preserved mandible portion with collapsed maxillary portions next to mandible isolated teeth.	Adult (+ 10 years)	1323 -1354.7-1375	F	Skull and elements of limbs present	Skinning-Defleshing

TABLE S6 (continuation)

Summary table of characteristics of burials and horses of Este-Nuova Casa di Ricovero.

Phase	1	1	1	1 Tum	1	1 Tum	1 Tum	1	2	2	2	2	2	2 Tum	2	**Total NR analised**
ANATOMICAL ELEMENTS	CV 6	CV 11	CV 15	CV 16	CV 31	CV 32b	CV 34	CV36	CV 2	CV 10	CV 17	CV 22	CV 24	CV 33	CV 35	
Skull						1						1	1	1	1	**5**
Atlas														1		**1**
Epistropheus														1		**1**
Vertebrae												28	19			**47**
Ribs												23	26			**49**
Scapula								2		2		2	2	2	1	**11**
Humerus						1	1	2	2	2		2	2	2	2	**16**
Radius-Ulna					5	1		9	2	1	1	2	2	2	2	**27**
Carpals					2		4	2	11	6		10	10		10	**55**
Metacarpals	1	2				1	2		2		1	2	2		1	**14**
Metacarpals vest.				1									2			**3**
Coxal			1						1	1		2	2	2	2	**11**
Femur	2		1			2	1		2	2		2	2	2	1	**17**
Rotula									1	1		2	2	2		**8**
Tibia			2	2	1	1	1	1	1		1	2		2	2	**16**
Fibula																
Malleolar bone																
Tarsals		8	9	7	2	5	10		10	10	5	10	10	10	6	**102**
Metatarsals		2	2	2	2	1	2	1	1	2	1	2	2	2	2	**24**
Metapodials indet.																
Phalanx I	2			2	1		3	2	2	2	3	4	3	1	3	**28**
Phalanx II	2			2	1		3	3	2	1	3	4	3	1	3	**28**
Phalanx III	2			2			3	3	2		3	4	3			**22**
Sesamoids				3					2	1		7	3		2	**18**
TOTAL	**9**	**12**	**15**	**21**	**14**	**13**	**30**	**25**	**41**	**31**	**18**	**109**	**96**	**31**	**38**	**503**

TABLE S7

Horse burials with evidence of butchering: a synthesis of remains analyzed by individual.

Phase	1	1	1	1 Tum	1	1 Tum	1 Tum	1	2	2	2	2	2	2 Tum	2	**Tot. with cuts**	**Total NR analised**	**%**
ANATOMICAL ELEMENTS	CV 6	CV 11	CV 15	CV 16	CV 31	CV 32b	CV 34	CV 36	CV 2	CV 10	CV 17	CV 22	CV 24	CV 33	CV 35			
Skull														1		**1**	5	20.0
Atlas																	1	
Epistropheus																	1	
Vertebrae																	47	
Ribs																	49	
Scapula														2		**2**	11	18.2
Humerus												1		1		**2**	16	12.5
Radius-Ulna								1					2	2		**5**	27	18.5
Carpals																	55	
Metacarpals						1	2	2	1							**6**	14	42.8
Metacarpals vest.																	3	
Coxal									1	1				1	1	**4**	11	36.4
Femur														1		**1**	17	5.9
Rotula																	8	
Tibia			1	1						1				2	1	**6**	16	37.5
Fibula																		
Malleolar bone																		
Tarsals																	102	
Metatarsals		2	1	1	1		1							2		**8**	24	33.3
Metapodials indet.																		
Phalanx I								1			1		2			**4**	28	14.3
Phalanx II	1							1	2	1					2	**7**	28	25.0
Phalanx III																	22	
Sesamoids																	18	
TOTAL	**1**	**2**	**2**	**2**	**1**	**1**	**3**	**5**	**4**	**3**	**1**	**1**	**4**	**12**	**4**	**46**	503	9.2

TABLE S8

Este-Nuova Casa di Ricovero. Horse burials with evidence of butchering: a synthesis of remains with traces of butchering and ratio to the anatomical elements analyzed.

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Strategie di sussistenza e mobilità dei gruppi di cacciatori-raccoglitori-pescatori nella Val d'Adige: tafonomia e stagionalità a Riparo Romagnano Loc III e Riparo Pradestel (TN)

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RIASSUNTO: I siti mesolitici di Riparo Romagnano Loc III e Riparo Pradestel sono noti in letteratura per la loro ricca e completa stratigrafia che abbraccia l'intero Mesolitico, dal Sauveterriano antico al Castelnoviano recente.
I due siti sono già stati analizzati in passato con un approccio archeozoologico di tipo strettamente tassonomico ed ecologico. La revisione preliminare del campione faunistico (integrato da nuovo materiale), conferma, per l'intero arco di frequentazione, una grande varietà dello spettro faunistico che testimonia lo sfruttamento di un variegato mosaico ambientale (ambienti di medio-alta quota, di bosco, di radura, fluvio-lacustre, ecc.). Tramite questa comunicazione si presentano nuovi dati desunti dall'analisi tafonomica e degli indicatori di stagionalità di abbattimento riguardanti le faune provenienti dai livelli di frequentazione sauveterriani e castelnoviani di questi due siti. Il fine ultimo è quello di portare un contributo alla ricostruzione delle strategie di sussistenza e della mobilità dei gruppi di cacciatori-raccoglitori e pescatori della valle dell'Adige durante il Mesolitico.

PAROLE CHIAVE: ARCHEOZOOLOGIA, TAFONOMIA, STAGIONALITÀ, MESOLITICO, VAL D'ADIGE – TRENTO

SUMMARY: The Mesolithic rock shelter sites of Romagnano Loc III rock and Pradestel are well known for their rich and detailed stratigraphy which covers the entire Mesolithic, from the Early Sauveterrian to the Late Castelnovian stages. Both sites have been already analyzed from a zooarchaeological perspective that involved taxonomic and ecological analyses. The preliminary data from the faunal samples (enhanced with new materials) revealed a wide faunal spectrum which testified to the exploitation of a varied environmental mosaic during the entire occupation, that included medium-high altitude environments, woodlands, forest clearings, fluvial-lacustrine biotopes, etc. In this paper, taphonomic analyses and seasonal indicators at death for the faunal remains from the Sauveterrian and Castelnovian levels on both sites, are presented. The aim is to gather a more precise reconstruction of subsistence and mobility strategies of the hunter-gatherers and fishermen of the Adige valley during the Mesolithic period.

KEYWORDS: ZOOARCHAEOLOGY, TAPHONOMY, SEASONALITY, MESOLITHIC, ADIGE VALLEY – TRENTO

RESUMEN: Los yacimientos mesolíticos de los abrigos rocosos de Romagnano Loc III y Pradestel son conocidos por su rica y bien detallada estratigrafía que abarca todo el Mesolítico, desde

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el Sauveterriense temprano hasta el Castelnoviense tardío. Los estudios zooarqueológicos previos en ambos yacimientos incluyen análisis taxonómicos y ecológicos. Los datos preliminares de las muestras faunísticas (ampliados ahora con nuevos materiales) revelaron un amplio espectro faunístico que atestiguaba la explotación de un variado mosaico ambiental a lo largo de la ocupación, procedentes de ambientes de media-alta montaña, que incluían bosques, claros forestales y biotopos fluviales-lagunares, entre otros. En este artículo se presentan los análisis tafonómicos y de indicadores estacionales en el momento de la muerte de las faunas de los niveles Sauveterrienses y Castelnovienses de ambos yacimientos. El objetivo es obtener una idea más precisa sobre las estrategias de subsistencia y movilidad de los cazadores-recolectores y pescadores del valle del Adigio durante el Mesolítico.

PALABRAS CLAVE: ZOOARQUEOLOGÍA, TAFONOMÍA, ESTACIONALIDAD, MESOLITICO, VALLE DEL ADIGIO – TRENTO

INTRODUZIONE

Le analisi sulle faune dei siti mesolitici di fondovalle dell'asta atesina sono, ad oggi, numerose. Tra queste si ricordano quelle sui siti di La Vela di Trento (Bazzanella, 1997), Acquaviva di Besenello (Riedel, 1982), Riparo Gaban (Kozlowski & Dalmeri, 2000; Thun Hohenstein *et al*., 2016), Riparo Soman (Tagliacozzo & Cassoli, 1993), Galgenbühel (Bazzanella & Wierer, 2001; Wierer & Boscato, 2006; Wierer *et al*., 2018), Riparo Pradestel (RP), Riparo Romagnano Loc III (RLoc) e Riparo Vatte di Zambana (Boscato & Sala, 1980).

Da un'analisi preliminare di tali studi emergono con chiarezza alcune criticità. Ad esempio, si evidenzia come alcuni siti, come quello di La Vela, Acquaviva di Besenello, e Riparo Vatte di Zambana, abbiano restituito un numero limitato di reperti e pertanto risultino inaffidabili dal punto di vista statistico. Altri siti, come Riparo Soman, Riparo Gaban e Riparo Galgenbühel, seppure abbiano restituito un ricco lotto faunistico, abbracciano solo una porzione limitata e parziale dell'estesa cronologia mesolitica. Infine, i siti di Romagnano Loc III e Pradestel, che presentano sia una serie mesolitica quasi completa che un abbondante lotto faunistico, sono in buona parte studiati (Boscato & Sala, 1980), restituiscono importanti dati di tipo ecologico ma sono carenti sia di indicazioni quantitative (indici di presenza e di rappresentatività degli animali) sia di dati di tipo tafonomico e di stagionalità.

Un altro importante contributo da ricordare in questa sede è la sintesi di Clark (2000), nella quale l'autore contestualizza le risorse animali e il materiale litico per la comprensione funzionale degli insediamenti e delle strategie di sussistenza in Trentino Alto-Adige durante il Mesolitico.

Il presente studio, originato da due tesi di laurea (Dipino, 2019-2020; Chiacchio, 2020-2021), si inserisce nel quadro del piano di valorizzazione delle collezioni archeologiche del MUSE – Museo delle scienze di Trento con la volontà di integrare tramite dati tafonomici e di stagionalità di occupazione i risultati di tipo ecologico (Boscato & Sala, 1980) pubblicati ormai più di quarant'anni fa.

Per la storia delle ricerche e la descrizione stratigrafica dettagliata dei siti di Romagnano Loc III e Pradestel si rimanda a Perini (1971), Broglio & Kozlowski (1984), Dalmeri *et al*. (2008) (Figura 1).

MATERIALI E METODI

L'analisi archeozoologica è stata effettuata utilizzando le collezioni osteologiche di confronto del MUSE e del Laboratorio di Archeozoologia e Tafonomia dell'Università di Ferrara. L'analisi tafonomica è stata effettuata tramite lenti a piccolo ingrandimento e con uno stereomicroscopio Leica M 165C con ingrandimenti da 0.75 a 124X; quando necessario, sono state acquisite immagini tramite microscopico elettronico a scansione ZEISS EVO XVP, Carl Zeiss SMT Ltd. L'intero campione è stato sottoposto anche ad analisi quantitativa tramite calcolo del numero dei resti (NR; Grayson, 1984) e del numero minimo degli individui (NMI; Lyman, 1994).

La distinzione tra le modificazioni di origine naturale è stata eseguita riferendosi a Behrensmeyer (1978), Cilli *et al*. (2000) e Fernández-Jalvo & Andrews (2016).

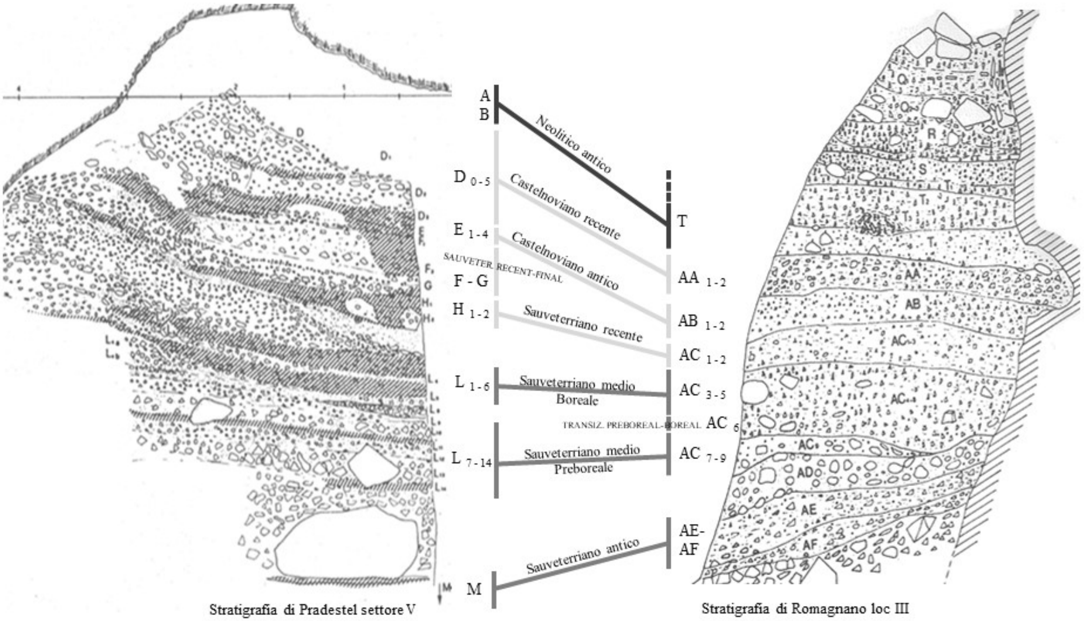


FIGURA 1

Schema stratigrafico dei depositi messi a confronto: nell'immagine sono proposti i raggruppamenti cronologici degli strati di Riparo Pradestel settore V (Dalmeri *et al*., 2008) e Riparo di Romagnano Loc III (Perini, 1971).

Le alterazioni di origine antropica sono state registrate e descritte qualitativamente in modo da poter definire eventuali ricorrenze o comportamenti codificati nelle pratiche e modalità di processamento delle carcasse (Binford, 1981; Bunn, 1981; Giacobini *et al*., 1992; Aimar *et al*., 1995; Blumenschine, 1995; Malerba & Giacobini, 1995; Romandini, 2012).

Lo studio della stagionalità si è basato sul presupposto dell'attualismo, ovvero che la stagione di nascita nella Preistoria delle specie indagate sia simile a quella attuale. La valutazione del periodo di nascita per le specie è considerata basandosi sui dati proposti da Stocker (1985), Tomé & Vigne (2003), Herr & Rosell (2004), Mustoni *et al*. (2005), Angst (2010). I dati sulla stagionalità, fanno riferimento alla stima dell'età basata sull'eruzione e usura dei denti e sulla fusione delle epifisi delle ossa lunghe.

RISULTATI E DISCUSSIONE

Composizione faunistica

Il campione faunistico preso in esame per il sito di Riparo di Romagnano Loc III (d'ora in poi RLoc) è costituito complessivamente da 6.099 reperti, dove i determinati ammontano all'87% (NR 5.311). L'insieme dei resti faunistici rinvenuti nel corso degli scavi a Riparo Pradestel (d'ora in poi RP) si compone di 16.400 reperti, dei quali solo il 24,5% (NR 4.014) è stato determinato tassonomicamente ed anatomicamente. (Figura 2).

La quantificazione per strato delle specie presenti nei due depositi è riportata nelle Tabelle supplementari 1 e 2. In entrambi i siti la fauna è dominata dagli ungulati (cervo, capriolo, stambecco, camoscio e cinghiale) con una significativa presenza del castoro a RP.

I carnivori sono scarsamente presenti e sono rappresentati da piccoli carnivori come tasso, martora/faina, volpe e gatto selvatico e da carnivori di medie e grandi dimensioni come orso, lupo e lince. Nel sito di RLoc è documentata anche la lontra.

Sia a RLoc che a RP vi è una spiccata presenza di animali legati ad ambienti dulciacquicoli: castoro, testuggine palustre e ittiofauna. I resti di questi animali sono oggetto di un altro contributo (Dipino *et al*. 2025, in questo volume).

Nello specifico, gli strati del Sauveterriano medio preboreale di RLoc (AC 7 - 9) sono ricchi di resti. La presenza più consistente è quella degli ungulati (NR 305), seguiti dall'ittiofauna

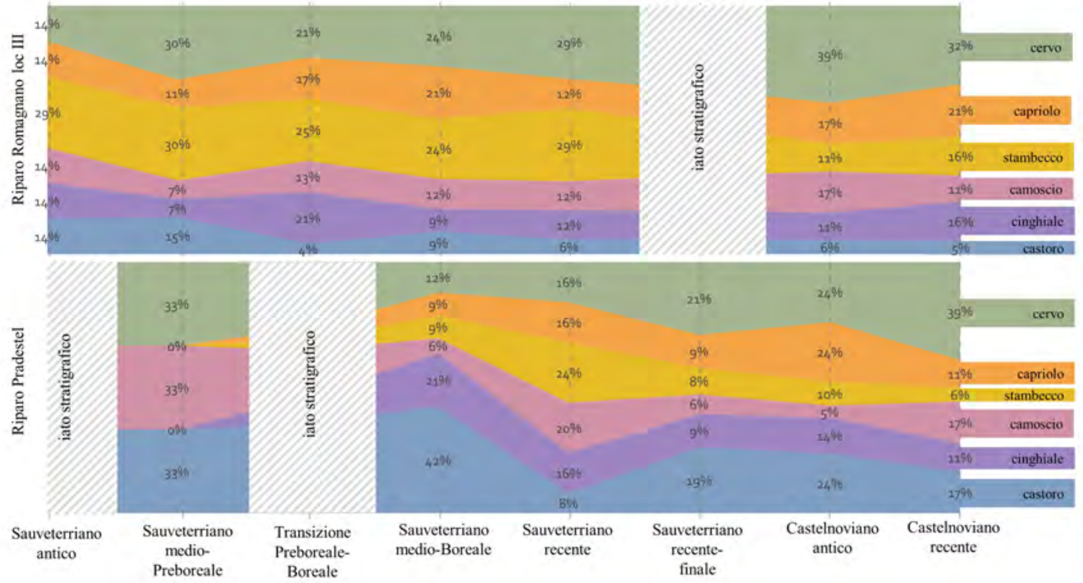


FIGURA 2

Percentuali degli ungulati e del castoro nelle varie fasi di occupazione. Esse si basano sul numero minimo di individui (NMI) calcolato sulla totalità del campione.

(NR 23), dal castoro (NR 11) e da *Martes* sp. (NR 5). Per quanto riguarda il sito di RP, dagli strati preboreali L_{7-9}, provengono pochi resti ossei: il mammifero più presente è il cervo (NR 13), seguito dal castoro e dal camoscio. Sono presenti solo pochi frammenti di *Martes* sp., *Canis lupus* ed *Emys orbicularis*.

I tagli databili al Sauveterriano medio boreale di RLoc (AC_{3-5}) sono caratterizzati dall'abbondante presenza di ungulati (NR 477), dominata dal cervo con 196 reperti. Seguono ittiofauna, castoro e testuggine palustre. A RP (L_{1-6}) vi è invece una predominanza di *Castor fibe*r (NR 196; NMI 14) sul cinghiale (NR 65; NMI 7).

Negli strati del Sauveterriano recente (H per RP e AC_{1-2} per RLoc) si osserva una predominanza del cervo seguito da capriolo e stambecco e a RP anche dal camoscio.

I resti di orso, nello strato H di RP, sono più abbondanti rispetto a tutto il resto del sito (NR 8); la stessa cosa vale per *Felis silvestris* nello strato AC di RLoc (NR 5).

Negli strati G ed F del Sauveterriano recente-finale di RP (assente a RLoc) vi è una predominanza del cervo (NR 376), seguito dal castoro (NR 102) e dagli altri ungulati. I carnivori sono presenti, ma in quantità esigue.

Anche negli strati Castelnoviani (AA_{1-2} e AB_{1-2} per RLoc e D ed E per RP), il mammifero più presente è il cervo (RLoc: NR 260; RP: NR 377), seguito dall'abbondante presenza di capriolo (RLoc: NR 120; RP: NR 149) e camoscio (RLoc: NR 82; RP: NR 31). I carnivori sono più rappresentati rispetto al resto della stratigrafia di entrambi i depositi, maggior presenza del genere *Martes* (RLoc: NR 30; RP: NR 41) e del tasso (RLoc: NR 4; RP: NR 22).

Analisi tafonomica

Tra gli agenti naturali che hanno maggiormente influenzato e caratterizzano le superfici ossee dei resti vi è il cosiddetto *weathering*. Le superfici ossee dei due siti, risultano fortemente alterate anche dall'azione di esfoliazione e dalle concrezioni. A RP una forte corrosione si aggiunge alle alterazioni delle superfici ossee. Sono marginalmente documentate le modificazioni dovute a roditori, carnivori e calpestio.

Lo sfruttamento delle carcasse nei depositi è attestato sia da tracce macroscopiche di taglio sulle superfici ossee sia da evidenti lavorazioni delle materie dure quali ossa e palco.

Cut-marks sono stati riscontrati su 37 frammenti (0,61% dell'intero campione analizzato) provenienti da RLoc principalmente dagli strati AC (NR 19), AA (NR 4) e Z (NR 5); Per quanto riguarda Pradestel, sono 83 i frammenti con *cut-marks* (0,63% dell'intero campione analizzato) rinvenuti principalmente negli strati D (NR 28), E (NR 19), F (NR 17) ed L (NR 16).

A RLoc le tracce sono riscontrate più frequentemente sulle ossa degli ungulati, in particolare dei cervi, seguiti da caprioli e camosci. Gli elementi anatomici maggiormente interessati sono le falangi e i metacarpi che presentano principalmente strie riconducibili ad azione di scuoiamento.

A RP gli elementi anatomici maggiormente interessati sono coste, prime falangi, omeri, femori e metatarsi. Le tracce sono state riscontrate più frequentemente sugli ungulati, in particolare su cervo e capriolo, e sulle ossa di castoro. Nei due depositi vi sono tracce riconducibili a *cut-marks* anche su carnivori: orso, lupo, tasso, *Martes* sp. e gatto. Tra i resti di RLoc, anche un primo metacarpo di orso con numerose tacche incise (Broglio, 1972).

A RP sono emersi 23 reperti con segni di lavorazione provenienti soprattutto dagli strati Sauveterriani (NR 14). Le tracce riscontrate attestano varie fasi di lavorazione: alcuni sono solo sbozzati mentre altri sono stati lisciati e sagomati fino a creare punte o spatole. Inoltre, 8 di questi manufatti mostrano segni di combustione, a volte localizzati sulla punta dell'oggetto.

I reperti combusti provenienti da RLoc sono 63, 49 dei quali hanno raggiunto il massimo grado di combustione e risultano calcinati; a RP i reperti combusti sono 3.698, 779 dei quali sono calcinati. La maggior parte dei resti combusti, per entrambi i siti, si concentra negli strati sauveterriani ed è costituita principalmente da elementi di cervo.

A RP, infine, vi sono tracce antropiche (*cut-marks*) in associazione a combustione su 5 resti: tre reperti indeterminati e due reperti riferibili al cervo.

Stagionalità

Attualmente il metodo più efficace per determinare la stagionalità di un sito è tramite l'eruzione dentaria (Rowley-Conwy, 1987). Prendendo come riferimento gli attuali periodi di gestazione e la stima dell'età dallo studio dei denti, è stato possibile valutare la stagione di morte di alcuni animali e dunque fare alcune considerazioni sulla stagionalità dei siti.

L'osservazione della corona e della superficie occlusale dei denti ha permesso di stabilire, tramite il confronto con i dati in letteratura (in MATERIALI E METODI), un range di età per ogni dente (Tabelles supplementari 5 e 6). A Rloc la stagione di morte è stata determinata sulla base di 37 denti mentre per RP sono 39 i denti presi in considerazione. Per questo studio sono stati presi in considerazione i soli denti isolati integri e i frammenti di mascella e mandibola con denti. Sono stati inoltre scartati i denti che rientravano in range di età troppo estesi.

I dati, riportati nelle tabelle supplementari 5 e 6, hanno permesso di fare alcune deduzioni.

Per RLoc la mortalità degli animali è ben attestata da metà aprile a metà ottobre. L'inverno è meno rappresentato. A RP i dati di mortalità sono piuttosto coerenti per l'intera cronologia e mostrano una distribuzione della mortalità in tutte le stagioni dell'anno, con una predominanza riferita ad animali cacciati tra la tarda primavera e l'inizio dell'inverno.

CONCLUSIONI

RLoc e RP sono caratterizzati da una stratigrafia mesolitica quasi completa e ben conservata che li rende particolarmente significativi nel contesto del sistema insediativo della Valle dell'Adige durante il primo Olocene. I dati sulle associazioni faunistiche analizzate in questo studio si aggiungono non solo ai dati paleoecologici pubblicati da Boscato & Sala (1980), ma anche a quelli palinologici (Cattani, 1977), alle datazioni radiocarboniche (Alessio *et al*., 1984), alle ricostruzioni climatiche proposte da Ravazzi *et al*. (2007), e a quelle geomorfologiche proposte da Bartolomei (1974).

Si nota una grande disparità numerica del rapporto tra determinati ed indeterminati tra i due siti che verosimilmente potrebbe essere attribuita a modalità di raccolta diverse o a trattamenti delle carcasse effettuati in zone non indagate dallo scavo. In entrambi i casi il risultato è la quasi completa assenza delle diafisi delle ossa lunghe.

Le attestazioni dell'attività umana (tracce di macellazione, combustione e lavorazione) e la scarsa presenza di tracce di rosicature sulle superfici ossee, suggeriscono un prevalente sfruttamento delle carcasse da parte dell'uomo rispetto all'attività dei carnivori. Le tracce antropiche meglio rappresentate sono i *cut-marks* da strumento litico che, nella maggior parte dei casi, si presentato insistiti e localizzati in corrispondenza di epifisi distali e prossimali o di ossa vicine alla superficie corporea compatibili con azioni di disarticolazione e spellamento. I segni sono stati riscontrati sulle ossa di ungulati, di castoro e di carnivori di piccola taglia; più frequentemente su quelle dei cervidi e di castoro (lo sfruttamento di quest'ultimo a RP verrà trattato in un altro contributo; cfr. Dipino *et al.*, 2025, in questo volume). I carnivori, sembrano giocare un ruolo solamente marginale nelle strategie di caccia con il raro sfruttamento rivolto principalmente ad animali di piccola taglia come martora/faina e tasso.

Per quanto riguarda le stagioni di occupazione del sito è necessario tenere a mente che l'assenza di dati sull'abbattimento di animali in determinate stagioni non è prova di assenza di frequentazione umana dell'accampamento. Dallo studio effettuato è stato possibile osservare, in quasi tutte le fasi cronologiche, una maggioranza di dati riferibili ad abbattimenti effettuati in primavera e in estate, mentre le informazioni relative all'autunno-inverno sono più limitate. Si nota comunque una dispersione dei dati durante il corso dell'anno in tutti i livelli che potrebbe indicare una frequentazione più o meno continua e non di tipo stagionale. Saranno fondamentali i futuri studi sulla fauna ittica volti a meglio indagare le stagioni di frequentazione dei siti della Valle dell'Adige.

MATERIALE SUPPLEMENTARE

Vedi materiale supplementare su https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_013

BIBLIOGRAFIA

AIMAR, A.; CILLI, C.; MALERBA, G. & GIACOBINI, G. 1995: L'étude au microscope électronique à balayage des surfaces osseuses. Le problème de l'identification des traces d'action anthropiques sur les objects archéologiques en matière dure animale. In: *1st international congress on "Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin"*, Siracusa.

ALESSIO, M.; ALLEGRI, L.; BELLA, F.; BROGLIO, A.; CALDERONI, G.; CORTESI, C.; IMPROTA, S.; PRIETE MARTINEZ, M.; PETRONE, V. & TURI, B. 1984: 14C datings of three Mesolithic series of Trento Basin in the Adige Valley (Vatte di Zambana, Pradestel, Romagnano) and comparison with Mesolithic series in other regions. *Preistoria Alpina* 19: 245–254.

ANGST, C. 2010: *Mit dem Biber leben. Bestandeserhebung 2008; Perspektiven für den Umgang mit dem Biber in der Schweiz*. Umwelt-Wissen Nr. 1008, Neuenburg.

BARTOLOMEI, G. 1974: I talus detritici e la stabilizzazione del versante destro della valle dell'Adige nella zona di Trento. *Studi Trentini di Scienze Naturali* 51: 213-228.

BAZZANELLA, M. 1997: The fauna of La Vela di Trento: preliminary analysis. *Preistoria Alpina* 33: 37-40.

BAZZANELLA, M. & WIERER, U. 2001: Die mesolithische Fundstelle am Galgenbühel in Salurn, Südtirol. Eine Sauveterrienstation im Etschtal. *Der Schlern* 75/2: 116-128.

BEHRENSMEYER, A.K. 1978. Taphonomic and ecologic information from bone weathering. *Antiquity* 4: 150-162.

BINFORD, L.R. 1981: *Bones*, *Ancient Men and Modern Myths*. Academic Press, New York.

BLUMENSCHINE, R.J. 1995: Percussion marks, tooth marks, and experimental determinations of the timing of hominid and carnivore ace to long bones at FLK Zinjanthropus, Olduvai Gorge, Tanzania. *Journal of Human Evolution* 27: 197-213.

BOSCATO, P. & SALA, B. 1980: Dati paleontologici, paleoecologici e cronologici di 3 depositi epipaleolitici in Valle dell'Adige (Trento). *Preistoria Alpina* 16: 45-61.

BROGLIO, A. 1972: I più antichi abitatori della Valle dell'Adige. *Preistoria Alpina* 8: 157-176.

BROGLIO, A. & KOZLOWSKI, S. K. 1984: Tipologia ed evoluzione delle industrie mesolitiche di Romagnano III. *Preistoria Alpina* 19: 93-148.

BUNN, H.T. 1981: Archaeological evidence for meat-eating by Plio-Pleistocene hominids from Kooby and Olduvai Gorge. *Nature* 291: 574-577.

CATTANI, L. 1977: Dati palinologici inerenti ai depositi di Pradestel e di Vatte di Zambana nella Valle dell'Adige (TN). *Preistoria Alpina* 13: 21-29.

CHIACCHIO, G. 2020-2021: Nuove *analisi archeozoologiche dal sito Mesolitico pluristrarificato di Romagnano loc. III (Trento): aspetti tafonomici e stagionalità di occupazione*. Tesi di laurea. Università di Ferrara.

CILLI, C.; MALERBA, G. & GIACOBINI, G. 2000: Le modificazioni di superficie dei reperti in materia dura animale provenienti da siti archeologici. Aspetti metodologici e considerazioni tafonomiche. *Bollettino del Museo Civico di Storia Naturale di Verona* 24: 73-98.

CLARK, R., 2000: The Mesolithic Hunters of the Trentino. A Case Study in Hunter-Gatherer Settlement and Subsistence from Northern Italy, *BAR Int. Series*, 832: 220 pp.

DALMERI, G.; CUSINATO, A.; NERI, S. & NICOLODI, F. 2008: Le industrie mesolitiche di Riparo Pradestel (Trento). Aspetti tipologici ed evolutivi. *Preistoria Alpina* 43: 131-186.

DIPINO, N. 2019-2020: *Contributo alla ricostruzione delle strategie di sussistenza e della mobilità dei gruppi di cacciatori-raccoglitori-pescatori nella Val d'Adige: tafonomia e stagionalità a Riparo Pradestel*. Tesi di laurea. Università di Ferrara.

DIPINO, N.; CHIACCHIO, G.; FONTANA, A.; FLOR, E.; FONTANA, F. & THUN HOHENSTEIN, U. 2025: Le risorse legate agli ambienti dulciacquicoli della valle dell'Adige nel Mesolitico: Riparo Romagnano Loc III e Riparo Pradestel (TN). *Archaeofauna* 34(1) (2025): 00-00.

FERNÁNDEZ-JALVO, Y. & ANDREWS, P. 2016: *Atlas of taphonomic identifications. 1001 + images of fossil and recent mammal bone modification*. Springer, New York.

GIACOBINI, G.; AIMAR, A. & MALERBA, G. 1992: Lo studio delle tracce di macellazione sui resti faunistici preistorici. In: *Atti del Colloquio, Sepolture preistoriche nelle Dolomiti e primi insediamenti storici, Belluno 1992:* 109-124.

GRAYSON, D.K. 1984: *Quantitative zooarchaeology. Topics in the analysis of archaeological faunas*. Academic Press, New York.

HERR, J. & ROSELL, F. 2004: Use of space and movement patterns in monogamous adult Eurasian beavers (*Castor fiber*). *Journal of Zoology* 262: 257–264.

KOSZLOWSKI, S.K. & DALMERI, G. 2000: Riparo Gaban: the Mesolithic layers. *Preistoria Alpina* 36: 3-42.

LYMAN, R.L. 1994: Quantitative units and terminology in zooarchaeology. *American Antiquity* 59: 36-71.

MALERBA, G. & GIACOBINI, G. 1995: Analisi delle tracce di macellazione in un sito paleolitico. L'esempio del Riparo di Fumane (Valpolicella, Verona). In: *Atti del I Convegno Nazionale di Archeozoologia, Rovigo 1993*: 97-108.

MUSTONI, A.; PEDROTTI, L.; ZANON, E. & TOSI, G. 2005: *Ungulati delle Alpi. Biologia, riconoscimento, gestione*. Nitida Immagine Editrice, Cles.

PERINI, R. 1971: I depositi preistorici di Romagnano Loc (Trento). *Preistoria Alpina* 7: 7-106.

RAVAZZI, C.; PERESANI, M.; PINI, R. & VESCOVI, E. 2007: Il Tardoglaciale nelle Alpi e in Pianura Padana. Evoluzione stratigrafica, storia della vegetazione e del popolamento antropico. *Il Quaternario* 20: 163-184.

RIEDEL, A. 1982: Die Fauna der vorgeschichtlichen Siedlung von Acquaviva im Trentino. *Preistoria Alpina* 18: 205-207.

ROMANDINI, M. 2012: *Analisi archeozoologica, tafonomica, paleontologica e spaziale dei livelli Uluzziani e tardo-Musteriani della Grotta di Fumane (VR). Variazioni e continuità strategico comportamentali umane in Italia Nord-Orientale: i casi di Grotta del Col della Stria (VI) e Grotta del Rio Secco (PN)*. Dottorato di ricerca in Scienze e Tecnologie per l'Archeologia e i Beni Culturali, ciclo XXIV, Università di Ferrara, Ferrara.

ROWLEY-CONWY, P. 1987: Animal bones in Mesolithic studies: recent progress and hopes for the future. In: Rowley-Conwy, P. & Zvelebil, H.P. (eds.): *Mesolithic Northwest Europe: Recent Trends*: : 74-81. Department of Archaology and Prehistory, Sheffield.

STOCKER, G. 1985: *Biber (Castor fiber L.) in der Schweiz. Probleme der Wiedereinbürgerung aus biologischer und ökologischer Sicht*. Eidgenössische Anstalt für das forstliche Versuchswesen, Berichte 274, Birmensdorf.

TAGLIACOZZO, A. & CASSOLI, P.F. 1993: Le macrofaune de l'Abri Soman (Val d'Adige-Italie). *Preistoria Alpina* 28: 181-192.

THUN HOHENSTEIN, U.; BERTOLINI, M.; VALVERDE, I.; DALMERI, G. & PEDROTTI, A. 2016: Exploitation of faunal resources at Riparo Gaban (Trento, Italy) during the Late Mesolithic period: preliminary results of archaeozoological and taphonomical analysis. *Preistoria Alpina* 48: 53-62.

TOMÉ, C. & VIGNE, J. D. 2003: Roe deer (*Capreolus capreolus*) age at death estimates: new methods and modern reference data for tooth eruption and wear, and for epiphyseal fusion. *Archaeofauna* 12: 157-173.

WIERER, U. & BOSCATO, P. 2006: Lo sfruttamento delle risorse animali nel sito mesolitico di Galgenbühel-Dos de la Forca, Salorno (BZ): la macrofauna. In: Tecchiati, U. & Sala, B. (eds.): *Studi di archeozoologia: in onore di Alfredo Riedel*: 85-98.

WIERER, U.; BETTI, L.; BOSCATO, P.; BAZZANELLA, M.; BOSCHIN, F.; CREZZINI, J.; GALA, M.; GIROD, A. & TAGLIACOZZO, A. 2018: Vivre près de l'eau. Environnement, économie du milieu humide y techniques de pêche du site mésolithique Galgenbühel/Dos de la Forca dans la vallée de l'Adige (Tyrol du Sud, Italie). In: Cupillard, C.; Séara, F. & Griselin, S. (Dirs.): *Au cœur des sites mésolithiques: Entre processus taphonomiques et données archéologiques, Actes de la table-ronde internationale de Besançon (Doubs, France) « Hommages au Professeur André Thévenin » 29–30 octobre 2013*: 241–257.

MATERIALE SUPPLEMENTARE

		ROMAGNANO Loc III																								
		NEOLITICO			CASTELNOVIANO						SAUVETERRIANO															
		T			AA 1 - 2			AB 1 - 2			AC 1 - 2			AC 3- 5			AC 6			AC 7 - 9			AE-AF			TOTALE	
	TAXA	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NISP	%
Artiodactyla	*Cervus elaphus*	36	62,1%	5	175	40,3%	7	85	20,0%	7	97	30,5%	5	194	24,6%	8	69	17,0%	5	123	23,2%	8	4	3,9%	1	783	25,55%
	Capreolus capreolus	10	17,2%	1	61	14,1%	3	59	13,8%	3	38	11,9%	2	93	11,8%	7	42	10,3%	4	32	6,0%	3	5	4,9%	1	340	11,10%
	Rupicapra rupicapra	4	6,9%	1	46	10,6%	3	36	8,5%	3	31	9,7%	2	65	8,2%	4	47	11,5%	3	41	7,7%	2	4	3,9%	1	274	8,94%
	Sus scrofa	-	-	-	22	5,1%	2	8	1,9%	2	11	3,5%	2	35	4,4%	3	37	9,1%	5	31	5,8%	2	5	4,9%	1	149	4,86%
	Capra ibex	-	-	-	11	2,5%	2	11	2,6%	2	37	11,6%	5	90	11,4%	8	72	17,7%	6	78	14,7%	8	12	11,8%	2	311	10,15%
	totale artiodattili	**50**	**86,2%**	**7**	**315**	**72,6%**	**17**	**199**	**46,7%**	**17**	**214**	**67,3%**	**16**	**477**	**60,5%**	**30**	**267**	**65,6%**	**23**	**305**	**57,4%**	**23**	**30**	**29,4%**	**6**	**1857**	**60,61%**
Rodentia	*Castor fiber*	-	-	-	3	0,7%	1	-	-	-	1	0,3%	1	19	2,4%	3	3	0,7%	1	11	2,1%	1	15	14,7%	4	52	1,70%
	Sciurus vulgaris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,2%	1	-	-	-	1	0,03%
	totale roditori	**-**	**-**	**-**	**3**	**0,7%**	**1**	**-**	**-**	**-**	**1**	**0,3%**	**1**	**19**	**2,4%**	**3**	**3**	**0,7%**	**1**	**12**	**2,3%**	**2**	**15**	**14,7%**	**4**	**53**	**1,73%**
Carnivora	*Ursus arctos*	3	5,2%	1	6	1,4%	2	1	0,2%	1	-	-	0	4	0,5%	1	9	2,2%	1	-	-	-	1	1,0%	1	24	0,78%
	Felis silvestris	-	-	-	3	0,7%	1	1	0,2%	1	5	1,6%	1	-	-	-	-	-	-	1	0,2%	1	-	-	-	10	0,33%
	Lynx lynx	-	-	-	-	-	-	-	-	-	-	-	-	2	0,3%	1	-	-	-	-	-	-	-	-	-	2	0,07%
	Martes foina	-	-	-	1	0,2%	1	-	-	-	-	-	-	-	-	-	1	0%	1	1	0%	1	-	-	-		
	Martes martes	-	-	-	1	0,2%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,03%
	Martes sp.	-	-	-	18	4,1%	2	11	2,6%	1	1	0,3%	1	2	0,3%	1	-	-	-	5	0,9%	1	-	-	-	37	1,21%
	Meles meles	1	2%	1	3	1%	1	1	0%	1	-	-	-	1	0%	1	6	1%	1	1	0%	1	-	-	-	13	0,42%
	Lutra lutra	-	-	-	5	1%		-	-	-	-	-	-	-	-	-				4	1%	1	-	-	-		
	Vulpes vulpes	1	1,7%	1	3	0,7%	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0,2%	1	-	-	-	5	0,16%
	Canis lupus	-	-	-	-	-	-	3	0,7%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0,10%
	Canis sp.	-	-	-	1	0,2%	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0,03%
	totale carnivori	**5**	**8,6%**	**3**	**41**	**9,4%**	**10**	**17**	**4,0%**	**5**	**6**	**1,9%**	**2**	**9**	**1,1%**	**4**	**16**	**3,9%**	**3**	**13**	**2,4%**	**6**	**1**	**1,0%**	**1**	**108**	**3,52%**
Lagomorpha	*Lepus* sp.	1	1,7%	1	1	0,2%	1	-	-	-	-	-	-	1	0,1%	1	-	-	-	-	-	-	-	-	-	3	0,10%
	totale lagomorfi	**1**	**1,7%**	**1**	**1**	**0,2%**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**0,1%**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**0,10%**
Testudines	*Emys orbicularis*	-	-	-	2	0,5%	-	142	33,3%	-	7	2,2%	-	16	2,0%	-	3	0,7%	-	6	1,1%	-	-	-	-	176	5,74%
	totale testudinati	**-**	**-**	**-**	**2**	**0,5%**	**-**	**142**	**33,3%**	**-**	**7**	**2,2%**	**-**	**16**	**2,0%**	**-**	**3**	**0,7%**	**-**	**6**	**1,1%**	**-**	**-**	**-**	**-**	**176**	**5,74%**
Avifauna	*Aves* sp.	-	-	-	14	3,2%	-	4	0,9%	-	-	-	-	5	0,6%	-	2	0,5%	-	2	0,4%	-	2	2,0%	-	29	0,95%
	totale avifauna	**-**	**-**	**-**	**14**	**3,2%**	**-**	**4**	**0,9%**	**-**	**-**	**-**	**-**	**5**	**0,6%**	**-**	**2**	**0,5%**	**-**	**2**	**0,4%**	**-**	**2**	**2,0%**	**-**	**29**	**0,95%**
Pisces	*Pisces* sp.	-	-	-	14	3,2%	-	23	5,4%	-	10	3,1%	-	45	5,7%	-	27	6,6%	-	23	4,3%	-	4	3,9%	-	146	4,8%
	totale pesci	**-**	**-**	**-**	**14**	**3,2%**	**-**	**23**	**5,4%**	**-**	**10**	**3,1%**	**-**	**45**	**5,7%**	**-**	**27**	**6,6%**	**-**	**23**	**4,3%**	**-**	**4**	**3,9%**	**-**	**146**	**4,8%**
	TOTALE DETERMINATI	**56**	**96,6%**	**-**	**390**	**89,9%**	**-**	**385**	**90,4%**	**-**	**238**	**74,8%**	**-**	**572**	**72,6%**	**-**	**318**	**78,1%**	**-**	**361**	**68,0%**	**-**	**52**	**51,0%**	**-**	**2372**	**77,42%**
	TOTALE INDETERMINATI	**2**	**3,4%**	**-**	**44**	**10,1%**	**-**	**41**	**9,6%**	**-**	**80**	**25,2%**	**-**	**216**	**27,4%**	**-**	**89**	**21,9%**	**-**	**170**	**32,0%**	**-**	**50**	**49,0%**	**-**	**692**	**22,58%**
	TOTALE REPERTI	**58**	**100%**	**-**	**434**	**100%**	**-**	**426**	**100%**	**-**	**318**	**100%**	**-**	**788**	**100%**	**-**	**407**	**100%**	**-**	**531**	**100%**	**-**	**102**	**100%**	**-**	**3064**	**100%**

TABELLA 1S

Quantificazione dell'insieme faunistico per taglio di Romagnano loc III. Riportati in tabella il Numero dei Resti (NR), la percentuale basata sulla totalità dei reperti per ogni strato ed il Numero Minimo degli Individui (NMI).

	PRADESTEL																												
	NEOLITICO						CASTELNOVIANO						SAUVETERRIANO																
	taglio A			taglio B			taglio D			taglio E			taglio F			taglio G			taglio H			taglio L (1÷6) - boreale			taglio L (7÷14) - preboreale			TOTALE	
TAXA	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%	NMI	NR	%
Cervus elaphus	21	53,8%	3	5	2,6%	1	162	11,0%	7	215	11,6%	5	274	12,8%	7	102	5,2%	4	62	3,1%	4	108	2,1%	4	13	2,3%	1	962	6,21%
Capreolus capreolus	4	10,3%	1	-	-	-	32	2,2%	2	117	6,3%	5	69	3,2%	3	18	0,9%	2	25	1,2%	4	28	0,5%	3	-	-	-	293	1,89%
Rupicapra rupicapra	3	7,7%	1	-	-	-	17	1,2%	3	14	0,8%	1	17	0,8%	1	36	1,8%	2	30	1,5%	5	22	0,4%	2	4	0,7%	1	143	0,92%
Sus scrofa	-	-	-	1	0,5%	1	6	0,4%	2	9	0,5%	3	30	1,4%	2	16	0,8%	3	14	0,7%	4	65	1,2%	7	-	-	-	141	0,91%
Capra ibex	-	-	-	-	-	-	13	0,9%	1	13	0,7%	2	19	0,9%	2	21	1,1%	2	20	1,0%	6	18	0,3%	3	-	-	-	104	0,67%
totale artiodattili	**28**	**71,8%**	**5**	**6**	**3,2%**	**2**	**230**	**15,6%**	**15**	**368**	**19,9%**	**16**	**409**	**19,1%**	**15**	**193**	**9,8%**	**13**	**151**	**7,4%**	**23**	**241**	**4,6%**	**19**	**17**	**3,0%**	**2**	**1643**	**10,61%**
Castor fiber	2	5,1%	2	-	-	-	80	5,4%	3	57	3,1%	5	71	3,3%	8	31	1,6%	2	40	2,0%	2	196	3,7%	14	6	1,1%	1	483	3,12%
Sciurus vulgaris	-	-	-	-	-	-	3	0,2%	1	-	-	-	-	-	-	-	-	-	2	0,1%	-	-	-	-	-	-	-	5	0,03%
totale roditori	**2**	**5,1%**	**2**	**0**	**-**	**0**	**83**	**5,6%**	**4**	**57**	**3,1%**	**5**	**71**	**3,3%**	**8**	**31**	**1,6%**	**2**	**42**	**2,1%**	**2**	**196**	**3,7%**	**14**	**6**	**1,1%**	**1**	**488**	**3,15%**
Ursus arctos	-	-	-	-	-	-	1	0,1%	1	2	0,1%	1	-	-	-	2	0,1%	1	8	0,4%	1	-	-	-	-	-	-	13	0,08%
Felis silvestris	-	-	-	-	-	-	4	0,3%	1	3	0,2%	1	7	0,3%	1	10	0,5%	1	2	0,1%	-	3	0,1%	1	-	-	-	29	0,19%
Lynx lynx	-	-	-	-	-	-	2	0,1%	1	2	0,1%	1	1	0,0%	1	-	-	-	-	-	-	1	0,0%	1	-	-	-	6	0,04%
Martes martes	-	-	-	-	-	-	1	0,1%	1	10	0,5%	3	3	0,1%	2	1	0,1%	1	-	-	-	3	0,1%	2	-	-	-	18	0,12%
Martes sp.	-	-	-	1	0,5%	1	22	1,5%	3	8	0,4%	1	18	0,8%	3	6	0,3%	1	10	0,5%	1	4	0,1%	1	1	0,2%	1	70	0,45%
Meles meles	-	-	-	-	-	-	9	0,6%	1	13	0,7%	1	14	0,7%	1	3	0,2%	1	4	0,2%	1	4	0,1%	1	-	-	-	47	0,30%
Vulpes vulpes	-	-	-	-	-	-	-	-	-	1	0,1%	1	3	0,1%	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0,03%
Canis lupus	-	-	-	-	-	-	-	-	-	-	-	-	1	0,0%	1	-	-	-	-	-	-	2	0,0%	1	2	0,4%	1	5	0,03%
Canis sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	0,0%	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0,01%
totale carnivori	**0**	**-**	**-**	**1**	**0,5%**	**1**	**39**	**2,7%**	**8**	**39**	**2,1%**	**9**	**48**	**2,2%**	**10**	**22**	**1,1%**	**5**	**24**	**1,2%**	**3**	**17**	**0,3%**	**7**	**3**	**0,5%**	**2**	**193**	**1,25%**
Lepus sp.	-	-	-	1	0,5%	1	-	-	-	-	-	-	1	0,0%	1	1	0,1%	1	-	-	-	-	-	-	-	-	-	3	0,02%
totale lagomorfi	0	-	-	1	0,5%	1	0	-	-	0	-	-	1	0,0%	1	1	0,1%	1	0	-	-	0	-	-	0	-	-	3	0,02%
Emys orbicularis	-	-	-	-	-	-	1	0,1%	-	-	-	-	-	-	-	21	1,1%	-	13	0,6%	-	377	7,2%	-	3	0,5%	-	415	2,68%
totale testudinati	**0**	**-**	**-**	**0**	**-**	**-**	**1**	**0,1%**	**-**	**0**	**-**	**-**	**0**	**-**	**-**	**21**	**1,1%**	**-**	**13**	**0,6%**	**-**	**377**	**7,2%**	**-**	**3**	**0,5%**	**-**	**415**	**2,68%**
Aves sp.	-	-	-	-	-	-	-	-	-	3	0,2%	1	3	0,1%	2	2	0,1%	1	-	-	-	1	0,0%	1	-	-	-	9	0,06%
totale avifauna	**0**	**-**	**-**	**0**	**-**	**-**	**0**	**-**	**-**	**3**	**0,2%**	**1**	**3**	**0,1%**	**2**	**2**	**0,1%**	**1**	**0**	**-**	**-**	**1**	**0,0%**	**1**	**-**	**-**	**-**	**9**	**0,06%**
Pisces sp.	4	10,3%	-	35	18,4%	-	187	12,7%	-	19	1,0%	-	140	6,6%	-	84	4,3%	-	66	3,3%	-	134	2,6%	-	250	44,0%	-	919	5,9%
totale pesci	**4**	**10,3%**	**-**	**35**	**18,4%**	**-**	**187**	**12,7%**	**-**	**19**	**1,0%**	**-**	**140**	**6,6%**	**-**	**84**	**4,3%**	**-**	**66**	**3,3%**	**-**	**134**	**2,6%**	**-**	**250**	**44,0%**	**-**	**919**	**5,9%**
TOTALE DETERMINATI	**34**	**87,2%**	**-**	**43**	**22,6%**	**-**	**540**	**36,7%**	**-**	**486**	**26,3%**	**-**	**672**	**31,4%**	**-**	**354**	**18,1%**	**-**	**296**	**14,6%**	**-**	**966**	**18,5%**	**-**	**279**	**49,1%**	**-**	**3670**	**23,71%**
TOTALE INDETERMINATI	**5**	**12,8%**	**-**	**147**	**77,4%**	**-**	**931**	**63,3%**	**-**	**1364**	**73,7%**	**-**	**1465**	**68,6%**	**-**	**1606**	**81,9%**	**-**	**1734**	**85,4%**	**-**	**4268**	**81,5%**	**-**	**289**	**50,9%**	**-**	**11809**	**76,29%**
TOTALE REPERTI	**39**	**100%**	**-**	**190**	**100%**	**-**	**1471**	**100%**	**-**	**1850**	**100%**	**-**	**2137**	**100%**	**-**	**1960**	**100%**	**-**	**2030**	**100%**	**-**	**5234**	**100%**	**-**	**568**	**100%**	**-**	**15479**	**100%**

TABELLA 2S

Quantificazione dell'insieme faunistico per taglio di Pradestel. Riportati in tabella il Numero dei Resti (NR), la percentuale basata sulla totalità dei reperti per ogni strato ed il Numero Minimo degli Individui (NMI).

		ROMAGNANO Loc III														
		azione cut-marks	frattura osso fresco	lavorato	calpestio	trcce di carnivori	trcce di roditori	concrezione	corrosione	esfoliazione	fluitazione	manganese	radici	weathering	combusto	calcinato
T	indeterminati	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	determinati	2	1	-	1	-	4	12	22	16	-	1	8	25	4	-
	TOTALE	2	1	-	1	-	4	12	22	16	-	1	8	25	4	-
	% NR	5,9%	50,0%	-	-	-	12,9%	2,2%	6,0%	3,0%	-	8,3%	14,8%	3,1%	0,9%	-
AA 1 - 2	indeterminati	-	-	9	-	-	1	11	8	0	-	-	-	15	6	2
	determinati	6	-	1	3	3	3	90	82	1	1	2	16	144	47	10
	TOTALE	6	-	10	3	3	4	101	90	1	1	2	16	159	53	12
	% NR	17,6%	-	26,3%	9,4%	100,0%	12,9%	18,1%	24,4%	0,2%	1,1%	16,7%	29,6%	19,6%	11,4%	16,9%
AB 1 - 2	indeterminati	-	-	6	2	-	-	7	3	4	1	-	1	7	11	2
	determinati	2	-	1	8	-	7	43	61	47	3	-	3	60	95	1
	TOTALE	2	-	7	10	-	7	50	64	51	4	-	4	67	106	3
	% NR	5,9%	-	18,4%	31,3%	-	22,6%	9,0%	17,3%	9,6%	4,5%	-	7,4%	8,3%	22,8%	4,2%
AC 1 - 2	indeterminati	0	-	2	1	-	-	11	5	9	2	-	-	14	11	2
	determinati	4	-	2	2	-	5	63	32	61	21	3	-	74	41	4
	TOTALE	4	-	4	3	-	5	74	37	70	23	3	-	88	52	6
	% NR	11,8%	-	10,5%	9,4%	-	16,1%	13,3%	10,0%	13,1%	26,1%	25,0%	-	10,9%	11,2%	8,5%
AC 3- 5	indeterminati	1	-	8	3	-	1	126	16	33	7	-	5	58	34	4
	determinati	6	1	1	7	-	7	32	67	157	28	1	12	172	87	6
	TOTALE	7	1	9	10	-	8	158	83	190	35	1	17	230	121	10
	% NR	20,6%	50,0%	23,7%	31,3%	-	25,8%	28,3%	22,5%	35,6%	39,8%	8,3%	31,5%	28,4%	26,0%	14,1%
AC 6	indeterminati	1	-	-	1	-	-	8	3	7	1	-	-	13	13	2
	determinati	6	-	3	3	-	1	60	40	87	9	5	6	92	27	3
	TOTALE	7	-	3	4	-	1	68	43	94	10	5	6	105	40	5
	% NR	20,6%	-	7,9%	12,5%	-	3,2%	12,2%	11,7%	17,6%	11,4%	41,7%	11,1%	13,0%	8,6%	7,0%
AC 7 - 9	indeterminati	-	-	5	-	-	-	12	6	13	2	-	1	29	25	10
	determinati	6	-	-	1	-	2	75	21	92	10	-	2	101	53	21
	TOTALE	6	-	5	1	-	2	87	27	105	12	-	3	130	78	31
	% NR	17,6%	-	13,2%	3,1%	-	6,5%	15,6%	7,3%	19,7%	13,6%	-	5,6%	16,0%	16,8%	43,7%
AE-AF	indeterminati	-	-	-	-	-	-	2	-	1	-	-	-	1	2	1
	determinati	-	-	-	-	-	-	6	3	5	3	-	-	5	9	3
	TOTALE	-	-	-	-	-	-	8	3	6	3	-	-	6	11	4
	% NR	-	-	-	-	-	-	1,4%	0,8%	1,1%	3,4%	-	-	0,7%	2,4%	5,6%
	TOTALE	34	2	38	32	3	31	558	369	533	88	12	54	810	465	71

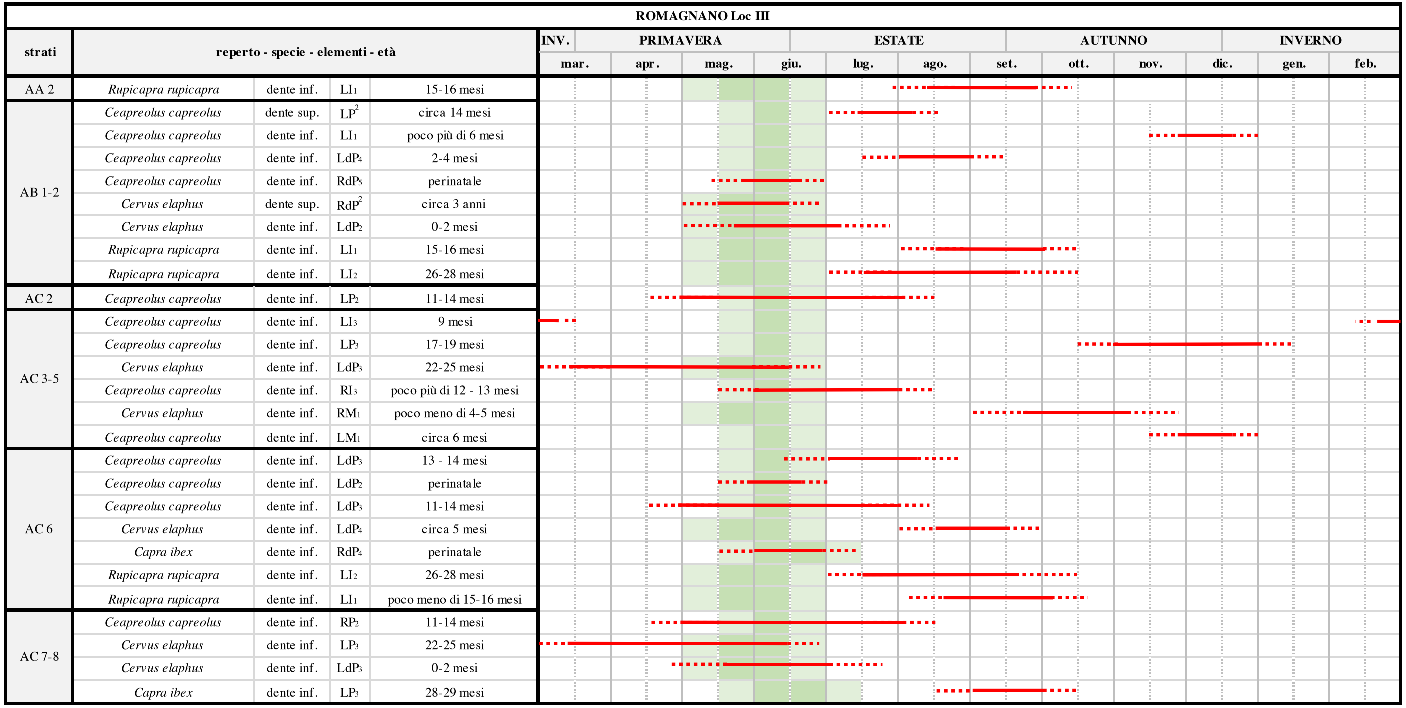
TABELLA 3S

Numero di Resti dal sito di Romagnano Loc III, suddivisi per strato, sui quale sono state riscontrate: tracce dovute a moficiazione antropica, alterazioni dovute a modificazione naturale, combustione e calcinazione. I resti sono stati suddivisi anche per determinazione a livello di specie (determinati o indeterminati).

		PRADESTEL																		
		azione cut-marks	flacking	estazione midollo	raschiatura	frattura osso fresco	lavorato	calpestio	trcce di carnivori	trcce di roditori	concrezione	corrosione	esfoliazione	fluitazione	manganese	radici	macchie da radici	weathering	combusto	calcinato
A	indeterminati	-	-	-	-	-	1	-	-	-	2	2	2	-	-	-	-	3	-	-
	determinati	-	-	-	-	1	-	-	-	4	8	11	12	-	1	-	-	16	-	-
	TOTALE	-	-	-	-	1	1	-	-	4	10	13	14	-	1	-	-	19	-	-
	% NR	-	-	-	-	25,0%	4,3%	-	-	1,6%	0,6%	0,6%	0,4%	-	50,0%	-	-	0,3%	-	-
B	indeterminati	-	-	-	-	-	0	-	-	1	-	1	10	-	-	-	-	5	45	3
	determinati	-	-	-	-	-	1	-	-	-	2	2	2	-	-	-	1	2	2	2
	TOTALE	-	-	-	-	-	1	-	-	1	2	3	12	-	-	-	1	7	47	5
	% NR	-	-	-	-	-	4,3%	-	-	0,4%	0,1%	0,1%	0,3%	-	-	-	0,2%	0,1%	1,3%	0,6%
D	indeterminati	13	-	-	-	-	-	20	3	14	224	535	325	-	1	-	217	506	71	25
	determinati	15	-	-	-	1	1	14	3	31	89	141	77	3	-	-	54	190	8	1
	TOTALE	28	-	-	-	1	1	34	6	45	313	676	402	3	1	-	271	696	79	26
	% NR	32,2%	-	-	-	25,0%	4,3%	38,6%	37,5%	17,0%	17,7%	37,7%	10,8%	37,5%	50,0%	-	62,7%	11,5%	2,1%	3,0%
E	indeterminati	1	-	-	-	-	2	3	-	24	165	187	379	1	-	-	55	558	402	155
	determinati	18	-	-	-	-	4	10	1	81	122	170	177	-	-	5	37	261	28	2
	TOTALE	19	-	-	-	-	6	13	1	105	287	357	556	1	-	5	92	819	430	157
	% NR	22,4%	-	-	-	-	26,1%	14,8%	6,3%	39,8%	16,2%	19,9%	14,9%	12,5%	-	29,4%	21,3%	13,5%	11,6%	18,1%
F	indeterminati	6	-	-	-	-	2	10	2	20	77	124	385	-	-	1	17	401	683	85
	determinati	11	-	-	-	-	6	11	4	50	75	78	164	1	-	4	15	270	83	9
	TOTALE	17	-	-	-	-	8	21	6	70	152	202	549	1	-	5	32	671	766	94
	% NR	20,0%	-	-	-	-	34,8%	21,0%	37,5%	25,8%	7,5%	9,7%	11,0%	11,1%	-	29,4%	7,0%	9,5%	20,7%	10,8%
G	indeterminati	-	-	-	-	-	3	2	1	3	19	51	232	-	-	2	19	589	572	74
	determinati	1	-	1	1	1	-	1	-	13	19	41	120	-	-	1	10	155	53	2
	TOTALE	1	-	1	1	1	3	3	1	16	38	92	352	-	-	3	29	744	625	76
	% NR	1,2%	-	50,0%	33,3%	25,0%	13,0%	3,0%	6,3%	5,9%	1,9%	4,4%	7,1%	-	-	17,6%	6,3%	10,5%	16,9%	8,8%
H	indeterminati	4	-	-	1	-	-	13	-	8	146	132	904	-	-	-	16	948	459	141
	determinati	2	1	-	-	1	-	6	1	10	27	28	63	-	-	-	4	110	19	4
	TOTALE	6	1	-	1	1	-	19	1	18	173	160	967	-	-	-	20	1058	478	145
	% NR	7,1%	100,0%	-	33,3%	25,0%	-	19,0%	6,3%	6,6%	8,6%	7,6%	19,4%	-	-	-	4,4%	15,0%	12,9%	16,7%
strato L - boreale	indeterminati	13	-	-	-	-	3	4	-	1	895	501	1951	3	-	1	1	2580	989	273
	determinati	3	-	1	1	-	-	6	1	10	76	74	163	1	-	3	10	288	189	69
	TOTALE	16	-	1	1	-	3	10	1	11	971	575	2114	4	-	4	11	2868	1178	342
	% NR	18,4%	-	50,0%	33,3%	-	13,0%	10,0%	6,3%	4,1%	48,0%	27,5%	42,4%	44,4%	-	23,5%	2,4%	40,6%	31,8%	39,4%
strato L - preboreale	indeterminati	-	-	-	-	-	-	-	-	-	70	12	12	-	-	-	-	163	89	21
	determinati	-	-	-	-	-	-	-	-	1	5	3	7	-	-	-	2	12	10	1
	TOTALE	-	-	-	-	-	-	-	-	1	75	15	19	-	-	-	2	175	99	22
	% NR	-	-	-	-	-	-	-	-	0,4%	3,7%	0,7%	0,4%	-	-	-	0,4%	2,5%	2,7%	2,5%
	TOTALE	87	1	2	3	4	23	100	16	271	2021	2093	4985	9	2	17	458	7057	3702	867

TABELLA 4S

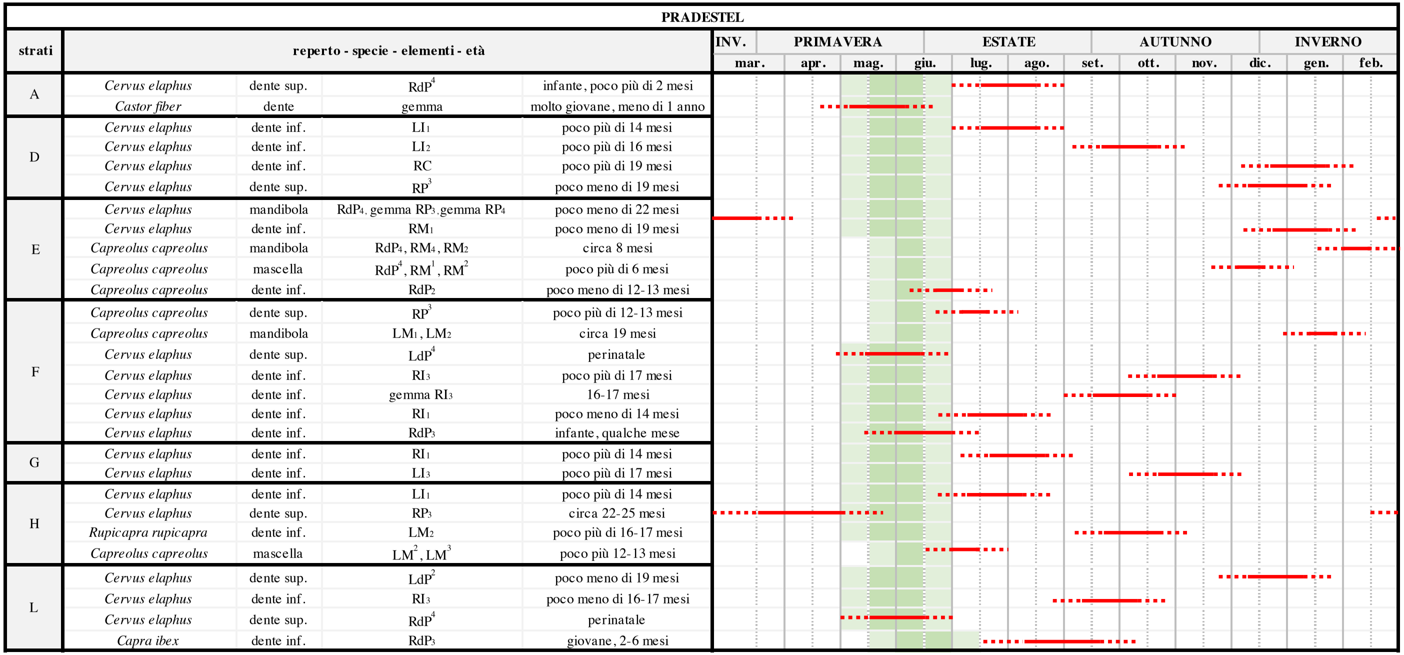
Numero di Resti dal sito di Pradestel, suddivisi per strato, sui quale sono state riscontrate: tracce dovute a moficiazione antropica, alterazioni dovute a modificazione naturale, combustione e calcinazione. I resti sono stati suddivisi anche per determinazione a livello di specie (determinati o indeterminati).



strati	reperto - specie - elementi - età			
AA 2	*Rupicapra rupicapra*	dente inf.	LI$_1$	15-16 mesi
AB 1-2	*Ceapreolus capreolus*	dente sup.	LP^2	circa 14 mesi
	Ceapreolus capreolus	dente inf.	LI$_1$	poco più di 6 mesi
	Ceapreolus capreolus	dente inf.	LdP$_4$	2-4 mesi
	Ceapreolus capreolus	dente inf.	RdP$_3$	perinatale
	Cervus elaphus	dente sup.	RdP^2	circa 3 anni
	Cervus elaphus	dente inf.	LdP$_2$	0-2 mesi
	Rupicapra rupicapra	dente inf.	LI$_1$	15-16 mesi
	Rupicapra rupicapra	dente inf.	LI$_2$	26-28 mesi
AC 2	*Ceapreolus capreolus*	dente inf.	LP$_2$	11-14 mesi
AC 3-5	*Ceapreolus capreolus*	dente inf.	LI$_3$	9 mesi
	Ceapreolus capreolus	dente inf.	LP$_3$	17-19 mesi
	Cervus elaphus	dente inf.	LdP$_3$	22-25 mesi
	Ceapreolus capreolus	dente inf.	RI$_3$	poco più di 12 - 13 mesi
	Cervus elaphus	dente inf.	RM$_1$	poco meno di 4-5 mesi
	Ceapreolus capreolus	dente inf.	LM$_1$	circa 6 mesi
AC 6	*Ceapreolus capreolus*	dente inf.	LdP$_3$	13 - 14 mesi
	Ceapreolus capreolus	dente inf.	LdP$_2$	perinatale
	Ceapreolus capreolus	dente inf.	LdP$_3$	11-14 mesi
	Cervus elaphus	dente inf.	LdP$_4$	circa 5 mesi
	Capra ibex	dente inf.	RdP$_4$	perinatale
	Rupicapra rupicapra	dente inf.	LI$_2$	26-28 mesi
	Rupicapra rupicapra	dente inf.	LI$_1$	poco meno di 15-16 mesi
AC 7-8	*Ceapreolus capreolus*	dente inf.	RP$_2$	11-14 mesi
	Cervus elaphus	dente inf.	LP$_3$	22-25 mesi
	Cervus elaphus	dente inf.	LdP$_3$	0-2 mesi
	Capra ibex	dente inf.	LP$_3$	28-29 mesi

TABELLA 5S

Frequenza stagionale del sito di Riparo Romagnano loc III. In verde sono indicati i periodi di nascita delle specie basandosi sui dati attuali (Mustoni et al., 2005): in verde scuro sono indicati i periodi in cui le nacite sono più probabili, in verde chiaro i periodi con probabilità di nascita più bassa. Le righe rosse rappresentano i periodi di decesso degli animali basati sui range desunti sallo studio dell'eruzione dentaria (il tratteggio rappresenta una minore probabilità di decesso). le lettere maiuscole *L* e *R*, poste davanti alla sigla dei denti indicano la lateralità, *left* e *right* mentre la *d* è indicativa di un dente deciduo.



PRADESTEL

strati	reperto - specie - elementi - età			
A	*Cervus elaphus*	dente sup.	RdP^4	infante, poco più di 2 mesi
	Castor fiber	dente	gemma	molto giovane, meno di 1 anno
D	*Cervus elaphus*	dente inf.	LI$_1$	poco più di 14 mesi
	Cervus elaphus	dente inf.	LI$_2$	poco più di 16 mesi
	Cervus elaphus	dente inf.	RC	poco più di 19 mesi
	Cervus elaphus	dente sup.	RP^3	poco meno di 19 mesi
E	*Cervus elaphus*	mandibola	RdP$_4$, gemma RP$_3$, gemma RP$_4$	poco meno di 22 mesi
	Cervus elaphus	dente inf.	RM$_1$	poco meno di 19 mesi
	Capreolus capreolus	mandibola	RdP$_4$, RM$_4$, RM$_2$	circa 8 mesi
	Capreolus capreolus	mascella	RdP^4, RM^1, RM^2	poco più di 6 mesi
	Capreolus capreolus	dente inf.	RdP$_2$	poco meno di 12-13 mesi
F	*Capreolus capreolus*	dente sup.	RP^3	poco più di 12-13 mesi
	Capreolus capreolus	mandibola	LM$_1$, LM$_2$	circa 19 mesi
	Cervus elaphus	dente sup.	LdP^4	perinatale
	Cervus elaphus	dente inf.	RI$_3$	poco più di 17 mesi
	Cervus elaphus	dente inf.	gemma RI$_3$	16-17 mesi
	Cervus elaphus	dente inf.	RI$_1$	poco meno di 14 mesi
	Cervus elaphus	dente inf.	RdP$_3$	infante, qualche mese
G	*Cervus elaphus*	dente inf.	RI$_1$	poco più di 14 mesi
	Cervus elaphus	dente inf.	LI$_3$	poco più di 17 mesi
H	*Cervus elaphus*	dente inf.	LI$_1$	poco più di 14 mesi
	Cervus elaphus	dente sup.	RP$_3$	circa 22-25 mesi
	Rupicapra rupicapra	dente inf.	LM$_2$	poco più di 16-17 mesi
	Capreolus capreolus	mascella	LM^2, LM^3	poco più 12-13 mesi
L	*Cervus elaphus*	dente sup.	LdP^2	poco meno di 19 mesi
	Cervus elaphus	dente inf.	RI$_3$	poco meno di 16-17 mesi
	Cervus elaphus	dente sup.	RdP^4	perinatale
	Capra ibex	dente inf.	RdP$_3$	giovane, 2-6 mesi

TABELLA 6S

Frequenza stagionale del sito di Riparo Pradestel. In verde sono indicati i periodi di nascita delle specie basandosi sui dati attuali (Mustoni et al., 2005): in verde scuro sono indicati i periodi in cui le nacite sono più probabili, in verde chiaro i periodi con probabilità di nascita più bassa. Le righe rosse rappresentano i periodi di decesso degli animali basati sui range desunti sallo studio dell'eruzione dentaria (il tratteggio rappresenta una minore probabilità di decesso). le lettere maiuscole *L* e *R*, poste davanti alla sigla dei denti indicano la lateralità, *left* e *right* mentre la *d* è indicativa di un dente deciduo.

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Vallese-Oppeano 4C: archaeozoological analysis of an Early Bronze Age pile-dwelling site in the Veronese Po Plain

Vallese di Oppeano 4C: analisi archeozoologica dell'insieme faunistico proveniente da un abitato palafitticolo dell'antica Età del Bronzo nella pianura veronese

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ABSTRACT: This study presents the results of the archaeozoological analysis carried out on faunal material from the site of Vallese-Oppeano 4C, a pile-dwelling settlement discovered during a preventive excavation conducted by the former Superintendency for Archaeological Heritage of Veneto, between 2014 and 2015, in Vallese di Oppeano (Verona, Italy). The site was occupied during the Early Bronze Age. This chronology is confirmed by anthropic material (pots and sherds) preserved in a waterlogged environment and associated with wooden structures and dump piles containing also animal remains. The faunal assemblage is mainly composed of domestic taxa than wild animals. Pigs are the most represented taxon, followed by sheep, goats and cattle. The presence of dogs is also documented. Wild animals identified include red deer, roe deer, wild boar and a rare attestation of auroch. Among carnivores few remains of wolf, fox, badger and otter are present. Beavers, birds and pond turtles are also scarce. Furthermore, artefacts in animal hard tissues were recovered, including some pointed tools made mainly from the ulnae of different-sized ungulates.

KEYWORDS: PILE-DWELLING, EARLY BRONZE AGE, NORTH-EASTERN ITALY, HUSBANDRY, HUNTING

RIASSUNTO: Il presente contributo fornisce i risultati preliminari dell'analisi archeozoologica condotta sul materiale faunistico proveniente dal sito di Vallese di Oppeano 4C, insediamento di tipo palafitticolo venuto alla luce durante gli scavi d'archeologia preventiva condotti tra 2014 e 2015 a Vallese di Oppeano, nella valle del Bussè, dalla ex Soprintendenza per i Beni Archeologici del Veneto (oggi SABAP Verona, Rovigo, Vicenza). L'occupazione del sito è riferibile al Bronzo antico ed è testimoniata dalla conservazione in ambiente umido di strutture d'abitato in legno, associate a cumuli di scarico contenenti materiale antropico e resti di pasto. La fauna risulta composta principalmente da animali domestici ed in piccola parte da selvatici. Il taxon maggiormente rappresentato è quello dei suini sia per numero dei resti che sulla base del NMI, mentre seguono caprovini e bovini; inoltre è presente il cane. Tra gli animali selvatici il più cacciato è il cervo, seguito da capriolo e cinghiale, mentre si segnala una rara attestazione di uro. Seppur sporadici, sono anche presenti lupo, volpe, tasso, lontra, castoro, qualche resto d'avifauna e di testuggine palustre. Infine, è attestata la produzione di manufatti in materia dura animale, tra cui alcuni punteruoli in osso ricavati soprattutto da ulne di ungulati di diversa taglia.

PAROLA CHIAVE: SITO PALAFITTICOLO, ANTICA ETÀ DEL BRONZO, ITALIA NORD-ORIENTALE, ALLEVAMENTO, CACCIA

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RESUMEN: Este estudio presenta los resultados del análisis arqueológico realizado sobre el material faunístico del sitio de Vallese-Oppeano 4C, un asentamiento de palafitos descubierto durante una excavación preventiva realizada por la antigua Superintendencia del Patrimonio Arqueológico del Véneto, entre 2014 y 2015, en Vallese di Oppeano (Verona, Italia). El sitio fue ocupado durante la Temprana Edad del Bronce. Esta cronología está confirmada por el material antrópico (vasijas y tiestos conservados en un ambiente anegado y asociado con estructuras de madera y vertederos que contienen también restos de animals. Los cerdos son el taxón más frecuente, seguido por las ovejas, las cabras y el ganado vacuno. También se documenta la presencia de perros. Los animales salvajes incluyen ciervos, corzos, jabalíes así como un registro de uro. Entre los carnívoros constan excasos restos de lobo, zorro, tejón y nutria. Los castores, las aves y los galápagos son también son escasos. Por último, se recuperaron artefactos óseos que incluyen herramientas puntiagudas hechas principalmente con ulnas de ungulados de diferentes tamaños.

PALABRAS CLAVE: POBLADO DE PALAFITOS, TEMPRANA EDAD DEL BRONCE, ITALIA NOR-ORIENTAL, GANADERÍA, CAZA

INTRODUCTION

An important point of reference for the study of the Bronze Age in Italy is represented by the work carried out by Alfredo Riedel in the Veronese plain in the second half of the 20th century. In the last years the discovery of numerous sites, especially in northern Italy, has allowed for broadening knowledge about the subsistence strategies adopted by human groups in this area (Bertolini *et al*., 2015a, 2015b, 2021; Bietti Sestieri *et al*., 2015; De Bandi, 2021; De Grossi Mazzorin, 2015, 2019). The archaeological record shows that from the Early Bronze Age settlements become more stable, adopting economic strategies strongly based on agriculture and animal breeding; the role of hunting in meat recovery seems instead to be strongly reduced (Riedel, 1996). The archaeozoological data available for the Early Bronze Age are still limited in the area between the high and medium Veronese plain. In this scenario the site of Vallese-Oppeano 4C has been recently added (Figure 1). In the Bussè plain (Vallese di Oppeano, Verona), not far from the already known Feniletto Late Bronze Age pile dwelling, during a preventive excavation conducted by the former Superintendency for Archaeological Heritage of Veneto, between 2014 and 2015, following the construction of the Zimella-Cervignano D'Adda pipeline, two new settlements were discovered: site 4C, to the east, dating to the Early Bronze Age, and site 4D, on the west, dating to the Middle Bronze Age, separated by a meter thick sandy-silty grey alluvial layer, deriving from the overbank flow of the river Adige. The site of Vallese-Oppeano 4C represents a complex pile-dwelling palimpsest of considerable extension. Wooden structures were recovered into a waterlogged environment, associated with dump piles containing anthropic material and animal remains. In particular, this study focuses on faunal remains from a small sector of the settlement, with an area of 5 m x 10 m (Figure 1c), discovered in 2015 south of the main excavation (2014). In this small investigated area, an alternating sequence in the use of space can be recognised: after one hut of the village was destroyed by fire (phase I), the same area was initially used for dumping waste materials from neighbouring dwellings (phase II) and subsequently reorganised with wooden structures (phase III), perhaps indicating a preparation (in Italian *bonifica*), and was finally abandoned after alluvial events (phase IV) (Gonzato *et al.,* 2021). Although chronological attribution of the individual phases is still being developed, the preliminary comparison of the ceramic materials with the sites of Lucone di Polpenazze (Baioni *et al*., 2021), Lavagnone (Rapi, 2002) as well as the dendrochronological dating of the charred wooden elements from the collapsed hut to a period immediately after 1989-88 ± 10 cal BC (Martinelli, 2022), make Vallese-Oppeano 4C the oldest pile-dwelling site in the Veronese plain. Overall, the site is related to an advanced phase of the Early Bronze Age.

MATERIALS AND METHODS

The faunal assemblage object of this preliminary study comes from the small area of site 4C that showed evidence of a hut destroyed by the fire.

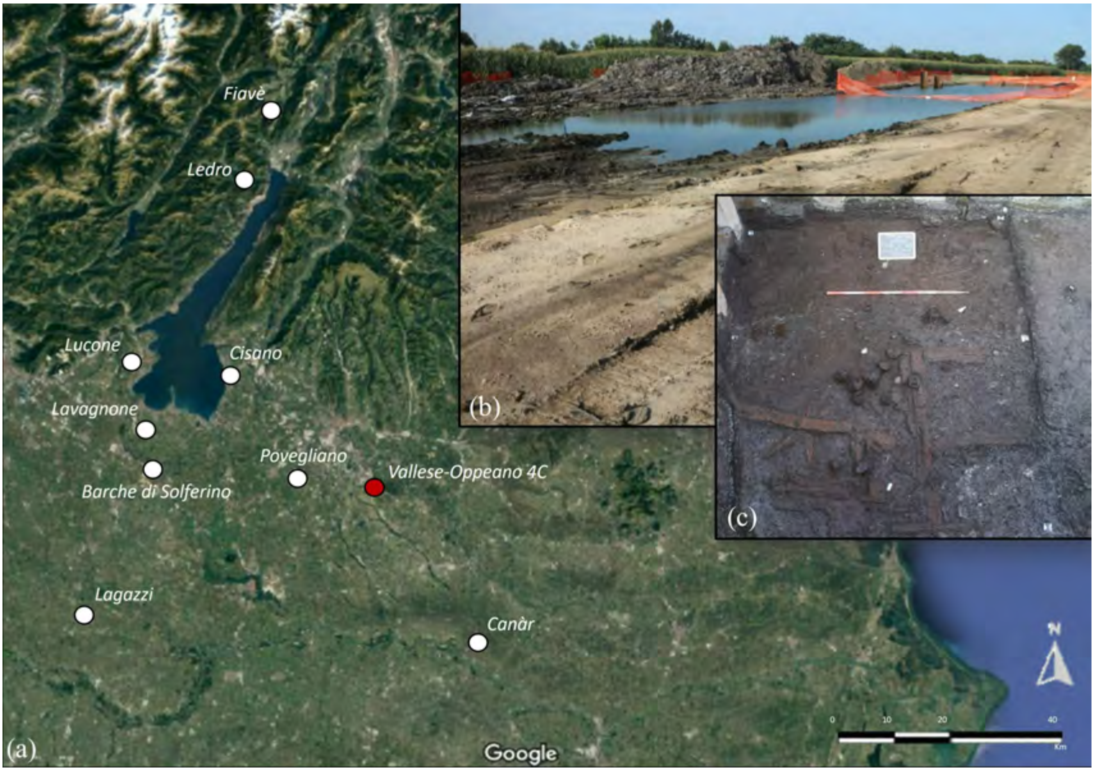

FIGURE 1

Vallese-Oppeano 4C. Localization of the site in the Po Plain (a), Overview of the excavated area (b) and the pile dwelling (c). Courtesy of the SABAP of Vicenza, Verona and Rovigo.

Overall, thanks to the wet conditions of the deposit, the faunal remains show good integrity and the bone surfaces are well preserved. Taxonomic identifications were carried out using the reference collections of the Laboratory of Archaeozoology and Taphonomy (LAT) and of the Large Vertebrates of the Department of Humanities, University of Ferrara. Anatomy atlases (Schmidt, 1972; Barone, 1980) were employed for skeletal and anatomical nomenclatures, and the measurements (in millimetres) were taken according to the criteria established by Driesch (1976). The distinction between sheep and goat was made according to the criteria proposed by Zeder & Lapham (2010) and Zeder & Pilaar (2010), while size was considered for the distinction between pig and boar (Rowley-Conwy *et al*., 2012) and between cattle and aurochs (Wright, 2013). Sheep and goat elements lacking discriminative morphological features were classified as *Capra* vel *Ovis*. When no uniquely diagnostic characters were present to distinguish a domestic taxon from its wild relative, the remains were included in the categories *Sus* sp. and *Bos* sp. Regarding the remains that were not identifiable at the species or genus level due to the lack of diagnostic morphological elements, e.g. vertebrae and ribs, the following taxonomic levels were used: cfr. *Sus* sp., small- and medium-sized Canidae, medium- and large-sized Cervidae and Bovidae. Unidentified remains were classified considering the morphology of the bones (long, flat and articulated/compact bones) related, whenever possible, to the size of the animals. NR (Number of Remains), NISP (Number of Identified Specimens), MNE (Minimum Number of Elements), MNI (Minimum Number of Individuals) and MAU (Minimum Animal Units) (Lyman, 1994a) are the indices used to quantify the identified elements. Since it was not possible to recognize a precise chronological attribution for each US to the different utilization phases of the area, in this preliminary work we decided to treat the faunal sample in a unified way for the estimation of the MNI. Teeth eruption degree, dental wear and stage of bones epiphysis fusion were used to assess the age at death of domestic mammals (Silver, 1969; Payne, 1973; Grant, 1982), while for wild mammals, the criteria of Mariezkurrena (1983) and Tomé & Vigne (2003) were applied to red deer and roe deer, respectively. In order to distinguish taphonomic modifications, microscopic analyses of bone surfaces were carried out using a Leica S6D Greenough stereomicroscope with a 0.75-70X magnification range, also employed for capturing images. Edaphic modifications were distinguished from anthropic marks according to the criteria established by Behrensmeyer (1978), Binford (1981), Lyman (1994b) and Fernández-Jalvo & Andrews (2016). The terminology proposed by Camps-Fabrer *et al*. (1990) was adopted for the hard animal material tools and the criteria established by Camps-Fabrer & Stordeur (1979) were followed for their orientation.

RESULTS AND DISCUSSION

Faunal assemblage

The analysed sample consists of 1,236 faunal remains. Identification at different taxonomic levels was possible for 1,004 finds, representing 81.2% of the bone assemblage, while the remaining percentage is represented by unidentified elements, which were related to the size of the animals whenever possible. Concerning the integrity of the finds identified, only 7% are complete elements, while incomplete elements (including diaphyses with at least one whole epiphysis for more than half) account for 46% and fragments for 47% of the assemblage. All identified skeletal elements belong to both the axial and appendicular skeletons, showing a clear prevalence of mandibles. Almost entirely mammals are documented in the faunal composition (Table 1), although birds (not yet identified at the species level) and pond turtles are also present in a small percentage. Among the identified elements, domestic mammal remains (379) prevail over those of wild mammals (139), while the remaining finds were classified at genus or family level for the lack of diagnostic anatomical morphologies. If we considered only the remains identified at species level, the percentages of domestic and wild mammals would be 83% and 17% respectively. Therefore, the most represented mammal taxon is the pig (*Sus domesticus*) with 34.3%. Sheep (*Ovis aries*) and goat (*Capra hircus*) count overall 24.4%, while cattle (*Bos taurus*) are 21.1%. The presence of dog (*Canis familiaris*) is attested with 3.5%. Concerning wild animals, red deer (*Cervus elaphus*) dominates the assemblage (10.8%), followed by roe deer (*Capreolus capreolus*) with 2.2%; to avoid overestimation of these two species, their shed-antlers were computed separately from the counting of wild mammals. Wild boar (*Sus scrofa*) is also present with 1.5%. Auroch (*Bos primigenius*) is attested by only one remain (0.2%), a large-size astragalus (GLl = 83). Among carnivores, wolf (0.2%), fox (0.2%), badger (0.4%) and otter (0.4%) are present. Among rodents, beaver (*Castor fiber*) reaches instead 0.7%. Only three remains belong to a large-sized bird of prey, while the pond turtle (*Emys orbicularis*) is represented by a few plastron fragments.

Domestic fauna exploitation

Considering only the relative proportions of the economically most important domestic taxa, pigs prevail with 43%, followed by sheep and goats (30.6%) and cattle (26.4%). Pig is represented by 14 individuals, including 3 juveniles, 6 sub-adults and 5 adults, based on the presence of erupting and worn permanent lower teeth (M_3) and scapulae with non-fused distal epiphysis. As shown by the mortality curve (Figure 2), 21% of the individuals were slaughtered within the first year of life, 43% within 22 months, and the remaining 36% passed their second year. Regarding the management of caprovines, a total of 11 individuals were estimated, of which 1 goat and 4 sheep were recognised. Based on the presence of deciduous (dp_4) and lower permanent teeth (P_4), there are at least 2 juveniles, 6 sub-adults and 3 adults. It was estimated that 18% of the individuals were killed within 6-12 months and 55% within 12-24 months, likely to obtain tender and higher-quality meat respectively. Furthermore, 27% of individuals killed within 48-72 months could instead indicate the exploitation of caprovines for milk production and wool supply. Lastly, cattle are represented by 6 individuals, distributed over 2 just young, 2 sub-adults and 2 adults, based on the presence of deciduous (dp_3) and lower permanent teeth (P_3). The mortality curve shows that 16% of individuals are slaughtered within 18-24 months, indicating the possibility of obtaining higher-quality meat. The contemporary presence of young individuals

Taxa	NISP	%NISP	%domestic / wild mammal species	%domestic		MNI	%MNI	MNE	MAU
Canis familiaris	16	1.6%	3.5%	4.2%		3	5.9%	5	2.5
Sus domesticus	156	15.5%	34.3%	4.01%	43.0%	14	27.5%	16	8
Bos taurus	96	9.6%	21.1%	25.3%	26.4%	6	11.8%	8	4
Capra hircus	9	0.9%	2.0%	2.4%	2.5%	1	2.0%	2	1
Ovis aries	14	1.4%	3.1%	3.7%	3.9%	4	7.8%	4	2
Capra vel *Ovis*	88	8.8%	19.3%	23.2%	24.2%	6	11.8%	11	5.5
Total domestic mammals	**379**	**38%**	**83%**	**100%**	**100%**	**34**	**66.7%**		
Castor fiber	3	0.3%	0.7%			1	2.0%	1	0.5
Lutra lutra	2	0.2%	0.4%			1	2.0%	1	0.5
Meles meles	2	0.2%	0.4%			1	2.0%	1	0.5
Cfr. *Canis lupus*	1	0.1%	0.2%			1	2.0%	1	1
Vulpes vulpes	1	0.1%	0.2%			1	2.0%	1	0.5
Sus scrofa	7	0.7%	1.5%			1	2.0%	1	0.5
Bos primigenius	1	0.1%	0.2%			1	2.0%	1	0.5
Cervus elaphus	49	4.9%	10.8%			4	7.8%	5	2.5
Capreolus capreolus	10	1.0%	2.2%			3	5.9%	2	1
Cervidae large size	51	5.1%							
Cervidae medium size	12	1.2%							
Total wild mammals	**139**	**14%**	**17%**			**14**	**27.5%**		
Canidae medium size	2	0.2%							
Canidae small size	1	0.1%							
Sus sp.	46	4.6%							
Cfr. *Sus* sp.	170	16.9%							
Bos sp.	28	2.8%							
Bovidae large size	104	10.4%							
Bovidae medium size	127	12.6%							
Aves	3	0.3%				1	2.0%	1	0.5
Emys orbicularis	5	0.5%				2	3.9%	2	2.0
Total identified	**1004**	**100%**	**100%**			**51**	**100%**		
Large-medium size mammals	6								
Medium size mammals	11								
Medium-small size mammals	11								
Small size mammals	2								
Total	**1,034**								
Unidentified	202								
Total faunal remains	**1,236**								

TABLE 1

Vallese-Oppeano 4C. Composition of the fauna assemblage.

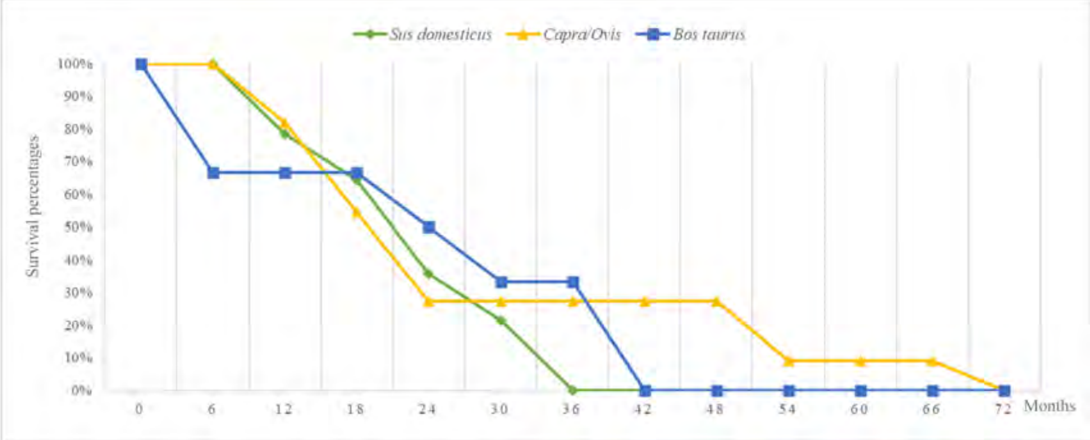

FIGURE 2

Vallese-Oppeano 4C. Mortality profiles of the domestic taxa.

slaughtered within 5-6 months from birth (33%) and adults older than 3 years (33%) could be related to the recovery of secondary products, such as milk. Regarding the distribution of the anatomical elements of these domestic species, both parts of the skull and parts of the appendicular skeleton are present (Figure 3); the elements of the axial skeleton (identified only at the taxonomic level of family), however, consist mainly of ribs rather than vertebrae. More precisely, the estimation of the skeletal survival index (MNE/eNE) (Supplementary Figure S1) shows that the most represented anatomical elements are portions of maxilla with M^2 (0.57) and mandible with M_3 (0.46) for pig, humerus (0.92), tibia (0.92) and portions of mandible with dP_4 (0.45) for goat and sheep, while astragalus (0.67), scapula (0.42) and radius (0.42) for cattle. According to these results, the estimation of MAU vs. MNI suggests that more than half of the pig, caprovine and cattle carcasses were slaughtered on-site. In contrast, the low representation of the femur for goats and cattle and the high fragmentation of the same element for pigs could indicate a selection and an off-site slaughter of this portion of the hind limb. Compared to the previously described domestic animal, the dog is represented by 3 individuals based on 3 right mandibles. Considering the age at death, estimated on the basis of a maxilla with erupting permanent premolars and a radius with both epiphyses fused, 1 sub-adult within 5-6 months and 1 adult older than 12 months have been recognised. The few remains attributed to this taxon consist mainly of mandibles, skull and forelimb bones.

Wild fauna exploitation

Hunting represents a secondary resource in the site's economy, but still plays a modest role in the food supply. Red deer and roe deer represent the most hunted species, with 4 individuals for the former and 3 for the latter. Considering their age at death, estimated on the basis of 1 unworn upper deciduous tooth (dp^4) and 3 humeri with fused distal epiphysis, 1 young and 3 adult red deer individuals have been recognized, while at least 1 juvenile (< 5 months) and 2 adult roe deers were estimated, based on the presence of 1 coxal with unfused acetabulum and 2 mandibles (M_3) with different extent of wearing. Regarding the distribution of the anatomical elements of these two cervid species, parts of the skull and the appendicular skeleton are present. Forelimb elements (mainly metacarpus and humerus) are the most represented for red deer, conversely, the hind limb (mainly tibia and femur) is more represented for roe deer. Elements belonging to the axial skeleton are almost completely absent for roe deer, whereas vertebrae and ribs determined as large-size Cervidae can be associated with red deer. The presence of unshed antlers and skulls of both cervids agrees with the results of the comparison between MAU and MNI, suggesting a complete carcass transport within the settlement for more than half of the red deer individuals and one-third of the roe deer ones. Some hypotheses on the seasonality of cervid hunting are also possible to be formulated. If we accept a standard birth at the end of May or in June, the presence on the base of the stratig-

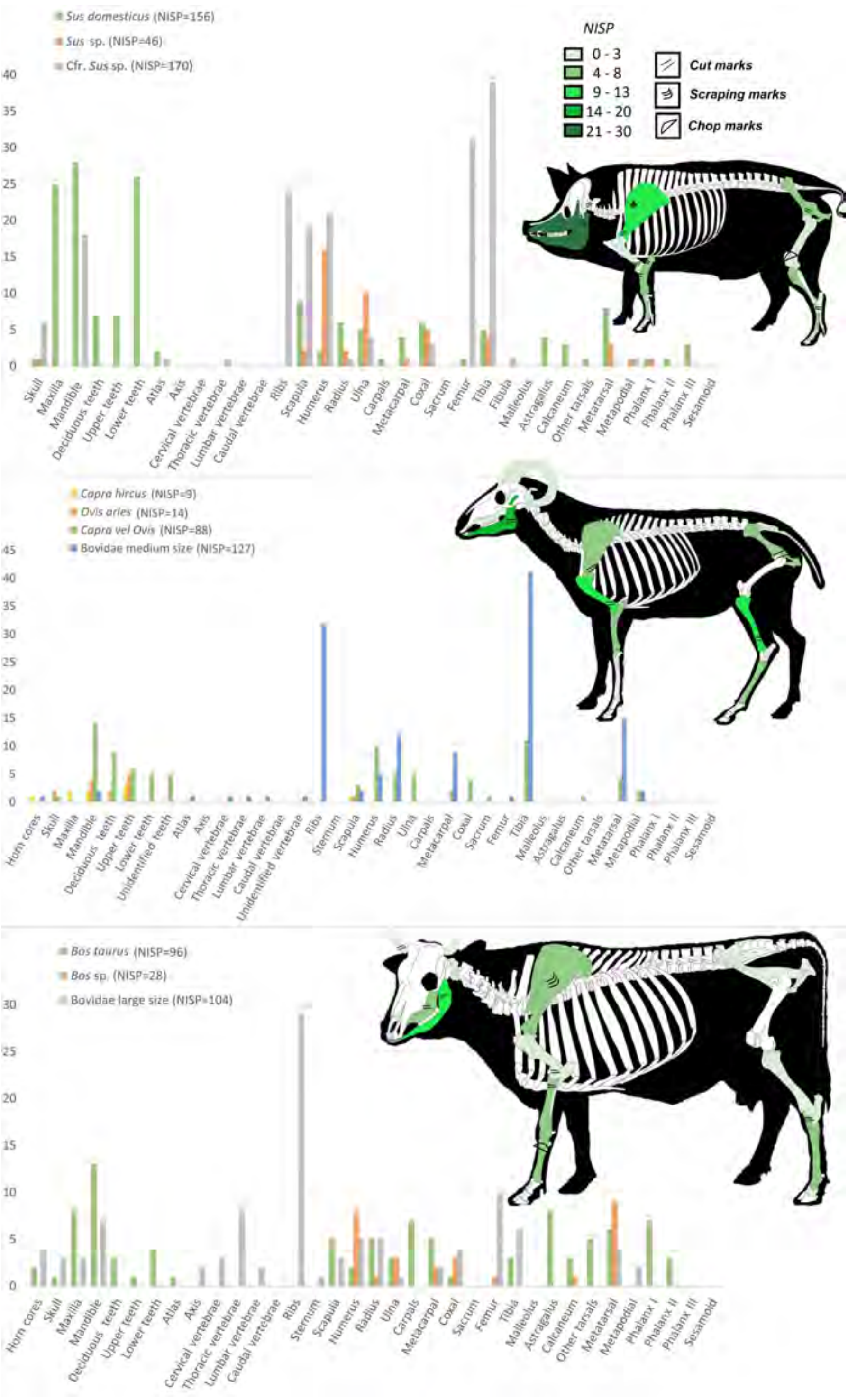

FIGURE 3

Vallese-Oppeano 4C. Frequency of the anatomical representation of the domestic taxa. The silohuettes show the chromatic distribution of the identified elements of *Sus domesticus*, *Capra* vel *Ovis* and *Bos taurus*, with localisation of cut marks, scraping marks and chop marks.

raphy of 2 well-developed antlers fused to skulls belonging to both species suggests probable times of death within May-September and August-February for roe deer and red deer respectively. The presence, instead, of a very young roe deer hip bone from the roof of the stratigraphy suggests that the animal must have died between June and October. Overlapping cervid seasons of death, it is possible to suppose that hunting was surely carried out from at least mid-spring (May) to mid-autumn (October). As for other wild taxa, all species are represented by only 1 individual each, except for the pond turtle (MNI 2).

State of preservation of bone surfaces

Overall, faunal remains are well preserved. Among the modifications affecting bone surfaces, weathering cracks are the most frequent alterations, showing that 5% of the bone assemblage had been exposed to changes in temperature and humidity. Root etching and fungal hyphae have been identified on 2.3% of the remains, while deposition of manganese and iron oxides was recorded on 2.6% and 3.1% of the analysed bones, respectively. Concretions (3%) and erosions (2.2%) are also present on bone surfaces. Carnivore activity was evidenced on 1.2% of the bone assemblage, with a prevalence of pits and puncture marks, while traces left by rodent incisors were found on only 1 remain.

Anthropic modifications

Regarding the processing of domestic carcasses, it is possible to propose some considerations only for the economically-relevant taxa, which are the most represented. The anthropic marks

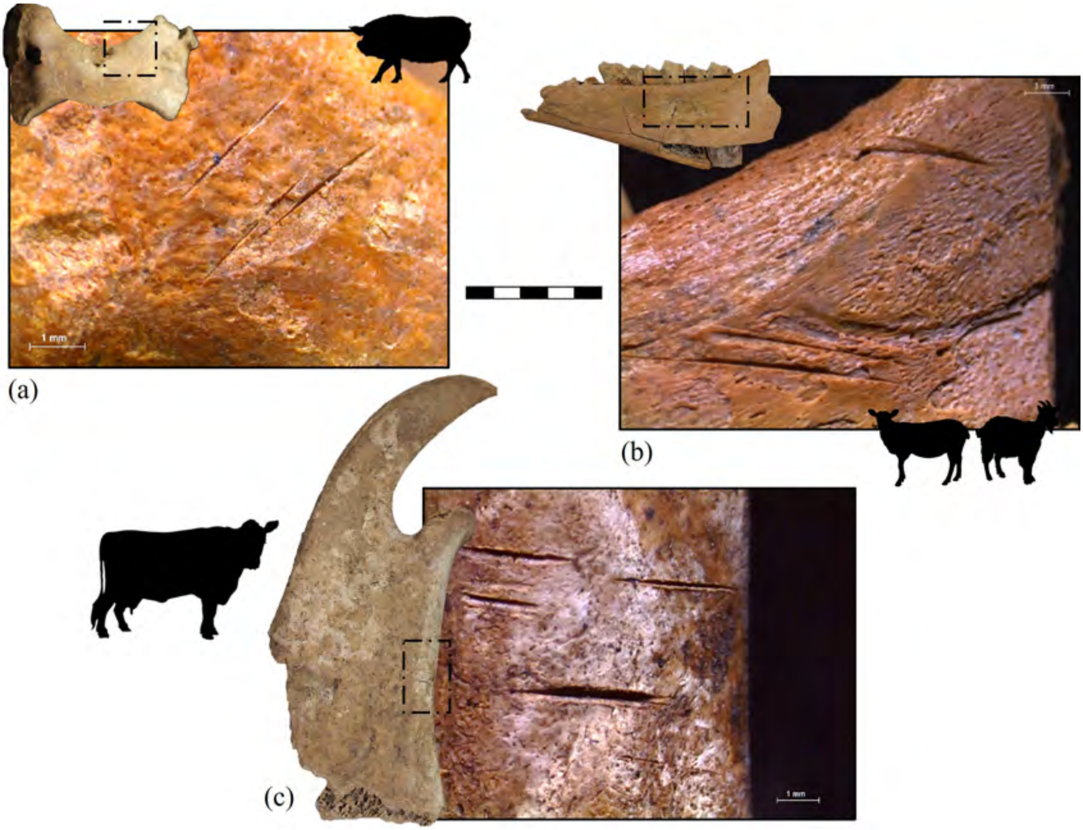

FIGURE 4

Vallese-Oppeano 4C. Butchery marks related to disarticulating the cranium on a pig atlas (a). Cutmarks for skinning on sheep/goat mandible (b) and for disarticulating the mandible on a cattle remain (c).

identified (Figure 4) on pig remains refer mainly to the skinning phase (with localisation on the mandible and tarsals) and disarticulation (on the atlas and coxal), but some related to defleshing were also documented. For goats and sheep, morphology and position of the marks mainly indicate defleshing and disarticulation of the forelimb, but the skinning phase was also observed. The traces found on the cattle remains document mainly skinning actions, but also those related to disarticulation and defleshing; furthermore, chop marks found at the base of a horn core could indicate the recovery of the horn sheath. Concerning the treatment of wild carcasses, the recognised evidence on cervid remains is mainly related to the skinning and disarticulation phases. Traces of the different slaughter phases were also found on wild boar and aurochs, on carnivores such as wolf, badger and otter, as well as on the few beaver and bird remains.

Bone industry

Pointed tools are the most represented category in the hard animal material industry. The production of bone awls is documented by shaping the distal edge of 2 ulnae with unfused proximal epiphyses of caprovine and cattle. Preliminary observation under the stereomicroscope revealed the presence of rounded, shiny and polished surfaces, suggesting the use of these tools to perforate soft materials such as skin. The awl obtained from a caprovine's ulna also shows evidence of anthropic modification on the cranial and caudal edges of the olecranon, aimed to obtain a more ergonomic grip or perhaps to hang this bone tool (Figure 5a, b). Furthermore, the exploitation of the red deer carcass is also aimed at the production of some bone tools, still under study, including an awl made from an ulna and a possible loom awl made from a metapodial (Figure 5c, d).

FIGURE 5
Vallese-Oppeano 4C. Bone tools; awls on a caprovine (a), cattle (b) and red deer (c) ulna and a loom awl on a red deer metapodial (d).

Comparison with other Early Bronze Age sites

Finally, the faunal assemblage of Vallese-Oppeano 4c was compared with those of northern Italy's main Early Bronze Age sites (Figure 6), most of which are pile-dwelling sites. Looking at the relative abundances of the main economically important domestic taxa, Vallese-Oppeano 4C is very similar to the Canàr and Lucone sites, with an economy based mainly on the exploitation of pigs, accompanied by the breeding of goats and sheep. On the other hand, the frequency of wild taxa for most sites is less than 5 %, while Vallese-Oppeano 4c and Barche di Solferino are the only exceptions, showing a fairly significant presence of wildlife (around 15 %).

CONCLUSIONS

The archaeozoological data show that the area surrounding the site of Vallese-Oppeano 4C comprised both woodlands (based on the presence of red deer, roe deer and wild boar) and wetlands (based on the presence of beaver, otter and pond turtle). The economy appears balanced and focuses mainly on pig and caprovines breeding as the main source of tender and high-yield meat. Goat and sheep breeding and the exploitation of cattle are also aimed at obtaining secondary products such as milk and wool. The production of bone tools (awls) is also attested for caprovines and cattle. In the subsistence economy of the settlement, hunting represents a secondary resource, yet the frequency of wild species at Vallese-Oppeano 4C, which represent 17% of the identified mammal remains, appears to be higher compared to other Italian sites in the Veronese plain. Hunting is mainly focused on red deer and roe deer. Based on the presence of unshed antlers and very young cervid remains, it is possible to assume a hunting seasonality from at least mid-spring (May) to mid-autumn (October). These animals, in addition to their food role in the economy, were used for the recovery of fur and the production of tools. Among other wild taxa, wild boar and aurochs are hunted, although less intensively, while the hunted carnivores include wolf, fox, badger and otter. The exploitation of beaver for fur recovery is also attested. In Vallese-Oppeano 4c a homogeneous breeding economy and a modest but significant presence of wildlife compared to other coeval sites could be linked to less intensive agriculture. In addition, the high proportion of pigs, which are considered pioneer domestic animals that adapt well to largely forested territories, could indicate a phase of colonization of the area. Therefore, Vallese-Oppeano 4c could be identified as a pioneer site for the activation of a new village in a territory still largely occupied by wooded areas associated with watercourses. To confirm these hypotheses and to establish whether the manage-

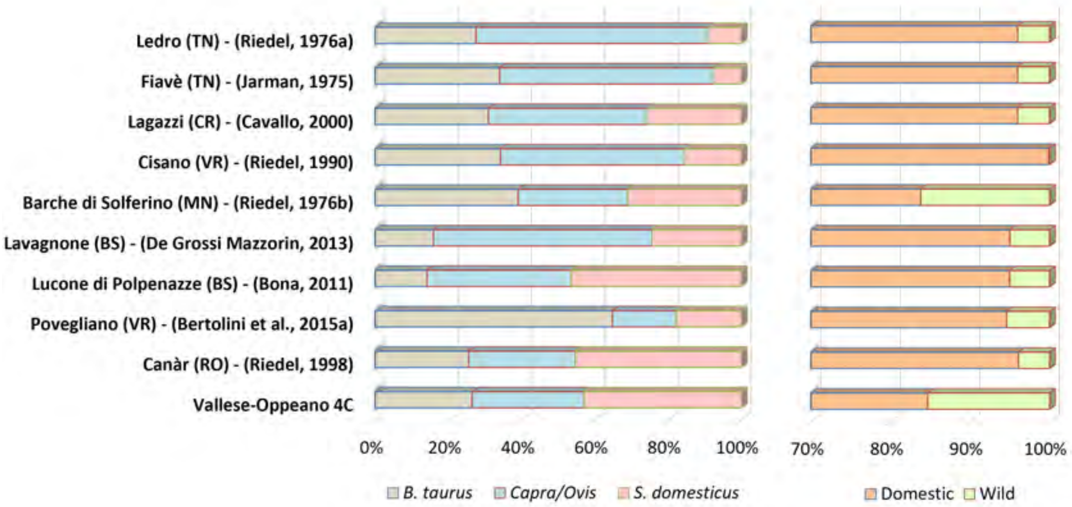

FIGURE 6

Vallese-Oppeano 4C. Comparison of the fauna composition of the main Bronze Age sites in north-eastern Italy.

ment of animal resources in the Vallese-Oppeano 4C site was linked to certain environmental conditions or precise cultural or economic aspects, it will be necessary to integrate these data with the study of faunal remains from the main excavation area (2014) and above all a comparison with archaeobotanical analyses.

LIST OF OSTEOMETRIC MEASUREMENTS - SUPPLEMENTARY APPENDIX S2

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REFERENCES

Baioni, M.; Bona, F.; Mangani, C.; Martinelli, N.; Nicosia, C.; Perego, R.; Quirini, T. & Saletta, E. 2021: Daily life in an Early Bronze Age pile dwelling of northern Italy: the case of Lucone di Polpenazze (Brescia). *Proceedings of the XVIII UISPP World Congress (2018, Paris)*, vol. 18: XXXII-1.

Barone, R. 1980: *Anatomia comparata dei mammiferi domestici*. Vol. 1: Osteologia. Bologna.

Behrensmeyer, A.K. 1978: Taphonomic and ecological information from bone weathering. *Paleobiology* 4: 150-162.

Bertolini, M.; Zanini, S. & Thun Hohenstein, U. 2015a: Nuovi dati sullo sfruttamento e gestione delle risorse animali tra il Bronzo antico ed il Bronzo recente nei territori del mediobasso Veronese e il basso Polesine. In: *Preistoria e protostoria del Veneto - Studi di preistoria e protostoria* 2: 321-326.

Bertolini, M. & Thun Hohenstein, U. 2015b: I manufatti in materia dura animale dell'insediamento dell'età del Bronzo di Cattolica, RN: analisi tecno-tipologica. *Rivista di scienze preistoriche* LXV.

Bertolini, M.; Curci, A.; De Grossi Mazzorin, J.; Depellegrin, V.; Maini, E.; Minniti, C. & Tecchiati, U. & Thun Hohenstein, U. 2021: Carne, latte e derivati: gli animali come fonte di cibo nell'età del Bronzo italiana. In: *Preistoria del cibo: l'alimentazione nella preistoria e nella protostoria - Studi di preistoria e protostoria*: 395-407. Vol. 6.

Bietti Sestieri, A.m.; Bellintani, P.; Salzani, L.; Angelini, I.; Chiaffoni, B.; De Grossi Mazzorin, J.; Giardino, C.; Saracino, M. & Soriano, F. 2015: Frattesina: un centro internazionale di produzione e di scambio nell'Età del bronzo del Veneto. In: *Preistoria e protostoria del Veneto - Studi di preistoria e protostoria*: 427-436. Vol.2.

Binford, L.R. 1981: *Bones: Ancient Men and Modern Myths*. Academic Press, New York.

Bona, F. 2011: Il sito palafitticolo del Bronzo antico del lago Lucone (area D). Abstracts del convegno "Le palafitte: ricerca, conservazione, valorizzazione, Desenzano del Garda, 6-8 ottobre 2011: 29-32.

Camps-Fabrer, H. & Stordeur, D. 1979: Orientation et définition des differents parties d'un object en os. In: *L'industrie en os et bois de cervidé durant le Néolithique et l'Age des Métaux*: 9-11. CNRS, Paris.

Camps-Fabrer, H.; Ramseyer, D. & Stordeur, D. avec la collaboration de Buisson, D. & Provenzano, N. 1990: Fiches typologiques de l'industrie osseuse prehistorique, Cahier III, Poinçons, Pointes, Poignards, Aiguilles. Publications de l'Université de Provence 6.

Cavallo, C. 2000: Analisi dei resti faunistici rinvenuti nel villaggio palafitticolo dell'antica età del Bronzo (cultura di Polada) di Lagazzi di Piadena (CR). *Atti del 2° Convegno degli Archeozoologi Italiani, Asti 14-16 novembre 1997, Forlì*: 231-239.

De Bandi, F.I. 2021: *Sistemi di gestione economica e alimentazione nelle comunità dell'età del Bronzo con particolare riferimento all'Italia settentrionale*. Bononia University Press, Bologna.

De Grossi Mazzorin, J. 2013: Considerazioni sullo sfruttamento animale nell'area delle palafitte. In: De Grossi Mazzorin J.; Curci A. & Giacobini G. (eds.): *Economia e ambiente nell'Italia padana dell'età del Bronzo. Le indagini bioarcheologiche*: 155-160. BACT 11, Edipuglia.

— 2015: Fondo Paviani e Frattesina: economia animale di due central places della tarda Età del bronzo veneta. In: *Preistoria e protostoria del Veneto - Studi di preistoria e* protostoria: 389-400. Vol. 2.

— 2019: L'economia animale dell'abitato di Frattesina nel quadro della tarda età del Bronzo veneta. In: Bietti Sestieri, A.M.; Bellintani P. & Giardino C. (eds.): *Atti dell'Accademia Nazionale dei Lincei, anno CDXV, Classe di Scienze Morali, Storico e Filologiche, Memorie serie IX, vol. XXXIX, fasc. I, Frattesina: un centro internazionale di produzione e di scambio nella tarda età del bronzo del Veneto*. Bardi Edizioni, Roma.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum of Archeology and Ethnology. Harvard University Press, Harvard.

Fernández-Jalvo, Y. & Andrews, P. 2016: *Atlas of taphonomic identifications*. Vertebrate Paleobiology and Paleoanthropology Series. Springer, Berlin.

GONZATO, F.; MANGANI, C.; MARTINELLI, N. & NICOSIA, C. 2021: Different ways to handle the domestic space by comparison: the case of Bronze age villages in Vallese di Oppeano (Verona, ITA). *Proceedings of the XVIII UISPP World Congress* (2018, Paris), vol. 18: XXXII-1.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, S. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*. B.A.R. (British Series), Oxford.

JARMAN, M. 1975: The fauna and economy of Fiavé. *Preistoria Alpina* 11: 65-73.

LYMAN, R.L. 1994a: Quantitative Units and Terminology in Zooarchaeology. *American Antiquity* 59(1): 36–71.

— 1994b: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

MARIEZKURRENA, K. 1983: Contribution al conocimiento del desarrollo de la dentición y el esqueleto post-craneal de *Cervus elaphus*. *Munibe* 35: 149-202.

MARTINELLI, N. 2022: Dendrocronologia dell'età del Bronzo in Italia settentrionale: stato dell'arte e aggiornamenti. In: *Preistoria e Protostoria in Lombardia e Canton Ticino, Rivista di Scienze Preistoriche* LXXII, S2, Firenze.

PAYNE, S. 1973: Kill-off patterns in sheep and goat: the mandibles from Asvan - Kale. *Anatolian Studies* 23: 281-303.

RAPI, M. 2002: Lavagnone di Desenzano del Garda (BS), settore B: la ceramica del Bronzo Antico I. Notizie Archeologiche Bergomensi, 10. In: De Marinis, R.C. (ed.): *Studi sul Lavagnone di Desenzano del Garda*: 109-185.

RIEDEL, A. 1976a: La fauna del villaggio preistorico di Ledro. Archeozoologia e paleoeconomia. *Studi Trentini di Scienze Naturali*, nuova serie, LIII, 5 B, Trento: 3-120.

— 1976b: La fauna del villaggio preistorico di Barche di Solferino. *Atti dei Musei Civici di Trieste,* XXIX, 4: 205-238.

— 1990: La fauna dell'età del Bronzo di Cisano (Verona). In: Salzani I. (a cura di): *Nuovi scavi nella palafitta di Cisano*, *Comune di Bardolino*: 53-59.

— 1996: Archaeological investigation in North-Eastern Italy: the exploitation of animals since the Neolithic. *Preistoria Alpina* 30: 43-94.

— 1998: The bronze age animal bone deposit of Canàr (Rovigo). In: Balista, C. & Bellintani, P. (eds.): *Canàr di San Pietro Polesine. Ricerche archeo-ambientali sul sito palafitticolo*: 151-167. «Padusa Quaderni» 2. Centro Polesano di Studi Storici Archeologici ed Etnografici.

ROWLEY-CONWY, P.; ALBARELLA, U. & DOBNEY, K. 2012: Distinguishing Wild Boar from Domestic Pigs in Prehistory: A Review of Approaches and Recent Results. *Journal of World Prehistory* 25: 1–44.

SCHMIDT, E. 1972: *Atlas of Animal Bones for Prehistorians, Archaeologists and Quaternary* Geologists. Elsevier, London.

SILVER, A. 1969: The ageing of domestic animals. In: Brothwell, D.R. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. Thames & Hudson, Bristol.

TOMÉ, C. & VIGNE, J.-D. 2003: Roe deer (*Capreolus capreolus*) age at death estimates: new methods and modern reference data for tooth eruption and wear, and for epiphyseal fusion. *Archaeofauna* 12: 157-173.

WRIGHT, E. 2013: The history of the European aurochs (*Bos primigenius*) from the Middle Pleistocene to its extinction: an archaeological investigation of its evolution, morphological variability and response to human exploitation. PhD thesis, University of Sheffield.

ZEDER, M.A. & LAPHAM, H.A. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905.

ZEDER, M.A. & PILAAR, S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth of sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 225-242.

SUPPLEMENTARY APPENDIX S2

LIST OF OSTEOMETRIC MEASUREMENTS (FOLLOWING VON DEN DRIESCH, 1976)

Sus domesticus

Mandible: **1)** (10L)=29; (10B)=15; **2)** (10L)=31; (10B)=15; **3)** (10L)=31; (10B)=14; **4)** (10L)=35; (10B)=16; **5)** (10L)=36; (10B)=17; **6)** (10L)=37; (10B)=16; **7)** (10L)=37; (10B)=17;

Scapula: **1)** GLP=32; BG=24; **2)** GLP=34; BG=25; **3)** GLP=37; BG=27,7; **4)** GLP=39; BG=28; **5)** GLP=41; BG=31;

Humerus: **1)** Bd=39; BT=33; **2)** Bd=43; BT=36;

Radius: **1)** Bp=29;

Ulna: **1)** DPA=55; SDO=46;

Tibia: **1)** Bp=43; **2)** SD=16; Bd=27; **3)** Bd=38; **4)** Bd=40; **5)** Bd=40;

Calcaneum: **1)** GB=19; **2)** GL=77; GB=20; **3)** GB=20;

Astragalus: **1)** GLm=35; Dm=23; Bd=22; **2)** GLl=42; GLm=38; Dl=21; Dm=23; Bd=25; **3)** GLm=39; Dm=24; **4)** GLl=44,4; GLm=42; Dl=24; Dm=22,2; Bd=25;

Cubonavicular: **1)** GB: 40

II Phalanx: **1)** GL=25; Bp=17; SD=15; Bd=16

III Phalanx: **1)** DLS=29; Ld=28; MBS=12; **2)** DLS=31; Ld=30; MBS=11

Bos taurus

Atlas: **1)** BFcd=86

Scapula: **1)** GLP=71; LG=60; BG=47

Humerus: **1)** Bd=75; BT=65;

Radius: **1)** Bp=73,3; BFp=66,2; **2)** Bp=86; BFp=78;

Tibia: **1)** Bd=53; **2)** Bd=64;

Astragalus: **1)** GLl=55; GLm=50; Dl=29; Dm=26,6; Bd=35; **2)** GLl=57,7; GLm=52,7; Dl=32; Dm=30; Bd=36,1; **3)** GLl=60; GLm=57; Dl=32; Dm=31; Bd=32,7; **4)** GLl=60,5; GLm=53,3; Dl=35,25; Dm=29,15; Bd=37,2; **5)** GLl=64,4; GLm=57,2; Dl=36,6; Dm=33; Bd=41; **6)** GLl=65; GLm=59; Dl=36,6; Dm=34; Bd=45; **7)** GLl=68,8; GLm=64,4; Dl=35,5; Dm=36; Bd=44,4;

Cubonavicular: **1)** GB=53; **2)** GB=54; **3)** GB=54,6; **4)** GB=57;

Metacarpal: **1)** Bp=48,3; **2)** Bp=51,1; **3)** Bp=63; **4)** Bd= 50;

Metatarsal: **1)** Bp=37,2; SD=20; **2)** SD=24,4; Bd=49; **3)** Bp=40; **4)** Bp=47,7; **5)** Bp=51;

I Phalanx: **1)** GLpe=58; Bp=38; SD=29; Bd=32 **2)** GLpe=59; SD=24,4; Bd=25,5; **2)** GLpe=60; Bp=36; SD=28; Bd=30,5; **3)** GLpe=64; Bp=31,1; SD=25; Bd=28,3; **4)** GLpe=65; Bp=30,5; SD=26; Bd=28;

II Phalanx: **1)** GL=38; Bp=29; SD=23; Bd=23;

Capra hircus

Scapula: **1)** GLP=33; BG=21

Ovis aries

Scapula: **1)** GLP=33; BG=21

Sus scrofa

Scapula: **1)** GLP=49,4; BG=35;

Humerus: **1)** Bd=52; BT=46;

Bos primigenius

Astragalus: **1)** GLl=83; GLm=75,5; Dl=46; Dm=42; Bd=50;

Cervus elaphus

Mandible: **1)** (10L)=31; (10B)=13; **2)** (10L)= 34; (10B)=14;

Humerus: **1)** Bd=53; BT=48; **2)** Bd=53,8; BT=50;

Astragalus: **1)** GLl=55,5; GLm=53; Dl=30; Dm=31; Bd=33;

Metacarpal: **1)** Bp=38; **2)** Bp=39; SD=22; **3)** Bp=39,4; **4)** Bp=42,2; **5)** Bp=43,3;

Metatarsal: **1)** Bp=35,5;

I Phalanx: **1)** GLpe=41; Bp=20,5; SD=16; Bd=17,2; **2)** GLpe=56; Bp=21; SD=18; Bd=21;

II Phalanx: **1)** GL=40; Bp=20; SD=15; Bd=16,6

III Phalanx: **1)** DLS=51; Ld=43; MBS=17;

Aves

Radius: **1)** Bd=16 SC=6,6

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Economia di sussistenza nel sudest iraniano tra IV e II millennio a.C. Nuovi dati archeozoologici da Shahr-I Sokhta (Iran) nell'ambito del progetto MAIPS

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RIASSUNTO: Il progetto MAIPS (Multidisciplinary Archaeological Italian Project at Shahr-I Sokhta) permette alla ricerca italiana, a partire dal 2017, di tornare ad essere protagonista in uno dei più importanti siti archeologici dell'Età del bronzo del sudest iraniano.

Gli studi faunistici, condotti dal laboratorio di Archeozoologia dell'Università del Salento (LAZUS) sui resti animali rinvenuti nelle più recenti campagne di scavo in contesto urbano, confermano un'economia di sussistenza basata prevalentemente sulla pastorizia e sull'allevamento delle principali specie animali. La scarsità della fauna selvatica rinvenuta ne conferma un ruolo marginale, tuttavia fornisce interessanti indicazioni circa l'ambiente circostante.

Un'analisi diacronica del contesto, alla luce delle nuove datazioni assolute, ha inoltre permesso di evidenziare le differenze nelle strategie di sfruttamento durante le varie fasi di occupazione, che vanno dalla seconda metà del IV millennio a.C. agli inizi del II millennio a.C.

I risultati ottenuti, seppur ancora parziali e in corso di implementazione, integrati ai dati provenienti dai principali siti protostorici del Sistan iraniano e delle regioni adiacenti, permettono di fornire un quadro unitario ed esaustivo in merito alle strategie di sfruttamento delle risorse animali durante l'età del Bronzo.

PAROLE CHIAVE: SHAHR-I SOKHTA, IRAN, ETÀ DEL BRONZO, ALLEVAMENTO, MAIPS

ABSTRACT: Since 2017 the MAIPS project (Multidisciplinary Archaeological Italian Project at Shahr-I Sokhta) allowed Italian researchers to play a pivotal role in one of the most important archaeological sites of the Bronze Age in southeast Iran.

The faunal studies carried out by the Archaeozoology Lab of Salento University (LAZUS) on the animal remains recently retrieved at this site confirm an economy based mainly on pastoral activities and the husbandry of the main livestock species. The scarcity of wild fauna confirms its marginal role despite these yielding useful environmental information on the surrounding landscape.

A diachronic analysis of contexts, together with new radiocarbon dates, highlights differences of the exploitation strategies during the successive occupation stages, that range from the second half of the fourth millennium BC to the beginning of the second millennium BC.

Although partial as of this writing, the results of these analyses with data from the main protohistorical sites of the Iranian Sistan and adjacent regions, allowed us to provide a unitary and comprehensive scenario of economies and the animal exploitation strategies in central and southeastern Asia during the Bronze Age.

KEYWORDS: SHAHR-I SOKHTA, IRAN, BRONZE AGE, BREEDING, MAIPS

RESUMEN: Desde 2017, el proyecto MAIPS (Proyecto Arqueológico Italiano Multidisciplinario en Shahr-I Sokhta) permitió a los investigadores italianos desempeñar un papel fundamental en uno de los yacimientos más importantes de la Edad del Bronce en el Irán sud-oriental.

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Los estudios faunísticos realizados por el Laboratorio de Arqueozoología de la Universidad de Salento (LAZUS) sobre restos animales recientemente recuperados en este yacimiento confirman una economía basada principalmente en actividades pastoriles y cría de las principales cabañas ganaderas. La escasez de fauna silvestre, en cambio, evidencia un papel marginal a pesar de aportar interesante información medioambiental sobre el entorno.

Un análisis diacrónico de contextos, junto con nuevas dataciones radiocarbónicas, puso de relieve diferentes estrategias de explotación durante las sucesivas etapas de la ocupación, que discurre desde la segunda mitad del cuarto milenio a.C. hasta principios del segundo milenio a.C.

Aunque parciales en estos momentos, al comparar los resultados de estos análisis con datos de los principales sitios protohistóricos del Sistán iraní y regiones adyacentes, nos permitieron vislumbrar un amplio escenario unitario de las economías y estrategias de la explotación animal en Asia central y sudoriental durante el Edad del Bronce.

PALABRAS CLAVE: SHAHR-I SOKHTA, IRAN, EDAD DEL BRONCE, CRÍA, MAIPS

INTRODUZIONE

Sharh-i Sokhta, la *“Città Bruciata”*, è un sito archeologico risalente all’età del Bronzo, un insediamento urbano attribuibile alla cultura Jiroft, collocato nella parte sud orientale dell’Iran, a pochi chilometri dai confini con Afghanistan e Pakistan, lungo il corso del fiume Helmand, nella regione del Sistan e Baluchistan (Figura 1). Il sito, nella sua massima espansione, si estende su un’area pari a 151 ettari e rappresenta una delle più ampie città del mondo antico. A partire dalla metà del IV millennio a.C., la sequenza cronologica della città, più volte dibattuta e analizzata (Salvatori & Tosi,

FIGURA 1

Planimetria dell’Asia centro-meridionale con individuazione del sito di Shahr-i Sokhta e dei principali siti presenti nella regione tra la fine del IV e gli inizi del II millennio a.C.

2005; Jarrige *et al*., 2011), in base alle più recenti cronologie (Ascalone, 2022; Ascalone *et al*., 2022) è stata divisa in cinque periodi e dodici fasi:

– Periodo I: fasi 10-9-8-7 (dal 3550 al 3000 a.C. circa), con estensione abitativa tra i 10 e i 20 ettari;
– Periodo II: fasi 6 a/b, 5 a/b e 4[1] (3000-2600 a.C. circa), con estensione abitativa 45 ettari ca.;
– Periodo III: fasi 3 e 2 (2600-2400 a.C. circa), con estensione abitativa 100 ettari ca.;
– Periodo IV: fase 1 (2400-2300 a.C. circa), con estensione abitativa non ancora delineata;
– Periodo V: fase 0 (2100-2000 a.C. circa), rioccupazione dopo un gap di abbandono.

Nelle fasi centrali della sua occupazione, tra il periodo II e III, Shahr-i Sokhta conobbe dunque la sua massima espansione e il suo ruolo centrale nella geografia del sudest iraniano.

Il sito venne indagato per la prima volta tra la fine degli anni ’60 e gli anni ’70 del secolo scorso, grazie al lavoro dell’IsMEO e in particolare del prof. Maurizio Tosi, del prof. Sandro Salvatori e del prof. Marcello Piperno (Tosi, 1983), che ne ebbero la direzione degli scavi fino al 1978, anno in cui, in corrispondenza della Rivoluzione iraniana del 1978-1979, si interruppero i rapporti di ricerca tra l’Istituto italiano e il governo iraniano.

Shahr-i Sokhta divenne successivamente oggetto di nuovi scavi sistematici a partire dal 1997, grazie alla Missione archeologica iraniana sotto la direzione di S. Mansur S. Sajjadi (Sajjadi, 2003). La ricerca ventennale fu incentrata soprattutto sull’indagine della necropoli, non tralasciando comunque la parte abitativa del sito (Sajjadi, 2003, 2007, 2009).

Dal 2017, invece, è avviato un progetto di ricerca multidisciplinare per uno studio approfondito dei processi antropici intervenuti a Shahr-i Sokhta e della cultura materiale che ne deriva (Ascalone, 2019). Il progetto intende mettere in relazione il sito con l’intero contesto del sud-est iraniano, per indagare affinità e differenze nelle interazioni fra uomo e ambiente e i cambiamenti sviluppatisi nel corso di oltre un millennio fra civiltà dell’Asia centrale e orientale che sono state a stretto contatto. Il progetto MAIPS (Multidisciplinary Archaeological Italian Project at Shahr-i Sokhta), a direzione congiunta del prof. Enrico Ascalone per la parte italiana e del prof. Mansur Sajjadi per la parte iraniana, coinvolge il Ministero Italiano degli Affari Esteri e della cooperazione Internazionale, l’Università del Salento, il R.I.C.H.T. (Research Institute of Cultural Heritage and Tourism) e l’I.C.A.R. (Iranian Center for Archaeological Research).

MATERIALI E METODI

Nelle analisi archeozoologiche sono stati identificati, laddove possibile, i resti di tutti gli animali rinvenuti. Mammiferi e resti di uccelli sono stati registrati quantificati utilizzando l’approccio della zona diagnostica selettiva[2] (Davis, 1992; Albarella & Davis, 1994).

La nomenclatura scientifica degli animali domestici segue le indicazioni di Gentry *et al*. (2004). La distinzione tra pecora e capra è stata possibile analizzando sia le particolarità morfologiche sui denti che le variazioni su alcuni specifici elementi post-craniali (Boessneck *et al*., 1964; Kratochvil, 1969; Payne, 1985; Prummel & Frisch, 1986; Halstead *et al*., 2002; Zeder & Lapham, 2010).

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[1] La fase 4 comprende un arco cronologico di soli 20 anni (2620-2600 a.C.). Tale fase non è distinguibile stratigraficamente: tutto il materiale ascrivibile a questa fase confluisce probabilmente in quel materiale di difficile attribuzione stratigrafica collocato tra II e III Periodo. Dallo scavo del Workshop 33 non sono stati recuperati resti animali di fase 4, essendo questa una fase nella quale erano presenti esclusivamente fornaci utilizzate per processi metallurgici e installazioni mobili sporadiche.

[2] Le “zone diagnostiche” dei mammiferi includono: cranio (zigomatico), atlante, epistrofeo, scapola (articolazione glenoidea), omero distale, radio prossimale, ulna prossimale, carpale (capitato trapezoide), metacarpo distale (solo terzo e quarto metacarpo per i carnivori), bacino (acetabolo e zona ischiatica), femore distale, tibia distale, astragalo, calcagno, tarsale (cubonavicolare), metatarso distale (solo terzo e quarto metatarso per i carnivori), metapodio distale (solo terzo e quarto metapodiale per i carnivori), parti prossimali della I, II e III falange. Per gli uccelli sono stati sempre registrati: scapola (estremità articolare), coracoidi prossimali, omero distale, ulna prossimale, carpometacarpo prossimale, femore distale, tibiotarso distale e tarsometatarso distale. Sono stati anche identificati astucci cornei e cavicchie ossee, anche se non sono stati utilizzati per la quantificazione. Testa articolare dell’omero, radio distale, ulna distale, testa articolare del femore e tibia prossimale sono stati registrati (OTH) per essere utilizzati nell’analisi dell’età di morte, ma non utilizzati per la quantificazione. Tutti gli altri frammenti di particolare interesse - come elementi non numerabili di specie più rare o parti che mostravano segni di macellazione/lavorazione o condizioni patologiche di interesse - sono stati sempre registrati ma non utilizzati per la quantificazione.

I resti animali sono stati generalmente rinvenuti in discreto stato di conservazione anche se frammentati, vista l'elevata incidenza di cristalli di sale nel sito che corrodevano le ossa. Sono stati osservati molti segni di rosicchiamento da parte dei roditori, mentre i morsi da parte dei carnivori sono meno frequenti.

RISULTATI

Le più recenti ricerche archeozoologiche sono incentrate sullo studio dei resti animali rinvenuti all'interno di due aree specifiche dell'insediamento di Shahr-i Sokhta: il Workshop 33 (Ascalone & Sajjadi, 2019, 2022), scavato dalla missione archeologica italiana nel progetto MAIPS a partire dal 2017 e ad oggi in corso di indagine, e il Building 1, scavato agli inizi del ventunesimo secolo dalla missione archeologica iraniana (Sajjadi & Moradi, 2015). I due edifici (Figura 2) si trovano nella zona residenziale nord-orientale dell'intera area archeologica. Cronologicamente, l'occupazione delle due aree copre quasi interamente il III millennio a.C., concentrandosi esclusivamente nei periodi II e III di Shahr-i Sokhta, dunque quelli in cui si è raggiunta la maggiore estensione dell'abitato. Solo il Building 1 sembrerebbe conservare alcune tracce di occupazione nel IV periodo, tuttavia la scarsità dei rinvenimenti di strutture e di elementi della cultura materiale lascia supporre di essere già in una fase di abbandono.

Nello specifico, nel Workshop 33 sono state individuate quattro fasi di occupazione riferibili ai periodi II e III di Shahr-i Sokhta (Salvatori & Tosi, 2005) e comprese, in base alle nuove cronologie elaborate nell'ambito del progetto MAIPS (Ascalone *et al*., 2022), tra il 3000 e il 2450 a.C. Nel Building 1 sono invece individuabili 6 livelli di occupazione compresi nel III millennio a.C. e nei Periodi II e III di Shahr-i Sokhta (Tabella 1).

Dal Workshop 33 (Potenza & Minniti, 2022) sono stati raccolti oltre 2000 resti di animali, dei quali 832,75 sono risultati determinabili. 319 frammenti (38,3% del totale) sono relativi alla fase 4

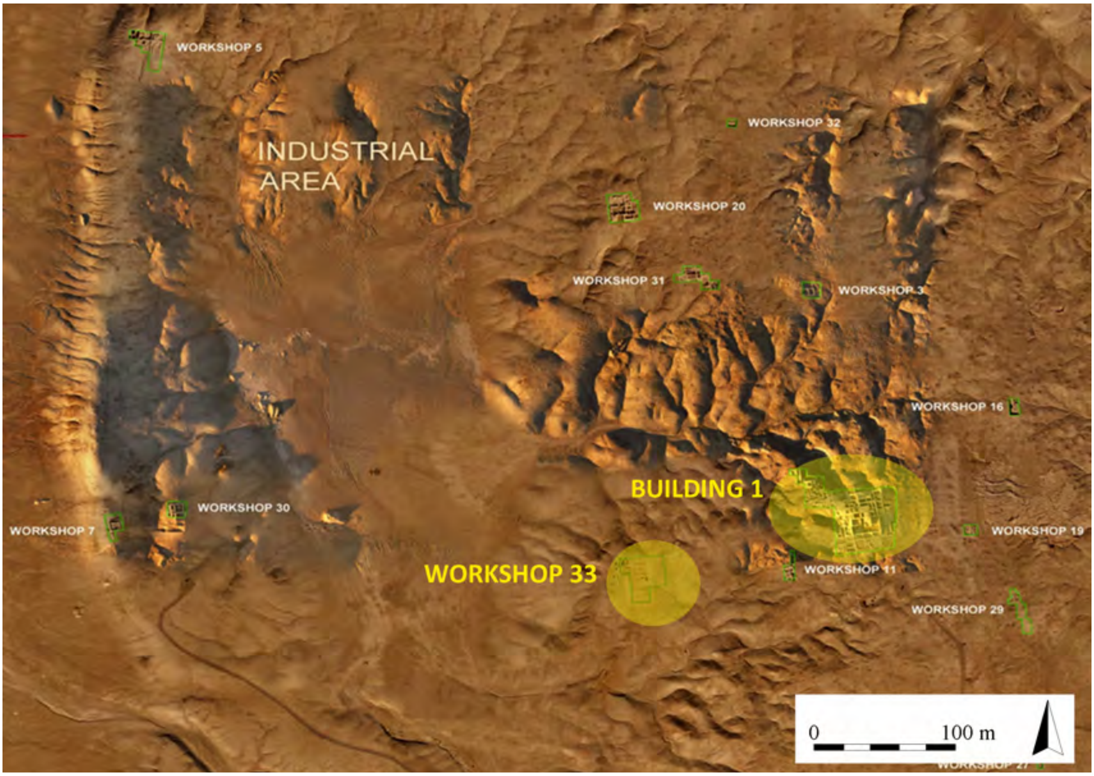
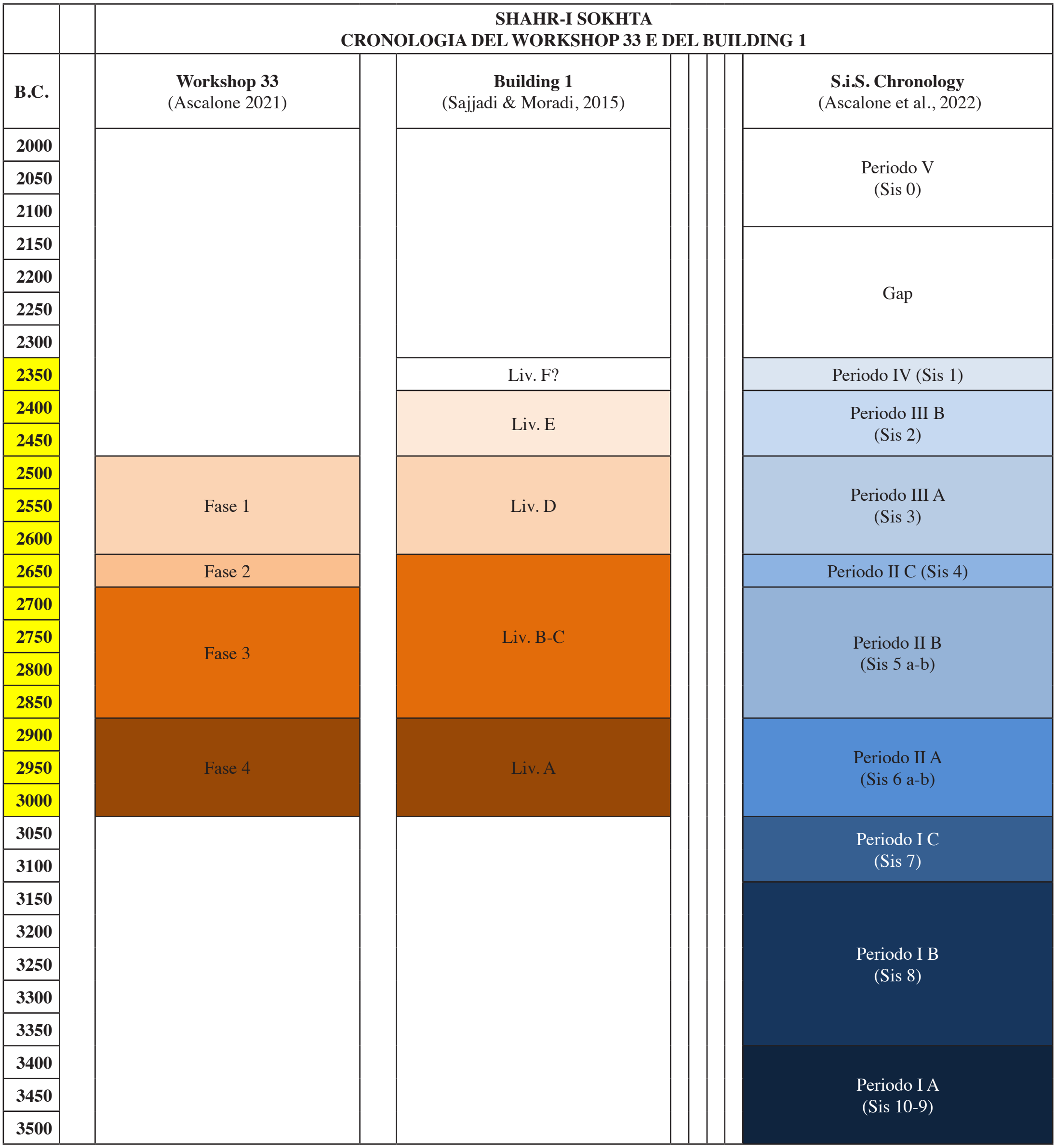


FIGURA 2

Shahr-i Sokhta. Planimetria dell'area di scavo con individuazione del Workshop 33 e del Building 1.



	SHAHR-I SOKHTA **CRONOLOGIA DEL WORKSHOP 33 E DEL BUILDING 1**		
B.C.	**Workshop 33** (Ascalone 2021)	**Building 1** (Sajjadi & Moradi, 2015)	**S.i.S. Chronology** (Ascalone et al., 2022)
2000			Periodo V (Sis 0)
2050			
2100			
2150			Gap
2200			
2250			
2300			
2350		Liv. F?	Periodo IV (Sis 1)
2400		Liv. E	Periodo III B (Sis 2)
2450			
2500	Fase 1	Liv. D	Periodo III A (Sis 3)
2550			
2600			
2650	Fase 2	Liv. B-C	Periodo II C (Sis 4)
2700	Fase 3		Periodo II B (Sis 5 a-b)
2750			
2800			
2850			
2900	Fase 4	Liv. A	Periodo II A (Sis 6 a-b)
2950			
3000			
3050			Periodo I C (Sis 7)
3100			
3150			Periodo I B (Sis 8)
3200			
3250			
3300			
3350			
3400			Periodo I A (Sis 10-9)
3450			
3500			

TABELLA 1

Planimetria dell'Asia centro-meridionale con individuazione del sito di Shahr-i Sokhta e dei principali siti presenti nella regione tra la fine del IV e gli inizi del II millennio a.C.

dell'edificio; 341,75 (41%) provengono dalla fase 3; 172 (20,7%) provengono dalla fase 1. Non sono stati invece rinvenuti resti di animali negli strati datati alla fase 2, definita *"squatter phase"*, ma ciò non stupisce poiché a questa fase, infatti, corrisponde un periodo di abbandono dell'area che si suppone fosse adibita ad area di lavorazione dei metalli. Dal Building 1 provengono invece 4405,75 frammenti ossei determinabili, la maggior parte dei quali riferibili al Periodo III di occupazione di Shahr-i Sokhta (Tabella 2).

Il campione è costantemente dominato dai resti dei principali animali domestici. In tutte le fasi pecore e capre erano le specie più comuni, seguite dai bovini, mentre i suini erano completamente assenti. Anche i cani sono stati registrati in quasi tutte le

SHAHR-I SOKHTA. NR DAL WORKSHOP 33 E DAL BUILDING 1							
Workshop 33	**Periodo II**			**Periodo III**		**Tot.**	**%**
	Fase 6	**Fase 5**		**Fase 3**			
Bue – *Bos t. taurus/indicus* L.	19,5	19,5		34		112,25	13,48
Ovicaprini - *Ovis* vel *Capra*	107,5	107,5		72		291	34,94
Pecora - *Ovis aries* L.	108,5	108,5		36,5		247	29,66
Capra - *Capra hircus* L.	49,5	49,5		13		100	12,01
Cane - *Canis familiaris* L.	2	2		2,5		5,5	0,66
				3			
Muflone - Ovis orientalis Gml.	4	3				10	1,20
Egagro - Capra aegagrus Erx.	3	3		3		6	0,72
Gazzella - Gazella subgutturosa Guld.	2	4				9	1,08
Roditori - Rodentia ind.	5	12		6		18	2,16
Uccelli - Aves ind.	18	9		1		33	3,96
Pesci - Pisces ind.				1		1	0,12
TOT.	**319**	**341,75**		**172**		**832,75**	**100,00**
Building 1	**Periodo II**		**II-III**	**Periodo III**		**Tot.**	**%**
	Fase 6	**Fase 5**		**Fase 3**	**Fase 2**		
Bue – *Bos t. taurus/indicus* L.	16,75	53	164,5	261	151,25	646,5	14,38
Ovicaprini - *Ovis* vel *Capra*	137	194	222,75	614,75	376,75	1545,25	35,07
Pecora - *Ovis aries* L.	116	143	198	543	326,5	1326,5	29,95
Capra - *Capra hircus* L.	40	57	82,5	218,5	108,5	506,5	11,45
Cane - *Canis familiaris* L.		1	1	3	3	8	0,18
Equidi - *Equus* sp.				5		5	0,11
Camelidi - *Camelus* sp.				0,5		0,5	0,01
Muflone - *Ovis orientalis* Gml.	5	9	9	29,5	25	77,5	1,94
Egagro - *Capra aegagrus* Erx.	6	4,5	7	10,5	4,5	32,5	0,76
Gazzella - *Gazella subgutturosa* Guld.	11	11,5	11	39	19	91,5	2,08
Cervo - *Cervus elaphus* L.		1	1	0,5	2	4,5	0,10
Capriolo - *Capreolus capreolus* L.	1		1		1	3	0,07
Uro - *Bos primigenius* L.	1	2	4,5	4	2	13,5	0,60
Sciacallo dorato - *Canis aureus* L.				4		4	0,09
Iena (?) – *Crocuta crocuta* Erx.				1		1	0,02
Lepre del Capo - *Lepus capensis* L.				1		1	0,02
Riccio - *Hemiechinus auritus* Gml.				1	2	3	0,07
Mangusta - *Herpestes auropunctatus* H.					4	4	0,09
Roditori - Rodentia ind.	2	8	18	23	17	68	1,54
Uccelli - Aves ind.	4	9	11	21	13	58	1,32
Pesci - Pisces ind.			4	2		6	0,14
TOT.	**339,75**	**493**	**735,25**	**1783,25**	**1054,5**	**4405,75**	**100,00**

TABELLA 2

Shahr-i Sokhta. Numero di resti (NR) provenienti dal Workshop 33 e dal Building 1 quantificati in base al metodo di analisi delle zone diagnostiche selettive.

fasi, ma con meno resti rispetto agli altri animali domestici. Nelle fasi di occupazione più recenti compaiono anche equidi e camelidi (Potenza, cds). Specie selvatiche sono presenti ma in numero minore: tra queste il muflone, l'egagro e la gazzella sono le specie maggiormente rappresentate, nonostante il loro apporto all'economia di sussistenza risulti marginale. Sono inoltre presenti uccelli e pesci, anche questi in percentuali minime, a testimonianza di esistenti ma meno frequenti attività di caccia e pesca. Le ossa di roditore sono rappresentate in modo significativo ma devono essere interpretate come resti di animali commensali all'insediamento umano.

Analizzando la frequenza delle specie domestiche in maniera diacronica, si osserva una leggera variazione nel rapporto tra bovini e ovicaprini nelle successive fasi di occupazione (Figura 3). Questi dati potrebbero suggerire un diverso ruolo del bestiame nel corso del tempo, probabilmente dovuto ad una specializzazione nelle tecniche di allevamento finalizzata all'aumento dell'uso dei bovini per la trazione nelle attività agricole (Potenza, cds).

DISCUSSIONE

L'economia di sussistenza a Shahr-i Sokhta era basata quasi esclusivamente sull'allevamento delle principali specie domestiche, ad esclusione del maiale. La caccia e la pesca sembrano rivestire in tutte le fasi di occupazione, in base alla quantità minima dei resti rinvenuti, un ruolo marginale: il dato sembrerebbe in contrasto con i precedenti studi faunistici, dove la presenza di avifauna suggerisce un'attività venatoria più frequente[3] (Gala & Tagliacozzo, 2014).

L'assenza dei suini è argomento estremamente dibattuto nella ricerca archeozoologica del Sistan: altre fonti, come figurine di argilla o terracotta, suggeriscono la presenza di suidi, ma il motivo della loro esclusione dalla dieta degli abitanti di Shahr-i Sokhta deve ancora essere chiarito. Precedenti analisi (Bökönyi & Bartosiewicz, 2000) hanno individuato nel sito la presenza di un singolo frammento di radio di maiale subadulto appartenente al periodo II-III, ma di questo frammento non si conosce l'esatta provenienza. Negli insediamenti dell'altopiano iraniano sono rari i maiali o i cinghiali, generalmente rappresentati da una percentuale molto bassa di resti. È il caso dei siti dell'età del bronzo

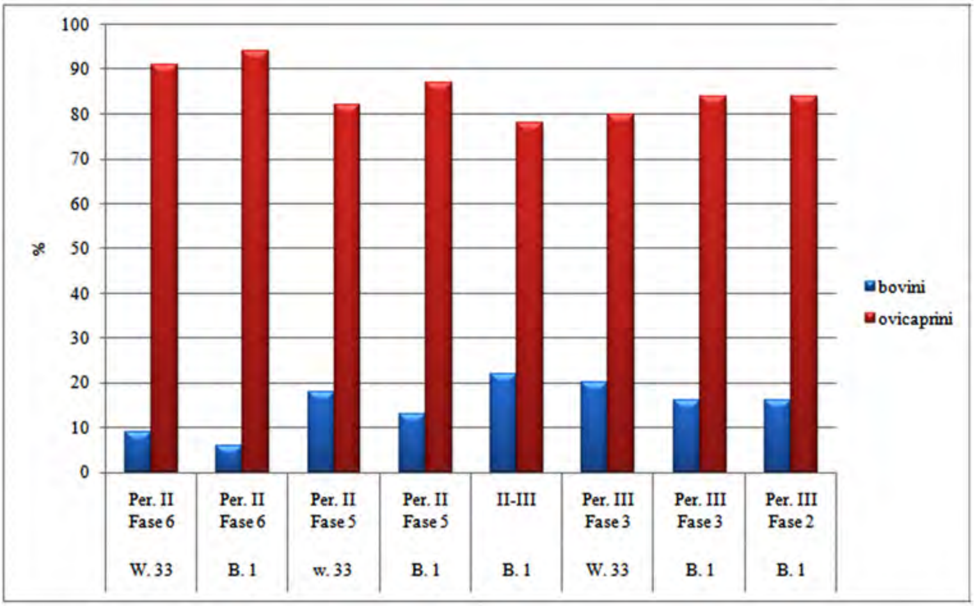


FIGURA 3

Shahr-i Sokhta. Rapporto percentuale di presenza di bovini e ovicaprini nelle diverse fasi di occupazione del Workshop 33 e del Building 1.

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[3] Per approfondimenti, si veda, all'interno del presente volume, il contributo: Potenza A., Gli uccelli a Shahr-i Sokhta: buoni da mangiare, buoni per lavorare, presentato con un poster al X Convegno AIAZ, Siena 3-6 Novembre 2021.

dell'altopiano iraniano come Konar Sandal, Shah Tepe, Tepe Hessar (fase III B), Tepe Yahya (IVC) e Dinkha Tepe (Mashkour, 2006). Le conoscenze sulla domesticazione e lo sviluppo dell'allevamento di suini nell'altopiano iraniano sono ancora poco definite.

L'attività venatoria, oltre che agli uccelli, era limitata a poche specie selvatiche, quelle maggiormente sfruttate erano la gazzella, il muflone e l'egagro. La presenza sporadica di uro e di emione potrebbe documentare attività di caccia più occasionali, mentre i resti di cervo e capriolo sembrerebbero legati per lo più alle attività commerciali che alla caccia regolare di questi animali: la presenza dei loro resti potrebbe infatti essere spiegata con l'arrivo di pelli e porzioni carnee dalla zona montuosa situata a nord di Shahr-i Sokhta (Potenza, cds).

Il presente contributo vuole inoltre sottolineare la centralità di Shahr-i Sokhta all'interno di un sistema insediamentale estremamente complesso, come quello che si sviluppa in Asia centro-meridionale durante il III millennio a.C.

A livello regionale, non si può prescindere dal considerare Shahr-i Sokhta come il fulcro di un sistema organico che comprendeva i "siti satellite", piccoli centri a pochi chilometri dal sito, dalle ridottissime dimensioni, spesso utilizzati per singole attività produttive (Moradi *et al.*, 2022). Il ruolo centrale di Shahr-i Sokhta fu sicuramente favorito dalla posizione geografica del sito: coltivazione, allevamento, caccia, pesca e raccolta dovevano essere coordinate all'interno del bacino deltizio, dove peraltro la variabilità degli ecosistemi forniva un ampio spettro di risorse. E proprio le variazioni del bacino idrico nel corso del tempo potrebbero essere uno dei fattori che determinarono, alla fine del III millennio, l'abbandono dell'insediamento. Le analisi archeozoologiche effettuate nei siti satellite di Shahr-i Sokhta, come ad esempio Tepeh Graziani (Mashkour *et al.*, 2019), l'unico sito satellite del quale abbiamo ad oggi una analisi archeozoologica esaustiva, confermano, nel III millennio, una strategia di sfruttamento animale simile a quella di Shahr-i Sokhta.

Il rapporto tra Shahr-i Sokhta e i siti satellite ci apre la porta a una possibile ipotesi di valutazione: da Shahr-i Sokhta i nuclei familiari si muovevano verso i siti satellite, per una produzione su piccola scala, cercando condizioni ambientali e stagionalità favorevoli. I prodotti derivanti da attività come caccia, pesca, pastorizia (ma non solo, anche attività agricole o metallurgiche ad esempio), rientravano poi a Shahr-i Sokhta per una distribuzione su più ampia scala, a favorire un commercio anche a livello sovraregionale.

A livello sovraregionale invece il discorso diventa più complesso. Per oltre un millennio Shahr-i Sokhta sembrerebbe aver avuto il ruolo di catalizzatore delle rotte commerciali nel sud-est iranico. Quello che viene evidenziato dai numerosi studi sulla cultura materiale di Shahr-i Sokhta è riscontrabile anche dall'analisi dei dati archeozoologici. Le culture Helmand, Jiroft, Indo e Oxus durante il III millennio a.C. ebbero uno sviluppo insediamentale molto simile a quello di Shahr-i Sokta (Kohl *et al.*, 1982). Il Jiroft e la valle dell'Helmand mostrano comunque uno sviluppo ininterrotto dalla metà del IV ai primi secoli del II millennio a.C. Tali civiltà ebbero inizialmente uno sviluppo territoriale locale, tuttavia nuovi dati archeologici in ogni regione consentono di identificare un cambiamento in Iran orientale, valle dell'Indo e Asia centrale intorno alla metà del III millennio a.C., cambiamento probabilmente condizionato da un nuovo sistema socio-economico avviato verso un controllo più articolato del proprio territorio e delle regioni lontane. Dall'inizio del III millennio a.C., dunque, i complessi culturali regionali iniziarono a far parte di un sistema relazionale più ampio, dove si sviluppò non solo una sorta di *koiné* nella cultura materiale, ma anche e soprattutto legami commerciali (Ascalone, 2006).

Per quanto riguarda l'allevamento nel III millennio a.C., che forniva il sostentamento primario in tutte le comunità di questo sistema culturale integrato, si osserva una netta similitudine di Shahr-i Sokhta con il territorio del Turkmenistan meridionale e della valle dell'Oxus. Questo poteva essere favorito anche da condizioni climatiche ed ambientali molto simili nei due contesti, favorevoli alla pastorizia.

A fornire un ulteriore spunto di riflessione sono le figurine in argilla raffiguranti animali: su un campione di oltre 2000 figurine rinvenute, circa l'80% raffigura bovidi, circa il 6% raffigura suidi e solo il 3% raffigura ovicaprini (Bökönyi & Bartosiewicz, 2000), un dato in controtendenza con il dato archeozoologico. Mentre la difformità di percentuali tra bovini e ovicaprini può dipendere da specifiche pratiche cultuali e da visioni immaginifiche differenti, che davano agli zebù particolare importanza, la presenza di statuine di suidi (che, come già detto, non compaiono nel campione archeozoologico di Shahr-i Sokhta), può essere il prodotto di scambi commerciali e culturali con le vicine culture settentrionali e orientali?

Infine, il rinvenimento di una sepoltura di macaco reso (*Macaca mulatta*) all'interno della necropoli di Shahr-i Sokhta e databile alla metà del III millennio a.C. (Minniti & Sajjadi, 2019), è una ulteriore conferma di contatti sovraregionali (Figura 4). Il macaco, originario dell'areale indiano ed estremo orientale, giungeva a Shahr-i Sokhta attraverso esistenti rotte commerciali, assumendo uno *status* particolare: un animale esotico la cui importanza è evidenziata appunto dal volergli dedicare una sepoltura apposita provvista di corredo funerario.

CONCLUSIONI

I nuovi studi sulle faune di Shahr-i Sokhta, effettuati nell'ambito del progetto MAIPS e che si sono basati sulle faune del III millennio provenienti da due nuove aree di scavo (Workshop 33 e Building 1), in parte confermano quanto evidenziato dai precedenti studi (Caloi & Compagnoni, 1977; Bökönyi & Bartosiewicz, 2000; Minniti, 2019), ovvero la centralità di un sito con un'economia basata prevalentemente sull'allevamento e in particolare sulla pastorizia, in parte ci forniscono nuovi importanti dati sulla differenza delle pratiche allevatorie nel corso del tempo, dati che potranno essere implementati con la prosecuzione delle analisi sui resti archeozoologici.

Il progetto MAIPS, sfruttando la multidisciplinarità della ricerca, cerca di rispondere ad alcune domande circa gli sviluppi regionali e i contatti sovraregionali del sito con il territorio circostante: mentre dal punto di vista regionale è possibile ipotizzare un rapporto diretto di Shahr-i Sokhta con le decine di siti satellite che, probabilmente, venivano sfruttati stagionalmente per attività produttive specifiche e che erano a stretto contatto con la vita della città principale (lasciando pensare anche ad un'organizzazione statale complessa), a livello sovraregionale si possono vedere dei contatti con le vicine culture Oxus e Indo non solo attraverso i manufatti o le materie prime, ma anche attraverso le pratiche di allevamento e la presenza di animali esotici.

Le nuove ricerche archeozoologiche permetteranno, nel prossimo futuro, di avere un quadro sempre più esaustivo circa l'importanza e il ruolo che Shahr-i Sokhta ebbe all'interno di un sistema estremamente complesso, quale era il sud-est asiatico durante il III millennio a.C.

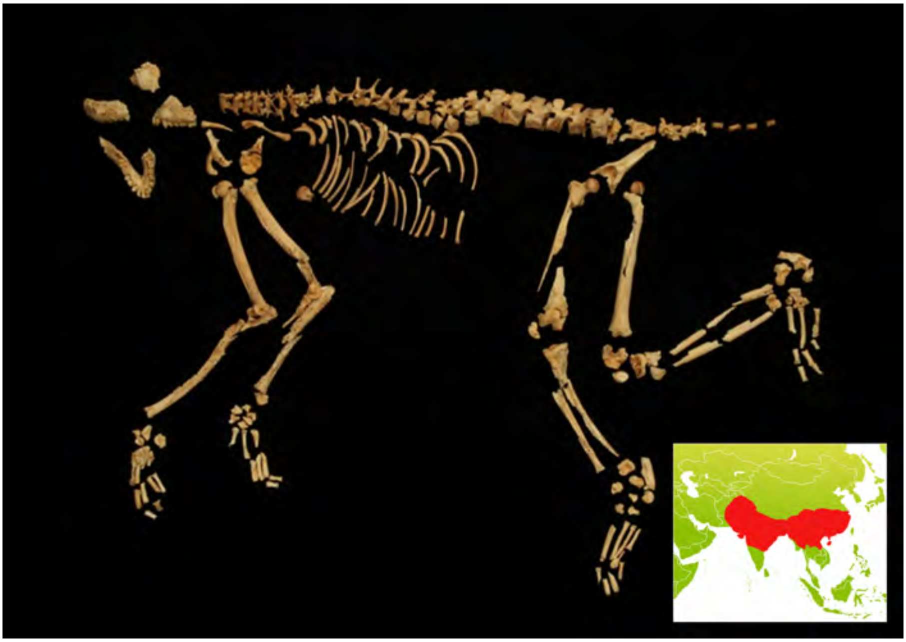

FIGURA 4

Shahr-i Sokhta. Scheletro di Macaca mulatta rinvenuto in una sepoltura (da Minniti & Sajjadi, 2019).

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BIBLIOGRAFIA

Albarella, U. & Davis, S. 1994: *The Saxon and Medieval animal bones excavated 1985–1989 from West Cotton*. Northamptonshire, AML report 17/94, London.

Ascalone, E. 2006: *Archeologia dell'Iran Antico. Interazioni, integrazioni e discontinuità nell'Iran del III millennio a.C.*, Di.Sc.A.M., Messina.

— 2019: Il "Progetto Archeologico Multidisciplinare Internazionale a Shahr-i Sokhta (MAIPS)", Università del Salento, dal 2017. In: Callieri, P.F.; Nokandeh, J.; Rossi, A.V. & Sajjadi, S.M.S. (eds.): *Iran and Italy: 60 Years of Collaboration on Cultural Heritage*: 59-61. National Museum of Iran, RICHT, ISMEO, Teheran.

— 2022: Preliminary Report on the 2018-2019 Excavations in Area 33 at Shahr-i Sokhta. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Excavations and researches at Shahr-I Sokhta 3 (=ERSS3)*: 137-226. Studies and Publications Institute, Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

Ascalone, E. & Sajjadi, S.M.S. 2019: *Scavi e ricerche a Shahr-i Sokhta, 1* (=ERSS 1). Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

— 2022: *Excavations and Researches at Shahr-i Sokhta, 2* (=ERSS 2). Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

Ascalone, E.; Moradi, H.; Sajjadi, S.M.S. & Vecchio P.F. 2022: Shahr-i Sokhta New Revised Sequence. *Iranica Antiqua*, Teheran.

Boessneck, J.; Müller, H.h. & Teichert, M. 1964: *Osteologische Unterscheidungsmarkmale zwichen Schaf (Ovis aries Linnè), und Ziege (Capra hircus Linnè)*. Kuhn-Archiv 78.

Bökönyi, S. & Bartosiewicz, L. 2000: A review of animal remains from Shahr-i Sokhta (Eastern Iran). In: Mashkour, M.; Choike, A.M.; Buitenhuis, H. & Poplin, F. (eds.): *Archaeozoology of the Near East*: 116-152. Vol. IV B. ARC – 32, Gronigen.

Caloi, L. & Compagnoni, B. 1977: I mammiferi. In: Tucci, G. (ed.): *La Città Bruciata del Deserto Salato*: 77-113. Ed. Erizzo, Venezia.

Davis, S.J.M. 1992: *A rapid method for recording information about mammal bones from archaeological sites*. Ancient Monuments Laboratory, Report 19/92, Historic Buildings and Monuments Commission for England, London.

Gala, M. & Tagliacozzo, A. 2014: The role of birds in the settlement of Shahr-I Sokhta (Sistan, Iran) during the 3rd Millennium BC. *International Journal of Osteoarcheaology* 24: 319-330.

Gentry, A.; Cutton-Brock, J. & Groves, C.P. 2004: The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Science* 31: 645-651.

Halstead, P.; Collins, P. & Isaakidou, V. 2002: Sorting sheep from the goats: morphological distinction between the mandibles and mandibular teeth of adult Ovis and Capra. *Journal of Archaeological Science* 2: 545-553.

Jarrige, J.F.; Didier, A. & Quivron, G. 2011: Shahr-i Sokhta and the Chronology of the Indo-Iranian Regions. *Paléorient* 37/2: 7-34.

Kohl, P.L.; Biscione, R. & Ingraham, M.I. 1982: Implications of Recent Evidence for the Prehistory of Northeastern Iran and Southwestern Turkmenistan. *Iranica, Antiqua, XVII*: 1-20.

Kratochvil, Z. 1969: Species criteria on the distal section of the tibia in *Ovis ammon* F. *aries* L. and *Capra aegagrus* F. *hircus* L. *Acta Veterinaria* 38: 483-490.

Mashkour, M. 2006: Boars and pigs: a view from the Iranian Plateau. In: Lion, B. & Michel, C. (eds.): *De la domestication au tabou: Le cas des suidés dans le Proche-Orient ancien*: 155-167. Travaux de la Maison René-Ginouvès 1, Paris.

Mashkour, M.; Fathi, H.; Davoudi, H. & Ali Kavosh, H. 2019: Animals remains from Tappeh Graziani. In: Ali Kavosh, H.; Vidale, M. & Fazeli Nashli, H. (eds.): *Tappeh Graziani, Sistan, Iran: stratigraphy,* *formation processes and chronology ofa suburban site of Shahr-i Sokhta*: 173-201. Prehistoric Sistan 2, ISMEO, Roma.

Minniti, C. 2019: Risultati preliminari dello studio dei resti animali provenienti dal sito di Shahr-i Sokhta, Iran: nuove ricerche. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Scavi e ricerche a Shahr-i Sokhta, I.C.A.R.*: 209-220.

Minniti, C. & Sajjadi, S.M.S. 2019: New data on non-human primates from the ancient Near East: The recent discovery of a rhesus macaque burial at Shahr-I Sokhta (Iran). *International Journal of Osteoarchaeology* 29: 538–548.

Moradi, H.; Sarhaddi Dadian, H.; Saadatian, M.; Marashi, S.M.J. & Keikha, M. 2022: Archaeological Survey on the East and Southeast Areas of Shahr-i Sokhta: Some Evidence for Making Chronology during the Third and Early Second Millennium BC. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Excavations and researches at Shahr-I Sokhta 3 (=ERSS3)*: 227-258. Studies and Publications Institute, Iranian Center for Archaeological Research, Pishin Pajouh, Teheran.

Payne, S. 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, Ovis, and Goats, Capra. *Journal of Archaeological Science* 12: 139-147.

Potenza, A. cds: *Lo studio dei resti animali di Shahr-i Sokhta per una ricostruzione dell'economia primaria in Asia centrale tra la metà del IV e la fine del III millennio a.C.* Tesi di dottorato in Scienze del Patrimonio Culturale, XXXV Ciclo, Università del Salento, Lecce.

Potenza, A. & Minniti, C. 2022: New data on animal exploitation at Shahr-i Sokhta (Iran). Preliminary results from the analysis of animal remains found in Area 33. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Excavations and Researches at Shahr-i Sokhta, 3 (=ERSS 3)*: 645-668. Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

Prummel, W. & Frisch, H.G. 1986: A guide for the Distinction of Species, Sex and Body side in bones of Sheep and Goat. *Journal of Archaeological Science* 13: 567-577.

Sajjadi, S.M.S. 2003: Excavations at Shahr-i Sokhta. First preliminary report on the excavations of the graveyard, 1997-2000. *Journal of the British Institute of Persian Studies* 41: 21-97.

— 2007: *Excavation at Shahr-e Sukhteh. Graveyard 1997-2000 preliminary report 1*. I.C.H.T.O. Iranian Center for Archaeological Research, Cultural Heritage, Handicrafts & Touring Organization of Sistan and Baluchistan.

— 2009: *Excavation at Shahr-e Sukhteh. Second preliminary report on the excavations of the graveyard (2001-2003)*. I.C.H.T.O. Iranian Center for Archaeological Research, Cultural Heritage, Handicrafts & Touring Organization of Sistan and Baluchistan.

Sajjadi, S.M.S. & Moradi, H. 2015: Excavation at Buildings Nos.1 and 20 at Shahr-i-Sokhta. *International Journal of the Society of Iranian Archaeologists* 1(1): 35-49.

Salvatori, S. & Tosi, M. 2005: Shahr-i Sokhta Revised Sequence. In: Jarrige, C. & Lefèvre, V. (eds.): *South Asian Archaeology 2001*: 281-292. Paris.

Tosi, M. 1983: Excavations at Shahr-i Sokhta 1969-1970. In: Tosi, M. (ed.): *Prehistoric Sistan*: 73-125.

Zeder, M.A. & Lapham, H.A. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905.

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The impact of data from early fusing and basipodial bones on adult body size estimate: methodological insights from Upper Palaeolithic sites in southern Italy

L'uso degli standard biometrici in archeozoologia: spunti metodologici da siti del Paleolitico superiore dell'Italia meridionale

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ABSTRACT: In this paper, we present a biometric dataset of four wild ungulate species from two Late Pleistocene sites of southern Italy to highlight potential issues in estimating population body size when bone remains are highly fragmented. The materials come from the Epigravettian archaeological layers of Grotta Paglicci (Rignano Garganico) and Grotta della Cala (Marina di Camerota) and are ascribed to *Bos primigenius*, *Capra ibex*, *Equus ferus* and *Cervus elaphus*. Width measurements of long bone epiphyses, as well as width measurements of carpal and tarsal bones, were compared to reference standards using logarithmic ratio. The analysis showed a systematic difference between the results obtained when considering bones without epiphyses (e.g., talus) and with early ossifying epiphyses, on the one hand, and those obtained when measuring later fusion epiphyses, on the other. In particular, the first group provided more variable and often more downwardly skewed values. This means that biometric analyses used to estimate adult body size in a population are affected by those anatomical elements that are more likely to belong to animals that still have a good margin for growth, despite the effort to discard bones that look juvenile. Our results underline the need for caution when choosing anatomical elements for biometric analysis.

KEYWORDS: BIOMETRY, LOG-RATIO, EPIGRAVETTIAN, GROTTA PAGLICCI, GROTTA DELLA CALA

RIEPILOGO: In questo contributo presentiamo i dati biometrici relativi a quattro specie di ungulati selvatici provenienti da due siti del Pleistocene finale dell'Italia meridionale per sottolineare potenziali criticità nella stima delle dimensioni corporee di una popolazione quando i resti ossei sono altamente frammentati. I materiali vengono dai livelli archeologici di Grotta Paglicci (Rignano Garganico, FG) e Grotta della Cala (Marina di Camerota, SA) e appartengono alle specie *Bos primigenius*, *Capra ibex*, *Equus ferus* e *Cervus elaphus*. Le misure di larghezza delle epifisi, così come quelle di ossa del carpo e del tarso, sono state confrontate con standard attraverso l'utilizzo del rapporto logaritmico. L'analisi ha mostrato una sistematica differenza tra i risultati ottenuti considerando ossa prive di epifisi (per esempio l'astragalo) o con epifisi ad ossificazione precoce, da un lato, e quelli ottenuti misurando epifisi a fusione più tarda, dall'altro.

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Il primo gruppo ha fornito valori molto più variabili e spesso più schiacciati verso il basso. Questo indica che, per quanto si cerchi di scartare le ossa che hanno un aspetto giovanile, le analisi biometriche volte a stimare la stazza degli individui adulti in una popolazione vengono influenzate dagli elementi anatomici che hanno maggiori probabilità di appartenere ad animali con ancora un buon margine di aumento della taglia corporea. I risultati ottenuti indicano la necessità di una certa cautela nella scelta degli elementi anatomici usati per le analisi biometriche.

PAROLE CHIAVE: BIOMETRIA, CONFRONTO LOGARITMICO, EPIGRAVETTIANO, GROTTA PAGLICCI, GROTTA DELLA CALA

RESUMEN: En este artículo presentamos una base de datos biométricos de cuatro especies de ungulados silvestres en dos yacimientos del Pleistoceno tardío del sur de Italia para resaltar problemas potenciales en la estimación de talla de una población cuando las osamentas se encuentran muy fragmentadas. Los materiales incorporan restos de *Bos primigenius*, *Capra ibex*, *Equus ferus* y *Cervus elaphus* de los niveles epigravettienses de la Grotta Paglicci (Rignano Garganico) y la Grotta della Cala (Marina di Camerota). Las anchuras de las epífisis de huesos carpales y tarsales, se compararon con los estándares de referencia utilizando relaciones logarítmicas. El análisis mostró diferencias sistemáticas entre los resultados obtenidos al considerar huesos carentes de epífisis (como, por ejemplo, el astrágalo) con huesos con epífisis de osificación temprana frente a los de epífisis de fusión tardía. Así, los valores de las epífisis de osificación temprana fueron más variables y, con frecuencia, más sesgados a la baja que los valores de las epífisis de osificación tardía. Esto significa que los análisis biométricos dirigidos a estimar el tamaño corporal adulto en una población se verán afectados por aquellos elementos anatómicos que tienen mayores probabilidades de pertenecer a animales que todavía presentan un amplio margen de crecimiento, con independencia del esfuerzo que se haga por descartar huesos que remitan a individuos juveniles. Nuestros resultados subrayan la precaución que resulta necesaria a la hora de elegir elementos anatómicos para análisis biométricos de estas características.

PALABRAS CLAVE: BIOMETRÍA, LOG-RATIOS, EPIGRAVETIENSE; GRUTA PAGLICCI, GRUTA DE LA CALA

INTRODUCTION

Biometry is a valuable tool for zooarchaeologists, insofar as it can provide useful data for interpreting various phenomena, such as the effect of climate on faunas (Wright & Viner-Daniels, 2015), the effect of hunting on wild populations (Davis & Mataloto, 2012), or the domestication process (Boschin *et al*., 2020). Although the use of new digital technologies begins to spread in zooarchaeological biometric studies (Harbers *et al*., 2020; Pelletier *et al*., 2022), the ‘traditional’ collection of linear measurements of skeletal elements continues to provide fundamental information for a better interpretation of human management of animals (e.g., Albarella, 2002; Salvagno & Albarella, 2017; Trentacoste *et al*., 2018, 2021). Yet, biometry is challenged by the high degree of fragmentation of skeletal elements when considering zooarchaeological material from prehistoric sites, especially those related to Mesolithic and Palaeolithic. In these contexts, the systematic recovery of within-bone fats by both humans and large carnivores is indeed a critical factor for bone integrity. As a result, skeletal elements are often reduced to fragments of a few centimetres (see for instance Boscato & Crezzini, 2012; Crezzini *et al*., 2016; Boschin, 2020; Spagnolo *et al*., 2020 for Italy). This implies the presence of a large number of isolated teeth, and a sharp reduction in the amount of postcranial elements available for measurement (e.g. epiphyses). The biometric significance of isolated teeth then faces a number of problems. Firstly, the sample of measurable teeth is always smaller than the total, as some of them are fragmented or not completely identifiable from an anatomical point of view. In fact, in many cases it is not possible to distinguish between certain molars, while in equids it is often not even possible to distinguish certain molars from certain premolars. In addition, in bovids the accurate measurement of tooth size may be prevented by the deposition of cementum. Moreover, some standard measurements are taken at the occlusal surface (Driesch, 1976), the size of which may vary with age. These latter problems can make data collected by different scholars scarcely comparable when, for instance, the level of abrasion of each measured tooth is not given. As for the postcranial elements, their scarcity makes it often necessary to merge data from different anatomical districts, thus implying the use of biometric standards and logarithmic ratios, as proposed by various authors (see Albarella, 2002 for a synthesis). In the selection of measurable bones within the appendicular skeleton, the above-mentioned problems affecting Palaeolithic assemblages are compounded by the presence of elements lacking ossification centres (carpals and tarsals), as well as elements whereby the epiphyses fuse early (e.g., proximal metapodials). It is hence difficult to determine whether some of these elements belong to adult individuals who are already fully developed or rather individuals who still have some room to increase their body size. From this point of view, it must be emphasised that fragmentation does not allow the analysis of length measurements on a large scale, thus bringing the focus to width measurements. However, while length growth appears to cease with the fusion of the epiphyses, width growth may continue (Payne & Bull, 1988). Taking these issues into account, the aim of this work is to evaluate width measurements of ungulate postcranial bones from two Late Pleistocene sites of southern Italy, to identify reliable datasets for inferring changes in large mammal body size during the last glacial cycle and discuss their validity from a methodological perspective.

MATERIALS AND METHODS

The specimens analysed in this work come from Grotta Paglicci (Apulia), and Grotta della Cala (Campania) (Figure 1). At Grotta Paglicci, apart from evidence dating back to the Middle Palaeolithic, the Upper Palaeolithic sequence ranges from the Aurignacian to the Final Epigravettian (Palma di Cesnola, 2004; Ronchitelli *et al*., 2015; Borgia *et al*., 2016). The sample from this site consists of remains of wild horse (*Equus ferus*), aurochs (*Bos primigenius*) and ibex (*Capra ibex*). The remains come from the early Epigravettian Stratigraphic Units 16 and 10, dated to about 20 and 18 ka BP, respectively. The faunal remains were accumulated in the cave by humans (Boschin *et al*., 2018; Boschin, 2019).

Grotta della Cala is another reference site for the Italian Upper Palaeolitic: its sequence, starting from the Mousterian, covers Uluzzian, Protoaurignacian, Gravettian, Epigravettian, Mesolithic and other Holocene phases (Palma di Cesnola, 2001; Moroni *et al*., 2016; Martini *et al*., 2018; Rossini *et al*., 2025). The sample from this site consists of remains of red deer (*Cervus elaphus*) from layer M (evolved Epigravettian, 19-16 ka cal BP).

Artiodactyl carpal and tarsal bones (except for talus, calcaneum and os centrotarsale) were measured following Boessneck *et al*. (1963). All other bones were measured following Driesch (1976). Horse bones were measured following Eisenmann *et al*. (1988). To make the comparison more reliable, only width measurements were considered, even where length and thickness measurements were available. The high degree of fragmentation at both sites led to few complete bones (usually basipodium and some phalanges). This resulted in many isolated epiphyses being found. Bone measurements were then divided into two groups:

- Group 1: measurements of bones that could still have increased in size. It includes the elements without ossification centres (for instance almost all carpals and tarsals) and those epiphyses that fuse early (distal scapula, distal humerus, proximal radius, proximal metacarpus and metatarsus, distal phalanges 1 and 2).
- Group 2: measurements of bones that should belong to individuals with little room for growth available. It includes the other measures (proximal humerus, distal radius, femur, tibia, calcaneum, distal metacarpal and metatarsal, proximal epiphysis of phalanx 1 and 2).

In some cases, measurements from the first group were included in the second one: an example is provided by the measurement of the proximal epiphysis of a radius with the distal epiphysis well ossified but not measurable due to fragmentation. In this case, the element we are dealing with does not have large margins for growth. The logarithmic ratio was used to assess the variability of the measurements within the two groups with respect to reference standards (Payne & Bull, 1988). To evaluate the dimensional variability of the aurochs, the measurements of the skeleton of a domestic cow from the osteological reference collection of the Research Unit of Prehistory and Anthropology at the DSFTA of the University of Siena were used as a standard. The specimen is a Maremmana hybrid that has lived in the wild. For the first and the second phalanges, the aver-

FIGURE 1
Sites' location.

age of the measurements of all 8 phalanges of the complete skeleton was used. As a standard for the horse, the averages of bone measurements of 20 individuals (males and females in equal proportion) of *Equus przewalskii* made available by Vera Eisenmann were considered (data from: http://www.vera-eisenmann.com). For the red deer, the standard used consisted of the averages of measurements of individuals from the Neolithic site of Ölkam, Austria (Schmitzberger, 2001). The standard used for the ibex comprised the measurements of current male individuals published by Fernández & Monchot (2007). Data processing and Mann-Whitney test for statistical significance were performed using PAST software (Hammer *et al*., 2001). Datasets are available in the Supplementary Materials.

RESULTS

Of the five datasets analysed, the horse and ibex samples from layer 10 of Grotta Paglicci are low in number (17+15 and 11+16 specimens respectively). Figure 2 shows the comparison of the biometric data for each species with the respective standard. In the case of the aurochs, the horse (layer 10) and the red deer, Group 1 presents the lowest extremes in value distribution. This is not the case for the ibex, but this result may be due to the low number of finds. In two cases (aurochs and horse - layer 10) the variability is much higher, and Group 1 also contains the highest values. This last finding is not surprising, as some of the elements included in Group 1 are certainly bones of adult individuals that have reached their maximum body size. In three cases, using a Mann-Whitney test, the difference between the medians is significant, although sometimes borderline (aurochs: p=0.03; horse: p=0.05; red deer: p=0.05). Although the datasets of the ibex look different, the variation between their medians is not significant (p=0.15). Once again, this could be due to the low number of observations. The most interesting case emerging from Figure 2 is that of the horse from layer 16 of Grotta Paglicci: in this case the distribution of values between Group 1 and Group 2 is very similar and the medians do not differ significantly (p=0.8). The results obtained for the horse population of layer 16 are consistent with the distribution of individuals by age classes, since in this layer deciduous or non-abraded permanent teeth represent 45.6% of the total, whereas in layer 10 only 23.4% belong to this category (Boschin, 2013). This suggests that the higher incidence of young individuals in layer 16 may lead to an overrepresentation of crossover cases and thus a harder separation between the groups, in contrast to layer 10 where the distinction is clearer.

DISCUSSION AND CONCLUSIONS

The aim of this work is to resume, through the discussion of new data, the problem of finding reliable post-cranial anatomical elements to be used in biometric analyses when bone remains are extremely fragmented. As other authors have pointed out (e.g., Payne & Bull, 1988), it is clear that certain anatomical parts have greater margins for growth during life and may therefore give an inaccurate estimate of adult body size within a population. The importance of the choice of anatomical elements to be relied upon becomes clear when our data are used to test the shift in horse size at Grotta Paglicci between layer 10 and layer 16. Indeed, the two datasets have different distributions, and a significant variation in the median values would result from merging Group 1 and Group 2 (p=0.002). Using only the data from Group 2, which can be considered more reliable based on our results, there is no difference in the distribution of values, and the medians do not differ (p=0.16). Another interesting aspect lies in the combination of age-at-death data with the biometric ones: as observed for the horse in layer 10 of Grotta Paglicci, the lower the number of young individuals, the less significant the difference between Group 1 and Group 2, and thus the greater the reliability of Group 1 values.

As a general assessment of the results obtained, all analysed populations refer to extremely late phases of the Last Glacial Maximum (Paglicci - layer 16) or to phases of the early Late Glacial (Paglicci - layer 10 and Cala - layer M). The horses tend to be larger than the average size of the reference population (*E. przewalski*), the latter consisting of both male and female individuals. As far as the aurochs are concerned, we are faced with individuals tending to be larger than the standard (although not all of them). The aurochs appear to be comparable in size to the individuals from MIS 9 published by Wright

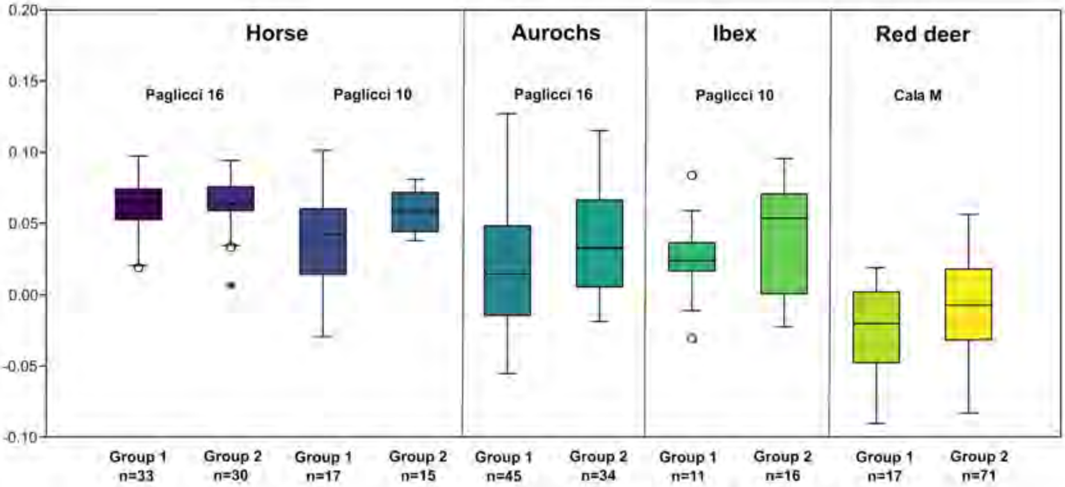

FIGURE 2

Distribution of values from the log-ratio analysis in the considered populations.

& Viner-Daniels (2015), although they do not reach the larger sizes. On the contrary, they seem to tend to be larger in size than Holocene individuals from northern Europe published by the same authors, even though some overlap is visible. The data on the ibex show a tendentially higher distribution with respect to the standard. This is striking to note, as the reference population averages are based on males only. Paglicci individuals would therefore be more robust than the current alpine individuals. Finally, the red deer show dimensions comparable to those of the reference standard, which has a Holocene chronology. Despite being thus faunas referable to a cold climatic phase, the red deer in Grotta della Cala do not show the same trend observed, for example, among the ibexes in Paglicci.

The data discussed here represent preliminary results. As stated earlier, the purpose of this work is to keep the debate on the choice of biometric data alive. This contribution can therefore serve as a basis for the collection of further biometric data from other layers of Grotta della Cala and Grotta Paglicci, to observe possible diachronic trends in size variations of individuals and to compare the Tyrrhenian and Adriatic areas of Italy during the last glacial period.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_016

REFERENCES

Albarella, U. 2002: "Size matters": how and why biometry is still important in zooarchaeology. In: Dobney, K. & O'Connor, T. (eds.): *Bones and the Man, Studies in honour of Don Brothwell*: 51-62. Oxbow Books, Oxford.

Boessneck, J.; Jequier, I.P. & Stampfli, H.R. 1963: Seeberg Burgäschisee-Sud, Teil 3, Die Tierreste. *Acta Berniensa 2*, Verlag Stämpfli & Cie, Bern.

Borgia, V.; Boschin, F. & Ronchitelli, A. 2016: Bone and antler working at Grotta Paglicci (Rignano Garganico, Foggia, southern Italy). *Quaternary International* 403: 23–39. DOI:10.1016/j.quaint.2015.11.116.

Boscato, P. & Crezzini, J. 2012: Middle-Upper Palaeolithic transition in Southern Italy: Uluzzian macromammals from Grotta del Cavallo (Apulia). *Quaternary International* 252: 90-98.
DOI: 10.1016/j.quaint.2011.03.028.

Boschin, F. 2013: *I macromammiferi epigravettiani di Grotta Paglicci: dati paleoecologici, tafonomici e paleoeconomici inseriti nel contesto Tardoglaciale dell'Italia Meridionale*. Università degli Studi di Siena, Siena.

— 2019: Exploitation of carnivores, lagomorphs and rodents at Grotta Paglicci during the Epigravettian: The dawn of a new subsistence strategy? *Journal of Archaeological Science: Reports* 26: 101871. DOI: 10.1016/j.jasrep.2019.101871.

— 2020: Holocene macromammal remains from Grotta dell'Edera/Stenašca, Trieste Karst (excavations in 1990–2001). *Arheološki vestnik* 71: 321–357; DOI: 10.3986/AV.71.11 321.

Boschin, F.; Boscato, P.; Berto, C.; Crezzini, J. & Ronchitelli, A. 2018: The palaeoecological meaning of macromammal remains from archaeological sites exemplified by the case study of Grotta Paglicci (Upper Palaeolithic, southern Italy). *Quaternary Research* 90: 470-482. DOI:10.1017/qua.2018.59.

Boschin, F.; Bernardini, F.; Pilli, E.; Vai, S.; Zanolli, C.; Tagliacozzo, A.; Fico, R.; Fedi, M.; Corny, J.; Dreossi, D.; Lari, M.; Modi, A.; Vergata, C.; Tuniz, C.; Moroni, A.; Boscato, P.; Caramelli, D. & Ronchitelli, A. 2020: The first evidence for Late Pleistocene dogs in Italy. *Scientific Reports* 10: 13313. DOI: 10.1038/s41598-020-69940-w.

Crezzini, J.; Boscato, P.; Ricci, S.; Ronchitelli, A.; Spagnolo, V. & Boschin, F. 2016: A spotted hyaena den in the Middle Palaeolithic of Grotta Paglicci (Gargano promontory, Apulia, Southern Italy). *Archaeological and Anthropological Sciences* 8: 227–240. DOI: 10.1007/s12520-015-0273-0

Davis, S.J.M. & Mataloto, R. 2012: Animal remains from Chalcolithic São Pedro (Redondo, Alentejo): evidence for a crisis in the Mesolithic. *Revista Portuguesa de Arqueologia* 15: 47-85.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from Archaeological Sites*. Peabody Museum, Harvard University, Cambridge.

EISENMANN, V.; ALBERDI, M.T.; DE GIULI, C. & STAESCHE U. 1988: Volume I: Methodology. In: Woodburne, M. & Sondaar, P. (eds.): *Studiyng Fossil Horses, Collected Papers after the "New York International Hipparion Conference, 1981"*. E.J. Brill, Leiden.

FERNÁNDEZ, H. & MONCHOT, H. 2007: Sexual Dimorphism in Limb Bones of Ibex (*Capra ibex* L.): Mixture Analysis Applied to Modern and Fossil Data. *International Journal of Osteoarchaeology 17*: 479–491. DOI: 10.1002/oa.876.

HAMMER, Ø.; HARPER, D.A.T. & RYAN, D.P. 2001: Past: Paleontological Statistics Software Pakage for education and data analysis. *Paleontologia Electronica* 4(1): 1-9.

HARBERS, H.; NEAUX, D.; ORTIZ, K.; BLANC, B.; LAURENS, F.; BALY, I.; CALLOU, C.; SCHAFBERG, R.; HARUDA, A.; LECOMPTE, F.; CASABIANCA, F.; STUDER, J.; RENAUD, S.; CORNETTE, R.; LOCATELLI, Y.; VIGNE, J-D.; HERREL, A. & CUCCHI, T. 2020: The mark of captivity: plastic responses in the ankle bone of a wild ungulate (Sus scrofa). *Royal Society Open Science* 7: 192039. DOI: 10.1098/rsos.192039.

MARTINI, I.; RONCHITELLI, A.; ARRIGHI, S.; CAPECCHI, G.; RICCI, S.; SCARAMUCCI, S.; SPAGNOLO, V.; GAMBASSINI, P. & MORONI, A. 2018: Cave clastic sediments as a tool for refining the study of human occupation of prehistoric sites: insights from the cave site of La Cala (Cilento, southern Italy). *Journal of Quaternary Science* 33: 586-596. DOI: 10.1002/jqs.3038.

MORONI, A.; BOSCATO, P.; ALLEVATO, E.; BENOCCI, A.; DI BELLA, F.; DI PASQUALE, G.; FAVILLI, L.; MANGANELLI, G. & GAMBASSINI, P. 2016: The Mesolithic occupation at Grotta della Cala (Marina di Camerota - Salerno - Italy). A preliminary assessment. *Preistoria Alpina* 48: 171–182.

PALMA DI CESNOLA, A. 2001: *Le Paléolithique supérieur en Italie*, Série 'Préhistoire d'Europe', 9. Jérôme Millon, Grenoble.

— 2004: La sequenza stratigrafica della Grotta. In: Palma di Cesnola, A. (ed.): *Paglicci. L'Aurignaziano e Il Gravettiano Antico*: 21-25. Claudio Grenzi Editore, Foggia.

PAYNE, S. & BULL, G. 1988: Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archaeozoologia* II (1-2): 27-66.

PELLETIER, M.; KOTIAHO, A.; NIINIMÄKI, S. & SALMI, A-K. 2022: Impact of selection and domestication on hindlimb bones of modern reindeer populations: Archaeological implications for early reindeer management by Sámi in Fennoscandia. *Historical Biology* 34: 805-820. DOI: 10.1080/08912963.2021.1947268.

RONCHITELLI, A.; MUGNAINI, S.; ARRIGHI, S.; ATREI, A.; CAPECCHI, G.; GIAMELLO, M.; LONGO, L.; MARCHETTINI, N.; VITI, C. & MORONI, A. 2015: When technology joins symbolic behaviour: the Gravettian burials at Grotta Paglicci (Rignano Garganico - Foggia -Southern Italy). *Quaternary International* 359: 423–441. DOI:10.1016/j.quaint.2014.08.038.

ROSSINI, M.; TOMASSO, A; BOSCHIN, F.; MARTINI, I.; CREZZINI, J.; DOMINICI, C.; MORONI, A. 2025: Early Epigravettian backed pieces from layer O of Grotta della Cala (Southern Italy). A techno-typological and use-wear integrated approach. Journal of Archaeological Science: Reports 62: 105046.
DOI: 10.1016/j.jasrep.2025.105046

SALVAGNO, L. & ALBARELLA, U. 2017: A morphometric system to distinguish sheep and goat postcranial bones. *PLoSONE* 12(6): e0178543. DOI: 10.1371/journal.pone.0178543.

SCHMITZBERGER, M. 2001: Die Tierknochen aus der mittelneolithischen Kreisgrabenanlage Ölkam (Oberösterreich). *Jahrbuch des Oberösterreichischen Musealvereins* 146/I: 43-86 + Ergänzungsheft.

SPAGNOLO, V.; MARCIANI, G.; AURELI, D.; MARTINI, I.; BOSCATO, P.; BOSCHIN, F. & RONCHITELLI, A. 2020: Climbing the time to see Neanderthal behaviour's continuity and discontinuity: SU 11 of the Oscurusciuto Rockshelter (Ginosa, Southern Italy). *Archaeological and Anthropological Sciences* 12:54. DOI: 10.1007/s12520-019-00971-9.

TRENTACOSTE, A.; NIETO-ESPINET, A. & VALENZUELA-LAMAS, S. 2018: Pre-Roman improvements to agricultural production: Evidence from livestock husbandry in late prehistoric Italy. *PLoSONE* 13(12): e0208109. DOI: 10.1371/journal.pone.0208109.

TRENTACOSTE, A.; NIETO-ESPINET, A.; GUIMARÃES, S.; WILKENS, B.; PETRUCCI, G. & VALENZUELA-LAMAS, S. 2021: New trajectories or accelerating change? Zooarchaeological evidence for Roman transformation of animal husbandry in Northern Italy. *Archaeological and Anthropological Sciences* 13: 25. DOI: 10.1007/s12520-020-01251-7.

WRIGHT, E. & VINER-DANIELS, S. 2015: Geographical variation in the size and shape of the Europeanaurochs (*Bos primigenius*). *Journal of Archaeological Science* 54: 8-22. DOI: 10.1016/j.jas.2014.11.021.

SUPPLEMENTARY MATERIALS

AUROCHS MEASUREMENTS

Group of measures	Site	Layer	Bone	Measurement	Value	Standard	Log ratio
Group 1	Paglicci	16	Talus	Bd	57	59,4	-0,018
Group 1	Paglicci	16	Talus	Bd	62,7	59,4	0,023
Group 1	Paglicci	16	Talus	Bd	52,1	59,4	-0,057
Group 1	Paglicci	16	Talus	Bd	66	59,4	0,046
Group 1	Paglicci	16	Talus	Bd	61,8	59,4	0,017
Group 1	Paglicci	16	Talus	Bd	58,4	59,4	-0,007
Group 1	Paglicci	16	Talus	Bd	60	59,4	0,004
Group 1	Paglicci	16	Os centrotarsale	GB	76,1	74,6	0,009
Group 1	Paglicci	16	Secundum et Terzium	2 - Breadth	57,1	47,4	0,081
Group 1	Paglicci	16	Secundum et Terzium	2 - Breadth	54	47,4	0,057
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	33,5	33,1	0,005
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	36,2	33,1	0,039
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	40,6	33,1	0,089
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	35,5	33,1	0,030
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	39,6	33,1	0,078
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	34,3	33,1	0,015
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	38,7	33,1	0,068
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	40,4	33,1	0,087
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	31,1	33,1	-0,027
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	34	33,1	0,012
Group 1	Paglicci	16	Intermedium	2 - Dorsal breadth	35,1	33,1	0,025
Group 1	Paglicci	16	Quartum	1 - Distal breadth	46,8	35,4	0,121
Group 1	Paglicci	16	Quartum	1 - Distal breadth	42	35,4	0,074
Group 1	Paglicci	16	Quartum	1 - Distal breadth	34,1	35,4	-0,016
Group 1	Paglicci	16	Quartum	1 - Distal breadth	38	35,4	0,031
Group 1	Paglicci	16	Quartum	1 - Distal breadth	32,1	35,4	-0,042
Group 1	Paglicci	16	Quartum	1 - Distal breadth	37,8	35,4	0,028
Group 1	Paglicci	16	Quartum	1 - Distal breadth	35,3	35,4	-0,001
Group 1	Paglicci	16	Quartum	1 - Distal breadth	31,5	35,4	-0,051
Group 1	Paglicci	16	Metatarsal	Bp	60,4	63,9	-0,024
Group 1	Paglicci	16	Metatarsal	Bp	60,8	63,9	-0,022
Group 1	Paglicci	16	Metatarsal	Bp	63,3	63,9	-0,004
Group 1	Paglicci	16	Metatarsal	Bp	73,9	63,9	0,063
Group 1	Paglicci	16	Phalanx 1	Bd	33,7	36,2	-0,031
Group 1	Paglicci	16	Great cuneiform	2 - GB	27,5	30,4	-0,044
Group 1	Paglicci	16	Great cuneiform	2 - GB	29,3	30,4	-0,016
Group 1	Paglicci	16	Great cuneiform	2 - GB	29,1	30,4	-0,019
Group 1	Paglicci	16	Great cuneiform	2 - GB	34,1	30,4	0,050
Group 1	Paglicci	16	Great cuneiform	2 - GB	32,4	30,4	0,028
Group 1	Paglicci	16	Great cuneiform	2 - GB	27,1	30,4	-0,050
Group 1	Paglicci	16	Great cuneiform	2 - GB	28,7	30,4	-0,025
Group 1	Paglicci	16	Great cuneiform	2 - GB	26,4	30,4	-0,061
Group 1	Paglicci	16	Great cuneiform	2 - GB	29,5	30,4	-0,013
Group 1	Paglicci	16	Great cuneiform	2 - GB	32,1	30,4	0,024
Group 1	Paglicci	16	Great cuneiform	2 - GB	29,4	30,4	-0,015
Group 2	Paglicci	16	Metacarpal	Bd	74	76,4	-0,014
Group 2	Paglicci	16	Metacarpal	Bd	81,8	76,4	0,030
Group 2	Paglicci	16	Tibia	Bp	126,1	125,3	0,003

Group 2	Paglicci	16	Tibia	Bd	80,2	83,1	-0,015
Group 2	Paglicci	16	Tibia	Bd	81	83,1	-0,011
Group 2	Paglicci	16	Tibia	Bd	82,6	83,1	-0,003
Group 2	Paglicci	16	Tibia	Bd	87,9	83,1	0,024
Group 2	Paglicci	16	Tibia	Bd	91,1	83,1	0,040
Group 2	Paglicci	16	Phalanx 1	Bp	36	38,1	-0,025
Group 2	Paglicci	16	Phalanx 1	Bp	38	38,1	-0,001
Group 2	Paglicci	16	Phalanx 1	Bp	38,5	38,1	0,005
Group 2	Paglicci	16	Phalanx 1	Bp	38,7	38,1	0,007
Group 2	Paglicci	16	Phalanx 1	Bp	41,6	38,1	0,038
Group 2	Paglicci	16	Phalanx 1	Bp	41,7	38,1	0,039
Group 2	Paglicci	16	Phalanx 1	Bp	41,9	38,1	0,041
Group 2	Paglicci	16	Phalanx 1	Bp	42	38,1	0,042
Group 2	Paglicci	16	Phalanx 1	Bp	42,4	38,1	0,046
Group 2	Paglicci	16	Phalanx 1	Bp	42,8	38,1	0,051
Group 2	Paglicci	16	Phalanx 1	Bp	48,1	38,1	0,101
Group 2	Paglicci	16	Phalanx 1	Bp	48,7	38,1	0,107
Group 2	Paglicci	16	Phalanx 1	Bp	48,9	38,1	0,108
Group 2	Paglicci	16	Phalanx 1	Bp	48,9	38,1	0,108
Group 2	Paglicci	16	Phalanx 1	Bp	49	38,1	0,109
Group 2	Paglicci	16	Phalanx 2	Bp	35,5	36,6	-0,013
Group 2	Paglicci	16	Phalanx 2	Bp	35,5	36,6	-0,013
Group 2	Paglicci	16	Phalanx 2	Bp	36,6	36,6	0
Group 2	Paglicci	16	Phalanx 2	Bp	37,3	36,6	0,008
Group 2	Paglicci	16	Phalanx 2	Bp	37,3	36,6	0,008
Group 2	Paglicci	16	Phalanx 2	Bp	37,7	36,6	0,013
Group 2	Paglicci	16	Phalanx 2	Bp	41,7	36,6	0,057
Group 2	Paglicci	16	Phalanx 2	Bp	43,2	36,6	0,072
Group 2	Paglicci	16	Phalanx 2	Bp	44	36,6	0,080
Group 2	Paglicci	16	Phalanx 2	Bp	44	36,6	0,080
Group 2	Paglicci	16	Radius	Bp	106	102,7	0,014

HORSE MEASUREMENTS

Group of measures	Site	Layer	Bone	Measurement	Value	Standard	Log ratio
Group 1	Grotta Paglicci	10	Metacarpal	5 - Proximal articular breadth	53,8	47,6	0,053
Group 1	Grotta Paglicci	10	Humerus	7 - Maximal breadth of the trochlea	76	70	0,036
Group 1	Grotta Paglicci	10	Humerus	7 - Maximal breadth of the trochlea	64,6	70	-0,035
Group 1	Grotta Paglicci	10	Talus	3 - Breadth of the trochlea at the apex of each condyle	28,6	28,5	0,002
Group 1	Grotta Paglicci	10	Talus	4 - Maximal breadth	61	57,11	0,029
Group 1	Grotta Paglicci	10	Talus	5 - Distal articular breadth	49,5	48,01	0,013
Group 1	Grotta Paglicci	10	Talus	5 - Distal articular breadth	56,2	48,01	0,068
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	48,7	43,6	0,048
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	48,7	43,6	0,048
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	54,3	43,6	0,095
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	49,5	43,6	0,055
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	50	43,6	0,059
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	46,3	43,6	0,026
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	47,7	43,6	0,039
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	46,1	43,6	0,024
Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	44	43,6	0,004

Group 1	Grotta Paglicci	10	Phalanx 3	4 - Articular breadth	43,3	43,6	-0,003
Group 2	Grotta Paglicci	10	Radius	11 - Breadth of the radial condyle	28,6	26	0,041
Group 2	Grotta Paglicci	10	Tibia	7 - Distal maximal breadth	73,6	68,4	0,032
Group 2	Grotta Paglicci	10	Tibia	7 - Distal maximal breadth	79,6	68,4	0,066
Group 2	Grotta Paglicci	10	Tibia	7 - Distal maximal breadth	81,3	68,4	0,075
Group 2	Grotta Paglicci	10	Phalanx 1	4 - Proximal breadth	53,8	49,6	0,035
Group 2	Grotta Paglicci	10	Phalanx 1	4 - Proximal breadth	56,8	49,6	0,059
Group 2	Grotta Paglicci	10	Phalanx 1	4 - Proximal breadth	58,1	49,6	0,069
Group 2	Grotta Paglicci	10	Phalanx 1	4 - Proximal breadth	58,4	49,6	0,071
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	55	48,8	0,052
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	55	48,8	0,052
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	55,3	48,8	0,054
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	54,5	48,8	0,048
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	54,4	48,8	0,047
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	53	48,8	0,036
Group 2	Grotta Paglicci	10	Phalanx 2	4 - Proximal maximal breadth	53,3	48,8	0,038
Group 1	Grotta Paglicci	16	Metacarpal	5 - Proximal articular breadth	53,3	47,6	0,049
Group 1	Grotta Paglicci	16	Metacarpal	5 - Proximal articular breadth	55	47,6	0,063
Group 1	Grotta Paglicci	16	Metacarpal	5 - Proximal articular breadth	55,6	49	0,055
Group 1	Grotta Paglicci	16	Metacarpal	7 - Maximal breadth of the trochlea	43,2	41,9	0,013
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	73,5	70	0,021
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	77,1	70	0,042
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	80,4	70	0,060
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	80,5	70	0,061
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	84	70	0,079
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	76	70	0,036
Group 1	Grotta Paglicci	16	Humerus	7 - Maximal breadth of the trochlea	83,4	70	0,076
Group 1	Grotta Paglicci	16	Radius	5 - Proximal articular breadth	80,6	69,6	0,064
Group 1	Grotta Paglicci	16	Radius	5 - Proximal articular breadth	77,2	69,6	0,045
Group 1	Grotta Paglicci	16	Radius	5 - Proximal articular breadth	72	69,6	0,015
Group 1	Grotta Paglicci	16	Radius	5 - Proximal articular breadth	72,4	69,6	0,017
Group 1	Grotta Paglicci	16	Radius	7 - Proximal maximal breadth	86	77	0,048
Group 1	Grotta Paglicci	16	Radius	7 - Proximal maximal breadth	87,1	77	0,054
Group 1	Grotta Paglicci	16	Scapula	5 - Articular maximal breadth	52,6	44,7	0,071
Group 1	Grotta Paglicci	16	Scapula	5 - Articular maximal breadth	48,7	44,7	0,037
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	57	48,01	0,075
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	54	48,01	0,051
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	55	48,01	0,059
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	55,1	48,01	0,060
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	55,1	48,01	0,060
Group 1	Grotta Paglicci	16	Talus	5 - Distal articular breadth	55	48,01	0,059
Group 1	Grotta Paglicci	16	Phalanx 1	7 - Distal articular breadth	49	39,7	0,091
Group 1	Grotta Paglicci	16	Phalanx 2	6 - Distal articular maximal breadth	50,7	45,2	0,050
Group 1	Grotta Paglicci	16	Phalanx 2	6 - Distal articular maximal breadth	50,9	45,2	0,052
Group 1	Grotta Paglicci	16	Phalanx 3	4 - Articular breadth	52,1	43,6	0,077
Group 1	Grotta Paglicci	16	Phalanx 3	4 - Articular breadth	50,7	43,6	0,066
Group 1	Grotta Paglicci	16	Phalanx 3	4 - Articular breadth	50,6	43,6	0,065
Group 1	Grotta Paglicci	16	Phalanx 3	4 - Articular breadth	53,2	43,6	0,086
Group 1	Grotta Paglicci	16	Phalanx 3	4 - Articular breadth	52,8	43,6	0,083
Group 2	Grotta Paglicci	16	Femur	7 - Distal maximal breadth	93,6	84,3	0,045
Group 2	Grotta Paglicci	16	Metacarpal	11 - Distal maximal articular breadth	49,6	45,7	0,036

Group 2	Grotta Paglicci	16	Metacarpal	10 - Distal maximal supra-articular breadth	54,5	45,7	0,076
Group 2	Grotta Paglicci	16	Radius	8 - Distal articular breadth	66,9	59	0,055
Group 2	Grotta Paglicci	16	Radius	8 - Distal articular breadth	68,2	59	0,063
Group 2	Grotta Paglicci	16	Radius	8 - Distal articular breadth	69,4	59	0,071
Group 2	Grotta Paglicci	16	Radius	8 - Distal articular breadth	63	59	0,028
Group 2	Grotta Paglicci	16	Radius	8 - Distal articular breadth	68,2	59	0,063
Group 2	Grotta Paglicci	16	Radius	10 - Distal maximal breadth	82	69,7	0,071
Group 2	Grotta Paglicci	16	Radius	10 - Distal maximal breadth	83	69,7	0,076
Group 2	Grotta Paglicci	16	Radius	10 - Distal maximal breadth	79,6	69,7	0,058
Group 2	Grotta Paglicci	16	Radius	10 - Distal maximal breadth	84	69,7	0,081
Group 2	Grotta Paglicci	16	Radius	10 - Distal maximal breadth	78,9	69,7	0,054
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	77,3	68,4	0,053
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	78,3	68,4	0,059
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	80,3	68,4	0,070
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	78,1	68,4	0,058
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	80,4	68,4	0,070
Group 2	Grotta Paglicci	16	Tibia	7 - Distal maximal breadth	77,6	68,4	0,055
Group 2	Grotta Paglicci	16	Phalanx 1	4 - Proximal breadth	56,5	49,6	0,057
Group 2	Grotta Paglicci	16	Phalanx 1	4 - Proximal breadth	49,7	49,6	0,001
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	55,9	48,8	0,059
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	52,6	48,8	0,033
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	59,8	48,8	0,088
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	55,5	48,8	0,056
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	55,1	48,8	0,053
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	52	48,8	0,028
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	55,3	48,8	0,054
Group 2	Grotta Paglicci	16	Phalanx 2	4 - Proximal maximal breadth	57,1	48,8	0,068
Group 2	Grotta Paglicci	16	Calcaneum	6 - Distal maximal breadth	56,4	48,4	0,066

IBEX MEASUREMENTS

Group of measures	Site	Layer	Bone	Measurement	Value	Standard	Log ratio
Group 1	Paglicci	10	Talus	Bd	24	23,4	0,011
Group 1	Paglicci	10	Talus	Bd	24,4	23,4	0,018
Group 1	Paglicci	10	Talus	Bd	24,5	23,4	0,020
Group 1	Paglicci	10	Talus	Bd	25,1	23,4	0,030
Group 1	Paglicci	10	Talus	Bd	25,1	23,4	0,030
Group 1	Paglicci	10	Metacarpal	Bp	34,2	33,3	0,012
Group 1	Paglicci	10	Metatarsal	Bp	27,8	27	0,013
Group 1	Paglicci	10	Metatarsal	Bp	30,5	27	0,053
Group 1	Paglicci	10	Metatarsal	Bp	32,3	27	0,078
Group 1	Paglicci	10	Humerus	Bd	40,9	44,5	-0,037
Group 1	Paglicci	10	Humerus	Bd	42,8	44,5	-0,017
Group 2	Paglicci	10	Calcaneum	GB	30,3	26,6	0,057
Group 2	Paglicci	10	Calcaneum	GB	32,6	26,6	0,088
Group 2	Paglicci	10	Metacarpal	Bd	43,1	37,1	0,065
Group 2	Paglicci	10	Metacarpal	Bd	43,5	37,1	0,069
Group 2	Paglicci	10	Metacarpal	Bd	45,6	37,1	0,090
Group 2	Paglicci	10	Metatarsal	Bd	32,3	33	-0,009
Group 2	Paglicci	10	Metatarsal	Bd	32,4	33	-0,008
Group 2	Paglicci	10	Metatarsal	Bd	37,4	33	0,054

Group 2	Paglicci	10	Metatarsal	Bd	38,2	33	0,064
Group 2	Paglicci	10	Radius	Bp	41,3	44,1	-0,028
Group 2	Paglicci	10	Radius	Bp	47,8	44,1	0,035
Group 2	Paglicci	10	Radius	Bp	48,2	44,1	0,039
Group 2	Paglicci	10	Tibia	Bd	33,6	34,1	-0,006
Group 2	Paglicci	10	Tibia	Bd	34	34,1	-0,001
Group 2	Paglicci	10	Tibia	Bd	37,8	34,1	0,045
Group 2	Paglicci	10	Tibia	Bd	38,3	34,1	0,050

RED DEER MEASUREMENTS

Group of measures	Site	Layer	Bone	Measurement	Value	Standard	Log ratio
Group 1	Grotta della Cala	M	Talus	Bd	35,3	35,4	-0,001
Group 1	Grotta della Cala	M	Talus	Bd	36,5	35,4	0,013
Group 1	Grotta della Cala	M	Talus	Bd	33,5	35,4	-0,024
Group 1	Grotta della Cala	M	Talus	Bd	34,9	35,4	-0,006
Group 1	Grotta della Cala	M	Talus	Bd	35,3	35,4	-0,001
Group 1	Grotta della Cala	M	Talus	Bd	33,9	35,4	-0,019
Group 1	Grotta della Cala	M	Talus	Bd	32,8	35,4	-0,033
Group 1	Grotta della Cala	M	Talus	Bd	31,2	35,4	-0,055
Group 1	Grotta della Cala	M	Humerus	Bd	54,8	58,2	-0,026
Group 1	Grotta della Cala	M	Humerus	Bd	50,6	58,2	-0,061
Group 1	Grotta della Cala	M	Humerus	Bd	58,1	58,2	-0,001
Group 1	Grotta della Cala	M	Humerus	BT	53,7	54,68	-0,008
Group 1	Grotta della Cala	M	Radius	BFp	47,7	53	-0,046
Group 1	Grotta della Cala	M	Radius	BFp	47,4	53	-0,048
Group 1	Grotta della Cala	M	Radius	BP	50,1	56,5	-0,052
Group 1	Grotta della Cala	M	Radius	BP	49,3	56,5	-0,059
Group 1	Grotta della Cala	M	Scapula	BG	34,3	42,83	-0,096
Group 2	Grotta della Cala	M	Tibia	Bd	48,1	50,38	-0,020
Group 2	Grotta della Cala	M	Tibia	Bd	54,7	50,38	0,036
Group 2	Grotta della Cala	M	Tibia	Bd	47	50,38	-0,030
Group 2	Grotta della Cala	M	Tibia	Bd	48,9	50,38	-0,013
Group 2	Grotta della Cala	M	Tibia	Bd	50,1	50,38	-0,002
Group 2	Grotta della Cala	M	Tibia	Bd	47,1	50,38	-0,029
Group 2	Grotta della Cala	M	Phalanx 1	Bp	22,7	22,26	0,009
Group 2	Grotta della Cala	M	Phalanx 1	Bp	23,3	22,26	0,020
Group 2	Grotta della Cala	M	Phalanx 1	Bp	22,2	22,26	-0,001
Group 2	Grotta della Cala	M	Phalanx 1	Bp	22,9	22,26	0,012
Group 2	Grotta della Cala	M	Phalanx 1	Bp	19,9	22,26	-0,049
Group 2	Grotta della Cala	M	Phalanx 1	Bp	18,4	22,26	-0,083
Group 2	Grotta della Cala	M	Phalanx 1	Bp	21,6	22,26	-0,013
Group 2	Grotta della Cala	M	Phalanx 1	Bp	23,4	22,26	0,022
Group 2	Grotta della Cala	M	Phalanx 1	Bp	21,6	22,26	-0,013
Group 2	Grotta della Cala	M	Phalanx 1	Bp	21,8	22,26	-0,009
Group 2	Grotta della Cala	M	Phalanx 1	Bp	22,9	22,26	0,012
Group 2	Grotta della Cala	M	Phalanx 1	Bp	21,2	22,26	-0,021
Group 2	Grotta della Cala	M	Phalanx 1	Bp	19,6	22,26	-0,055
Group 2	Grotta della Cala	M	Phalanx 1	Bp	22,8	22,26	0,010
Group 2	Grotta della Cala	M	Phalanx 1	Bp	20,4	22,26	-0,038
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,3	21,73	0,030
Group 2	Grotta della Cala	M	Phalanx 2	Bp	17,8	21,73	-0,087

Group 2	Grotta della Cala	M	Phalanx 2	Bp	24,4	21,73	0,050
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22,4	21,73	0,013
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,9	21,73	0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,1	21,73	0,027
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,1	21,73	-0,034
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22,1	21,73	0,007
Group 2	Grotta della Cala	M	Phalanx 2	Bp	18,3	21,73	-0,075
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,1	21,73	0,027
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,9	21,73	0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,8	21,73	0,040
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22,6	21,73	0,017
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,7	21,73	-0,021
Group 2	Grotta della Cala	M	Phalanx 2	Bp	18,3	21,73	-0,075
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,7	21,73	-0,021
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22,4	21,73	0,013
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,2	21,73	0,028
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,4	21,73	0,032
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,9	21,73	0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,6	21,73	-0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22,1	21,73	0,007
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,8	21,73	0,001
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,9	21,73	0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	23,1	21,73	0,027
Group 2	Grotta della Cala	M	Phalanx 2	Bp	19,8	21,73	-0,040
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,2	21,73	-0,032
Group 2	Grotta della Cala	M	Phalanx 2	Bp	19,6	21,73	-0,045
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,2	21,73	-0,032
Group 2	Grotta della Cala	M	Phalanx 2	Bp	22	21,73	0,005
Group 2	Grotta della Cala	M	Phalanx 2	Bp	17,7	21,73	-0,089
Group 2	Grotta della Cala	M	Phalanx 2	Bp	19,4	21,73	-0,049
Group 2	Grotta della Cala	M	Phalanx 2	Bp	19,6	21,73	-0,045
Group 2	Grotta della Cala	M	Phalanx 2	Bp	21,6	21,73	-0,003
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20,3	21,73	-0,030
Group 2	Grotta della Cala	M	Phalanx 2	Bp	20	21,73	-0,036
Group 2	Grotta della Cala	M	Metacarpal	Bd	41,7	43,2	-0,015
Group 2	Grotta della Cala	M	Metacarpal	Bd	45,3	43,2	0,021
Group 2	Grotta della Cala	M	Metacarpal	Bd	41,6	43,2	-0,016
Group 2	Grotta della Cala	M	Metacarpal	Bd	46,4	43,2	0,031
Group 2	Grotta della Cala	M	Metacarpal	Bd	41,5	43,2	-0,017
Group 2	Grotta della Cala	M	Metacarpal	Bd	36,9	43,2	-0,068
Group 2	Grotta della Cala	M	Metacarpal	Bd	40,3	43,2	-0,030
Group 2	Grotta della Cala	M	Metacarpal	Bd	37,3	43,2	-0,064
Group 2	Grotta della Cala	M	Metatarsal	Bd	46,4	44,7	0,016
Group 2	Grotta della Cala	M	Metatarsal	Bd	39,9	44,7	-0,049
Group 2	Grotta della Cala	M	Metatarsal	Bd	38,8	44,7	-0,061
Group 2	Grotta della Cala	M	Metatarsal	Bd	43,1	44,7	-0,016
Group 2	Grotta della Cala	M	Metatarsal	Bd	39,1	44,7	-0,058
Group 2	Grotta della Cala	M	Metatarsal	Bd	41	44,7	-0,038

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Gli animali nell'alto medioevo toscano tra fonti scritte e dati archeozoologici

Animals between written sources and archaeozoological data in tuscany in the early middle ages

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RIASSUNTO: Nel panorama dei documenti altomedievali informazioni utili alla comprensione delle modalità di gestione del bestiame da parte delle aziende rurali, sono fornite soprattutto dai polittici e dai contratti agrari. I primi, spesso redatti da grandi proprietari monastici con svariate aziende dipendenti, offrono un panorama più ampio occupandosi di inventariare i beni posseduti e in quali aree questi vengono prodotti, mentre i secondi possono fornire indicazioni sulla gestione del bestiame all'interno dei possedimenti delle singole aziende.

In questo contributo i dati provenienti da alcuni siti rurali toscani, con particolare attenzione per i campioni provenienti dalle fasi altomedievali degli abitati di Miranduolo (Chiusdino - SI) e Poggio Imperiale (Poggibonsi – SI), vengono integrati con le fonti scritte al fine di comprendere con più precisione i rapporti tra centri curtensi e contadini dipendenti.

Lo scavo in estensione del sito di Miranduolo ha permesso di individuare alcuni indicatori che, confrontati con le fonti scritte, hanno permesso di ipotizzare la presenza di affittuari nei dintorni del sito fortificato. Poggio Imperiale, dove risulta indagato il solo nucleo dominico, rivela un modello di sfruttamento delle risorse animali diverso dagli altri siti rurali toscani orientato all'allevamento di buoi e caprini domestici.

PAROLE CHIAVE: SITI RURALI, ALTO MEDIOEVO, PRODUZIONI SPECIALIZZATE, *CURTIS*, FONTI SCRITTE

ABSTRACT: Information from early medieval documents is useful to understand husbandry strategies in farmhouses. In this paper, details are provided by polyptychs and agrarian contracts. Polyptychs, often drawn by monastic owners and/or their dependent farmhouses, offer broad scenarios by laying focus on inventorying assets and the properties in which they were produced. Agrarian contracts, in turn, can provide indications on the management of livestock within individual properties. This paper surveys the data from the Tuscan rural sites of Miranduolo (Chiusdino - SI) and Poggio Imperiale (Poggibonsi - SI), with particular attention laid on the animal remains from the early medieval phases. By comparing the material evidence with the written sources we tried to more precisely understand the relationship existing between the *Curtes* and their peasants.

The extensive excavation at Miranduolo revealed indicators which, when compared with the written sources, hinted at the presence of dependent farmhouses in the surroundings of this fortified site. At Poggio Imperiale, where only the dominic core area was investigated, husbandry practices oriented towards the breeding of cattle and sheep/goat were revealed that contrasted with those recorded on other Tuscan rural sites.

KEYWORDS: RURAL SITES, EARLY MIDDLE AGES, SPECIALIZED PRODUCTIONS, *CURTIS*, WRITTEN SOURCES

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RESUMEN: La información que proporciona la documentación temprana medieval resulta útil para conocer las estrategias pecuarias en granjas de aquel momento. En este artículo, los detalles vienen proporcionados por polípticos y contratos agrarios. Los polípticos, con frecuencia dibujados por los propietarios monásticos o en granjas dependientes, ofrecen escenarios generales por centrarse en el inventario de activos y sobre las propiedades donde se realizaron. Los contratos agrarios, a su vez, pueden proporcionar indicaciones sobre la gestión del ganado dentro de las distintas propiedades.
Este artículo analiza datos de los yacimientos rurales de Miranduolo (Chiusdino - SI) y Poggio Imperiale (Poggibonsi - SI) en la Toscana, dedicando especial atención a los restos animales de las fases medievales tempranas. Comparando la evidencia material con las fuentes escritas intentamos comprender con mayor precisión la relación que existía entre las *Curtes* y sus campesinos.
La extensa excavación de Miranduolo reveló indicios que, una vez comparados con las fuentes documentales, apuntaban a la presencia de granjas asociadas en los alrededores del asentamiento fortificado. En Poggio Imperiale, donde sólo se estudió el núcleo dominical, se evidenciaron prácticas ganaderas orientadas a la cría de ganado vacuno y ovino/caprino que contrastaban con las registradas en otros sitios rurales de la Toscana.

PALABRAS CLAVE: SITIOS RURALES, ALTA EDAD MEDIA, PRODUCCIONES ESPECIALIZADAS, *CURTIS*, FUENTES ESCRITAS

INTRODUZIONE

Il presente articolo mira a fornire una spiegazione alle differenze riscontrate in alcuni campioni faunistici altomedievali della Toscana centro meridionale. I siti analizzati nello specifico sono Miranduolo (Chiusdino, SI), indagato tra il 2001 ed il 2016 (direttore scientifico Marco Valenti, Università degli studi di Siena), e Poggio Imperiale (Poggibonsi, SI), investigato negli anni 1993-2009 e 2017-2019 (direttori scientifici Riccardo Francovich e Marco Valenti, Università degli studi di Siena), (Figure 1) per i quali era possibile accedere ai dati archeozoologici.

Miranduolo inizia la sua vita nel VII secolo e continua ad essere abitato senza soluzione di continuità fino alla metà del XIV secolo (Valenti, 2022), mentre Poggio Imperiale presenta sequenze abitative alternate ad abbandoni. Sull’insediamento tardoantico abbandonato, sorge un villaggio in età longobarda a cui segue l’occupazione di età carolingia strutturata in un’azienda curtense. L’insediamento viene abbandonato nel corso del X secolo. L’area verrà nuovamente rioccupata a partire dal 1155 con la fondazione della “quasi città” di Poggio Bonizio e, con vicende alterne, sarà abitata fino al 1313 (Valenti, 2007: 84).

Oggetto di questo studio sono i nuclei dominici di IX-X secolo dei due insediamenti. Nel caso di Miranduolo si tratta dell’area sommitale del sito con *longhouse*, magazzini e aree artigianali separate dal resto dell’abitato da un fossato e da una palizzata difensiva (vedi ricostruzione in Figura 1). Per Poggio Imperiale l’analisi è stata limitata alla *longhouse* e alle strutture funzionali nelle sue immediate vicinanze, tra cui una interpretata come macelleria (Valenti, 2007: 118-119). In questo insediamento mancano ad oggi tracce di strutture per separare l’area in questione dal resto dell’abitato (vedi ricostruzione in Figura 1).

Se per il primo sito i dati archeozoologici discussi in questa sede sono quelli definitivi[1], per il secondo è necessario precisare che i risultati qui esposti riguardano solo una parte del campione faunistico[2]. In attesa dello studio completo dei resti osteologici, i risultati dell’analisi dei dati disponibili sono suscettibili a future modifiche.

METODO

Per la determinazione tassonomica e anatomica sono state utilizzate le collezioni di confronto dell’Università degli Studi di Siena[3]. Maiali e cinghiali non sono stati distinti a causa della scarsità

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[1] In attesa della pubblicazione integrale, una sintesi dei dati è stata recentemente pubblicata (Dall’Olio, 2022).

[2] Si fa riferimento ai resti osteologici schedati da Frank Salvadori tra la fine degli anni ’90 del secolo scorso ed il 2005, già pubblicati in forma sintetica (Salvadori, 2007). A questi resti è stata aggiunta l’avifauna schedata da chi scrive.

[3] Per entrambi i campioni sono state utilizzate le collezioni del Laboratorio di Archeologia Ambientale del Dipartimento di Scienze storiche e dei beni culturali e del Laboratorio di Archeozoologia del Dipartimento di Scienze Fisiche, della Terra e dell’Ambiente.

FIGURA 1
Localizzazione dei siti trattati e rispettive ricostruzioni dei nuclei dominici.

di dati osteometrici utili a distinguere le diverse forme. La determinazione del sesso dei maiali è avvenuta sulla base della morfologia dei canini.

I dati provenienti da sequenze mandibolari e denti isolati sono stati raccolti seguendo i parametri di Grant (1982) poi convertiti in età ontogenetiche attraverso i codici proposti da Hambleton (2001) per maiali, mentre per i caprini domestici è stato utilizzato Payne (1973). I dati riguardanti lo stato di fusione delle epifisi fanno riferimento a Bull & Payne (1982) per i maiali, Bullock & Rackham (1982) per i caprini domestici e Silver (1969) per i buoi.

I CASI DI MIRANDUOLO E POGGIO IMPERIALE: DUE CENTRI DI POTERE A CONFRONTO

I due centri differiscono sia dal punto di vista strutturale che da quello delle restituzioni materiali. Miranduolo presenta un'area fortificata che ospita, oltre alla casa dominica, attività produttive e magazzini in cui sono attestati grandi contenitori da conserva funzionali allo stoccaggio di risorse alimentari che venivano poi redistribuite agli altri abitanti dell'insediamento (Menghini *et al*., 2020). A Poggio Imperiale il controllo su risorse alimentari e attività produttive è indicato dalla presenza di una struttura dedicata alla preparazione dei tagli di carne e alla lavorazione delle pelli, di un'officina metallurgica, di un granaio e di una fornace da ceramica nelle immediate vicinanze della *longhouse* (Valenti, 2007: 114-122; Menghini, 2021).

La principale fonte di carne nel caso di Miranduolo è il maiale, seguito da caprini domestici e bue (Tabella 1). Il campione, per quanto riguarda le ossa lunghe, si presenta molto frammentario a causa dei processi tafonomici subiti dai resti dovuti soprattutto alla macellazione. I dati sull'età di morte, ottenuti principalmente da denti isolati e sequenze mandibolari che rappresentano la maggior

	Miranduolo	Poggibonsi
Sus sp. (Maiale, cinghiale, incroci)	268	90
Ovis vel *Capra* (Pecora/Capra)	179	156
Bos taurus L. (Bue)	47	108
Equus asinus L. (Asino domestico)	4	7
Equidae (Cavallo/Ibridi/Equidi indeterminati)	4	6
Canis familiaris L. (Cane)	2	0
Cervus elaphus L. (Cervo)	5	0
Capreolus capreolus L. (Capriolo)	3	0
Lepus europaeus P. (Lepre)	3	1
Oryctolagus cuniculus L. (Coniglio)	0	1
Gallus domesticus L. (Gallo domestico)	16	15
Anser sp. L. (Oca domestica/selvatica)	0	1
Testudo spp. (Testuggine di Hermann/Greca)	26	1
Totale resti determinati	**557**	**386**

TABELLA 1

Resti determinati nei nuclei dominici dei siti di Miranduolo e Poggio Imperiale.

parte delle ossa rinvenute per le tre categorie dei principali domestici (Figura 2), indicano per i maiali abbattimenti concentrati tra i 12 ed i 27 mesi a cui si aggiunge un piccolo nucleo di animali macellati entro primo anno di vita. I caprini domestici rinvenuti nell'area oggetto di questo contributo vengono abbattuti in età sub-adulta o adulta e più precisamente tra il secondo ed il terzo/quarto anno o entro i sei/otto anni, mentre sono rari gli esemplari di età inferiore ai 12 mesi. L'allevamento era quindi orientato principalmente verso la produzione di carne e lana. Per i buoi sono attestati almeno un esemplare giovane (al di sotto degli otto mesi) ed animali sub-adulti e senili.

Tra gli altri domestici comunemente utilizzati per l'alimentazione sono presenti asino, cavallo/mulo (di cui uno di età inferiore ai 36 mesi) ed esemplari maturi di gallo domestico. La cacciagione è rappresentata da lepre, capriolo e cervo con pochi frammenti per specie.

Nel caso di Poggio Imperiale la categoria più rappresentata è quella dei caprini domestici, seguiti dal bue e dal maiale (Tabelle 1). Le ossa lunghe si presentano meno frammentate rispetto a quelle di Miranduolo. Inoltre, per le principali specie domestiche la frequenza dei denti e dei frammenti mascellari e mandibolari è molto bassa. Di conseguenza, i dati sull'età di morte sono stati ricavati solo dallo stato di fusione delle epifisi delle ossa lunghe. Per i maiali risulta un modello di abbattimento simile a quello di Miranduolo con una prevalenza di sub-adulti accompagnati da esemplari di età inferiore agli 11/12 mesi a cui si aggiungono però animali adulti che hanno superato i tre anni (Materiale Supplementare 1). I caprini domestici vengono abbattuti soprattutto in età sub-adulta ma sono presenti anche esemplari di età inferiore ai 12 mesi e altri, in minor misura, che superano i cinque anni (Materiale Supplementare 2). Le età di abbattimento indicano quindi un allevamento tendente principalmente alla produzione di carne, anche di buona qualità con la macellazione di animali giovani, e lana. La produzione di latte aveva forse un ruolo meno marginale rispetto a Miranduolo ma l'assenza di dati sull'usura dentaria non permette di quantificarla. I buoi erano in generale adulti anche se almeno un esemplare deve essere stato abbattuto prima dei 24/30 mesi (Materiale Supplementare 3). La scarsità di frammenti cranici e denti non permette di stabilire con maggiore precisione le classi di abbattimento, ma la presenza di maiali e caprini domestici abbattuti entro i 12 mesi e di maiali di età superiore ai tre anni (probabilmente scrofe), consente di ipotizzare che l'allevamento degli animali di media taglia si svolgesse quantomeno nei dintorni dell'insediamento.

Tra gli altri domestici sono presenti sia asino che cavallo/mulo, rappresentato da parti terminali delle zampe (falangi e sesamoidi) rinvenuti nella struttura interpretata come macelleria, e il gallo domestico. Un tarsometatarso attribuito a generico galliforme immaturo ma con ogni probabilità riferibile al gallo domestico (l'unica specie dell'ordine presente nel campione), potrebbe confermare l'allevamento di questi animali all'interno dell'abitato finora solo ipotizzato per la presenza di una strut-

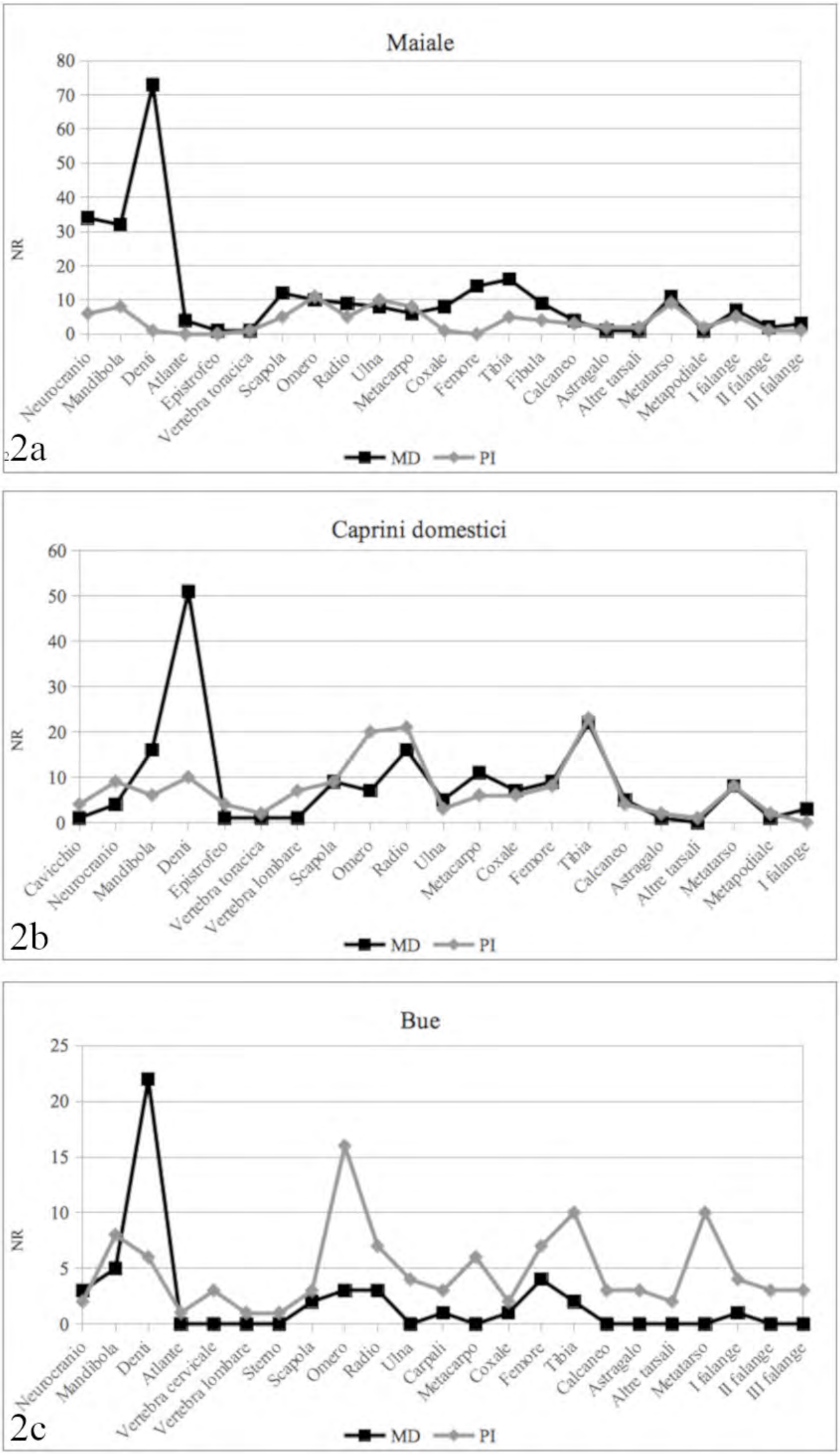

FIGURA 2

Frequenze anatomiche dei principali domestici nei siti di Miranduolo e Poggio Imperiale.

tura nei pressi della *longhouse* interpretata come pollaio (Valenti, 2007: 116-117).

Tra gli altri animali determinati compaiono l'oca ed il coniglio con un solo frammento per specie. Nell'alto medioevo l'oca era allevata nelle aziende dell'Italia settentrionale[4], ma non sembra che fosse presente nei siti rurali del centro-sud (Corbino & Albarella, 2019) quindi potrebbe trattarsi di un'intrusione da stratigrafie cronologicamente posteriori o di un esemplare selvatico.

Il coniglio sembra essersi diffuso attraverso le comunità monastiche perché i monaci per primi ne praticarono l'allevamento claustrale, forse già a partire dall'alto medioevo (Masseti, 2008: 223-226). La vicinanza del sito all'abbazia di Marturi rende quindi possibile, almeno teoricamente, la presenza della specie nell'area già in questo periodo. Tuttavia, è più probabile che si tratti di un'intrusione perché le identificazioni note in Toscana riguardano il basso medioevo. La specie è presente a Miranduolo (metà XII-metà XIV secolo), nelle fasi cantieristiche e di vita della cucina e del refettorio dell'Abbazia di San Galgano (prima metà XIII-XIV secolo) (Dall'Olio, 2022), e a Prato nel contesto di XIV secolo di Palazzo Banci Buonamici (Corbino, 2010: 88).

La selvaggina è rappresentata da un solo frammento attribuito a lepre.

GLI ANIMALI NEI DOCUMENTI ALTOMEDIEVALI

Ciò che emerge dalla documentazione di età longobarda è l'importanza di pastori e allevatori (in genere di condizione servile) in qualità di gestori di beni economici. L'editto di Rotari, riportando le pene inflitte per le offese arrecate ai servi pastori, rivela l'esistenza di addetti specializzati nella cura dei diversi animali allevati (tra questi, il valore più alto è riconosciuto al capo porcaro). Menzioni di allevatori e pastori specializzati si trovano poi nelle dotazioni iniziali di vari enti religiosi a cui venivano forniti animali e servi che ne avessero cura (Montanari, 1979: 222-223).

Dalla prima metà dell'VIII secolo compaiono nei diplomi regi le *casae bubulcaricie*, ben distinte dalle *casae massariciae* come i *bubulci* sono ben distinti dai *massari*. Esistevano quindi aziende e/o dipendenti che si occupavano dell'allevamento di buoi. Poiché le menzioni di queste figure sono poco numerose rispetto a quelle delle *casae massariciae* e dei *massari*, è probabile che vi fosse una quantità limitata di allevatori specializzati che rifornivano di buoi le aziende con vocazione prevalentemente agricola. Questa interpretazione sembra essere confermata dai successivi inventari dei grandi proprietari monastici (o polittici) che riportano i beni dominici presenti nelle aziende dipendenti. Rispetto alla quantità di terra arabile, il numero di buoi è generalmente molto basso come sono scarse le attestazioni di vacche e tori. Solo in poche aziende si trova un buon numero di buoi e/o vacche. Due esempi in tal senso provengono dagli inventari del monastero di Farfa dell'855 e del monastero di Santa Giulia di Brescia datato alla seconda metà del IX-inizio X secolo. Nel caso di Farfa, l'azienda è quella di Antrodoco in cui sono presenti vacche e un toro; nel caso di Santa Giulia è la *curtis* di Bradellas a mostrare un buon numero di buoi e un'alta produzione di fieno necessario al loro mantenimento nei mesi invernali. La scarsità di buoi nelle terre dominicali è spiegabile in parte con le prestazioni d'opera legate all'aratura dei terreni che spesso per contratto gli affittuari dovevano eseguire con i propri animali. Inoltre, in almeno un caso il bue rientra nelle corresponsioni. Dall'inventario di fine X secolo del monastero di Santa Cristina di Corteolona (Pavia), risulta che alcuni dipendenti dovevano consegnare un bue ogni tre anni del valore di cinque o sei soldi (Fumagalli, 1985).

Le specie di grande taglia, presenti solo in alcune aziende e di rado in quantità relativamente alte, erano comunque sempre affiancate da maiali, pecore e/o capre e da volatili da cortile rappresentati, almeno nel caso di Santa Giulia, da polli e oche (Montanari, 1979: 226-227). Tra questi, un ruolo di primo piano è assegnato anche in età carolingia all'allevamento del maiale tanto che l'estensione dei boschi viene spesso misurata in base alla quantità di capi che potevano sostentare (Montanari, 1979: 232-237). Il maiale costituiva la principale fonte di proteine animali, non solo in Italia. Gli statuti dell'Abbazia di Corbie dell'822 prevedono la consegna della decima parte degli animali e dei loro prodotti ma per il maiale viene richiesto un preciso numero di capi per averne abbastanza da poter soddisfare il fabbisogno dei monaci, degli ospiti e dei servi prebendari. Inoltre, era previsto

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[4] L'oca è presente in buona parte delle aziende rurali citate nell'inventario di X secolo del monastero di Santa Giulia di Brescia (Montanari, 1979: 226-227).

che un certo numero di animali dovesse essere tenuto come riserva in caso di bisogno (Montanari, 1985).

I beni richiesti per l'affitto dei terreni vengono riportati nei contratti agrari e a volte negli inventari delle grandi aziende. Per la Toscana la maggior parte delle informazioni provengono da contratti stipulati in Garfagnana, Lunigiana e Maremma tra l'VIII ed il X secolo, e da notizie contenute negli inventari del vescovato lucchese datati alla seconda metà del IX secolo (Andreolli, 1999: 111-116).

Nei contratti più antichi di età longobarda, spesso la specie da corrispondere non viene definita ma l'animale deve avere un anno di età (*annotino*). Quando la specie viene precisata, si tratta di maiali, pecore e capre. A questi si aggiungono polli, uccelli selvatici e pesci in qualche caso. Caprini domestici, formaggi e a volte fieno e ghiande per il mantenimento degli animali delle terre dominicali vengono richiesti più frequentemente nelle aree a nord di Lucca, mentre per la Maremma sono più attestate le corresponsioni di maiali e uccelli selvatici. Le ultime richieste di animali imprecisati si trovano all'inizio del IX secolo, mentre quelle di maiali diminuiscono fino a sparire nel X secolo. Il quadro generale vede una rarefazione dei canoni in natura tra il IX ed il X secolo che vengono trasformati in censi in denaro, pratica che si riscontra anche nel nord Italia (Andreolli, 1999: 206-208).

Tuttavia, continuano ad essere richiesti i donativi, beni dal valore simbolico da corrispondere in determinati periodi dell'anno in aggiunta al canone. Tra questi figurano l'*amiscere*, citato nei contratti dell'Italia centro-settentrionale, che indica generalmente una spalla di maiale da consegnare a Natale, e polli e uova di solito in rapporto di 1:5 o 1:10 (Andreolli, 1999: 208; Pasquali, 2002: 102-105).

DISCUSSIONE E CONCLUSIONI

Le fonti relative all'età carolingia nel complesso mostrano una certa attenzione alle vocazioni produttive delle aree in cui sono situate le aziende.

Non si tratta però di una specializzazione esclusiva poiché nelle aziende per cui si può supporre l'allevamento di specie di grande taglia atto a rifornire le altre terre dominiche, sono presenti anche caprini domestici, maiali e uccelli domestici. La richiesta di canoni, che almeno in apparenza variano a seconda del tipo di produzione più adatta al territorio (maiali nell'area maremmana e caprini domestici nella Toscana settentrionale), potrebbe anche essere legata al permanere di usi longobardi. Infatti, prima della conquista carolingia i canoni sono raramente precisati e si fa piuttosto riferimento alle consuetudini locali. Dopo la conquista, sia le corresponsioni che le prestazioni d'opera vengono definite con precisione (Andreolli, 1999: 111-124) ma è possibile che i beni richiesti siano rimasti gli stessi, cioè quelli definiti dalle consuetudini.

I campioni dei siti rurali toscani dell'area compresa tra Siena, Grosseto e la costa tirrenica, confermano la prevalenza del maiale tra le specie allevate almeno fino ai secoli centrali del medioevo e più spesso fino al XIII secolo. Negli insediamenti di Montarrenti (Clark, 2003), Campiglia Marittima (Salvadori, 2004), Rocchette Pannocchieschi (Salvadori, 2013), Vetricella (Aniceti, 2020) e Miranduolo (Dall'Olio, 2022) la principale risorsa carnea è il maiale seguito generalmente dai caprini domestici. Le analisi sono state condotte quasi esclusivamente sui resti provenienti dai nuclei dominici degli insediamenti che, oltre alla prevalenza del maiale, hanno in comune anche l'alta frequenza delle ossa della testa per tutti i principali domestici dovuta probabilmente a un controllo diretto sulla macellazione da parte degli abitanti delle aree indagate. È anche possibile che i dipendenti fossero tenuti a consegnare le teste degli animali allevati (Baruzzi & Montanari, 1981: 55) ma questa pratica è nota dalle fonti solo per la cacciagione. Le teste dei cervi cacciati sono richieste dalla Corte di Sermide nel 1082, mentre dei maiali si chiede la decima parte e ai piccoli proprietari anche due lombi (Fumagalli, 1974: 17). Altre richieste di teste compaiono nel tardo medioevo in Lazio ma si tratta sempre di selvatici (Cortonesi, 1995: 154-156). Nei campioni osteologici citati i resti di selvatici sono poco frequenti e di conseguenza non è possibile verificare se questa pratica fosse in uso.

Gli animali allevati richiesti come canone venivano probabilmente consegnati soprattutto vivi o comunque interi. Possibili tracce della corresponsione di determinate parti anatomiche sono state riconosciute per il sito di Campiglia Marittima nel X secolo in cui l'arto posteriore del maiale è poco rappresentato rispetto a quello anteriore che veniva forse utilizzato come canone (Salvadori, 2004).

Qualche indicazione in più proviene dal sito di Miranduolo. Lo scavo in estensione ha permesso di individuare delle differenze nella distribuzione dei resti osteologici nelle zone indagate. Scrofe, equidi e parti anatomiche relative ai tagli di buona qualità del bue (omero e femore) sono attestati solo nel nucleo dominico e nelle strutture esterne all'insediamento principale poste alle pendici settentrionali del poggio, mentre esemplari giovani di bue e caprini domestici sono stati rinvenuti solo nell'area privilegiata. Si ipotizzano quindi una gestione diretta dell'allevamento dei principali domestici da parte del nucleo dominico che redistribuisce le risorse ai servi, e la presenza di affittuari nei dintorni del sito[5] che posseggono e allevano animali di loro proprietà utilizzati per il pagamento di canoni e per le prestazioni d'opera.

Oltre a questi dati, la presenza di soli esemplari maturi di gallo domestico, potrebbe indicare la recezione di donativi da parte del *dominus*[6].

Il sito di Poggio Imperiale presenta invece delle caratteristiche anomale rispetto al panorama generale perché negli altri nuclei dominici indagati in Toscana e citati precedentemente, la prevalenza di caprini domestici e bue sul maiale non trova confronto fino al basso medioevo, momento in cui aumentano la richiesta di lana da immettere sui mercati e le terre coltivabili (Salvadori, 2015: 116-117). Inoltre, è l'unico insediamento in cui il maiale è l'animale meno frequente tra i principali domestici ed i frammenti cranici sono poco rappresentati. Queste evidenze, unite all'assenza di femori (fig.2), sono state interpretate come indicatori del fatto che i maiali non venissero allevati nell'insediamento e che parti scelte fossero introdotte nell'area dominica sotto forma di canoni (Salvadori, 2007). Tuttavia, la scarsità di frammenti cranici riguarda tutti i principali domestici (Figure 2) quindi è possibile che l'area di uccisione e di prima lavorazione delle carcasse non sia stata individuata.

Sebbene resti plausibile la recezione di donativi, in questo caso spalle di maiale (*amiscere*), va precisato che il dato potrebbe essere falsato. L'assenza dei femori potrebbe essere dovuta alla produzione di prosciutti conservati in una zona dell'insediamento non indagata. Un'altra spiegazione potrebbe essere data dalla vicinanza dell'Abbazia di Marturi di cui probabilmente l'azienda era dipendente. Infatti, è possibile che tra i canoni dovuti vi fossero anche prosciutti che venivano portati direttamente nei magazzini dell'Abbazia.

Il dato archeozoologico non offre un'interpretazione certa delle modalità di sfruttamento delle risorse animali, ma l'azienda probabilmente disponeva di pascoli abbastanza estesi da poter sostentare un buon numero di buoi per la lavorazione dei terreni rientrando forse in quelle aziende che rifornivano di buoi gli altri centri dominici. L'allevamento del maiale non era prioritario e parte di questi animali poteva arrivare nel sito come pagamento per i canoni di locazione.

MATERIALE SUPPLEMENTARE

Vedi materiale supplementare su https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_017

BIBLIOGRAFIA

ANDREOLLI, B. 1999: *Contadini su terre di signori: studi sulla contrattualistica agraria dell'Italia medievale*. CLUEB, Bologna.

ANICETI, V. 2020: The zooarchaeological analyses from Vetricella (Scarlino, Grosseto): an overview of animal exploitation at the site. In: Bianchi, G. & Hodges, R. (eds.): *Origins of a new economic union (7th-12th centuries). Preliminary results of the ERC nEU-Med project*: 85-93. All'insegna del Giglio, Firenze.

BARUZZI, M. & MONTANARI, M. 1981: *Porci e porcari nel Medioevo. Paesaggio economia e alimentazione*. CLUEB, Bologna.

BULL, G. & PAYNE, S. 1982: Tooth Eruption and Epiphysial Fusion in Pigs and Wild Boar. In: *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (British Series) 109. Oxford.

BULLOCK, D. & RACKHAM, J. 1982: Epiphysial Fusion and Tooth Eruption of Feral Goats from Moffatdale, Dumfories and Galloway. In: *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (British Series) 109. Oxford.

CLARK, G. 2003: The mammal bone finds from Montarrenti. In: Cantini, F. (ed.): *Il castello di Montarrenti. Lo scavo archeologico 1982-1987. Per la storia della formazione del villaggio medievale in Toscana (secc. VII-XV)*: 181-212. All'insegna del Giglio, Firenze.

CORBINO, C.A. 2010: *"Dall'allevamento alle mense" la toscna tra il XIII e la prima metà del XV secolo. Ana-*

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[5] Indicatori simili sono già presenti nell'VIII secolo (Dall'-Olio, 2022).

[6] È possibile che le ossa più fragili non si siano conservate ma va precisato che gli immaturi mancano solo in questa fase poiché sono attestati sia nella fase precedente (VIII secolo) che in quella successiva (fine X-inizio XI secolo) (Dall'Olio, 2022).

lisi archeozoologiche. Università degli Studi di Siena, Siena.

Corbino, C.A. & Albarella, U. 2019: Wild Birds of the Italian Middle Ages: Diet, Environment and Society. *Environmental Archaeology* 24(4): 449-459. DOI: 10.1080/14614103.2018.1516371

Cortonesi, A. 1995: *Ruralia. Economie e paesaggi del medioevo italiano*. Editrice "il Calamo" s.n.c., Roma.

Dall'Olio, L. 2022: I resti archeozoologici come indicatori socio-economici: la gestione della risorsa animale tra VII e XIV secolo. In: Valenti, M.; Nardini, A. & Bertoldi, S. (eds.): *Miranduolo. Le lunghe mutazioni del potere tra VII e XIV secolo*: 135-150. All'insegna del Giglio, Sesto Fiorentino.

Fumagalli, V. 1974: *Terra e società nell'Italia padana: i secoli IX e X*. Tamari, Bologna.

— 1985: Gli animali e l'agricoltura. In: *L'uomo di fronte al mondo animale nell'alto Medioevo*: 579-617. CISAM, Spoleto.

Grant, A. 1982: The Use of Tooth Wear as a Guide to the Age of Domestic Ungulates. In: *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

Hambleton, E. 2001: A Method for Converting Grant Mandible Wear Stage to Payne style Wear Stages in Sheep, Caw and Pig. In: *Archaelogical Sciences '97. Proceedings of the Conference Held at the University of Durham 2nd – 4th September 1997*: 103-108. B.A.R. (International Series) 939. Oxford.

Masseti, M. 2008: *Uomini e (non solo) topi. Gli animali domestici e la fauna antropocora*. Firenze University Press, Firenze.

Menghini, C. 2021: L'altro volto della ricchezza: due aree di potere a confronto. Miranduolo (Chiusdino-SI) e Poggibonsi (SI) tra IX e X secolo. In: Fabiani, F. & Gattiglia, G. (eds.): *Paesaggi urbani in trasformazione. Contesti e dinamiche dell'insediamento letti alla luce della fonte archeologica*: 97-108. Archaeopress Publishing Ltd, Oxford.

Menghini, C.; Nardini, A.; Palmas, C. & Bertoldi, S. 2020: Sistema di valutazione dei manufatti per un'interpretazione socio economica del sito di Miranduolo fra VIII e inizi IX secolo. *Facta* 14: 119-149.

Montanari, M. 1979: *L'alimentazione contadina nell'alto Medioevo*. Liguori Editore, Napoli.

— 1985: Gli animali e l'alimentazione umana. In: *L'uomo di fronte al mondo animale nell'alto Medioevo*: 619-672. CISAM, Spoleto.

Pasquali, G. 2002: La condizione degli uomini, In: Cortonesi, A.; Pasquali, G. & Piccinni, G. (eds.): *Uomini e campagne nell'Italia medievale*: 73-122. Laterza, Roma-Bari.

Payne, S. 1973: Kill-off Patterns in Sheep and Goats: The Mandibles from Aşvan Kale. *Anatolian Studies* 33: 281-303.

Salvadori, F. 2004: I reperti osteologici animali. In: Bianchi, G. (ed.): *Campiglia. Un castello e il suo territorio, vol.II – Indagine archeologica*: 477-511. All'insegna del Giglio, Firenze.

— 2007: Le ossa animali della fase carolingia: il consumo di carne come indicatore sociale. In: Francovich, R. & Valenti, M. (eds.): *Poggio Imperiale a Poggibonsi. Il territorio, lo scavo, il parco*: 124-131. Silvana editoriale Spa, Milano.

— 2013: I reperti osteologici animali. In: Grassi, F. (ed.): *L'insediamento medievale nelle Colline Metallifere (Toscana, Italia). Il sito minerario di Rocchette Pannocchieschi dall'VIII al XIV secolo*: 140-160. B.A.R. Publishing, Oxford.

— 2015: *Uomini e animali nel Medioevo. Ricerche archeozoologiche in Italia, tra analisi di laboratorio e censimento dell'edito*. Edizioni Accademiche Italiane, Saarbrücken.

Silver, A. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. London.

Valenti, M. 2007: La corte aperta e le strutture artigianali. In: Francovich, R. & Valenti, M. (eds): *Poggio Imperiale a Poggibonsi. Il territorio, lo scavo, il parco*: 83-124. Silvana editoriale Spa, Milano.

— 2022: Le lunghe mutazioni del potere (VII-inizi XIV secolo). In: Valenti, M.; Nardini, A. & Bertoldi, S. (eds.): *Miranduolo. Le lunghe mutazioni del potere tra VII e XIV secolo*: 14-39. All'insegna del Giglio, Sesto Fiorentino.

MATERIALE SUPPLEMENTARE 1

Stato di fusione delle epifisi – Maiale				
Elemento anatomico	**Età** (Bull, Payne 1982)	**Dati campione**		
		Non fusa	**In fusione**	**Fusa**
Scapola	7-11 mesi	1	-	2
Coxale (acetabolo)	7-11 mesi	-	-	-
Radio prossimale	> 11 mesi	-	-	3
Omero distale	> 11 mesi	4	1	2
II falange	12-18 mesi	-	-	2
I falange	19-23 mesi	4	-	1
Tibia distale	19-23 mesi	-	1	-
Metacarpo distale	> 23 mesi	4	-	1
Metatarso distale	> 23 mesi	5	-	2
Metapodio distale	> 23 mesi	2	-	-
Fibula distale	24-30 mesi	-	-	1
Omero prossimale	> 35 mesi	2	-	1
Radio distale	> 35 mesi	1	-	-
Ulna prossimale	> 35 mesi	7	-	7
Tibia prossimale	> 35 mesi	4	-	-
Fibula prossimale	> 35 mesi	2	-	-
Calcaneo	> 35 mesi	3	-	-

Poggio Imperiale. Dati sulla mortalità dei maiali in base allo stato di fusione delle epifisi.

MATERIALE SUPPLEMENTARE 2

Stato di fusione delle epifisi – Caprini domestici				
Elemento anatomico	**Età** (Bullock, Rackham 1982)	**Dati campione**		
		Non fusa	**In fusione**	**Fusa**
Scapola	12 mesi	2	-	2
Radio prossimale	-12 mesi	1	-	7
Omero distale	-12 mesi	5	-	10
Tibia distale	35 mesi	1	-	8
Metacarpo distale	48 mesi	-	-	2
Metatarso distale	48 mesi	-	-	2
Metapodio distale	48 mesi	1	-	-
Femore prossimale	36 mesi	2	-	1
Femore distale	48 mesi	-	-	1
Tibia prossimale	48 mesi	1	-	2
Omero prossimale	48-60 mesi	3	-	-
Radio distale	48-60 mesi	5	-	1
Ulna prossimale	48-60 mesi	-	-	2
Calcaneo	48-60 mesi	3	-	1

Poggio Imperiale. Dati sulla mortalità dei caprini domestici in base allo stato di fusione delle epifisi.

MATERIALE SUPPLEMENTARE 3

Stato di fusione delle epifisi – Bue				
Elemento anatomico	**Età** (Silver, 1969)	**Dati campione**		
		Non fusa	**In fusione**	**Fusa**
Radio prossimale	12-18 mesi	-	-	5
Omero distale	12-18 mesi	-	-	10
I falange	18 mesi	-	-	3
II falange	18 mesi	-	-	3
Tibia distale	24-30 mesi	1	-	5
Metatarso distale	30-36 mesi	1	-	5
Calcaneo	36 mesi	-	-	3
Femore prossimale	42 mesi	-	-	2
Omero prossimale	42-48 mesi	-	-	3
Radio distale	42-48 mesi	-	-	1
Ulna prossimale	42-48 mesi	1	-	3
Femore distale	42-48 mesi	-	-	2
Tibia prossimale	42-48 mesi	2	-	1

Poggio Imperiale. Dati sulla mortalità dei buoi in base allo stato di fusione delle epifisi.

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Zooarchaeological analysis of the faunal remains from a *pozzo di butto* of the Palazzo Ugurgieri in the historic centre of Siena

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ABSTRACT: The archaeological excavations carried out in the historic centre of Siena have recorded wells ('pozzi di butto') which were used in former times by the Sieneses for the disposal of domestic waste. Although many of these wells contained large amounts of faunal remains, to date, no zooarchaeological study has been ever conducted on them. In this paper, we report the animal remains from one *pozzo di butto* located in a wing of the Palazzo Ugurgieri. Since the second half of the 12th century AD this building was occupied by the Ugurgieri's, one of the most powerful Sienese families. The location of the residential complex in a strategic area of Siena highlights its importance, lying very close to Piazza del Campo, which was the economic and political centre of the city during the Middle Ages. The faunal analysis provides the first zooarchaeological data regarding the animal exploitation and culinary practices carried out in one of the most important buildings of the city during the 13th century.

KEYWORDS: POZZO DI BUTTO, UGURGIERI, ZOOARCHAEOLOGY, SIENA, 13th CENTURY

RIASSUNTO: Le indagini archeologiche condotte nel centro storico di Siena hanno permesso l'individuazione di alcuni pozzi di butto utilizzati in passato dai senesi per lo smaltimento dei rifiuti domestici. Nonostante molti di questi contesti abbiano restituito una buona quantità di resti faunistici, fino ad oggi nessun studio archeozoologico ha interessato questi reperti. Nel presente lavoro si sono esaminate le ossa animali recuperate in un pozzo di butto collocato in un'ala del Palazzo Ugurgieri nel centro storico di Siena. A partire dalla seconda metà del XII secolo l'edificio fu abitato da una delle più potenti famiglie senesi, appunto quella degli Ugurgieri. L'ubicazione del complesso residenziale ne evidenzia l'importanza, trovandosi in un'area strategica di Siena, immediatamente a ridosso della Piazza del Campo, centro economico e politico cittadino durante il Medioevo. Le analisi dei resti faunistici ritrovati hanno fornito i primi dati archeozoologici riguardo lo sfruttamento degli animali e le pratiche culinarie condotte nel XIII secolo all'interno di uno degli edifici più importanti della Città.

PAROLE CHIAVE: POZZO DI BUTTO, UGURGIERI, ARCHEOZOOLOGIA, SIENA, XIII SECOLO

RESUMEN: Las excavaciones arqueológicas realizadas en el centro histórico de Siena han permitido descubrir la existencia de pozos (pozzi di butto) que antiguamente utilizaban los sieneses para la eliminación de los residuos domésticos. Aunque muchos de estos pozos contenían grandes cantidades de restos faunísticos, hasta el momento no se ha realizado ningún estudio zooarqueológico

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sobre ellos. En este artículo presentamos el estudio la fauna de uno de estos pozos situado en un ala del Palacio Ugurgieri, que desde la segunda mitad del siglo XII estuvo ocupado por los Ugurgieri, una de las familias más poderosas de Siena. La ubicación del complejo residencial en una zona estratégica de la ciudad pone de relieve su importancia, pues se encuentra muy cerca de la Piazza del Campo, que fue el centro económico y político de la ciudad durante la Edad Media. El análisis faunístico proporciona los primeros datos zooarqueológicos sobre la explotación animal y las prácticas culinarias que se llevaron a cabo durante el siglo XIII en uno de los edificios más emblemáticos de la ciudad.

PALABRAS CLAVE: POZZO DI BUTTO, UGURGIERI, ZOOARQUEOLOGIA, SIENA, SIGLO XIII

INTRODUCTION

The Palazzo Ugurgieri is one of the most evocative and best-preserved sites of the medieval Siena (Figure 1S). This building is comprised into the Castellare of the Ugurgieri, a fortified complex within the city walls of Siena (Figure 9S, see Supplementary Material for further information). Between 2016 and 2017, an archaeological excavation was carried out within Palazzo Ugurgieri, which yielded for the discovery of a complex stratigraphic palimpsest dated between the 12th century and the modern age. Together with a series of plastered walls and hypogea locals, the investigations brought to light three wells. These structures, common named “pozzi di butto”, were used in the past by the Sieneses for the disposal of domestic waste. Although archaeological investigations in the historical centre of Siena have led to the identification of a good number of such structures, to date, no zooarchaeological analyses of the faunal remains recovered within them have ever been carried out. So, this paper represents a pioneering work which results underline the importance of the zooarchaeological exam of these materials to reconstruct the economic activities and the habits of the inhabitants of Siena during the Middle Age.

MATERIALS AND METHOD

This paper discusses the study of the animal assemblages from the *pozzo di butto* located in the ‘Sala Nannini’ in the Palazzo Ugurgieri (Figure 2S) containing a deposit with a chronology spanning from the second half of the 13th century to the post-medieval period (Figure 3S).

The US 18, from which the faunal sample analysed in the present study, is the lower layer of the well. It was approximately 40 cm thick. In addition to a large amount of animal bones, within it numerous and different typologies of archaeological remains were recovered (see Supplementary Material for further information). All the material was collected by hand and a sieving was undertaken. The identification of the animal remains was aided using the reference collection held in the R.U. of Prehistory and Anthropology in the Department of the Physical Science, Earth, and Environment at the University of Siena. To quantify the relative proportion of each *taxon* the NISP (Number of Identified Specimens), was used and the composition of the assemblage was described through the Minimal Number of Individuals (MNI), the Minimal Number of Elements (MNE) and the Minimal Animal Unit, expressed in MAU (Binford, 1984; Plug & Plug, 1990; Lyman, 1994; O’Connor, 2001). To assess the death age of the ungulates the eruption and wear stages were recorded for suid and caprine teeth according to Payne (1973), Grant (1982), Payne & Bull (1988) and to Wright *et al*. (2014), and the fusion stages according to Silver (1969). Biometrical measures on ungulate and bird remains were taken according to Driesch (1976). To explain the under- or over-representation of the ungulate remains the bone densities were compared with MAU through a correlation test. In order to estimate the meat value (the quantity and quality) of the ungulate bones present in the assemblage we used the three grades defined by Uerpmann (1973) (see Supplementary Material for further information regarding to the Method).

RESULTS

The faunal assemblage is composed of 858 bone fragments (NR). The analysis of the fragmentation degree of the material shows the prevalence of the fragments with size comprise between 6 and 10 cm. Remains with smaller size (1-3 and 3-6 cm) are however represented. A wide variety of species characterizes the assemblage, and the animal bones mainly belong to macromammals. The 87% of the whole sample was identified at taxonomic level (Figure 1 and Table 1S); the rest includes bone fragments related to large (e.g., *Bos taurus*, *Cervus elaphus*) and small size ungulates (e.g., suids and caprines), principally ribs, vertebrae, and scapulae fragments. Sheep/goats are the predominant ungulates according to the number of identified specimens (NISP), followed by suids. The identification of sheep and goat bones to species level was attempted on a limited range of elements, of which 30 were identified as sheep and 13 as goat. The separation of domestic pigs (*Sus domesticus*) and wild boars (*Sus scrofa*) through biometrical analyses was not possible since that on only 6 elements was possible revealed the useful measures indicated by Wright *et al*. (2014).

The proportion of cattle is low, and the red deer is the only wild ungulate identified. Only one lagomorph identification was obtained in the whole assemblage from U.S. 18: a lower third premolar of rabbit (Vismara, 2012). Birds are documented by 267 remains including a predominant quantity of bones of *Galliformes* and few elements of other *taxa* (*Anser* sp. = 6, *Columbia livia/oenas* = 3, *Perdicinae*=1). It was possible to discerning 59 elements belonging to *Gallus domesticus* and 12 belonging to *Phasianus colchicus*. Six remains of tench and one element of *Dicentrarchus labrax* were also identified (Table 1S). The skeleton frequencies of caprines, suids and cattle show an under-representation of most distal parts of the skeleton, especially, metapodials, carpal and tarsal bones and phalanges. These latter, in particularly, are completely absent in the caprine sample. Moreover, we underline the very low recovery of cranial elements of *Ovis/Capra*. The most common caprine remains are related to vertebrae, ribs, tibiae, and scapula. The hind-limbs are represented by a slightly higher number of elements (MNE) than the fore-limbs (Figure 2, Table 2S).

Concerning the overall distribution of body parts for suids, the proportion of vertebrae, ribs and scapula is higher than the proportion of other post-cranial elements, which are more equally represented. Carpal and tarsal bones are absent and only three fragments of metapodials (two of metacarpal and one of metatarsal) and two first phalanges were identified. In opposite way of caprines the suid remains included cranial elements; the hind-limbs are larger represented than the fore-limbs (Figure 3, Table 2S).

Again, in the *Bos taurus* sample the lack of acropodium elements is recorded and the most represented elements are the vertebrae, the scapula,

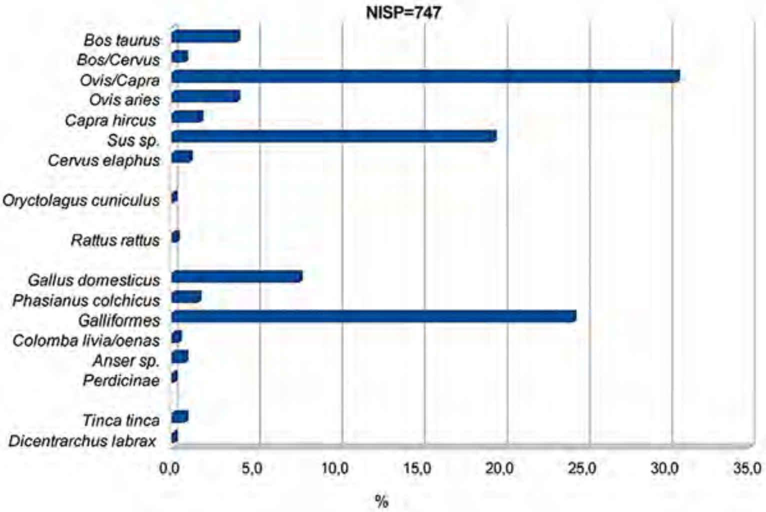

FIGURE 1
Faunal association of the US 18.

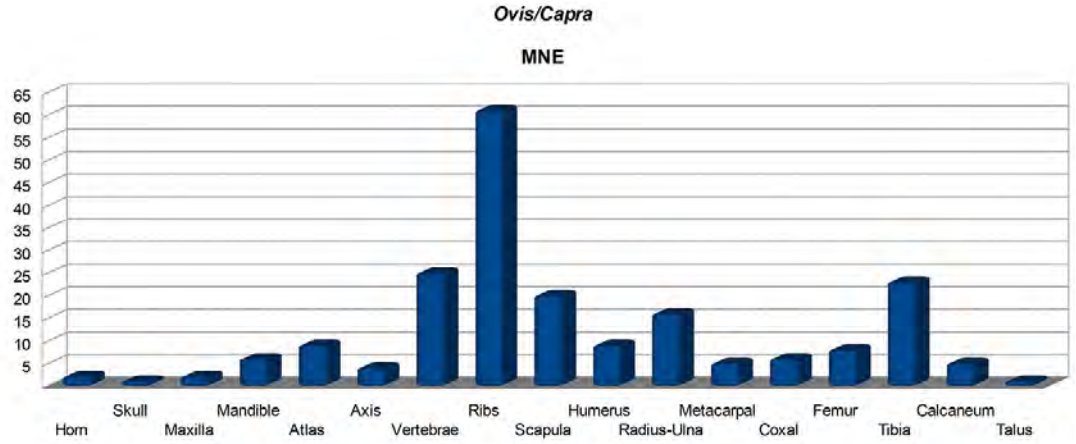

FIGURE 2
Skeletal representation of sheep/goat (MNE).

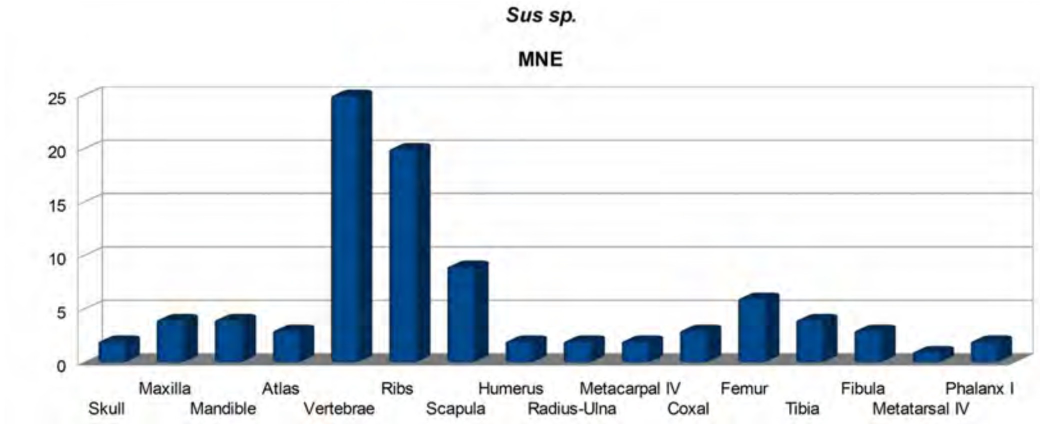

FIGURE 3
Skeletal representation of suids (MNE).

the mandible, and the tibiae. Fore-limb bones are less common than the hind-limb bones (Figure 4, Table 2S). The red deer is exclusively represented by a portion of axis and by 7 fragments of skull elements. Among the remains of *Gallus domesticus* the whole skeleton is represented, and the most numerous bones are the humerus, the femur and the tarsometatarsus (Figure 4S). For caprines and cattle there is no correlation between the MAU and the mineral density ($r_s = 0.001132$; p-value: 0.8264 and $r_s = 0.07078$; p-value: 0.2569 respectively) while for suids a significative correlation exists ($r_s = 0.1644$; p-value: 0.01414) (Figures 5S, 6S and 7S). Caprines were mostly slaughtered before they were three-four years old (Figure 8S), while suids were consumed when they were more than 12 months old (MNI=4). The evaluation of the death age in the bones of the cattle is consistent with the suggestion that most bones belonged to animals younger than 4 years (MNI=3). The 19.5% of the suid, caprine and cattle bones bear butchering marks left during the carcass processing. Predominantly, the cutmarks can be related to meat retrieval. These *striae* are mostly located on the ribs, on the spinous process of the vertebrae, on the scapula (supraspinatus, infraspinatus and subscapularis fossa), on the ileum and on the diaphyseal portions of the proximal limb bones (humerus, radius-ulna, femur and tibia). Several vertebrae were cut longitudinally at their centre probably due to the separation of the carcasses in quarters. Deeply cuts on some atlas fragments of caprines indicate the remotion of the

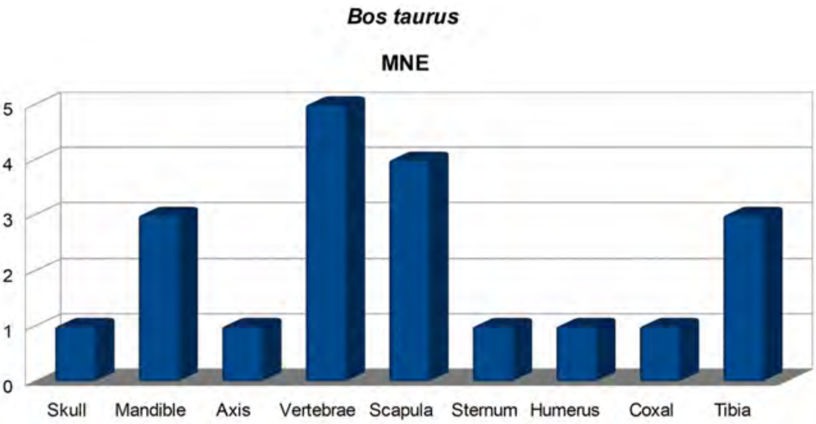

FIGURE 4

Skeletal representation of cattle (MNE).

skull while many cranial fragments of suids bear cutmarks. Traces of disarticulation and/or skinning located on the articulation regions of the bones are scarce. Impact scars are not very frequent and found exclusively on the diaphyseal fragments of a radium, a tibia and a humerus of caprines. Among the red deer remains a fragment of a hyoid bear cut marks and the axis is sawed in longitudinally at its centre. Cutmarks located in the epiphysial fragments of three tibiotarsus of *Galliformes* and of a humerus and a femur of *Gallus domesticus* were also identified.

DISCUSSION

The sheep and the goat were the *taxa* most consumed at Palazzo Ugurgieri, followed by the suids and the cattle. The results of the statistical analysis suggest that density did not play a role in the cattle and in the caprine samples compositions. Although there is a positive and significative relationship between suid bone representation and the bone mineral density, it is important to note that some elements with very low-density indices are however well represented among the suid remains (scapula, humerus, tibiae). Moreover, the exclusion from this statistical test of the MAU values related to ribs and to the vertebrae (due to the unavailability of their density values), could interferes with the right evaluation of other factors involved in the assemblage formation. Among these latter's can be included the human selection. On the other hand, the evaluation of the suid, cattle and caprine bones (MAU) in according to the meat values categories indicates the higher proportions of the categories A and B bones, related to the richest quantity and quality of the meat (Uerpmann, 1973). The carcasses of *Ovis/Capra, Sus sp*. and *Bos taurus* probably reached the cuisines of Palazzo Ugurgieri separated in quarters. In particularly, the ratio between right and left elements is around 2:1 for the caprine and for the cattle elements suggesting that the carcasses of this animal were subdivided into two halves. Differently, the ratio between right and left elements for suid remains is around 1:1 and it could indicate a carcass including both the side of the body. The first stages of the butchering occurred probably in different places where the cranium of caprines was separated from the rest of the body at the atlas or at the occipital condyle, in according to the scarcity of the cranial elements identified in our sample. In opposite way of caprines, the skull of suids was probably systematically consumed at Palazzo Ugurgieri, as suggest by the presence of cranial elements bearing cut-marks. The scarcity/absence of metapodials, carpals and tarsals bones and phalanges referable to the cattle, suids and caprines (category C bones, Uerpmann, 1973) seems also exclude the transport of these parts in the Palazzo Ugurgieri. A hypothesis is that these non-meat bearing limb bones, but rich in bone grease, could be gnawing by dogs living in the palace and/or not wasted in the *pozzo di butto*. However only a little percentage of the ungulate bones, 3.4%, bear tooth marks related to the action of a small-medium carnivore. Regarding to the origin of the anthropic traces on the bone surfaces, the cuts produced while detaching meat are more numerous than those related to the cutting of tendon insertions suggesting consumer activities than slaughtering activities. Caprine mortality profiles correspond mainly to meat consumption (Payne, 1973; Horard-Herbin, 1997) mostly focused on younger individuals than three-four years old that ensuring to the Ugurgeri's the most quality of meat from these animals. Similarly, the suid carcasses treated in Palazzo Ugurgieri were related to individuals slaughtering when they have grown enough to produce a substantial amount of high-quality meat (Horard-Herbin, 1997). Regarding to the red deer the presence of only 8 remains related to the skull and to the axis ruled out the role of this *taxa* as animal systematically exploited as food. The presence of these skeletal elements alone could suggest its function as a trophy and the cuts recorded on the bone surfaces (a striae located on the hyoid and the cut longitudinally at the centre of the axis) could be due to the removal/recovery of the tongue and of the muscle mass of the neck. Among the remains of *Gallus domesticus* we can underline the similar proportions in the occurrence of wing and leg bones that could be due to local breeding and consumption of chickens than a preferential consumption of items purchased from the market suggest by the higher frequencies of leg bones (Corbino *et al*., 2016). Data from the bird remains indicates the exploitation of wild species, although these animals are not represented by a high amount of remains. However, their consumption could be underestimated due to different factors: the fragility of small size species bones causing their less preservation (Corbino & Albarella, 2018), the difficulty to discern the pheasant elements among the remains of *Galliformes* and to identify the wild or domestic form in the few rests of *Anser* sp. and *Columba livia/oenas*. Despite we can't exclude the roasting of the meat, the scarcity of burnt bones (three remains) in the examined sample suggests the boiling as principal cooking method. Among the pottery remains the presence of fragments of ollae, adopted to the boiling of the food, can confirm this hypothesis.

CONCLUSIONS

The results of the preliminary zooarchaeological study carried out on the faunal sample from the U.S. 18 of the *pozzo di butto* locate in the "Sala Nannini" are abundant and promising. The present study has furnished important information regarding to the animal exploitation in the Palazzo Ugurgieri evidencing several aspects that can suggest the elite character of the context. The macromammal sample composition indicates the central role played by domesticates, and especially sheep and goat, in the diet of inhabitants of the palace. In several late-medieval Italian contexts, the zooarchaeological investigations show a dominance of these species than suids (Salvadori, 2003, 2015). Pinto & Zazzeri (2005) underline that in this period the sheep meat was the one of the most prized foods and it reached very high prices in according to the animal's age. At Palazzo Ugurgieri the most of caprines and suids being consumed at an age at which good quality and quantity meat should have been obtained. Moreover, the analysis of skeletal frequencies carried out on the three most exploited ungulates *taxa* indicates the dominance of bones associated with top quality meat. The parts of the skeleton related to the lesser cuts of meat are comparatively rare (or absent). During the Tuscan Middle Age, the low-middle classes had access to the less valuable fractions of these animals such as the neck and the distal limb parts (metapodials) (Pinto & Zazzeri, 2005). The high presence of these parts seems then to highlight the low social level of the population that occupied the investigated area, as recorded by Corbino (2009) in the site of the Biblioteca Magliabechiana (first half of the 13th century), for which it is hypothesised that the best cuts of the sheep and goats were destined for other parts of the city (Florence), probably inhabited by more affluent people. The relative absence of wild mammals doesn't seem sufficient to exclude the elite character of the context. In the late medieval period meat consumption alone had become an insufficiently strong marker of status (Albarella & Thomas, 2002); therefore, birds became an important component of the late medieval high-status table, contributing to a more diversified meat diet. Late medieval sources emphasise a widespread consumption of chicken, together with wild and other domestic birds, among the upper class, and this is supported by the archaeological evidence (Nigro, 1997; Corbino *et al*., 2016; Corbino & Albarella, 2018). Beside this, it is useful to underline that if the wild games could represent a food reserved to high-status people during the middle-late Middle Age, in the urban centres the foods derived by hunting practices appears often be identified with just the wild birds. The urban communities of the Central Italy in fact would have hunted predominantly birds in a ruralised environment, which surrounded the city (i.e., in the typical habitat of bird as pheasants, partridges, quails, etc.) (Salvadori, 2015). Wild birds were surely consumed by the inhabitants of the Palazzo Ugurgieri (pheasant), though the presence of small size wild bird bones in the zooarchaeological record, as often occurred in coeval site (Corbino & Albarella, 2018), is probably underestimated. Due to the frequent eve periods indicated by the Church in the year, the fishes (both marine and fluvial fishes) were high represented one of the more expensive foods during the Middle Ages (Pinto, 2002). In the assemblage from Palazzo Ugurgieri fish remains are poorly represented but these bones can have suffered the same preservation problems of the brittle wild bird bones. Nevertheless, the identification among these remains of the sea bass demonstrates the availability of goods coming from areas not close to the settlements (Salvadori, 2015). The systematic study of the ceramic remains and the other archaeological material from US 18 will permit to better understand the use of the *pozzo di butto* during the first phases of its utilization. Moreover, the enlarging of the zooarchaeological investigations to the faunal remains from the other layers of the deposit will allow to clarify many aspects regarding to the life of the people who lived in an one of the most important sienese residence during the 13th century.

SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_018

REFERENCES

Albarella, U. & Thomas, R. 2002: They Dined on Crane: Bird Consumption, Wild Fowling and Status in “Medieval England”. *Acta zoologica cracoviensia* 45 (special issue): 23-38.

Binford, L.R. 1984: *Faunal Remains from Klasies River Mouth*. Academic Press, Orlando.

Corbino, C. 2009: “Dall’allevamento alle mense” la Toscana tra il XIII e la prima metà del XV secolo. Analisi archeozoologiche. PhD dissertation, Universita degli Studi di Siena, Siena, Italy.

Corbino, C.A. & Albarella, U. 2018: Wild birds of the Italian Middle Ages: diet, environment and society. *Environ. Arch*. ISSN 1461-4103

Corbino, C.a.; Minniti, C.; Mazzorin, J. & Albarella, U. 2016: The role of chicken in the medieval food system: evidence from Central Italy. *Tijdschrift voor Mediterrane Archeologie* 28(56): 50-56.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletin, Harvard University Press, Cambridge. MA.

Grant, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing animal bones from archaeological sites:* 91-108. B.A.R. (British Series). Archaeopress, Oxford.

Horard-Herbin, M.P. 1997: Le village celtique des Arènes à Levroux. L’élevage et les productions animales dans l’économie de la fin du second âge du Fer - Levroux 4. *Fédération pour l’édition de la Revue archéologique du Centre de la France*. Supplément à la Revue archéologique du centre de la France, 12.

Lyman, R.L. 1994: Relative abundances of skeletal specimens and taphonomic analysisi of vertebrate remains. *Palaios* 9(3): 288-298.

Nigro, G. 1997: Mangiare di grasso, mangiare di magro. Il consumo di carni e pesci tra Medioevo e Età moderna. In: Cavaciocchi, S. (ed.): *Alimentazione e nutrizione secc. XIII-XVIII*. Proceddings of “Ventottesima Settimana di Studi”, 22-27 aprile 1996: 111-146. Le Monnier, Firenze.

O’connor, T.P. 2001: Animal bone quantification. In: Brothwell, D.R. & Pollard, A.M. (eds.): *Handbook of Archaeological Science*: 703–710. Wiley & Sons, New York.

Payne, S. 1973: Kill-off Patterns in Sheep and Goats: the Mandibles from Aşvan Kale. *Anatolian Stud*. 23: 281–303. https://doi.org/10.2307/3642547

Payne, S. & Bull, G. 1988: Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archaeozoologia* 2: 27–65.

Pinto, G. 2002: *Campagne e paesaggi toscani nel Medioevo*. Nardini, Firenze.

Pinto, G. & Zazzeri, R. 2005: Sulla mensa dei toscani nel medioevo: consumo, produzioni, mercati. In: Cioucfoletti, Z. & Pinto, G. (eds.): *Storia dell’alimentazione a Firenze e in Toscana*: 31-56. Firenze.

Plug, C. & Plug, I. 1990: MNI Counts as Estimates of Species Abundance. *South Afr. Archaeol. Bull*. 45: 53–57. https://doi.org/10.2307/3887918.

Salvadori, F. 2003: Archeozoologia e Medioevo: lo stato degli studi. I: Congresso Nazionale di Archeologia Medievale, Salerno 2003.

SALVADORI, F. 2015: *Uomini e Animali nel Medioevo*. 1st ed. Edizioni Accademiche Italiane.

SILVER, I.A. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology:* 283-302. Thames and Hudson, London.

UERPMANN, H.P. 1973: Animal Bone Finds and Economic Archaeology: A Critical Study of "Osteo-Archaeological" Method. *World Archaeology* 4(3): 307–322.

VISMARA, P. 2012: Il genere *Lepus* in Italia: chiavi diagnostiche morfo-odontologiche e contributi paleobiogeografici. PhD Thesis, Università di Milano.

WRIGHT, E.; VINER-DANIELS, S.; PARKER PEARSON, M. & ALBARELLA, U. 2014: Age and season of pig slaughter at late Neolithic Durrington Walls (Wiltshire, UK) as detected through a new system for recording tooth wear. *Journal of Archaeological Science* 52: 497–514.

SUPPLEMENTARY MATERIAL

FIGURE 1S

Location of the Palazzo Ugurgieri. In the lower left corner of the image a portion of the Piazza del Campo is visible.

FIGURE 2S

The *pozzo di butto* locate in the Sala Nannini (Photo: Jacopo Bruttini).

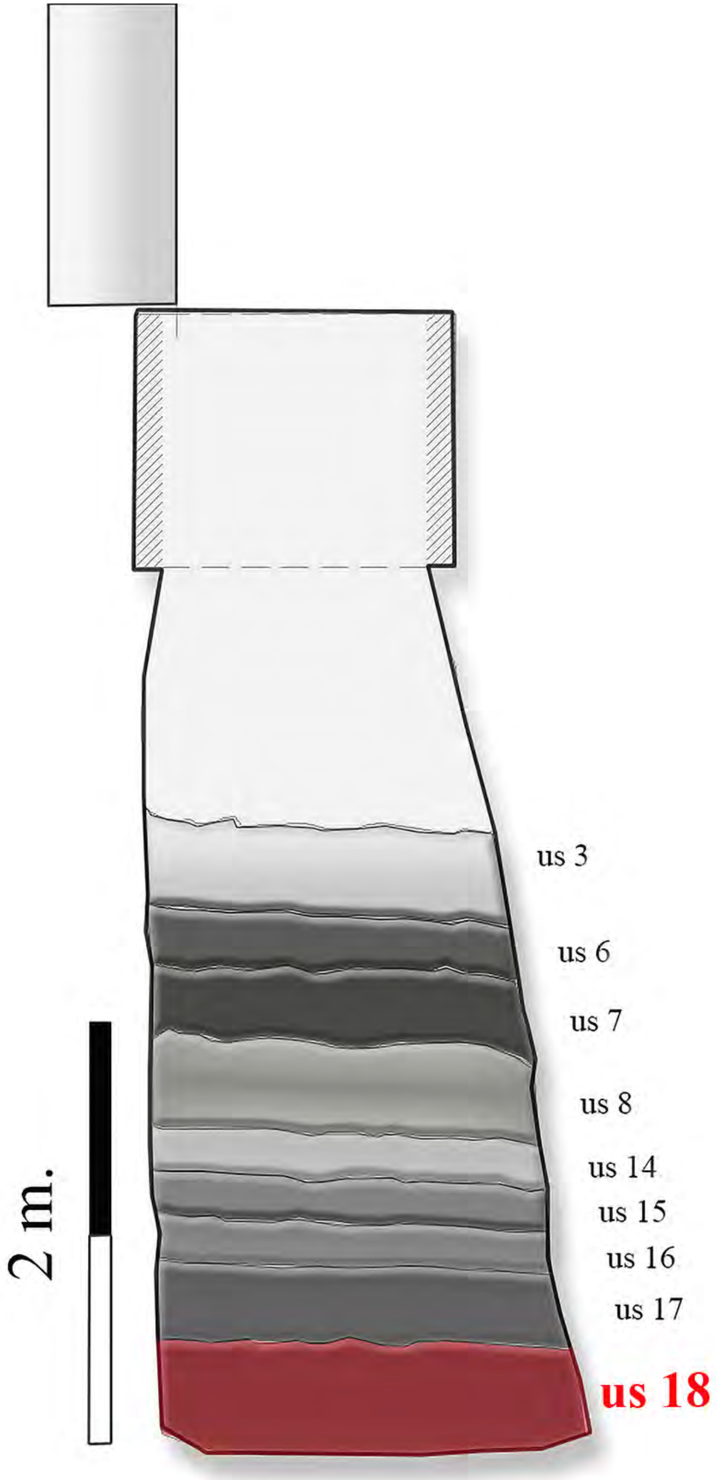

FIGURE 3S
Stratigraphy of the ***pozzo di butto*** locate in the Sala Nannini (Photo: Jacopo Bruttini).

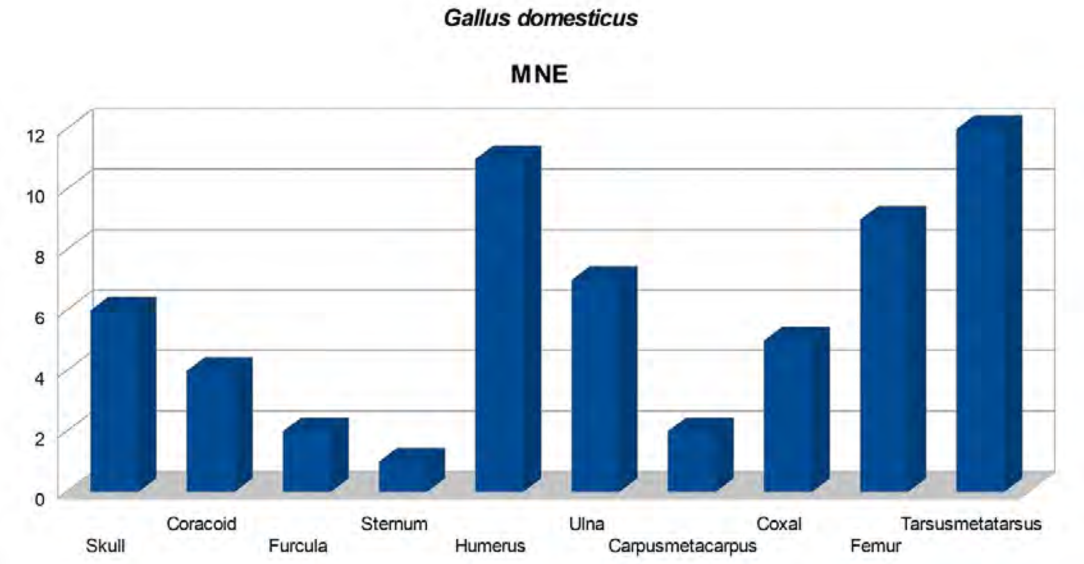

FIGURE 4S

Skeletal representation of *Gallus domesticus* (MNE).

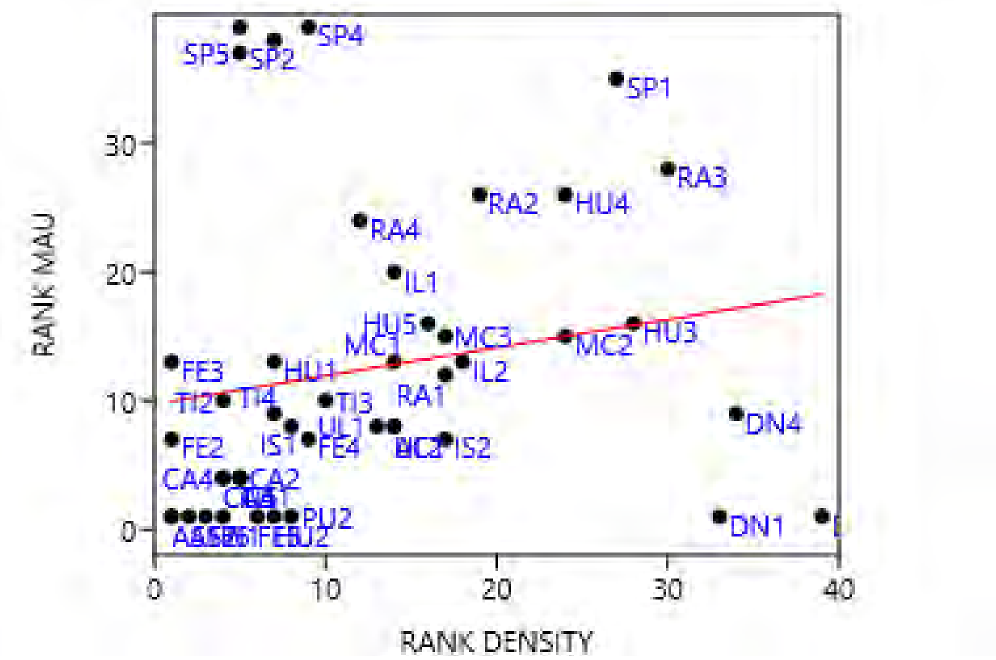

FIGURE 5S

Comparison of sheep/goat skeletal parts (RANK MAU) and mineral density indices. See Lyman (1984) for codes used.

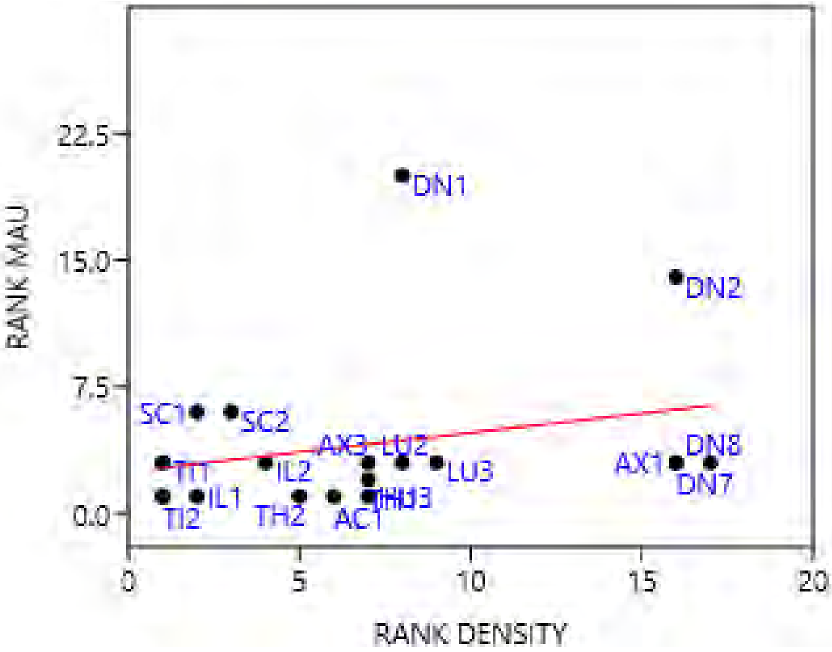

FIGURE 6S

Comparison of cattle skeletal parts (RANK MAU) and mineral density indices. See Lyman (1984) for codes used.

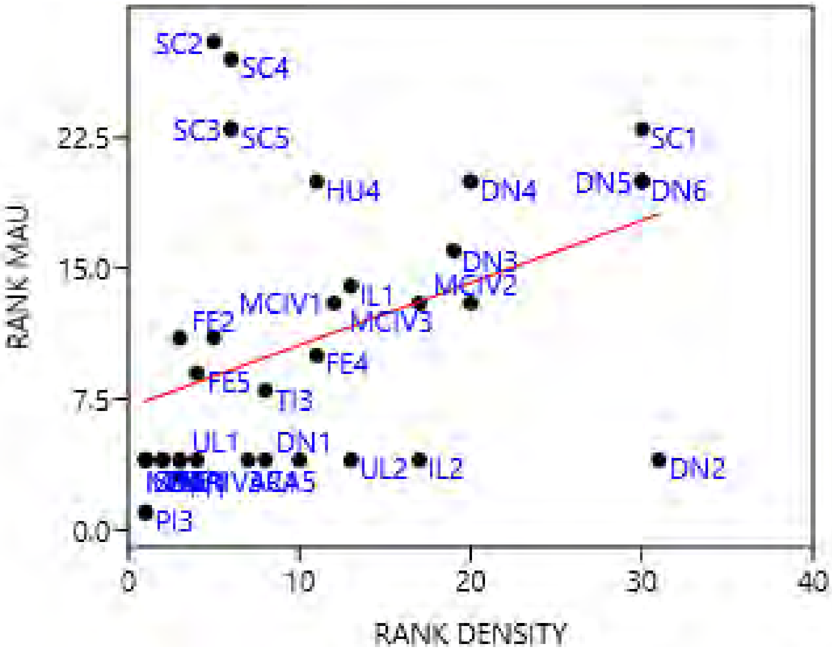

FIGURE 7S

Comparison of suid skeletal parts (RANK MAU) and mineral density indices. See Lyman (1984) for codes used.

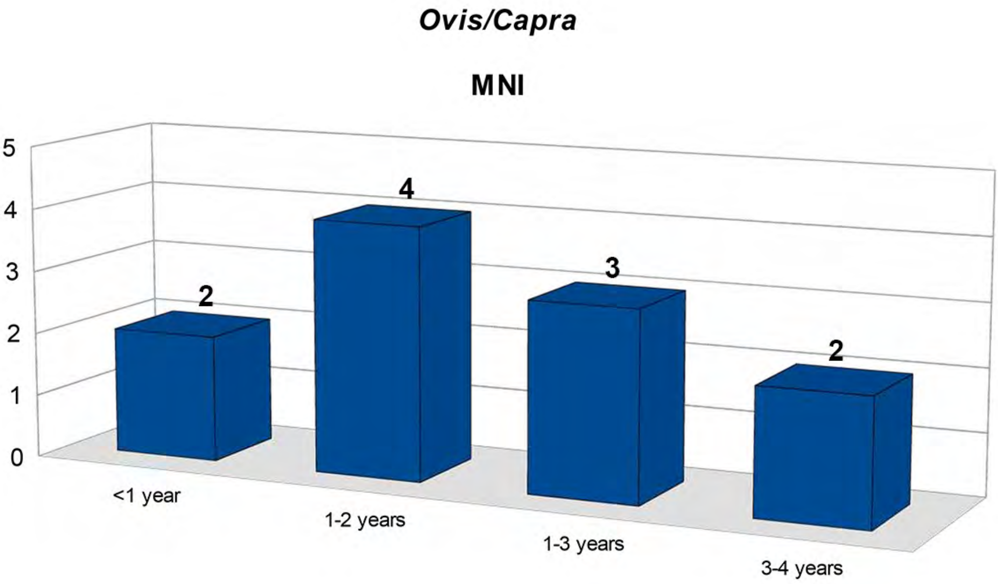

FIGURE 8S
Slaughtering ages for sheep/goat expressed in MNI.

FIGURE 9S
The Castellare of the Ugurgieri (Photo by Jacopo Bruttini).

FIGURE 10S

Orthophoto (Photo: Jacopo Bruttini). The Ugurgieri tower along Via Cecco Angiolieri. On the right, the alleyway leading to the Castellare.

FIGURE 11S

To the top of the figure wall front on Via Sallustio Bandini up to the entrance of Vicolo al Vento. At the left-bottom of the Photogrammetry, indicated with an arrow and made of stone, are the early 12th-century walls on which the Castellare was built (Photo: Jacopo Bruttini). In the middle planimetry obtained through Photogrammetry. At the bottom planimetry from the "Piano Regolatore Secchi" (https://opendata.comune.siena.it/?q=metarepo/datasetinfo&id=PRG_Secchi_tavole). Close to the points the altitudes are indicated.

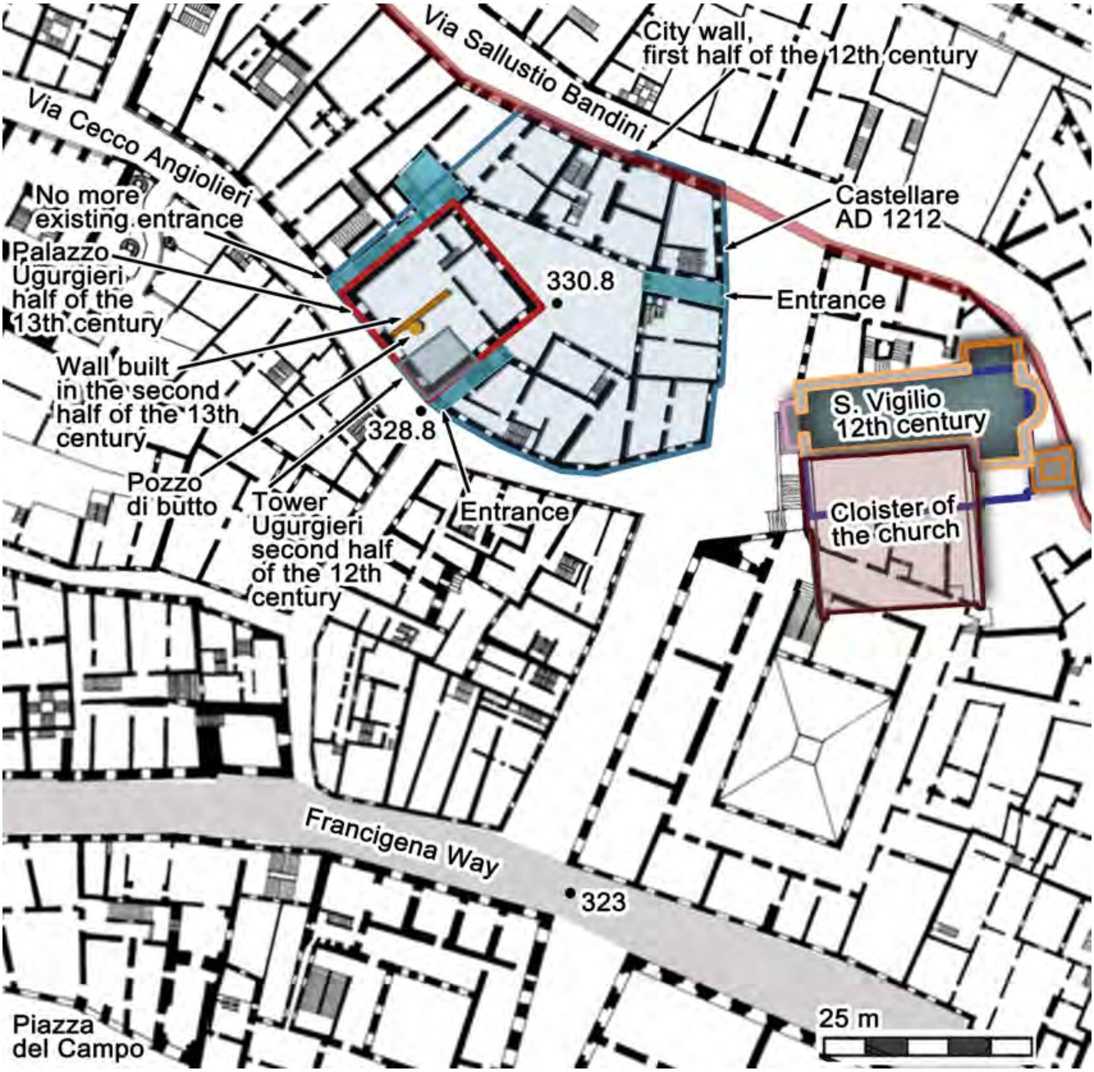

FIGURE 12S

Plan of the investigated area, with the the city wall (first half of the 12th century), the tower Ugurgieri (second half of the 12th century), the Castellare (A.D. 1212) with the 3 entrances, the Saint Vigilio church (beginning of the 12th century), the Palazzo Ugurgieri (half of the 13th century), the Pozzo di butto (second half of the 13th century), at the bottom the Francigena way. Close to the points the altitudes are indicated.

	NISP	**%**
Bos taurus	30	4.0
Bos/Cervus	6	0.8
Ovis/Capra	234	31.3
Ovis aries	30	4.0
Capra hircus	13	1.7
Sus sp.	149	19.9
Cervus elaphus	8	1.1
Oryctolagus cuniculus	1	0.1
Rattus rattus	2	0.3
Gallus domesticus	59	7.9
Phasianus colchicus	12	1.6
Galliformes	186	24.9
Colomba livia/oenas	3	0.4
Anser sp.	6	0.8
Perdicinae	1	0.1
Tinca tinca	6	0.8
Dicentrarchus labrax	1	0.1
Tot.	**747**	

TABLE 1S

The faunal association from US 18.

	NISP			MNE			MAU			%MAU		
	Ovis/ Capra	***Sus sp.***	***Bos taurus***	***Ovis/ Capra***	***Sus sp.***	***Bos taurus***	***Ovis/ Capra***	***Sus sp.***	***Bos taurus***	***Ovis/ Capra***	***Sus sp.***	***Bos taurus***
Horn	2	-	-	2	-	-	1	-	-	8.7	-	-
Skull	1	14	1	1	2	1	1	2	1	8.7	44.4	50
Maxilla	2	5		2	4	-	1	2	-	8.7	44.4	-
Mandible	8	11	4	6	4	3	3	2	1.5	26.1	44.4	75
Isolated teeth	-	11	-	-	11	-	-	0.25	-	-	5.6	-
Atlas	9	4	-	9	3	-	9	3	-	78.3	66.7	-
Axis	5	-	2	4	-	1	4	-	1	34.8	-	50
Other Vertebrae	30	34	6	25	25	5	1	1	0.4	8.7	22.2	20
Ribs	59	20	-	59	20	-	4.7	1.3	-	40.9	28.9	-
Scapula	44	17	5	20	9	4	10	4.5	2	87	100	100
Sternum	-		1	-	-	1	-	-	0.5	-	-	25
Humerus	21	2	2	9	2	1	4.5	1	0.5	39.1	22.2	25
Radius	-	-	-	-	-	-	-	-	-	-	-	-
Radius-Ulna	19	2	-	16	2	-	8	1	-	69.6	22.2	-
Ulna	4	-	-	-	-	-	-	-	-	-	-	-
Metacarpal	4	-	-	5	-	-	2.5	-	-	21.7	-	-
Metacarpal IV	-	2	-	-	2	-	-	1	-	-	22.2	-
Coxal	20	5	5	6	3	1	6	3	1	52.2	66.7	50
Femur	9	9	-	8	6	-	4	3	-	34.8	66.7	-
Tibia	33	7	4	23	4	3	11.5	2	1.5	100	44.4	75
Fibula	-	3	-	-	3	-	-	1.5	-	-	33.3	-
Metatarsal IV	-	1	-	-	1	-	-	0.5	-	-	11.1	-
Metapodial	1	-	-	1	-	-	0.25	-	-	2.2	-	-
Calcaneum	5	-	-	5	-	-	2.5	-	-	21.7	-	-
Talus	1	-	-	1	-	-	0.5	-	-	4.3	-	-
Phalanx I	-	2	-	-	2	-	-	0.16	-	-	3.6	-

TABLE 2S

NISP, MNE and MAU values for the main ungulate species.

THE UGURGIERI'S, THEIR CASTELLARE AND THE INVESTIGATED WELL

The Castellare of the Ugurgieri is a fortified complex within the city walls of Siena (Figures 9S and 12S), aimed at defending the members of the Family. The complex, founded in 1212 (Ugurgieri Azzolini, 1649; Cammarosano, 1974; Balestracci, 1984) reuses the ancient walls from the beginning of the 12th century as its northern perimeter, while to the south-west it abuts a tower that can probably be attributed to the second half of the 12th century, built when the founder of the family moved from the countryside to the city (Cammarosano, 1974; Pellegrini, 2004) (Figures 10S-12S), to form the complex with a "closed" structure around a courtyard that still characterises it today. Two small entrances currently provide access to the courtyard, which is located at several metres above the surrounding road system. A third entrance (Figure 12S), consisting of a narrow street and a cloister, both closed in modern times, must have been located on the west side of the fortress (Franchina, 1984). The residence's location responds to a precise logic of urban space management and it demonstrates the high-status of the Ugurgieri's: the proximity to the monastery of San Vigilio (of which the Ugurgieri family boasted very close ties; Balestracci, 1984) and to the Francigena Way, the contiguity with the walls of the city, which in case of need could guarantee a rapid escape to the countryside, the presence at the beginning of the 13th century of an area without buildings and, apparently, of imminent urbanisation under the direct influence of the Ugurgieri's. Finally, the elevated position improved the defensibility of the site (Ugurgieri, Azzolini, 1649) and made the control over the underlying road system more efficient. The maximum elevation in the small square of the Castellare is in fact, around 330 metres above sea level, while the Piazza del Campo and the underlying Francigena Way are 322 and 323 metres above sea level (Ugurgieri, Azzolini 1649; Balestracci, 1984). Finally, some historical documents attest that the Palazzo Ugurgieri hosted the *Podestà* of Siena (the most important policy figures of the city) in the 1270s and, again, in the 1300s (Balestracci, 1984). So, despite the study of the Ugurgieri's is severely limited by the loss of the family archive occurred in the late of the 19th century (Cammarosano, 1974), many historical documents and archaeological testify how the Ugurgieri's occupied a privileged stratum of the Sienese urban society (Ugurgieri, Azzolini, 1649; Grottanelli, 1881; Cammarosano, 1974; Balestracci, 1984).

The "pozzo di butto" investigated in this work was realized a few years after the palace was erected, at the same time of a brick wall that divided the ground floor of the building into two areas (Figure 12S); a channel placed inside the wall allowed a direct connection with the upper floors of the palace (Bruttini, 2017). The well was entirely excavated in the sandstone bench and used for the disposal of domestic waste. It's depth of approximately 5.3 m from the current floor level, with a base diameter of approximately 2 m and a width of 1.2 m at its top. It cannot be ruled out that the well was built to improve the sanitary conditions of Palazzo Ugurgieri, in order to host very important figures of the Communal Siena. An archaeological deposit of approximately 2.83 m was found inside, with a chronology spanning from the second half of the 13th century to the post-medieval period (Figures 2S and 3S).

Within the layer examined in this paper (US 18), in addition to a large amount of animal bones, numerous achromatic ceramics, probably dating to the third quarter of the 13th century, bricks, split stones, charcoal, glass, metals, ash lenses, traces of lime and a coin were recovered (Bruttini, 2017).

SUPPLEMENTARY INFORMATION REGARDING TO THE METHOD

The separation between sheep (*Ovis aries*) and goat (*Capra hircus*) was carried out according to the morphological criteria outlined by Boessneck (1969) for postcranial bones and Payne (1985), and Zeder & Pilaar (2010) for mandibular teeth. All sheep and goat specimens that could not be attributed to a species were assigned to the sub-family of caprines.

The identification of bird and fish remains was also carried out using animal bone atlases (Bacher, 1967 and Erbersdobler, 1968 for the bird remains; Radu, 2005 for the fish remains).

For sheep/goat, suids and cattle the skeletal bone density indices used were those suggested by Lyman (1984), Ioannidou (2003) and Lam *et al*. (1999).

REFERENCES

Bacher, A. 1967: Vergleichend morphologische Untersuchungen an Einzelknochen des postkranialen Skeletts in Mitteleuropa vorkommender Schwäne und Gänse. Ludwig-Maximilian Universität. München.

Balestracci, D. 1984: Il nido dei nobili, Il popolo di San Cristoforo e la famiglia degli Ugurgeri in età comunale. In: Officina Grafica Sagep (eds.): Contrada della Civetta le sedi storiche. Genova.

Boessneck, J. 1969: Osteological differences between sheep (*Ovis aries* Linné) and goat (*Capra hircus* Linné). In: Brothwell, D.R. & Higgs, E. (eds.): *Science in archaeology: asurvey of progress and research*: 331–358. Cambridge University Press, Cambridge.

Bruttini, J. 2017: Risultati preliminari delle indagini archeologiche effettuate per la ristrutturazione del Museo. In: Il Leccio (ed.): *Uno spazio nella Storia, 2017: il Museo della Contrada Priora della Civetta*: 72-90. Siena.

Cammarosano, P. 1974: La famiglia dei Berardenghi. Contributo alla storia della società senese nei secoli XI-XIII. Biblioteca degli "Studi Medievali", VI, Centro italiano di studi sull'alto Medioevo, Spoleto 1974.

Erbersdobler, K. 1968: Vergleichend morphologische Untersuchungen an Einzelknochen des postcranialen Skeletts in Mitteleuropa vorkommender mitelgroßer Hühnervögel. Ludwig Maximilians Univerisität, München.

Franchina, L. 1984. I misteri del Castellare. In: Officina Grafica Sagep (eds.): *Contrada della Civetta le sedi storiche*: 103-104. Genova.

Grottanelli, L. 1881: Genealogia e storia degli Ugurgeri conti della Berardenga, Ignazio Gati (eds.), Siena: 75.

Ioannidou, E. 2003: Taphonomy of animal bones: species, sex, age and breed variability of Sheep, Cattle and Pig bone density. *Journal of Archaeological Science* 30(3): 355–365.

Lam, Y.M.; Chen, X.B. & Pearson, O.M. 1999: Intertaxonomic variability in patterns of bone density and the differential representation of bovid, cervid, and equid elements in the archaeo-logical record. *American Antiquity* 64(02): 343–362.

Lyman, R.L. 1984: Bone density and differential survivorship of fossil classes. *Journal of Anthropology and Archaeology* 3: 259-299.

Payne, S. 1985: Morphological distinctions between the mandibular teeth of young sheep, *Ovis*, and goat, *Capra*. *Journal of Archaeological Science* 12(2): 139–147.

Pellegrini, M. 2004: Chiesa e città. Uomini, comunità religiose, istituzioni nella società senese tra XII e XIII secolo. In: Herder (ed.): *Italia Sacra, Studi e documenti di storia ecclesiastica* 78: 370-371. Roma.

Radu, V. 2005: Atlas for the identification of bony fish bones from archaeological sites. Contrast, Bucarest, 2005.

Ugurgieri, Azzolini, 1649: Le Pompe sanesi. Vol. II, Libro XXXII, Pistoia: 309.

Zeder, M.a. & Pilaar, S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37(2): 225–242.
https://doi.org/10.1016/j.jas.2009.10.002

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Due set di metapodiali e falangi con esemplari iscritti dall'area artigianale C1 del Bostel di Rotzo (VI): elementi rituali o funzionali?

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RIASSUNTO: Oltre alle svariate costruzioni semi-interrate di tipo abitativo, gli scavi condotti nel villaggio del Bostel di Rotzo hanno messo in luce i resti di una struttura artigianale attiva nella produzione ceramica, con cronologia inquadrabile tra la fine del IV e il II sec. a.C.
All'interno dell'officina sono stati rinvenuti due set di reperti osteologici spazialmente discreti composti da parti anatomiche selezionate. Il primo (2006-2010), rinvenuto nei pressi del forno sud-ovest, conta 60 reperti suddivisi in 32 metapodiali, 27 falangi e 1 frammento di cavicchia ossea; ben 12 esemplari risultano iscritti. Il secondo set, messo recentemente in luce entro un vano con pavimentazione lignea ubicato nel quadrante nord-orientale della struttura conta, invece, 78 elementi di cui 7 recanti segni incisi. Anche in questo caso, è evidente una selezione sistematica delle parti anatomiche suddivise tra falangi e metapodiali. Si segnala, in particolare, la presenza di svariate epifisi non fuse, ma rinvenute in perfetta connessione anatomica, che suggeriscono la presenza del tessuto connettivo in fase pre-deposizionale.
Nel contributo si discuteranno il contesto di rinvenimento, la determinazione osteologica e i possibili modelli interpretativi. In particolare, sarà valutata l'ipotesi di una ritualità connessa alle pratiche artigianali, già ipotizzata per altri contesti del Veneto pre-romano, oppure quella di un impiego pratico con funzione numerale.

PAROLE CHIAVE: OSTEOMANZIA, ETÀ DEL FERRO, ARCHEOLOGIA DELLE PRODUZIONI, ISCRIZIONI RETICHE, SORTES

ABSTRACT: In addition to several pit houses, the excavations on the village of Bostel di Rotzo unearthed the remains of a pottery workshop with activity held between the end of the 4th and the 2nd centuries BC. Inside it, two sets of spatially confined, selected anatomical elements, were recovered. The first cluster (2006-2010) was found near the south-western furnace and totalled 60 items, including 32 metapodials, 27 phalanxes and 1 horncore fragment; 12 of these featured inscriptions. The second lot was discovered recently in a wooden-floor area on the north-eastern part of the same structure and totalled 78 elements, of which 7 featured inscriptions. The system-

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atic selection of phalanxes and metapodials was once more evident. The presence of several unfused epiphyses found in undisturbed anatomical connection suggested the existence of connective tissue in the pre-depositional phase.
This paper presents the context of the discovery, the osteological analysis, and alternative models of interpretation. In particular, the hypothesis of a rituality connected to craft activities, as has been hypothesized for other contexts of the pre-Roman Veneto, or a practical use with a numeral function, will be evaluated.

KEYWORDS: OSTEOMANCY, IRON AGE, ARCHAEOLOGY OF CRAFT PRODUCTIONS, RHAETIAN INSCRIPTIONS, SORTES

RESUMEN: Además de alguna serie de casas con foso, las excavaciones en el pueblo de Bostel di Rotzo sacaron a la luz los restos de un taller de cerámica que funcionó entre finales del siglo IV y II a.C. En su interior se recuperaron dos conjuntos de osamentas seleccionadas en espacios bien definidos. El primer conjunto (2006-2010) se encontró cerca del horno sudoeste y contenía 60 elementos, incluidos 32 metapodios, 27 falanges y un fragmento de estuche córneo; 12 de estos elementos presentaban inscripciones. El segundo lote se descubrió recientemente en una zona de suelo de madera en la parte noreste de la misma estructura y contenía 78 elementos, de los cuales 7 presentaban inscripciones. La selección sistemática de falanges y metapodios fue de nuevo aquí evidente. La presencia de varias epífisis no fusionadas encontradas en conexión anatómica sugiere la existencia de tejido conectivo en la fase previa al depósito.
En este artículo se presenta el contexto del descubrimiento, el análisis osteológico y los modelos alternativos de interpretación. En particular, se evaluarán las hipótesis de una ritualidad vinculada con las actividades artesanales, como se ha postulado ya en otros contextos del Véneto prerromano, o la de un uso práctico con función numérica.

PALABRAS CLAVE: OSTEOMANCIA, EDAD DEL HIERRO, ARQUEOLOGÍA DE LAS PRODUCCIONES ARTESANALES, INSCRIPCIONES RÉTICAS, SORTES

INTRODUZIONE

Il villaggio della media/seconda età del Ferro del Bostel di Rotzo (V-II sec. a.C.) è localizzato sulle propaggini sud-occidentali dell'Altopiano dei Sette Comuni (Vicenza) su un pianoro prospicente la Val d'Assa e la Valdastico, principali direttrici per lo spostamento di uomini e merci attraverso l'Altopiano e dalla pianura verso le valli alpine (Magnini *et al*., 2019). Il sito è naturalmente difeso su tre versanti e risulta un punto strategico fondamentale per il controllo del territorio circostante (Magnini & Bettineschi, 2021).

Tra le numerose case semi-interrate di tipo alpino rinvenute a partire già dal 1781, il sito ha restituito anche un'interessante struttura "doppia" in cui un'abitazione (settore C2) condivide un setto murario con un secondo impianto coevo, probabilmente dedicato ad attività di tipo artigianale/commerciale (settore C1) (De Guio *et al*., 2011). Accanto ai numerosi reperti fittili rinvenuti all'interno di questo ambiente, spiccano due set composti da materiale osteologico selezionato e in alcuni casi inciso con segni di natura non esclusivamente alfabetica (Figura 1). I ritrovamenti sono emersi a partire dal 2006, ma grazie a un attento lavoro topografico è stato recentemente possibile delimitare la distribuzione spaziale dei due nuclei. Va anche sottolineato che l'abbandono repentino e l'incendio che ha posto fine al villaggio offrono l'eccezionale possibilità di analizzare i rinvenimenti strutturali e mobiliari nel loro contesto di giacitura (sub)primaria.

Lo studio osteologico e contestuale dei rinvenimenti ha l'obiettivo di chiarire la funzione di questi peculiari ecofatti (dicotomia funzionale/rituale) anche in relazione alla tipologia di struttura entro cui sono stati rinvenuti. Oltre alle tradizionali metodologie di riconoscimento degli elementi scheletrici, il lavoro è stato condotto integrando dati stratigrafici e topografici di rinvenimento, confronti con ambiti geograficamente e cronologicamente affini e un ampio comparto di modelli interpretativi teorici.

CONTESTO ARCHEOLOGICO

Le recenti campagne d'indagine nel settore C1 hanno consentito di precisare e approfondire le

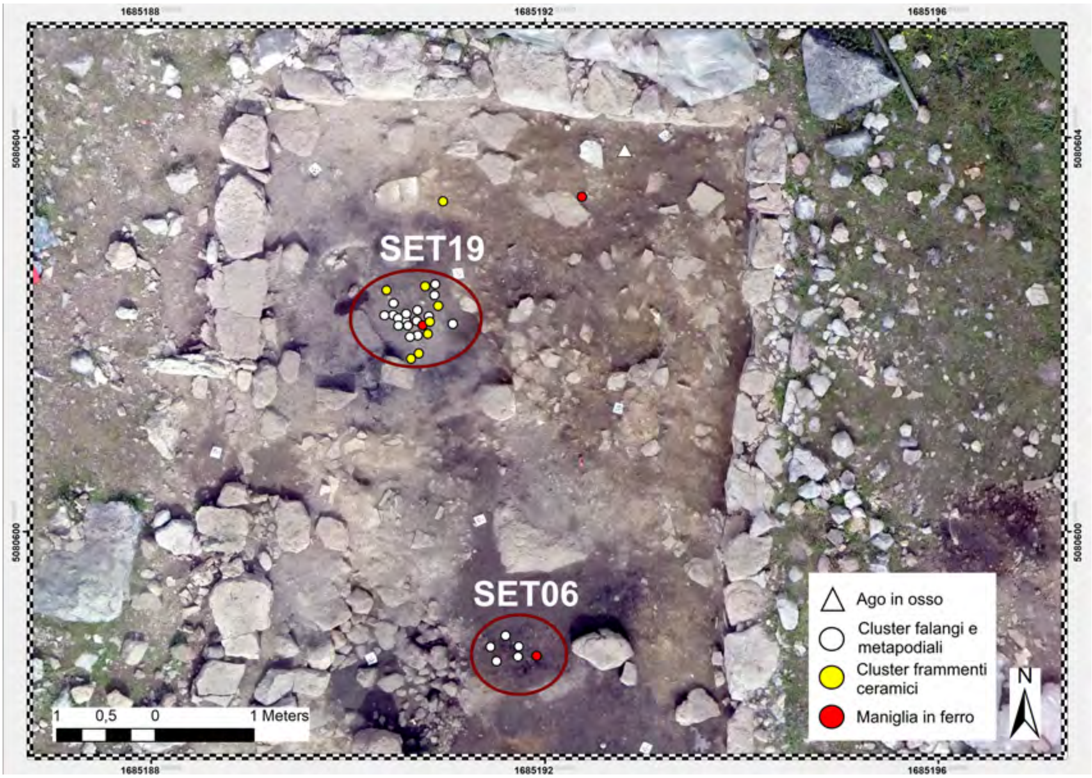


FIGURA 1

Fotopiano del settore C1 del Bostel di Rotzo con indicata la distribuzione dei due set osteologici e i principali reperti associati (il cluster ceramico in giallo del SET19 è relativo alla distribuzione dei frammenti del bicchiere carenato) (elaborazione grafica a cura di Anna Michielin).

conoscenze emerse dai primi scavi condotti nel decennio 2001-2012. L'area ospita una struttura quadrangolare di ca. 6x9 m con basamento in muratura a secco, sopra cui si impostava un alzato in materiale deperibile di cui oggi restano limitate tracce combuste. A livello cronologico, i rinvenimenti ceramici così come un recente set di datazioni radiocarboniche suggeriscono una datazione tra la fine del IV e la fine del II sec. a.C. (De Guio *et al*., 2011).

L'interno doveva ospitare almeno una struttura piro-tecnologica, possibilmente associata alla produzione ceramica (De Guio *et al*., 2011). Le indagini nel quadrante NW mostrano invece la presenza di un assito ligneo pavimentale poggiato su una serie di massi piatti rialzati rispetto al battuto sottostante a scopo di isolamento termico (Bettineschi *et al*., 2023). I resti faunistici qui considerati sono emersi a più riprese in almeno due concentrazioni discrete nell'area centro-meridionale della struttura, entro gli scarichi di quella che era stata interpretata come fornace (indagini 2001-2012, già editi sommariamente in De Guio *et al*., 2011, in seguito definiti come SET06), e nel lato centro-settentrionale, poggiati sull'assito pavimentale (indagini 2019-2021, in seguito definiti come SET19). Altri metapodiali e falangi sporadici stanno emergendo in diverse zone della struttura anche durante la campagna 2022 (in corso), ma non in quantità sufficiente – al momento – da definire un ulteriore nucleo unitario.

Durante gli scavi 2019, è stato possibile accertare che i reperti osteologici si trovavano in stretta relazione stratigrafica a frammenti ricomponibili di un bicchiere carenato in ceramica grigia con iscrizione in caratteri retici (Figura 4). I resti faunistici e i frammenti ceramici erano giustapposti con andamento radiale, suggerendo che metapodiali e falangi fossero in origine contenuti all'interno del contenitore ceramico e che entrambi siano stati dispersi a seguito dell'impatto con l'assito. La caduta va certamente riferita al momento dell'incendio della struttura e al contestuale cedimento delle pareti, come documentato dalla diretta sovrapposizione degli strati di crollo. I materiali osteologici dovevano quindi essere accuratamente stoccati su una mensola a parete, dove erano conservati in vista di un futuro (ri)utilizzo. Si segnala, inoltre, che epifisi e diafisi non fuse sono state frequentemente rinvenute in connessione anatomica, suggerendo che le ossa fossero iscritte e impiegate a fresco.

MATERIALI E METODI

Lo stato di conservazione dei reperti osteologici analizzati è buono e le fratture sono per la maggior parte di natura post-deposizionale. I reperti ossei esaminati ammontano ad un totale di 320 (NR). Di questi, 60 provengono dalle campagne di scavo 2006-2010 (SET06) e 260 dalle campagne 2019-2021 (SET19).

La sostanziale differenza numerica tra i due campioni si deve soprattutto al restauro effettuato prima di questa ricerca sul SET06 per consentirne l'esposizione museale.

La determinazione anatomica e tassonomica è stata eseguita con l'ausilio di manuali specifici (Schmid, 1972; Hillson, 1996) e di una personale collezione di confronto. La stima dell'età di morte è stata calcolata sul grado di fusione delle epifisi come descritto in Silver (1963). L'analisi osteometrica (Supplementary Material 1) è stata svolta seguendo le indicazioni di Driesch (1976) e le misure si intendono espresse in millimetri.

L'analisi tafonomica, prima ad occhio nudo e in seguito con lente d'ingrandimento, è stata svolta con lo scopo di identificare tracce di scarnificazione e di lavorazione. Le tracce rinvenute sono state poi confrontate con quelle descritte in Fernández-Jalvo & Andrews (2016). Entrambi i campioni recano evidenti tracce di combustione che vanno dal grado 1 (in particolare per il SET06) al grado 5 (Stiner *et al*., 1995).

Durante la campagna del 2019 è inoltre stato rinvenuto un ago in osso iscritto. Sebbene non facente parte dei set, risulta essere un elemento utile al confronto con altri siti coevi e per l'interpretazione del contesto (vedi *infra*).

CAMPIONE FAUNISTICO COMPLESSIVO (CAMPAGNE 1997-2017)

Il lotto faunistico complessivo del sito recuperato tra il 1997 e il 2017 (NR tot. 3350) (escluso il SET06) (Figura 2) è composto principalmente da resti appartenenti al genere *Ovis* vel *Capra* con il 39% di reperti; seguono il *Bos taurus* con il 35% e il *Sus domesticus* con il 14% di resti attribuiti. In

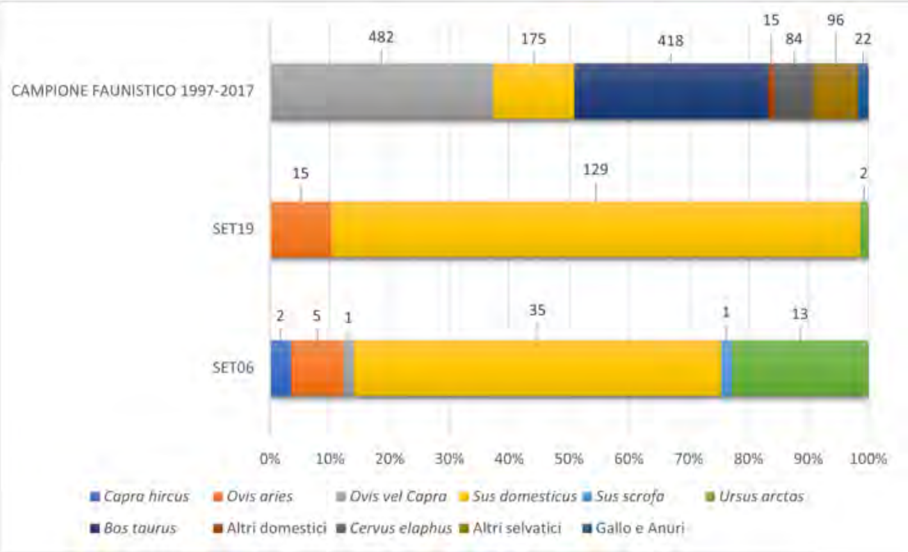


FIGURA 2

Grafico relativo al numero dei resti (NR) dei due set di falangi-metapodiali in rapporto al campione faunistico del sito (grafico a cura di Veronica Venco).

percentuali minori sono state identificate ulteriori forme domesticate e specie selvatiche quali *Cervus elaphus, Sus scrofa* e *Ursus arctos*.

La quasi egual presenza dei bovini e dei caprovini suggerisce una scelta economica volta al pascolo e all'allevamento. La scarsa presenza del maiale trova riscontro con altri siti coevi e testimonia, probabilmente, una gestione dettata non solo da scelte della comunità, ma in parte anche dal clima e dall'ambiente (Fiorentin *et al*., 2021).

RISULTATI

SET06

Il SET06 (Tabella 1) è composto da un totale di 60 resti di cui 58 determinati tassonomicamente (NRDt), e 2 non determinati (ND). Gli elementi anatomici sono per la maggior parte riconducibili allo scheletro appendicolare, nel dettaglio, a metapodiali (sia degli arti anteriori che posteriori) e falangi (1 e 2). Tre reperti sono estranei alla natura

SET06				
Elemento anatomico	**NR**	**%NR**	**NME**	**NMI**
Sus domesticus				
Falange 1	11	31,43	11	4
Metacarpo II	1	2,86	1	1
Metacarpo III	9	25,71	9	4 sub ad. + 1 ad. + 1 nd
Metacarpo IV	4	11,43	4	2
Metatarso III	5	14,29	5	4
Metatarso IV	2	5,71	2	2
Metapodiale	3	8,57	2	2
Totale	**35**	**58,33**	**34**	**4 sub ad. + 1 ad. + 1 nd.**
Capra hircus				
Falange 1	2	66,67	2	1
Cavicchia ossea	1	33,33	1	1
Totale	**3**	**5,00**	**3**	**1 ad.**
Ovis aries				
Falange 1	3	60	3	1
Metatarso	2	40	2	1
Totale	**5**	**8,33**	**5**	**1 ad.**
Ovis* vel *Capra				
Falange 1	**1**	**1,67**	**1**	**1 ad.**
Sus scrofa				
Falange 2	**1**	**1,67**	**1**	**1 ad.**
Ursus arctos				
Falange 1	10	76,92	10	2
Falange 2	1	7,69	1	1
Metapodiale	2	7,69	2	1
Totale	**13**	**21,67**	**13**	**1 ad. + 1 juv**
Totale indeterminati	**2**	**3,33**	**-**	**-**
Totale determinati	**58**	**96,67**	**-**	**-**
Totale fauna	**60**	**100**	**57**	**12**

TABELLA 1

Numero dei resti (NR), numero minimo di elementi (NME), numero minimo degli individui (NMI) del SET 2006 (a cura di Veronica Venco).

del campione: un frammento di cavicchia ossea di *Capra hircus* e due frammenti non determinati di diafisi di osso lungo di taglia media.

Il campione faunistico di questo nucleo di reperti vede una presenza consistente di *Sus domesticus* con 35 frammenti ossei (NME 34); seguono l'*Ursus arctos* (NME 13), *Ovis aries* (NME 5), *Capra hircus* (NME 3), *Ovis* vel *Capra* (NME 1) e *Sus scrofa* (NME 1). In totale sono stati conteggiati 58 elementi anatomici di cui 27 prime falangi.

Il numero minimo di individui è stato calcolato sul grado di fusione delle epifisi dei differenti elementi anatomici. Per la forma domestica del *Sus* sono stati individuati 4 individui sub-adulti e 1 adulto e 1 non determinato. Per gli ovicaprini invece risultano 3 individui adulti, un solo individuo adulto di *Sus scrofa* ed infine un individuo giovanile e uno adulto di *Ursus arctos*.

SET19

Il SET19 (Tabella 2) è composto da un totale di 260 frammenti di cui 146 determinati e 114 non determinati. Anche in questo nucleo si evidenzia

SET19				
Elemento anatomico	**NR**	**%NR**	**NME**	**NMI**
Sus domesticus				
Falange 1	24	18,6	14	2 juv/sub.ad+1 ad
Falange 2	1	0,78	1	1
Falange 3	2	1,55	2	1
Metacarpo II	9	6,98	2	1
Metacarpo III	13	10,08	4	2
Metacarpo IV	27	20,93	11	2 sub.ad + 1 ad
Metatarso III	16	12,4	9	1 sub.ad+1 ad+1 ind
Metatarso IV	15	11,63	5	1 sub.ad+1 ad
Metatarso V	3	2,33	2	1 sub.ad+1 ad
Metapodiale	18	13,95	17	2
Omero	1	0,78	1	1
Totale	**129**	**49,62**	**68**	**2 sub.ad + 1 ad**
Ovis aries				
Falange 1	9	60	5	2
Falange 2	5	33,33	2	1
Falange 3	1	6,67	1	1
Totale	**15**	**5,77**	**8**	**2 ad**
Ursus arctos				
Falange 1	1	50	1	1
Metapodiale	1	50	1	1
Totale	**2**	**0,77**	**2**	**1 juv**
Totale indeterminati	**114**	**43,85**	**-**	**-**
Totale determinati	**146**	**56,15**	**-**	**-**
Totale fauna	**260**	**100**	**78**	**6**

TABELLA 2

Numero dei resti (NR), numero minimo di elementi (NME), numero minimo degli individui (NMI) del SET 2019 (a cura di Veronica Venco).

una selezione degli elementi anatomici dello scheletro appendicolare. Solo un frammento di omero risulta estraneo rispetto la composizione del campione caratterizzata dalla presenza di metapodiali e falangi.

Nel campione prevale il *Sus domesticus* con 129 frammenti (NME 68), *Ovis aries* (NR 15, NME 8) e infine *Ursus arctos* (NR 2, NME 2). In questo secondo nucleo di resti osteologici si sono conteggiati 2 individui sub-adulti e 1 adulto di *Sus domesticus*, 2 individui adulti di *Ovis aries* e infine 1 esemplare giovanile di *Ursus arctos*.

ANALISI TAFONOMICA

Entrambi i campioni osteologici sono stati intaccati dal fuoco. Per il SET06 il grado più frequente è 1 e solo alcuni resti raggiungono lo stato carbonizzato (grado 3, Stiner *et al*., 1995), mentre il SET19 include anche resti calcinati (gradi 4-5).

Le tracce antropiche lasciate durante la lavorazione e preparazione dell'osso come supporto scrittorio sono visibili anche a occhio nudo. In primis, il periostio presenta numerose, ma sottili, linee parallele all'asse longitudinale dell'osso, legate all'attività di raschiatura. Vicino alle superfici articolari, in particolare presso le epifisi prossimali sono state riscontrate tracce lineari riferibili all'attività di disarticolazione dei legamenti e dei muscoli.

Inoltre, un frammento di metatarso destro di *Ovis aries* del SET06 è frammentato volontariamente a metà della diafisi. Sono infatti evidenti dei tagli trasversali e l'angolo di frattura lasciato in seguito alla rottura della parte corticale.

DISCUSSIONE E CONCLUSIONI

La presenza all'interno dei due set di elementi con tracce di preparazione dell'osso e incisioni volontarie a formare segni (alfabetici e simbolici) sulla superficie non è estraneo al mondo retico (cfr. es. Tecchiati, 2006 e bibliografia ivi citata). In tutti gli esemplari del Bostel le incisioni si presentano piuttosto sottili ma ben definite e l'analisi autoptica ha permesso di ipotizzare l'utilizzo di uno strumento metallico per la loro esecuzione.

Il primo gruppo (SET06) (Figura 3), pur avendo un numero totale di elementi inferiore (57 NME), presenta un numero di esemplari incisi decisamente superiore (12). Infatti, si distinguono 10 falangi e 2 metapodiali incisi (1 metatarso e 1 metacarpo). Questi costituiscono il 21% del campione e coprono uno spettro di quattro *taxa* sui sei individuati (tra cui due falangi di *Ursus arctos*).

La situazione cambia parzialmente osservando il secondo nucleo (SET19) (Figure 4) dove su un totale di 78 elementi (NME) solo 7 presentano tracce di incisioni sulla superficie (il 9% del totale). In questo caso i metapodiali (3 metacarpi e 2 metatarsi) di *Sus domesticus* sono preponderanti rispetto alle falangi (una di *Sus domesticus* e una di *Ovis aries*). Anche la variabilità dei *taxa* è limitata con quasi tutto il campione iscritto determinato come *Sus domesticus* (solo un elemento appartiene a *Ovis aries*).

Sebbene anche nel secondo set siano presenti falangi di orso, queste non risultano iscritte, sottolineando una non totale omogeneità o standardizzazione tra i due nuclei. Questa assenza può forse essere spiegata da un parziale disinteresse da parte del gruppo che ha prodotto i manufatti nei confronti dei *taxa* di appartenenza del materiale osteologico, prediligendone piuttosto l'aspetto dimensionale e dunque funzionale. Infatti, se si considera la scelta delle parti anatomiche e si osservano le misure degli elementi, tutte risultano piuttosto contenute. L'unica parte anatomica di dimensioni maggiori è il metatarso di *Ovis aries* del SET06 che è però stato intenzionalmente spezzato (Figure 3, n. 5). Questa esigenza può essere anche ricondotta alla necessità di stoccare il materiale all'interno di contenitori di piccole dimensioni come accertato per il SET19.

È comunque indubbia l'importanza simbolica che l'orso doveva rivestire in questi gruppi di manufatti: nel campione faunistico complessivo del sito, infatti, l'orso risulta assai scarsamente rappresentato, con soli tre elementi identificati. Interessante è anche notare l'abbondanza di resti di *Sus domesticus* all'interno dei due set rispetto al campione faunistico totale. Quest'ultimo ha infatti evidenziato uno scarso apporto di *Sus domesticus* (il 14%), mentre all'interno dei due nuclei la percentuale cresce al 61% per SET06 e raggiunge l'88% per SET19.

Alla luce di quanto esposto, due sono le ipotesi avanzate per spiegare la presenza di tali reperti all'interno di un ambiente a vocazione verosimilmente artigianale: che si trattasse di elementi simbolici, connessi a rituali divinatori (cfr. *sortes*),

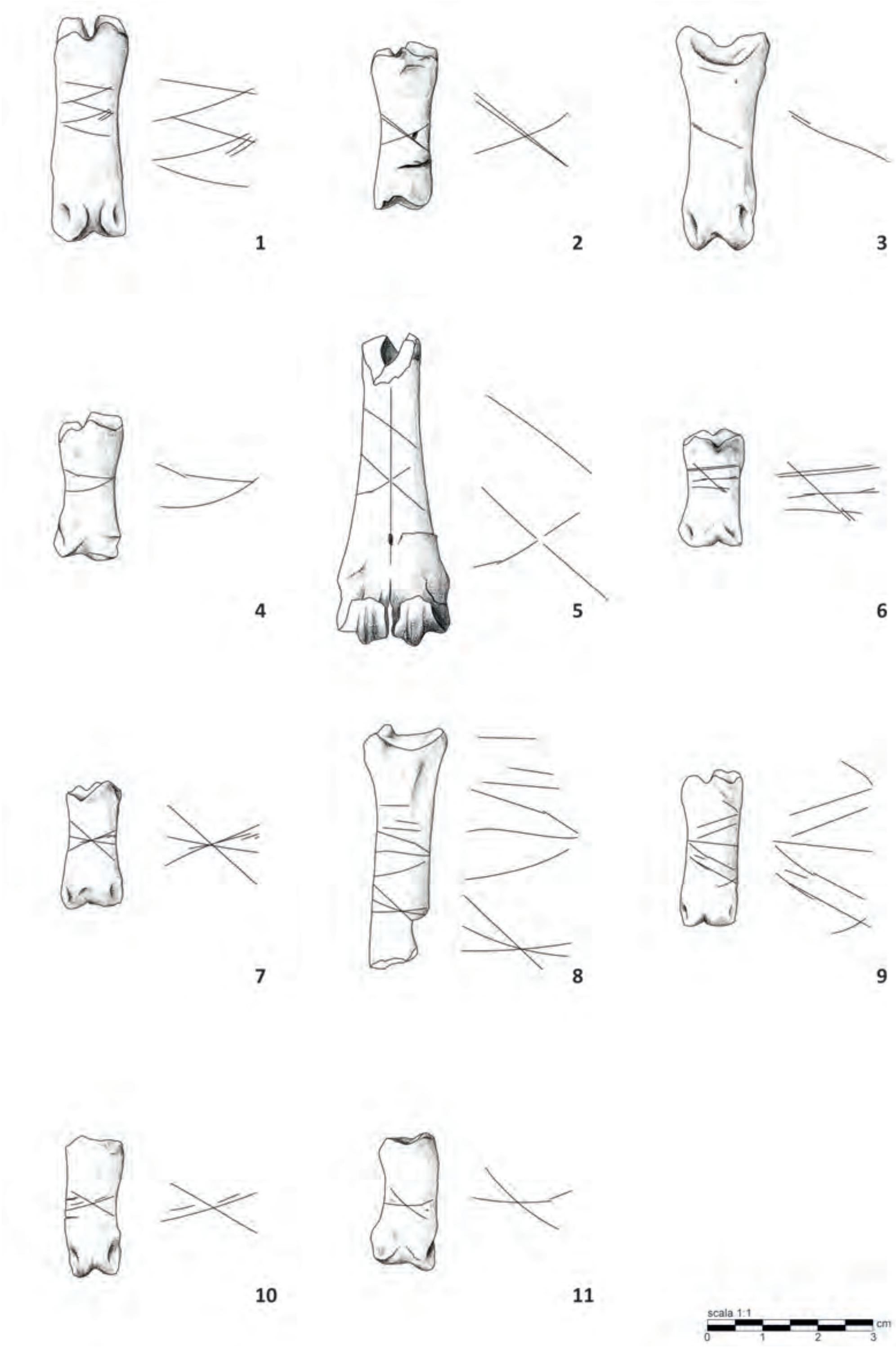
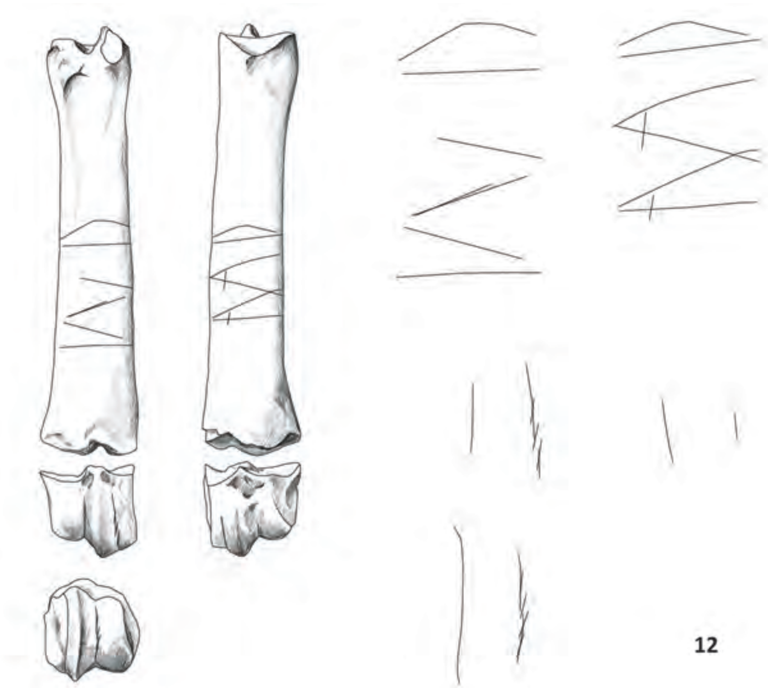
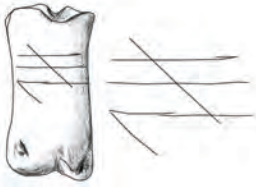


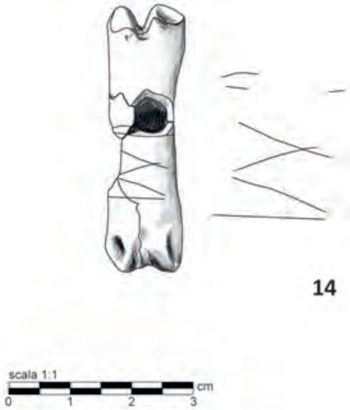
FIGURA 3
Tavola con selezione di elementi incisi dal SET06 (elaborazione grafica a cura di Elena Griggio).



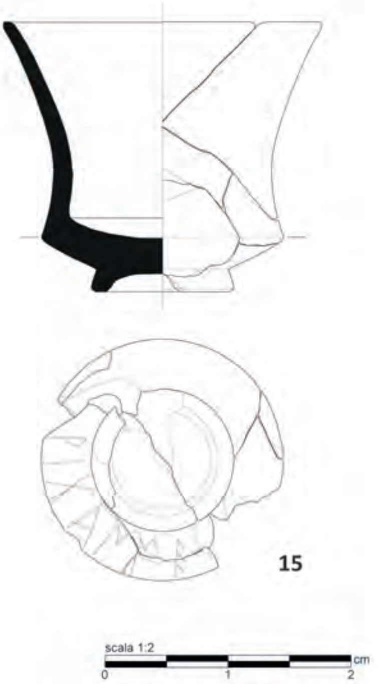
12



13



14



15

FIGURA 4

Tavola con selezione di elementi incisi dal SET19 e bicchiere carenato in associazione (15) (elaborazione grafica a cura di Elena Griggio).

propiziatori o di abbandono, oppure che avessero un impiego pratico con valore numerale, per le attività di conteggio connesse alla manifattura e alla vendita degli oggetti ivi prodotti. Una terza ipotesi, ovvero che possa trattarsi di resti della concia delle pelli, è al momento in fase di valutazione; pur tuttavia, l'assenza di altri elementi che possano corroborare questa tesi, la presenza di svariati esemplari iscritti e la centralità della struttura all'interno del villaggio (cfr. *smellscape*) rendono questa interpretazione meno probabile rispetto alle precedenti.

Va, infine, sottolineata l'associazione diretta tra il rinvenimento dei due set di ossa qui presentati con altrettante maniglie di ferro (una delle quali ancora collegata al legno combusto della porta) (Figura 1). Tecchiati & Salvagno (2019) avevano già evidenziato la pratica di deporre resti faunistici selezionati come offerte beneauguranti in fosse nei pressi delle soglie delle strutture abitative della seconda età del Ferro. Nello specifico caso studio, però, il SET19 è stato rinvenuto stratigraficamente al di sopra della pavimentazione lignea e in stretta relazione con un bicchiere carenato (Figure 4, n. 15) i cui frammenti, ancora in parte, contenevano le ossa. Questo lascia intendere che il contenitore fosse collocato su una mensola o sul pavimento nei pressi della porta del vano. L'assenza di una deposizione in fossa non invalida tuttavia la possibile funzione simbolica dei set.

È possibile, inoltre, escludere che si tratti di oggetti connessi a rituali di abbandono programmato, in quanto il villaggio venne distrutto in maniera repentina, come testimoniato dalle tracce di combustione in tutte le strutture finora indagate e dal rinvenimento dei reperti in deposizione (sub) primaria, compresi elementi di prestigio (e di valore) come le chiavi di tipo Sanzeno e soprattutto il tesoretto nel settore C2 (De Guio *et al*., 2011).

In definitiva, sembra potersi escludere un uso funzionale di questi elementi e si suggerisce, piuttosto, un impiego simbolico forse in una ritualità connessa all'attività produttiva (es. chiusura/ attivazione di ciclo, valutazione dei momenti più propizi per le attività di cottura, o pratiche divinatorie sulla buona riuscita dei prodotti finiti). L'esistenza di rituali connessi alle attività e agli spazi artigianali è peraltro già stata suggerita per il Veneto pre-romano in relazione al rinvenimento di corna nei livelli di fondazione di una fornace a Concordia Sagittaria (Di Filippo Balestrazzi, 1996; Perego, 2010).

MATERIALE SUPPLEMENTARE

Vedi materiale supplementare su https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_019

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BIBLIOGRAFIA

BETTINESCHI, C.; FIORENTIN, A.; MAGNINI, L.; MARCHESINI, M. & DE GUIO, A. 2023: Tecnologia edilizia e determinazione dei resti lignei da una struttura produttiva della Seconda Età Ferro al Bostel di Rotzo (VI). In: Previato, C. & Bonetto, J. (eds.): *Atti del Convegno Internazionale "Terra, Legno e Materiali Deperibili nell'Architettura Antica", Costruire nel Mondo Antico* 5: 121-130. Quasar, Roma.

DE GUIO, A.; BRESSAN, C.; FERRARI, G.; MANTOAN, R.; GAMBA, M.; MIGLIAVACCA, M.; PADOAN, C. & NICOSIA, C. 2011: Bostel di Rotzo (VI) – Stato di avanzamento delle ricerche. *Quaderni di archeologia del Veneto* 27: 168-183.

DI FILIPPO BALESTRAZZI, E. 1996: L'Insediamento protostorico nell'area del Teatro-Quartiere Nord Ovest. In: Malnati, L.; Croce Da Villa, M. & Di Filippo Balestrazzi, E. (eds.): *La Protostoria tra Sile e Tagliamento. Antiche Genti tra Veneto e Friuli*: 201-204. Esedra Editrice, Padova.

DRIESCH, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletins, Harvard University. MA.

FERNÁNDEZ-JALVO, Y. & ANDREWS, P. 2016: *Atlas of taphonomic identifications: 1001+ images of fossil and recent mammal bone modification*. Vertebrate Paleobiology and Paleoanthropology Series. Springer Netherlands, Amsterdam.

Fiorentin, A.; Pieragostini, F. & Marchesini, M. 2021: Il faggio e la capra: il paleoambiente del Bostel alla luce degli studi archeobotanici e archeozoologici. In: Magnini, L.; Bettineschi, C. & Burigana, L. (eds.): *Traces of Complexity. Studi in Onore di Armando De Guio/ Studies in Honour of Armando De Guio*: 313-323. SAP, Quingentole.

Hillson, S. 1996: *Mammal bones and teeth. An introductory guide to methods of identification*. Institute of Archaeology, University College London, London.

Magnini, L. & Bettineschi, C. 2021: Object-Based Predictive Modeling (OBPM) for archaeology: finding control places in mountainous environments. *Remote Sensing* 13: 1197.

Magnini, L.; Bettineschi, C.; De Guio, A.; Burigana, L.; Colombatti, G.; Bettanini, C. & Aboudan, A. 2019: Multisensor-multiscale approach in studying the proto-historic settlement of Bostel in northern Italy. *Archeologia e Calcolatori* 30: 347-365.

Perego, E. 2010: Magic and ritual in Iron Age Veneto, Italy. *Papers from the Institute of Archaeology* 20: 67-96.

Schmid, E. 1972: *Atlas of animal bones: for prehistorians, archaeologists and Quaternarian geologists*. Elsevier Publishing Company, Amsterdam.

Silver, A.I. 1963: The ageing of domestic animals. In: Brothwell, D.R. & Higgs, E.S. (eds.): *Science in Archaeology*: 284-302. Thames and Hudson, London.

Stiner, M.c.; Kuhn, S.l.; Weiner, S. & Bar-Yosef, O. 1995: Differential burning, recrystallization, and fragmentation of archaeological bone. *Journal of Archaeological Science* 22: 223-237.

Tecchiati, U. 2006: La fauna della casa del II-I secolo a. C. di San Giorgio di Valpolicella – via Conca d'Oro (VR). In: Sala, B. & Tecchiati, U. (eds.): *Archaeozoological Studies in Honour of Alfredo Riedel*: 181-216. Ufficio Beni Archeologici, Bolzano.

Tecchiati, U. & Salvagno, L. 2019: Deposito rituale o deposito speciale? Il contributo dell'archeozoologia alla definizione dei contesti cultuali: alcuni casi di studio della preistoria e protostoria italiana. In: De Grossi Mazzorin, J.; Fiore, I. & Minniti, C. (eds.): *Atti 8° Convegno Nazionale di Archeozoologia (Lecce, 2015)*: 267-274.

MATERIALE SUPPLEMENTARE

APPENDICE 1. Tabella osteometrica del campione analizzato (a cura di Veronica Venco).

Misure

Ovis aries			
N. Inv	**Anno**	**El. Anatomico**	**Misure (mm)**
SET06_05	2006	Metatarso dx	Bd 20,6; DD* 5,9
SET06_18	2006	Metatarso dx	Bp 16,6
SET06_26	2006	Falange I dx	Bp 12,4; SD 9,7; Bd 12; GLpe 42,5
SET06_51	2006	Falange I dx	Bp 8,4; SD 6,7; Bd 7,9; GLpe 25,7
SET06_31	2006	Falange I sn	Bp 9,7; SD 7,9; Bd 10,3; GLpe 31,1
Capra hircus			
SET06_19	2006	Falange I dx	Bp 11,2; SD 8,2; Bd 11,9; GLpe 36,8
Sus domesticus			
SET06_55	2006	Metacarpo II ind	GL 41,2
SET06_47	2006	Metacarpo III dx	Bp 11,7; B 8,4
SET06_50	2006	Metacarpo III dx	Bp 11,9; B 9,6
SET06_56	2006	Metacarpo III dx	Bp 11,6; B 9,5
SET06_08	2006	Metacarpo III sn	Bp 12,3
SET06_14	2006	Metacarpo III sn	Bp 12,3; B 10,6
SET06_23	2006	Metacarpo III sn	Bp 9,9
SET06_ 37	2006	Metacarpo III sn	Bp 12; B 10,1
SET06_43	2006	Metacarpo III sn	Bp 11,8; GL 58,8; Bd 12,8; B 11,2; GLpe 56,6
SET06_54	2006	Metacarpo III sn	Bp 11,9; B 8,4
SET06_15	2006	Metacarpo IV dx	Bp 11,4; B 8,5
SET06_24	2006	Metacarpo IV dx	Bp 9,5; GL 52,3; Bd 10,3; Lep 50,1; B 8,1
SET06_41	2006	Metacarpo IV sn	Bp 11,5; B 8,4
SET06_57	2006	Metacarpo IV sn	Bp 10,3; GL 53,9; Bd 10,8; LeP 50; B 8
SET06_12	2006	Metatarso III sn	Bd 7,9; LeP 58,4; B 4,3
SET06_13	2006	Metatarso III sn	Bp 10; GL 60,1; Bd 9,3; B 6,3
SET06_ 30	2006	Metatarso III sn	Bp 9,7; GL 48,6; B 8,3
SET06_60	2006	Metatarso III sn	GLpe 8,4
SET06_59	2006	Metatarso IV sn	Bp 10,7; GLpe 8,8
SET06_02	2006	Falange I dx	Bp 11,9; GL 27,5; SD 9,9; Bd 10,5
SET06_04	2006	Falange I dx	Bp 12,3; GL 24; SD 9,2; Bd 11,5
SET06_06	2006	Falange I dx	Bd 10,8; GLpe 26,2
SET06_09	2006	Falange I dx	Bp 10,6; SD 9,8; Bd 9,8; GLpe 26,3
SET06_11	2006	Falange I dx	Bd 10,4
SET06_ 25	2006	Falange I dx	SD 7,8; Bd 97; GLpe 21,1
SET06_07	2006	Falange I sn	Bd 10,7
SET06_17	2006	Falange I sn	Bp 12,9; SD 9,4; Bd 10,5; GLpe 24,1
SET06_ 29	2006	Falange I sn	Bp 14
SET06_45	2006	Falange I sn	Bp 10,9; SD 8,2; Bd 10,1; GLpe 23,3

Ovis aries			
N. Inv	**Anno**	**El. Anatomico**	**Misure (mm)**
SET19_92	2019	Metatarso dx	Bp 14,1; SD 9,6; Bd 9,4; GLpe 21,8
SET19_31	2019	Falange I dx	Bp 9,9; Bd 10,2; GLpe 29,2
SET19_38	2019	Falange I dx	Bd 9,4
SET19_60	2019	Falange I dx	Bp 11,8; SD 9; Bd 10,8; GLpe 30,1
SET19_120	2019	Falange I dx	GL 25,3; SD 9; Bd 9,5;
SET19_132	2019	Falange I sn	Bp 12,6; SD 11,7; Bd 11,7; GLpe 36
SET19_10	2019	Falange I sn	Bp 12,2; GL 42; SD 10,9; Bd 12; GLpe 41,6
Sus domesticus			
SET19_100	2019	Metacarpo II sn	GL 55,4
SET19_02	2019	Metacarpo III dx	Bp 14,9; GL 66,8; Bd 15; LeP 64,5; B 13,7
SET19_81	2019	Metacarpo III dx	Bp 15,2; GL 56,4; B 13,5
SET19_90	2019	Metacarpo III dx	Bd 13,1
SET19_1	2019	Metacarpo IV dx	Bp 13; GL 67,7; Bd 15,3; LeP 64,7; B 11
SET19_39	2019	Metacarpo IV dx	Bp 12,6
SET19_59	2019	Metacarpo IV dx	Bd 15,5
SET19_62	2019	Metacarpo IV dx	Bd 14,2
SET19_72	2019	Metacarpo IV dx	Bd 11,7
SET19_73	2019	Metacarpo IV dx	Bd 14,1
SET19_74	2019	Metacarpo IV dx	Bp 12,5
SET19_107	2019	Metacarpo IV dx	Bp 13,1; GL 50,2; LeP 63,6; B 10,7
SET19_7	2019	Metacarpo IV sn	Bp 12,5
SET19_53	2019	Metacarpo IV sn	Bd 14,2
SET19_70	2019	Metacarpo IV sn	Bp 13,5
SET19_84	2019	Metacarpo IV sn	Gl 69,6; Bd 15,4
SET19_116	2019	Metacarpo IV sn	Bp 12,3
SET19_8	2019	Metatarso III dx	Bp 14,6; GL 67; LP 65,7; B 12,1
SET19_46	2019	Metatarso III dx	Bd 12,6
SET19_64	2019	Metatarso III dx	Bp 12,8
SET19_68	2019	Metatarso III dx	Bp 12,8
SET19_6	2019	Metatarso III sn	Bp 14,5; B 11,7
SET19_61	2019	Metatarso III sn	Bp 13,4; GL 75,9; Bd 14,9
SET19_80	2019	Metatarso III sn	Bp 13; LeP 67,9; B 11,5
SET19_83	2019	Metatarso III sn	Bp 11,9; GL 68,9; LeP 67,4
SET19_83	2019	Metatarso III sn	Bd 12
SET19_94	2019	Metatarso III sn	Bp 13,9
SET19_50	2019	Metatarso IV dx	Bp 12,1
SET19_54	2019	Metatarso IV dx	Bd 12,8
SET19_63	2019	Metatarso IV sn	B 11,6
SET19_91	2019	Metatarso IV sn	Bp 12,1
SET 19_58	2019	Metatarso V sn	GL 56,7
SET19_75	2019	Metapodiale Ind	Bd 14,4
SET19_77	2019	Metapodiale Ind	Bd 15,3
SET19_93	2019	Metapodiale Ind	Bd 14

SET19_95	2019	Metapodiale Ind	Bd 13,3
SET19_106	2019	Metapodiale Ind	Bd 14
SET19_9	2019	Falange I dx	Bp 13,5; GL 27,4; SD 12,9; Bd 14,1; GLpe 24,5
SET19_40	2019	Falange I dx	SD 9,5
SET19_55	2019	Falange I dx	Bp 13,8; SD 11,3; Bd 12; GLpe 30,5
SET19_56	2019	Falange I dx	Bp 14,7; SD 10,1; Bd 10,9; GLpe 26,6
SET19_66	2019	Falange I dx	Bp 13,6; SD 14,1; Bd 13,2; GLpe 29,8
SET19_67	2019	Falange I dx	Bp 15,1; SD 12,2; Bd 14; GLpe 27,6
SET19_69	2019	Falange I dx	Bp 14,8; SD 11,6; Bd 13,8; GLpe 30
SET19_79	2019	Falange I dx	Bd 13,8
SET19_121	2019	Falange I dx	Bp 13,4
SET19_136	2019	Falange I dx	Bp 12,6; GL 28,2; SD 10,9; Bd 11,7
SET19_30	2019	Falange I sn	Bp 13,5; SD 9,2; Bd 10,6; GLpe 24,7
SET19_35	2019	Falange I sn	Bd 10,3; GL 15,7; SD 9,6; Bd 10,2
SET19_57	2019	Falange I sn	Bd 13,2; SD 11; Bd 12,5; GLpe 26,3
SET19_76	2019	Falange I sn	Bp 14,9
SET19_85	2019	Falange I sn	Bp 13,6
SET19_119	2019	Falange I sn	Bp 12,6; SD 10,8; GLpe 29,9
SET19_71	2019	Falange II dx	Bp 10,8; GL 15,9; SD 10,2; Bd 9,9

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The faunal assemblage of Piano dei Cardoni: a Neolithic context on the island of Ustica (Italy)

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ABSTRACT: Since the end of the Pleistocene, and possibly also since its first human occupation, the island of Sicily witnessed a number of human land management techniques and exploitation of resources. In addition, the limited resources of the closed environments that the small islands adyacent to the main one represent, make it possible to document some of the earliest human impacts on nature. Within such endeavour, zooarchaeological research can help one reach a more precise understanding of ancient resource exploitation.

A good example of these considerations is the faunal assemblage from Piano dei Cardoni. This is a Middle/Late Neolithic (4.7-4.2 ka cal BCE) settlement with associated burials, recently discovered in Ustica, a small volcanic island off the coast of Palermo. This assemblage represents the earliest phases of human occupation of this island, making it a unique archaeological instance to understand the dynamics of movement, adaptation and selection of domestic species in pristine environments.

KEYWORDS: SICILY, ZOOARCHAEOLOGY, NEOLITHIC, ISLANDS, USTICA

RIASSUNTO: Fin dalla fine del Pleistocene e probabilmente sin dalla prima occupazione umana, la Sicilia è stata un contesto ideale per l'attuazione di diverse strategie di sfruttamento ambientale. Le piccole isole circostanti, caratterizzate da risorse limitate, offrono l'opportunità di osservare le prime tracce dell'impatto umano sull'ambiente fin dal Neolitico. Gli studi archeozoologici permettono di comprendere sia le dinamiche di sfruttamento delle risorse nel passato, sia i sistemi di sussistenza sviluppati in relazione agli ambienti da cui l'uomo traeva tali risorse.

Un esempio significativo è il campione archeozoologico di *Piano dei Cardoni*, un insediamento del Neolitico Medio/Recente (4.7–4.2 ka cal BCE) con funzioni funerarie, situato a Ustica, una piccola isola vulcanica al largo di Palermo. Questo record faunistico risale alla prima fase di occupazione umana dell'isola, costituendo un caso archeologico unico per comprendere le dinamiche di spostamento, selezione e adattamento delle specie domestiche in ambienti insulari incontaminati.

PAROLE CHIAVE: SICILIA, ARCHEOZOOLOGIA, NEOLITICO, INSULARE, USTICA

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RESUMEN: Desde finales del Pleistoceno, y posiblemente incluso desde los tiempos de las primeras ocupaciones humanas, la isla de Sicilia fue testigo de la implementación de diversas técnicas de gestión del territorio y de explotación de los recursos. Adicionalmente, los limitados recursos de los entornos cerrados que representan las pequeñas islas adyacentes a la principal, permiten documentar algunos de los primeros impactos humanos sobre el medio ambiente. Dentro de este marco, la investigación zooarqueológica contribuye a poder alcanzar una comprensión más precisa de la explotación de ciertos recursos pretéritos.

Un buen ejemplo de estas consideraciones es el conjunto faunístico de Piano dei Cardoni. Se trata de un asentamiento del Neolítico medio/tardío (4,7-4,2 ka cal BCE) con enterramientos asociados, descubierto recientemente en Ustica, una pequeña isla volcánica frente a la costa de Palermo. Este conjunto faunístico documenta las primeras fases de la ocupación humana de esa isla, convirtiéndolo en un ejemplo arqueológico único para comprender las dinámicas de movimiento, adaptación y selección de especies domésticas en ambientes prístinos.

PALABRAS CLAVE: SICILIA, ZOOARQUEOLOGÍA, NEOLÍTICO, ISLAS, USTICA

INTRODUCTION

Zooarchaeology has always been an essential subject to understand different aspects of past human communities, including occupation and exploitation of different environments; as a matter of fact, zooarchaeological studies are pivotal in the theme of insularity, i.e., the combination of local features and the human adaption strategies on islands. The introduction of domestic and wild species may shape the natural environment of these isolated realities, even leading to catastrophic effects on the ecosystem (Masseti, 2003, 2009; Vigne, 2014) or extinction phenomena caused by reckless preying on certain species (Alcover *et al*., 1998).

Currently, the excavations at Piano dei Cardoni provide the earliest evidence of permanent human occupation on Ustica island; therefore, the faunal remains recovered fall perfectly in the topic of insularity, allowing us to understand the animal exploitation strategies of Ustica's first settlers. The site was first located in 2018 after survey campaigns, then archaeological excavations were carried out between 2019 and 2020[1], uncovering two excavation areas: in Area 2, a megalithic burial structure was discovered, with at least eight secondary human depositions inside and around it. In Area 3, a large ceramic pot was found standing amidst a cluster of stones, which may also refer to ritual practices (Speciale *et al*., 2021-2022).

In the following paper, zooarchaeological analysis of Piano dei Cardoni samples will be presented; other faunal records will be used as reference to better address the theme of insularity through the study of animal remains.

MATERIALS AND METHODS

The zooarchaeological sample was divided between the two excavation areas (Table 1). The number of identified specimens (NISP) was calculated by counting each bone element attributed to a specific *taxon*. The minimum number of individuals (MNI) was only calculated for the most common ones, following Bökönyi (1970). Different osteological atlases were used as a reference for the taxonomic identification: Schmid (1972), for mammals, Cohen & Serjeanston (1996) for the avifauna and Wilkens (2012) for all species, especially marine mollusks and fish. The reference collection from the Laboratory of Zooarchaeology of the University of Salento (LAZUS, Lecce) was also used to identify some specimens. The distinction between sheep and goat was attempted using the criteria described in Boessneck *et al*. (1964), Boessneck (1969), Payne (1985), Halstead *et al*. (2002), Zeder & Lapham (2010). Data from the epiphyseal fusion of long bones were registered following the works of Silver (1969) for cattle, Bullock & Rackham (1982) for caprines, Bull &

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[1] The research activities were included in the project Brains2Islands – Fondazione CON IL SUD, led by the INGV (Vesuvius Observatory National Institute of Geophysics and Volcanology) of Naples.

	AREA 2 (2019-2020)			**AREA 3 (2020)**		
Taxa	**NISP**	**NISP %**	**MNI**	**NISP**	**NISP %**	**MNI**
Cattle - *Bos taurus* L.	7	0,1	1 A	4	0,7	1 SA
Sheep - *Ovis aries* L.	121	3	12 A (6 O, 3 C), 3 SA (1 O), 2 J	14	2,4	4 A (1 O, 1 C), 2 SA (1 O, 1 C), 1 J
Goat - *Capra hircus* L.	41	1		13	2,2	
Caprines - *Ovis* vel *Capra*	582	14,4		135	23,3	
Pig - *Sus domesticus* Erx.	78	1,9	3 A, 1 SA	18	3,1	2 A, 1 SA
Dog - *Canis familiaris* L.	3	0,1	1 A			
Fox - *Vulpes vulpes* L.	2	0,1	1 A			
Hare - *Lepus* sp.	2	0,1	1 A			
Rodents - Rodentia ind.	9	0,2	1 A			
Mammalia ind.	2650	65,5		370	63,8	
Total Mammalia	**3516**	**86,7**		**554**	**95,5**	
Mallard - *Anas platyrhynchos* L.	1	0,1	1 A			
Heron - *Ardea* sp.	1	0,1	1 A			
Marsh harrier – *Circus aeruginosus* L.	20	0,5	5 A	3	0,5	1 A
Kestrel - *Falco tinnunculus* L.	1	0,1	1 A			
Phasianidae ind.	6	0,1				
Aves ind.	227	5,6		11	1,9	
Total Aves	**256**	**6,3**		**14**	**2,4**	
Grouper ind. – *Epinephelus* sp.	66	1,6	8	7	1,2	2
Mediterranean moray – *Muraena helena* Rafinesque	1	0,1	1			
Common smooth-hound – *Mustelus mustelus* L.	1	0,1	1	1	0,2	1
Red porgy - *Pagrus pagrus* L.	6	0,1	3			
Sparidae ind.	4	0,1		1	0,2	
Shark ind.	1	0,1				
Pisces ind.	21	0,5		1	0,2	
Total *Pisces*	**100**	**2,5**		**10**	**1,7**	
Calliostoma sp.	1	0,1	1			
Cockle - *Cerastoderma edule* L.	1	0,1	1			
Cerithium sp.	1	0,1	1			
Naria spurca L.	1	0,1	1			
Melanella sp.	1	0,1	1			
Phorcus turbinatus L.	4	0,1	4	1	0,2	1
Purple dye-murex - *Hexaplex trunculus* L.	2	0,1	2			
Naticarius sp.	1	0,1	1			
Neverita josephinia Risso	6	0,1	6			
Oyster - *Ostrea edulis* L.	1	0,1	1			
Mediterranean limpet – *Patella caerulea* L.	88	2,2	54	1	0,2	1
Common limpet – *Patella vulgata* L.	2	0,1				
Turritellinella tricarinata Brocchi	1	0,1				
Mollusca ind.	12	0,3				
Total Mollusca	**122**	**3**		**2**	**0,4**	
Amphibia ind.	3	0,1				
Total Amphibia	**3**	**0,1**				
Sea turtle – *Caretta caretta* Rafinesque	1	0,1	1			
Tortoise - *Testudo hermanni* L.	4	0,1	4 A			
Total Reptilia	**5**	**0,1**				
Sea urchin - Echinoidea ind.	40	1				
TOTAL ANIMAL REMAINS	**4043**	**100,00**		**580**	**100,0**	

TABLE 1

Piano dei Cardoni archaeozoological sample divided between the two excavation areas with their NISP (Number of Identified Specimens) and MNI (Minimal Number of Individuals) and relative percentage (O=*Ovis aries*, C=*Capra hircus*; J=Juvenile, SA=Subadult, A=Adult). Age categories for MNI have been calculated by looking both at tooth wear stage and epiphyseal fusion data.

Payne (1982) for pigs. Wear teeth stages were recorded according to Grant (1982) for cattle, Grant (1982), Bull & Payne (1982) for pigs, Payne (1973) for caprines.

8 teeth samples from sheep, goats and pigs were analysed for Sr isotopes together with 4 soil, 9 plants and 2 water samples from different sites of the island, including Piano dei Cardoni (PdC). The procedures are described in Arienzo *et al*. (2020).

RESULTS

The faunal record from PdC is mostly composed of mammal bones, between which caprines predominate, followed by pig and scarce cattle remains. Mortality data were reliable only for caprines in Area 2 due to the low frequency of other mammal bones and the overall paucity of samples from Area 3. Tooth wear stages represent the most accurate mortality data (Figure 1), suggesting that more than 20% of the animals were killed off before their first year of life, while ca. 30%. were slaughtered between the first and third year and, lastly, most of the killings (40%) happened when the animals reached their full maturity (i.e., after their third year of life). The high mortality of adult individuals is confirmed by epiphyseal fusion data, which indicates that 70% of the flock (where sheep predominates over goats with a ratio of 2:1) was killed off in this age stage.

Sr isotopes acquired on sheep, goat and pig teeth are characterised by a significant variability ($^{87}Sr/^{86}Sr$ varies from c.a. 0.7066 to 0.7074). Pig samples display the smallest variation (from c.a. 0.7071 to 0.7074). The isotope variability of the analysed faunal remains agrees with the range of $^{87}Sr/^{86}Sr$ of soils, plants and water samples from Ustica island ($^{87}Sr/^{86}Sr$ from 0.7055 to 0.7085; Figure 2). Conversely, the obtained ratios differ from those relative to the Sicily Island published by Reinberger *et al*. (2021).

Beyond the main domestic species, other food resources of animal origin were exploited by the first settlers of Ustica. The wild mammals were only represented by sporadic fox and hare remains. The high number of bird remains probably refers to hunting activities of migratory and local species, between which marsh harrier bones prevail. Marine resources were also part of the diet, as confirmed by the recovery of different mollusks and fish species, where limpets and groupers respectively, constituted the most frequent *taxa* recorded[2].

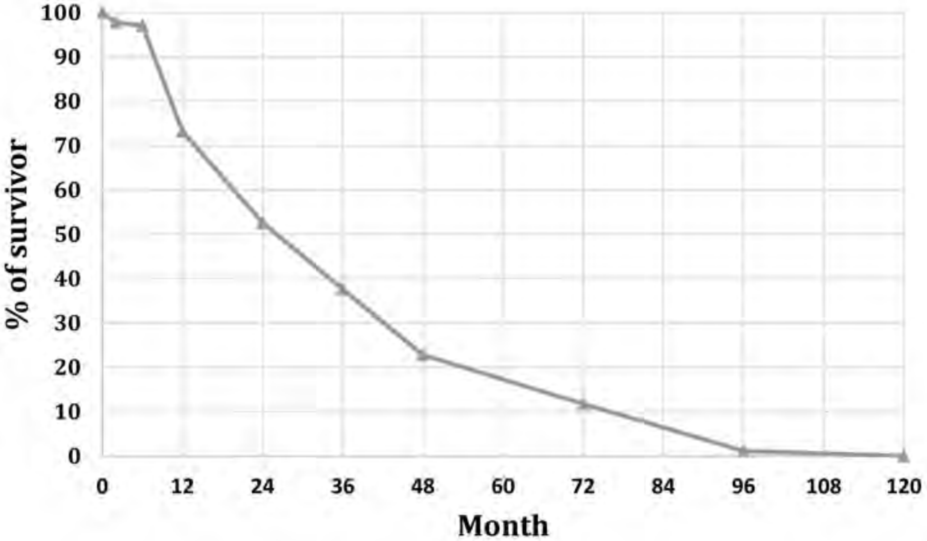

FIGURE 1
Piano dei Cardoni, Area 2 - kill-off patterns from the tooth wear stage data of caprines (n = 68).

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[2] Data for bird and fish bones are still preliminary since the zooarchaeological analysis for these two categories is still ongoing.

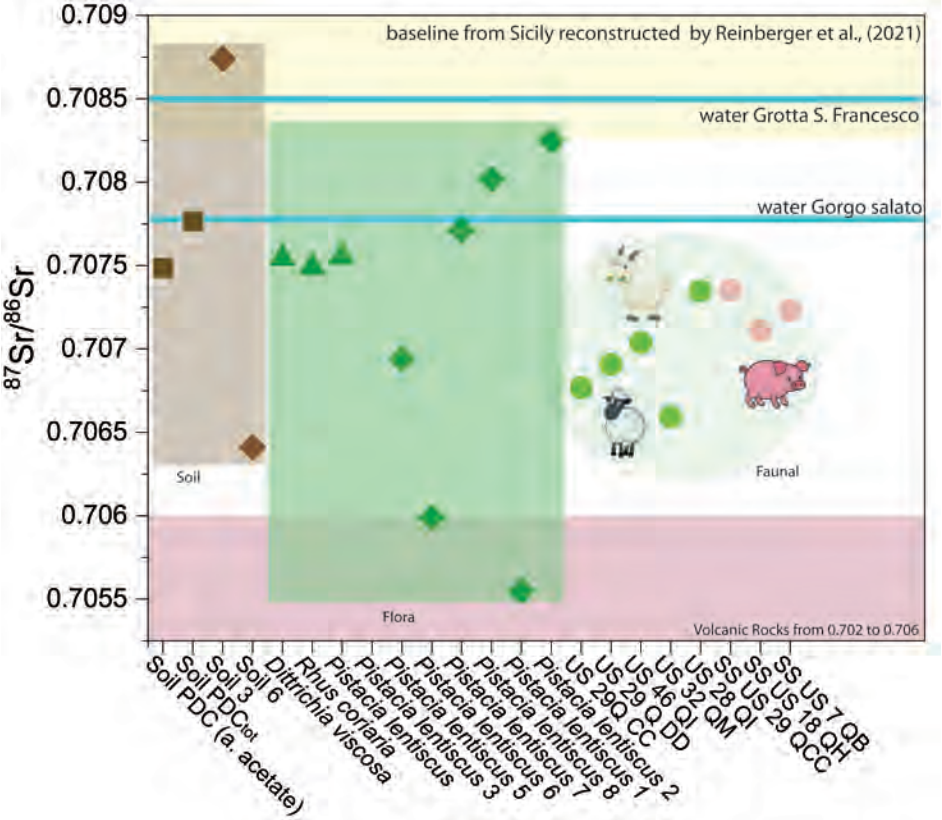

FIGURE 2

Sr-isotopic compositions of samples collected and analysed for characterising the local background on Ustica. Soil, plant, water samples and domestic fauna have been analysed. Results are compared with those of the volcanic rocks from Ustica (Barberi *et al*., 1969) and with the Sr isotopic baseline reconstructed by (Reinberger *et al*., 2021) for Sicily.

DISCUSSION

To better understand some aspects of the PdC faunal record, other zooarchaeological studies will be cited in the text as reference[3]. Adult individuals are the most attested for caprines, the predominant domestic category, which reflects a choice meant to let the animals reach their maximum yield. The absence of wool production tools seems to exclude an interest in this product, while the low frequency of animals killed off in their first months of life does not suggest a specific interest in milk and their derivates. Therefore, these aspects seem to indicate that caprines were exploited mostly for their meat, a vital food resource in a closed-off environment where large wild fauna was probably absent. On this matter, we cannot rule out the possibility that the two wild mammals *taxa* found in the record -hare and fox- have been introduced by humans to increase the numbers of prey on the island, as observed in other Mediterranean islands (Masseti, 2003, 2009).

A striking feature of the sample examined is the low presence of cattle bones, which may reflect a specific choice for an insular context like PdC due to the higher water needs of this *taxon* compared to caprines (Ramís, 2014). Water resources were present on the island, as confirmed by the occurrence of bird species like heron and mallard, although we may assume that they have been very limited (as a matter of fact, they are absent today). The preliminary zooarchaeological

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[3] Due to the limited space of this paper, supplementary materials will be provided online to describe the comparison drawn between Ustica and other prehistoric and protohistoric Sicilian sites (tab. 2, fig. 3); in the text only specific and important examples will be used to better address the PdC faunal record and its importance. For a more detailed discussion see (Prillo *et al*., 2024).

analysis of the Middle Bronze Age Villaggio dei Faraglioni (located on the other side of the island) indicates similar numbers for both caprines and cattle bones (Cruz-Uribe, 1995), prompting questions about how the management of the water sources could have changed through time. Other insular Sicilian sites are characterised by higher-but never predominant-cattle bone remains (Fiori & Curci, pers. comm.; Wilkens, 1987; Villari, 1991, 1995). We may conclude that the low frequency of this species in the PdC record may refer to other factors, such as problematic transportation by sea due to their size (Vigne, 2014: 52-53). Based on the results of Sr isotopic analyses, we may assess that the domestic species found in the excavation, were born and raised in Ustica island; at the same time, we cannot rule out the possibility that some animals were introduced from elsewhere during the growth and development of the human community.

Another important aspect of the PdC record is the exploitation of avian and marine resources. These certainly played a major role in the economy of the island, especially considering that their preservation and recovery during excavation activities have always been challenging and may be affected by their smaller size. The importance of these food resources can be observed in the Middle Bronze Age settlement of Mursia on the island of Pantelleria (Fiori & Curci, pers. comm; Wilkens, 1986, 1987), while mollusks are the most predominant category in the Early/Middle Bronze Age record of Capo Graziano on the island of Filicudi (Villari, 1991). In the zooarchaeological records from other islands, avian and marine resources were almost absent. In the mainland, only in Grotta dell'Uzzo these categories were present with high numbers: to be more specific, bird remains were greatly exploited in the Late Mesolithic phase, then around the shift to the Neolithic period they decrease in favour of fish remains (Tagliacozzo, 1993). We can assume that non-mammalian species were likely exploited more intensively in earlier periods, before a sedentary economy focused on domestic species had fully developed. In this regard, insular sites appear to be the only exception.

CONCLUSION

This work aimed to address the theme of insularity by looking at faunal records from prehistoric and protohistoric sites in Sicily. The new data from PdC were an ideal starting point to better understand this theme, however a better and thorough comparison with new data is required. Furthermore, each site needs to be analysed by looking at its cultural and geographical background. For instance, the PdC animal bones probably represent remains of ritual activities done for the dead, thus deriving from specific choices that may affect our interpretation of the faunal record.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_020

REFERENCES

Alcover, J.A.; Sans, A. & Palmer, M. 1998: The extent of extinctions of mammals on islands. *Journal of Biogeography* 25: 913–918. DOI: https://doi.org/10.1046/j.1365-2699.1998.00246.x

Arienzo, I.; Rucco, I.; Di Vito, M.A.; D'antonio, M.; Cesarano, M. & Carandente, A. 2020: Sr isotopic composition as a tool for unraveling human mobility in the Campania area. *Archaeological and Anthropological Sciences* 12(8): 157. DOI: https://doi.org/10.1007/s12520-020-01088-0

Barberi, F.; Borsi, S.; Ferrara, G. & Innocenti, F. 1969: Strontium Isotopic Composition of Some Recent Basic Volcanites of the Southern Tyrrhenian Sea and Sicily Channel. *Contributions to Mineralogy and Petrology* 23: 157-172.

Bedini, E. 1996: Reperti faunistici dall'area sepolcrale di Ribera, contrada Ciavolaro. In: Castellana, G. (ed.): *La stipe votiva del Ciavolaro nel quadro del Bronzo Antico Siciliano*: 276-281. Museo Archeologico Regionale di Agrigento, Agrigento.

BOESSNECK, J. 1969: Osteological Differences between Sheep (*Ovis aries* Linné) and Goat (*Capra hircus* Linné). In: Brothwell, D. & Higgs, E. (eds.): *Science in Archaeology. A Comprehensive Survey of Progress and Research*: 331-358. Thames & Hudson, London.

BOESSNECK, J.; MÜLLER, H.H. & TEICHERT, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries*) und Ziege (*Capra hircus*). *Kühn Archiv* 78: 1-129.

BÖKÖNYI, S. 1970: A new method for the determination of the number of individuals in animal bone material. *American Journal of archaeology* 74: 291-292.

BULL, G. & PAYNE, S. 1982: Tooth Eruption and Epiphysial Fusion in Pigs and Wild Boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (British Series) 109. Oxford.

BULLOCK, D. & RACKHAM, J. 1982: Epiphysial Fusion and Tooth Eruption of Feral Goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (British Series) 109. Oxford.

CHILARDI, S. & VIGLIO, F. 2010: Patologie dentarie nei resti animali provenienti dalle UUSS 1 16 del fossato neolitico di Contrada Stretto Partanna (Trapani). In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds): *Atti del 5° Convegno Nazionale di Archeozoologia, Rovereto, 10-12 December 2006*: 119-127. Museo Civico di Rovereto, Rovereto.

COHEN, A. & SERJEANSTON, D. 1996: *A manual for the identification of bird bones from archaeological sites*. Revised edition. Archetype Publications, London.

CRUZ-URIBE, K. 1995: Appendix II: Preliminary report on the faunal remains. In: Holloway, R.R. & Lukesh, S.S. (eds.): *Ustica I. Archaeologia Transatlantica 14. The results of the excavation of the Regione Siciliana Soprintendenza ai Beni Culturali ed Ambientali Provincia di Palermo in collaboration with Brown University in 1990 and 1991*. Publications d'Histoire de l'Art et d'Archeologie de l'Universitè Catholique de Louvain, 78. Institut supérieur d'archéologie et d'histoire de l'art, Louvain-la-Neuve.

CULTRARO, M. 2004: Food for the gods: animal consumption and ritual activities in the early Bronze Age Sicily. In: Santillo Frizell, B. (ed.): *PECUS. Man and animal in antiquity*: 1-10. Proceedings of the Conference at the Swedish Institute in Rome, 9-12 September 2002. The Swedish Institute in Rome, Rome.

DI SIMONE, G. 2013-2014: *Gestione e sfruttamento delle risorse faunistiche nei siti di Vallone Inferno (PA) e Case Bastione (EN)*. University of Ferrara.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

HALSTEAD, P.; COLLINS, P. & ISAAKIDOU, V. 2002: Sorting the Sheep from the Goats: Morphological Distinction between the Mandibles and the Mandibular Teeth of Adult Ovis and Capra. *Journal of Archaeological Science* 29: 543-545.

MANNINO, A.M.; PLUCIENNIK, M. & GIANNITRAPANI, E. 2010: Risultati preliminari dello studio archeozoologico dei reperti faunistici dal Riparo San Tommaso (Enna). In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del 5° Convegno Nazionale di Archeozoologia, Rovereto, 10-12 December 2006*: 165-167. Museo Civico di Rovereto, Rovereto.

MARTÍN, P.; MESSANA, C.; DI SIMONE, G.; ALLUÉ, E.; EXPÓSITO, I.; OLLÉ, A.; VERGÈS, J.M. & FORGIA, V. 2023: Animal husbandry in Sicilian prehistory: The zooarchaeological perspective from Vallone Inferno (Scillato, Palermo). *Journal of Archaeological Science: Reports* 48. DOI: https://doi.org/10.1016/j.jasrep.2022.103813

MASSETI, M. 2003: Holocene endemic and non-endemic mammals of the Aegean islands. In: *Zooarchaeology in Greece: recent advances*: 53-63. British School at Athens Studies 9. British School at Athens, Athens.

— 2009: Mammals of the Mediterranean islands homogenization and the loss of biodiversity. *Mammalia* 73: 184-186. DOI: https://doi.org/10.1515/MAMM.2009.029

MICCICHÈ, R. & MANZELLA, G. 2022: Le faune e l'industria dura di origine animale. In: Ianni, F.; Miccichè, R.; Manzella, G. & Vassallo, S. (eds.): *Il Neolitico medio nel Palermitano e il Sito di Castellaccio di Fiaccati / le Rocche (Roccapalumba)*: 33-42. Notiziario Archeologico della Soprintendenza di Palermo, 59. Sezione Archeologica della Soprintendenza per i Beni Culturali e Ambientali, Palermo.

NARDI, N. 1979: Le faune dello stanziamento protostorico di Poggio Biddini (RG). *Studi per l'ecologia del Quaternario* 1: 175-179.

PAYNE, S. 1973: Kill-off Patterns in Sheep and Goats: The Mandibles from Asvan Kale. *Anatolian Studies* 33: 281-303.

— 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, *Ovis*, and, Goats, *Capra*. *Journal of Archaeological Science* 12: 139-147.

PRILLO, V.G.; SPECIALE, C. & MICCICHÈ, R. 2024: Insularity and singularity: exploitation of animal resources in

Sicilian insular and inland territories during Prehistoric times. In: Mladenovic T. & Markovic D. (eds.): *Case Studies in European Zooarchaeology*: 27-43. BAR Publishing, Oxford.

Ramis, D. 2014: Early island exploitations: productive and subsistence strategies on the prehistoric Balearic Islands. In: Knapp, A.B. & van Dommelen, P. (eds.): *The Cambridge Prehistory of the Bronze and Iron Age Mediterranean*: 44–56. Cambridge University Press, Cambridge.

Reinberger, K.L.; Reitsema, L.J.; Kyle, B.; Vassallo, S.; Kamenov, G. & Krigbaum, J. 2021: Isotopic evidence for geographic heterogeneity in Ancient Greek military forces. *PLOS ONE* 16(5). DOI: https://doi.org/10.1371/journal.pone.0248803

Schmid, E. 1972: *Atlas of animal bones. For prehistorians, archaeologists and quaternary geologists*. Elsevier, Amsterdam.

Silver, I.A. 1969: The Ageing of Domestic Animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. Thames & Hudson, London.

Speciale, C.; Battaglia, G.; Larosa, N. & Magrì, A. 2021-2022: Piano dei Cardoni (Ustica, PA). *Notiziario di Preistoria e Protostoria. Sardegna e Sicilia* 8(2): 80-82.

Tagliacozzo, A. 1993: Archeozoologia della Grotta dell'Uzzo, Sicilia: da un'economia di caccia ad un'economia di pesca ed allevamento. *Bullettino di paletnologia italiana* 84, suppl. 2. EDIFTR, Florence.

Vigne, J.-D. 2014: The origins of mammals on the Mediterranean islands as an indicator of early voyaging. In: Ammerman, A.J. & Davis, T. (eds.): *Island Archaeology and the origins of seafaring in the Eastern Mediterranean*: 45-46. Proceedings of the Wenner Gren workshop, Reggio Calabria, 19-21 October 2012. *Eurasian Prehistory* 10(1-2). Department of Anthropology - Harvard University, Peabody Museum, Cambridge.

Villari, P. 1991: Le faune del villaggio di Capo Graziano nel contesto archeologico eoliano e siciliano dell'età del Bronzo. In: Bernabò Brea, L. & Cavalier, M. (eds.): *Meligunìs Lipara, 6, Insediamenti dell'età del Bronzo*: 317-330. Appendix 5. Flaccovio, Palermo.

— 1995: *Le faune della tarda preistoria nella Sicilia orientale*. Ente Fauna Siciliana, Siracusa.

Wilkens, B. 1986: L'Ittiofauna del villaggio dell'età del Bronzo di Mursia (Pantelleria). *Atti della Società Toscana di Scienze Naturali, Memorie*, Serie A 93: 315-327.

— 1987: La fauna dell'età del Bronzo di Mursia. Nota preliminare. *Atti della Società Toscana di Scienze Naturali, Memorie*, Serie A 94: 215-224.

— 2012: *Archeozoologia. Manuale per lo studio dei resti faunistici dell'area mediterranea*.

Zeder, M.A. & Lapham, H.A. 2010: Assessing the Reliability of Criteria Used to Identify Postcranial Bones in Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905.

SUPPLEMENTARY MATERIAL

Site	***Chronology***	***NISP***	***Caprines %***	***Cattle %***	***Pigs %***	***Wild Mammals %***	***Avifauna %***	***Mollusks %***	***Fish %***	***Bibliography***
1 – Grotta dell'Uzzo (San Vito Lo Capo)	LM I,	1374				36	30,5	5,4	0,1	Tagliacozzo (1993)
	LM II,	3959				47	3,2	34,8	1,2	
	Transitional phase,	12222				23,7	0,7	64,7	4	
	EN I,	11564	1,4	0,4	3	6,7	0,3	73,4	4,1	
	EN II	2894	13,2	1	4,3	5,7	0,2	56,6	5,3	
2 – Piano dei Cardoni (Ustica)	MN-LN.									See the main article
	Area 2,	1238	60	0,5	6,3	0,3	20,6	8,9	7,2	
	Area 3	199	81,4	2	9		7	1	4,5	
2 - Villaggio Faraglioni (Ustica)	MBA	2265	44	46,2	8		0,6		1,2	Cruz-Uribe (1995)
3 – Acropoli di Lipari (Lipari)	MN	795	37,9	41,6	17	0,1	0,2	3	0,2	Villari (1995)
4 – Le Rocche (Roccapalum-ba)	MN	204	46	19,1	20,5	4,9	1,4	3,9		Miccichè & Manzella (2022)
5 – Contrada Stretto, Partanna	EN-LN	1247	48,1	15,3	16,1	16,7	1,8			Chilardi & Vaglio (2010)
6 – Mursia (Pantelleria)	MBA	24322	61,6	9	4	0,004	14,6	8,2	1,6	Wilkens (1986, 1987)
7 – Contrada Ciavolaro (Ribera)	EBA-MBA	75	8	85,3	1,3	5,3				Bedini (1996)
8 – Capo Graziano (Filicudi)	EBA,	782	17	6,1	3,9	0,1	0,2	72,4	0,1	Villari (1991)
	MBA	36	58,3	19,5	22,2					
9 – Muculufa (Butera)	EBA – Sanctuary,	5350	84	5,7	9,4	1				Cultraro (2004)
	village	736	62	19	13,6	3,7				
10 – Poggio Biddini (Acate)	EBA	144	47,2	20,8	29,1	2				Nardi (1979)
11 – Case Bastione (Villarosa)	EBA	230	66	8	8	8				Di Simone (2013-2014)
12 – Riparo S. Tommaso	EBA,	692	1,8		2,4	42,6	1			Mannino *et al.* (2010)
	MBA,	58	3,4		8,6	10				
	LBA	228	7,4	2,1	7,8	17,1	1,3			
13 – Vallone Inferno (Scillato)	MN-EBA,	678	71,2	4,7	0,4	12,1				Martín *et al.* (2023) Di Simone (2013-2014)
	EBA-MBA	407	70	6	10	11				

TABLE 2

An updated version of the table published in (Prillo *et al*., 2024) with fish and mollusks remains clearly distinguished. The table is a list of the archaeological sites and their faunal record used as comparison, expressed in terms of NISP (Number of Identified Specimens) and species abundance (expressed in percentage calculated using the NISP). LM = Late Mesolithic; EN = Early Neolithic; MN = Middle Neolithic; LN = Late Neolithic; EBA = Early Bronze Age; MBA = Middle Bronze Age; LBA = Late Bronze Age.

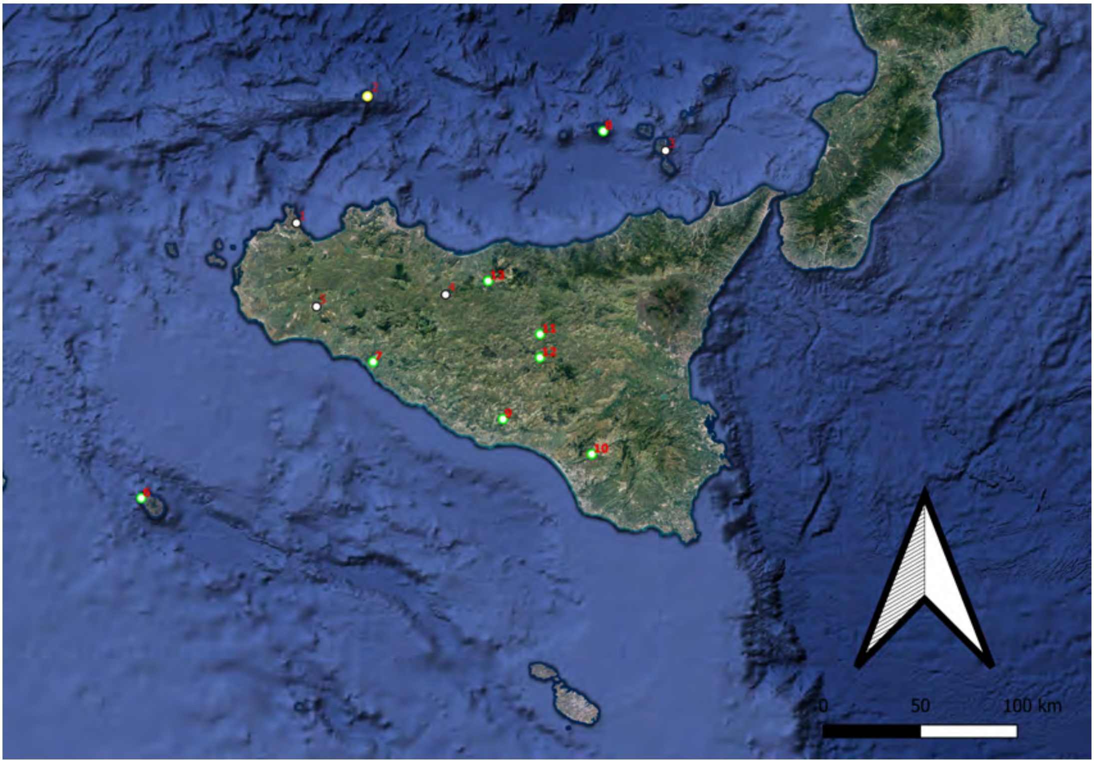

FIGURE 3

Map showing the archaeological sites used as comparison and expressed in the Table 2 (created with QGIS 3.16 by Andrea De Martino). Mesolithic-Neolithic sites are marked in black, Ustica island is marked in yellow and Bronze Age sites are marked in green.

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Jesolo (VE, Italy): a lagoon site from the Late Antiquity to the Middle Ages. Preliminary results of an archaeozoological and archaeobotanical study

Il sito lagunare di Jesolo (VE) tra Tarda Antichità e Medioevo: risultati preliminari delle analisi archeozoologiche e archeobotaniche

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ABSTRACT: Since 2011, the archaeological project in the area of "Antiche Mura" in Jesolo (VE) attempts to reconstruct the environmental and settlement processes of the early colonisation stages in the northern lagoon of Venice. This work presents the preliminary results of the archaeozoological and archaeobotanical analyses conducted on remains from different stages of occupation at this site. These phases date from the 4th-5th AD, when the settlement of ancient *Equilo* was organised around a *mansio* (a station for postal services for officers and soldiers who travelled from Altino to Aquileia, along the endolagunar roads of the *cursus publicus*) and from the 10th-12th AD, when the area was exploited for the storage of food surpluses, possibly related to the Diocese of *Equilo*. Bioarchaeological analyses appear to reveal a change in the exploitation of resources, probably resulting from environmental and economic transformations taking place between the Late Antiquity and the Middle Ages.

KEYWORDS: LATE ANTIQUITY, MIDDLE AGES, JESOLO (VE), ARCHAEOZOOLOGY, ARCHAEOBOTANY

RIASSUNTO: Il progetto archeologico Jesolo (VE), in località "Antiche Mura", dal 2011 si propone di ricostruire il mutevole quadro ambientale e i processi insediativi delle prime fasi di colonizzazione e di stabilizzazione nella laguna nord di Venezia. In questo lavoro vengono presentati i risultati preliminari delle analisi archeozoologiche e archeobotaniche eseguite su resti provenienti da diverse fasi di occupazione del sito, comprese tra il IV-V secolo, quando l'abitato dell'antica *Equilo* si organizzava attorno a una *mansio* (una stazione per servizi postali, per ufficiali e soldati, che viaggiavano da Altino ad Aquileia, lungo le vie endolagunari del *cursus publicus*) e il X-XII secolo, quando l'area è sfruttata per la conservazione di surplus alimentari, forse collagata alla Diocesi di *Equilo*. Le analisi bioarcheologiche sembrano evidenziare un mutamento nello sfruttamento delle risorse, derivato probabilmente da trasformazioni di carattere ambientale ed economico tra Tarda Antichità e Alto Medioevo.

PAROLE CHIAVE: TARDA ANTICHITÀ, MEDIOEVO, JESOLO (VE), ARCHEOZOOLOGIA, ARCHEOBOTANICA

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RESUMEN: Desde 2011, el proyecto arqueológico en la zona de “Antiche Mura” en Jesolo (VE) intenta inferir pautas ambientales y de asentamiento de las primeras etapas de colonización en la laguna septentrional de Venecia. Nuestro estudio presenta los resultados preliminares de los análisis arqueozoológicos y arqueobotánicos realizados sobre los restos en diferentes etapas de la ocupación del yacimiento. Las fases analizadas datan, en primer lugar, de los siglos IV-V d.C., cuando el asentamiento de la antigua *Equilo* se estructuró en torno a una *mansio* (estación de correos para oficiales y soldados que viajaban de Altino a Aquileia, por los caminos endolagunares del *cursus publicus*) y, en segundo lugar, de los siglos X-XII d.C., cuando la zona era explotada para el almacenamiento de excedentes de alimentos, posiblemente relacionados con la Diócesis de *Equilo*. Los análisis bioarqueológicos parecen evidenciar un cambio en la explotación de los recursos, probablemente relacionado con transformaciones ambientales y económicas documentadas entre la Antigüedad Tardía y la alta Edad Media.

PALABRAS CLAVE: ANTIGÜEDAD TARDÍA, EDAD MEDIA, JESOLO (VE), ARQUEOZOOLOGÍA, ARQUEOBOTÁNICA

INTRODUCTION

Jesolo is located between the northern Lagoon of Venice and the Adriatic coast (Figure 1). The archaeological site is on the edge of the modern settlement, in an area that was formerly characterized by lagoon and marsh waters, reclaimed between the end of the 19th and the beginning of the 20th century. Jesolo’s environmental history is closely linked to the evolution of the mouth of the Piave River, which transformed the original lagoon environment into a freshwater marsh during the Middle Ages. At the end of the 14th century, the river reached the town, leading to a deterioration of the environmental conditions and a progressive depopulation of the area. The original settlement,

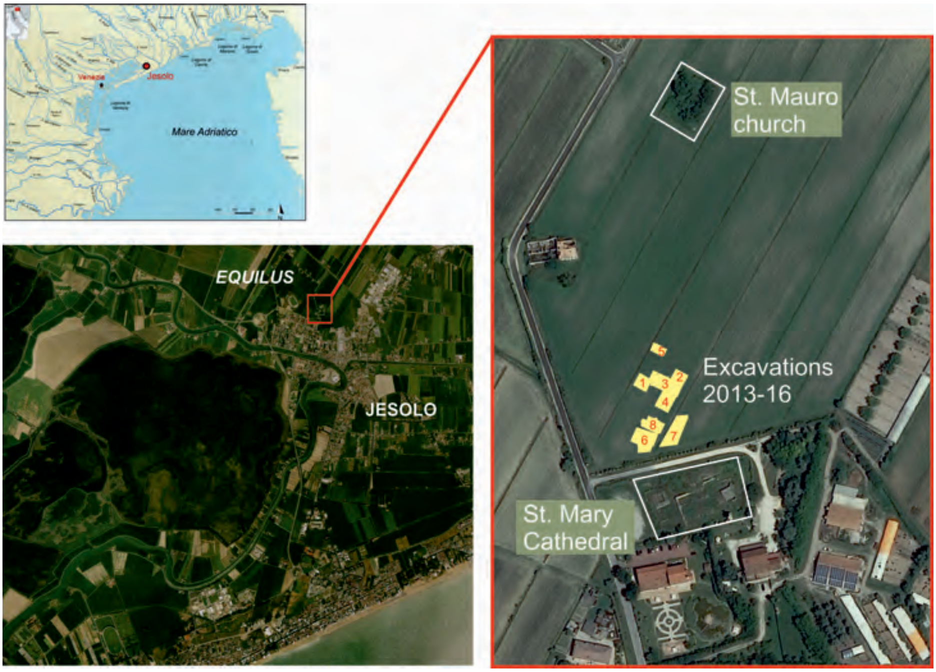

FIGURE 1

Location of the site of ancient Jesolo (*Equilus*) and areas investigated by archaeological excavations (elaboration by A. Cianciosi, Laboratory of Medieval Archaeology, Ca' Foscari University of Venice).

Periods	Chronology	Archaeological features
Period 6	1st c. BC - 3rd c. AD	Traces of occupation dating back to the Roman period
Period 5	4th c. AD - beginning of the 6th c. AD	*Mansio* and workshops foundation; Fire and abandonment of the *mansio*
Period 4	6th c. AD - beginning of the 7th c. AD	*Mansio* spoliation; Settlement reorganisation
Period 3	end of the 6th c. AD - 7th c. AD	Limestone kiln; Cemetery
Period 2	10th c. AD. - 12th c. AD	Service structures and silos for the storage of foodstuff
Period 1	20th c. AD - 21st c. AD	Agricultural use

TABLE 1

The chronology of the Jesolo excavations and brief description of the main archaeological features of each period.

known from historical sources as *insula Equilus* (or *Equilo*), developed on a morphological relief, connected to the lagoon system and the river Piave, representing a strategic position for communications between the lagoon area and the hinterland (Granzo, 2018).

The archaeological excavations carried out between 2013 and 2016 by the Department of Humanities, under the scientific direction of Prof. Sauro Gelichi of Ca' Foscari University of Venice[1] focused on the island in the ancient lagoon where the settlement of *Equilo* developed; the excavations documented a long settlement sequence between the 1st century BC and contemporary times (Cadamuro *et al.*, 2017; Gelichi *et al.*, 2018), which was organised into 6 periods (Table 1). Between the 4th-5th centuries the settlement is represented by a *mansio*, i.e. a place of rest and exchange that, through the endolagunar routes, allowed the connection between Altino and Aquileia. The *mansio* consisted of a large building, subdivided into quadrangular rooms for accommodation, storage of foodstuffs, and workshops for manufacturing activities related to the *mansio* itself (Figure 2). At the end of the 5th century it was destroyed by a fire and never rebuilt. During the 6th century, the site was transformed and was later partly occupied by a cemetery near a newly founded church. In the Early Middle Ages a progressive enlargement of the occupied areas occurred, thanks to substantial land reclamation works, which probably began with the settlement of an episcopal seat in *Equilus*. Archaeological evidence concerning the later occupation phase is poor due to modern land reclamation works. Between the 10th-12th centuries, the area investigated is occupied by service structures for the storage and preservation of food surpluses (probably managed by the episcopal authority), which, once disused in the 12th century, were filled with waste. The abandonment of the site occurs in the 14th century, when changes in the river structure resulted in the progressive transformation of the local lagoon into a freshwater marsh (Primon & Mozzi, 2023).

MATERIALS AND METHODS

The faunal sample analysed in this study relates to the Late Antique phases, when the *mansio* was first active (Period 5) and then when part of the structures was later re-organized (Period 4), and to the Middle Ages (Period 2), when some wooden structures were reused as waste dumps. The aim of this preliminary study is to highlight possible changes in the exploitation of animal and plant resources between the late antique and medieval phases.

A total of 8181 vertebrate remains (Table 2) and 1961 invertebrate remains, almost all belonging to molluscs, was recorded (Table 3).

The remains were identified with the aid of modern reference collections and animal bone atlases (Schmid, 1972; Cohen & Serjeanton, 1986; Barone, 1995). Most of the bones belonging to

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[1] The investigations were conducted under the concession of the Ministry of Culture, and were funded by the town of Jesolo and Ca' Foscari University of Venice. The research project at the "Antiche Mura" in Jesolo, aimed at understanding the development of the ancient settlement, started in 2011 and is still ongoing.

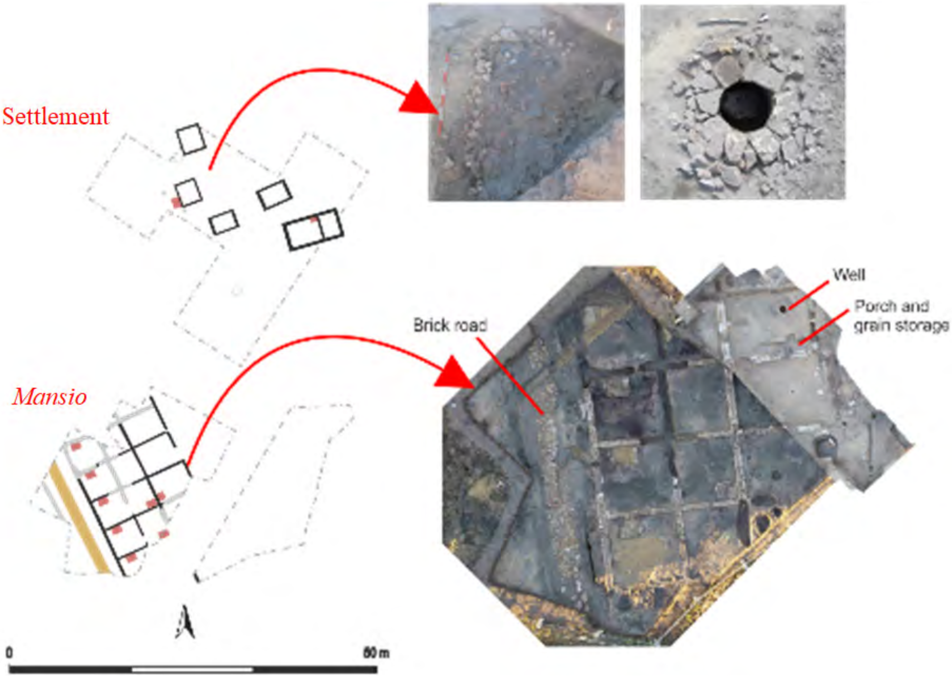

FIGURE 2

Late Antique settlement structures pertaining to a *mansio* (elaboration by A. Cianciosi, Laboratory of Medieval Archaeology, Ca' Foscari University of Venice).

ducks and geese are determined at the family level, due to the high fragmentation of the remains. The separation of sheep and goat remains was attempted following Zeder & Lapham (2010) and Zeder & Pilaar (2010); the remains belonging to these two species are referred to as "caprine" in the text.

The relative proportion of each taxon was quantified through the analysis of the number of identified specimens (NISP) and the minimum number of individuals (MNI). In the latter case, elements were separated according to their presence within the individual structures.

Due to a dearth of mandibles, the age profile of cattle relied only on epiphyseal fusion data (Silver, 1969). For pigs and caprines, epiphyseal fusion data were compared with tooth wear data: for pigs, the methods of Bull & Payne (1982) were used; for caprines, those of Bullock & Rackham (1982) and Payne (1973).

Sex distinction was based on the morphological difference in the canine teeth of male and female pigs, on the presence/absence of a spur in the tarsometatarsi and in the presence of medullary deposits in the fractured bones of domestic fowl.

Reference was made to the WoRMS (World Register of Marine Species) for the classification of molluscs.

The animal remains were hand-collected; it is likely that the faunal sample is affected by recovery bias, with smaller specimens more likely to have been overlooked during the excavation. This is suggested, for example, by the low presence of fish remains (not yet analysed), which account for around 2% of the identified sample and which certainly must have represented a more important resource in the site's economy.

A good number of plant remains, both charcoal and seeds, were also recovered from Jesolo. The archaeobotanical remains were collected from three different contexts. For the Late Antique phase, the samples were collected from the fire layer (Period 5) of a *mansio* room and from four deposits scattered on the floor of the same room sampled in four different subsamples (20a, 20b, 20c, 20d). Other samples were collected from an early medieval limestone kiln (Period 3); these represent the fuel used in the last combustion event. Finally, the later medieval samples (Period 2) come from the filling layer of a basket found

	Late Antiquity				Middle Ages	
Period	Period 5		Period 4		Period 2	
Taxa	NISP	NMI	NISP	NMI	NISP	NMI
Bos taurus	123	16	80	12	365	24
Ovis/Capra	256	28	169	24	560	58
Ovis aries	[50]		[40]		[55]	
Capra hircus	[19]		[13]		[51]	
Sus domesticus	480	50	424	48	326	41
Equus caballus	1	1		2	4	1
Equus sp.			2		1	
Canis familiaris	1	1			2	1
Felis sp.					7	1
Sus scrofa	[3]		2]1]	1	[1]	
Capreolus capreolus	2	2			1] 2]	2
Cervus elaphus	7] 3]	3	5] 2]	2	1] 1]	1
Castor fiber	1	1				
Rattus sp./*Arvicola* sp.	5	3			2	2
Emys orbicularis/Testudo hermanni	16	2				
Galliformes	31	10	8	4	19	5
Gallus gallus	88	19	43	13	121	22
Anatidae	80	9	63	14	20	4
Anser anser	3	3	3	3	10	4
Anas cfr. *platyrhynchos*	34	13	18	9	8	4
Cygnus sp.	1	1				
cfr. *Scolopacidae*	4	2			2	1
Ardeidae	1	1	3	2		
Larus sp.	3	3				
Phalacrocorax carbo			2	1		
Columba sp.					1	1
Falconiformes					1	1
Large mammal	295		113		374	
Medium mammal	1125		378		1038	
Aves	159		101		114	
Pisces	33		13		24	
Unidentified	339		239		419	

TABLE 2

List of all the *taxa* recorded, divided by period. NISP (Number of Identified Specimens); MNI (Minimum Number of Individuals).

in a hole dug in the ground, as well as from the overlying layer.

All samples were water-sieved with 1 mm and 0.5 mm meshes, then the materials were sorted under a stereomicroscope to collect charcoals, seeds but also bone fragments, microfaunal remains, shells etc.

The analysis of these remains was conducted using standard methods of anatomical and morphological observation and through comparison with specific atlases (Greguss, 1955; Renfrew, 1973; Schweingruber, 1990; Neef *et al*., 2012) and comparison collections.

RESULTS

In relation to both the NISP and the MNI (Figure 3), pig turns out to be the most important species during Late Antiquity.

Age-at-death data reveal that pigs were preferably culled, in all periods, once they reached their

	Late Antiquity		Middle Ages
Period	Period 5	Period 4	Period 2
Taxa	NISP	NISP	NISP
Marines bivalves			
Glycymeris sp.	33	29	28
Acanthocardia tuberculata (Linnaeus, 1758)		1	
Cerastoderma glaucum (Bruguière, 1789)	154	256	147
Donax trunculus Linnaeus, 1758		1	4
Scrobicularia plana (da Costa, 1778)	1		
Mytilus cfr. galloprovincialis Lamarck, 1819	1		
Ostrea edulis Linnaeus, 1758	155	152	56
Pinna nobilis Linnaeus, 1758		1	
Flexopecten glaber (Linnaeus, 1758)	11	11	1
Pecten jacobaeus (Linnaeus, 1758)	1	1	
Pectinidae	1	4	
Chamelea gallina (Linnaeus, 1758*)*	7	5	628
Polititapes aureus (Gmelin, 1791)	1	2	
Ruditapes decussatus (Linnaeus, 1758)	1		
Marine gastropods			
Steromphala sp.	6	3	
Phorcus turbinatus (Born, 1778)	2		
Trochidae	1		
Bolma rugosa (Linnaeus, 1767)		1	
Turritellinella tricarinata (Brocchi, 1814)	1	4	
Cerithium vulgatum Bruguière, 1792	36	23	3
Bolinus brandaris (Linnaeus, 1758)	12	8	7
Hexaplex trunculus (Linnaeus, 1758)	16	32	4
Muricidae	8	3	2
Tritia nitida (Jeffreys, 1867)	35	36	2
Tritia neritea (Linnaeus, 1758)	1		
Terrestrial gastropods			
Cornu cfr. *aspersum* (Müller, 1774)		2	5
Cornu/*Helix*	3	2	1
Eobania vermiculata (Müller, 1774)		1	
Cernuella virgata (Da Costa, 1778)	1		
Crustaceans			
Eriphia verrucosa (Forskål, 1775)		2	
Gastropoda indet.	2		1
Crustacea indet.	1		1

TABLE 3

List of mollusc and crustacean remains, divided by period.

optimum weight. Based on tooth wear, however, animals killed into the second year of life predominate in Late Antique times, suggesting a more specialised breeding, compared to Period 2 when slaughter is more equally distributed (Figure 4). In all periods, boars are better represented than sows. Even though male canines can be more easily collected because of their larger size, the record sug-

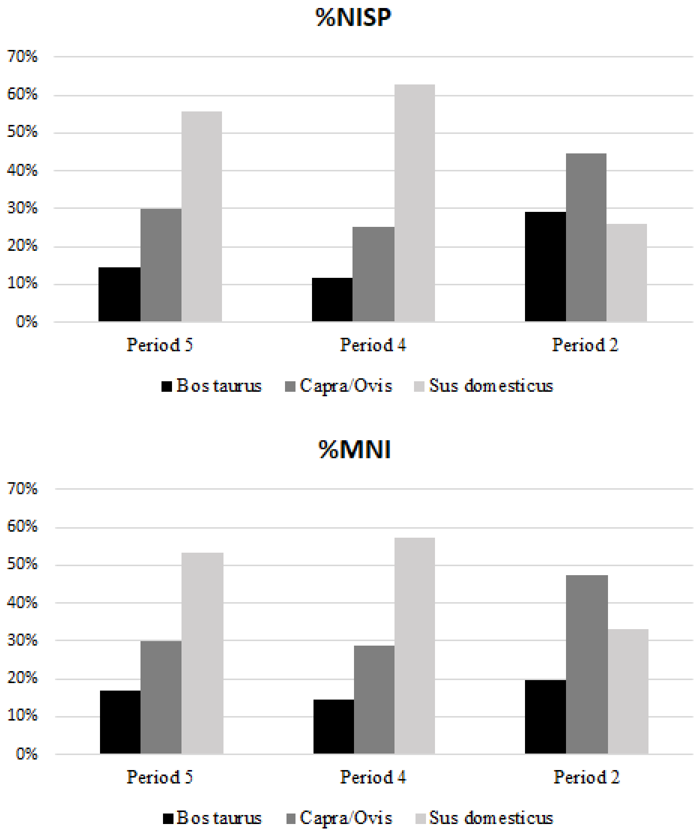

FIGURE 3

Frequencies based on the Number of Identified Specimens (NISP) and Minimum Number of Individuals (MNI) for the main domesticates, divided by period.

gests that probably sows were culled less often, only when they were old and not anymore useful for reproduction.

It is possible that some bones belong to wild boar, although the limited biometrical data do not allow a more accurate analysis (Garavello & Rizzetto, *in press*)[2].

In Period 2, caprines are the best represented taxon; based on NISP frequencies, the importance of cattle also increases, doubling their presence compared to the previous periods. The difference between NISP and MNI cattle frequencies could be in part due to the higher fragmentation of cattle bones, resulting from more intensive butchery activities.

Sheep seem to predominate in Periods 5 and 4, while in Period 2 sheep and goats are present in a similar proportion (Table 1); however, as most remains cannot be attributed to one of the two species, these results remain tentative, and separate ageing analyses could not be carried out.

Caprine mortality data cover a broad spectrum of age classes in all periods, signifying that the animals were exploited for different purposes. At the same time, the dental evidence suggests a greater incidence of sub-adult individuals in Period 2 (stages d-e), an advantageous age for meat exploitation (Figure 5).

The sample of cattle remains is not large enough for ageing analyses. The very few data on epiphysial fusion of post-cranial elements suggest that most of the animals were slaughtered as adults. Only in a few cases could anatomical elements be attributed to animals younger than four years of age and, rarely,

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[2] Some remains that could belong to wild boar due to their size are marked in brackets in Table 2. Their small number would confirm the marginal presence of the wild component.

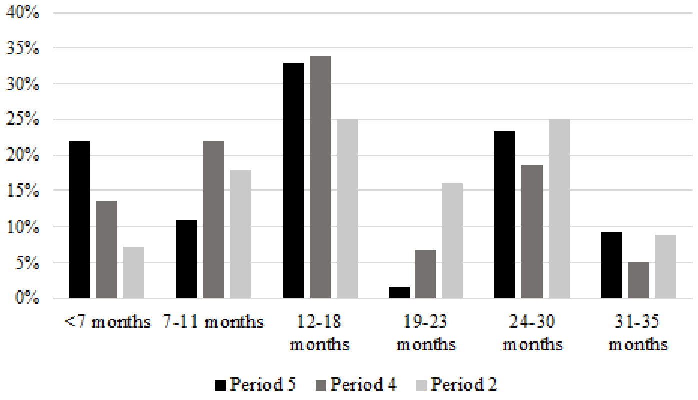

FIGURE 4

Kill-off patterns of pigs from mandibular wear stage data.

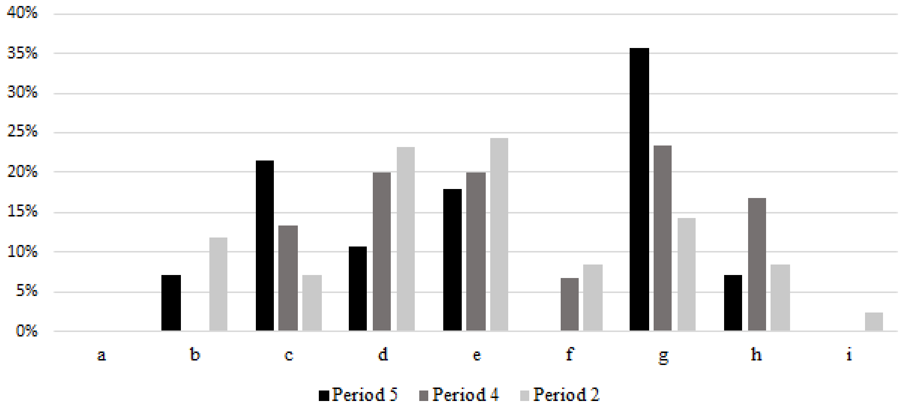

FIGURE 5

Kill-off patterns of caprines from mandibular wear stage data.

younger than one year of age. Some phalanges show exostoses, often associated with the exploitation of cattle as draught animals or with their advanced age.

Other domestic and wild mammals are uncommon and mostly represented by species that were generally not part of the diet (equids, dogs, cats, rodents), confirming the remains under consideration mostly represent food waste and the minor role of wild mammals in the diet. However, cervid antlers were present, especially in the Late Antique phase (in brackets in Table 2), as indicated by several sawn and polished remains of this element; some semi-processed artefacts also confirm the working of antler at the site (Garavello, 2018).

The presence of skinning marks on a cat skull (Period 2) could be associated with the intention of using its fur. This type of evidence is found in other medieval Italian and especially northern European deposits (De Venuto, 2010).

Birds represent 22% of the vertebrate remains of Period 5, 17% of Period 4 and 12% of Period 2, showing a decrease in importance over the centuries. Bones belonging to the Galliformes order and the Anatidae family dominate the bird sample. Few other species are present, including some typical of wetland environments.

As far as the Galliformes are concerned, the only identified species is the domestic fowl (*Gallus gallus*) and it is therefore likely that most of the indeterminate elements also belong to this species. Some elements belong to immatures. Both males and females were found in all periods; a preliminary analysis of the incidence of medullary bone suggests a prevalence of females and, therefore, an interest in egg production. For the category of Anatidae, except for a few fragments assigned to the mallard (*Anas* cfr. *platyrhynchos*) and the greylag goose (*Anser anser*), the majority of finds have been identified at the family level.

In the Late Antique periods, the proportion of Anatidae is equal to or greater than that of Galliformes. Instead, in Period 2, domestic fowl prevails (Figure 6).

With the exception of a few fragments belonging to terrestrial species (Table 2), the mollusc shells analysed belong to marine bivalves and gastropods, a natural resource from the lagoon and sea exploited as a complementary food supply.

The Late Antique assemblage is dominated by the lagoon cockle (*Cerastoderma glaucum*) and the flat oyster (*Ostrea edulis*). The first is a common species of soft, sandy or muddy bottoms, particularly frequent in areas of low water salinity, while the latter is more typical of rocky coasts.

The 10th-12th centuries sample, instead, shows the almost exclusive presence of clams (*Chamelea gallina*). This species, traditionally fished on the mid-upper Adriatic coasts, lives on sandy or sandy-muddy bottoms and it is also common in lagoons that have maintained sandy bottoms and waters with marine characteristics. At the same time, a smaller range of *taxa* is observed compared to previous centuries, resulting from the almost total absence of the less represented species (Figure 7).

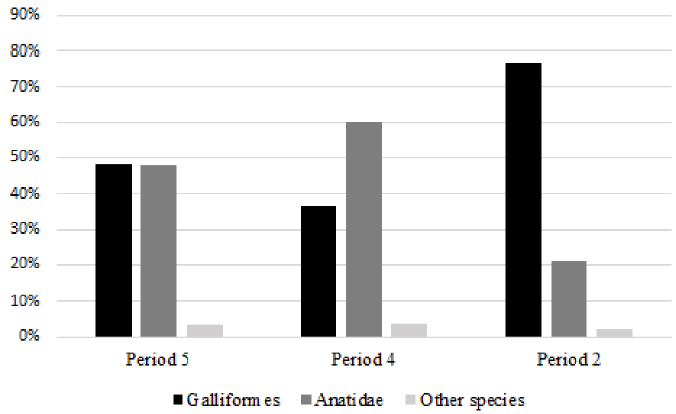

FIGURE 6

Frequencies based on the Number of Identified Specimens (NISP) for Galliformes and Anatidae, divided by period.

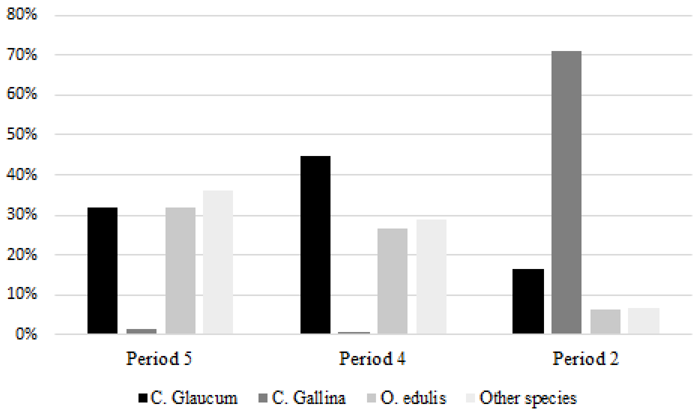

FIGURE 7

Frequencies based on the Number of Identified Specimens (NISP) for molluscs, divided by period.

		Late Antiquity	Early Middle Ages	Middle Ages
Taxa	type of remains	Period 5	Period 3	Period 2
Acer sp.	charcoal		2	4
Abies alba Mill.	*charcoal*	5		
Carpinus betulus L.	*charcoal*	2		
Castanea sativa Mill.	*charcoal*	9		1
Fraxinus excelsior L.	*charcoal*	18	6	6
Juglans regia L.	*charcoal*	2		
Picea abies Karsten	*charcoal*	11		
Pinus sylvestris L.	*charcoal*	10		5
Maloideae	*charcoal*	14	2	3
Malus domestica L.	*charcoal*		2	
Pyrus/Malus	*charcoal*	10	7	11
Sorbus sp.	*charcoal*	1		
Mespilus germanica/Sorbus	*charcoal*			1
Populus/Salix	*charcoal*	3		1
Prunus sp.	*charcoal*	2	9	
Prunus tipo avium L.	*charcoal*	2		2
Prunus cfr. spinosa/domestica/padus	*charcoal*			5
Quercus sp.	*charcoal*	120	22	10
Ulmus sp.	*charcoal*	2		3
Indeterminate	charcoal	12	2	5

TABLE 4

List of all the charcoal *taxa* recorded, divided by period.

Regarding plant remains, from the fire layer of the *mansio* (Period 5), four wood *taxa* were identified: oak, ash, chestnut and poplar/willow, probably belonging to the porch structure of the building. The four sub-samples, on the other hand, produced more arboreal species associated with lowland forest, as well as conifers such as silver fir, Scots pine and spruce (Table 4).

The archaeobotanical assemblage of the four sub-samples was also rich in cereals and legumes. A total amount of 2145 carpological remains were identified, with 9 *taxa* typical of Late Antique polyculture (Castiglioni & Rottoli, 2013). Among cereals, the genus *Triticum* prevails, particularly naked wheat, while the other *genera*, barley and oats, are present in very low numbers. Among legumes, *Vicia faba minor* is clearly preponderant compared to *Pisum sativum* and *Lathyrus sativus* (Table 5).

Charcoal from a limekiln (Period 3) was also examined. Seven *taxa* were identified, all with a very good calorific value and related to the pyrotechnical stages of the long lime production process (Table 4).

Finally, plant remains from the filling of a basket, found in one of the underground silos belonging to Period 2, were studied. The basket was made from branches of poplar/willow. Numerous plant remains were found at the bottom in a ‘fresh’ state. These are endocarps of typical summer fruits. *Vitis vinifera* seeds are the most numerous and they were mixed with endocarps of cherry, plum, pear or apple, melon, and hemp (Table 5). Charcoal in the layer that covered the basket belong to fruit trees and species typical of lowland forest, except for the Scots pine (*Pinus Silvestris* L.) (Table 4).

		Late Antiquity	Middle Ages
Periods		Period 5	Period 2
Taxa	type of remains		
Cereals			
Triticum aestivum/ durum/compactum	cariopses	1239	
Triticum dicoccum	cariopses	2	
Hordeum sp.	cariopses	3	
Avena sativa	cariopses	2	
Legumes			

Vicia faba L. *min*.	seed	885	
Pisum sativum	seed	6	
Weeds			
Galium aparine L.	seed	1	
Vicia sativa L.	seed	6	
Fruits			
Vitis vinifera L.	seed		2161
Cannabis sativa L.	seed		11
Citrullus colocynthis (L.) Schrad	seed		1
Cucumis melo L.	seed		2
Olea europea L.	endocarp		3
Pyrus communis L.	seed		4
Pyrus malus L.	seed		1
Prunus cerasus L.	endocarp		8
Prunus domestica L.	endocarp		6

TABLE 5
List of all the carpological *taxa* recorded, divided by period.

DISCUSSION AND CONCLUSIONS

Late Antique Jesolo appears as a trade centre connected to a *mansio*, perfectly embedded within a Mediterranean network. Food consumption seems in line with what observed elsewhere in lowland north-east Italy (Riedel, 1994; Rottoli, 2014), where pigs prevail. The prevalence of pig is also documented in other lagoon sites, such as Torcello (Riedel, 1979) and San Pietro di Castello (under study[3]), in the Venetian Lagoon, and Comacchio in the Po Delta (Garavello, 2021), where pig breeding was well adapted to the wet environment of the sites. Also the greater importance of caprines, in the 12th century, seems partially in line with the trends suggested for the Italian Middle Ages by Salvadori (2015).

Since pigs are bred exclusively for meat production, their relevance in Late Antique Jesolo may be linked to trade activities occurring at the *mansio* and the demands of the people hosted there. Mutton would have also been important. The high incidence of ducks and geese, if wild animals, indicate an exploitation of the wetland/lagoon environment around the site, through hunting; wildfowling decreases in the later Middle Ages, anyway the importance of wild resources from the lagoon in integrating food production is testified by mollusc exploitation.

Molluscs represented a complementary source of food; changes in their frequencies may reflect both dietary preferences and environmental changes. In Late Antiquity the lagoon cockle and the flat oyster prevail. The consumption of the former was widespread in the Venetian lagoon until recently. The oyster was farmed in Italy since the end of the 2nd century BC; evidence for oyster farming has also been found in the nearby Roman town of Altino (Balista & Sainati, 2003). The oysters from Jesolo, however, do not seem to have been farmed. As in Jesolo, a higher frequency of *Chamelea gallina* was also observed in Comacchio (Province of Ferrara) since the 10th century (Garavello, 2021), reinforcing the hypothesis that, at some point in the Middle Ages, the consumption of this species was preferred and/or clams had become more readily available.

The carpological remains from Jesolo are very interesting as we do not have much evidence of pulses and cereal remains from archaeological sites in the Venetian Lagoon[4], with the exception of Torcello, where barley (*Hordeum*), millet (*Panicum miliaceum* L.) and cereal bran have been recovered (Housley *et al*., 2004). The small size of these islands, especially that of Jesolo (Granzo, 2018), suggests that the main foodstuffs were imported (cereals, legumes and probably some of the domestic animals as well) although local resources (fruit trees, anatid fowling, shellfish harvesting) were essential for subsistence activities and the maintenance of the people that were hosted there. For the same reason, wood remains from building materials and fire layers may represent timber imported from the mainland.

To conclude, these preliminary data on Jesolo's bio remains represent the beginning of future more comprehensive project that will investigate the exploitation of animal and plant resources and reconstruct the changes between Late Antiquity and Middle Ages.

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[3] Two recent projects based at Ca' Foscari University of Venice (a PhD by S. Garavello and a post-doctoral research funded by a Marie Skłodowska Curie Individual Fellowship by M. Rizzetto) aim to reconstruct human-animal-environment relationships in the Venetian Lagoon and the northern Adriatic from the Roman period to the Middle Ages.

[4] Indeed, pollen analyses from archaeological sites in the Venetian Lagoon have revealed the presence of cereal pollen. However, they could derive from cereal processing rather than *in situ* cultivation. For a general overview of pollen analyses see Bon *et al*. (2011).

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REFERENCES

BALISTA, C. & SAINATI, C. 2003: *Ostrea* non *pectines* ad Altino: le evidenze archeologiche. In: Cresci Marrone, G. & Tirelli, M. (eds.): *Produzioni, Merci e Commerci in Altino Preromana e Romana. Atti del Convegno (Venezia, 12-12 Dicembre 2001)*: 331-346. Edizioni Quasar, Roma.

BARONE, R. 1995: *Anatomia comparata dei mammiferi domestici. Vol. 1°: Osteologia*. Edagricole - Edizioni Agricole, Bologna.

BON, M.; BUSATO, D. & SFAMENI, P. 2011 (eds.): *Forme del vivere in laguna. Archeologia, paesaggio, economia della Laguna di Venezia*. Centro Studi Riviera Brenta.

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphyseal fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 53-71. B.A.R. (British Series), Oxford.

BULLOCK, D. & RACKHAM, J. 1982: Epiphyseal fusion and tooth eruption of feral goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (British Series), Oxford.

CADAMURO, S.; CIANCIOSI, A. & NEGRELLI, C. 2017: The *Insula Equilus*: a lagoon community in the Early Middle Ages. In: Gelichi, S. & Gasparri, S. (eds.): *Venice and Its Neighbours from the 8th to 11th Century. Through Renovation and Continuity*: 90-115.

CASTIGLIONI, E. & ROTTOLI, M. 2013: Broomcorn millet, foxtail millet and sorghum in northern Italian Early Medieval sites. *European Journal of Post-Classical Archaeologies* 30: 131-144.

COHEN, A. & SERJEANTON, D. 1986: *A manual for the identification of bird bones from archaeological sites*. Archetype Publications, London.

DE VENUTO, G. 2010: Il gatto nel Medioevo: recenti acquisizioni dal sito archeologico di Canne della Battaglia (Barletta). In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del 5° Convegno Nazionale di Archeozoologia (Rovereto, 10-12 novembre 2006)*: 311-315. Edizioni Osiride, Rovereto.

GARAVELLO, S. 2018: Le attività produttive locali: la lavorazione dell'osso. In: Gelichi, S.; Cadamuro, S. & Cianciosi, A. (eds.): In limine. *Storie di una Comunità ai Margini della Laguna*: 60-63. Edizioni All'Insegna del Giglio, Firenze.

— 2021: Alimentazione e allevamento attraverso l'analisi archeozoologica: i reperti faunistici. In: Gelichi, S; Negrelli, C. & Grandi, E. (eds.): *Un Emporio e la sua Cattedrale. Gli Scavi di Piazza XX Settembre e Villaggio San Francesco a Comacchio*: 555-574. Edizioni All'Insegna del Giglio, Firenze.

GELICHI, S.; CADAMURO, S. & CIANCIOSI, A. (eds.) 2018: In limine. *Storie di una Comunità ai Margini della Laguna*. Edizioni All'Insegna del Giglio, Firenze.

GRANZO, A. 2018: Il contesto ambientale. In: Gelichi, S.; Cadamuro, S. & Cianciosi, A. (eds.): In limine. *Storie di una Comunità ai Margini della Laguna*: 60-63. Edizioni All'Insegna del Giglio, Firenze.

GREGUSS, P. 1955: *Xilotomische Bestimmung der heute lebenden. Gymnospermen*. Akadémiai Kiadò, Budapest.

HOUSLEY, R.A.; AMMERMAN, A.J. & MCCLENNEN, C.E. 2004: That sinking feeling wetland investigations of the origins of Venice. *Journal of Wetland Archaeology* 4: 139-153.

NEEF, R.; CAPPERS, R.T.J. & BEKKER, R.M. 2012: *Digital atlas of economic plants in archaeology*. Barkhuis & Groningen University Library, Groningen.

PAYNE, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 33: 281-303. DOI: https://doi.org/10.2307/3642547

Primon, S. & Mozzi, P. 2023: *Antichi paesaggi a Jesolo. Trasformazioni ambientali alle foci del Piave dall'età romana al Medioevo*. Edizioni All'Insegna del Giglio, Firenze.

RENFREW, J.M. 1973: *Palaeoethnobotany*. Columbia University Press, New York.

RIEDEL, A. 1979: La fauna degli scavi di Torcello (1961-1962). *Atti del Museo Civico di Storia Naturale di Trieste* 31: 75-154.

— 1996: Archaeozoological investigations in North-Eastern Italy: the exploitation of animals since the Neolithic. *Preistoria Alpina* 30: 43-94.

ROTTOLI, M. 2014: Reflections on early medieval resources in northern Italy: the archaeobotanical and archaeozoological data. *Quaternary International* 346: 20-27. DOI: https://doi.org/10.1016/j.quaint.2014.01.014

SALVADORI, F. 2015: *Uomini e animali nel Medioevo. Ricerche archeozoologiche in Italia, tra analisi di laboratorio e censimento dell'edito*. Edizioni Accademiche Italiane, Berlin.

SCHMID, E. 1972: *Atlas of Animal Bones. For prehistorians, archaeologists and Quaternary geologists*. Elsevier Publishing Company, Amsterdam.

SCHWEINGRUBER, H.F. 1990: *Microscopic wood anatomy*. 3rd edition. Swiss Federal Institute for Forest, Snow and Landscape Research, Birmensdorf.

SILVER, I.A. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E. (eds.): *Science in Archaeology - Survey of Progress and Research*: 238-302. Thames and Hudson, London.

WORMS database. Accessed September 5, 2022, https://www.marinespecies.org/

ZEDER, M. & LAPHAM, H.A. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905. DOI: https://doi.org/10.1016/j.jas.2010.06.032

ZEDER, M. & PILAAR S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 225-242. DOI: https://doi.org/10.1016/j.jas.2009.06.032

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Leisure and Feasts at *HORTI LAMIANI*: faunal evidence from some samples unearthed at Emperor Caligula's Villa in Rome

HORTI LAMIANI tra diletto e banchetti: evidenza faunistica da alcuni campioni provenienti dalla Villa di Caligola a Roma

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ABSTRACT: A preliminary faunal analysis on selected samples from rescue archaeology operations carried out between 2006 and 2012 on behalf of Soprintendenza of Rome as a prelude of renovation works at the ENPAM headquarters located in Piazza Vittorio Emanuele II is presented. Originally, the area was an elite estate of consul L. Aelius Lamia, embellished with gardens, which became state property under emperor Tiberius and was later occupied by Caligula as his private urban villa. During Mid-Empire times, the property underwent a general refurbishment of structural features which included the construction of a major reception hall. The faunal samples, spanning from the 2nd half of 1st c. AD until the beginning of 4th c. AD, are the first to yield information on this Roman district lacking so far any published faunal data. Together with species representing food consumption, the study bears evidence of game and exotic taxa who might have been wandering in the gardens entertaining guests during banquets. Marine shells and mollusc would have boosted the food offer, enriching fountain decorations as symbols of wealth and abundance.

KEYWORDS: *HORTI*, GARDENS, GAME, FEASTINGS, SHELLS

RIASSUNTO: L'analisi preliminare dei resti faunistici è stata condotta su alcuni contesti oggetto di uno scavo preventivo condotto dal 2006 al 2012 per conto della Soprintendenza sotto la sede dell'ENPAM in Piazza Vittorio Emanuele II a Roma. L'area, interessata inizialmente da una lussuosa residenza periurbana con giardini del console *L. Elio Lamia*, poi passata al demanio imperiale con Tiberio e utilizzata da Caligola come villa urbana, conobbe in epoca medio-imperiale la costruzione di un'aula di rappresentanza e modifiche strutturali. I campioni, riferibili ad un periodo dalla seconda metà del I sec. d.C. agli inizi del IV sec. d.C., apportano nuovi dati su un quartiere di Roma finora poco documentato: a fianco delle specie destinate al consumo alimentare quotidiano non mancano attestazioni di selvaggina e di fauna esotica che avrebbero verosimilmente popolato i giardini e allietato i banchetti. Conchiglie e molluschi di varie specie arricchivano i pasti ed impreziosivano le pareti di ninfei e fontane.

PAROLE-CHIAVE: *HORTI*, GIARDINI, SELVAGGINA, BANCHETTI, MOLLUSCHI

RESUMEN: Este análisis faunístico preliminar documenta muestras procedentes de excavaciones de rescate realizadas por la Superintendencia de Roma entre 2006 y 2012 como preludio a obras en la sede de la ENPAM situada en la Piazza Vittorio Emanuele II. Originalmente, el lugar, embellecido con jardines, fue propiedad del cónsul L. Aelius Lamia, pasando a ser propiedad estatal con el emperador Tiberio convirtiéndose en la villa urbana privada del emperador Calígula. A mitad del Imperio, la propiedad sufrió una remodelación que supuso, entre otras estructuras, la

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construcción de una gran sala de recepciones. Las muestras faunísticas, que abarcan desde la segunda mitad del siglo I d. C. hasta principios del siglo IV d. C., son las primeras que aportan información sobre este barrio romano carente hasta la fecha de datos sobre fauna. Junto con las especies clásicas de consumo, destacan aquí las evidencias de fauna cinegética y de taxones exóticos que deambularían por los jardines entreteniendo a los invitados durante los banquetes. Los moluscos habrían diversificado la oferta alimentaria mientras que las conchas marinas enriquecieron la decoración de las fuentes como símbolos de riqueza y abundancia.

PALABRAS CLAVE: *HORTI*, JARDINES, CARNES VENATORIAS, BANQUETES, CONCHAS

INTRODUCTION

In 2001 a building project financed by ENPAM (National Corporation for the Physician and Dentist Welfare and Care) in the SE border of Piazza Vittorio Emanuele II in Rome planned a new headquarter provided with a six level parking below street level by demolishing the pre-existing 19th century premises. Following the positive response on any possible ancient remains resulted from core-drilling extensive archaeological excavations ensued covering an area as wide as 2000 m^2 (Barbera *et al.,* 2010; Barbera, 2013). Investigations exposed a portion of what likely represented the *Horti* belonging to *Lucius Aelius Lamia*, whose precise location and extent were barely known (Figure 1). Meant to be suburban luxury premises situated just outside the city Servian walls, *Horti* consisted of several multi-purpose pavilions situated in vast gardens and populated by a wide variety of animals and plants (La Rocca, 1986; Mattei, 1986). A first occupation of the area basically for agriculture since 4th century BC soon coexisted with the appearance of pits intended for pozzolana sand extraction and conveniently used then as mass graves (Cima, 1986; Cima & La Rocca, 1986); towards the end of the 1st century BC the whole area was reclaimed and levelled with a significant earth backfill when entering the property of *Lucius Aelius Lamia* (Mattei, 1986). Following *Lamia*'s death in 33 AD the *Horti* became part of the State Property and were embellished with even more luxury decorations, fountains, canals and vineyards. At the end of the 2nd century AD a wide area was levelled paving the way a few decades later for a monumental enclosed square stretching for about 400 m^2, veneered with marble and provided with a fountain and service rooms on its southern side. Soon, though, following some refurbishment works due to structural issues, around the 5th century the building fell into progressive disrepair until being eventually abandoned: the area was partially occupied by huts and burials and receded to agriculture. What occurred later is rather patchy and mostly unknown due to 19th century works that erased all the evidence concerning Late Antique and Mediaeval periods (Barbera *et al.,* 2010).

MATERIALS AND METHODS

The excavation removed more than 12000 m^3 of soil: dry-sieving was rarely an option because of the tight schedule of works. Under such circumstances more than 8500 boxes of archaeological material were nonetheless collected: with reference to animal bone, a fairly significant assemblage was retrieved amounting to approximately 3600 fragments distributed among 367 Units.

A representative sample, which would meet homogeneity, low residuality rate and good stratigraphic definition as key criteria, was selected in order to offer a meaningful view of the occupation at the site: it includes seven contexts spanning almost three centuries during the Empire and further grouped into four major chronological phases. After a major midden of mixed refuse in the 2nd half of 1st century AD was scattered to the west of a garden area suffering from stagnant water to drain it out (cont. C: 54 fr.), massive heaps of marble and fresco paintings veneers were dumped further south (cont. D: 64 fr., E: 48 fr.) towards the end of 2nd century AD following the renovation of a long colonnaded edifice situated close by and setting up a solid platform for the extensive square which would be raised in the middle of the site a few decades later (233 AD); more waste was disposed of nearby at the same time of the piazza (cont. F: 238

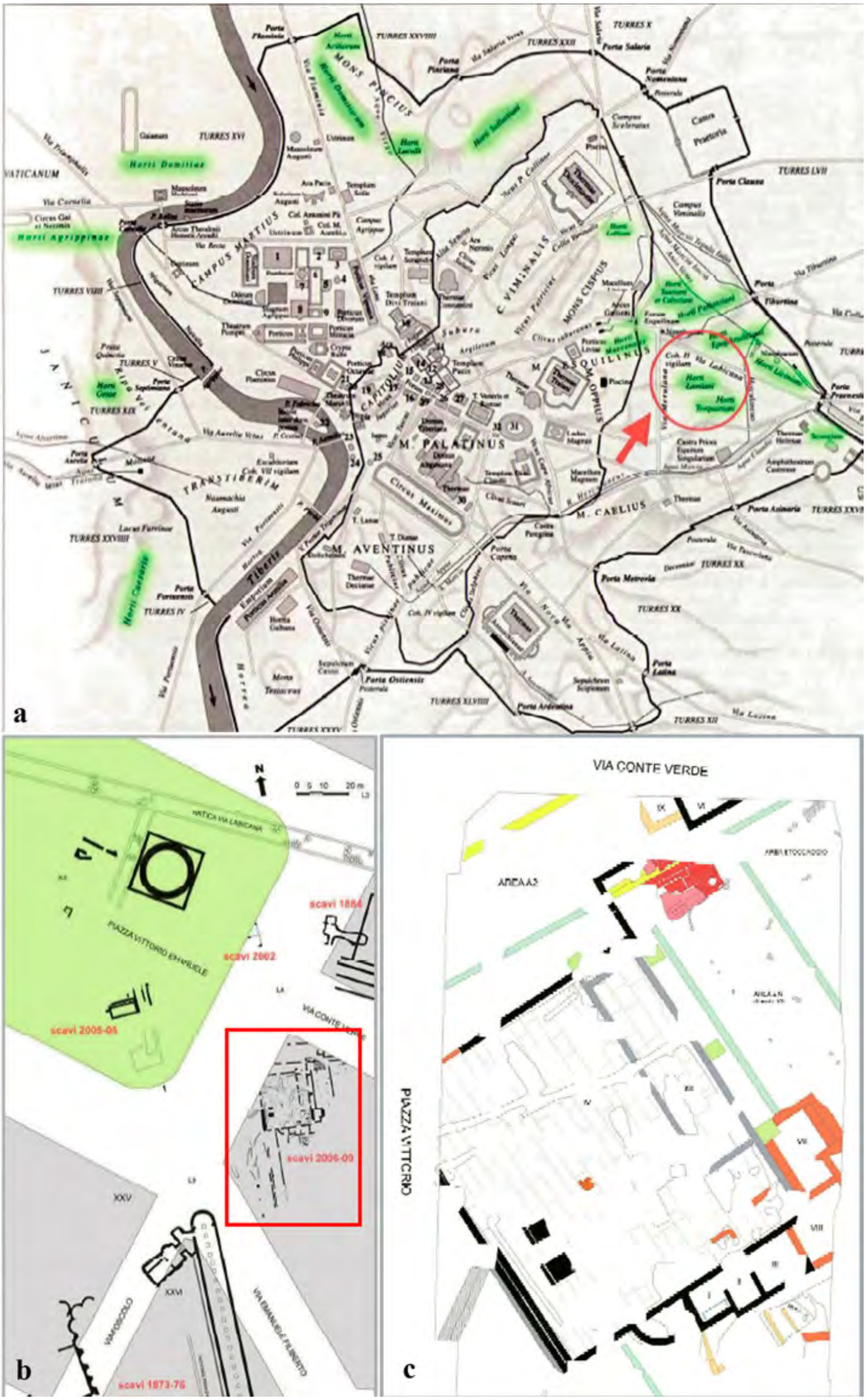

FIGURE 1

Location of the site: a. overall plan of ancient Rome with location of Lamia’s Horti (circled); b. specific location of the site (circled); c. detail of the multi-phase plan (modified after Barbera *et al*. 2013: fig. 1, 3, 31

TAXA	**C**			**D-E**			**F-H**			**G1-G2**		
	NISP	**%**	**MNI**	**NISP**	**%**	**MNI**	**NISP**	**%**	**MNI**	**NISP**	**%**	**MNI**
Sus domesticus Erx.	7	14,0	4	28	75,0	5	146	38,4	23	31	45,0	7
Ovis aries L.				2	8,3	1	16	5,1	5	4	5,0	2
Capra hircus L.										9	10,0	5
Ovis vel *capra*	1	2,0	1				12	1,4	4	7	8,3	3
Tot Caprovini	1	2,0	1	2	8,3	1	28	6,5	9	20	23,3	10
Bos taurus L.	1	2,0	1				19	7,9	4	10	11,6	3
Gallus gallus L.							1		1	2		1
Alim. Domestic	**9**	**18,0**	**6**	**30**		**6**	**194**	**53,9**	**37**	**63**	**84,0**	**21**
Equus sp.				1	4,2	1						
Domestic				**31**	**52,5**	**7**						
Cervus elaphus L.				1		1	2		1			
Lepus sp.							1	0,5	1			
Sus scrofa L.							3	1,4	1			
Ursus arctos L.							1	0,5	1			
Wild				**1**	**1,7**	**1**	**7**	**1,9**	**4**			
Galliformes										1	1,7	1
Struthio camelus L.							1	0,7	1			
Birds							**1**	**0,3**	**1**	**1**	**1,3**	**5**
Epinephelus marginatus Low.							1	0,5	1			
Sparus auratus L.							3	2,1	1			
Fish							**4**	**1,1**	**2**			
Ostrea edulis L.	2	4,1	2	12	34,3	6	83	24,5	49	2	3,3	2
Glycymeris sp.	1	2,0	1	1	2,8	1	3	1,4	3	2	3,3	2
Mytilus galloprovincialis Lam.				1	2,8	1	1	0,5	1			
Cerastoderma sp.							1	0,7	1			
Donax sp.							1	0,5	1	3	5,0	2
Pecten jacobaeus L.							1	0,5	1			
Pecten sp.	1	2,0	1				1	0,5	1			
Spondilus gadaeropus L.	2	4,1	2	2	5,7	2	10	2,3	7			
Venerupis decussata L.							1	0,5	1			
Veneridae (cf. *Venus nux* Gme.)							1	0,5	1			
Hexaplex trunculus L.	4	8,2	4	6	17,1	6	28	7,4	28	2	3,3	2
Bolinus brandaris L.	27	55,1	27	2	4,2	2	16	5,1	16	2	3,3	2
Charonia sp.				1	4,2	1						
Cypraea sp.							1	0,5	1			
Sepia officinalis L.							3	2,1	1			
Unionidae				1	4,2	1						
Cantareus apertus Bo.	1	2,0	1									
Eobania vermiculata Mül.	3	6,1	3				2	1,4	2			
Helix sp.							1	0,5	1			
Unid.				1	2,8	1						
Molluscs	**41**	**82,0**	**42**	**27**	**45,8**	**21**	**154**	**42,8**	**115**	**11**	**14,7**	**10**
Tot determinated	50	92,6	46	59	52,7	29	360	90,7	158	75	71,4	36
Tot ribs	1			39			11			9		
Tot vertebrae				2			4			5		
Undetermined	3			12			22			16		
Tot undetermined	4	7,4		53	62,5		37	9,2		30	26,8	
TOTAL	**54**			**112**			**397**			**105**		

TABLE 1

Overall NISP and MNI frequency of the sample by taxa, genus or family sorted by contexts.

fr., H: 159 fr.) whereas the deliberate backfill of two sewer drains (cont. G1-G2: 105 fr.) gone out of order offers some insight on the area less than a century after the central piazza was erected (Barbera *et al.*, 2010).

As a whole, the sample includes 668 faunal remains: it was analysed as for basic NISP and MNI count; body elements survival rates were also grouped in meat choice cuts to highlight possible patterns in food consumption (districts were modified following Choyke & Bartosiewicz, 1982-83, and Barker, 1982: teeth were grouped separately due to their distinctive taphonomic relevance: I. girdles and upper limbs; II. lower limbs; III. head; IV. appendicular limbs; V. isolated teeth); age at death was estimated by examining stages of post-cranial epiphyseal fusion, tooth eruption and wear while at this preliminary stage only descriptive statistics have been undertaken by adopting MS Excel® and IBM SPSS® v.26 software waiting for a larger faunal sample to be processed.

RESULTS

The selected sample represents approximately almost 20% of the whole faunal assemblage collected during the excavations carried out at Piazza Vittorio Emanuele II.

The overall NISP composition of the assemblage (Table 1) appears mostly described by domestic taxa and shells while game, fish and bird seem to have held just a marginal role for the local diet. To the former group belong essentially species consumed as food which increased markedly for importance over time from below 20% to well above 80% of total NISP: pigs (Figure 2) stand out since 1st century AD as the primary source of meat totalling more than 70% of domestic species, experiencing a progressive reduction till as down as below 50% less than three centuries later; a decline that seems to have been counterbalanced by a slight rise in proportion of caprines from just one element to almost one third of domesticates whilst cattle did

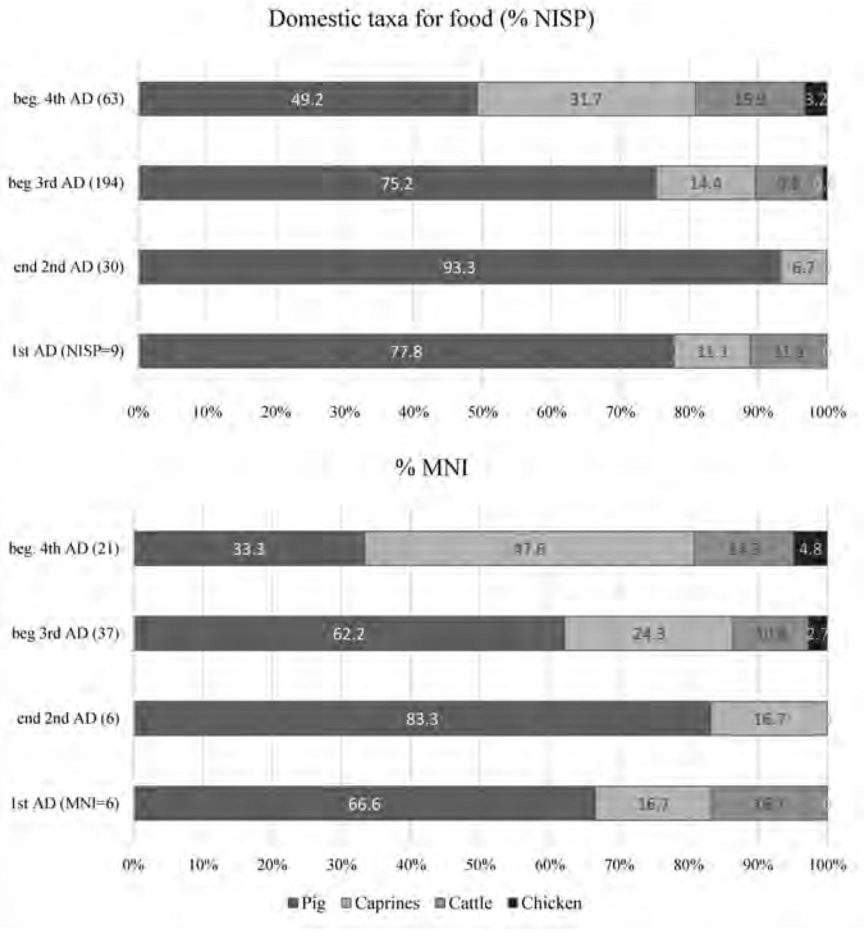

FIGURE 2

Frequency compared by NISP and MNI of the main domestic species intended for food.

not attain a frequency higher than 16% during later periods. Just 3 elements, finally, were assigned to chicken, corresponding to 2 adult individuals and consisting of 1 femur and 2 tibiae unearthed from contexts FH and G. When an estimate by numbers of individuals (MNI) is considered, a consistent trend defines the overall picture over the 3 centuries: the slightly decreasing predominance of pigs would include mostly male subadult individuals that, according to epiphysis fusion, tooth eruption and wear stages (Silver, 1969; Bull & Payne, 1982), were culled mainly between 15 and 31 months of age when the best balance between husbandry costs and meat yield was achieved (Table 2); adults are secondarily represented, probably associated to herd reproduction with a marginal incidence of sows deduced from canine morphology; juveniles and new-borns, on the contrary, are rare. Caprines, moreover, show similar proportions: however limited was the sample and despite it was not always possible to distinguish sheep from goats according to morphological traits (Boessneck *et al*., 1964; Prummel & Frisch, 1986; Halstead & Collins, 2002; Salvagno & Albarella, 2017), age-at-death classes provided mainly by mandible tooth-wear (Payne, 1973; Bullock & Rackham, 1982) display a frequency in which subadults prevail during later periods, followed by some adults and juveniles hinting at a strategy possibly orientated towards meat and wool yields (Payne, 1973). With regards to cattle (Grant, 1982; Jones & Sadler, 2012) little evidence is attested largely as for 3rd and 4th centuries, being composed of 2 and 1 adult individuals respectively whilst 1 juvenile and 1 subadult relate to the former period.

Group		Newborn	Juvenile	Subad.	Adult
1st cent. AD	Pig			2	2
	Caprines		1		
	Cattle				
	Chicken				
end 2nd cent. AD	Pig			5	
	Caprines				1
	Cattle				
	Chicken				
1st half 3rd cent. AD	Pig		1	17	5
	Caprines		2	6	1
	Cattle		1	1	2
	Chicken				1
beg. 4th cent. AD	Pig	1		3	3
	Caprines			3	
					1
	Chicken				1

Table 2
Frequency of age-at-death groups sorted by individuals of the main domestic taxa.

A few elements assigned to wild taxa, furthermore, have been identified only in contexts dating to late 2nd and 3rd centuries: to game hunting may allude to a hare and an adult boar mandible as well as some red deer metapodials. It adds to the sample a lower canine of an adult brown bear showing some abrasion on its tip and a posterior first phalanx of ostrich shedding some unexpected light on keeping exotic taxa in the area (Figure 3).

Figure 3
Posterior first phalanx of ostrich (*Struthio camelus* L.).

The overall picture of food consumption at the site is further enriched by some evidence of marine fish elements: a dusky grouper (*Epinephelus marginatus* Low.) preopercular and a premaxillary belonging to the Sparidae family (cf. *Sparus aurata*), would hint at fishing undertaken in shallow-to-medium deep waters with respectively rocky reefs and sandy bottoms often populated by Posidonia seagrass (Louisy, 2010).

Rather unusual in a suburban context as *Lamia*'s *Horti* looks the relative abundance of shells: as the frequency of domestic taxa progressively rose over time until dominating the sample with more than 80% of the total at the beginning of 4th century, a notable drop in the supply of molluscs occurred from as much as 82% in the second half of 1st century AD to just 15% at the beginning of 4th century AD. Marine environment represents the major source of provision while freshwater molluscs, often to be accounted for as intrusive, do not amount to more than 10 of the shells %NISP. A large number of marine remains includes mainly bivalves like flat (*Ostrea edulis*), thorny (*Spondilus gadaeropus*) oysters and clams on one side as well as gastropods like murices (*Bolinus brandaris*; *Hexaplex trunculus*) on the other: both categories show a rising trend attaining a marked peak at roughly the same time of the existence of piazza during the 1st half of 3rd century with 96 bivalve and 44 murices fragments respectively whilst they appear almost negligible almost a century later. Such a profusion of these commonly edible marine molluscs could presume a provision not too far away from Rome in shallow subtidal waters with both rocky seabed as for oysters and murices and sandy multi-grained sediments with respect to bittersweet clams; To the significant variety of marine molluscs, including clams, cockles, mussels and scallops, there must be accounted for also fragments of some exceptionally large-sized gastropods: a portion of the aperture outer lip of Triton's Trumpet Shell *Charonia sp*. (cf. *lampas* L. or *variegata* La.) which has a wide distribution across the Atlantic, the Indian Ocean and the Eastern Mediterranean. In ancient times, apart from the smaller specimens being used as pendants on necklaces, the shell apex was often trimmed off in order to use the shell as a wind musical instrument (Del Lucchese & Olcese, 2015). Another fragment, next, of the aperture outer lip has been assigned to the cowry *Cypraea* sp. (cf. *pantherina* Lght.), a large and heavy tropical sea snail showing its shiny whitish outer surface covered with tiny round dark spots (Figure 4): distributed in the Red Sea and Indian Ocean some specimens were found at Pompeii and it was likely used as an exotic ornament (Reese, 2002).

FIGURE 4

Fragment of aperture outer lip belonging to *Cypraea* sp. (cf. *pantherina* Lght.).

DISCUSSION

Although the sample appears limited on a quantitative basis, nevertheless it offers a good chance to describe the exploitation of animal resources in a peculiar context like *Horti* were expected to be, featuring gardens and luxury pavilions to display the financial and political power of the owner (La Rocca, 1986). Unlike every other urban context in Rome studied so far, the sample spanning almost 3 centuries shows how the general faunal composition at the site seems to be dually based on: as on one side the frequency of domestic taxa intended for food soared progressively until overshadowing all the other types of sources at the beginning of 4th century, on the other the incidence of shells at the site is all the more noticeable experiencing quite an opposite trend over time right up to become only a negligible part of the local supply in the later period taken into account.

With respect to domestic species meant for consumption as food, the sample describes a composition closely matching the situation at other sites in Rome through a similar timespan (De Grossi Mazzorin & Minniti, 2009): pig confirms to hold the traditionally dominating role since Mid-Republic in supplying the city due to its prolific nature and by adopting husbandry strategies conveniently diversified to meet the high urban demand (MacKinnon, 2001); such a picture is completed by the subordinate role attributed to caprines and even more marginally to cattle and chicken, integrating the diet with less regarded meat sources and by-products like cheese, wool and eggs. Over the 3 centuries taken into consideration though, a significant decline in pork consumption seems to be paralleled by a corresponding growing preference to mutton and beef. Despite the limited size of each context may bias such a trend, similar patterns could somehow be traced at other multi-period sites like *Aqua Marcia* (De Grossi Mazzorin, 1996), Arch of Constantine (De Grossi Mazzorin & Minniti, 2009) and at the Palatine NE slopes (Soranna, 2024). In our case, though, it might have played a role the suburban nature of the area that underwent around the 4th century a general refurbishment (Barbera *et al.,* 2010): as the overall ground level kept on rising, the local sewer network went out of order and the piazza enclosing walls were reinforced to prevent from collapse. While a complete abandonment of the site is likely to have occurred only some decades later due to lack of maintenance (Cima, 1986), the broad scenario in the *Horti Lamiani* must have evolved substantially: as a progressive shrinkage of the urban population impacted unevenly on the Esquiline hill and on the whole city occupation and supply efficiency (Panella, 2013), the local ownership, possibly different, might have repurposed some premises and reshaped local consumption accordingly to comply with an altered demand and different resources.

The frequency of choice cuts belonging to the major taxa consumed as food might also hint at some possible change over the three centuries in consideration (Figure 5). In earlier contexts pig remains appear to consist of rather mixed cuts including both lower limb bones and little meat-bearing portions: while on one side it could indicate a slightly more diversified consumption with a moderate prevalence of kitchen refuse perhaps suggesting various stages of food processing taking place, on the other some influence should also be attributed to the nature of the layers containing mixed ma-

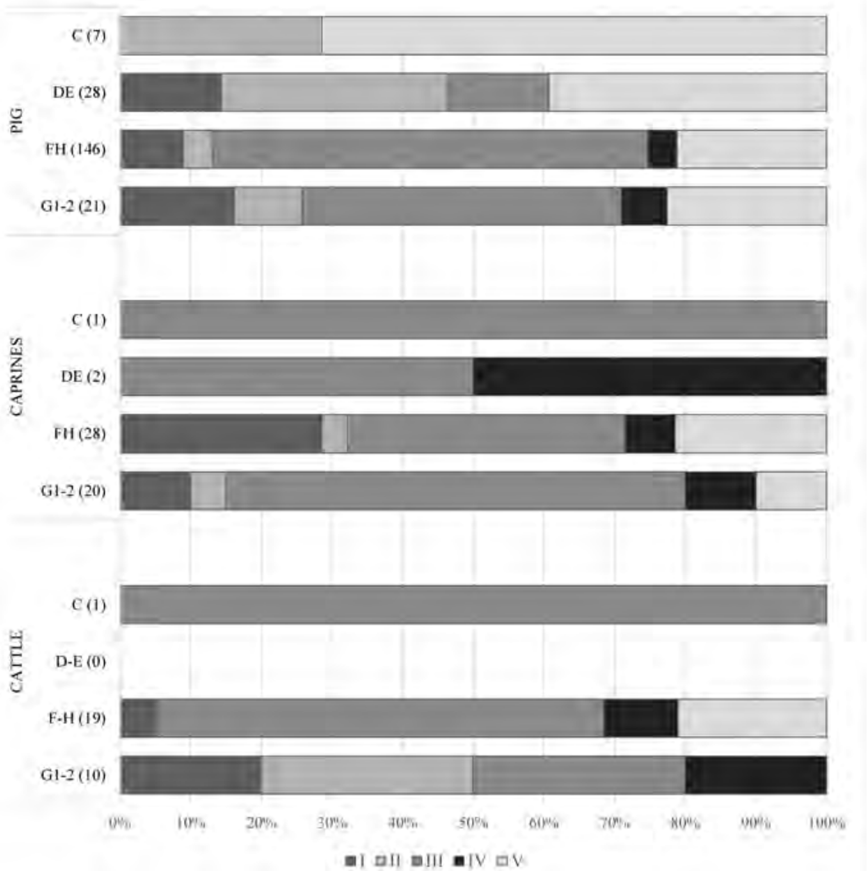

FIGURE 5

Frequency of meat cuts of the three main domestic categories at the site sorted by period: expressed as % of total elements per anatomical district, (see note 1).

terial (cont. C) or massive backfills (cont. DE). In later periods, conversely, the scenario looks more neatly orientated towards butchery waste including head, teeth and appendicular elements resulting from primary processing: kitchen activities occurring close by could describe a more specifically defined destination of the area. Surely the lack of prime-choice cuts might point the location of consumption venues elsewhere. When switching to caprines the incidence of low meat-bearing portions is higher, even though at the time of the piazza (3rd century) a more equal distribution can be interestingly detected. Such a minimal divergence could possibly reveal either a diet at the site differentiated by rank, in this case perhaps reserved to the working personnel, or a different origin of the remains, showing a more generalized consumption. In later periods cattle cuts similarly describe a greater incidence both of head fragments, more prone to fragmentation, and of teeth and appendicular elements, more resistant to taphonomic processes. Still, in this case as well, a more balanced frequency of body parts detected at the beginning of 4th century indicates that the meat supply by then was locally more diversified with a larger reliance on mutton and beef and was possibly consumed close by.

In addition, wild taxa would have enhanced the occupation at *Lamia*'s *Horti* by adding an exotic touch: if small-to-medium sized game like hare, boar and deer integrated the diet, bear and ostrich were primarily intended as a source of entertainment and as rare food delicacies to relish on. While scanning the rest of the assemblage among coeval contexts for any comparable specimens, there has occurred also a large felid metatarsus IV, with all probability belonging to a lion (*Panthera leo* L.) and an ostrich tarsus-metatarsus that looks compatible with the previously mentioned phalanx. Even assuming that the bear canine could have arrived at the site already isolated with the intention to become a pendant and the lion paw bone, bearing some skinning marks on its shaft, could represent what was left of a status garment, deer and ostrich remains would point at those animals kept with all probability alive in the surroundings.

Another evidence that stood out of the sample was the frequency of marine shells, in particular oysters and murices: if it is not unusual for other urban sites in Rome dated to the same period to have yielded a particular abundance of molluscs like at Quirinale (De Grossi Mazzorin, 1998) or Baths of Trajan (De Grossi Mazzorin, 2015), the incidence related to the total NISP looks nonetheless significant, at least until 3rd century when the large piazza occupied most of the site. Such a tendency, while it seems compatible with the oyster supply in Rome during the Mid-Empire, it does not show the same sort of resurgence for later periods (De Grossi Mazzorin & Minniti, 2001) probably because of the site-specific development of the area. A differential preservation of the valves could be easily detected only around the 3rd century (cont. FH) with a ratio of approximately 1.5 in favour of lower ones (Table 3) possibly suggesting a consumption of the flesh raw by using the lower valve as a cup while disposing of the left one elsewhere rather than cooking and discarding them together (De Grossi Mazzorin, 2015). If on one side notches referable to the opening process (Winder, 2017) have been rarely identified on the valves from the sample, on the other anthropogenic holes

***Ostrea edulis* (NISP)**	**SIDE**		**HOLES**					**TOT**
			1	**2**	**3**	**TOT**	**%**	
1st cent. AD	Upper	1						**2**
	Lower	1						
end 2nd cent. AD	Upper	6	4	1		9	75,0	**12**
	Lower	4	1	2	1			
	Unid.	2						
1st half 3rd cent. AD	Upper	48	25	5		63	76,8	**82**
	Lower	33	24	9				
	Unid.	1*						
beg. 4th cent. AD	Upper	1						**2**
	Lower	1						

TABLE 3

Overview of man-made drilled holes identified along oysters' edge in the sample. (marked with an asterisk two attaching fragments counted as one).

drilled close to the pallial line along the edge are fairly frequent involving more than 70% of the valves, particularly in 2nd and 3rd century contexts: a single hole recurs more often (55%) than two (17%) whilst only on one specimen as many as three holes were clearly bored along the same edge of the shell. Evidence of such holes has been related to the way oysters were secured to thin ropes while being carried to the intended destination with the aim of keeping them edible in salty water or solutions of water and vinegar from spoiling (Schneider & Lepetz, 2007; De Grossi Mazzorin, 2015); it could also suggest, on the contrary, that these shells might have been the produce of farming (Carannante *et al.*, 2014): such a practice consisted of letting oyster larvae to grow on potsherds and tufa beds set in shallow waters as long as they attained a specific age (Arist. Gen. Anim. 3.11); once detached, the small oysters were tethered to vertical thin ropes secured to wooden pergola systems in freshwater lagoons so as to thrive as long as the desired size was achieved (Bardot-Cambot & Forest, 2013; Marzano, 2015). The usually poor state of preservation detected on the oyster valve edges accounted for some caution when assessing their frequency by size according to the maximum length and height measurements (Campbell, 2010; Winder, 2017): some homogeneity, anyway, already visually apparent to a first inspection and leaving aside juvenile individuals, seems to be confirmed by a preliminary scatter plot shown in Figure 6.

Murices too show a significant frequency at the site: often associated to purple dye extraction, in our case they were with all probability appreciated mainly as food. The poor preservation of the siphonal canal extremity both for *Hexaplex trunculus* and for *Bolinus brandaris* specimens made any

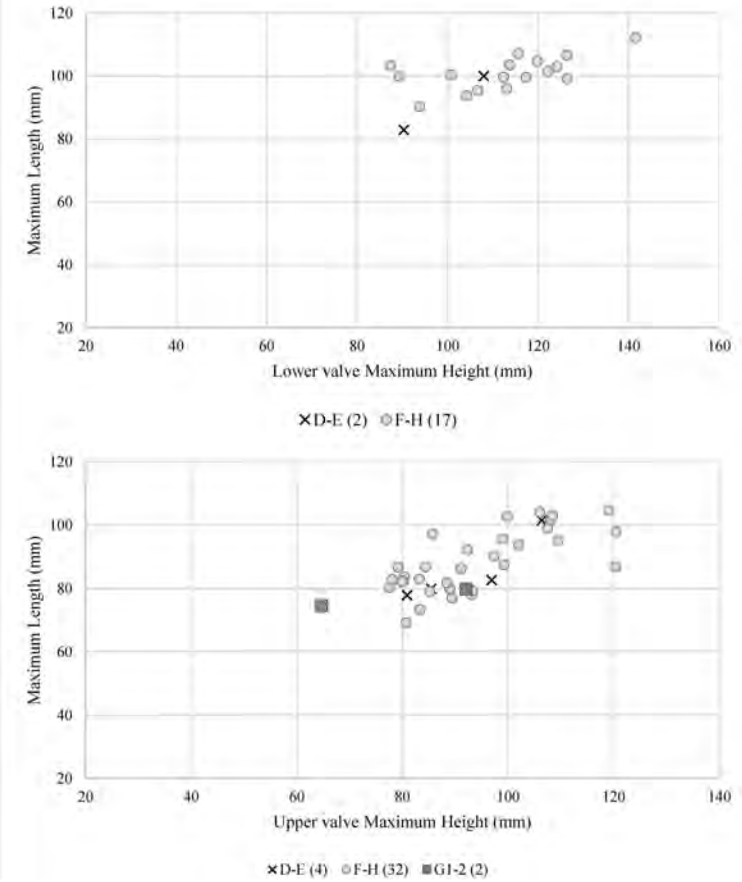

FIGURE 6

Scatter chart of oysters left (above) and right (below) valves maximum length plotted against maximum height sorted by period.

size frequency based on maximum measurements hard to estimate: the apex length (AL) and the aperture dimensions (height AH and width AW) were therefore tentatively considered (measurements were recorded following Claassen (1998). When performing a Shapiro-Wilk Test, the assumption that the samples were normally distributed being >5% due to chance (α=0,05) was accepted about period C for AL (.278), AH (.192) whilst as for period FH was rejected with respect to AL (.030), AW (.024) and accepted about AH (.162)). Even though gastropods experience an allometric growth (Vasconcelos *et al.,* 2012), a preliminary bar distribution would display an approximate clustering by size with a roughly normal distribution over time of some variables (Figure 7): if on one side this could be associated to a selective pressure exerted to procure the best ratio of flesh for specimen, on the other it might have responded to another, secondary, purpose. On several specimens

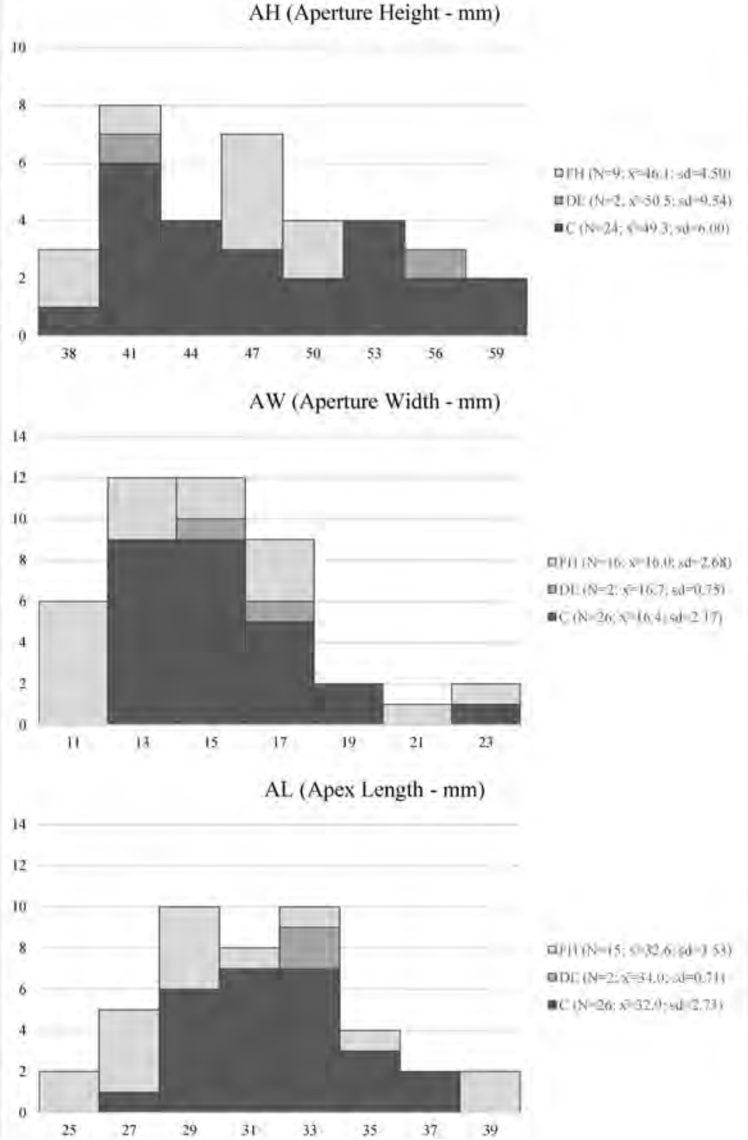

FIGURE 7

Bar charts showing Apex length (AL), Aperture Height (AH) and Aperture Width (AW) measurement (following Claassen 1998) frequency in *Bolinus brandaris* L. specimens sorted by period.

traces of red and yellow plastered pigments have been detected suggesting that these shells might have been intended, following their consumption as food, also as decorative veneer for walls and fountains: since the mid-2nd century B.C. specific shell taxa like murices, cockles, limpets and oysters were laid in mortar along with glass paste tesserae or twisted rods, marble veneers and pumice fragments to decorate fountains or walls in wealthy private houses, baths or other buildings related to any water facilities (Sear, 1977).

CONCLUSIONS

The sample unearthed from the excavation carried at Piazza Vittorio Emanuele II in Rome offers some prime insight on an area outside the ancient former walls of the city barely known with reference to animal exploitation in the past. A preliminary examination of a selected sample produced an interesting picture of daily life occurring at the suburban properties known as *Horti Lamiani*. The main domestic species, like pig and caprines, were consumed essentially as food: the former endured a slight decline over time in favour of the latter counterbalancing the diet along with cattle. The prevalence of primary butchery waste over time suggests a kitchen area at work nearby where less valued cuts from beef could have contributed to a more generalized supply during later periods. The lack of chicken, coupled with the absence of wild birds, which would have surely populated the gardens in the area might also point to a periodical cleaning and ground level rising, given also how scarce is the evidence of weathering and animal gnawing marks.

It completes the picture a noticeable abundance of marine shells, progressively decreasing over time: oysters, on one hand, were the pricey delicacy par excellence, the *Food of the masters* as Martial (3.60; 6.11) put it, and supplied from as far as Britain or Syria (De Grossi Mazzorin, 2015; Marzano, 2015). They could have been the product of farming in order to meet the demand among the higher ranks of Roman society, as their size homogeneity and recurrent drilled holes on their edge might suggest. Murices, on the other hand, were appreciated for food at the site integrating the marine supply along with other species: traces of painted plaster on the dorsum as well a relatively consistent size distribution might hint at their use also as decorative elements on walls and fountains backgrounds to emphasize the exotic marine-like look miles away from the coast during the first centuries of the Empire.

REFERENCES

BARBERA, M. 2013: Gli *Horti Lamiani*: topografia e organizzazione del complesso, alla luce dei vecchi e nuovi scavi. In: Ghini, G. (ed.): *Caligola. la trasgressione al potere:* 151-163. Gangemi editore, Roma.

BARBERA, M.; BARRANO, S.; DE COLA, G.; FESTUCCIA, S.; GIOVANNETTI, L.; MENGHI, O. & PALES, M. 2010: La villa di Caligola. Un nuovo settore degli *Horti Lamiani* scoperto sotto la sede dell'ENPAM a Roma. *Fasti Online Documents & Research* www.fastionline.org/php/download.php?file=FOLDER-it-2010-194.pdf

BARDOT-CAMBOT, A. & FOREST, V. 2013: Ostréiculture et myticulture à l'époque romaine? Des definitions modernes à l'épreuve de l'archéologie. *Revue Archéologique* 2013(2): 367-388.

BARKER, G.W. 1982: IV. The Animal Bones. In: Whitehouse, D.; Barker, G.; Reece, R. & Reese, D. (eds.): The Schola Praeconum I. *Papers British School at Rome* 50: 81-101.

BOESSNECK, J.; MULLER, H.H.; TEICHERT, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries L.*) und Ziege (*Capra hircus L.*). *Kühn Archiv* 78: 1-129.

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphyseal fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-71. B.A.R. (British Series) 109. Oxford.

BULLOCK, D. & RACKHAM, J. 1982: Epiphyseal fusion and tooth eruption of feral goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (British Series) 109. Oxford.

CAMPBELL, G. 2010: Oysters ancient and modern: potential shape variation with habitat in flat oysters (*Ostrea edulis L.*), and its possible use in archaeology. *Munibe* 31: 176-187.

CARANNANTE, A.; CHILARDI, S.; REBBECCHI, D.; DEL SANTO, A. & VEDOVELLI, R. 2014: Oysters, Pheasant and Fine Foods. "High Class" products in Alifae (Campania, Italy) during and after the Roman Empire. In: Szabò, K.; Dupont, C.; Dimitrijević, V.; Gastélum, L.G. & Serrand, N. (eds.): *Archaeomalacology: shells in the archaeological record*: 181-194. B.A.R. (International Series) 2666. Oxford.

CHOYKE, A.M. & BARTOSIEWICZ, L. 1982-83: Interactions between game biology, environment and human behaviour in patterns of deer hunting. *Mitteilungen des Archäologischen Instituts der Ungarischen Akademie der Wissenschaften* 12-13: 253-264.

CIMA, M. 1986: Dagli scavi dell'Esquilino all'interpretazione dei monumenti. In: Cima, M. & La Rocca, E. (eds.): *Le tranquille dimore degli Dei*: 37-60. Catalogo della mostra (Roma, Palazzo dei Conservatori, maggio-settembre 1986), Roma.

CIMA, M. & LA ROCCA, E. (eds.) 1986: *Le tranquille dimore degli Dei*. Catalogo della mostra (Roma, Palazzo dei Conservatori, maggio-settembre 1986), Roma.

CLAASSEN, CH. 1998: *Shells*. Cambridge University Press, Cambridge.

DE GROSSI MAZZORIN, J. 1996: I resti faunistici. In: Volpe, R. (ed.): *Aqua Marcia. Lo scavo di un tratto urbano*: 203-214. Edizioni All'Insegna del Giglio, Firenze.

— 1998: L'analisi dei resti ossei animali. In: Candilio, D. (ed.): *Roma – Saggio di scavo nell'aula di S. Isidoro*: 416-425. *Thermis. Notizie degli Scavi di Antichità serie IX, vol. VII-VIII (1996-7).*

— 2015: Consumo e allevamento di ostriche e mitili in epoca classica e medievale. In: Girod, A. (ed.): *Appunti di Archeomalacologia*: 153-158. Edizioni del Giglio, Firenze.

DE GROSSI MAZZORIN, J. & MINNITI, C. 2001: L'allevamento e l'approvigionamento alimentare di una comunità urbana. L'utilizzazione degli animali a Roma tra il VII e il X secolo. In: Arena, M.S.; Paroli, L.; Delogu, P.; Saguì, L. & Vendittelli, L. (eds.): *Roma dall'antichità al Medioevo. Archeologia e storia nel Museo Nazionale Romano Crypta Balbi*: 69-78. Electa, Roma.

— 2009: L'utilizzazione degli animali nella documentazione archeozoologica a Roma e nel Lazio dalla preistoria recente all'età classica. In: Drago Troccoli, L. (ed.): *Il Lazio dai Colli Albani ai Monti Lepini tra preistoria ed età moderna*: 39-67. Quasar, Roma.

DEL LUCCHESE, A. & OLCESE, M. 2015: La buccina di Tritone. Le trombe di conchiglia tra indagine archeologica ed etnografia. In: Girod, A. (ed.): *Appunti di Archeomalacologia*: 159-166. Edizioni del Giglio, Firenze.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

HALSTEAD, P. & COLLINS, P. 2002: Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult *Ovis* and *Capra*. *Journal of Archaeological Science* 29: 545-553.

JONES, G.G. & SADLER, P. 2012: Age at death in cattle: methods, older cattle and known-age reference material. *Environmental Archaeology* 17(1): 11-28.

LA ROCCA, E. 1986: Il lusso come espressione di potere. In: Cima, M. & La Rocca, E. (eds.): *Le tranquille dimore degli Dei*: 3-35. Catalogo della mostra (Roma, Palazzo dei Conservatori, maggio-settembre 1986), Roma.

LOUISY, P. 2010: *Guida all'identificazione dei pesci marini d'Europa e del Mediterraneo*. Il Castello, Milano.

MACKINNON, M. 2001: High on the hog: Linking zooarchaeological, Literary, and Artistic Data for Pig Breeds in Roman Italy. *American Journal of Archaeology* 105(4): 649-673.

MARZANO, A. 2015: Sergio Orata e il Lago Lucrino: alcune considerazioni sull'allevamento di ostriche nella Campania romana. *Oebalus. Studi sulla Campania nell'Antichità* 10: 131-150.

MATTEI, M. 1986: Testimonianze epigrafiche e attestazioni letterarie relative all'area degli *Horti Lamiani*. In: Cima, M. & La Rocca, E. (eds.): *Le tranquille dimore degli Dei:* 153-164. Catalogo della mostra (Roma, Palazzo dei Conservatori, maggio-settembre 1986), Roma.

PANELLA, C. 2013: Roma e gli altri. La cultura materiale al tempo del sacco di Alarico. In: Lipps, J.; Machado, C. & von Rummel, Ph. (eds.): *The Sack of Rome in 410 AD. The Event, its Context and its Impact*: 365-402. Dr. Ludwig Reichert Verlag, Wiesbaden.

PAYNE, S. 1973: Kill-off patterns in sheep and goat: the mandibles from Aşvan Kale. *Anatolian Studies* 33: 281-303.

PRUMMEL, W. & FRISCH, H.J. 1986: A guide for the distinction of species, sex and body side in bones of sheep and goat. *Journal of Archaeological Science* 13: 567-577.

REESE, S. 2002: Marine Invertebrates, Freshwater Shells and Land Snails: Evidence from specimens, mosaics, wall paintings, sculpture, jewellery and Roman Authors. In: Jashemski, W.F. & Meyer, F.G. (eds.): *The Natural History of Pompeii*: 292-314. Cambridge University Press, Cambridge.

SALVAGNO, L. & ALBARELLA, U. 2017: A morphometric system to distinguish sheep and goat post-cranial bones. *PLoS ONE* 12(6): 1-37.

SCHNEIDER, M. & LEPETZ, S. 2007: L'exploitation, la commercialisation et la consommation des huîtres à l'époque romaine en Gaule. In: Ridel, E.; Barré, É. & Zysberg, A. (eds.): *Les nourritures de la mer, de la criée à l'assiette*: 11-34. Colloque du Musée Maritime de l'île Tatihou (2-4 octobre 2003). Centre de recherche d'Histoire quantitative. Histoire Maritime n° 4, Caen.

SEAR, F.B. 1977: *Roman wall and vault mosaics*. Mitteilungen des Deutschen Archäologischen Instituts. Römische Abteilung 23 Ergänzungsheft. F.H.Kerle, Heidelberg.

SILVER, I. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. Thames and Hudson, London.

SORANNA, G. 2024: L'approvvigionamento alimentare urbano di Roma in età tardoantica: aggiornamenti e osservazioni in base ai dati faunistici provenienti dalle pendici nord-orientali del Palatino. In: Curci, A.; Maini, E.; Serrone, E. (eds.): *Atti del 9° Convegno Nazionale di Archeozoologia*, Ravenna 28 Novembre - 1 Dicembre 2018: 163-176. Elios Digital Print, Ravenna.

VASCONCELOS, P.; PEREIRA, A.M.; CONSTANTINO, R.; BARROSO, C.M. & GASPAR, M.B. 2012: Growth of the purple dye murex, *Bolinus brandaris* (Gastropoda: Muricidae), marked and released in a semi-intensive fish culture earthen pond. *Scientia Marina* 76(1): 67-78.

WINDER, A. 2017: Oysters in archaeology. In: Allen, M.J. (ed.): *Molluscs in Archaeology: methods, approaches and applications*: 238-258. Oxbow books, Oxford.

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Resti animali da contesti rituali etruschi da Orvieto (Umbria, Italia)

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RIASSUNTO: I resti in questione provengono da due siti di Orvieto: Cannicella e Campo della Fiera. Si tratta di fosse contenenti, tra le altre cose, resti di animali, spesso in connessione, tra i quali spiccano cani (Cannicella) e cavalli (Campo della Fiera), insieme ad altre specie e piccoli animali viventi in loco. I due contesti sono cronologicamente riferibili al momento del conflitto con i romani (IV-III secolo a.C.).
Il materiale osteologico ritrovato nella fossa pertinente al santuario di Cannicella si riferisce probabilmente a una unica azione rituale e ha restituito, oltre ai cani che presentano numerosi segni di macellazione, resti di maiali, caprini e bovini insieme a uccelli, tra cui pollame e corvo imperiale, pesci e altre specie presenti in minore quantità. Al Campo della Fiera invece, pur essendo rappresentate anche altre specie, prevalgono gli animali di grossa taglia, bovini e cavalli in qualche caso in connessione. In particolare in una fossa sono stati trovati gran parte dei resti di un cavallo di circa sei anni.

PAROLE CHIAVE: ETRUSCHI, ROMANI, SACRIFICI, CANE, CAVALLO

ABSTRACT: Animal remains were found in two pits found on the sites of Cannicella and Campo della Fiera in Orvieto. Although several species, including small animals inhabiting the site, were identified the only remains which appear in anatomical connection, are exclusively dogs in the Cannicella pit and horses in the Campo della Fiera pit. Both pits chronologically refer the moment of conflict between the Etruscans and the Romans (4th-3rd century B.C.).
The osteological material found in the Cannicella sanctuary pit probably refers a single ritual action and in addition to the dogs featuring numerous slaughter marks, the remains of pigs, goats and cattle as well as birds, including poultry and raven, fish and other species in smaller number. At Campo della Fiera, although other species are present, prevalent are the large animals prevail, such as cattle and horses, including most of the skeleton of a six-year-old horse.

KEYWORDS: ETRUSCANS, ROMANS, SACRIFICES, DOG, HORSE

RESUMEN: En dos fosas descubiertas en los yacimientos de Cannicella y Campo della Fiera en Orvieto se han encontrado restos de animales. Aunque se han identificado varias especies, incluidos pequeños animales que habitaban el lugar, los únicos restos que aparecen en conexión anatómica son siempre perros en la fosa de Cannicella y caballos en de Campo della Fiera. Ambas fosas datan del momento de conflicto entre etruscos y romanos (siglos IV-III a.C.).
El material osteológico de la fosa del santuario de Cannicella probablemente refiere una única acción ritual donde, además de los perros con marcas de matanza, se han encontrado restos de cerdos, cabras y ganado vacuno, aves como la gallina y el cuervo, peces y otras especies. En Campo della Fiera, aunque están presentes otras especies, predominan los animales de gran talla, como el vacuno y los caballos, entre quienes encontramos gran parte del esqueleto de un ejemplar de seis años

PALABRAS CLAVE: ETRUSCOS, ROMANOS, SACRIFICIOS, PERRO, CABALLO

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INTRODUZIONE

I resti faunstici da me studiati in questi ultimi anni relativi alla città etrusca di Orvieto, antica *Velzna* (*Volsinii* in latino) provengono da due aree sacre attualmente denominate Campo della Fiera e Cannicella (Wilkens, 2008) (Figura 1). Campo della Fiera, recentemente identificato con il *Fanum Voltumnae*, citato da Tito Livio (*Ab Urbe Condita Libri*, 4, 23, 5; 5, 1, 3-7; 17, 6-10; 6, 2, 2; 25, 7-8; 61, 2) e noto per essere il santuario federale dei dodici popoli etruschi. I materiali provengono dagli scavi della professoressa S.Stopponi a partire dal 2000 per quanto riguarda Campo della Fiera (Stopponi, 2018). Riguardo alla necropoli e al tempio della Cannicella, le prime esplorazioni iniziarono già alla fine del XIX secolo, e furono successivamente riprese a partire dal 1977 ad opera dei prof. Francesco Roncalli e Simonetta Stopponi. Si tratta di un'area sacra a vocazione cimiteriale cui si affianca un tempio, con relativo temenos e fossa contenente materiali di varia natura, compresi resti ossei animali (Stopponi, 2008).

MATERIALI E METODI

Sono stati studiati i resti ossei e malacologici provenienti da alcune strutture di questi siti. Per l'identificazione è stata usata una collezione di confronto personale.

Le misurazioni sono state prese secondo Driesch (1976), sono stati calcolati il numero di frammenti identificati (NISP) e il numero minimo di individui (NMI) con il metodo di Bökönyi (1970). Le tabelle con le misure sono riportate in appendice.

È stata calcolata l'età di morte secondo K.H.Habermehl (Habermehl, 1961) e sono state utilizzati i miei criteri per lo studio della mortalità (Wilkens, 2012).

FIGURA 1

Da Google Earth Pro 2022, localizzazione dei due scavi presso Orvieto.

Le altezze al garrese sono state calcolate secondo J. Matolcsi per i bovini (Matolcsi, 1970), M.Teichert per le pecore (Driesch & Bössneck, 1974; Teichert in Driesch, 1976) e per i maiali (Teichert, 1969), L.Kiesewalter per i cavalli (Kiesewalter, 1888). Per il riconoscimento del sesso nei bovini è stato utilizzato il lavoro di Howard (1963). Sono stati rilevati i segni di macellazione e le eventuali patologie.

RISULTATI

CAMPO DELLA FIERA – *FANUM VOLTUMNAE*

Questo sito si trova sul pianoro occidentale a poca distanza dalla rupe di Orvieto (Stopponi, 2018). Si tratta di una importante area cultuale identificata con il *Fanum Voltumnae*, il santuario federale etrusco. Per Fanum in latino si intendeva un santuario, di varia natura e entità. In questo caso ci si riferiva a un santuario sovranazionale, relativo alle dodici città stato dell'Etruria e che, oltre alle normali funzioni religiose, espletava anche funzioni politiche, come luogo di raduni e decisioni comunitarie. Le cerimonie religiose erano affiancate da mercati, fiere e giochi sportivi. La vocazione religiosa dell'area continuò in età romana fino al Medioevo (Stopponi, 2012), ad indicare l'importanza e il sentimento religioso che si era radicato nella coscienza popolare e che era sopravvissuto al cambiamento delle divinità e delle fedi religiose. Sono state individuate alcune fosse contenenti resti di animali e considerate testimonianze di sacrifici, per la vicinanza alle strutture templari e al relativo *temenos*, alla via sacra e alla presenza di manufatti di particolare interesse (Stopponi & Giacobbi, 2017), mentre dal punto di vista archeozoologico è confermata dalla deposizione di individui completi che escludono un mero utilizzo alimentare. Come datazione sono riferibili al IV-III secolo a.C. e si trovano in prossimità di templi, in particolare molte di queste deposizioni sembrano in rapporto con il tempio C. (Figura 2).

FIGURA 2
Campo della Fiera (Stopponi, 2015).

Per meglio individuare la natura rituale dei contesti, si ragiona in queste descrizioni in termine di numero minimo di individui. Il numero dei frammenti può essere osservato nella tabella Appendix 10. In quattro casi si parla di fosse (fossa 1, fossa 2, fossa cavallo, fossa 1259). Negli altri casi si tratta di US non meglio definibili, caratterizzate da una concentrazione di resti ossei, probabile residuo di azioni rituali. In un caso (US 1332) si tratta di un livello argilloso presso un altare.

Fossa 1 (US 651) a N-E del tempio C (fine IV-inizio III a.C.). (Figura 3).

In questa fossa si trovano i resti di due bovini (un vitellone di tre anni e mezzo e una femmina o castrato sui cinque anni) più una pecora e un maiale.

Il maiale, rappresentato da due frammenti di cranio e due frammenti della stessa scapola, ha la dentatura definitiva completa ma poco usurata (fase I), e probabilmente è sui 18/20 mesi. Purtroppo manca la parte anteriore del cranio ed è impossibile stabilirne il sesso.

La pecora è rappresentata da un calcaneo non fuso, quindi di età inferiore ai tre anni. Se consideriamo pertinenti allo stesso individuo i quattro frammenti attribuiti genericamente a caprini (un ileo, un ischio, un frammento di tibia e un P_4) possiamo delimitare l'età tra due e tre anni. Anche in questo caso il sesso non è definibile.

Il gruppo più numeroso e meglio conservato è costituito dalle ossa bovine, appartenenti ad almeno due individui. Al bovino A sono stati attribuiti 32 frammenti (21 frammenti di vertebre indefinibili, 1 vertebra cervicale, 4 vertebre toraciche, una vertebra lombare, due epifisi prossimali di femore non fuso, un altro frammento di diafisi di femore, un frammento di diafisi di omero, una epifisi prossimale di omero non fuso. Data la presenza di elementi non fusi (anche le vertebre non sono fuse), ma la taglia abbastanza vicina a quella dell'altro

FIGURA 3
Campo della Fiera, fossa 1 US 651 (Stopponi, 2015).

soggetto adulto, si può pensare a un vitellone di età di poco inferiore ai tre anni e mezzo.

Il bovino B è rappresentato da 26 frammenti: 8 vertebre indeterminate, 2 toraciche, 6 lombari, 2 caudali, un frammento di metacarpo destro, gran parte dell'arto posteriore sinistro e precisamente il femore, parte della tibia, due ossa del tarso, il metatarso, una prima e una seconda falange. Le epifisi sono fuse o in fusione nel caso di alcune vertebre, cosa che permette di attribuire a questo soggetto una età di circa 5 anni. L'altezza al garrese da metatarso (coefficiente femminile) è sui 135 cm, se utilizziamo la media l'altezza sale a 138, da femore (peraltro non perfettamente integro) sui 125. L'indice DB/L per la determinazione del sesso, calcolato sul metatarso, è di 23,11 e lo pone nel campo di variabilità delle femmine, come pure l'indice MB/L anche se quest'ultimo, di 12,17 per il nostro esemplare, è molto vicino anche al minimo dei castrati di 12,7 (Howard, 1963). Un leggero allargamento del condilo mediano del metacarpo e del metatarso lascia supporre che questo animale avesse alle spalle una non eccessiva attività lavorativa (Bartosiewicz *et al*., 1997). Si tratta quindi di un esemplare di buona taglia, soprattutto nel caso fosse effettivamente una femmina.

Fossa 2 (US 647) a S-E del tempio C (fine IV-inizio III a.C.). L'associazione faunistica è simile a quella della fossa 1 e comprende un bovino di 2-4 anni e uno di 5-6 mesi, due pecore femmine adulte e un agnello di 9 mesi, un verro vicino a 2 anni, un maiale adulto e un giovane di circa un anno, più due frammenti di palco di cervo semilavorato. Sono state identificate anche due ossa di cervo, una vertebra cervicale e un frammento di metatarso, appartenenti a un soggetto adulto.

Tra i suini sono stati riconosciuti almeno tre individui: il più giovane (maiale C) è rappresentato da un solo frammento di scapola non fusa. Le piccole dimensioni fanno supporre che questo soggetto fosse di molto inferiore a un anno di età. Il maiale A è stato riconosciuto sulla base di un frammento di frontale, un canino inferiore maschile senza usura, un frammento di ulna destra e un frammento distale di tibia con epifisi in fusione. Si tratta quindi di un maschio di età poco inferiore ai due anni. Il maiale B è stato identificato da un frammento di mascellare, uno di mandibola, un frammento di ulna, le due epifisi distali fuse delle tibie. Si tratta di un soggetto di età più avanzata rispetto agli altri due. Sulla base del terzo molare inferiore e dei denti conservati sul mascellare ($P^3P^4M^1M^2$) può essergli attribuita una usura di grado III (Wilkens, 2012), quindi un adulto di età media. Il muso doveva essere di forma accorciata e il P^4 e M^1 sono disposti in modo scorretto per mancanza di spazio. Il primo molare superiore è inoltre interessato da una grossa carie e da un ascesso nella zona dell'alveolo. Non è stata possibile la determinazione del sesso. Un gruppo consistente di ossa suine (16) sono state attribuite ai due soggetti A e B senza possibilità di distinzione. Un frammento di epifisi distale di omero presenta dei segni di disarticolazione.

I bovini sono almeno due: il bovino A è rappresentato da tre costole, tre vertebre indeterminate, due cervicali, due toraciche, un frammento di mandibola con alveolo del terzo molare, un frammento di radio, un frammento di omero, un frammento di metacarpo, un frammento di femore, due frammenti di tibia di cui uno con epifisi prossimale non fusa, un osso del tarso, un frammento di metatarso, due prime e una seconda falange. Si tratta quindi di un soggetto adulto di età superiore ai due anni ma inferiore ai tre anni e mezzo, quattro anni. Il metatarso mostra un lieve allargamento prossimale indice di attività lavorativa. Il sesso non è definibile. Il bovino B è rappresentato solo da un frammento di mascellare e da una seconda falange. Il mascellare conserva il Pd^3 e il Pd^4 e M^1 in eruzione. La seconda falange non è fusa. Si tratta quindi di un vitello sui 5-6 mesi.

Sono state identificate due pecore adulte di età superiore ai 15-20 mesi, da due epifisi distali fuse di tibia e una prima falange fusa. Un terzo individuo, identificato sulla base di una mandibola con M_2 in eruzione e quindi sui 9 mesi di età, non è stato identificato a livello specifico. Un buon numero di frammenti di caprini (14) è probabilmente da attribuire alle due pecore e al caprino già identificati. Questi resti non attribuiti comprendono un frammento di epistrofeo, una vertebra lombare non fusa, due frammenti di costola, un frammento di scapola, due frammenti di omero, un frammento di radio, sei frammenti di coxale.

Queste due fosse, che risalgono al momento delle lotte contro Roma e sono posizionate in modo diametralmente opposto rispetto al tempio C, vengono interpretate come pertinenti a un rito di desacralizzazione contemporaneo alla distruzione e alla fine della frequentazione del tempio stesso (Stopponi, 2015-2016).

Fossa con deposizione di cavallo (vedere la tabella del cavallo A in Supplementary Material 1) a N-O del Tempio C, US 1296-1295 (fine IV-III a.C.). (Figura 4).

Si tratta di un individuo adulto di circa 6 anni (età calcolata dagli incisivi secondo Habermehl, 1961), di sesso più probabilmente maschile sulla base della presenza del canino ben sviluppato. Dato comunque che manca un elemento fondamentale come il pube, l'indicazione del sesso resta in forma dubitativa. Il secondo e il terzo premolare superiore presentano una evidente plica caballina e il secondo e il terzo incisivo superiore e il canino hanno ancora la radice aperta. L'altezza al garrese, calcolata sulla lunghezza del femore (secondo Kiesewalter, 1888) era di cm 136,5 circa. Il soggetto portava il morso, il fatto che l'usura da morso sia sul piano masticatorio di P^2 e non solo sul margine anteriore, può indicare che lo stesso veniva tenuto allentato. Come è noto infatti, il morso provoca usura sul margine anteriore dei P2. Se lo stesso viene tenuto allentato, può essere masticato dall'animale e quindi l'usura si manifesta sul piano masticatorio dello stesso premolare. Altri segni patologici che possono essere collegati al lavoro svolto da questo animale, sono i modesti osteofiti sul corpo vertebrale in prossimità della epifisi prossimale delle vertebre toraciche da 13 a 18. Il corpo del cavallo si trova nella US 1295, la testa nella US 1295 e altre parti nelle US 656 e 659 che hanno tagliato la fossa in tempi successivi.

US 656. Un frammento di bovino, più due frammenti pertinenti al cavallo A.

US 659. Contiene i resti di un verro adulto e di due bovini (un adulto e un neonato). Presenza di resti umani.

US 1260-1273, riempimento della **fossa 1259** a sud del lato SE del tempio C, probabilmente relativa a un rituale di desacralizzazione (Stopponi, 2012, 2015-2016).

Sono stati identificati i resti di due cani adulti, un maiale di età superiore a 1 anno e inferiore a 2 e mezzo, un bovino adulto, un caprino di età inferio-

FIGURA 4
Campo della Fiera, cavallo A (Stopponi, 2015).

re a 5 mesi, un cavallo anziano e un cavallo adulto più giovane. Il cavallo anziano, deposto in connessione, (vedere la Tabella del cavallo B in SM2) conserva parte dei denti, degli arti anteriori e posteriori, costole e vertebre. I P^4 e M^1 superiori mancano di plica caballina, fatto che può essere attribuito alla età avanzata di questo soggetto piuttosto che a caratteristiche asinine peraltro non riscontrate su altre parti dello scheletro.

US 1305. Probabili resti di una fossa (SM10). Sono stati rilevati i resti di un maiale adulto e uno subadulto, un cervide, un bovino anziano (Usura V-VI) e uno giovane, una pecora adulta, un caprino adulto, un cavallo giovane adulto (vedere la tabella del cavallo C in SM3), più due frammenti di palco di cervo semilavorato. Presenza di ossa umane.

US 1332, (1° metà III a.C.), livello argilloso a nord dell'altare US 1244. (SM10).

Una lepre adulta, un maiale maschio sui 6-9 mesi e un secondo di età e sesso ignoto, un bovino adulto di notevoli dimensioni (altezza al garrese cm 130/133). 1 adulto di taglia inferiore, 1 cavallo adulto, una pecora femmina di 56 cm, due caprini, presenza di ossa umane. Tra i reperti non ossei è da ricordare una ghianda missile pertinente agli scontri intorno al tempio C.

Le seguenti unità sono scarsamente caratterizzate dal punto di vista strutturale, ma la concentrazione di resti ossei appartenenti alle medesime specie di cui sopra, fa supporre una loro origine rituale.

US 1302. I resti faunistici da questa unità sono riferibili a un bovino adulto, un verro adulto e un caprino adulto o subadulto (SM10).

US 1314. Di nuovo un contesto comprendente un bovino, due maiali (un adulto e un giovane) e un caprino anziano (Appendix 10).

US 1333, (1° metà III a.C.)

Un maiale subadulto meno di 3 anni e mezzo, un bovino adulto, un caprino adulto o subadulto, un cavallo adulto.

US 3123, (1° metà III a.C.)

Un bovino e un caprino adulti o subadulti.

US 3128, (1° metà III a.C.)

Un maiale meno di un anno e uno più di 2, un bovino adulto, una capra adulta, un cavallo adulto, presenza di ossa umane.

US 3148, (1° metà III a.C.)

Un maiale giovane adulto usura I, un bovino adulto, un caprino adulto o subadulto, presenza di ossa umane.

LA FOSSA RITUALE DAL SANTUARIO DELLA CANNICELLA (Wilkens, 2008)

La necropoli e il santuario della Cannicella si trovano immediatamente a ridosso della rupe, nella parte meridionale. Nonostante il materiale faunistico sia già stato oggetto di una pubblicazione, il discorso viene ripreso per un confronto diretto con il *Fanum Voltumnae* al fine di mettere in evidenza le diverse ritualità. I resti studiati provengono da una grande fossa relativa al tempio datata al III secolo a.C., momento della conquista da parte dei romani. Si tratterebbe di un'unica grande azione rituale legata alla desacralizzazione del santuario, oppure a una azione di espiazione e riconsacrazione, comunque legata all'azione violenta in cui era rimasto coinvolto. Pur non avendo collegamenti diretti con la necropoli, i riti e i culti praticati non potevano non essere influenzati dall'ambiente cimiteriale che caratterizza il sito. La fossa sembra essere stata riempita in una sola volta con materiale vario relativo alla distruzione del tempio (Stopponi, 2008) mentre i resti ossei potrebbero essere in gran parte originati da offerte rituali e sacrifici del tipo *suovetaurilia* e sacrificio del cane.

Le vittime sono numerose e in diverse fasi di età precisamente:

21 maiali tra cui sei di 2/4 settimane; quattro tra 6 e 8 mesi; due di 8/12mesi; uno tra 12 e 18 mesi; tre sui 18/20 mesi; tre poco oltre due anni; due più anziani (Wilkens, 2008: 592).

3 bovini tra cui un adulto di età superiore ai 5 anni, un adulto di età inferiore ai 5 anni, e un giovane sui 5/6 mesi.

19 caprini tra cui 8 pecore: una di età inferiore ai 2 anni, quattro di età inferiore ai 3 anni, due sui 3 anni; una di età superiore ai 3 anni e mezzo; sei caprini non identificati; cinque capre: una di circa 1 mese, una di età inferiore ai 2 anni, una di età

superiore ai 3 anni e mezzo e infine due capre di età non definibile (Wilkens, 2008: 593-594).

È possibile che anche alcuni uccelli siano stati sacrificati, in particolare i polli, i corvi imperiali il colombo, la civetta e il germano (SM4). Si tratta di uccelli di interesse alimentare o che potevano essere collegati con l'oltretomba come i corvi e la civetta.

Altri resti potrebbero essere pertinenti a offerte alimentari, come i pesci (scardola e cavedano), la lepre, la volpe, o di altro tipo come la ciprea (*Monetaria annulus*) lavorata, di provenienza esotica dall'Oceano indiano, che poteva ornare qualche oggetto, e i palchi dei cervidi. Altri animali potevano essere vissuti e morti autonomamente sul posto ed essere finiti nella fossa durante le operazioni di ripulitura e sgombero come la chiocciola terrestre *Campylaea cingulata*, la testuggine, il pettirosso, lo storno e il merlo, il riccio, i roditori, la donnola e il gatto. Gli ultimi due potevano anche essere addetti al servizio del tempio come contrasto ai roditori.

DISCUSSIONE

Lo studio dei materiali dal *Fanum Voltumnae* ha messo in evidenza due tipi principali e ben definibili di sacrificio, il sacrificio contemporaneo di bovini, maiali e pecore (*suovetaurilia*) e il sacrificio del cavallo. Il *suovetaurilia* è riconoscibile nella fossa 1 (US 651), Fossa 2 (US 647), US 1302, US 1314.

Fossa 1 (US 651). Il tipo di rituale ricorda il *Suovetaurilia* anche se differisce da quello più tipico di ambiente romano per la probabile presenza di una bovina femmina e per la preponderanza di resti bovini su quelli delle altre specie, fatto peraltro che potrebbe essere del tutto casuale e legato alla maggiore solidità dello scheletro bovino. Inoltre un eventuale consumo della carne tra i fedeli potrebbe avere disperso le ossa delle specie di taglia media, che potevano venire distribuite con la carne, mentre quelle dei bovini per le loro dimensioni dovevano essere eliminate in gran parte prima del consumo.

Fossa 2 (US 647) a S-E del tempio C (fine IV-inizio III a.C.). Contesto simile a quello precedentemente descritto. Anche in questo caso sembra di essere in presenza di un *suovetaurilia* arricchito dall'offerta di un cervo o di parti di esso.

US 1302. Resti di un tipico *suovetaurilia* comprendente un bovino adulto, un verro adulto e un caprino adulto o subadulto.

US 1314. Di nuovo un *suovetaurilia* comprendente un bovino, due maiali (un adulto e un giovane) e un caprino anziano.

Il sacrificio del cavallo, accompagnato o meno da altre specie, si evidenzia in tre casi.

Fossa con deposizione di cavallo (vedere la tabella del cavallo A in SM1) a N-O del Tempio C, **US 1296-1295** (fine IV-III a.C.). In questo caso si hanno i resti in connessione di un solo cavallo. Dai rilievi effettuati in fase di scavo sembra che la testa fosse stata tagliata e posta sopra il resti del corpo (Stopponi, 2015-2016).

Fossa 1259 US 1260-1273, a sud del lato SE del tempio C, probabilmente relativa a un rituale di desacralizzazione (Stopponi, 2012 e 2015-16). In questo caso sono stati identificati diversi individui: i resti di due cani adulti, un maiale di età superiore a 1 anno e inferiore a 2 e mezzo, un bovino adulto, un caprino di età inferiore a 5 mesi, un cavallo anziano e un cavallo adulto più giovane.

US 1305. Probabili resti di una fossa (SM10). Sono stati rilevati I resti di un maiale adulto e uno subadulto, un cervide, un bovino anziano (Usura V-VI) e uno giovane, una pecora adulta, un caprino adulto, un cavallo giovane adulto (vedere la tabella del cavallo C in SM3), più due frammenti di palco di cervo semilavorato. Resti non ben definibili di probabili sacrifici. Si tratta in questo caso di un limitato numero di resti di animali diversi che potrebbero provenire da una attività di ripulitura di diversi contesti tra i quali si riconoscono comunque possibili pertinenze a *suovetaurilia* e sacrifici di cavalli. In questo gruppo possiamo comprendere le US 1332, 1333, 1323, 1328, 1348 (SM10).

Alla Cannicella risultano in evidenza i *suovetaurilia* e il sacrificio del cane, ma le specie identificate sono molto numerose (SM5) e possono quindi rimandare ad altri tipi di offerte di ambito funerario, spostate dalla sede originaria e deposte nella fossa, unitamente ad altri materiali di recupero (Wilkens, 2008).

CONCLUSIONI

Riassumendo, al *Fanum Voltumnae*, per quanto si desume dalla situazione attuale degli studi, abbiamo tre tipologie di sacrifici: il *suovetaurilia* la cui lunga tradizione lo fa risalire alla preistoria (Wilkens, 2004) e che troviamo codificato e descritto in sacrifici diversi nelle *Tabulae Iguvinae*, il cui modello viene fatto risalire da G. Devoto (Devoto, 1975) più o meno a questo periodo. In particolare il *suovetaurilia* classico si può riconoscere nel sacrificio espiatorio delle *Tabulae*. Da notare che prima di ogni sacrificio si osservavano gli uccelli per gli auspici, fatto che noi non possiamo cogliere col semplice studio archeozoologico. Quando il responso degli auspici era avverso, si facevano sacrifici delle stesse tre specie a diverse divinità per propiziarsene l'attenzione e il favore.

In alcuni casi una delle tre specie poteva mancare, per esempio nella cerimonia della lustrazione del popolo dove venivano offerti solo suini e bovini. Anche al *Fanum Voltumnae* troviamo un caso (US 659) in cui sono state identificate solo due specie, bovini e suino. Difficile dire se si tratti di una perdita di parte del materiale conservabile o di una effettiva mancanza.

Il *suovetaurilia* continuerà poi nel mondo romano sia come cerimonia pubblica, sia come rito privato in particolari occasioni. Catone (*De agri cultura*, CXLI, 1-2) descrive un *suovetaurilia* di tipo privato indetto per la lustrazione dei campi: "*Agrum lustrare sic oportet: impera suovetaurilia circumagi: "Cum divis volentibus quodque bene eveniat, mando tibi, Mani, uti illace suovetaurilia fundum, agrum terramque meam quota ex parte sive circumagi circumferenda censeas, uti cures lustrare." Così bisogna fare la lustrazione dei campi: comanda che siano portati in giro dei suovetaurilia: "Con la volontà degli dei e che ne venga bene, ti affido, Manio, che tu prenda la cura di lustrare, facendo fare a questi suovetaurilia il giro del mio fondo, dei miei campi, della mia terra per quella parte che tu ritieni che debbano percorrere o essere trasportati"*

Il sacrificio del cane (SM6) nelle *Tabulae Iguvinae* viene collegato a Hondo Giovio e alle fasi lunari mentre Plinio (*Naturalis historia*, XXIX, 14) lo cita per i riti in favore di Genita Mana, divinità legata al ciclo mestruale, e nei Fasti di Ovidio (Fasti, IV, XXXVI, 901-936) a riti di tipo agricolo per scongiurare la ruggine dei cereali (Wilkens, 2006). Al *Fanum Voltumnae* il cane è presente solo nella fossa 1259 con pochi frammenti pertinenti a due individui. Nel corso di questi sacrifici (*suovetaurilia* e sacrificio del cane) si praticava la "comunione" cioè la distribuzione di porzioni ai fedeli, mentre il rimanente era destinato ad essere interrato. Questo portava alla partizione dell'animale con conseguenti segni di macellazione. Il cane può anche essere visto come elemento legato all'oltretomba e probabilmente per questo motivo avrebbe una maggiore importanza alla Cannicella. A parte le raffigurazioni di cani in ambito sepolcrale, il cane è visto come animale psicopompo o come custode delle porte infernali. Si può trovare un confronto con il pozzetto dell'età del Ferro sopra la tomba 743 di Lavello (Wilkens, 1997). In questo caso si può ipotizzare che il sacrificio di numerosi cani sia stato messo in atto per riparare alla casuale e involontaria violazione di una tomba più antica, intercettata dallo scavo del pozzo. Lo scavo del pozzo daunio avrebbe infatti danneggiato la tomba 743 utilizzata per un lungo periodo durante l'età del Bronzo e particolarmente ricca di resti umani.

In ambito etrusco, una deposizione di cane completo si ha dal santuario di Pyrgi (Caloi & Palombo, 1980) e resti di cani in relazione ad azioni rituali sono state segnalate a Marzabotto e in altre località dell'Italia padana (Curci & Sertori, 2015).

È invece da mettere in evidenza il sacrificio del cavallo, in genere meno comune da trovare al di fuori di contesti funerari. Si ha evidenza del sacrificio del cavallo fino dai primi momenti della introduzione di questo animale in Italia con i resti di Maccarese presso Roma (Tagliacozzo, 1995). Il sacrificio di un cavallo in ambito funerario è tipico di sepolture di persone appartenenti alle classi abbienti, spesso, ma non esclusivamente, di sesso maschile. Sepolture di cavalieri o sepolture di cavalli con carri sono state trovate in Italia settentrionale e centrale anche in necropoli etrusche (Vitali, 2006).

In ambito greco il cavallo poteva avere una sepoltura individuale come ad Himera (Groppo &Vassallo, 2019) o a Priniàs, Creta (Wilkens, in studio). Una fossa sacrificale non collegata a sepolture può essere considerata quella di cultura villanoviana ritrovata presso Rimini, contenente tre cavalli (Catagnano *et al*., 2015). Si deve supporre che anche in questo contesto il cavallo doveva avere un valore superiore a quello delle altre specie, in particolare quando si tratti di cavalli adulti ma nel pieno del loro vigore. Inoltre il cavallo non era un animale utilizzato comunemente a scopo alimentare, veniva deposto in una fossa e si trova spesso in connessione. Si tratta quindi di una azione puramente simbolica che doveva portare prestigio all'offerente sia che si trattasse di un privato che di una comunità.

La presenza del cavallo può essere anche comparata al rito dell'*October Equus* celebrato a Roma alle Idi di Ottobre, quando veniva sacrificato a Marte il cavallo di destra vincitore nel Campo Marzio (Stopponi, 2015-2016). È da ricordare che anche al *Fanum Voltumnae* erano previsti giochi. Un altro rituale che coinvolgeva un cavallo avveniva a Roma durante i *Parilia* del 21 aprile, in questo caso sacrificato a Vesta (Stopponi, 2015-2016).

Dal punto di vista morfologico si può supporre che gli animali da offrire alla divinità rappresentassero quanto di meglio era reperibile e si può anche ipotizzare che, mentre le vittime della Cannicella, dedicate a un culto locale, venissero allevate sul posto, le vittime del *Fanum Voltumnae* potessero essere anche portate da lontano in occasione di cerimonie alle quali partecipavano diverse città.

CARATTERISTICHE METRICHE E MORFOLOGICHE DELLE SPECIE IDENTIFICATE

Le misure degli animali dai due siti di Orvieto sono riportate nelle tabelle da SM1 a SM9.

Per quanto riguarda i bovini (SM7), alla Cannicella non è stato possibile calcolare altezze al garrese, ma è stata trovata una cavicchia di grandi dimensioni. Dal *Fanum Voltumnae* sono state calcolate alcune altezze (Matolcsi, 1970), dalla US 1333, da radio, di cm 131; dalla US 651 per il bovino B probabilmente femmina due altezze da femore incompleto di cm 125 e da metatarso di cm 135; dalla US 1332 due altezze di cm 134 (da metacarpo) e di cm 131 (da metatarso). Si tratta quindi di soggetti di buona taglia per il periodo. Per fare un esempio da un contesto non certo povero, da di diversa estrazione sociale, nel villaggio etrusco di San Rocchino presso l'attuale Massarosa in Toscana, l'altezza media dei bovini è di cm 114, con variabilità da 108 a 121. In questo caso dobbiamo pensare a bovini sfruttati essenzialmente per il lavoro (Wilkens, 2012). Le caratteristiche craniali sono poco note, ma si nota una variabilità nelle dimensioni e nella forma delle cavicchie.

Nel caso dei cavalli, presenti solo nel *Fanum Voltumnae*, si ha una altezza di cm 136,5 per il cavallo A mentre negli altri casi non è stato possibile calcolarla a causa della frammentazione dei resti ossei. Non si conoscono le caratteristiche del cranio. Dal sito di confronto di San Rocchino proviene una altezza di cm 133,8 ad indicare come i cavalli da lavoro e quelli di pregio avessero più o meno le stesse dimensioni. A San Rocchino i cavalli venivano occasionalmente macellati, cosa che non è stata riscontrata nel sito di Orvieto.

Non è stato possibile calcolare altezze per il cane (SM6) che appare comunque di dimensioni medie, con qualche esemplare di taglia maggiore. Il cranio è di forma allungata, con dentatura regolare, gli arti sono slanciati. Anche i cani di confronto da San Rocchino presentavano caratteristiche simili, in questo caso sono state calcolate anche alcune altezze che danno una media di cm 53,4 con variabilità da 52,8 a 54,6.

Per il maiale (SM8) abbiamo diverse altezze dalla Cannicella da metacarpi, metatarsi e astragali Teichert, 1969), che danno una media di cm 69,1 con variabilità da 66,2 a 75,1. Al *Fanum Voltumnae* abbiamo solo due altezze con una media di cm 73 e variabilità da 67,8 a 78,2. A San Rocchino (Wilkens, 2012) le altezze vanno da 65,3 a 88,7, con una media di 72,5, quindi senza sostanziali differenze con i siti di Orvieto. Nei tre siti mancano resti consistenti del cranio, ma in alcuni casi sembra di poter riconoscere una forma accorciata del muso.

Per la capra (SM9) è stata calcolata una sola altezza dalla Cannicella di cm 72,2 da radio, mentre per la pecora si hanno diverse altezze dallo stesso sito da metacarpo, metatarso e astragalo che vanno da cm 52,8 a 74,8 con una media di 56,9. Al *Fanum* sono state calcolate solo due altezze femminili da astragalo da cm 61,2 a 63,5 con una media di 62,3 (Teichert in Driesch & Böessneck, 1974; Driesch, 1976). Nel sito di confronto di San Rocchino, la capra raggiunge i cm 56,4 e la pecora una media di 60,5 con variabilità da 54,3 a 70,4 e quindi non variano sostanzialmente nelle dimensioni.

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MATERIALE SUPPLEMENTARE

Vedi materiale supplementare su https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_023

BIBLIOGRAFIA

Bartosiewicz, L.; Van Neer, W. & Lentacker, A. 1997: Draught Cattle: Their Osteological identification and history. *Annales Sciences Zoologiques* 281. Musée Royal de L'Afrique Tervuren, Belgique.

Bökönyi, S. 1970: A new method for the determination of the number of individuals in animal bone material. *American Journal of Archaeology* 74: 291-292.

Caloi, L. & Palombo, M.R. 1980: Il cane domestico di Pyrgi. *Studi Etruschi* XLVIII: 293-328.

Catagnano, V.; De Grossi Mazzorin, J. & Von Eles, P. 2015: Analisi preliminare di una sepoltura di cavalli nella necropoli villanoviana di Verucchio (Rimini). In: Hohenstein, U.T.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Congresso Nazionale di Archeozoologia*: 133-138. Annali dell'Università degli Studi di Ferrara vol. 11 n. 2.

Catone, M.P. : *De agri cultura*. CXLI, 1-2, ed. Les Belle Lettres, Paris, 1975.

Curci, A. & Sertori, S. 2015 : Il cane in Etruria Padana: usi domestici e valenze rituali. In: De Grossi, M.; Fiore, M. & Minniti, C. (eds.): *Atti 8° Convegno Nazionale di Archeozoologia (Lecce, 2015)*: 297-306. Università del Salento, Lecce.

Devoto, G. 1975: *Le tavole di Gubbio*. Sansoni.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletins, Harvard University. MA.

Driesch, A. von den & Böessneck, J. 1974: Kritische Anmerkungen zur Widerristhöhenberechnung aus Längenmaben vor- und frühgeschichtlicher Tierknochen. *Säugetierkundliche Mitteilungen* 40, 22(4): 325-348.

Groppo, V. & Vassallo, S. 2019: Le tombe e i morsi ad anello dei cavalli morti nella battaglia di Himera del 480 a.C. *Notiziario Archeologico della Soprintendenza di Palermo* 53.

Habermehl, K.H. 1961: *Die Altersbestimmung bei Haustieren, Pelztieren und beim jagdbaren Wild*. Paul Parey Verlag, Berlin.

Howard, M. 1963: The metrical determination in the metapodials and skulls of cattle, Man and cattle. *Royal Anthropological Institute, Occasional Paper* 18: 91-100.

Kiesewalter, L. 1888: *Skelettmessungen an Pferden als Beitrag zur theoretischen Grundlage der Beurteilungslehre des Pferdes*. Dissertation, Leipzig.

Matolcsi, J. 1970: Historische Erforschung der Körpergröbe des Rindes auf Grund von ungarischem Knochenmaterial. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 87(2): 89-137.

Ovidio, P.N.: Fasti, IV, XXXVI: 901-936, ed. 1993, Les Belles Lettres, Paris.

Plinio, G.S.: *Naturalis historia,* XXIX, 14. ed. 1982, Einaudi, Torino.

Stopponi, S. 2008: Un luogo per gli dèi nello spazio per i defunti. In: Raventòs, X.D.; Ribichini, S. & Verger, S. (eds.): *Saturnia Tellus Definizioni dello spazio consacrato in ambiente etrusco, italico, fenicio-punico, iberico e celtico*: 559-588. Atti del Convegno Internazionale, Roma 10-12 novembre 2004.

— 2012: Il Fanum Voltumnae: dalle divinità *Tluschva* a San Pietro. *Annali della fondazione per il museo «Claudio Faina»* XIX: 7-77.

— 2015-2016: Il santuario di Campo della Fiera a Orvieto I, Nuovi dati dallo scavo e nuove riflessioni sui culti. In: *Rendiconti Pontificia Accademia Romana di Archeologia* LXXXVIII: 382-387.

— 2018: Orvieto – località Campo della Fiera: la scoperta del Fanum Voltumnae. In: *Annali Fondazione Faina* XXV: 9-36.

Stopponi, S. & Giacobbi, A. 2017: La "Terna sacrificale" a Campo della Fiera. *Scienze dell'Antichita* 23(3): 491-503.

Tagliacozzo, A. 1995: Il più antico cavallo in Italia? Scoperte nella fossa rituale di le Cerquete. *Archeo* X(3): 116.

Teichert, M. 1969: Osteometrische Untersuchungen zur Berechnung der Widerristhöhe bei vor- und frühgeschichtlichen Schweinen. *Kühn-Archiv* 83(3): 237-292.

Tito Livio: *Ab Urbe Condita Libri*, 4, 23, 5; 5, 1, 3-7; 17, 6-10; 6, 2, 2; 25, 7-8; 61, 2, ed.1997, Newton Compton, Milano.

Vitali, D. 2006: Cavalli in tombe – Tombe di cavalli in necropoli lateniane d'Italia. In: Curci, A. & Vitali, V. (eds.): *Animali tra uomini e dei. Archeozoologia del mondo preromano*: 133-138. Atti del convegno internazionale, 8-9 novembre 2002. Ante Quem.

Wilkens, B. 1997: Restes de chiens provenant d'un puits de l'age du Fer à Lavello, Potenza, Italie. *Anthropozoologica* 25-26: 799-801.

— 2004: The roman Suovitaurilia and its predecessors. In: Day, S.J.O'; van Neer, W. & Ervynck, A (eds.): *Behaviour Behind Bones: The Zooarchaeology of*

Ritual, Religion, Status and Identity: 73-76. Oxbow Books, Durham.

— 2006: The sacrifice of dog in ancient Italy. In: Moore, E.A. & Snyder, L.M. (eds.): *Dogs and People in Social, Working, Economic or Symbolic Interaction:* 131-136. Oxbow, Durham.

— 2008: Resti faunistici da una fossa rituale di Orvieto. In: Dupré Raventòs, X.; Ribichini, S. & Verger, S. (eds.): *Saturnia Tellus*: 589-597. Atti del Convegno Internazionale, Roma 10-12 novembre 2004. CNR, Roma.

— 2012: *Archeozoologia. Manuale per lo studio dei resti faunistici dell'area mediterranea* . Edes, Sassari.

MATERIALE SUPPLEMENTARE 1

Orvieto, *Fanum Voltumnae*										
US 1295-1296-659										
Equus caballus A	n°	US	età	lato	fr.					
cranio							L	B	L.prot.	
mascellare	1	1295		sn	P2-P3	P2	39,14	26,3	21,75	
						P3	29,84	28,13	12,03	
premascellare	2	1295		sn	I2-I3-C					
	1	1295		dx	fr.					
nasale	1	1295			fr.					
zigomatico	1	1295			fr.					
mandibola										
	1	1295			fr.					
	1	1296			fr.					
con I/alv.C	1	656	6 anni	dx/sn	fr.					
Vertebre toraciche						PL	BFcr	BFcd	HFcr	HFcd
T13		1296	F		I	40,13	47,51	56,44	37,06	37,65
T14		1296	F		I	39,22	47,52	54,86	40,11	39,14
T15		1296	F		I	38,79	41,33	54,38	35,31	41,61
T16		1296	F		I	41,41	69,26	59,13	37,12	39,59
T17		1296	F		I	40,89	66,23	55,99	41,28	36,25
T18		1296	F		I	40,4			42,41	39,57
frammenti	27	1296			fr.					
Vertebre lombari						PL	BFcr	BFcd	HFcr	HFcd
LI	1	1296	F		I	45,67	41,11	45,2	37,7	35,11
LII	1	1296	F		I	45,44	39,03	43,35	37,72	38,86
LIII	1	1296	F		I	44,11	40,25	46,25	38,25	38,53
LIV	1	1296	F		I	44,92	41,39	47,58	68,94	42,8
LV	1	1296	F		I	46,27	46,61	47,82	34,91	28,29
LVI	1	659	F		I	43,74		44,26		24,38
sacro						BFcr	HFcr			
	1	659			fr.	40,46	20,42			
	1	659			fr.					
Vertebre indet.										
	1	1296			fr.					
costole										
	11	1296		dx						
	17	1296		sn						
	22	1296			fr.					
omero						BT				
	1	1296	F	sn	D	70,94				
	1	1296	F	dx	P					
	1	659		sn	P					
	1	1296		sx	fr.					
radio										
	1	1296	F	dx	P					
	1	656	F	dx	P					
coxale						LA				
	1	1296	cr.il.F	sn		63,09				
	1	1296	cr.il.F	sn						
	1	1296	c.p.F	dx						
	1	1296	s.pub.NF	sn						
femore						GL	Glcaput	SD	Bd	
	1	1296	F	dx	I	392	352	39,08	85,1	
patella						GL	GB			
	1	1296		dx	I	68,2	66,38			
tibia						GL	Bp	SD		
	1	1296	F	dx	P		92,02	40,13		
	1	1296	F	sn	I	340		41,01		

MATERIALE SUPPLEMENTARE 2

Orvieto, *Fanum Voltumnae*									
US 1260-1273, fossa 1259									
Equus caballus B	n°	sigla	età	lato	fr.				
cranio						m34	m37	m36	
mascellare	1	1260			fr.				
occipitale	1	1260			fr.	74,47	32,18	29,76	
mandibola									
	1	1260			fr.				
diastema	1	1260		dx					
	1	1260		sn					
gonion	1	1260		dx					
	1	1260		sn					
ramo orizzontale	2	1260			fr.				
ramo verticale	11	1260			fr.				
denti superiori						L	B	L.prot.	Hcorona
P4	1	1260		sn		26,81	25,47	8,9	32,43
M1	1	1260		sn		21,81	23,36	10,25	28,61
denti inferiori						L	B	L.fiocco	Hcorona
P2	1	1260		sn		26,78	15,76		12,87
P3/P4	1	1273	Us.M.Av.			24,85	18,93	12,91	
M1	1	1260		sn		26,13	18,58	16,72	23,18
M2	1	1260		sn		25,39	15,45	14,5	26,57
M2	1	1273	Us.av.	dx		24,96	16,88	14,54	
M3	1	1260		sn					
I2	1	1260		dx					
I3	1	1260		dx					
I1	1	1260		sn					
I2	1	1260		sn					
Incisivi indeterminati									
	3	1273							
V. cervicali									
	1	1260	F						
V. dorsali									
	6	1260	F						
V. lombari									
ultima lombare	1	1260	F						
V. caudali									
	4	1260	F						
Vertebre indet.									
	5	1260							
costole									
	13	1260							
scapola						SLC	GLP	LG	BG
	1	1260	F	dx	I	62,27	87,94	52,87	81,33
omero						Bp	SD	Bd	BT
	1	1260		sn	fr.				
	1	1260		sn	fr.				
	1	1260	F	dx	I	86,42	33,98	76,49	68,69
	1	1273	F	sn	P	-76,09			
radio						Dp	SD		
	1	1260	F	dx	P	39,99	35,53		
ulna									
	1	1260	F	dx	P				
magnum									
	1	1260							
uncinato	1	1260		dx	I				
	1	1260		sn	I				
piramidale	1	1260			I				
coxale									

ischio	1	1260		dx					
ischio		1260	tub.F	dx					
femore						Bd			
	1	1260	F	dx	D				
	1	1260	F	sn	D	84,18			
patella						GL	GB		
	1	1260		sn	I	69,33	57,02		
astragalo						GH	GB	BFd	LmT
	1	1260		dx	I	56,82	64,8	49,32	58,8
metatarso						Bp	Dp		
	1	1260		sn	P	49,47	43,4		
metapodi accessori	1	1260							
IV mt	1	1260		sn	fr.				
II falange						GL	Dp	SD	
	1	1260	F	sn	I	44,25	28,45	42,27	

MATERIALE SUPPLEMENTARE 3

Orvieto*, Fanum Voltumnae*									
US 1305									
Equus caballus C	n°		età	lato	fr.				
mandibola						L	B	L fiocco	
	1	1305	us.scarsa	sn					
P2				sn		34,58	15,47	14,98	
P3				sn		29,65	15,6	16,43	
P4				sn		29,64	17,54	14,56	
M1				sn		27,56	16,77	14,9	
M2				sn		29,92	14,95	14,03	
M3				sn		23,57	11,13	10,4	
denti inferiori						L	B	L fiocco	Hcorona
M2	1	1305	C.alta	dx	I	26,66	18,41	-15,15	
Vertebre toraciche									
	2	1305	F		fr.				
costole									
	1	1305							
metapodi						Dd	Bd	BFd	
	1	1305	F		D	-34,96	48,12	45,54	
Altri cavalli, ***Fanum Voltumnae***									
Equus caballus									
denti inferiori						L	B	L fiocco	Hcorona
M2	1	1332		dx	I	28,5	19,3	17	63,4
M1	1	3128		dx	I	24	16,7	13	35,9

MATERIALE SUPPLEMENTARE 4

Aves								
Orvieto – Cannicella	sigla	lato	fr.					
Coracoide				GL	Lm	BF		
Corvus corax	10Q		I	58,6	54	16,8		
Corvus corax Individuo A	9L	dx	I	60,2	55,2	17,7		
Corvus corax Individuo A	9L	sn	I	60,4	55	17,5		
omero				GL	Bp	SC	Bd	
Erithacus rubecula	3P		I	17,4				
Corvus corax Individuo A	9L	dx	I	91	26	9	20,7	
Corvus corax Individuo A	3L	sn	D				21,3	
ulna				GL	Bp	Did		
Sturnus vulgaris	3M		D			4,7		
Corvus corax	9P		D			12,7		
Corvus corax Individuo A	3L+9L	dx	I	112,6	14,5	13		
Corvus corax Individuo A	3L+9L	sn	I	112,7	14,1	13,2		
Carpometacarpo				GL	Bp	Did		
Anas platyrhynchos	4M	sn	I	55	13			
Anas platyrhynchos	2/33	dx	I	55	13			
Gallus gallus	3H		I	40,8	12			
Gallus gallus	2/33		I	32	10			
Corvus corax Individuo A	3L+9L	dx	I	66,8	15,5	16,5		
Corvus corax Individuo A	9L	sn	D			16,4		
femore				GL	Lm	Bp	SC	Bd
Columba livia	10E	sn		40,8		8,7	34	7,7
Gallus gallus	10I		D					13,5
Gallus gallus	4F		P			12,5		
Corvus corax Individuo A	9L	dx	I	67,9	64,5	14,7	6,7	15
Corvus corax Individuo A	9L	sn	D					15,2
tibia				GL	Dip	SC	Bd	
Gallus gallus	2/33		P		20,5			
Athene noctua	8F+6A	sn	I	56	6	3	7	
Athene noctua	6L	dx	P				6,6	
Corvus corax Individuo A	9L	dx	P		19,2			
Corvus corax Individuo A	9L	sn	P		19			
Corvus corax Individuo A	9L		D				11,7	
tarsometatarso				GL	Bp	SC	Bd	
Sturnus vulgaris	7A		I	33,8				
Corvus corax Individuo A	9M	dx	I	68	13,4	6	9,3	
Corvus corax Individuo A	9L+9M	sn	I	68,2	13,6	5,8	9,7	

MATERIALE SUPPLEMENTARE 5

Orvieto NISP	Cannicella	*Fanum Voltumnae*
Cypraea annulus L.	1	
Campylaea cingulata Studer	1	
Pisces	4	
Leuciscus cephalus (L.)	2	
Scardinius erythrophthalmus (L.)	2	
Testudo sp.	8	
Aves	39	
Anas sp.	2	
Anas platyrhynchos L.	3	
Corvus corax L.	46	
Gallus gallus L.	25	
Athene noctua (Scopoli)	2	
Erithacus rubecula (L.)	1	
Sturnus vulgaris L.	2	
Merula merula L.	3	
Columba livia Gmelin	3	
Erinaceus europaeus L.	10	
Rodentia	2	
Lepus sp.	15	2
Leporidae	1	
Mustela nivalis L.	1	
Felis catus L.	1	
Vulpes vulpes L.	12	
Canis familiaris L.	87	5
Sus scrofa L.	1010	85
Dama dama L.	4	
Cervus elaphus L.	1	2
Cervidae	1	3
Bos taurus L.	58	198
Ovis aries L.	102	8
Capra hircus L.	37	1
Ovis vel *Capra*	774	51
Equus caballus		263

MATERIALE SUPPLEMENTARE 6

Orvieto – Canidi-altro														
Canis familiaris	sito	sigla	età	lato	fr.									
cranio						m1	m15	m16	m17	m18	m18a	m20	m21	m37
	Cannicella	1/33+4b	adulto	sn		195,5	54,6	19,3	50,7	20,7	11,1	13,1	15,8	26,8
	Cannicella	N3	adulto	dx						20	11,4	13,2	15,9	
mandibola						m1	m8	m10	m11	m13	m14	m19		
	Cannicella	2/33	adulto	sn				36,6		23	9	29,8		
	Cannicella	5F	adulto	sn			80,9	37,1	44,4	23,4	9	26,2		
	Cannicella	7B	adulto	sn		149,9	74,8	34,6	40,5	19,8	8,4	25,1		
Atlante						GB	GL	BFcd	GLF					
	Cannicella	10Q	F				38,6		30,3					
	Cannicella	5N+4R	F			83,3	40,2	31,7	31,3					
scapola						SLC	GLP	LG	BG					
	Cannicella	10F	F	dx		27,5	32	27,8	20,4					
	Cannicella	5C	F	sn		29,4	32,5							
	Cannicella	3G	F	sn		27,6	32,7	28,7	19,5					
omero						Bp	Bd	BT						
	Cannicella	7F	F	dx	P	34,5								
	Cannicella	3C	F	sn	P	34,3								
	Cannicella	9M	F	dx	D		34,3	23						
	Cannicella	9M	F	sn	D		34,5	24,2						
radio						Bp	Dp	Bd						
	Cannicella	CB	F	dx	P	19,4	12,4							
	Cannicella	7L	F	dx	P	11,3	7							
	Cannicella	Q4	F	dx	D			24,3						
	Cannicella	9F	F	sn	D			24,4						
ulna						DPA	LO	SDO	BPC					
	FanumVoltumnae	1273	F	sn	P	26,95	31,76	22,06	16,89					
	FanumVoltumnae	1260	F	sn	P	24,07			12,41					
	Cannicella	6Q	F	dx	P	25,6	31,2	22,5	18					
	Cannicella	2/33	F	dx	P	26,8			17,4					
II metacarpo						GL	Bd							
	Cannicella	8P	F	sn	I	61	11,6							
coxale						LA								
	Cannicella	2/33	tuttoF	dx		22								
	Cannicella	8E	tuttoF	dx		23,2								
femore						Bp	DC	Bd						
	Cannicella	7L	F	dx	P	37,5	20,1							
	Cannicella	3L	F	dx	P		19,5							
	Cannicella	6L	F	sn	P	41,3	20,3							
	Cannicella	9M	F	sn	P	42	20,8							
	Cannicella	4P	F	sn	D			35,8						
	Cannicella	4P	F	dx	D			33,3						
calcaneo						GL								
	Cannicella	9P	F	dx	I	44,4								
I falange						GL	Bp	SD	Bd					
	Cannicella	6M	F		I	23,8	10	6,9	7,9					
	Cannicella	8G	F		I	22,5	8,5	5,4	7,3					
Vulpes vulpes														
II metacarpo						GL	Bd							
	Cannicella	4P	F	sn	I	43	6,7							
	Cannicella	7C	F	sn	I	38,4	6,3							
III metacarpo						GL	Bd							
	Cannicella	7C	F	sn	I	43,7	5,7							
IV metacarpo						GL	Bd							
	Cannicella	7C	F	sn	I	43	5,6							
	Cannicella	4L	F	sn	I	47,4	6							
V metacarpo						GL	Bd							
	Cannicella	7C	F	sn	I	36,3	6,3							
tibia						Bd	Dd							
	Cannicella	6A	F	sn	D	24,9	9,9							
I falange						GL	Bp	SD	Bd					
	Cannicella	2/34	F		I	19	5,8	3,7	4,8					

Altri mammiferi														
Erinaceus europaeus	misure leporidi													
mandibola						m1	m5							
	Cannicella	4Q				44,6	23,8							
omero						Bd	BT							
	Cannicella	1/34	F	dx	D	11,5	8,9							
	Cannicella	4P	F	sn	I	12,2	9,4							
radio						Bp								
	Cannicella	3M	F	sn	P	5,7								
Lepus sp.														
tibia						Bp								
	Cannicella	5L	F	sn	P	-18,8								
calcaneo						GL								
	Cannicella	5R	F	sn	I	28,2								
metatarsi						GL	Bd							
II metatarso	Cannicella	5R	F	sn	I	54,2	6,3							
III metatarso	Cannicella	5R	F	sn	I	56	6							
IV metatarso	Cannicella	5R	F	sn	I	53	5,8							
V metatarso	Cannicella	5R	F	sn	I	46,8	5,1							
III metatarso	Cannicella	6A	F	dx	I	56	6							
IV metatarso	Cannicella	6L	F	dx	I	53,1	5,8							
V metatarso	Cannicella	6A	F	dx	I	47,2	5,2							
I falange						GL	Bp	SD	Bd					
	Cannicella	5b	F		I	24,3	5,6	3,3	4,2					
	Cannicella	6A	F		I	20,4	6	3,4	4,4					
	Cannicella	6L	F		I	18	4,7	2,7	3,9					
	Cannicella	5R	F		I	20,6	5,8	3,3	4,5					
Dama dama														
omero						Bd	BT							
	Cannicella	I6	F	dx	D	33,7	33							

MATERIALE SUPPLEMENTARE 7

Orvieto											
Bos taurus	sito	sigla	età	lato	fr.						
corna o cavicchie						D base	DAPbase				
	Cannicella	5P		sn		77,1	66,8				
cranio						L M3	L Pd4	B Pd4			
mascellare	Fanum Voltumnae	1332	I	dx		29,3					
	Cannicella	3Q	2	sn			23,5	17,4			
	Fanum Voltumnae	647	2	sn			23,03	17,9			
M3 superiore						L	B				
	Fanum Voltumnae	3128		sn	I	29	23,7				
scapola						SLC	GLP	LG	BG		
	Fanum Voltumnae	1302	F	sn		58,23					
	Fanum Voltumnae	1305	F	sn		54,16	69,92	60,79	50,22		
	Fanum Voltumnae	1332	F	dx		65,5		69,5			
omero						Bd					
CdF		1260	F	sn	D	72,34					
radio						GL	Bp	Dp	SD	Bd	BFd
	Fanum Voltumnae	1333	F	sn	P		73,2	39,3			
	Fanum Voltumnae	1333	F	dx	I	303,5		34	41	68,5	59
metacarpo						GL	Bp	Dp	SD	Bd	Dd
	Fanum Voltumnae	1305		sn	P		68,27	40,91			
	Fanum Voltumnae	1305		dx	P			38,04			
	Fanum Voltumnae	1332	F	sn	I	216,6	65	43,6	40	73,3	35,5
	Cannicella	4Q	F	sn	D					76,1	38,2
	Fanum Voltumnae	651	F	dx	D					66,67	
femore						GL	DC	SD			
	Fanum Voltumnae	3148	F	dx	I		43				
	Fanum Voltumnae	651	F	sn	I	-388,3	48,74	38,99			
tibia						Dd					
	Fanum Voltumnae	3148	F	dx	D	45					
astragalo						GLl	GLm	Dl	Dm	Bd	
	Fanum Voltumnae	3128		dx	I	66,3	60,8	36,1	38,3	44,7	
scafocuboide						GB					
	Fanum Voltumnae	1332		sn	I	63,5					
	Fanum Voltumnae	651		sn	I	58,89					
	Fanum Voltumnae	647		sn	I	53,1					
metatarso						GL	Bp	Dp	SD	Bd	Dd
	Fanum Voltumnae	656		dx	P		51,59	51,31			
	Fanum Voltumnae	3128	F	sn	D					51,7	
	Fanum Voltumnae	1332	F	sn	I	239	53,3	48	33,5	65,2	
	Cannicella	6P	F	dx	D					64,8	
	Fanum Voltumnae	651	F	sn	I	253	51,95		30,8	58,48	35,38
	Fanum Voltumnae	647		dx	P		53,42	54,37			
I falange						GLpe	Bp	SD	Bd		
	Cannicella	6F	F	sn	I	72,2	33,2	28,6	32,7		
	Cannicella	4G	F	dx	I	69,9	37,7	32,6	35,8		
	Cannicella	2/33	F	dx	I	70,1	36,8	31,4	35		
	Cannicella	7H	F	dx	I	65,1	34,8	28,9	32,3		
	Fanum Voltumnae	651	F	dx	I	65,68	31,01	25,66	30,19		
	Fanum Voltumnae	647	F	dx	I			29,65	33,86		
	Fanum Voltumnae	647	F	sn	I	63,38	33,83	28,72	32,33		
II falange						GL	Bp	SD	Bd		
	Fanum Voltumnae	651	F	dx	I	43,94	31,35	26,13	25,55		

	Fanum Voltumnae	647	F	sn	I		34,44	26,74	30,69		
	Cannicella	6I	F	dx	I	47,7	36,7	29,9	32,1		
	Cannicella	2/33	F	dx	I	46,6	37	29,2	31,5		
	Cannicella	4M	F	dx	I	46,7	33,8	28	28,8		
	Cannicella	5M	F	sn	I	47,2	37	29,6	32,1		
	Cannicella	3M	F	sn	I	46,9	34,4	28,2	28,8		
	Cannicella	3E	F	sn	I	44,7	32	24,8	26,1		
	Cannicella	2/33	F	sn	I	42,5	30,6	24	25,4		
III falange						Ld	DLS	MBS			
	Fanum Voltumnae	1305		sn	I			16,84			
	Cannicella	4M		dx	I	66,4	91,6	29,6			
	Cannicella	4L		sn	I	60,3	76,7	28,8			
	Cannicella	4L		sn	I			25,1			

MATERIALE SUPPLEMENTARE 8

Orvieto													
Sus scrofa	sito	sigla	età	lato	fr.								
mascellare						m28	m29	m29a	m30	m31	L Pd	L Pd4	B Pd4
	Cannicella	4R	3	dx								13,8	10,7
	Cannicella	3M	3	dx								14,6	12
	Cannicella	5Q	4	dx								13	10,4
	Cannicella	2E	3	dx							34,6	13,6	11
	Cannicella	6M	V	sn					34,1				
	Cannicella	3L	II	sn					27,1	16			
	Cannicella	9L	II	sn		60			28,8	17,3			
♀	Cannicella	9L		dx			43	36,8					
	Cannicella	2/33	III/IV	dx					31				
	Cannicella	7P	III	dx					30	17,6			
mandibola						m9	m9a	m10	m10	L Pd	L Pd4	B Pd4	
♂	Cannicella	6M		sn			36,6						
♂	Cannicella	9E	IV	sn		44,4	35						
♀	Cannicella	6M	I	sn		48,7	35						
	Cannicella	3L	III	sn				30,9	14,5				
	Cannicella		V	sn				31,4	16,2				
	Cannicella	8E		dx			33,5						
	Cannicella	7F	I	dx			34,5						
	Cannicella	6C	II	dx				31,8	14,6				
	Cannicella	2/33	III	dx				31,7	13,9				
	Cannicella	8P	III	sn				30	15,2				
	Cannicella	8I	1	sn							19,4	9	
	Cannicella	8P	1	sn							17	8,1	
	Cannicella	4L	1	dx							17,2	8	
	Cannicella	6P	1	dx							17,8	8,2	
	Cannicella	6A	4	sn						34,7	17,7	8,4	
	Cannicella	9I	3	sn							16,7	8	
	Cannicella	6I	3	sn						37	18,6	9,4	
	Cannicella	6P	3	sn						36,5	17,4	9	
M3 superiore						L	B						
	Cannicella	5M	I	dx	I	31,9	19,6						
	Cannicella	5B	I	dx	I		19						
	Cannicella	4M	I	sn	I	32,4	18,8						
M3 inferiore						L	B						
	Fanum Voltumnae	3148	I	dx	I	34,7	14,4						
	Cannicella	10Q	I	sn	I	30	14,8						
Pd4 inferiore						L	B						
	Cannicella			dx	I	18,5	8,1						
	Cannicella	2/33		dx	I	19	8,8						
	Cannicella			sn	I	17,1	8,6						

Atlante						BFcr	BFcd	H	
	Cannicella	7E	F		I		45,7		
	Cannicella	5I	F		I			45,3	
	Cannicella	2/33	F		I	50,8			
	Cannicella	5E	F		I			43	
scapola						SLC	GLP	LG	BG
	Fanum Voltumnae	1332	F	sn		22,5			
	Fanum Voltumnae	1332	F	sn		23,4			
	Fanum Voltumnae	1305	F	dx		24,31	35,7	28,18	24,41
	Cannicella	7R	F	dx		22	32,7	27	22
	Cannicella	5Q	F	dx		26	36,8	30	24
	Cannicella	3IL	F	dx		23			23
	Cannicella	10G	F	dx		20,8	34	29,5	23,7
	Cannicella	4F	F	dx			33,6		
	Cannicella	5IL	F	sn		22,9	33,8	30,4	23
	Cannicella	9P	F	sn		26,9	36	30,1	22,5
omero						Bd	BT		
	Cannicella	7B	F	sn	D	37,5	28,4		
	Cannicella	9L	F	dx	D	34	26,7		
	Cannicella	7P	F	dx	D	38,7	30,8		
	Cannicella	7M	F	dx	D	35	28		
	Fanum Voltumnae	647	F	sn	D	33,66			
radio						Bp	Dp		
	Fanum Voltumnae	1260	F	dx	P	25,43	17,7		
	Fanum Voltumnae	647	F	dx	P	25,19	17,9		
	Fanum Voltumnae	647	F	sn	P		18,27		
	Fanum Voltumnae	647	F	sn	P	25,16	17,81		
	Cannicella	9L	F	dx	P	25,1	18,3		
	Cannicella	9L	F	dx	P	25,1	18,4		
	Cannicella	9M	F	dx	P	27			
	Cannicella	9L	F	dx	P	26,6	18,3		
	Cannicella	9L	F	sn	P	32	21,3		
	Cannicella	4N	F	sn	P	27,1	18,5		
	Cannicella	9I	F	sn	P	25,3	17		
ulna						DPA	LO	SDO	BPC
	Fanum Voltumnae	1305	F	sn	P	36,52	50,39	-27,21	
	Cannicella	4C	F	dx	P	35	48,3	25	20,2
	Cannicella	6B	F	sn	P	39	58,3	28,5	
III metacarpo						GL	Bp	SD	Bd
	Cannicella	9I	F	sn	I	63,8	17,3	12,9	16,3
	Cannicella	4Q	F	sn	I		16,6	13	
	Cannicella	4M	F	sn	I	70,1	17	13,4	16,5
	Cannicella	2/33	F	sn	I	63,8	17,2	13,2	16,8
IV metacarpo						GL	Bp	SD	Bd
	Fanum Voltumnae	3128	F	sn	I	74,3			17
	Cannicella	5G	F	sn	I	65,8	15,5	11,7	16,4
	Cannicella	4Q	F	sn	I		15	12,1	
	Cannicella	8Q	F	sn	I		16	12,5	
V metacarpo						GL			
	Cannicella	8L	F	sn	I	52,3			
	Cannicella	6Q	F	dx	I	46,5			
coxale						LA			
	Cannicella	4IL	c.p.F	dx		28,5			
	Cannicella	7A	c.p.F	dx		29			
	Cannicella	10E	c.p.F	dx		30,5			
	Cannicella	8P	c.p.F	sn		28,9			
femore						Bp	DC		
	Cannicella	8M	F	dx	P	52,8	23,9		
	Cannicella	9L	F	dx	P		21,2		
	Cannicella	10Q	F	sn	P	53,8			
	Cannicella	8E	F	sn	P	48,1	20,8		

	Cannicella	4H	F	sn	P	51,3	23,7			
tibia						Bp	Bp	Bd	Dd	
	Fanum Voltumnae	1302	F	dx	D			26,45	-22,82	
	Cannicella	3Q	F	dx	P	44,5	44,5			
	Cannicella	4G	F	sn	P	45,4	45,4			
	Cannicella	5C	F	sn	D			28	26,4	
	Cannicella	1/33	F	dx	D			28,4	24,6	
	Cannicella	9E	F	dx	D			29,8		
	Cannicella	7L	F	dx	D			27,6	25	
	Fanum Voltumnae	647	F	dx	D			29	24,51	
	Fanum Voltumnae	647	F	dx	D			27,57	26,23	
	Fanum Voltumnae	647	F	sn	D			27,67	23,43	
astragalo						GLl	GLm	Dl	Dm	Bd
	Campo della Fiera	1305		sn	I	37,87	34,88	19,14	22,55	23
	Cannicella	6A		dx	I	38,7	35	20	23,9	23,1
	Cannicella	9F		dx	I	37,7	35	19	23	22
	Cannicella	7I		dx	I	37	32,3	18,4	21	23,2
	Cannicella	3M		sn	I	38	35	20,3	24	24
	Cannicella	8G		sn	I					23
II metatarso						GL				
	Cannicella	3L	F	dx	I	55,5				
III metatarso						SD	Bd			
	Cannicella	7M	F	dx	I	12	16,4			
	Cannicella	7M	F	dx	I	12	16			
	Cannicella	8G	F	sn	I	12	16,1			
IV metatarso						GL	Bp	SD	Bd	
	Cannicella	2/33	F	dx	I	80	14,7	13	16,7	
	Cannicella	4P	F	sn	I		14	12		
	Cannicella	8G	F	sn	I	77	13	11,5	16,1	
	Cannicella	5Q	F	sn	I			13,4	16	
V metatarso						GL				
	Fanum Voltumnae	1305			I	56,16				
I falange						GLpe	Bp	SD	Bd	
	Fanum Voltumnae	1314	F	sn	I	29,7	14,84	12,14	14,54	
	Cannicella	9E	F	dx	I	34,4	15,9	12,6	14,4	
	Cannicella	8M	F	dx	I	29,6	13	10,4	12,7	
	Cannicella	6F	F	dx	I	29,9	13,9	11,3	12,4	
	Cannicella	8I	F	sn	I	31,8	16	13,5	15,4	
	Cannicella	2/33	F	sn	I	34	16	12	14,5	
	Cannicella	6I	F	sn	I	31	16	13,1	14	
	Cannicella	5R	F	sn	I	30,8	16	12,4	13,8	
	Cannicella	9P	F	sn	I			12,8	14,2	
II falange						GL	Bp	SD	Bd	
	Cannicella	3A	F	dx	I	22	16	13	13	
	Cannicella	1/33	F	dx	I	22,1	16,3	13,5	12,9	
	Cannicella	4L	F	dx	I			13,2	14,8	
	Cannicella	10P	F	sn	I	19,7	14	11,5	12,6	
	Cannicella	5N	F	sn	I		15,5			
III falange						Ld	DLS	MBS		
	Cannicella			dx	I	26	25,8	11,1		
	Cannicella			dx	I	28,5	27,7	12,2		
	Cannicella			dx	I	24,8	23,7	10		
	Cannicella			dx	I	26,3	24	10		
	Cannicella			dx	I	24,5	23,2	11		
	Cannicella			dx	I	25,1	26	10,4		
	Cannicella			dx	I	26	23,6	10,7		
	Cannicella			dx	I	28	26	11		
	Cannicella			dx	I	24,2	23,6	10,7		
	Cannicella			sn	I	25,8	25,2	11		
	Cannicella			sn	I	26	25,5	10,7		
	Cannicella			sn	I	25	24,7	10,7		

MATERIALE SUPPLEMENTARE 9

Orvieto												
Ovis aries – Capra hircus	sito	sigla	età	lato	fr.							
corna o cavicchie	DAPbae											
Capra hircus ♀	Cannicella	6B-105		dx		31,3						
mascellare						m22	m23	L M3	B M3			
	Cannicella	6L		dx				19				
	Cannicella	4Q		dx		41,2		17,7	10,6			
	Cannicella	9M		sn			24,6					
mandibola						m7g	m8M	m9P	m10	m10	m15a	m15c
	Cannicella	7P	IV	dx		70,5	49	22	22,1	29,1		19
	Cannicella	6G	III	dx				22,7				18,3
	Cannicella	8M	IV	dx				22,4				15,9
	Cannicella	6M	IV	dx					23,8		35,3	
	Cannicella	4B	III	dx		74,5	49,7	23	20,7	8,7	35,4	17,6
	Cannicella	3M	IV	sn		71,1	49	21,1				19
	Cannicella	5L	III	sn		70,2	47,4	20,9	20,9	8,4	39,5	16,6
	Cannicella	6M	IV	sn					23,2	8,7	36	
	Cannicella	4I		sn				23,7				17,7
	Cannicella	8Q		sn				22,6				17,7
	Cannicella	7E	III	sn		71	47,9	22,3	21,2	8,3	39,1	
M3 superiore						L	B					
	Fanum Voltumnae	1314	VI/VII	dx	I	21,32	11,92					
	Fanum Voltumnae	3128		sn	I	18,6	11,1					
	Fanum Voltumnae	1332	I/II	sn	I	21,2						
	Cannicella	3M		dx	I	19,5	12					
	Cannicella	2/33		sn	I	19	11,1					
	Cannicella	7P		sn	I	19						
M3 inferiore						L	B					
	Cannicella	3Q	III	dx	I	22,6	8,6					
	Cannicella	4M	III	dx	I	22	8,5					
	Cannicella	8M	III	dx	I	22,9	8					
	Cannicella	2/33	IV	dx	I		9,1					
	Cannicella	9F	II	sn	I	24,1	8,7					
	Cannicella	3M	IV	sn	I	22,6	8,5					
Atlante						BFcr	BFcd	GLF	H			
Ovis aries	Cannicella	3E	F		I	55,5						
Capra hircus	Cannicella	6I	F		I	53,6	50,6		40,6			
Ovis aries	Cannicella	10G	F		I	52,2	49,1	52,9	37,2			
Epistrofeo						BFcr						
Ovis aries	Cannicella		F/NF		I	47						
scapola						SLC	GLP	LG	BG			
Ovis aries	Fanum Voltumnae	1332	F	dx		20,3			20,6			
Capra hircus	Cannicella	7H	F	sn		17	30,6	23,7	17,7			
Ovis aries	Cannicella	9M	F	dx			33,4	27	20,7			
omero						Bd	BT					
Ovis aries	Cannicella	8M	F	dx	D	30,6	30					
Ovis aries	Cannicella	7G	F	dx	D	27,9	25,7					
Ovis aries	Cannicella	9L	F	dx	D	33,5	30,5					
Ovis aries	Cannicella	6G	F	dx	D	34,2	31,3					
Ovis aries	Cannicella	7A	F	dx	D	28,8	27,7					
Ovis aries	Cannicella	4H	F	dx	D	28	26,7					
Ovis aries	Cannicella	7A	F	sn	D		29,3					
Ovis aries	Cannicella	5G	F	sn	D	27,4	26,9					
Ovis aries	Cannicella	9L	F	sn	D	28,3	25,7					
	Fanum Voltumnae	647	F	sn	P	28,67						
radio						GL	Bp	Dp	SD	Bd		
Capra hircus	Cannicella	5L	F	dx	P		31,7	16,3				
Capra hircus	Cannicella	8M	F	sn	I	181,5	32,2		20	31		
Capra hircus	Cannicella	6F	F	dx	P		36,2					

Capra hircus	Cannicella	4R	F	dx	P		31,6					
Capra hircus	Cannicella	9P	F	sn	P		31,3					
Capra hircus	Cannicella	4I	F	sn	P		35,9					
Capra hircus	Cannicella	4Q	F	sn	P		36,2					
Ovis aries	Cannicella	8L	F	dx	P		31,9	16				
Ovis aries	Cannicella	5	F	dx	P		28,4	15,1				
Ovis aries	Cannicella	7G	F	sn	P		33,1	17				
Ovis aries	Cannicella	7Q	F	sn	P		33,8	19,6				
Ovis aries	Cannicella	8M	F	sn	P		35,2	18,1				
Ovis aries	Cannicella	6G	F	sn	P		33	17,4				
Ovis aries	Cannicella	9F	F	sn	P		29					
Ovis aries	Cannicella	10Q	F	sn	D					30,8		
Ovis aries	Cannicella	7L	F	dx	D					31,3		
ulna						DPA	LO	SDO				
Ovis aries	Cannicella	8G	in F	sn	P		43,1	25,3				
Ovis aries	Cannicella	4N	in F	sn	P	31	46,6	25				
Trapezoidecapitato						GB						
Ovis aries	Cannicella	3G			I	15,6						
metacarpo						GL	Bp	Dp	SD	Bd	Dd	
Capra hircus	Cannicella	3G	F	dx	D					27,4		
Capra hircus	Cannicella	6L	F	sn	D					26,9	16,9	
Ovis aries	Cannicella	8R	F	sn	D					25	16,3	
Ovis aries	Cannicella	3H	F	sn	I	133,4	25	18,1	15	26,8	28,3	
Ovis aries	Cannicella	6B	F	dx	I	-132,8			14,2	28	18	
Ovis aries	Cannicella	7C	F	dx	I	-108			11,7	22,8	14,7	
Ovis aries	Cannicella	8F	F	dx	I	127,6	24,7	18,5				
coxale						LA						
	Cannicella	2/33	c.p.F	sn		26,3						
	Fanum Voltumnae	647	c.p.F	sn		28,4						
femore						Bd						
Capra hircus	Cannicella	4C	F	dx	D	38,5						
Ovis aries	Cannicella	2/33	F	sn	D	36						
patella						GL	GB					
Capra hircus	Cannicella	5Q			I		23,2					
Ovis aries	Cannicella	3G		dx	I	31,4						
tibia						Bp	Bd	Dd				
Capra hircus	Cannicella	6L	F	dx	D		29,9	21,7				
Capra hircus	Cannicella	6R	F	dx	D		30,5	22,3				
Capra hircus	Cannicella	9P	F	sn	D		28,4	21,5				
Ovis aries	Cannicella	10Q	F	sn	P	44,9						
Ovis aries	Cannicella	5Q	F	dx	D		27,9	22,5				
Ovis aries	Cannicella	1/33	F	dx	D		26,6	22				
Ovis aries	Cannicella	10Q	F	sn	D			22				
Ovis aries	Cannicella	7Q	F	sn	D		23,5	18				
Ovis aries	Fanum Voltumnae	647	F	sn	D		26,21	20,57				
Ovis aries	Fanum Voltumnae	647	F	sn	D		24,96	19,21				
calcaneo						GL	GB					
Capra hircus	Cannicella	4C	F	sn	I	69,3	22,2					
Ovis aries	Cannicella	7B	F	dx	I	64,1	21,2					
Ovis aries	Cannicella	6A	F	dx	I		21,9					
Ovis aries	Cannicella	10Q	F	sn	I	59,4	19,9					
Ovis aries	Cannicella	9L	F	sn	I	63	22					
astragalo						GLl	GLm	Dl	Dm	Bd		
Ovis aries ♀	Fanum Voltumnae	1332		dx	I	28	26,1	17,3	16,4	18,7		
Ovis aries ♀	Fanum Voltumnae	1332		sn	I	27	25,6	14,7	16	17,4		
Ovis aries	Cannicella	9I		dx	I	33	30,8	18,4	19,6	20,5		
Ovis aries	Cannicella	2/33		sn	I	31,7	30,3	17,5	18,9	20,4		
Ovis aries	Cannicella	7H		sn	I	27,9	27	15,7	16,5	18		
Ovis aries	Cannicella	4M		sn	I		27,8					
scafocuboide						GB						
Ovis aries	Cannicella	6L		dx	I	23,8						

Ovis aries	Cannicella	5G		sn	I	26,5						
metatarso						GL	Bp	Dp	SD	Bd	Dd	
Ovis aries	Cannicella	8M	F	dx	I	158	23,7	23,5	14,5	27,5	19,1	
Ovis aries	Cannicella	7C	F	dx	I	-116,6			10	21,4	14,9	
I falange						GLpe	Bp	SD	Bd			
Capra hircus	Fanum Voltumnae	3128	F	dx	I	39	12,8	10,2	13			
Capra hircus	Cannicella	6P	F	dx	I	38,8	12,3	10,1	11,8			
Capra hircus	Cannicella	4G	F	dx	I	41	13	11,2	13,3			
Capra hircus	Cannicella	10B	F	sn	I	43,3	15,6	13,3	15,6			
Capra hircus	Cannicella	9C	F	sn	I	46,1	15,8	13,6	15,7			
Ovis aries	Cannicella	8C	F	dx	I	30,6	11	8,8	11			
Ovis aries	Cannicella	6M	F	dx	I	35,5	13,4	10,6	12,4			
Ovis aries	Cannicella	8G	F	dx	I	38,5	12	9,3	11,7			
Ovis aries	Cannicella	2/34	F	dx	I	32,6	10,6	7,8	9			
Ovis aries	Cannicella	9P	F	dx	I	36,3	13,5	10,5	11,9			
Ovis aries	Cannicella	1/33	F	sn	I	39,4	13,8	10,6				
Ovis aries	Cannicella	7I	F	sn	I	40	12,4	9,4	11,9			
Ovis aries	Cannicella	8Q	F	sn	I	38,8	14,2	12	13,5			
Ovis aries	Fanum Voltumnae	647	F	dx	I	40,27	15,34	1,92	14,01			
II falange						GL	Bp	SD	Bd			
Ovis aries	Cannicella	8P	F	sn	I	22,1	12,2	9,4				
Ovis aries	Cannicella	7M	F	sn	I		13					
Ovis aries	Cannicella	8H	F	sn	I	22	12,2	9	10			
III falange						Ld	DLS	MBS				
Capra hircus	Cannicella	1/33		dx	I	27,1	35	6,7				
Ovis aries	Cannicella	9M		dx	I	24,4	30,4	5,6				
Ovis aries	Cannicella	3M		dx	I			6,1				
Ovis aries	Cannicella	9O		sn	I			6,4				

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Gli animali tra vita quotidiana e attività cultuali nel complesso santuariale preistorico di Grotta dei Cervi, Porto Badisco (Otranto – LE, Italy)

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RIASSUNTO: Gli scavi condotti a partire dagli anni ’70 del secolo scorso nella Grotta dei Cervi di Porto Badisco (Otranto-LE) misero in luce un complesso labirinto di corridoi, alcuni dei quali caratterizzati da un ingente quantitativo di pitture che fanno della grotta uno dei più importanti siti di arte rupestre nel Mediterraneo. La grotta venne frequentata fin dal Paleolitico superiore (da 31.000 a.C.), ma soprattutto fu sede di cerimonie collettive, senza soluzione di continuità, da una fase avanzata del Neolitico antico (metà VI millennio a.C.) fino all’età del Bronzo finale (XI-X secolo a.C.), cui si aggiungono parziali frequentazioni in età storica (messapica e romana). Il Neolitico medio e finale e l’Eneolitico sembrerebbero coincidere con i periodi di massima frequentazione della grotta e della produzione artistica. Soltanto di recente è stato affrontato lo studio sistematico di tutti i materiali recuperati da Lo Porto negli anni 1970 e 1971; questo ha anche consentito la rilettura delle stratigrafie messe in luce cinquant’anni fa e una elaborazione delle analisi archeozoologiche. Purtroppo il metodo di scavo per tagli di 20 cm utilizzato negli anni ‘70 ha causato la commistione di materiale e solo i resti animali recuperati nella cavità E hanno una discreta affidabilità cronologica, con l’associazione dei materiali ceramici dai livelli più alti all’ Eneolitico e quelli dai livelli più bassi al Neolitico. Il rinvenimento in tutti i livelli di resti di equidi documenta tuttavia come lo scavo abbia almeno in alcune parti anche intaccato le stratigrafie inferiori più antiche. I risultati, pur da considerare con estrema prudenza, delineano comunque strategie di sfruttamento delle specie domestiche in linea con il quadro economico generale fino ad oggi delineato in contesti coevi dell’Italia meridionale.

PAROLE-CHIAVE: GROTTA DEI CERVI, NEOLITICO, ENEOLITICO, RESTI ANIMALI, ATTIVITÀ DOMESTICHE, RITUALI

ABSTRACT: The archaeological excavations carried out since the 1970s on Grotta dei Cervi at Porto Badisco (Otranto-LE, Italy) brought to light a complex labyrinth of corridors, some of which featured a rich collection of rock paintings that turned the cave into one of the most important art monuments of the Mediterranean. Frequented since the Upper Palaeolithic (from 31,000 ca BC), the cave became a locus of collective rituals, that run, uninterrupted, from a late phase of the early Neolithic (mid-6th millennium BC) to the final Bronze Age (11th-10th century BC), along with partial frequentations during historical times (Messapian and Roman periods). The middle and final Neolithic and the Chalcolithic appear to be the peak periods of use and artistic production. Only recently has the systematic study of the Lo Porto materials recovered in the 1970s and 1971s been made. This allowed for a revision of the one-half-century old stratigraphy, and the study of the zooarchaeological data. Unfortunately, the old method of excavation fostered a mixing of materials so that only the remains from cavity E seem partly reliable in terms of chronology, being associated with Chalcolithic pottery in the upper levels and Neolithic pottery in the lower ones (the retrieval of equid remains in all levels of cavity E indicates that, in some parts at least, the lowermost (more ancient) levels incorporate materials from more recent times).

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Despite the need for extreme caution, the faunal data reflect that the exploitation of domesticates at Grotta dei Cervi appear to conform with the general economic frame of strategies postulated for contemporary contexts in southern Italy.

KEYWORDS: GROTTA DEI CERVI, NEOLITHIC, CHALCOLITHIC, ANIMAL REMAINS, DOMESTIC ACTIVITIES, RITES

RESUMEN: Las excavaciones arqueológicas realizadas desde los años 70 en la Grotta dei Cervi, en Porto Badisco (Otranto-LE, Italia) revelaron un complejo laberinto de galerías, algunas de las cuales presentaban ricos repertorios de pinturas rupestres que convirtieron a la cueva en una de los más importantes monumentos artísticos en el Mediterráneo. Frecuentada desde el Paleolítico Superior (desde 31.000 ca. a.C.), la cueva se convirtió en un lugar de rituales colectivos, que discurren, de forma ininterrumpida, desde una fase tardía del Neolítico temprano (mediados del VI milenio a.C.) hasta la Edad del Bronce final (siglos XI-X a.C.), junto con visitas puntuales durante épocas históricas (períodos Mesapio y Romano). Los Neolíticos medio y final y el Calcolítico parecen ser los períodos de mayor uso y producción artística. Sólo recientemente se ha realizado el estudio sistemático de los materiales de Lo Porto recuperados en los años 1970 y 1971. Ello permitió una revisión de aquella estratigrafía y el estudio zooarqueológico. Desgraciadamente, el método de excavación originalmente empleado favoreció la mezcla de materiales, de tal suerte que sólo los restos de la cavidad E parecen medianamente fiables en términos cronológicos, por estar asociados los niveles superiores con cerámicas eneolíticas y los inferiores con cerámicas neolíticas (de todos modos, la recuperación de équidos en todos los niveles de la cavidad E indica que, en al menos algunas partes, los niveles inferiores (más antiguos) incorporan materiales de épocas más recientes). A pesar de la extrema precaución que la interpretación requiere en estos casos, los datos de fauna reflejan que la explotación pecuaria en Grotta dei Cervi parece ajustarse al marco económico general de las estrategias evidenciadas en contextos contemporáneos del sur de Italia.

PALABRAS CLAVE: GROTTA DEI CERVI, NEOLÍTICO, CALCOLÍTICO, RESTOS ANIMALES, ACTIVIDADES DOMÉSTICAS, RITOS

INTRODUZIONE

La Grotta dei Cervi situata nei pressi di Porto Badisco, a 6 km a sud di Otranto (LE), fu scoperta nel 1970 e fu interessata da diverse campagne di scavo a partire dallo stesso anno e successivamente nel 1971, nel 1975 (Orofino, 1970; Lo Porto, 1971, 1972, 1976, 1980) e poi riprese negli anni ’80 e ’90 del secolo scorso (Graziosi *et al*., 1981; Cremonesi, 1984; Guerri, 1984, 1985-86, 1992, 1997; Revedin, 1985-86), fino ad un ultimo piccolo intervento del 2005, anche volto alla ricostruzione in 3D della planimetria complessiva (Gorgoglione & De Marinis, 2004). I risultati di tutte queste campagne di scavo, a partire da quelle iniziali di Felice Gino Lo Porto, sono confluiti in brevi notizie e in parziali e preliminari pubblicazioni, lasciando sostanzialmente inedito e sconosciuto questo importante patrimonio culturale. Solo in tempi recenti è stato affrontato in maniera globale lo studio del materiale ceramico e dell’industria in osso recuperati da Lo Porto negli scavi del 1970 e ’71, rispettivamente da Tiberi (2019) e da Potenza (2019). Soprattutto il lavoro di Tiberi è confluito in una rilettura completa di tutta la documentazione di scavo ancora disponibile e delle sigle riportate sui cartellini che ancora accompagnavano il materiale; ciò ha permesso la comprensione del deposito stratigrafico e della metodologia di scavo usata da Lo Porto.

La grotta, di origine carsica, è caratterizzata da una planimetria molto articolata, che si sviluppa in quattro corridoi principali accessibili tramite cinque ingressi, indicati con le lettere A-E. Essi immettono in altrettante cavità, collegate tramite cunicoli tortuosi a corridoi articolati che si diramano per circa 200 metri con percorsi a tratti difficoltosi, perché stretti ed angusti. Essi scendono fino alla profondità di circa 20 metri con punte massime di 26-28 metri e un’altezza variabile fino a 5 metri. Il deposito archeologico presenta una sequenza stratigrafica, che documenta la sua utilizzazione a partire dal Paleolitico superiore fino all’età del Bronzo. Il periodo di massimo uso fu nel Neolitico e nell’Eneolitico, con una successiva e sporadica frequentazione in età storica.

La grotta fu utilizzata come luogo cultuale e dei riti rimangono tracce nei focolari, nei manufatti in selce e ornamenti in pietra e materia dura animale, in ossidiana liparota e pietra verde di provenienza alpina, nella ceramica e in alcuni manufatti particolari, forse d'uso cerimoniale, come i vasi antropomorfi, le pintadere, i *rhyta* e le figurine di oranti (Tiberi, 2019) e i numerosi strumenti in osso (Potenza, 2019).

L'estesa frequentazione da parte di diverse comunità è documentata dalla ceramica che trova confronti puntuali in altre facies peninsulari ed extra peninsulari, ad esempio l'Adriatico orientale, i Balcani, la Grecia, oltre che l'Italia centrale. Testimonianza di scambi e contatti è anche la presenza di materie prime esogene, come il bitume, proveniente dall'Albania, il cinabro proveniente dall'hinterland montuoso dell'Adriatico orientale o forse dai giacimenti dell'Italia centrale (Tiberi, 2019).

La sua fama proviene soprattutto dalla presenza di un articolato apparato pittorico che adorna gran parte della grotta e che fa di essa uno dei monumenti di arte parietale post-paleolitica più importanti del Mediterraneo (Graziosi, 1980). Alcune affinità con la ceramica Masseria La Quercia, tricromica e Serra d'Alto, suggeriscono una datazione per almeno alcune delle pitture tra la metà del VI e il V millennio a.C. (Tiberi, 2019).

Dagli studi di Tiberi (2019) è emersa una visione complessiva del sito e della storia delle ricerche che di fatto hanno interessato solo una parte dell'intero complesso. In particolare gli scavi condotti da Lo Porto nel 1970-71 hanno interessato le cavità A, D ed E e alcuni cunicoli di collegamento tra esse. Il metodo di scavo seguito da Lo Porto è consistito nell'asportazione grossomodo giornaliera di livelli di terreno di 20 cm a partire dalla volta delle cavità A, D ed E e nell'asportazione di un livello spesso 20 cm nel cunicolo di collegamento tra le cavità D ed E (Tiberi, 2019: 40-44). Il materiale ceramico e faunistico deve essere stato quindi raccolto a vista. L'interesse era soprattutto nel ricavare un passaggio per raggiungere i corridoi delle pitture.

Lo studio del materiale degli scavi 1970 e '71 documenta un'asportazione del sedimento con commistione di ceramica di età neolitica, eneolitica e dell'età del Bronzo in alcuni livelli e in percentuali diverse a seconda della quota di profondità. In occasione dello scavo di una ulteriore cavità di accesso, denominata B e posta a pochi metri di distanza dalle cavità D ed E, svolta nel 1975, si tentò anche di definire una sequenza stratigrafica e temporale del deposito (Lo Porto, 1980: XII-XIII).

MATERIALI E METODI

Sono stati analizzati i resti animali provenienti dagli scavi del 1970-71, del 1975 e del 2005, ma ad oggi abbiamo la possibilità di datare, in base all'associazione con la ceramica, solo i resti del 1970 e '71. Questo lavoro quindi viene dedicato alla presentazione e discussione dei resti animali provenienti dagli scavi del 1970 e '71.

Il campione è formato nel suo complesso da 908 resti determinati come taxon ed elemento anatomico, cui si aggiungono 78 frammenti di vertebre, 193 di coste non identificate a livello di specie e 1007 resti non identificabili (Tabella 1).

Anno	determinati	non determinati	vertebre	coste	Totale
1970-71	908	1007	78	193	2186
1975	931	1182	114	285	2512
2005	116	124	21	55	315

TABELLA 1

Grotta dei Cervi: elenco dei resti animali recuperati per campagna di scavo.

I resti animali sono stati determinati presso il Laboratorio di Archeozoologia dell'Università del Salento mediante confronto diretto con la collezione di confronto e l'uso dell'atlante di Schmid (1972). La nomenclatura scientifica delle specie segue Gentry *et al*. (2004). La distinzione tra pecora e capra segue i lavori di Boessneck *et al*. (1964), Kratochvil (1969), Payne (1985), Halstead *et al*. (2002). La determinazione dell'età segue le metodologie di Silver (1969) per i bovini, di Bullock & Rackham (1982) e Payne (1973) per gli ovicaprini e di Bull & Payne (1982) per i suini.

Alcuni resti di equidi provenienti dell'area di scavo del 1975 sono stati sottoposti ad analisi radiometriche da parte del CEDAD dell'Università del Salento (Aprile *et al*., 2017). I risultati hanno indicato l'appartenenza di questi a un periodo collocabile tra 31.000 BC e 8.000 BC circa in datazione calibrata. La datazione più recente di 8.224-7.756 BC, compatibile con un'altra proveniente dalla Grotta delle Mura a Bisceglie (Bon & Boscato, 1993), conferma la sopravvivenza di popolazioni di equini selvatici nell'Italia meridionale almeno fino alla fine del Boreale. Tuttavia si deve sottolineare che questo reperto in particolare proviene dalla terra rimossa insieme ai blocchi di crollo della volta che ostruivano l'accesso alla grotta. Invece, quello con datazione più antica (31.863-30.662 BC), proviene dal cosiddetto strato 5 definito come strato di base sabbioso, sterile di industrie (Lo Porto, 1976) che poggiava direttamente sul pavimento roccioso della grotta e che nel diario di scavo viene descritto come "*il più antico livello di frequentazione da parte dell'Uomo*". Tutte le altre datazioni intermedie (collocabili tra 29.498 e 11.131 BC) sono perfettamente compatibili con la frequentazione della grotta nel Paleolitico superiore (Aprile *et al.*, 2017).

RISULTATI

I resti animali recuperati negli scavi del 1970 e'71 provengono dalle cavità A, D, E e dai cunicoli di collegamento D-E e Cunicolo N (Figura 1).

Il campione proveniente dallo scavo della cavità A e recuperato nel 1970 è formato da 185 resti identificati a livello specifico (Tabellas 2-3). Dallo studio della ceramica associata risulta una frequentazione a partire dalle fasi avanzate del Neolitico antico fino al Bronzo finale e la commistione tra ceramiche di periodo diverso lungo tutto il deposito. Tuttavia emerge che negli strati più alti prevale la ceramica dell'età del Bronzo, mentre tra 3 e 3,60 m di profondità dalla volta si registra una prevalenza di ceramica eneolitica e tra 3,60 e 3,80 m una dominanza di ceramica neolitica. I livelli posti a quota inferiore a questi presentano di nuovo un rimescolamento delle ceramiche appartenenti al Neolitico e all'Eneolitico (Tiberi, 2019: 183-184).

Dal cunicolo Nord, direttamente collegato alla cavità A, provengono 20 resti animali (Tabella 4) recuperati dal terreno basale e mescolati a fram-

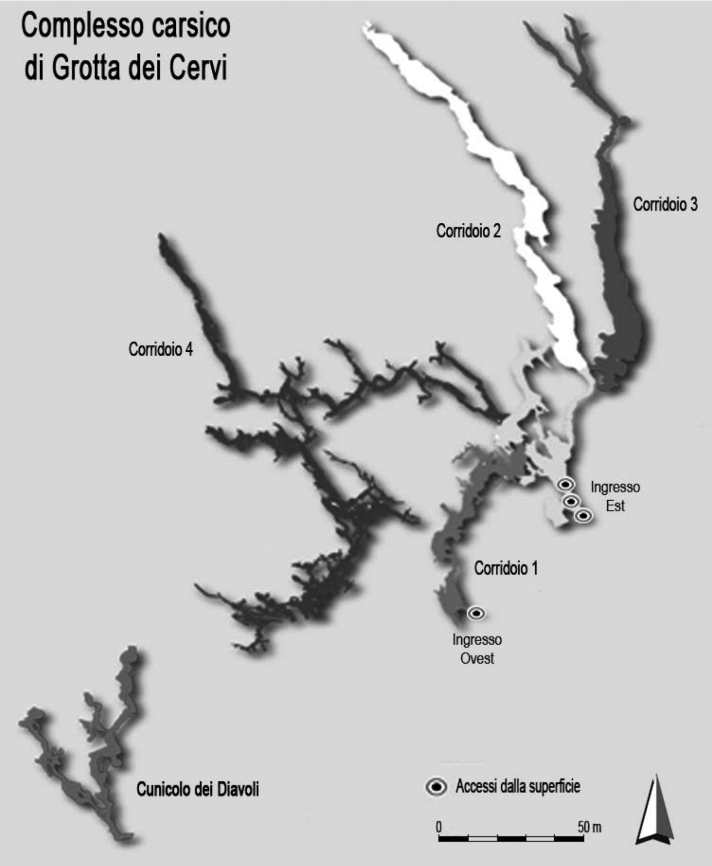

FIGURA 1
Planimetria della Grotta dei Cervi. Ingresso Est: cavità C, D, E. Ingresso Ovest: A (da Potenza, 2019, figura 9).

quota	superficie	2,80 / 3,00	3,00 / 3,20	3,00 / 3,40	3,40 / 3,60	3,60 / 3,80
Equus sp.				8		
Bos taurus L.		1	1	1		3
Ovis/*Capra*		7	3	9	3	11
Ovis aries L.				4		8
Capra hircus L.				1		
Sus domesticus Erx.	1	1		9		
Canis familiaris L.						1
Cervus elaphus L.				2		
Capreolus capreolus L.	1					
Sus scrofa L.			1			7
Canis lupus L.						5
Vulpes vulpes L.		3				2
Lepus sp.		1	1			
Testudo hermanni Gml.	3	2	1	4	1	
Aves ind.		1				
Pisces ind.			1			2
Mollusca ind.			2	2	1	1
Totale determinati	**5**	**16**	**10**	**40**	**5**	**40**

TABELLA 2

Grotta dei Cervi, cavità A, scavo da superficie a quota 3,80 m: elenco dei resti animali suddivisi per quota.

quota	3,80 / 4,00	4,00 / 4,20	4,20 / 4,40	4,40 / 4,60	4,60 / 4,80	4,80 / 5,00	5,00 / 5,20
Equus sp.	8	6	1	2	3	2	1
Bos taurus L.	3			3	2	3	
Ovis/*Capra*	7	3	1		2	3	
Sus domesticus Erx.	4						
Canis familiaris L.	1				2		
Bos primigenius L.	1	1	1				1
Cervus elaphus L.	1						
Capreolus capreolus L.					1		
Sus scrofa L.	1						
Squaliformes sp.	1			1			
Mollusca ind.			1		1		1
Totale determinati	**27**	**10**	**4**	**6**	**11**	**8**	**3**

TABELLA 3

Grotta dei Cervi, cavità A, da 3,80 a 5,20 m: elenco dei resti animali suddivisi per quota.

menti ceramici sia neolitici che eneolitici (Tiberi, 2019: 184).

Dal deposito della cavità D scavato nel 1970 provengono 18 resti animali identificati tassonomicamente (Tabella 4) e che sono stati recuperati dai livelli a quota tra 1,40 e 3 m di profondità. Questi erano prevalentemente associati a ceramica all'età del Bronzo e all'Eneolitico, sebbene non mancasse la presenza di alcuni frammenti ceramici neolitici (Tiberi, 2019: 184-185).

Sempre nel 1970 venne indagato lo strato superficiale del deposito che riempiva il cunicolo che collega le cavità D ed E. Da questo livello provengono 47 resti animali identificati a livello specifico (Tabella 4), associati a ceramica prevalentemente datata all'età del Bronzo e all'Eneolitico (Tiberi, 2019: 185).

Numericamente più ampio (637 resti determinati a livello specifico) e meno inquinato è il campione faunistico recuperato nel 1970 e nel '71 nella cavità E (Tabella 5). Lo studio della ceramica documenta una frequentazione della cavità esclusivamente nel Neolitico e nell'Eneolitico. Infatti, sebbene sia sempre attestata una piccolissima

	cav. D	**cav. D**	**cun. D-E**	**cun. N**
quota	1,40 / 2,00	2,00 / 3,00	livello superficiale	4,60 / 5,20
Equus sp.	3	1	9	12
Bos taurus L.	3	1	6	2
Ovis/*Capra*	2	1	3	1
Ovis aries L.	1			1
Sus domesticus Erx.		2	4	
Canis familiaris L.	1			
Bos primigenius L.			2	2
Cervus elaphus L.				2
Sus scrofa L.			2	
Canis lupus L.			1	
Vulpes vulpes L.			4	
Erinaceus europaeus L.			1	
Testudo hermanni Gml.	1			
Squaliformes sp.		1	2	
Mollusca ind.		1	13	
Totale determinati	**11**	**7**	**47**	**20**

TABELLA 4

Grotta dei Cervi: elenco dei resti animali dalle cavità D, cunicolo di collegamento tra D ed E e cunicolo N, suddivisi per specie.

	livelli alti	livelli alti	livelli alti	livelli medi	livelli medi	livelli bassi
quota	**0,60 / 2,80**	**2,80 / 3,00**	**3,10 / 4,10**	**4,50 / 6,50**	**6,50 / 8,50**	**8,50 / -**
Equus sp.	13	3			21	14
Bos taurus L.	7		3	1	56	28
Ovis/*Capra*	8		1		137	69
Ovis aries L.			4	1	46	19
Capra hircus L.				1	5	
Sus domesticus Erx.	5		6		70	10
Canis familiaris L.	3		2		5	
Bos primigenius L.					2	
Cervus elaphus L.	4			3	17	5
Capreolus capreolus L.	1				10	2
Sus scrofa L.				1	7	
Lutra lutra L.						1
Canis lupus L.						1
Vulpes vulpes L.	5				7	2
Felis silvestris L.					1	
Lepus sp.					1	
Cetacea ind.					1	
Testudo hermanni Gml.					1	
Aves ind.					2	
Pisces ind.	1				2	1
Squaliformes sp.			1			1
Malacostraca ind.			1			
Mollusca ind.	7		5	2	2	1
Totale determinati	**54**	**3**	**23**	**9**	**393**	**155**

TABELLA 5

Grotta dei Cervi, cavità E: elenco dei resti animali suddivisi per quota.

percentuale di commistione di ceramica neolitica ed eneolitica, la ceramica eneolitica è largamente prevalente nei livelli alti, fino a quota 3 m, mentre nei livelli sottostanti e fino a quota 4,10 m la ceramica neolitica inizia ad essere predominante e ad aumentare progressivamente con la profondità. Inoltre, dallo scavo tra quota 4,10 e 9 m che venne effettuato nel 1971, è documentata la presenza di ceramica neolitica al 70% fino a quota 6,50 m e al 99% nei livelli sottostanti (Tiberi, 2019: 185-188; Figura 2).

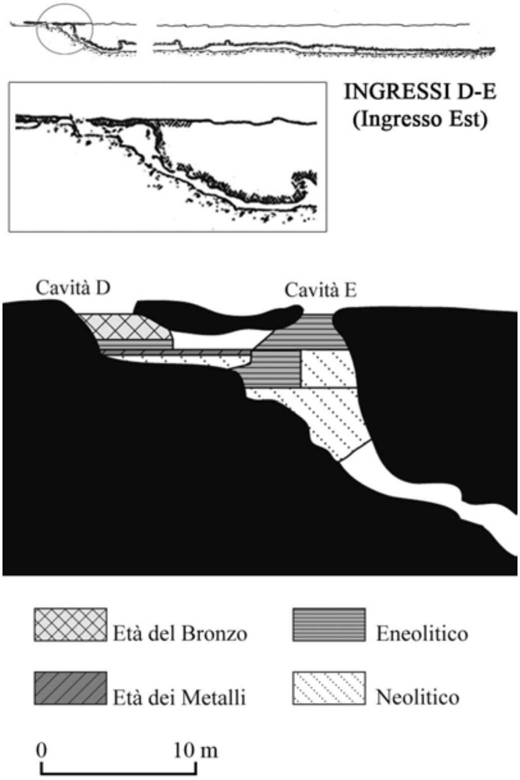

FIGURA 2

Grotta dei Cervi: sezioni delle cavità D-E con indicati i diversi periodi di frequentazione (da Potenza 2019, figura 18).

Il campione relativo ai livelli prevalentemente eneolitici della cavità E risulta quindi numericamente esiguo e composto soprattutto dai resti dei principali animali domestici, di alcuni selvatici e da resti di equidi. Da segnalare inoltre una vertebra di cetaceo (Figura 3).

FIGURA 3

Grotta dei Cervi, cavità E: vertebra di cetaceo.

Maggiormente cospicuo il campione dai livelli neolitici della cavità E che permette di effettuare alcune considerazioni sulle modalità di sfruttamento degli animali.

I resti attribuibili ai principali animali domestici - bovini, ovicaprini e suini - sono dominanti, e tra questi gli ovicaprini rappresentano la categoria maggiormente rappresentata. Tra i selvatici è attestata un'ampia varietà di specie, tra le quali prevalgono cervo, capriolo, cinghiale e uro, questi ultimi identificati per le grandi dimensioni di alcuni reperti. Da sottolineare ancora la presenza di numerosi resti di equidi. Pochi sono invece i resti riferibili ad altre classi, come uccelli, pesci e rettili, anche a causa del mancato uso di adeguata setacciatura per il recupero dei resti più piccoli. Tra i resti di pesci sono documentati diversi denti di squaliformi fossili.

I dati sulla mortalità degli ovicaprini ricavabili dallo stadio di dentizione e relativa usura (Tabella 6; Figura 2) indicano come questi fossero uccisi e consumati prevalentemente tra il primo e il quarto anno (categorie D/E/F) e in misura leggermente minore tra i 6 e i 12 mesi (categoria C). I dati relativi allo stato di fusione delle epifisi delle ossa (Tabella 7; Figura 4) suggeriscono invece una mortalità più alta dopo i 48 mesi (52%) e prima del primo anno di vita (14%).

	N	%
A (0-2 m)	0	0,0
B (2-6 m)	0,5	2,6
C (6-12 m)	5,5	28,9
D (1-2 a)	4,25	22,4
E (2-3 a)	2,25	11,8
F (3-4 a)	4,25	22,4
G (4-6 a)	2,25	11,8
H (6-8 a)	0	0,0
I (8-10 a)	0	0,0
Totale	**19**	

TABELLA 6

Grotta dei Cervi, cavità E: mortalità degli ovicaprini in base allo stadio di dentizione e relativa usura dei resti recuperati nei livelli a prevalenza neolitici (m: mesi; a: anno). Ogni dente isolato o serie di denti è stato inserito in uno stadio di usura (A-I) in base al metodo di Payne (1973) cui corrisponde una determinata età. Quei denti che sono riferibili a più stadi sono ripartiti proporzionalmente.

	età	NF	F
omero dist.	-12 m	5	30
radio pross.	-12 m	4	25
coxale	-12 m	1	8
scapola	12 m	3	9
I falange	14-35 m	1	3
tibia dist.	35 m	11	14
femore pross.	35 m	5	4
femore dist.	48 m	3	3
metacarpo dist.	48 m	4	3
metatarso dist.	48 m	5	5
metapodio dist.	48 m	2	0
tibia pross.	48 m	6	4
omero pross.	48-60 m	8	6
radio dist.	48-60 m	5	11
ulna pross.	48-60 m	0	3
calcagno	48-60 m	1	4

TABELLA 7

Grotta dei Cervi, cavità E: mortalità degli ovicaprini in base allo stadio di fusione delle epifisi articolari delle ossa dei resti recuperati nei livelli a prevalenza neolitici (pross.: prossimale; dist.: distale, m: mesi; NF: non fuso; F: fuso).

Tra i suini invece si documenta un largo impiego di animali molto giovani uccisi prima del raggiungimento di un anno di vita (Tabella 8), mentre i bovini, al pari degli ovicaprini, sono rappresentati in buone percentuali sia da animali adulti che giovani e giovani/adulti (Tabella 9).

Anche la rappresentazione degli elementi anatomici delle tre categorie di domestici mette in evidenza alcuni fattori tafonomici legati alle modalità di recupero utilizzate negli anni ’70 del secolo scorso; infatti soprattutto per gli ovicaprini e suini le ossa piccole delle estremità degli arti sono poco rappresentate. Sono inoltre state riconosciute diverse tracce di macellazione e combustione.

	età	NF	F
scapola	7-11 m	4	0
coxale	7-11 m	2	0
radio pross.	+11 m	4	2
omero dist.	+11 m	7	0
tibia dist.	19-23 m	3	1
metacarpo dist.	+23 m	5	0
metatarso dist.	+23 m	2	1
femore pross.	31-35 m	2	0
omero pross.	+35 m	4	0
ulna pross.	+35 m	1	1
femore dist.	+ 35 m	7	0
calcagno	+35 m	2	0

TABELLA 8

Grotta dei Cervi, cavità E: mortalità dei suini in base allo stadio di fusione delle epifisi articolari delle ossa dei resti recuperati nei livelli a prevalenza neolitici (pross.: prossimale; dist.: distale, m: mesi; NF: non fuso; F: fuso).

	età	NF	F
coxale	7-10 m	1	4
omero dist.	12-18 m	1	3
radio pross.	12-18 m	0	1
I falange	18 m	0	3
metacarpo dist.	24-30 m	0	3
tibia dist.	24-30 m	2	1
metapodio dist.	24-36 m	1	1
metatarso dist.	30-36 m	0	3
calcagno	36 me	0	2
femore pross.	42 m	3	0
omero pross.	42-48 m	2	1
radio dist.	42-48 m	0	1
ulna pross.	42-48 m	0	1
femore dist.	42-48 m	0	1
tibia pross.	42-48 m	1	0

TABELLA 9

Grotta dei Cervi, cavità E: mortalità dei bovini in base allo stadio di fusione delle epifisi articolari delle ossa dei resti recuperati nei livelli a prevalenza neolitici (pross.: prossimale; dist.: distale, m: mesi; NF: non fuso; F: fuso).

La composizione faunistica del campione neolitico della cavità E è perfettamente compatibile con quelle documentate in altri siti coevi dell’Italia meridionale, dove gli ovicaprini sono dominanti tra le categorie dei domestici fin dalle fasi più antiche del Neolitico e mostrano un costante incremento nelle fasi successive (Vigne, 2003; Tagliacozzo, 2005; Tagliacozzo & Pino Uría, 2009; Minniti *et al*., 2024). Le curve di abbattimento ottenute dai

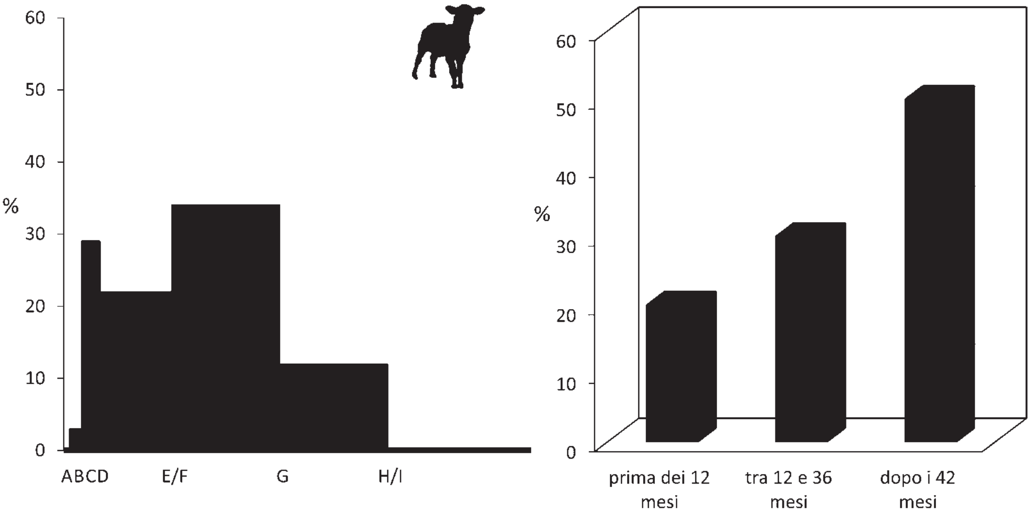

FIGURA 4

Grotta dei Cervi, cavità E, livelli Neolitici: mortalità degli ovicaprini in base alla dentizione (a sinistra; in accordo a Helmer & Vigne, 2004; dati in tabelle 6) e allo stadio di fusione delle ossa lunghe (a destra; in accordo a Bull & Rackham, 1982; dati in tabelle 7).

resti degli ovicaprini di diversi siti neolitici suggeriscono prevalentemente lo sfruttamento per la carne sebbene sia documentata anche una piccola percentuale di alcuni animali sfruttati per il latte e di altri per la riproduzione (Vigne & Helmer, 2007). I mammiferi selvatici sono documentati in diversi siti e mostrano una certa varietà di specie, ma la loro percentuale rimane sempre marginale nell'economia di sostentamento delle comunità pertinenti. In alcuni siti si segnala anche una maggiore presenza di resti di pesce e di molluschi marini, indicatori di uno sfruttamento diversificato di tutte le risorse naturali, favorito dall'ubicazione dei siti.

CONCLUSIONI

La grotta dei Cervi fu utilizzata per attività di carattere cerimoniale prevalentemente nel Neolitico e nell'Eneolitico e il consumo di carne dovette svolgere un ruolo importante nell'ambito di queste attività, data l'abbondanza dei resti faunistici, nella maggior parte interpretabili come resti di pasto.

Tuttavia la natura del contesto come grotta e il metodo di scavo utilizzato da Lo Porto, consistito nell'asportazione giornaliera di livelli di spessore prestabilito (20 cm) e senza tener conto dell'articolazione stratigrafica del deposito, finalizzato soltanto a liberare le cavità di accesso alla grotta per raggiungere in modo più agevole i corridoi delle pitture (sono stati lasciati testimoni di deposito lungo tutto il percorso), ha causato la perdita di numerose informazioni e la commistione di materiale. Solo per la cavità E lo studio del materiale ceramico ha documentato una buona corrispondenza tra i livelli di quota e diversi orizzonti culturali, cogliendo differenze tra i livelli più alti che hanno restituito materiale eneolitico e i livelli più bassi che hanno restituito materiale neolitico. Se il campione faunistico dei livelli eneolitici risulta piuttosto esiguo, maggiormente consistente rimane il campione neolitico che mostra dati perfettamente compatibili con il quadro economico generale fino ad oggi delineato in altri siti coevi dell'Italia meridionale, in cui gli ovicaprini sono dominanti su suini e bovini, mentre le specie selvatiche seppur presenti avevano un ruolo marginale. I risultati vanno tuttavia considerati con prudenza. Infatti la presenza di resti di equidi in quasi tutti i livelli appartenenti ai diversi orizzonti cronologici, compresi quelli identificati nella cavità E, documenta come gli scavi condotti da Lo Porto in ogni parte della grotta possano aver intaccato i depositi pleistocenici inferiori, se consideriamo l'ipotesi di una datazione antica per tutti i resti di equidi identificati, come nel caso di quelli rinvenuti negli scavi del 1975 e sottoposti a datazione radiometrica. La presenza di equidi di datazione molto antica in livelli con materiali neolitici ed eneolitici potrebbe quindi implicare che anche parte della fauna selvatica possa non essere pertinente alle frequentazioni neolitica ed eneolitica, mentre possiamo essere certi dell'attribuzione cronologica per i resti delle specie domestiche, ma non possiamo sempre essere certi della loro attribuzione ai diversi orizzonti culturali compresi tra Neolitico ed età del Bronzo.

Non si esclude l'ipotesi che la presenza di resti di equidi di età pleistocenica associata a materiale neolitico ed eneolitico possa essere anche il risultato di un prelievo operato in antico di fossili già presenti nella grotta per essere usati nei riti stessi che le comunità neolitiche ed eneolitiche svolgevano, ma la validità di questa ipotesi, sebbene molto suggestiva, allo stato attuale della documentazione, non può essere verificata.

Infine, da segnalare la presenza di diversi denti di squaliformi che per lo stato di conservazione possono essere interpretati anch'essi come fossili che dovevano essere già presenti nella grotta all'epoca delle frequentazioni neolitica ed eneolitica.

BIBLIOGRAFIA

Aprile, G.; Calcagnile, L.; De Grossi Mazzorin, J.; Minniti, C.; Montefinese, R.; Quarta, G. & Tiberi, I. 2017: Concerning the extinction of the wild horse in Italy and the newly introduction as domesticate: recent evidence from Grotta dei Cervi - Porto Badisco (Otranto, south Italy). In: *Proceedings of Imeko International Conference on Metrology for Archaeology and Cultural Heritage, (October 23-25)*: 12-15. Lecce.

Bon, M. & Boscato, P. 1993: Analisi paleontologica e paleoecologica di macro e micromammiferi dei livelli romanelliani e mesolitici della grotta delle Mura (Monopoli, Bari). *Quaternaria Nova* 3: 53-104.

Boessneck, J.; MÜller, H.-H. & Teichert, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* L.) und Ziege (*Capra hircus* L.). *Kühn Archiv* 78: 1-129.

Bull, G. & Payne, S. 1982: Tooth eruption and epiphysial fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (International Series) 109. Oxford.

Bullock, D. & Rackham, J. 1982: Epiphysial fusion and tooth eruption of feral goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (International Series) 109. Oxford.

Cremonesi, G. 1984: Porto Badisco (Otranto, Prov. di Lecce). *RSP XXXIX, Notiziario* 1-2: 387.

Gentry, A.; Clutton-Brock, J. & Groves, C.P. 2004: The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Science* 31: 645-651.

Gorgoglione, M.a. & De Marinis, R. 2004: La Grotta dei Cervi a Porto Badisco. In: Bernabò Brea, M. & Revedin, A. (eds.): *Antichi Segni dell'Uomo. Guida alla Mostra*. Istituto Italiano di Preistoria e Protostoria, Firenze.

Graziosi, P. 1980: *Le pitture preistoriche della Grotta dei cervi di Porto Badisco*. Giunti Martello, Firenze.

Graziosi, P.; Cremonesi, G.; Guerri M. & VigliardI, A. 1981: Porto Badisco (Otranto, Prov. di Lecce). *RSP XXXVI, Notiziario* 1-2: 315-316.

Guerri, M. 1984: Porto Badisco (Otranto, Prov. di Lecce). *RSP XXXIX, Notiziario* 1-2: 349-351.

— 1985-86: Porto Badisco (Otranto, Prov. di Lecce). *RSP XL, Notiziario* 1-2: 385-386.

— 1992: *Scoperte di arte visiva paleolitica nella grotta di Porto Badisco (Lecce). Scavi e ricerche 1981-1989*. Istituto Italiano di Preistoria e Protostoria, Firenze.

— 1997: Porto Badisco (Otranto, Prov. di Lecce). *RSP XLVIII, Notiziario*: 443-444.

Halstead, P.; Collins, P. & Isaakidou, V. 2002: Sorting the sheep from the goats: morphological distinctions between the mandibles and mandibular teeth of adult *Ovis* and *Capra*. *Journal of Archaeological Science* 29: 545-553.

Helmer, D. & Vigne, J.-D. 2004: La gestion des cheptels de caprinés au Néolithique dans le Midi de la France. In: Bodu, P. & Constantin, C. (eds): *Approches Fonctionnelles en Préhistoire*: 397-407. Atti del XXV Congresso di Preistoria Francese (Nanterre, 24-26 novembre 2000). Parigi.

Kratochvil, Z. 1969: Species criteria on the distal section of the tibia in *Ovis ammon* F. *aries* L. and *Capra aegagrus* F. *hircus* L. *Acta veterinaria* 38: 483-490.

Lo Porto, F.G. 1971: L'attività archeologica in Puglia. In: *Atti Taranto X*: 523-555. Istituto per la storia e l'archeologia della Magna Grecia, Taranto.

— 1972: L'attività archeologica in Puglia. In: *Atti Taranto XI*: 473-502. Istituto per la Storia e l'Archeologia della Magna Grecia, Taranto.

— 1976: L'attività archeologica in Puglia. In: *Atti del XV Convegno di Studi sulla Magna Grecia*: 635-645. Napoli.

— 1980: Considerazioni sulla stratigrafia della Grotta di Badisco. In: Graziosi, P. (ed.): *Le Pitture Preistoriche della Grotta di Porto Badisco*. Origines: XI-XVI.

MINNITI, C.; RADINA, F. & SIVILLI, S. 2024: Il sito di Titolo di Bari nel quadro economico e ambientale del Neolitico nell'Italia meridionale: analisi preliminare dei resti animali dagli scavi 2012-14. In Curci, A., Maini, E. & Perrone, E. (eds.): Atti del 9° Convegno Nazionale di Archeozoologia: 85-93. Associazione Nazionale di Archeozoologia, Ravenna.

OROFINO, F. 1970: Grotta di Porto Badisco, n. 902. *Speleologia Emiliana* 7: 81-91.

PAYNE, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Aşvan Kale. *Anatolian Studies* 33: 281-303.

— 1985: Morphological distinctions between the mandibular teeth of young sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 12: 139-147.

POTENZA, A. 2019: L'*industria su materia dura di origine animale proveniente dalla Grotta dei Cervi di Porto Badisco (Otranto – LE). Scavi 1970-1971*. B.A.R. (International Series) 2953. Oxford.

REVEDIN, A. 1985-86: Porto Badisco (Otranto, Prov. di Lecce). *RSP XL, Notiziario* 1-2: 425-426.

SCHMID, E. 1972: *Atlas of animal bones for prehistorians, archaeologists and Quaternary geologists*. Elsevier Publishing Company, Amsterdam.

SILVER, I. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology*: 283-302. Thames & Hudson Ltd, London.

TAGLIACOZZO, A. 2005: Animal exploitation in the Early Neolithic in Central-Southern Italy. *Munibe (Antropologia-Arkeologia)* 57: 429-439.

TAGLIACOZZO, A. & PINO URÍA, B. 2009: 10.1. Mammiferi. In: Tinè, V. (ed.): *Favella. Un villaggio neolitico nella Sibaritide*. Studi di Paletnologia III: 431-472. Istituto Poligrafico e Zecca dello Stato, Roma.

TIBERI, I. 2019: *Grotta dei Cervi a Porto Badisco. Un santuario per le genti del Mediterraneo. Millenni*. Studi di archeologia preistorica n. 19. Bandecchi & Vivaldi, Pontedera (PI).

VIGNE, J.-D. 2003: L'exploitation des animaux à Torre Sabea. Nouvelles analyses sur les débuts de l'élevage en Méditerranée centrale et occidental. In: Guilaine, J. & Cremonesi, G. (eds): *Torre Sabea, un* Établissement *du Néolithique Ancien en Salento*. Collection de l'École Française de Rome 315: 325-359. Roma.

VIGNE, J.-D. & HELMER, D. 2007: Was milk a "secondary product" in the Old World Neolithisation process? Its role in the domestication of cattle, sheep and goats. *Anthropozoologica* 42(2): 9-40.

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The faunal remains of the Roman villa of San Marco on the island of Elba: diet and livestock economy in the late Republican and early Imperial periods

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SUMMARY: The Roman villa of San Marco is located in the eastern margin of the coastal plain of S. Giovanni, on the northern coast of the island of Elba. The property belonged to the noblemen family of the *Valerii* and the main economic activity of the villa was viticulture. On the basis of the study of the ceramics and epigraphic data, it is estimated that the building was constructed at the end of the 2nd century BC and abandoned after a fire which ocurred in the 1st century AD. This event fostered an outstanding preservation of the earthen structures and the organic materials including those made on wood.
This paper reports on the faunal remains retrieved during the excavations which were carried out from 2012-2019. Most of the finds belong to the three main categories of domesticates (cattle, caprines and pigs), the remains of wild species, including birds and marine molluscs, being secondary items of the faunal assemblage. Our study focuses on the livestock economy and the consumption of animals to characterize the site within the broader frame of animal resources exploitation in villas from the late Republican and early Imperial periods.

KEY WORDS: ANIMAL REMAINS, DIET, ROMAN ARCHAEOLOGY, *VALERII*, TUSCANY

RIASSUNTO: La villa romana di San Marco è localizzata nell'estremità orientale della pianura costiera di S. Giovanni, lungo la costa settentrionale dell'isola d'Elba. La proprietà apparteneva alla nobile famiglia dei *Valerii* e la principale attività produttiva della villa di San Marco era quella vinicola. Sulla base dello studio dei materiali ceramici rinvenuti e delle attestazioni epigrafiche si stima che l'edificio fu costruito alla fine del II secolo a.C. ed il suo abbandono è segnato da un incendio avvenuto nel I secolo d.C. È proprio questo tragico evento che ha garantito la conservazione straordinaria delle strutture in terra cruda, delle strutture lignee e dei materiali organici. In questo contributo verranno presentati i reperti faunistici rinvenuti durante la campagne di scavo che si sono susseguite dal 2012 al 2019. I reperti sono riferibili prevalentemente alle tre principali specie domestiche (bovini, ovicaprini e suini). Sono presenti anche alcuni resti riferibili a specie selvatiche, ad avifauna e molluschi marini. Lo studio ha lo scopo di delineare l'economia d'allevamento e i consumi alimentari presenti nel sito e di profilare un quadro più ampio relativo allo sfruttamento delle risorse animali nelle ville tra la tarda età repubblicana e la prima età imperiale.

PAROLE CHIAVE: RESTI ANIMALI, ALIMENTAZIONE, ARCHEOLOGIA ROMANA, *VALERII*, TOSCANA

RESUMEN: La villa romana de San Marco está situada en la margen oriental de la llanura costera de S. Giovanni, en la costa norte de la isla de Elba. La propiedad pertenecía a la familia

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nobiliaria de los *Valerii* y la principal actividad económica de la villa era la viticultura. A partir del estudio de la cerámica y de datos epigráficos, se postula que el edificio fue construido a finales del siglo II a.C. y abandonado tras un incendio ocurrido en el siglo I d.C. Este evento explica la excelente preservación de las estructuras de tierra, así como la de los materiales orgánicos, incluida la madera.
Este artículo refiere los restos de fauna recuperados durante las excavaciones que se llevaron a cabo entre 2012 y 2019. La mayoría de los hallazgos pertenecen a las tres principales categorías de animales domésticos (bovinos, caprinos y cerdos), siendo los restos de especies silvestres, incluidas aves y moluscos marinos, elementos secundarios dentro del conjunto faunístico. Nuestro estudio se centra en la economía ganadera y el consumo de animales y caracteriza el yacimiento dentro de un marco más amplio referido a la explotación de los recursos animales en las villas romanas de finales del período Republicano y principios de la etapa imperial.

PALABRAS CLAVE: RESTOS ANIMALES, DIETA, ARQUEOLOGIA ROMANA, *VALERII*, TOSCANA

INTRODUCTION

The archaeological investigations conducted on the San Marco estate, in the San Giovanni district near Portoferraio, began in 2012. The excavations, headed by Prof. Franco Cambi of the University of Siena, have brought to light an extensive Roman villa, built close to the shore, characterised by a ground floor used for the production and storage of products, and an upper floor used as living quarters, with rooms facing the sea and richly decorated areas.

Identified on the ground floor was an area with six large *dolia* for the fermentation of wine, with a total estimated volume of 8000 litres, and a room for the storage of amphorae containing cider vinegar. Goods were shipped in and out of the villa via a small dock, as indicated by the presence of submerged structures in the sea near the villa. The construction of the building is dated to the 2nd century B.C. and was destroyed by a fire in the 1st century AD, which resulted in an extraordinary state of preservation. In addition, the archaeological excavations have made it possible to attribute the ownership of the villa of San Marco to the *Valerii*, a powerful Roman family that was well established along the coast of Tuscany (Cambi *et al.*, 2018).

The study of the faunal material, recovered from various contexts in the Roman villa of San Marco, concerned the finds recovered during the 2012-2019 excavation campaigns, dated to the period from the end of the 2nd century BC to the 1st century AD. Only in some areas of the excavation was soil sieving performed.

METHODOLOGY

The finds were identified by consulting the osteological atlases of Schmid (1972) and Barone (1976) and by comparative morphological assessment, usingthe osteological collections of the Laboratory of Archaeozoology (Department of Cultural Heritage) at the University of the Salento. The sheep and goats were distinguished by observing key osteological characteristics marked by minimal differences, visible in certain bones of the skeleton, consulting specific works on the two species' distinctive morphological features (Boessneck *et al.*, 1964; Boessneck, 1969; Payne, 1985; Prummel & Frisch, 1986; Halstead *et al.*, 2002; Zeder & Lapham, 2010; Zeder & Pilaar, 2010).

For each category identified, the bone remains were counted (NISP, number of identified specimens) and the minimum number of individuals (MNI) was calculated. The latter was assessed for all taxa, considering the most numerous anatomical elements found and taking account of the sex and age data (Bökönyi, 1970). In addition to the identified remains, vertebrae, ribs and unidentified bones were also counted.

The age-at-death of the three main domestic species (cattle, caprines and pigs) was estimated by examining both the degree of epiphyseal fusion of the long-bones (Silver, 1969; Bull & Payne, 1982; Bullock & Rackham, 1982) and the state of eruption, tooth replacement and wear stage of the teeth (Payne, 1973; Bull & Payne, 1982; Grant, 1982).

The sex of the pigs was based on the morphology of the canines, while for cattle the osteometric features were studied (Nobis, 1954).

The bone measurements were taken in accordance with Driesch (1976); the BT and HTC of the humerus in all species were measured using the technique described by Payne & Bull (1988) for pigs. The measurements of the metapodials of cattle follow Davis (1992), while those of equids follow Eisenmann *et al*. (1988) (see Appendix 4 in Supplementary Materials). To estimate the height at the withers, the Matolcsi coefficients (Matolcsi, 1970) were used for the cattle, the Teichert coefficients (Teichert, 1969, 1975) for the sheep and pigs and the Harcourt (1974) and Clark (1995) coefficients for the dogs. Lastly, biometric analysis was performed using the "Zoolog" package of the Rstudio development environment (Pozo *et al*., 2022). The standard values used are from Johnstone & Albarella (2002) for the cattle, Davis (1996) for the caprines and Albarella & Payne (2005) for the pigs.

RESULTS

The osteological sample analysed is made up of 2055 fragments, of which 564, corresponding to 27.5%, can be determined to species level. The state of preservation of the material, which in some stratigraphic units was highly fragmented, prevented the identification of 1329 fragments, equivalent to 64.7% of the sample. The remains of ribs and vertebrae, respectively accounting for 5.7% and 2.1% of the sample, were also identified.

Analysing the determined fragments, it emerges that the faunal sample is mainly made up of domestic mammals. Table 1 shows the number of remains (NISP) and the minimum number of individuals (MNI) of each species discovered. Among the categories of domestic animal, excluding species that were not part of the human diet, the most abundant is pigs, accounting for 43.5% of the total NISP, followed by caprines (30.4%), cattle (25.9%) and lastly poultry, accounting for just 0.2% (Table 2).

The most frequently attested domestic species is pigs. On the basis of the remains, the minimum number of individuals was determined to be thirteen, composed of five juveniles and eight subadults. The classification and quantification of the pig bones are shown in Appendix 1 (see in Supplementary Materials), which gives the number of specimens and the relative percentages accounted for by each anatomical element. There are more

Taxa	**NISP**	**%**	**MNI**
Domestic animals			
Equids - *Equus* sp.	7	1,2%	1
Cattle - *Bos taurus* L.	119	21,1%	5
Sheep or goat - *Ovis* vel *Capra*	101	17,9%	13
Sheep - *Ovis aries* L.	9	1,6%	
Goat - *Capra hircus* L.	30	5,3%	
Pig - *Sus domesticus* L.	200	35,5%	13
Dog - *Canis familiaris* L.	11	2,0%	1
Chicken - *Gallus gallu*s L.	1	0,2%	1
Wild animals			
Roe deer - *Capreolus capreolus* L.	1	0,2%	1
Hare - *Lepus europaeus* Pall.	3	0,5%	2
Birds – Aves ind.	5	0,9%	-
Tortoise - *Testudo hermanni* Gml.	3	0,5%	1
Toad - *Bufo bufo* L.	3	0,5%	1
Rustic limpet - *Patella rustica* L.	2	0,4%	2
Turbinate monodont - *Phorchus turbinatus* Born	12	2,1%	12
Common cerith - *Cerithium vulgatum* Brug.	4	0,7%	4
Murex trunculus - *Hexaplex trunculus* L.	46	8,2%	39
Common cockle - *Cerastoderma edule* L.	5	0,9%	3
Lagoon cockle - *Cerastoderma glaucum* Brug.	2	0,4%	1
Total	**564**	**100%**	**100**

TABLE 1

Number of identified specimens (NISP) and minimum number of individuals (MNI) of each taxon.

fragments belonging to the forelimbs (24%) than the hindlimbs (18%) and foot bones (17%), but the highest percentages are accounted for by cranial bones (mandible, maxilla and loose teeth).

	NISP	%NISP
cattle	119	25,9%
sheep/goat	140	30,4%
pig	200	43,5%
chicken	1	0,2%
Total	**460**	**100%**

TABLE 2

Number of identified specimens (NISP) and relative percentages of total remains accounted for by the main categories of domestic animal.

From the mortality data, obtained from observation of the degree of epiphyseal fusion, about 29% of the pigs were slaughtered in the first year of life, 41% in the second and third and the remaining 30% in the fourth or later. To obtain a more precise and reliable picture of the pigs' age of death, the degree of eruption, replacement and wear of the teeth was also analysed using the method devised by Bull & Payne (1982). This analysis showed that about 50% of the pigs were butchered in the first year of life, about 12.5% in the second and about 37.5% in the fourth or later (see Appendix 2 in Supplementary Materials).

The sex ratio of the pigs was obtained by observing the morphology of the canines and was found to be roughly balanced; six boars and four sows were identified. The sample contained only one intact 3rd metatarsal, which gave a height at the withers of 73.2 cm.

The sample contained 140 remains of caprines. Calculation of the minimum number of individuals (MNI) indicated that there were at least thirteen individuals, two of which were juveniles and eleven adults. Observing the distribution of the anatomical elements (see Appendix 1 in Supplementary Materials), the highest percentages were recorded for parts belonging to the skull and the foot bones, followed by bones of the fore and hindlimbs.

The data on the age-at-death of the caprines, obtained from the analysis of the fusion of the long-bone epiphyses (Bullock & Rackham, 1982), demonstrate that about 29% of the animals were butchered in the first year of life, 50% in the second or third years and about 21% in the fourth year or older. Analysis of the eruption, replacement and wear of the teeth (Payne, 1973) confirm that in the villa of San Marco it was mainly immature and subadult animals that were slaughtered. The largest proportion (50%) of caprines slaughtered were two or three years old, followed by 16% slaughtered in the second year of life. 23% were slaughtered as adults, some of which were aged from eight to ten years. The remainder (11%) were killed in the first year of life (see appendix 2 in supplementary materials). Comparing the mortality curve obtained from the San Marco sample with the ideal curves set out by Payne (1973), it may be deduced that the livestock was mainly exploited for meat (Figure 1). Some animals were probably kept alive until an advanced age for breeding purposes.

Where possible, sheep and goats were distinguished on the basis of morphological differences and the ratio of goats to sheep was observed to be 3:1. It was possible to calculate the height at the withers only with reference to one sheep calcaneus and two talus bones that may have been either sheep or goat. In the former case, a height at the withers of 64.5 cm was obtained. Considering all three caprines, the average height was 62.7 cm.

119 specimens were attributed to cattle, representing at least five individuals, of which one was a juvenile, one a subadult and three adults.

Analysing the distribution of the anatomical elements (see Appendix 1 in Supplementary Materials), as observed for pig and sheep/goats, there are more fragments belonging to the forelimbs than the hindlimbs, but the highest percentages are accounted for by cranial bones (mandible, maxilla and loose teeth).

The data regarding the fusion of the long bone epiphyses (Silver, 1969) yield mortality profiles that suggest interest mainly in meat production and the use of animals for draught purposes. There were no remains attributable to young individuals, with about 67% butchered as subadults and the remaining 33% at the age of 42 months or older. The mortality data obtained from the state of eruption, replacement and wear of the teeth (Grant, 1982), both hemimandibles and loose lower teeth, confirm the trend highlighted by the preceding analysis, but they also indicate the presence of immature individuals (see Appendix 2 in Supplementary Materials).

The presence of an intact metacarpal and an intact metatarsal made it possible to determine the sex on the basis of osteometric data (Nobis, 1954).

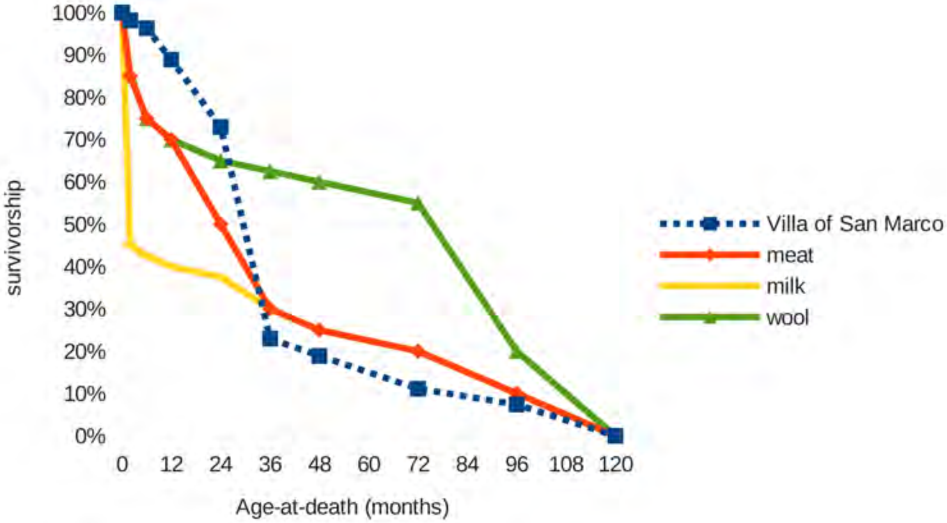

FIGURE 1

Caprine kill-off patterns based on mandibular wear stage data.

The metacarpal is attributable to a female individual, while the metatarsal might be either a female or a castrated male. In addition, it was possible to estimate the height at the withers. The data obtained enable calculation of an average for the pair of 121.4 cm (Matolcsi, 1970).

Despite the small quantity of osteometric data available for the villa of San Marco, biometric analysis of the three main domestic categories was performed in accordance with the Log-size index method. The sample was compared with materials from a range of contexts linked to the Roman Republican and Imperial periods. Very few data are available for cattle; there are even fewer osteometric data on lengths than on widths, and they are not statistically significant in either case. The shortage of data is due to the fragmentary nature of the samples and the division into portions of the anatomical elements consumed as part of people's diets. A greater quantity of data is available for the caprines; there is a gradual increase in size from the 5th century BC to the 3rd century AD, with the exception of the samples from Rome dated to the late 3rd and 2nd centuries BC, which are leaner than those of the 4th and early 3rd centuries BC (Figures 2, 3). The average values of the San Marco villa are fully consistent with this pattern, which indicates growth in size from the Republican to the Imperial periods (Minniti & Abatino, 2022). In the sample considered here, regarding the pigs, there are no data on lengths and only two observations on widths. This prevents any considerations concerning this species. The near absence of measurements is due to the fact that the pigs were butchered as juveniles and subadults, while for biometric analyses, measurements of adult bones are generally used. It should also be pointed out that in addition to the paucity of the available data, the results obtained from the biometric analysis can be influenced by sexual dimorphism, which is a factor that is hard to calibrate for.

In addition to these domestic species, there are also the remains of equines, whose exact species could not be reliably determined, corresponding to at least one individual, presumably used as a draught or pack animal. Other remains were attributed to dogs, including an intact femur and an intact 4th metacarpal which in both cases enabled calculation of the height at the withers. The resulting values (54.7 cm and 60.5 cm) suggest the presence of at least two dogs of medium-to-large size, probably used as guard dogs.

Wild animals appear to have played only a marginal role in the diet of the inhabitants of the villa of San Marco. The sample contains just one fragment attributable to a roe deer and three fragments of hare. The roe deer, whose meat was highly sought after (Jori, 2016: 79), is not found on Mediterranean islands (Carnevali *et al*., 2009: 57), due to its inability to survive in island contexts (Masseti, 2011). It

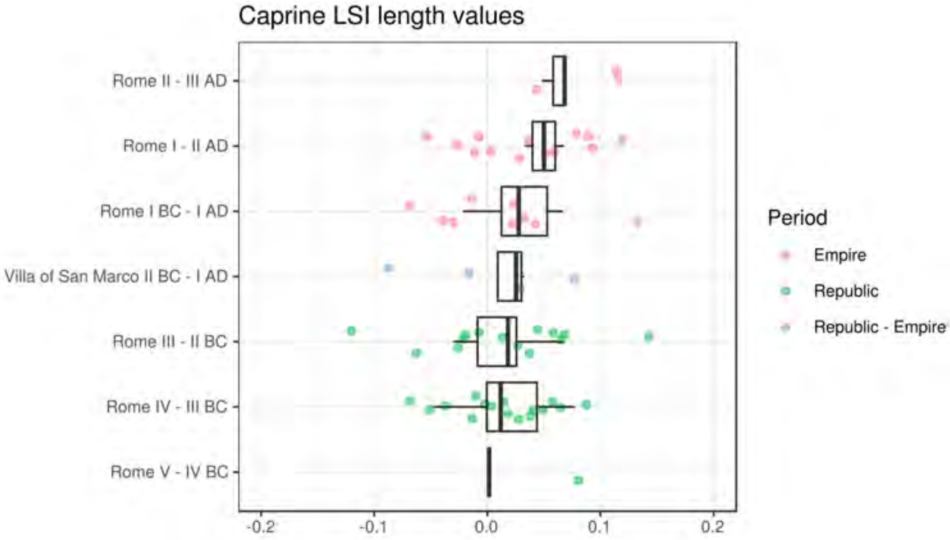

FIGURE 2
Caprine LSI length values per period.

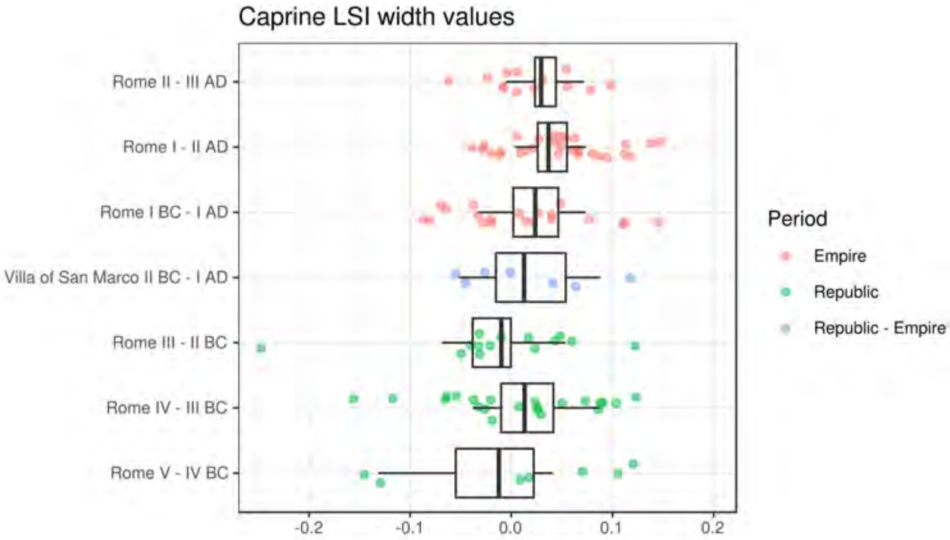

FIGURE 3
Caprine LSI width values per period.

was presumably imported from the mainland, given that it is attested in the fauna of Populonia (De Grossi Mazzorin & Minniti, 2008, 2010).

In the assemblage there are bones attributable to birds, including a single coracoid attributable to the species *Gallus gallus* and five other remains concerning which however it was not possible to determine the species because of the high fragmentation, together with a few remains of testudines and toads. The list of animal resources used for food is completed by marine molluscs. There are 71 shell fragments, almost all of which are from Room VII, belonging to six species, with *Hexaplex trunculus* accounting for the largest number of remains (Table 1). The species discovered are mainly gastropods (*Patella rustica*, *Phorchus turbinatus*, *Cerithium vulgatum*, *Hexaplex trunculus*), but there are also a few remains of bivalves, specifically fragments attributable to *Cerastoderma edule* and *Cerastoderma glaucum*.

DISCUSSION

The animal remains analysed from the villa of San Marco reflect a system of production and consumption aimed primarily at the sustenance of the owner-occupier. The villa belonged to an important senatorial family, the *Valerii*, who at the time of the building's construction had privileged ties even with the imperial family. This family, together with the *Aurelii*, appears to be firmly rooted along the entire Tuscan coast and has close relations with the capital, from which it sources skilled labour, building materials and artistic works (Cambi, 2024). The position overlooking the sea suggests a private villa connected with port facilities serving also as a hub for the traffic of the entire roadstead (Cambi *et al*., 2024). The island of Elba had played, and continues to play in this period, a pivotal role in trade routes. As an island rich in springs and waterways, it was a junction and an almost obligatory passage for sailors and merchants; a place where water could be supplied. From the Etruscan period until the end of the 2nd century BC, like much of the Popolunia territory to which it belonged, the island of Elba was mainly exploited for its iron ore, of which it was particularly rich. Later, at the beginning of the 1st century BC, there was first a sharp decline in mining activity and then a cessation of it. The territory undergoes a deep transformation and begins to have a mainly agricultural connotation. The construction of the villa of San Marco by a noble family marks the end of the era of the great ironworks in the territory of Populonia and the island of Elba and opens another, guided by the same social protagonists but with a totally reformulated landscape. Here there is clear evidence of the leading role that the island of Elba played in the Roman world between the end of the republican age and the beginning of the imperial age in terms of both trade and relations with important *gentes* in the capital and surrounding areas (Cambi, 2024).

The animal remains found at the site, almost exclusively attributable to domestic species used for food purposes, reflect a livestock rearing primarily aimed at the production and consumption of high quality meat. Evidence for that can be found in the fact that most of the cattle were slaughtered at an immature or sub-adult age, a choice that underlines the desire to produce tender and delicious cuts of meat. Only about a third of the cattle, on the other hand, were over four years old. These were probably exploited in field work and then slaughtered and consumed once their productive cycle was over.

The same scenario applies to the mortality figures for sheep and goats, which were mainly slaughtered between their second and third year of life. Moreover, the presence of both suckling lambs and lambs shows a consumption of good cuts of meat. However, a small part of the flock was left alive beyond the fourth year of life, presumably for breeding purposes.

Pigs are the domestic species most represented in the villa of San Marco. This finding is consistent with the well-known predominance of the pig in Imperial Roman Italy (MacKinnon, 2001; De Grossi Mazzorin, 2004; De Grossi Mazzorin & Minniti, 2022). The pig is a suitable animal to satisfy the nutritional needs of communities, as it does not require complex management and, furthermore, grows and reproduces very quickly. These animals were usually slaughtered when they had reached their optimum weight, around their second year of age. This was done in order to minimise management costs and maximise meat yield. The considerable presence in the villa of San Marco of individuals slaughtered within the age of 18 months, most of them slaughtered even before they had reached their seventh month of age, once again underlines the exploitation aimed at producing better cuts of meat.

A recent study has mapped zooarchaeological analyses that have been carried out within the national territory concentrating on sites from the Roman period. It shows the presence of a fair number of analysed samples in the territory of Etruria (Schmidtova *et al*., 2023). As already mentioned, comparison of the data on the three main categories of domestic animals highlights the prevalence of pig remains, followed by caprines and cattle in the villa of San Marco. The percentages accounted for by these domestic animals were compared with the data available for other Roman villas and urban contexts in order to assess the strategies adopted for the management of the animals and their role in diets. The sites examined are dated to the period from the 2nd century BC to the 2nd century AD, considering only contexts that yielded more than 90 remains of cattle, caprines and pigs (see Appendix 3 in Supplementary Materials). This choice does not allow for the inclusion of a number of sites identified as farms and small rural settings, which are represented by a small number of faunal remains (cfr. Boscato & Mascione, 2008; Aniceti *et al*., 2021; Arnoulds *et al*., 2021). In the case of Marzuolo, although it preserves a substantial number of remains, it was not included in the comparison materials because it is a rural production site (MacKinnon, 2021).

Analysing villas and urban sites separately, it was found that in Roman villas, from the 1st century AD onwards, pig remains are much more abundant than remains of the other two categories. In the more ancient contexts, including the villa of San Marco, the gap is not so wide, with the exception of the site of Gravina in Puglia, a Roman villa with an agricultural-pastoral vocation far away from the geographical and landscape context of Etruria, where caprines prevail (more than 70%) (MacKinnon, 2004). In the urban contexts, a sharp increase in pigs is seen from as early as the late 1st century BC. Indeed, it is known that the consumption of pork in Rome peaked at the time of the city's greatest expansion in geographical and demographic terms, the only exceptions being the contexts of Via Sacchi (De Grossi Mazzorin & Coppola, 2008).

The extensive consumption of pork in the villa of San Marco thus reflects a trend that was widespread in the territory of Etruria and well established in the city of Rome, the place of origin of the important senatorial family that continued to maintain close relations with the capital.

CONCLUSIONS

The study of the faunal remains of the villa of San Marco adds to our knowledge of diet and the livestock economy in the late Republican and early Imperial periods.

It constitutes the first archaeozoological study of an elitist context from the Roman period on the Island of Elba. The analysis of the remains has made it possible to reconstruct the diet of the residents of the building. It clearly demonstrates the high social rank to which they belonged. It emerged that the diet was characterised by high consumption of pork, followed by sheep and goat meat, veal and beef. The livestock rearing strategies indicate an emphasis on the production and consumption of meat, and the animals' age of slaughter attests to a preference for a product that was tender and of high value.

The presence of equine remains, used as pack or draught animals, can be traced back to activities related to the productive areas of the villa. The remains of dogs suggest the presence of at least two large individuals probably used as guard dogs.

The wild species played a marginal role in the diet. However, there is evidence that certain highly prized cuts of game were imported from the mainland, as shown by the discovery of the fragment of a roe deer tibia.

The diet was enriched by the consumption of marine molluscs, obtained directly from the sea. In contrast, there are no remains of fish, although it may be assumed that fish was among the species consumed. Indeed, finds linked to fishing, such as hooks and fishing net weights, were recovered from various areas of the villa's lower floor. The absence of fish remains could depend on the methodology of collecting the material during the excavation.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_025

BIBLIOGRAFIA

Albarella, U. & Payne, S. 2005: Neolithic pigs from Durrington Walls, Wiltshire England: a biometrical database. *Journal of Archaeological Science* 32: 589-599.

Aniceti, V.; Umberto, A. & Alessandro, S. 2021: The faunal assemblage from the manufacturing district at Spolverino: from the Roman Imperial period to Late Antiquity. *Archaeofauna International Journal of Archaeozoology* 30: 167-183.

Arnoulds, A.; Bowes, K.; MacKinnon, M.; Mercuri, A.M.; Rattighieri, E. & Rinaldi, R. 2021: Agriculture and land use. In: Bowes, K. (ed.): *The Roman Peasant Project 2009-2014: Excavating the Roman Rural Poor*: 498-514. University Museum Monograph 154(II). University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Barone, R. 1976: *Anatomia comparata dei Mammiferi domestici*. *Osteologia*, vol. I. Edagricole, Bologna.

Boessneck, J. 1969: Osteological Differences between Sheep (*Ovis aries* Linné) and Goat (*Capra hircus* Linné). In: Brothwell, D. & Higgs, E. (eds): *Science in Archaeology. A Comprehensive Survey of Progress and Research*: 331-358. Thames & Hudson, London.

Boessneck, J.; Müller, H.h. & Teichert, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* L.) und Ziege (*Capra hircus* L.). *Kühn Archiv* 78: 1-129.

Bökönyi, S. 1970: A new method for the determination of the number of individuals in animal bone material. *American Journal of Archaeology* 74(3): 291-292.

Boscato, P. & Mascione, C. 2008: I resti faunistici dall'insediamento romano di Pantani-Le Gore (Torrita di Siena-SI). *Rassegna di archeologia: classica e postclassica*, 23/B, 2007/2008: 95-110.

Bull, G. & Payne, S. 1982: Tooth eruption and epiphysial fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (British Series) 109. Oxford.

Bullock, D. & Rackham, J. 1982: Epiphyseal Fusion and Tooth Eruption of Feral Goats from Moffatdale, Dumfories and Galloway, Scotland. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological sites*: 73-80. B.A.R. (British Series) 109. Oxford.

Cambi, F. in press: L'isola d'Elba in età repubblicana. In: Vanni, E.; Pagliantini, L. & Cambi, F. (eds.): *Archeologia e storia nella rada di Portoferraio. La villa di San Marco*. Brepols Publishers, Turnhout.

Cambi, F.; Pagliantini, L. & Vanni, E. in press: Conclusioni. In: Vanni, E.; Pagliantini, L. & Cambi, F. (eds.): *Archeologia e storia nella rada di Portoferraio. La villa di San Marco*. Brepols Publishers, Turnhout.

Cambi, F.; Pagliantini, L.; Vanni, E.; Longo, C.; Manca, R.; Milanesi, C.; Paratico, C.; Scapolaro, S.; Graziano, A. & Corretti, A. 2018: Isola d'Elba. Archeologia e storia nella rada di Portoferraio: la villa repubblicana di San Giovanni. In: Michelini, C. (ed.): *Scavi e ricerche a Locri Epizefiri (Locri, RC;2017), Segesta (Calatafimi-Segesta, TP), Kaulonia (Monasterace, RC) e Isola d'Elba (LI; 2013-17)*: 147-294. Supplemento agli Annali della Scuola Normale Superiore di Pisa, Classe di Lettere e Filosofia, Serie 5 (10/2). SAET, Pisa.

Carnevali, L.; Pedrotti, L.; Riga, F. & Toso, S. 2009: Banca Dati Ungulati. Status, distribuzione, consistenza, gestione e prelievo venatorio delle popolazioni di Ungulati in Italia. *Rapporto/Report 2001-2005, Biologia e Conservazione della Fauna* 117: 57-76. ISPRA Ambiente.

Clark, K.M. 1995: The later prehistoric and protohistoric dog: the emergence of canine diversity. *Archaeozoologia* 7(2): 9-32.

Davis, S.J.M. 1992: A rapid method for recording information about mammal bones from archaeological sites. *Ancient Monuments Laboratory Report,* 19/92. Historic Buildings and Monuments Commission for England, London.

— 1996: Measurements of a Group of Adult Female Shetland Sheep Skeletons from a Single Flock: a Baseline for Zooarchaeologists. *Journal of Archaeological Science* 23: 593-612.

De Grossi Mazzorin, J. 2004: Some considerations about the evolution of the animal exploitation in Central Italy from the Bronze Age to the Classical period. In: Santillo Frizell, B. (ed.): *PECUS. Man and animal in antiquity. Proceedings of the conference at the Swedish Institute in Rome, September 9-12, 2002*: 38-49. The Swedish Institute in Rome, Rome.

De Grossi Mazzorin, J. & Coppola, C. 2008: L'analisi dei resti faunistici nel quadro delle strategie di allevamento e alimentazione nella Roma imperiale. In: Filippi, F. (ed.): *Horti et sordes. Uno scavo alle falde del Gianicolo*: 410-419. Quasar Editore, Roma.

De Grossi Mazzorin, J. & Minniti, C. 2008: Resti faunistici dal saggio IX. In: Acconcia, V. & Rizzitelli, C. (eds.): *Materiali per Populonia VII*: 197-214. Edizioni ETS, Pisa.

— 2010: Populonia: analisi dei resti faunistici di un'abitazione di età romana. In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del V Convegno Nazionale di Archeozoologia*: 243-246. Edizioni Osiride, Rovereto.

— 2022: Dall'economia di sussistenza a quella produttiva: alimentazione e allevamento. In: De Grossi Mazzorin, J. & Minniti, C. (eds.): *Gli animali a Roma. Tre millenni di interazione con l'uomo*: 33-53. All'Insegna del Giglio, Sesto Fiorentino.

Driesch, A. von den 1976: *A Guide to the Measurement of Animal Bones from Archaeological sites*. Harvard University Press, Cambridge. MA.

Eisenmann, V.; Alberdi, M.T.; De Giuli, C. & Staesche, U. 1988: Volume I: Methodology. In: Woodburne, M. & Sondaar, P. (eds.): *Studying Fossil Horses. Collected papers after the "New York International Hipparion Conference, 1981"*: 1-71. E. J. Brill, Leiden.

Grant, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological sites*: 91-108. B.A.R. (British Series) 109. Oxford.

Halstead, P.; Collins, P. & Isaakidou, V. 2002: Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult *Ovis* and *Capra*. *Journal of Archaeological Science* 29(9): 545-553.

Harcourt, R.A. 1974: The dog in prehistoric and early historic Britain. *Journal of Archaeological Science* 1(2): 151-175.

Johnstone, C. & Albarella, U. 2002: The Late Iron Age and Romano-British Mammal and Bird Bone Assemblage from Elms Farm, Heybridge, Essex (Site Code: Hyef93-95). *Centre for Archaeology, English Heritage, Report 45/2002*.

Jori, A. 2016: *La cultura alimentare e l'arte gastronomica dei Romani. Contributo alla filosofia dell'alimentazione e alla storia culturale del mondo Mediterraneo*. Quaderni dell'Accademia, Accademia Nazionale Virgiliana di Scienze Lettere e Arti, vol. 5. Publi Paolini, Mantova.

Mackinnon, M. 2001: High on the hog: linking zooarchaeological, literary and artistic data for pig breeds in Roman Italy. *American Journal of Archaeology* 105(4): 649-673.

— 2004: The role of caprines in Roman Italy: idealized and realistic reconstructions using ancient textual and zooarchaeological data. In: Santillo Frizell, B. (ed.): *PECUS. Man and animal in antiquity. Proceedings of the conference at the Swedish Institute in Rome, September 9-12, 2002*: 54-60. The Swedish Institute in Rome, Rome.

— 2021: Faunal materials. In: Bowes, K. (ed.): *The Roman Peasant Project 2009-2014: Excavating the Roman Rural Poor*: 304-314. University Museum Monograph 154(II). University of Pennsylvania Museum of Archaeology and Anthropology, Philadelphia.

Masseti, M. 2011: Notes on the diffusion in Sicily of the roe deer *Capreolus capreolus* (L., 1758) (Mammalia, Cervidae). *Biogeographia - The Journal of Integrative Biogeography* XXX: 299-306. https://doi.org/10.21426/B630110587

Matolcsi, J. 1970: Historische Erforschung der Körpergrösse des Rindes auf Grund von ungarischem Knochenmaterial. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 87: 89-137.

Minniti, C. & Abatino, C. 2022: Biometric variation of domestic animals in Rome from the Orientalizing/Archaic period to the Middle Ages. *Quaternary International*. https://doi.org/10.1016/j.quaint.2022.06.010

Nobis, G. 1954: Ur- und frühgeschictlichen Rinder Nord- und Mitteldeutschlands. *Zeitschrift für Tierzüchtung und Züchtungsbiologie* 63: 155-194.

Payne, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 23: 281-303.

— 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, *Ovis*, and Goats, *Capra*. *Journal of Archaeologocal Science* 12(2): 139-147.

Payne, S. & Bull, G. 1988: Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archæozoologia* 2: 27-65.

Pozo, J.m.; Trentacoste, A.; Nieto-Espinet, A.; Guimarães, S. & Valenzuela-Lamas, S. 2022: Zoolog R package: Zooarchaeological Analysis with Log-Ratios. *Quaternary International*. https://doi.org/10.1016/j.quaint.2022.08.006

Prummel, W. & Frisch, H-J. 1986: A guide for the distinction of species, sex and body side in bones of sheep and goat. *Journal of Archaeological Science* 13(6): 567-577.

Schmid, E. 1972: *Atlas of Animals Bones for Prehistorians, Archaeologists and Quaternary Geologists*. Elsevier, Amsterdam.

Schmidtova, D.; King, A.C.; Klontza Jaklova, V; Reese, D.S.; Rizzetto, M. & Fernandes, R. 2023: Presenting the *RomAniDat* data community and an archaeofaunal dataset for Roman Italy. *Journal of Archaeological Science: Reports* 47: doi.org/10.1016/j.jasrep.2022.103764.

Silver, I.A. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology. A Comprehensive Survey of Progress and Research*: 250-268. Thames & Hudson, London.

Teichert, M. 1969: Osteometrische Untersuchungen zur Berechnung der Widderisthöhe bei vor- und frühgeschichtlichen Schweinen. *Kühn Archiv* 83(3): 237-292.

— 1975: Osteometrische Untersuchungen zur Berechnung der Widderisthöhe bei Schafen. In: Clason, A.T. (eds.): *Archaeozoological Studies*: 51-69. American Elsevier, New York.

Zeder, M.A. & Lapham, H.A. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37(11): 2887-2905. https://doi.org/10.1016/j.jas.2010.06.032

Zeder, M.A. & Pilaar, S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37(2): 225- 242. http://doi.org/10.1016/j.jas.2009.10.002

SUPPLEMENTARY MATERIAL

APPENDIX 1. Number of remains (NISP) and relative percentages of cattle, caprines and pigs, subdivided by anatomical element. (S=sheep, G=goat).

Skeletal element	**Cattle**		**Sheep/Gota**		**Pig**	
	NISP	**%**	**NISP**	**%**	**NISP**	**%**
Horn core	-	-	2 (2 G)	1,4%	-	-
Skull	12	10,1%	4 (1 G)	2,9%	7	3,5%
Maxilla	-	-	1	0,7%	4	2,0%
Upper teeth	8	6,7%	14	10,0%	15	7,5%
Mandible	10	8,4%	17 (5 S; 9G)	12,1%	21	10,5%
Lower teeth	11	9,2%	25 (14 G)	17,9%	30	15,0%
Indeterminate teeth	2	1,7%	2	1,4%	6	3,0%
Hyoid	-	-	-	-	-	-
Atlas	-	-	1	0,7%	-	-
Axis	1	0,8%	-	-	-	-
Scapula	6	5,0%	5	3,6%	7	3,5%
Humerus	11	9,2%	14	10,0%	19	9,5%
Radius	8	6,7%	4	2,9%	9	4,5%
Ulna	4	3,4%	2	1,4%	13	6,5%
Carpal	1	0,8%	-	-	1	0,5%
Metacarpal	6	5,0%	4	2,9%	8	4,0%
Pelvis	6	5,0%	2	1,4%	8	4,0%
Femur	4	3,4%	9	6,4%	9	4,5%
Tibia	6	5,0%	8 (1 G)	5,7%	14	7,0%
Fibula	-	-	-	-	5	2,5%
Patella	-	-	-	-	-	-
Calcaneus	1	0,8%	3 (1 S)	2,1%	3	1,5%
Astragalus	3	2,5%	2	1,4%	1	0,5%
Tarsal	-	-	-	-	3	1,5%
Metatarsal	5	4,2%	7	5,0%	9	4,5%
Metapodial	5	4,2%	6	4,3%	1	0,5%
Sesamoid	-	-	-	-	-	-
Phalanx I	3	2,5%	7 (3 S; 3 G)	5,0%	7	3,5%
Phalanx II	6	5,0%	-	-	-	-
Phalanx III	-	-	1	0,7%	-	-
Total	**119**	**100%**	**140**	**100%**	**200**	**100%**

APPENDIX 2. Data on the mortality of cattle, caprines and pigs, on the basis of the fusion of articular epiphyses and the eruption, replacement and wear of the teeth.

Bone	**Age**	**NF-F**
scapula	7-10 months	0-3
pelvis	7-10 months	0-1
distal humerus	12-18 months	0-5
proximal radius	12-18 months	0-4
phalanx I	18 months	0-2
phalanx II	18 months	0-5
distal metacarpal	24-30 months	1-1
distal tibia	24-30 months	0-2
distal metapodial	24-36 months	2-1
distal metatarsal	30-36 months	0-2
proximal femur	42 months	0-1
distal femur	42-48 months	1-0
proximal tibia	42-48 months	1-0

2a. Epiphysial fusion data for cattle (Silver, 1969). NF = not fused; F = fused.

	C	V	E	½	U	a	b	c	d	e	f	g	h	j	k	l	m	n	o	p
dP4																				
P4																				
M1										1	1	1	1							
M2									1			1		1						
M3	1		1											1	1					

2b. Cattle wear stages of individual teeth (following Grant, 1982).

Bone	**Age**	**NF-F**
distal humerus	< 12 months	2-2
proximal radius	< 12 months	0-1
scapula	12 months	0-2
phalanx I	14-35 months	4-3
distal tibia	35 months	0-2
proximal femur	35 months	1-0
distal metacarpal	48 months	0-1
distal metatarsal	48 months	0-1
distal metapodial	48 months	0-2
proximal humerus	48-60 months	0-1
calcaneus	48-60 months	0-3

2c. Epiphysial fusion data for caprines (Bullock & Rackham, 1982). NF = not fused; F = fused.

Tooth wear stages	**Age**	**Number**	**%**
A	0-2 months	0,50	0,01
B	2-6 months	0,50	0,01
C	6-12 months	2	0,07
D	1-2 years	4.3	0,15
E	2-3 years	13.5	0,5
F	3-4 years	1.1	0,04
G	4-6 years	2.1	0,03
H	6-8 years	1	0,07
I	8-10 years	2	0,07

2d. Age estimates for caprine mandibles and loose teeth (after Payne, 1973).

Bone	**Age**	**NF-F**
scapula	7-11 months	1-2
pelvis	7-11 months	0-1
proximal radius	>11 months	0-4
distal humerus	>11 months	3-3
distal tibia	19-23 months	2-3
phalanx I	19-23 months	6-1
distal metacarpal	>23 months	4-1
distal metatarsal	>23 months	3-2
distal metapodial	>23 months	1-0
proximal femur	31-35 months	1-0
distal radius	>35 months	1-1
proximal ulna	>35 months	0-1
distal femur	>35 months	1-1
proximal tibia	>35 months	2-0
calcaneus	>35 months	2-0

2e. Epiphysial fusion data for pigs (Bull & Payne, 1982). NF = not fused; F = fused.

	Number	%
< 7 months	3	37,5%
7-11 months	1	12,5%
12-18 months	1	12,5%
19-23 months	0	0,0%
24-30 months	2	25,0%
31-35 months	1	12,5%
> 35 months	0	0,0%
Total	**8**	**100%**

2f. Age estimates for pigs mandibles and loose teeth (Bull & Payne, 1982).

APPENDIX 3. Urban contexts and villas dated to the period from the 2nd century BC to the 2nd century AD. NISPd = number of remains of the main categories of domestic animal.

Site	Type	Century	NISPd	% cattle	% sheep/ goat	% pig	Reference
Cosa	Urban	early 2nd BC	111	5.4%	55.9%	38.7%	Scali, 1993
Populonia	Urban, Saggio IX	2nd-1st BC	346	13%	42%	45%	De Grossi Mazzorin & Minniti, 2008, 2010
Settefinestre I	Villa	2nd BC - 1st AD	175	10.9%	42.9%	46.3%	King, 1985
Villa of San Marco	Villa	end 2nd BC - 1st AD	459	25.9%	30.5%	43.6%	infra
Bolsena	Urban	2nd BC - 1st AD	1093	12.2%	50%	37.8%	Tagliacozzo, 1995
Gravina	Villa	early 1st BC	290	2.4%	73.5%	24.1%	MacKinnon, 1994
Pompei, forum I	Urban	1st BC - early 1st AD	1478	14%	20%	66%	King, 1999
Rome, Aqua Marcia	Urban	1st BC - 1st AD	152	28.3%	5.3%	66.4%	De Grossi Mazzorin, 1996
Ferento	Urban	1st BC - 1st AD	95	7.4%	41.1%	51.6%	Alhaique & Fortunato, 2010; Alhaique et al., 2012
Rome, Meta Sudans US 3399	Urban	1st BC - 1st AD	382	6.6%	18.8%	74.6%	De Grossi Mazzorin & Minniti, 1995
Pompei, forum II	Urban	1st AD	502	10.6%	27.1%	62.3%	King, 1999
Matrice	Villa	1st AD	262	31%	33.2%	45.8%	Barker & Clark, 1995
Modena	Urban	1st AD	1309	11.2%	39.5%	49.3%	De Grossi Mazzorin, 1988
Caere	Urban	1st AD	23	21%	18%	61%	Trentacoste, 2016
Rome, via Sacchi	Urban	1st AD	199	71.4%	6%	22.6%	De Grossi Mazzorin & Coppola, 2008
Rome, Quirinal	Urban	1st AD	1201	4%	15.5%	80.5%	De Grossi Mazzorin, 1996-97
Napoli, CM III	Urban	end 1st AD	137	5.8%	23.4%	70.8%	King, 1994
Villa dei Quintili	Villa	1st-2nd AD	132	0%	13.6%	86.4%	De Grossi Mazzorin, 1987
Monte Gelato	Villa	1st-2nd AD	294	6.8%	21.8%	71.4%	King, 1997
Ostia, Baths of the Swimmer	Urban	1st-2nd AD	1381	12.8%	31.8%	55.4%	King, 1999
Rome, Aqua Marcia	Urban	1st-2nd AD	139	8%	14%	78%	De Grossi Mazzorin, 1996
Le Colonne	Villa	1st-2nd AD	508	22.6%	28.7%	48.7%	King, 1999
Settefinestre II	Villa	1st-2nd AD	1518	13%	17%	70%	King, 1985
Rome, Caput Africae	Urban	2nd AD	163	0.6%	25.8%	73.6%	Tagliacozzo, 1993
Rome, Baths of Trajan	Urban	2nd AD	144	6.9%	14.6%	78.5%	De Grossi Mazzorin & Minniti, 2017
Roma, via Sacchi	Urban	2nd AD	826	9.2%	46.6%	44.2%	De Grossi Mazzorin & Coppola, 2008
Roma, Arch of Constantine	Urban	2nd AD	265	6%	20.4%	73.6%	De Grossi Mazzorin & Minniti, 2017

REFERENCES

ALHAIQUE, F. & FORTUNATO, M.T. 2010: Il campione faunistico del pozzo 593 dal sito di Ferento (Viterbo): tra alimentazione ed artigianato. In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del 5° Convegno Nazionale di Archeozoologia*: 261-264. Edizioni Osiride, Rovereto.

ALHAIQUE, F.; DE BERNARDIS, D. & FORTUNATO, M.T. 2012: Attività produttive legate allo sfruttamento delle risorse animali tra età romana e medioevo: il caso di Ferento. In: De Minicis, E. & Pavolini, C. (eds.): *Risorse naturali e attività produttive. Ferento a confronto con altre realtà (27-28 aprile 2010)*: 195-208. Daidalos 12. Università degli studi della Tuscia, Viterbo.

BARKER, G. & CLARK, G. 1995: The faunal data. In: Barker, G. (eds.): *The Biferno Valley Survey. The archaeological and geomorphological record*: 143-171. Leicester University Press, Leicester.

DE GROSSI MAZZORIN, J. 1987: La fauna. In: Ghini, G. (eds.): *La villa dei Quintili a Monteporzio, Quaderni di Archeologia Etrusco-Italica* 14: 234-235.

— 1988: I resti faunistici. In: Cardarelli, A.; Pulini, I. & Zanasi, C. (eds.): *Modena dalle Origini all'Anno Mille. Studi di archeologia e storia* vol. I: 449-456. Panini, Modena.

— 1996 – 1997: L'analisi dei resti ossei animali. In: Candilio, D. and others (eds.): *Roma: Saggio di scavo nell'aula di S. Isidoro in Thermis. Notizie degli scavi di antichità*, Serie IX vol. 7/8: 416-425.

— 1996: I resti faunistici. In: Volpe, R. (eds.): *Aqua marcia. Lo scavo di un tratto urbano*: 203-214. All'Insegna del Giglio, Firenze.

DE GROSSI MAZZORIN, J. & COPPOLA, F. 2008: L'analisi dei resti faunistici nel quadro delle strategie di allevamento e alimentazione nella Roma imperiale. In: Filippi, F. (eds.): *Horti et sordes. Uno scavo alle falde del Gianicolo*: 410-419. Quasar Editore, Roma.

DE GROSSI MAZZORIN, J. & MINNITI, C. 1995: Gli scavi nell'area della Meta Sudans (I sec. d.C.): l'industria su osso. In: *Atti del 1° Convegno Nazionale di Archeozoologia, Rovigo, Accademia dei Concordi, 5–7 marzo 1993*: 371-374. Centro Polesano di Studi Storici, Archeologici ed Etnografici, Rovigo.

— 2008: Resti faunistici dal saggio IX. In: Acconcia, V. & Rizzitelli, C. (eds.): *Materiali per Populonia VII*: 197-214. Edizioni ETS, Pisa.

— 2010: Populonia: analisi dei resti faunistici di un'abitazione di età romana. In: Tagliacozzo, A.; Fiore, I.; Marconi, S. & Tecchiati, U. (eds.): *Atti del V Convegno Nazionale di Archeozoologia*: 243-246. Edizioni Osiride, Rovereto.

— 2017: Changes in lifestyle in ancient Rome (Italy) across the Iron Age/Roman transition: the evidence from animal remains. In: Albarella, U.; Rizzetto, M.; Russ, H.; Vickers, K. & Viner-Daniels, S. (eds.): *The Oxford Handbook of Zooarchaeology*: 127-146. Oxford University Press, New York.

KING, A.C. 1985: I resti animali; i mammiferi, i rettili e gli anfibi. In: Carandini, A. (eds.): *Settefinestre. Una villa schiavistica nell'Etruria romana* vol. III: 278-300. Edizione Panini, Parma.

— 1994: Mammiferi. In: Arthur, P. (eds.): *Il Complesso Archeologico di Carminiello ai Mannesi, Napoli (scavi 1983-1984)*: 367-406. Congedo Editore, Galatina.

— 1997: Mammal, reptile and amphibian bones. In: Potter, T.W. & King, A.C. (eds.): *Excavations at the Mola di Monte Gelato: A Roman and Medieval Settlement in South Etruria. Archaeological Monographs of the British School at Rome* 11: 384-404. British School at Rome, London.

— 1999: Diet in the Roman Provinces: A Regional Inter-Site Comparison of the Mammal Bones. *Journal of Roman Archaeology* 12: 168-202.

MACKINNON, M. 1994: The faunal remains. In: Small, A. and others (eds.): *A pit group of c. 80-70 BC from Gravina di Puglia. Papers of the British School at Rome* 62: 243-257. British School at Rome, London.

STEFANO, S. 1993: I resti faunistici provenienti dalle case romane di Cosa (Ansedonia). In: Bruno, V.J. & Scott, R.T. (eds.): *Cosa IV: the houses, Memoirs American Academy in Rome* 38: 193-200. University of Michigan Press, Pennsylvania.

TAGLIACOZZO, A. 1995: I resti ossei faunistici. In: Santrot, M.-H. & Santrot, J. (eds.): *La Citerne 5 et son Mobilier. Fouilles de l'École française de Rome à Bolsena*: 323-347. Ecole Française de Rome, Rome.

TRENTACOSTE, A. 2016: Animal Remains. In: Colivicchi, F.; Gregori, G.L.; Lanza, M.; Lepone, A.; Scalici, M.; Trentacoste, A. & Zaccagnino, C. (eds.): *New Excavations in the Urban Area of Caere*, *Mouseion. Journal of the Classical Association of Canada*, Series III, vol. 13: 409-435. University of Toronto Press, Toronto.

APPENDIX 4. The osteometric measurements are expressed in millimetres and were taken in accordance with the method proposed by Driesch (1976). The abbreviations are those used by the same author. The BT and HTC measurements of the humerus in all species were taken in the way described by Payne & Bull (1988) for pigs, the measurements of the metapodials of cattle follow Davis (1992), while those of equids follow Eisenmann *et al*. (1988).

Equus sp.

Metatarsal: 1) 8=11.3; 10=47.7; 11=45.4; 12=35.7; 13=26.5; 14=31.3

Bos taurus

Metacarpal: 1) GL 205 Bp 56.1 SD 34.4 DD 22.3 Batf 55.3 WCL 27.2 DIM 29.3 DEL 23.1; 2) Bp 54.7 Dp 31.2
Metatarsal: 1) GL 218 Bp 48.6 Dp 43.8 Bd 56.1 Dd 31.5 SD 29 DEM=24.8; DVM=32.1; DIM=28.2; DEL=22.8; DVL=31; DIL=28.6; BFdm=26.8; Bfdl=25.2; 2) Bd 69.7 Dd 37.6 WCM 31.6 WCL 31.4 DEM 29.7 DVM 38 DIM 34.5 DEL 28.3 DVL 37.2 DIL 34.6

Ovis aries

M3: 1) L 13.6 B 8
Calcaneus: 1) GL 56.6 GB 19.2

Capra hircus

M3: 1) L 15
Tibia: 1) Bd 25.6 Dd 19.1

Ovis vel *Capra*

Scapula: 1) SLC 20 GLP 32.4 LG 26.1 BG 22.2; 2) SLC 23.6
Humerus: 1) Bd 30.9 BT 30.6 HTC 14.4
Radius: 1) Bp 26.9 Dp 15.4;
Metacarpal: 1) Bd 24.4 Dd 16; 2) Bd 29
Astragalus: 1) GLl 29.1 Dl 16.1 Bd 20.2; 2) GLl 25.3 GLm 25.6 Dl 13.8 Dm 15 Bd 16.4
Metatarsal: 1) Bp 20.9

Sus domesticus

dP^4: 1) L 14.3 WP 11.3
M^1: 1) L 16.1 WA 13.5 WP 13.1
M^2: 1) L=21.6 WA=15.2 WP=16.2; 2) L 21.2
dP_4: L=18 WP=8
M_1: 1) L=16.3 WA=9.9 WP=10; 2) L 15.1 WA: 10.4; 3) L 16.1 WA 10 WP 10.4
M_2: 1) L=21.3 WA=13.3 WP=13.9; 2) L 21.6 WP 13.8
M_3: 1) L 15.2
Scapula: 1) GLP 33.4 LG 26.1 BG 24.6
Radius: 1) Bp 26.7 Dp 18; 2) Bp 26.9 Dp 17.9; 3) Bd 35.5
Ulna: 1) DPA 32.8
IV metacarpal: 1) Bp 14.6
Tibia: 1) Bd 29.7 Dd 26.6; 2) Bd 29.8 Dd 24.5
III metatarsal: 1) GL 77.8 LeP 75.5 Bp 16.1 B 11 Bd 15.2
IV metatarsal: 1) Bp 13; 2) Bp 12.5

Canis familiaris

IV metacarpal: 1) GL 68.2 Bd 8.7; 2) Bp 7.9
Femur: 1) GL 197 SD 14.7 Bd 34.2

Tibia: 1) Bd 24.4 Dd18.2
III metatarsal: 1) Bp 9.9

REFERENCES

DAVIS, S.J.M. 1992: A rapid method for recording information about mammal bones from archaeo-logical sites. Ancient Monuments Laboratory Report, 19/92. Historic Buildings and Monu-ments Commission for England, London.

DRIESCH, A. von den 1976: A Guide to the Measurement of Animal Bones from Archaeological sites. Harvard University Press, Cambridge.

EISENMANN, V.; ALBERDI, M.T.; DE GIULI, C. & STAESCHE, U. 1988: Volume I: Methodol-ogy. In: Woodburne, M. & Sondaar, P. (eds.): *Studying Fossil Horses. Collected papers after the "New York International Hipparion Conference, 1981"*: 1-71. E.J. Brill, Leiden.

PAYNE, S. & BULL, G. 1988: Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *Archæozoologia* 2: 27-65.

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A preliminary investigation of cattle (*Bos taurus*) size and shape changes between the Copper Age and the Bronze Age in Northern Italy

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ABSTRACT: The period spanning between the Late Neolithic and the Bronze Age in Northern Italy witnessed the introduction of a number of innovations, such as new settlement patterns and new husbandry strategies, which signalled a distinct break from previous Neolithic cultural and economic traditions. Previous zooarchaeological studies suggest that, until the late Copper Age, cattle were large, closer to their Neolithic counterparts in terms of size. In the Bronze Age, however, a significant reduction in body size was noted. Since that phenomenon has been mainly based on macroscopic observations, and the size reduction has never been confirmed in terms of biometry, this work aims to explore the presence (or absence) of size and shape variations in cattle throughout this period through the use of a variety of biometrical techniques. Our results appear to contradict what previous researchers had noted since postcranial measurements reveal no significant changes in body size and shape trends emerging between periods.

KEYWORDS: BIOMETRY, COPPER AGE, BRONZE AGE, CATTLE, NORTHERN ITALY

RIASSUNTO: Il periodo tra il tardo Neolitico e l'età del Bronzo in Italia settentrionale vide l'introduzione di una serie di innovazioni (nuovi modelli di insediamento e nuove strategie di allevamento) e una netta rottura con le tradizioni culturali ed economiche proprie del Neolitico. Precedenti studi archeozoologici suggeriscono che fino alla tarda età del Rame i bovini erano di grandi dimensioni, più vicini agli esemplari neolitici. Nell'età del Bronzo, tuttavia, si può notare una significativa riduzione di taglia degli individui. Poiché tale affermazione si basa principalmente su osservazioni macroscopiche e la riduzione di taglia non è mai stata pienamente dimostrata biometricamente, il presente lavoro si propone di identificare, con l'uso di diverse tecniche biometriche, la presenza (o l'assenza) di tali variazioni di taglia e forma nei bovini nel corso del tempo. I risultati del nostro studio sembrano contraddire quanto notato in studi precedenti: dalle analisi delle misure postcraniali dei bovini, infatti, non sono emerse significative variazioni di taglia e forma nelle popolazioni considerate.

PAROLE CHIAVE: BIOMETRIA, ETÀ DEL RAME, ETÀ DEL BRONZO, BOVINI, ITALIA SETTENTRIONALE

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RESUMEN: En la Italia septentrional, el período comprendido entre el Neolítico tardío y la Edad del Bronce evidencia la aparición de una serie de innovaciones en los patrones de asentamiento y estrategias pecuarias, que marcan una ruptura con las tradiciones culturales y económicas del Neolítico. Estudios zooarqueológicos previos sugieren que, hasta finales de la Edad del Cobre, el vacuno era grande, más cercano a sus homólogos del Neolítico, en términos de tamaño, en tanto que en el Bronce se comenta una reducción significativa del tamaño corporal en esta cabaña. Dado que este fenómeno se ha basado principalmente en observaciones macroscópicas, y la reducción de tamaño nunca ha sido confirmada en términos biométricos, nuestro estudio tiene por objeto explorar la presencia (o ausencia) de variaciones de tamaño y forma del vacuno durante estos períodos mediante el uso de distintas técnicas biométricas. Los resultados parecen contradecir lo que investigadores anteriores habían observado, puesto que nuestras mediciones de elementos poscraneales no revelan cambios significativos en el tamaño y forma del cuerpo referidas entre períodos.

PALABRAS CLAVE: BIOMETRÍA, EDAD DEL COBRE, EDAD DEL BRONCE, BOVINO, ITALIA SEPTENTRIONAL

INTRODUCTION

It is well known that the Bronze Age (*c*. 2200 B.C. – 900 B.C.) in Northern Italy brought significant changes in the way ancient communities interacted with their environment and represented, in several respects, a break from the Neolithic (*c*. 5500 B.C. – 3400 B.C.) and Copper Age (*c*. 3400 B.C. – 2200 B.C.) cultural traditions. During the Neolithic, cyclical and itinerant agriculture was practised: human communities inhabited short-lived villages until the fertility potential of the land was exhausted, forcing them to move on to another location (Rottoli & Pessina, 2007; Nisbet, 2013; Starnini *et al*., 2017). Conversely, in the Bronze Age, thanks to the technological innovations introduced during the Copper Age (such as metallurgy, the introduction of the plough and the wheel), sedentary and long-lasting settlements appeared to be systematically inhabited (Tecchiati *et al*., 2020). This change in settlement patterns went hand in hand with other important developments: human communities started to rely more heavily on husbandry and slowly abandoned hunting and gathering activities which, in previous periods, had great economic significance (Carra, 2012). Animal husbandry, as we know it, was established in the Bronze Age (although this process was very slow and was not equally widespread in all of Northern Italy), and zooarchaeological evidence (Salvagno & Tecchiati, 2011; Tecchiati *et al*., 2020) shows that it is in this period that the exploitation of the highlands for transhumance became systematic. Finally, we believe that it is only in the Bronze Age that the secondary products revolution took place [*i.e*., the systematic exploitation of domestic animals not only for meat, leather and bones, but also for milk, wool and traction power. See Sherratt (1981) and Putzolu (2021)].

Zooarchaeology has the potential to give us an insight into husbandry practices and shows us how these were influenced by, and adapted to, the changing economy and society that characterized the period between the Late Neolithic and the Bronze Age (Riedel, 1976a). While it is a well-known phenomenon that across Neolithic Europe cattle size tends to get smaller through time (Bökönyi, 1974; Meadow, 1989; Manning *et al*., 2015) in Norther Italy like in Switzerland (Bopp-Ito *et al*., 2018; Wright *et al*., 2021), we do not see such pattern. It is generally believed that cattle size changed later, between the Copper Age and the Bronze Age in this area: cattle seem to be large until the end of the Copper Age (possibly due to the persistence of a type of exploitation where breeds were not selected for different uses), in the Bronze Age, new exploitation techniques led to a decrease in size of this species (Riedel, 1976a). While a most recent study conducted by Trentacoste *et al*. (2018) has showed that in Northern Italy cattle size increases between the Bronze Age and the Iron Age (*c*. 1650-150 B.C.), comprehensive biometrical studies such as this have not been carried out for earlier periods. In fact, the belief that between the Copper Age and the Bronze Age cattle underwent a size decrease in Northern Italy is still mainly based on Alfredo Riedel's macroscopic observations (*i.e*., visual inspection of faunal remains). An early attempt to biometrically detect such phenomenon was made by Riedel himself (1976b, c). However, a common practice in Riedel's work was to compare the average of measurements from one site with the same data from other contemporary (or not contemporary) sites. Riedel can rightly be considered a pioneer of Zooarchaeology, and his work holds still indisputable scientific value; nevertheless, with the adoption of new biometrical techniques, his approach might be regarded as obsolete, especially when seeking an in-depth insight into size and shape variations in archaeological populations. Considering these premises, the aim of this paper is to start a very preliminary biometrical analysis of Northern Italian cattle (*Bos taurus*) assemblages dated between the Late Neolithic and the Bronze Age in order to: A) identify, with the use of a variety of biometrical techniques, the presence (or absence) of size and shape variations in cattle through time; B) if present, try to identify the timing of such changes; and C) assess whether cattle size changes were influenced by/adapted to the adoption of different political and economic systems happening in the period considered.

MATERIALS AND METHODS

The cattle assemblages used in this study were selected from archaeological sites in Northern Italy from which extensive and chronologically reliable faunal collections originated. All assemblages are dated to between the Late Neolithic and the Late Bronze Age (Table 1 in Supplementary Material 1, Figure 1). Within each main chronological period several chronological sub-phases existed, however, these had a small number of measurements. As such, in order to improve sample sizes, the data were organised in three main groups: the Late Neolithic, the Copper Age and the Bronze Age. While this data organization increased sample sizes, it

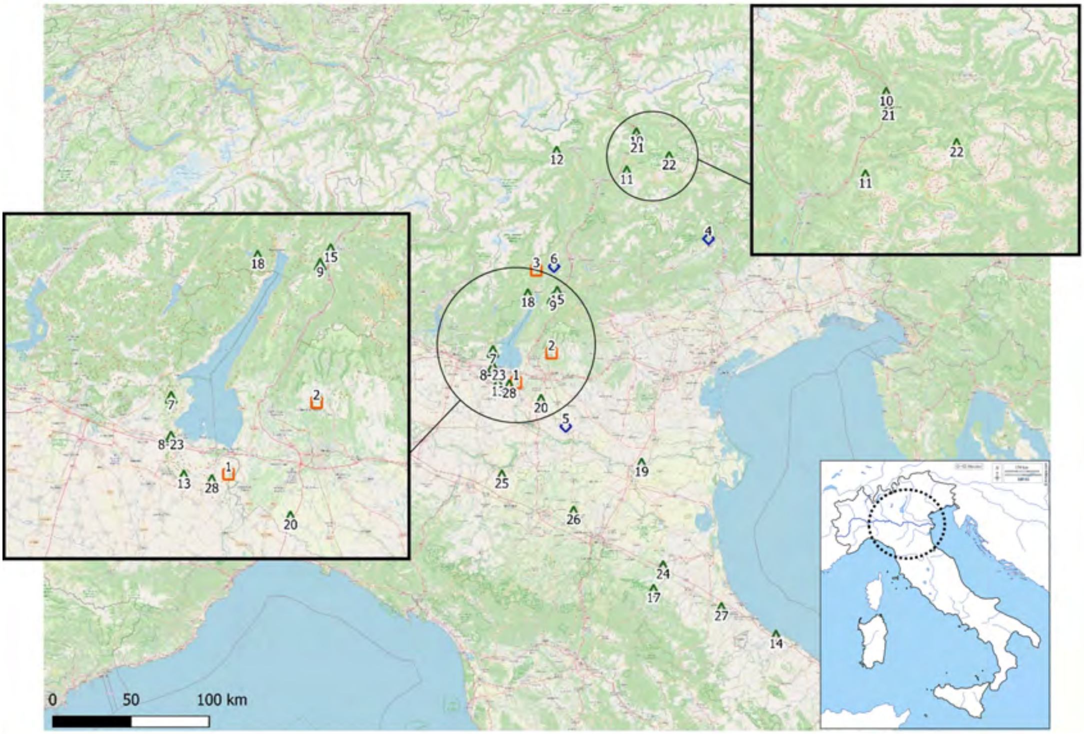

FIGURE 1

Map showing the location of the sites included in this study (GIS by Dr. Fiorenza Gulino). 1: Tosina di Monzambano; 2: Colombare di Negrar; 3: Fiavè 1; 4: Belluno, Col del Buson; 5: Gazzo Veronese, Il Cristo; 6: Lasino, Riparo del Santuario; 7: Lucone; 8: Lavagnone; 9: Colombo di Mori; 10: Nössing; 11: Siusi, Castelrotto; 12: Naturno; 13: Barche di Solferino; 14: Cattolica; 15: Grotte di Castel Corno, Isera; 16: Sergnano; 17: Grotta dei Banditi; 18: Ledro; 19: Canàr; 20: Camponi di Nogarole Rocca; 21: Albanbühel; 22: Sotciastel; 23: Lavagnone; 24: Solarolo, Via Ordiere; 25: Santa Rosa di Poviglio; 26: Montirone di Sant'Agata Bolognese; 27: Case Missiroli; 28: Castellaro Lagusello. Chronological periods are referred to as follows: orange square = Late Neolithic; blue rhombus = Copper Age, green triangle = Bronze Age.

also made it impossible to assign patterns to tighter chronological periods.

In order to carry out our biometrical analysis, measurements of cattle molars and postcranial bones were collected from the relevant literature (see Table 1 in SM 1). All measurements collected were taken using the guidelines published by Driesch (1976), however, only fusing and fully fused specimens were included in the analysis. Both tooth and postcranial measurements were considered. Tooth size tends to be more conservative and less affected by environmental factors, age and sex, thus allowing us to make considerations about genetic change in the livestock population (Payne & Bull, 1988). Contrarily, changes in postcranial measurements could be linked to changes in the environment, nutrition, or sex ratio of the herd (Grau-Sologestoa & Albarella, 2019). An initial metric assessment was carried out using scatterplots for both tooth and postcranial measurements. Change in the shape of postcranial bones was investigated using shape ratios of astragalus measurements (Bd/GLl vs Dl/GLl). These measurements were chosen due to their relatively large sample size. Maximum M_3 (third lower molar) width was plotted as a histogram to identify change in tooth size through time. Molar width was chosen for this assessment as it is not much affected by sexual dimorphism and shows less age-related changes than length.

To better evaluate size changes through time, the log ratio technique was used (Simpson, 1941; Meadow, 1999; Albarella, 2002); this allows us to combine different measurements on the same axis, (i.e., lengths, widths and depths) thus enabling us to work with larger sample sizes. Lengths, widths, and depths (when possible) were analysed separately, as combining different planes could blur changes affecting one particular dimension of the bones. Measurements from teeth and postcranial bones are usually considered separately in this technique to distinguish genetic from environmentally induced changes (Albarella & Payne, 2005); however, in our case, cattle tooth measurements were not enough and, as such, they were excluded. The log ratio technique is a size scaling method which is based on the comparison of the relative size (rather than absolute) of archaeological specimens to a standard (a population or a single individual) by calculating the logarithm of the ratio between the archaeological measurement and the standard (Payne & Bull, 1988). In this study the standard used is a 13-year-old modern Hinterwälder female (Z-2431) (Breuer *et al*., 1999; Bopp-Ito *et al*., 2017; Wright, 2021). Only a selection of all possible measurements was considered for this analysis; these were chosen because: A) they are commonly present in archaeological assemblages; B) they are standardised and commonly taken, thus allowing comparability across different researchers; C) they are not highly affected by sexual dimorphism and D) they are not highly age dependant (Popkin *et al*., 2012). The list of anatomical elements and measurements used for this analysis is provided in Table 2 in SM1. SM1 also shows measurements sample size for each axis per chronological period (Table 3 in Supplementary Material).

The statistical significance of observed differences in size between periods was tested using a non-parametric test such as the Kruskal-Wallis test (1952). This test was chosen because sample sizes for the different chronological periods were unequal and not normally distributed.

RESULTS

A first attempt to detect changes in size and shape of cattle was made by using scatterplots comparing linear measurements for as many anatomical elements as possible. Due to the small number of measurements at our disposal (dominated by breadth), we could only use the following elements and combination of measurements: scapula (BG/GLP), radius (BP/BFp), ulna (DPA/BPC) and astragalus (Bd/Dl and Bd/GLl). Scatterplots for all the above-mentioned elements (excluding the astragalus) are provided in SM2 (Figure 1). Figure 2 shows the results we obtained with the astragalus, the only element for which we had a relatively large sample.

If we look at Figure 1 in SM2 and Figure 2, some considerations can be made. First, it should be noted that there is a significant difference in terms of sample size: the Bronze Age sample is much larger than the Late Neolithic sample and even more so for the Copper Age sample. Secondly, if we look at the distribution of the data, the Bronze Age sample presents a very similar variability to the Late Neolithic sample: both groups, in fact, occupy the same area of the graph (evident in both the astragalus and the scapula). If a difference in size was present, we would expect both samples to be aligned to the regression line but both plotting in a different area of

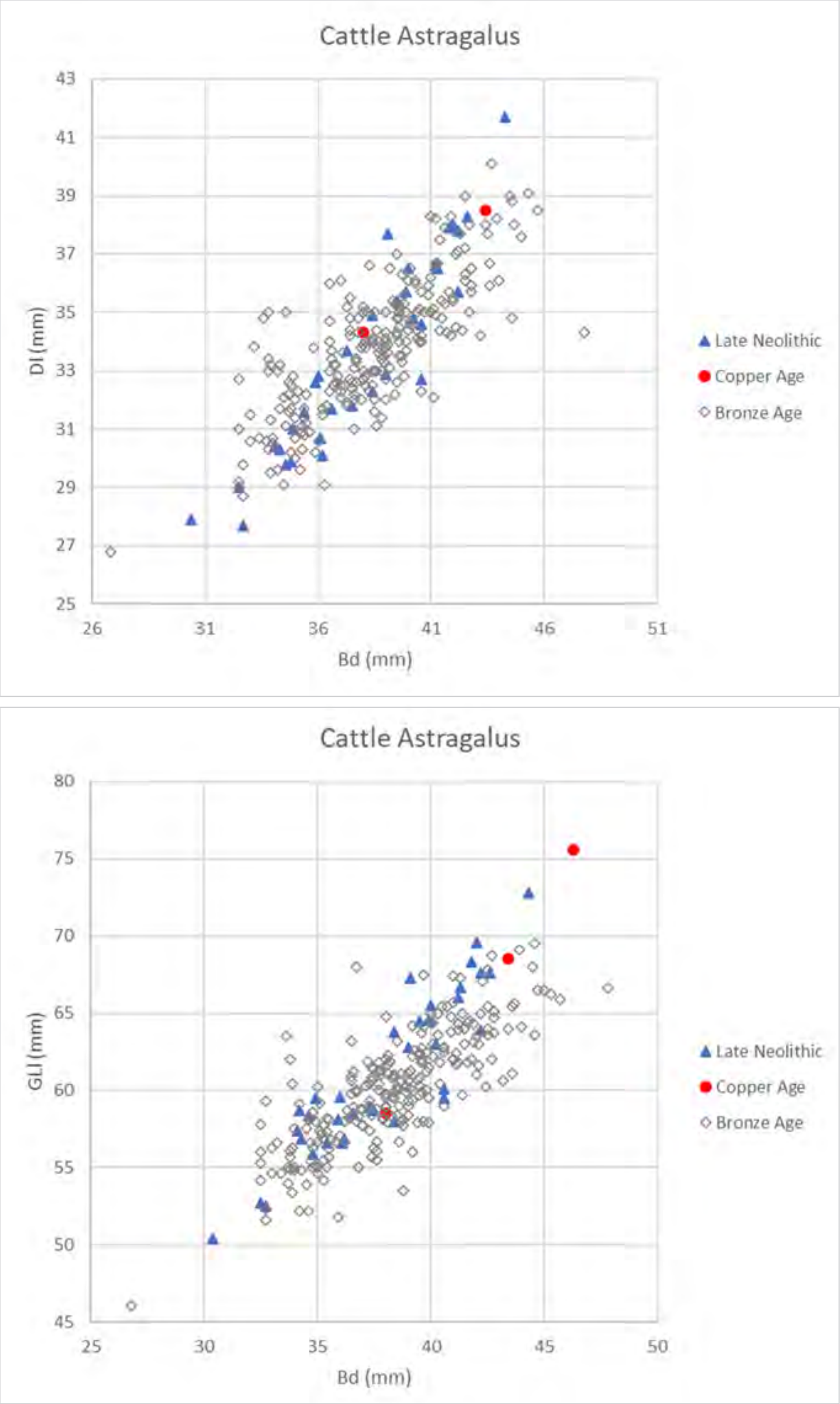

FIGURE 2

Scatter plots comparing cattle astragalus measurements (Bd= greatest breadth of distal end; Dl= greatest depth of the lateral half; GLl= greatest length of the lateral half).

the graph. This is not what our graphs show. While this pattern could perhaps not be genuine due to the relative paucity of data for the Late Neolithic and the Copper Age, we cannot ignore the fact that, even when the sample size increases (see astragalus in Figure 2), no clear pattern can be seen.

Maximum breadth and length of cattle upper and lower third molars (M^3 and M_3) were also used to assess whether patterns of size change could be identified. Figure 2 in SM2 shows that, when tooth measurements are considered, sample sizes increase for all periods (except for the Copper Age sample which is still underrepresented). For both M^3 and M_3, the Bronze Age population shows much more variability than the Late Neolithic (especially for the width measurements, see Figure 2 in SM2): the Bronze Age specimens are more scattered on the graph than the Late Neolithic specimens, which appear to be concentrated more tightly. Furthermore, in both teeth (but especially in M_3) a pattern can be identified: the Late Neolithic animals have, in general, a very similar width to the Bronze Age animals. However, many Bronze Age individuals tend to have smaller length values compared to the Late Neolithic populations. This pattern seems to suggest the existence of morphological differences between some of the Late Neolithic and the Bronze age animals (as changes involve prominently one of the two dimensions - the length of the tooth).

Change in postcranial bones shape was investigated using the shape ratio technique on the astragalus (chosen for its relatively large sample size). The combination of measurements used were Bd/GLl *vs* Dl/GLl (Figure 3). The plot shows that, once again, there is much more variability among the Bronze Age sample than the Late Neolithic. There is a lot of overlap between the Late Neolithic and the Bronze Age groups; however, even though no clear separation between periods is present, some of the Bronze Age individuals seem to occupy an area of the graph where not many Late Neolithic (and Copper Age) specimens lie (i.e. the top right corner). This distribution seems to suggest that some shape differences exist between the Late Neolithic group and the Bronze Age individuals (having generally higher values on both axes). This pattern is, however, not very clear.

The log ratio technique was then applied to detect size changes over time. By grouping different measurements on the same axis (in our case lengths

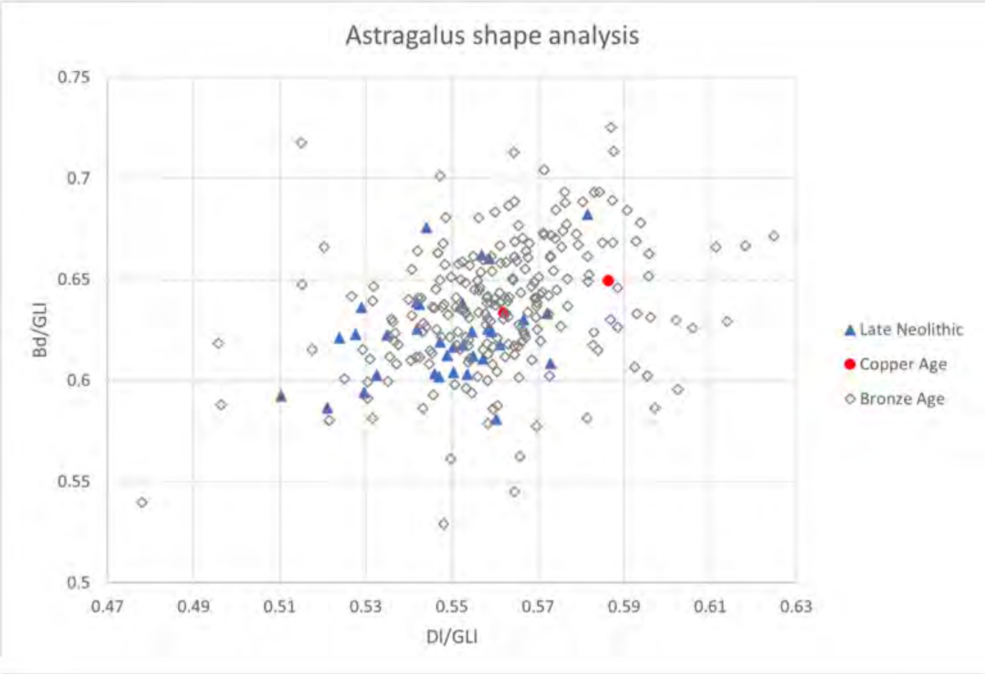

FIGURE 3

Scatter plot comparing the ratios of astragalus measurements for cattle (Bd= greatest breadth of distal end; Dl= greatest depth of the lateral half; GLl= greatest length of the lateral half).

and widths as we did not have enough measurements to evaluate depth), we could work on larger sample sizes. Figure 3 in SM2 shows log ratio histograms for cattle postcranial length measurements for each chronological period. Unsurprisingly, the Late Neolithic and the Bronze Age samples are significantly larger (respectively 42 and 349 length measurements) than the Copper Age sample; this latter has a very small sample size making it impossible to draw any meaningful observation. If we consider the mean log value for the Late Neolithic sample (–0.03) and the Bronze Age sample (–0.04), we can see that they are both smaller than the standard but very close to each other. A similar result is also given when cattle postcranial bone widths measurements are considered (Figure 4 in SM2): the Late Neolithic and the Bronze Age log mean values (respectively –0.01 and –0.02) are very similar. This evidence suggests that the Bronze Age animals were similar in size to the Late Neolithic animals as far as postcranials measurements are concerned. The mean log values for both postcranial length and width measurements for the Late Neolithic and the Bronze Age samples were tested with a Kruskal-Wallis test and no statistically significant differences emerged (Table 1 in SM2).

Since it was not possible to apply the log ratio technique on tooth measurements due to their small sample size, we decided to use the maximum width of the M_3 (larger sample size than the M^3) to see whether we could see hints of size change in teeth. Figure 5 in SM2 shows that the width of the M_3 does not reveal a significant size change between periods (Late Neolithic Mean=13.32; Copper Age Mean= 13.03; Bronze Age Mean=14.00). These values were also statistically tested, and the results were not significant (Table 2 in SM2). It must be noted that the data for the Bronze Age have a wider distribution compared to the sample from the Neolithic period. Moreover, several Bronze Age animals have tooth width above 15mm showing, therefore, to have relatively more robust M_3. This might be an indication of some morphological differences, however the sample size for the two periods is very unequal.

DISCUSSION AND CONCLUSIONS

In this article we have only begun to uncover important research questions concerning changes in husbandry practices occurring in Northern Italy between the Late Neolithic and the Bronze Age. The Copper Age has, on many levels, always been considered a continuation of Neolithic economic and cultural traditions. On the contrary, the Bronze Age (especially during its earlier phases) represents a break from previous patterns of behaviour and brings elements of innovation which must have had an impact on the economic system adopted by human communities and, as such, on the husbandry strategies practised.

Previous studies suggest that, until the late Copper Age, larger animals, closer in size to their Neolithic counterparts were present (for example, in our sample see cattle size at the site of Gazzo Veronese, Il Cristo. Riedel & Rizzi-Zorzi, 2005). In the Bronze Age however, a significant reduction in body size can be noted. The results from our study seem to contradict the above statement. When cattle postcranial measurements were analysed using different techniques, no significant changes in body size emerged between periods. Even the results obtained from the biometrical analysis of the astragalus, the only element for which we had a good sample size, show no clear size pattern; however, we cannot help but wonder whether size differences in Figure 2 would be clearer if a group of very small individuals dated to the Late Neolithic (from the sites of Tosina di Monzambano and Fiavè 1) were excluded from the analysis. This exclusion would, in fact, determine a more defined size separation (with half of the Bronze Age astragali plotting on the left bottom corner while the Late Neolithic sample would mainly occupy the upper right area). Interestingly, the presence of very small cattle in Tosina and Fiavè 1 could be explained by the introduction of smaller animals from Switzerland and the Alpine area where their presence is well documented in the zooarchaeological records in the Late Neolithic (Boessneck *et al*., 1963; Förster, 1974; Wright, 2021). Naturally, such an introduction would first take place in the area around the Lake Garda (where the above-mentioned sites are located) as it is geographically closer to the Alpine regions and, most likely, heavily influenced by the Northern Alpine cultural facies.

Shape was also analysed using shape ratios (only on the astragalus) but very little indication of changes emerged (Figure 3). As far as cattle postcranial bone measurements are concerned, our results seem to describe a relatively static scenario.

A slightly different situation emerges from the analysis of cattle tooth measurements. In fact, some differences seem to be present between the Late Neolithic and the Bronze Age populations affecting the length of the M_3 (Figure 2 in SM2). It would be very tempting to interpret this evidence as a possible indication of genetic change in the cattle population; however, these results must be taken with caution. Firstly, because we are comparing samples with very uneven sizes and, secondly, because we are using measurements that have been collected by different researchers and measurer variability is higher in tooth measurements than in postcranial measurements. In conclusion, our study has not brought to light clear evidence of size or shape changes affecting cattle between the Late Neolithic and the Bronze Age. However, some hints are present and only further studies will be able to clarify the situation. In addition, from our analysis, the presence of particularly small individuals dated to the Late Neolithic emerged. The introduction in Northern Italy of a smaller type of cattle in the Late Neolithic was contemporaneous with the presence of a larger type of animal, well attested in the archaeological record in the Early and Middle Neolithic (Cazzella *et al*., 1976; Rowley-Conwy, 1997; Agrostelli *et al*., 2015). Only in the Middle and Late Bronze Age did these larger animals disappear, and the smaller type become predominant. In a context in which animal husbandry starts to be dominated by new forms of animal management, such as pastoralism and transhumance, and characterised by the progressive transition from a nomadic way of life to the creation of permanent settlements, the "selection" of smaller animals seems understandable: smaller individuals would be much easier to control and to periodically move.

Our study also gave us the opportunity to identify areas of research which need further exploration and research aspects which should be prioritised:

a) Sample size is notoriously a problem when working with very old assemblages. We recommend that future studies on this topic collect as much metric data as possible and widen the geographic range considered. In addition, we recommend integrating the zooarchaeological data with paleoenvironmental and paleoecological data.

b) This, in turn, will allow consideration of to what extent ancient economies were subject to/changed by their local environment. In this regard, it would be interesting to see whether, with a bigger sample, differences in cattle size and morphology could be found between populations living in different geographical areas. This, in fact, would allow the evaluation of potential regional variability at play.

c) Early in this study the need for better defined chronologies emerged. While this is unfeasible for assemblages excavated in the 70s and 80s, it is highly desirable for more recently excavated assemblages. A more precisely defined chronology would, in fact, allow us to identify patterns with much greater temporal precision.

d) In our study we focused on anatomical elements which are less influenced by age and sex. However, considering the paucity of measurements available, we suggest including in the analysis other anatomical elements often abundantly present in Late Neolithic-Copper-Bronze Age assemblages. However, this will then require a more in-depth consideration of the extent to which factors such as age and sexual dimorphism affect size and shape in the sample. It is important to bear in mind that we are dealing with two chronological periods dominated by different economic choices: in the Late Neolithic with the main economic focus being on meat, we would expect both sexes to be killed equally. Contrarily, in the Bronze Age, with the interest shifting from meat to secondary products (especially milk), we would expect most of the herd to have been dominated by females. Biometrically, these economic choices would and should result in the Late Neolithic sample having larger measurements than the Bronze Age sample. To what extent it is possible to clarify whether size changes are genuine rather than the result of different male/female propositions in the sample is something we hope future researchers will be able to clarify.

We are aware of the preliminary nature of our study and that since our article was drafted and submitted for publication more cattle biometric data for our regions of interest were made publicly available (Trentacoste *et al*., 2022). As such, we hope that our research will represent a jumping off point for further and wider research on this topic to be undertaken.

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SUPPLEMENTARY MATERIAL

See supplementary material at https://revistas.uam.es/archaeofauna/article/view/archaeofauna34.1_026

REFERENCES

Agrostelli, M.; Fontana, A. & Tecchiati, U. 2015: Castelnuovo di Teolo (Padova), scavi 2011. I dati archeobotanici e faunistici. In: Leonardi, G. & Tine, V. (eds.): *Studi di Preistoria e Protostoria* 2: 647-651. Preistoria e Protostoria del Veneto, Firenze.

Albarella, U. 2002: Size matters: how and why biometry is still important in zooarchaeology. In: Dobney, K. & O'Connor, T. (eds.): *Bones and the man. Studies in honour of Don Brothwell*: 51-62. Oxbow Books, Oxford.

Albarella, U. & Payne, S. 2005: Neolithic pigs from Durrington Walls, Wiltshire, England: a biometrical database. *Journal of Archaeological Science* 32: 589-599.

Amato, A. 2019/2020: *Il contributo dell'archeozoologia e della petroarcheometria degli impasti ceramici allo studio della mobilità e del transfert culturale nell'Antica età del Bronzo dell'Italia settentrionale. Il caso dell'insediamento di Canàr di San Pietro Polesine (RO)*. Università degli Studi di Milano, Milano.

Boessneck, J.; Jéquier, J.-P. & Stampfli, H. R. 1963: Seeberg Burgäschisee-Süd. Die Tierreste. *Acta Bernensia* II, Teil 3. Stämpfli, Bern.

Bona. 2015

— 2019.

Bonardi, S.; Marconi, S.; Riedel, A. & Tecchiati, U. 2002: La fauna del sito dell'antica età del Bronzo del Colombo di Mori (TN); campagne di scavo 1881 e 1970: aspetti archeozoologici, paleoeconomici e paleoambientali. *Annali del Museo Civico di Rovereto, Sezione: Archeologia, Storia, Scienze Naturali* 16: 63-102.

Bökönyi, S. 1974: *History of Domestic Mammals in Central and Eastern Europe*. Akadèmiai Kiadó, Budapest.

Bopp-Ito, M.; Deschler-Erb, S.; Vach, W. & Schibler, J. 2018: Size diversity in Swiss Bronze Age cattle. *International Journal of Osteoarchaeology* 28: 294-304 doi:10.1002/oa.2654.

Breuer, G.; Rehazek, A. & Stopp, B. 1999: Grössenveränderungen des Hausrindes. Osteometrische Untersuchungen grosser Fundserien aus der Nordschweiz von der Spätlatènezeit bis ins Frümittelalter am Beispiel von Basel, Augst (Augusta Raurica) und Schleitheim-Brüel. *Jahresberichte aus Augst und Kaiseraugst* 20: 207–228.

Carra, M. 2012: *Per una storia della cerealicoltura in Italia settentrionale dal Neolitico all'Età del Ferro: strategie adattive e condizionamenti ambientali*. Alma Mater Studiorum – Università di Bologna, Bologna.

Cazzella, A.; Cremaschi, M.; Moscoloni, M. & Sala, B. 1976: Siti neolitici in località Razza di Campegine (Reggio Emilia). *Preistoria Alpina* 12.

De Grossi Mazzorin, J. & Solinas, A. M. 2013: L'analisi dei resti faunistici provenienti dai settori A ed E della palafitta del Lavagnone. In: De Grossi Mazzorin, J.; Curci, A. & Giacobini, G. (eds.): *Economia e ambiente nell'Italia padana dell'età del Bronzo. Le indagini bioarcheologiche*: 21-102. Quaderno BACT 11, Bari, Edipuglia.

Driesch, A. 1976: A guide to the measurement of animal bones from archaeological sites. *Peabody Museum Bulletin* 1. Peabody Museum of Archaeology and Ethnology. Harvard University, Cambridge MA.

Fapanni, F. 2018/2019: *I resti faunistici dell'età del Bronzo di Sergnano – Agnadello (CR): aspetti archeozoologici, paleoeconomici e paleoambientali. Il Settore 1*. Università degli Studi di Milano, Milano.

Fontana, A.; Marconi, S. & Tecchiati, U. 2010: La fauna dell'antica età del Bronzo delle Grotte di Castel Corno (Isera – TN). *Annali del Museo Civico di Rovereto, Sezione: Archeologia, Storia, Scienze Naturali* 25: 27-66.

Fontana, A.; Tecchiati, U.; Bianchin Citton, E. & Mondini, C. 2015: I resti faunistici dell'età del

Rame del Col del Buson, Valle dell'Ardo (Belluno). Aspetti archeozoologici e paleoeconomici. In: Thun Hohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7⁰ Convegno Nazionale di Archeozoologia*, *Annali dell'Università degli Studi di Ferrara* 11/2: 51-56. DOI: http://dx.doi.org/10.15160/1824-2707/1044.

Förster, W. 1974: *Die Tierknochenfunde aus der neolithischen Station Feldmeilen-Vorderfeld am Zürichsee II. Die Wiederkäuer*. Tiermed. Diss. Univ. München, München.

Grau-Sologestoa, I. & Albarella, U. 2019: The 'long' 16th century: a key period of animal husbandry change in England. *Archaeological and Anthropological Sciences* 11: 2781–2803.

Kruskal, W.H. & Wallis, W.A. 1952: Use of ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association* 47(260): 583-621. DOI 10.2307/2280779.

Maini, E. 2012: *Lo sviluppo dell'allevamento in Emilia-Romagna. Aspetti economici e implicazioni sociali nella gestione della risorsa animale durante l'età del Bronzo*. Alma Mater Studiorum – Università di Bologna, Bologna.

Malerba, G.; Rocci Ris, A.; Giacobini, G. & Fasani, L. 2004: I macromammiferi del sito dell'età del Bronzo di Castellaro Lagusello (Monzambano – MN): primi dati. In: Malerba, G. & Visentini, P. (eds.): *Atti del 4⁰ Convegno Nazionale di Archeozoologia*, *Quaderni del Museo Archeologico del Friuli Occidentale* 6: 223-235.

Manning, K.; Timpson, A.; Shennan, S. & Crema, E. 2015: Size reduction in Early European Domestic Cattle Relates to Intensification of Neolithic Herding Strategies. *Plos One* 10: e0141873.

Meadow, R. 1989: Osteological evidence for the process of animal domestication. In: Clutton-Brock, J. (ed.): *The walking larder: patterns of domestication, pastoralism, and predation*. Unwin Hyman, London.

— 1999: The use of size index scaling techniques for research on archaeozoological collections from the Middle East. In: Becker, C.; Manhart, H.; Peters, J. & Schibler, J. (eds.): *Historia animalium ex ossibus. Festschrift für Angela von den Driesch*: 285-300. Verlagmarie Leidorf GmbH, Rahden/Westf.

Nisbet, R. 2013: Rapid Rivers, Slow Forests: Early Neolithic Charcoal from Northern Italy. In: Starnini, E. (ed.): *Unconformist Archaeology: Papers in honour of Paolo Biagi*: 3-13. B.A.R. (International Series) 2528. Oxford.

Payne, S. & Bull, G. 1988: Components of variation in measurements of pig bones and teeth, and the use of measurements to distinguish wild from domestic pig remains. *ArchaeoZoologia* II: 27–66.

Pizzini, G. 2014: *Studio dei resti faunistici del sito dell'età del Bronzo di Siusi, Castelrotto (BZ)*. Università degli Studi di Trento.

Popkin, P.R.W.; Baker, P.; Worley, F.; Payne, S. & Hammon, A. 2012: The sheep project: determining skeletal growth, timing of epiphyseal fusion and morphometric variation in unimproved Shetland sheep of know age, sex, castration status and nutrition. *Journal of Archaeological Science* 39: 1775-1792.

Putzolu, C. 2021: The Secondary Product Revolution: a model for the understanding of population dynamics in Northern Italy between the Neolithic and the Bronze Age. *IpoTESI di Preistoria* 14: 123-142.

Riedel, A. 1976a: La fauna del villaggio eneolitico delle Colombare di Negrar (Verona). *Bollettino del Museo Civico di Storia Naturale di Verona* III: 205-238.

— 1976b: La fauna del villaggio preistorico di Barche di Solferino. *Atti del Museo Civico di Storia Naturale di Trieste*, vol. XXIX, fasc. 4, n. 12: 215-318.

— 1976c: La fauna del villaggio preistorico di Ledro. Archeo-zoologia e paleo-economia. *Studi Trentini di Scienze Naturali*, vol. LIII, n. 5B.

— 1992: The Bronze Age animal bone deposit of Nogarole Rocca I Camponi (Verona). *Padusa: bollettino del centro polesano di studi storici archeologici ed etnografici (CPSSAE)* XXVIII: 86-104.

— 1996: Archaeozoological investigations in North-eastern Italy: the exploitation of animals since the Neolithic. *Preistoria Alpina, Museo Tridentino di Scienze Naturali* 30 (1994): 43-94.

— 2004: La fauna. In: Bernabò Brea M. & Cremaschi M. (eds.): *Il Villaggio Piccolo della terramara di S. Rosa di Poviglio (Scavi 1987/1992)*: 703-736. I.I.P.P., Firenze.

Riedel, A. & Rizzi-Zorzi, J. 2005: La fauna dell'età del Rame di Gazzo Veronese, "Il Cristo" (VR). *Padusa: bollettino del centro polesano di studi storici archeologici ed etnografici (CPSSAE)* XLI: 153-176.

Riedel, A. & Tecchiati, U. 1993: La fauna del Riparo del Santuario (Comune di Lasino – Trentino): aspetti archeozoologici, paleoeconomici e rituali. *Annali del Museo Civico di Rovereto, Sezione: Archeologia, Storia, Scienze Naturali* 8: 3-46.

— 1999: I resti faunistici dell'abitato d'altura dell'antica e media età del Bronzo di Nössing in Val d'Isarco (Com. di Varna, Bolzano). *Atti dell'Accademia roveretana degli Agiati*, a. 249, ser. VII, vol. IX, B: 285-327.

— 2000: La fauna dell'antica età del Bronzo di Naturno – Naturns, loc. Schnalserhof (Bolzano). *Atti del 2⁰*

Convegno Nazionale di Archeozoologia (Asti, 1997). Editions ABACO, Forlì.

Rizzi, J. 1996/1997: *Lo studio della fauna dell'età del Bronzo Medio di Albanbuhel-Bressanone (Bolzano)*. Università degli Studi di Padova, Padova.

Rottoli, M. & Pessina, A. 2007: Neolithic agriculture in Italy: an update of archaeobotanical data with particular emphasis on northern settlements. In: Colledge, S. & Conolly, J. (eds.): *The origins and spread of domestic plants in Southwest Asia and Europe*: 141–54. Left Coast Press, Walnut Creeck, CA.

Rowley-Conwy, P. 1997: The Animal Bones from Arene Candide. Final report. In: Maggi, R. (ed.): *Arene Candide: A Functional and Environmental Assessment of the Holocene Sequence (Excavation Bernabò Brea-Cardini 1940-50)*: 153-277. Istituto Italiano di Paleontologia Umana 5.

Salvagno, L. & TecchiatI, U. 2011: I resti faunistici del villaggio dell'età del Bronzo di Sotćiastel. Economia e vita di una comunità protostorica alpina (ca. XVII-XVI sec. a.C.). *Ladinia monografica* 3, Istitut Ladin Micurà de Rü.

Sherratt, A. 1981: Plough and pastoralism: aspects of the secondary products revolution. In: *Pattern of the Past. Studies in honour of David Clarke*: 261-305. Cambridge University Press, Cambridge.

Simpson, G.G. 1941: The large Pleistocene felines of North America. *American Museum Novitates* 1136: 1–27.

Starnini, E.; Biagi, P. & Mazzucco, M. 2017: The beginning of the Neolithic in the Po Plain (northern Italy): Problems and perspectives. *Quaternary International* 470: 1-17.

Tecchiati, U.; Salvagno, L.; Amato, A.; De March, M.; Fontana, A.; Marconi, S.; Rinaldi, G. & Zanetti, A.L. 2020: Zooarchaeological evidence of functional and social differentiation in northern Italy between the Neolithic and Bronze ages. *Quaternary International* 539: 105-121.

Trentacoste, A.; Nieto-Espinet, A. & Valenzuela-Lamas, S. 2018: Pre-Roman improvements to agricultural production: Evidence from livestock husbandry in late prehistoric Italy. *Plos One* 13: e0208109.

Trentacoste, A.; Nieto-Espinet, A., Guimarães Chiarelli, S. & Valenzuela-Lamas, S. 2022: N Italy Zooarchaeological Dataset [Data set]. Zenodo. https://doi.org/10.5281/zenodo.6917159.

Vaga, E. 2020/2021: *I resti faunistici tardo neolitici di Fiavè 1 (Trento)*. Università degli Studi di Milano, Milano.

Wright, E. 2021: Investigating cattle husbandry in the Swiss Late Neolithic using different scales of temporal precision: potential early evidence for deliberate livestock "improvement" in Europe. *Archaeological and Anthropological Sciences* 13: 1-36.

SUPPLEMENTARY MATERIAL 1

Site Number	Site Name	Chronology	Environment/function of the site	NISP	Cattle NISP	References
1	Tosina di Monzambano	LN	Lowland/settlement	39570	2772	Bona, 2015 and unpublished
2	Colombare di Negrar	LN-MBA	Prealpine/hill-slope/settlement	954	355	Riedel, 1976*
3	Fiavè 1	LN	Alpine/pile-dwelling	817	172	Vaga, 2020/2021*
4	Belluno, Col del Buson	CA	Alpine/settlement	766	297	Fontana *et al*., 2015*
5	Gazzo Veronese, Il Cristo	CA	Lowland/settlement	1958	454	Riedel & Rizzi-Zorzi, 2005*
6	Lasino, Riparo del Santuario	LCA-EBA	Alpine/cave/ritual-funeral	2058	597	Riedel & Tecchiati, 1993*
7	Lucone	EBA	Morenic hills/pile-dwelling	46799	2808	Bona, 2019 and unpublished
8	Lavagnone	EBA	Morenic hills/pile-dwelling	5423	1190	De Grossi Mazzorin & Solinas 2013*
9	Colombo di Mori	EBA	Alpine/hill-slope/cave settlement	742	161	Bonardi *et al*., 2002
10	Nössing	EBA	Alpine/Hill-top/settlement	1797	812	Riedel & Tecchiati, 1999*
11	Siusi, Castelrotto	EBA	Alpine/hill-top/settlement	1220	439	Pizzini, 2014*
12	Naturno	EBA	Alpine/valley bottom/ settlement	374	102	Riedel & Tecchiati, 2000*
13	Barche di Solferino	EBA	Morenic hills/pile-dwelling	3260	963	Riedel, 1976b*
14	Cattolica	EBA	Coastal/settlement	848	176	Maini, 2012*
15	Grotte di Castel Corno, Isera	EBA	Alpine/hill-top/cave settlement	1347	253	Fontana *et al*., 2010*
16	Sergnano	EBA-MBA	Lowland/settlement	582	240	Fapanni, 2018/2019*
17	Grotta dei Banditi	EBA-MBA	Apennines/Cave settlement	561	28	Maini, 2012*
18	Ledro	EBA-MBA	Alpine/pile-dwelling	8449	101	Riedel, 1976c
19	Canàr	EBA-MBA	Lowland/pile-dwelling	2095	346	Amato, 2019/2020*
20	Camponi di Nogarole Rocca	MBA	Lowland/settlement	1118	487	Riedel, 1992*
21	Albanbühel	MBA	Alpine/hill-top/settlement	Not detected	Not detected	Rizzi, 1996/1997*
22	Sotciastel	MBA	Alpine/hill-top/settlement	9096	3805	Salvagno & Tecchiati, 2011*
23	Lavagnone	MBA	Morenic hills/pile-dwelling	2629	810	De Grossi Mazzorin & Solinas 2013*
24	Solarolo, Via Ordiere	MBA	Lowland/settlement	2249	284	Maini, 2012*
25	Santa Rosa di Poviglio	MBA	Lowland/Terramara	1923	321	Riedel, 2004*
26	Montirone di Sant'Agata Bolognese	MBA-LBA	Lowland/settlement	188	31	Maini, 2012*
27	Case Missiroli	MBA-LBA	Lowland/settlement	1288	188	Maini, 2012*
28	Castellaro Lagusello	MBA-LBA	Morenic hills/settlement	3520	1117	Malerba *et al*., 2004*

TABLE 1

List of sites included in this study along with their chronology, landscape type, NISP (Number of Identified Specimens), cattle NISP and references. Chronological periods are referred to as follows: LN: Late Neolithic (including Late Neolithic circa 4500 b.C. – 3800 b.C. and Final Neolithic 3800 b.C. – 3400 b.C.); CA: Copper Age (circa 3400 b.C. – 2200 b.C.); EBA: Early Bronze Age (circa 2200 b.C. – 1600 b.C.); MBA: Middle Bronze Age (circa 1600 b.C. – 1300 b.C.); LBA: Late Bronze Age (including Late Bronze Age circa 1300 b.C. – 1150 b.C. and Final Bronze Age circa 1150 b.C. – 900 b.C.). * means that raw biometrical data are included in the original publication.

Axis	Measurements
Postcranial bones	
Widths	Astragalus Bd, Humerus BT, Metacarpal Bd Metatarsal Bd, Tibia Bd.
Lengths	Astragalus GLl, Calcaneum GL, Humerus HTC (when not available GL), Metacarpus GL, Metatarsus GL.
Depths	Insufficient measurements available
Teeth	
Insufficient measurements available	

TABLE 2

List of measurements used for the metric analysis in this paper. All measurements used for this analysis were taken according to Driesch (1976). To avoid the issue of variable interdependence, only one measurement per element per axis was considered.

	Late Neolithic	Copper Age	Bronze Age
Postcranial Lengths	42	5	361
Postcranial Widths	71	10	581
TOTAL			
	113	15	942

TABLE 3

Number of measurements considered in this study for each axis and chronological period.

SUPPLEMENTARY MATERIAL 2

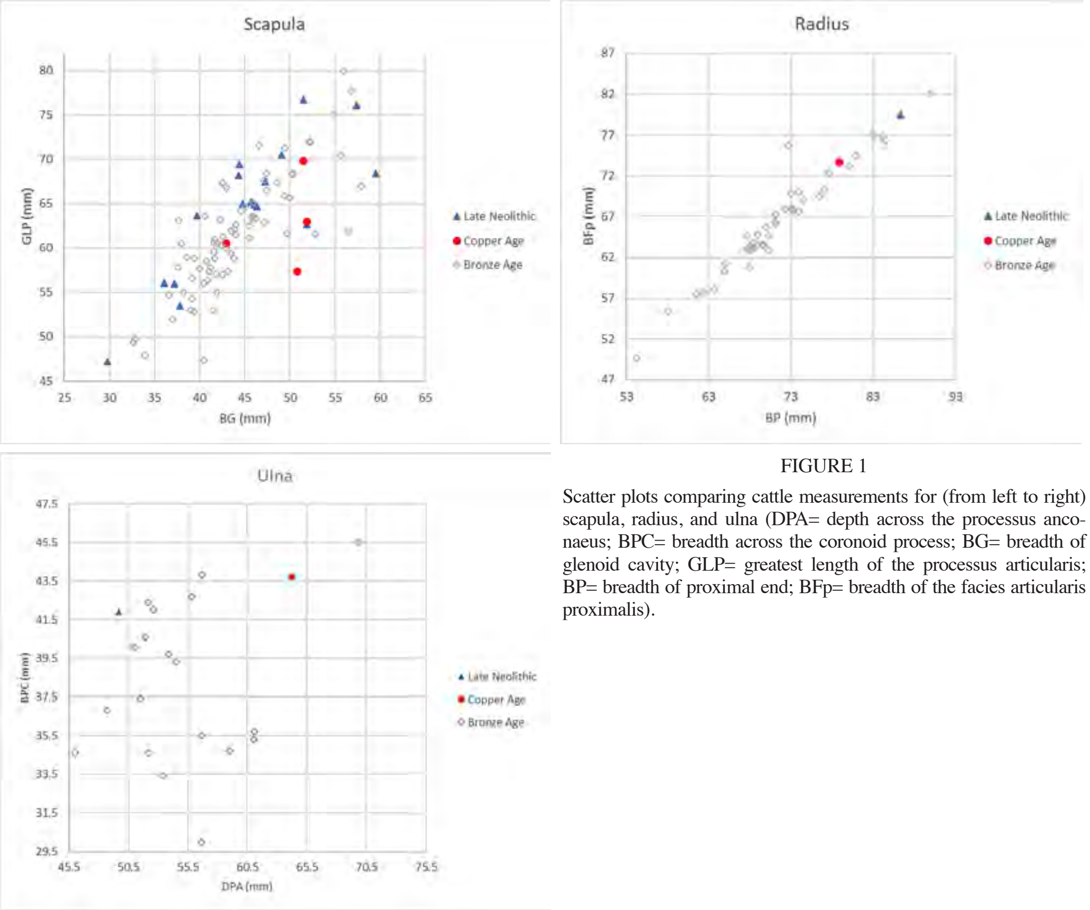


FIGURE 1

Scatter plots comparing cattle measurements for (from left to right) scapula, radius, and ulna (DPA= depth across the processus anconaeus; BPC= breadth across the coronoid process; BG= breadth of glenoid cavity; GLP= greatest length of the processus articularis; BP= breadth of proximal end; BFp= breadth of the facies articularis proximalis).

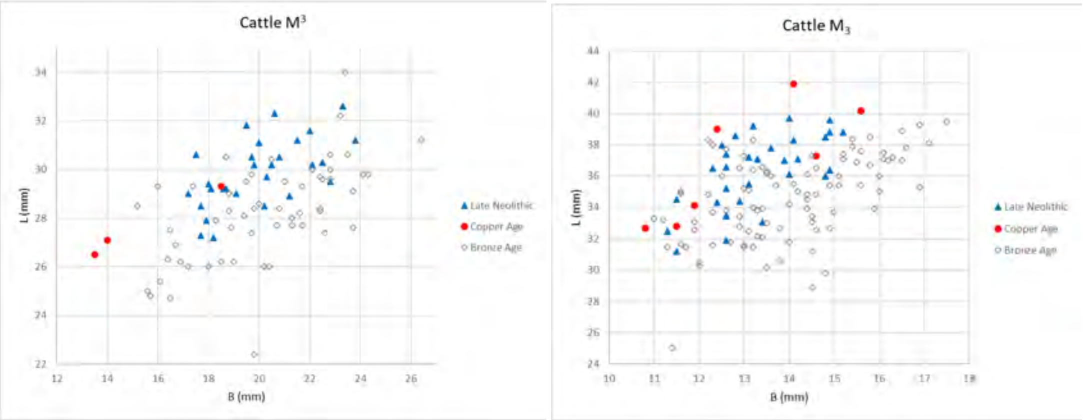


FIGURE 2

Scatter plots comparing cattle upper and lower 3rd molar measurements (L=greatest length; B=greatest breadth).

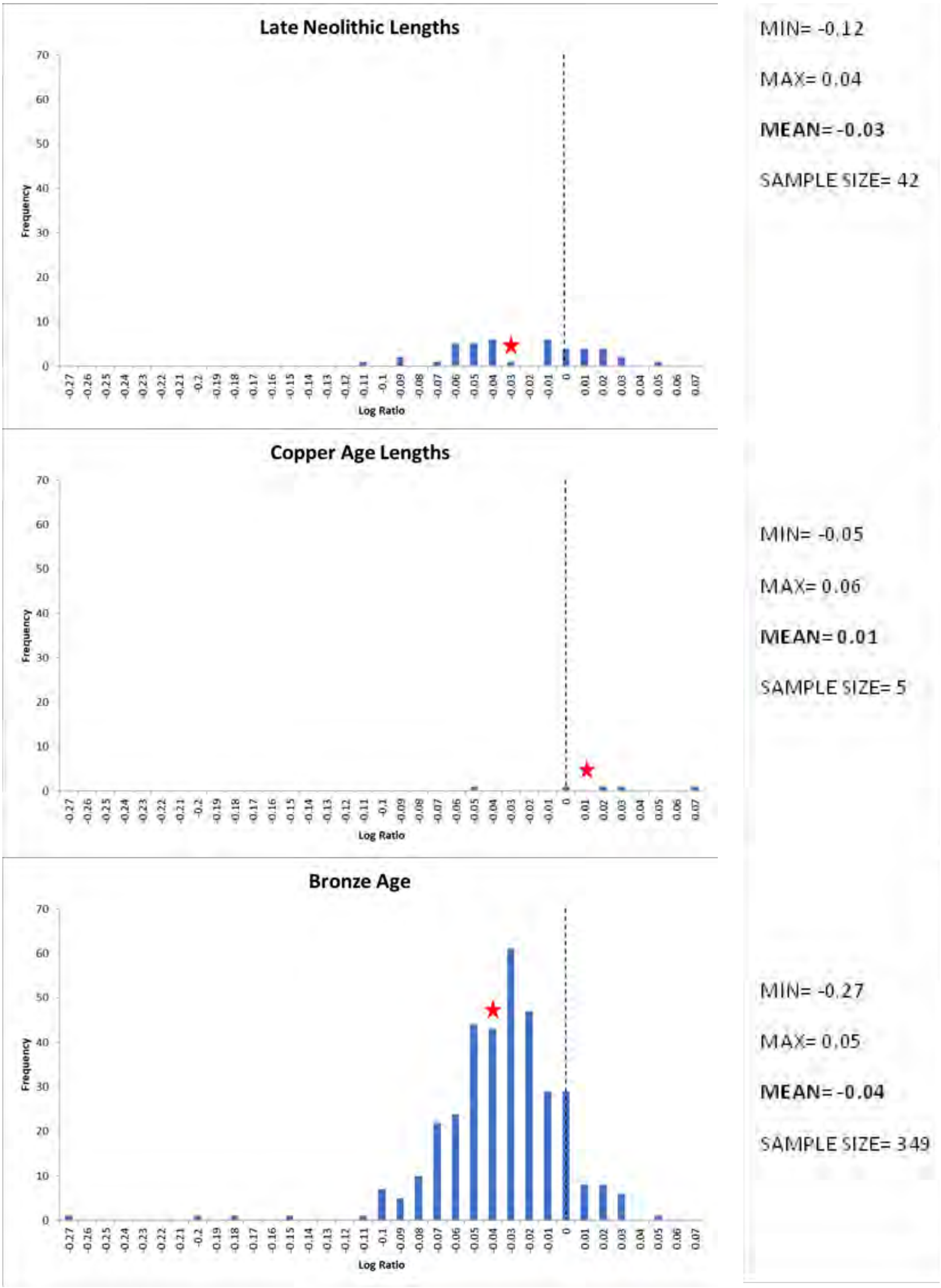
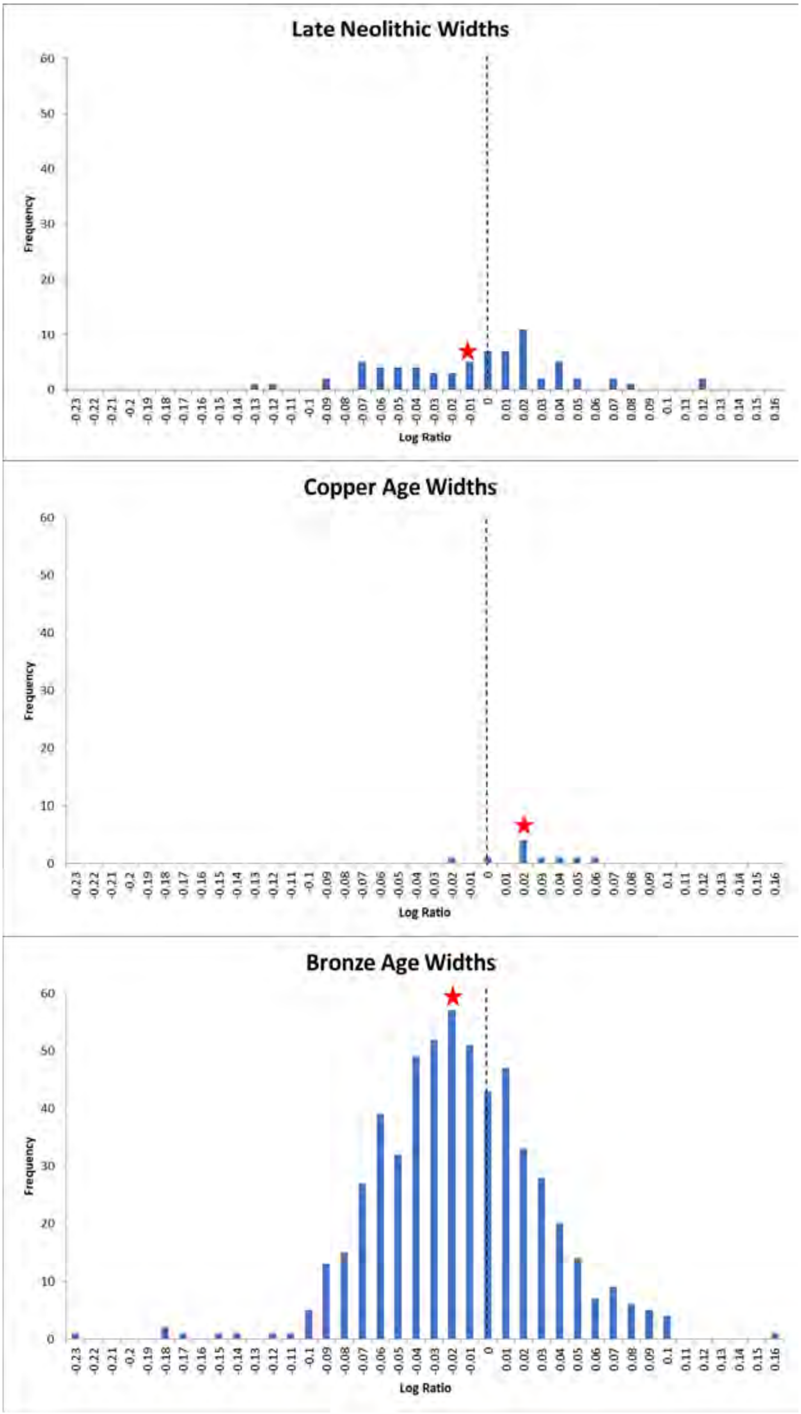


FIGURE 3

Log ratio histograms for cattle postcranial length measurements for each chronological period. The star represents the mean, the dotted line indicates the standard.



MIN= -0.13

MAX= 0.12

MEAN= -0.01

SAMPLE SIZE= 71

MIN= -0.03

MAX= 0.06

MEAN= 0.02

SAMPLE SIZE= 10

MIN= -0.23

MAX= 0.15

MEAN= -0.02

SAMPLE SIZE= 565

FIGURE 4

Log ratio histograms for cattle postcranial width measurements for each chronological period. The stars represent the mean, the dotted line indicates the standard.

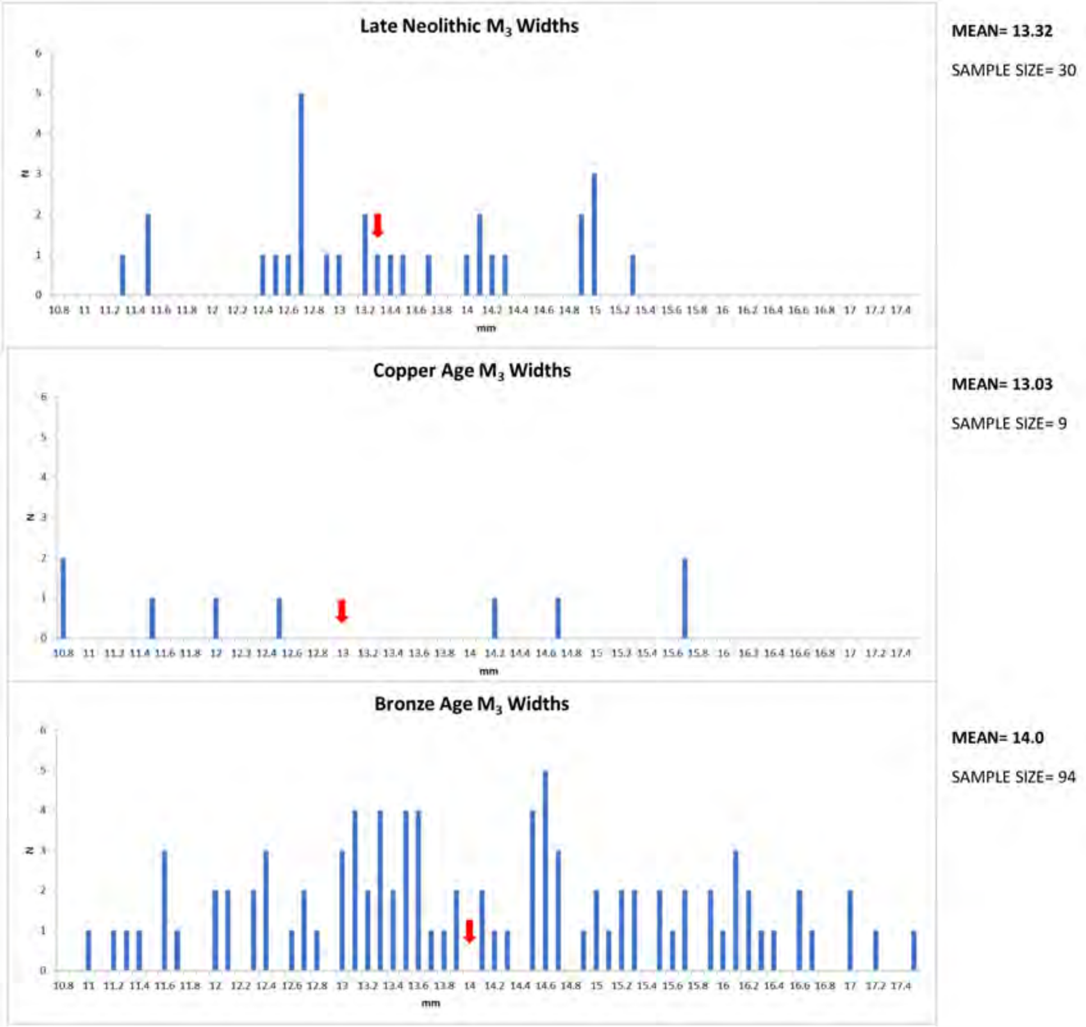


FIGURE 5

Histograms plotting width measurements of cattle lower 3rd molars by period. The arrow indicates the position of the mean.indicates the standard.

Pairwise Comparisons of Group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. [a]
BA-LN	30.641	18.584	1.649	.099	.298
BA-CA	136.574	51.249	2.665	.008	.023
LN-CA	-105.933	53.829	-1.968	.049	.147

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
[a] Significance values have been adjusted by the Bonferroni correction for multiple tests.

Pairwise Comparisons of Group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. [a]
BA-LN	43.584	23.441	1.859	.063	.189
BA-CA	192.774	59.391	3.246	.001	.004
LN-CA	-149.190	62.882	-2.373	.018	.0523

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
[a] Significance values have been adjusted by the Bonferroni correction for multiple tests.

TABLE 1

Kruskal-Wallis test results done on mean log values for respectively postcranial length (top) and width (bottom). LN = Late Neolithic; CA = Copper Age; BA = Bronze Age.

Pairwise Comparisons of Group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig. [a]
CA-LN	5.050	14.642	.345	.730	1.000
CA-BA	-21.498	13.442	-1.599	.110	.329
LN-BA	-16.448	8.078	-2.036	.042	.125

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .050.
[a] Significance values have been adjusted by the Bonferroni correction for multiple tests.

TABLE 2

Kruskal-Wallis test results done on M_3 width measurements. LN = Late Neolithic; CA = Copper Age; BA = Bronze Age.

EFFECT SIZE FOR POST-CRANIAL LENGTHS

Statistical significance alone can be misleading because it is influenced by the sample size. Increasing the sample size always makes finding a statistically significant effect more likely, no matter how small the effect truly is in the real world. Effect sizes are independent of the sample size (Bhandari 2022). It follows that as the effect size increases, the null hypothesis that the observed differences between the two groups are due to chance decreases, so that the effect size does not only test the null hypothesis but it is also a system which expresses precisely how large the effects we see in our data really are (Walker 2007-2008). A small effect size is one in which there is a real effect but it is not large enough to be observed with the naked eye. On the other hand, a large effect size measures an effect which is substantial and can be seen without an in depth study (Walker 2007-2008).

In order to avoid type I error, the critical significance level usually adopted (0.05) was corrected. The corrected value (α) using **Bonferroni** correction method is **0.01667** (i.e. critical significant level (0.05)/number of comparisons. Corrected $\alpha = \alpha / m = 0.05 / 3 = 0.01667$).

Sample size for lengths

Sample size Late Neolithic= 42
Sample size Copper Age= 5
Sample size Bronze Age= 349 Effect size for post-cranial widths

Pair	Mean Rank difference	Z	SE	Critical value	p-value	p-value/2
Late Neolithic-Copper Age	-105.9333	1.968	53.8292	128.8622	0.04907	0.02454
Late Neolithic-Bronze Age	30.6409	1.6488	18.5836	44.4874	0.09919	0.04959
Copper Age-Bronze Age	136.5742	2.6649	51.2487	122.6846	0.0077	0.00385

Group	Copper Age	Bronze Age
Late Neolithic	**-105.93**	**30.64**
Copper Age	0	**136.57**

Effect size r formula: Z value/√n. of observation (according to Field 2009). According to Cohen (1988, 1992), the effect size is low if the value of *r* varies around 0.1, medium if *r* varies around 0.3, and large if r varies more than 0.5.

- Comparison 1 Late Neolithic-Copper Age= 1.968/√47= 0.287 Low-Medium Effect
- Comparison2 Late Neolithic-Bronze Age= 1.6488/√391= 0.083 Negligible Effect
- Comparison 3 Copper Age-Bronze Age= 2.6649/√354= 0.141 Low Effect

Effect size for post-cranial widths

The same procedure as described above was followed to test effect size on the width values.

Sample size for widths

Sample size Late Neolithic= 71
Sample size Copper Age= 10
Sample size Bronze Age= 565

Pair	Mean Rank difference	Z	SE	Critical value	p-value	p-value/2
Late Neolithic-Copper Age	-149.1901	2.3726	62.8815	150.5325	0.01767	0.008833
Late Neolithic-Bronze Age	43.5842	1.8593	23.4415	56.1167	0.06299	0.03149
Copper Age-Bronze Age	192.7743	3.2459	59.3908	142.1761	0.001171	0.0005855

Group	Copper Age	Bronze Age
Late Neolithic	**-149.19**	**43.58**
Copper Age	0	**192.77**

Effect size *r* values considered as explained above.

- Comparison 1 Late Neolithic-Copper Age= 2.3726/√81= 0.263 Low-Medium Effect
- Comparison2 Late Neolithic-Bronze Age= 1.8593/√636= 0.073 Negligible Effect
- Comparison 3 Copper Age-Bronze Age= 3.2459/√575= 0.135 Low Effect

Considering that a high effect size means that there is a high probablilty that the observed differences between the two groups are not due to chance, our results seem to suggest that, for both length and width log ratio values, potentially significant differences between groups are most likely due to chance.

REFERENCES:

Bhadari, P. 2020: What is Effect Size and Why Does It Matter? https://www.scribbr.com/statistics/effect-size/#:~:text=What%20is%20effect%20size%3F,size%20indicates%20limited%20practical%20applications.

Field, A. 2009: Discovering statistics using SPSS. 3rd Edition. London: Sage publications Ltd.

Walker, I. 2007-2008: Null hypothesis testing and effect sizes. http://staff.bath.ac.uk/pssiw/stats2/page2/page14/page14.html.

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Fauna a bordo: relitti sulle rotte siciliane dall'età greca all'età tardo antica

Faunal Remains on Board: Shipwrecks on the Sicilian Routes

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RIASSUNTO: Situata al centro del Mediterraneo, la Sicilia è uno di quei luoghi raggiunto da diverse popolazioni che, in tempi diversi hanno conquistato e popolato varie parti dell'isola. Fenici, Greci e Romani che hanno solcato le acque del Mediterraneo hanno pagato un tributo al mare restituendoci un patrimonio di conoscenze sulle tipologie di imbarcazioni, sul tipo di merci trasportate e sui metodi di stivaggio. I resti faunistici analizzati nel presente lavoro provengono da quattro relitti pertinenti a diversi periodi storici. I primi due sono stati recuperati nel mare antistante Gela (CL) e rappresentano, finora, le più antiche imbarcazioni recuperate (V secolo a.C.). Il terzo relitto è stato recuperato nel mare antistante Marsala (TP), si tratta di una imbarcazione punica da guerra datata al III secolo a.C. L'ultimo relitto analizzato, datato tra la fine del III e l'inizio del IV secolo d.C., è stato rinvenuto nella zona di Marausa (TP). All'interno dei relitti sono stati rinvenuti resti ossei rappresentativi sia di fauna domestica che selvatica. Malgrado l'alto grado di frammentazione, è stato possibile riconoscere diverse specie quali ovicaprini, bovini, suini, cani ed asini unitamente a specie selvatiche come cervidi, tartarughe, pesci, uccelli e mammiferi marini.

PAROLE CHIAVE: FAUNA DOMESTICA E SELVATICA, ALIMENTAZIONE, COMMERCIO, RELITTO, SICILIA, V SEC A.C.- IV SEC D.C.

ABSTRACT: Located at the centre of the Mediterranean Sea, Sicily was colonized by various populations who, at different times, settled on different regions of the island. The Phoenicians, Greeks and Romans, in particular, left us a substantial legacy in terms of vessels, goods carried and stowage methods. In this paper, we analyse the faunal remains from four shipwrecks from different historical periods. The first two wrecks were located off the coast of Gela (Caltanissetta) and constitute the oldest vessels salvaged to date in Sicily (5th century BC). The third shipwreck, a Punic war vessel, was salvaged off the coast of Marsala (Trapani) and constitutes the sole evidence of our knowledge concerning Punic naval construction techniques. The last shipwreck is a Roman cargo, dated from the end of the 3rd century BC to the beginning of the 4th century AD, was found on the Marausa-Trapani coastal sector. Despite their generally intensive fragmentation, the bones from these shipwrecks incorporate a majority of domestic animals including sheep, goat, cattle, pigs, dogs and donkeys. The minority of wild animals, in addition to deer, tortoise, fish, and bird remains, includes bones from the false killer whale.

KEY WORDS: DOMESTIC AND WILD FAUNA, DIET, SHIPWRECKS, SICILY, 5th CENTURY BC – 4th CENTURY AD.

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RESUMEN: Situada en el centro del mar Mediterráneo, Sicilia fue colonizada por diversos grupos humanos quienes, en distintos momentos, se asentaron en diversas regiones de la isla. En concreto, fenicios, griegos y romanos dejaron un importante legado en términos de embarcaciones, transporte de mercancías y métodos de almacenamiento. En este artículo analizamos los restos faunísticos de cuatro pecios de diferentes épocas históricas. Los dos primeros se localizaron frente a la costa de Gela (Caltanissetta) y constituyen las embarcaciones más antiguas conocidas hasta la fecha en Sicilia (siglo V a. C.). El tercer pecio, correspondiente a un navío de guerra púnico, fue recuperado frente a las costas de Marsala (Trapani) y es la única evidencia disponible sobre las técnicas de construcción naval cartaginesa. El último pecio es un navío de carga romano, encontrado en el sector costero de Marausa-Trapani y fechado entre finales del siglo III a.C. y principios del IV d.C. A pesar de su elevado grado de fragmentación, parece claro que los restos óseos de estos pecios representan mayoritariamente animales domésticos como las ovejas, cabras, y vacas, así como cerdos, perros y burros. Entre los escasos restos de fauna salvaje, además de ciervos, tortugas, peces y aves, destaca la falsa orca.

PALABRAS CLAVE: FAUNA DOMÉSTICA Y SALVAJE, ALIMENTACIÓN, NAUFRAGIOS, SICILIA, SIGLO V a.C. – SIGLO IV d.C.

INTRODUZIONE

Grazie alla posizione al centro del Mediterraneo, la Sicilia è stata ed è luogo di transito obbligato delle rotte che attraversano il mare *Nostrum*. L'archeologia subacquea in Sicilia ha contribuito notevolmente a comprendere il valore e le grandi potenzialità del mare, inteso come immenso scrigno di storia e di civiltà. I rinvenimenti archeologici subacquei sono così numerosi che nel 2004 la Regione Siciliana si è dotata di una soprintendenza specifica la "Soprintendenza del Mare" che accorpa in un unico organismo tutte le competenze relative al patrimonio culturale sommerso della Sicilia; la tutela e il monitoraggio dei siti e la realizzazione di itinerari subacquei sono alcuni degli aspetti di cui la Soprintendenza del mare si occupa. Gli studi effettuati dagli archeologi sulle ceramiche rinvenute nei relitti hanno permesso di individuare i luoghi di produzione delle merci e di tracciare le rotte commerciali. Tra i tanti reperti rinvenuti all'interno dei relitti vi sono resti umani e animali. Nel presente lavoro vengono analizzati i resti faunistici rinvenuti a bordo di quattro relitti recuperati lungo le coste siciliane (Figura 1). I primi due relitti sono stati rinvenuti nel mare antistante la potente colonia greca di Gela (Panvini, 2001). Il terzo relitto è stato rinvenuto nel Mediterraneo occidentale presso Marsala (Frost, 1981). Si tratta di una nave punica affondata il 10 marzo del 241 a. C. nel corso della battaglia navale combattuta tra Romani e Cartaginesi nel mare delle Egadi che concluse la prima guerra punica. L'ultimo relitto analizzato è stato rinvenuto nel litorale di Marausa (Trapani), si tratta di una nave tardo-romana (III-IV sec. d. C.) (Tusa, 2015). L'analisi dei reperti faunistici rinvenuti all'interno dei relitti ha permesso di fornire interessanti dati sulle abitudini alimentari degli uomini dell'equipaggio e di completare il quadro della vita di bordo.

METODO

I reperti ossei analizzati nel presente lavoro sono pervenuti alle scriventi in tempi diversi e con diverse modalità. I reperti delle navi di Gela sono stati rinvenuti nel 1988 e oggetto di una precedente analisi (Di Patti *et al*., 2003). I reperti relativi alla nave punica e alla nave romana sono stati analizzati in periodi successivi. Nel presente lavoro sono descritte le evidenze riscontrate sui reperti ossei al fine di comprendere lo sfruttamento degli animali da parte dell'uomo per scopi alimentari e/o commerciali. La prima attività è stata l'identificazione delle diverse specie avvalendosi delle collezioni di confronto del Museo Gemmellaro e del supporto di testi specifici (Pales & Lambert, 1971; Barone, 1995). Per la stima dell'età di morte ci si è basati sull'eruzione dentaria e sulla saldatura delle ossa lunghe (Schmid, 1972; Barone, 1995). Ove possibile sono stati rilevati i dati morfometrici (Driesch, 1976) al fine di calcolare l'altezza al garrese. Infine, sono state osservate tutte le superfici ossee per individuare le tracce tafonomiche (Lyman, 1994) utili a comprendere l'azione antropica o quella di altri agenti tafonomici. Vista la differenza cronolo-

FIGURA 1
Ubicazione dei relitti analizzati nel presente lavoro (da Oliveri, 2020 modificata).

gica dei contesti in cui sono stati rinvenuti i reperti, i dati verranno presentati separatamente in base all’ordine cronologico dei relitti.

ANALISI E RISULTATI

I relitti greci di età arcaica di Gela

Il primo relitto fu scoperto nel 1988, si tratta di una nave greca di età arcaico-classica (500-480 a.C.), lunga circa 18 metri e larga 7, trasportava un carico costituito da numerose anfore di diversa tipologia che contenevano vino e olio; vasi a figure nere, a figure rosse e a vernice nera fanno ipotizzare il bacino dell’Egeo come luogo di provenienza. Un secondo relitto, ritrovato successivamente, giaceva a circa 1 km di distanza dal primo e si presentava molto danneggiato, anch’esso trasportava un carico simile al primo e in base al materiale rinvenuto, è stato datato alla fine del V sec. a. C. All’interno dei relitti sono stati rinvenuti resti di stuoia e canestri ricoperti di pece adibiti a contenere derrate alimentari e ancora, pentole, brocche e piatti. La zavorra costituita da pietrame vario, tra cui granito della Calabria, sta ad indicare che quella regione fosse stata una delle ultime tappe prima di Gela. È molto probabile che un’improvvisa tempesta abbia impedito alla nave di raggiungere il porto di Gela inabissandosi tra flutti nei pressi della costa sabbiosa in un periodo compreso tra il 500 e il 480 a.C. (Panvini, 2001). I reperti ossei si presentavano in parte ossidati e in parti ricoperti da colonie di organismi marini. L’esame faunistico ha interessato 67 reperti, 35 rinvenuti nel primo relitto e 32 nel secondo, che hanno consentito il riconoscimento di: *Bos taurus*, *Equus asinus*, *Equus* sp., *Ovis/Capra* e uccelli (Tabella 1). Le specie riconosciute appartengono tutte alla fauna domestica e gli animali sono rappresentati da varie parti anatomiche. Il bue è la specie più rappresentata in entrambi i relitti. La maggior parte delle ossa presenta evidenti tracce di macellazione, ciò fa supporre che, almeno in parte, questi animali venissero trasportati a bordo già macellati per l’approvvigionamento dell’equi-

SPECIE	RELITTO GELA 1			RELITTO GELA 2			RELITTO MARSALA			RELITTO MARAUSA		
	V sec. a.C.			V sec. a.C.			NAVE PUNICA			III-IV sec. d. C.		
							III sec. a. C.					
	TOTALE REPERTI 35			TOTALE REPERTI 32			TOTALE REPERTI 32			TOTALE REPERTI 102		
	NISP	MNI	ETA’	NISP	MNI	ETA’	NISP	MNI	ETA’	NISP	MNI	ETA’
Canis lupus							2	1	>8 mesi			
Equus asinus	1	1					2	1	>18 mesi			
Equus sp.	10	1		1	1							
Bos Taurus	15	2	< 2 anni	10	1					2	1	
Bos sp.							5	2	> 4 anni < 3 anni			
Ovis/Capra	5	1	>3-4 anni	3	1		3	1	< 1 anno	35	2	>3 anni
Sus domesticus							2	1		14	4	<2 anni
Cervidi							2					
Sparus aurata							2	1				
Zeus faber							1	1				
Pseudorca crassidens							2	1				
Testudo sp.							2	1				
Dermochelys coriacea							1	1				
Gallus gallus										2	1	
Aves gen. e sp. Indet.	1			2			2	1				
Indeterminati	3			16			6			49		

TABELLA 1
Totale complessivo del numero di reperti identificati per ciascuna specie (NISP), numero minimo individui (MNI) ed età di morte.

paggio. Il numero minimo di individui (MNI) è pari a tre: due nel primo relitto ed uno nel secondo. Sui reperti riferibili ad *Equus* sp. e ad *Equus asinus* non sono visibili tracce di macellazione e ciò fa supporre che questi animali fossero stati caricati a bordo vivi per essere adibiti al trasporto di materiali o al commercio. In base alla quantità di reperti si può affermare che il MNI risulta essere di un esemplare per ogni relitto. Un esemplare di *Ovis/Capra* è presente in entrambi i relitti. Sulle ossa non sono visibili tracce di macellazione e l’età calcolata superiore ai 3-4 anni fa supporre che gli animali fossero trasportati a bordo per fornire latte all’equipaggio o come riserva di carne o ancora per essere commerciati. I reperti riferiti agli uccelli, a causa della frammentarietà degli stessi, non sono determinabili; è plausibile che comunque completassero l’approvvigionamento alimentare di bordo. In conclusione, si può affermare che per i componenti dell’equipaggio delle due navi greche, l’apporto di carne fosse basato principalmente sul consumo di carne bovina; altro importante apporto proteico era fornito da latte di capra/pecora e quindi questi animali probabilmente venivano trasportati a bordo vivi, così come cavalli e asini che venivano utilizzati come bestie da soma o a scopo commerciale.

La nave punica di Marsala

Tra i relitti rinvenuti nel Mediterraneo, la nave punica di Marsala è stata per lungo tempo l’unico relitto il cui scafo ligneo sia stato recuperato e trattato per essere musealizzato ed esposto. Fu trovato casualmente sul basso fondale (tra i due e i cinque metri) nei pressi di Punta Scario, al di fuori dello Stagnone di Mozia, a poche decine di metri dalla costa dell’Isola Lunga. Il relitto è stato rinvenuto dalla missione inglese diretta da Honor Frost nel 1971 e rappresenta l’unico documento oggi noto per conoscere la tecnica di costruzione navale seguita dalle maestranze puniche. È noto che i Fenici e, successivamente, i Cartaginesi, abili navigatori, erano dotati di capacità indiscusse nel campo della cantieristica navale (Griffo, 2007; Tusa, 2015).

La linea slanciata dell’imbarcazione, che doveva essere lunga circa 35 metri e larga 4,80, ha fatto supporre che si trattasse di una nave da guerra (Giglio, 1985). Tuttavia, alcune caratteristiche dello scafo, tra cui la forma della chiglia, avvalorerebbero l’ipotesi che questa imbarcazione fosse una nave oneraria (Averdung & Pedersen, 2012). La caratteristica fondamentale che ha permesso di individuare la nave come punica consiste nella presenza di lettere dell'alfabeto fenicio-punico tracciate durante le operazioni cantieristiche allo scopo di accelerare l'assemblaggio delle parti prefabbricate. Le navi cartaginesi erano prodotte in parti presso alcuni cantieri e assemblate presso altri grazie alla coincidenza delle lettere (Griffo, 2007). Il relitto ha restituito pochi reperti rappresentati da ceramiche comuni da mensa a vernice nera, oltre a frammenti di anfore di tipo greco-italico, puniche e romane. Erano presenti anche funi e spaghi intrecciati di diverso spessore, steli di una pianta simile alla *Cannabis*; foglie e ramoscelli di *Phillyrea*. Pochissime erano le armi. Lo scafo era ingombro di pietre di zavorra di origine vulcanica provenienti da Pantelleria. I reperti, insieme ai dati epigrafici e alle determinazioni al ^{14}C concordano nel datare la nave alla metà del III sec. a. C. (Giglio,1985). A bordo erano presenti almeno 68 uomini che azionavano 17 remi per lato, non considerando altri membri dell'equipaggio (Giglio, 1985; Griffo, 2007). I materiali rinvenuti a bordo sono costituiti da stoviglie di piccole dimensioni e legna da ardere. Dalla parte centrale del relitto, che è stata definita "cucina" per la tipologia dei materiali rinvenuti, provengono i resti ossei umani ed animali. In totale sono stati rinvenuti 37 reperti ossei di cui 5 umani rinvenuti in un contesto sigillato situato a poppa della nave. I reperti umani rappresentato un *unicum*, in quanto finora negli altri relitti analizzati sono state rinvenute solo ossa animali. L'analisi antropologica ha messo in evidenza la presenza di due individui di sesso maschile (Ferembach *et al*., 1979; Bertoldi, 2009). Si tratta di un adulto che presenta una robustezza superiore alla media, una rugosità in prossimità della linea aspra del femore e della tuberosità deltoidea dell'omero dovuta a stress funzionali che attestano una intensa attività lavorativa che richiedeva l'utilizzo continuo e ripetitivo del movimento delle braccia e delle gambe come può essere l'attività di un rematore (Borgognini Tarli & Reale, 1997; Capasso *et al*., 1999; Lora & Bertoldi, 2009). Il secondo individuo è un giovane-adulto di media robustezza, alto m. 1,72 (Lippi, 2009) le cui ossa non presentano rugosità ad indicare che probabilmente l'individuo non svolgeva attività che richiedono un notevole sforzo fisico.

Ciò che sorprende ulteriormente nel carico di questa nave è il fatto che pur avendo rinvenuto pochi resti ossei animali (32), questi sono riferiti a ben 12 specie (Tabella 1) alcune delle quali di notevoli dimensioni. Una prima analisi della fauna, come riporta Frost (1981) era stata effettuata da F. Poplin del Museo di Storia Naturale di Parigi. In occasione della musealizzazione del relitto, oggi esposto al Museo Lilibeo di Marsala, si è proceduto allo studio di tutti i materiali in esso rinvenuti. L'analisi della fauna non trova riscontro con quella di altri relitti e sorprende per la varietà di specie che vanno dalla fauna domestica a quella selvatica e fra questi mammiferi e rettili marini. Nella maggior parte dei casi non si è riusciti ad arrivare ad una determinazione specifica sia per l'esiguità dei reperti sia per la frammentarietà degli stessi; non vi è una specie predominante poiché ogni singola specie è rappresentata da uno o due reperti. Solo nel caso dei reperti appartenenti ad un bovino di piccole dimensioni possiamo dire che siamo in presenza di due individui analizzando l'età di morte. Sono infatti presenti un omero con le epifisi saldate e una mandibola che per la presenza del premolare da latte può essere attribuita ad un esemplare di età compresa tra 24 e 30 mesi. Anche i cervidi sono rappresentati da due metatarsi sinistri ma, in questo caso, non possiamo parlare di due esemplari perché uno dei due metatarsi sembra essere uno strumento e può essere considerato un utensile di bordo. La fauna comprende resti pertinenti a capra/pecora, bue, asino, maiale, cervo, cane, uccelli, pesci, mammiferi marini, rettili terrestri e marini. Solo due reperti hanno consentito misurazioni: un omero di un bovino adulto che in base al coefficiente di Matolcsi (1970) presenta un'altezza al garrese di 103 cm., e un metacarpo di asino, di età superiore a 18 mesi, da cui si ricava l'altezza al garrese di 147 cm. (Kiesewalter, 1888). I tre reperti attribuiti ad *Ovis*/*Capra* sono riferibili ad un individuo di età inferiore ad 1 anno e presentano evidenti tracce di macellazione. Tra le specie domestiche vi è la presenza di un cane di dimensioni medio/grandi rappresentato da un'ulna la cui estremità prossimale saldata ci consente di attribuire un'età superiore a 8 mesi. Oltre alle specie domestiche, l'equipaggio si nutriva anche dei prodotti della pesca come testimoniato da un dentale di orata e da una vertebra di pesce San Pietro. La scarsità di vasellame da fuoco e la presenza di legna da ardere hanno fatto ipotizzare una cottura alla griglia (Frost,1981). Altra fonte di proteine è rappresentata dalle tartarughe terrestri che nel caso in questione non presentano tracce da taglio come riscontrato in altri siti (Di Patti & Piscopo, 2005). Tra la fauna selvatica è da segnalare la presenza di *Pseudorca crassidens* (Figura 2) presente nel mediterraneo in maniera sporadica ed occasionale (Stanzani & Piermarocchi, 1992) e di *Dermochelys coriacea*. Nel caso della prima specie si tratta di un grosso cetaceo della famiglia dei delfini i cui maschi possono arrivare anche a due tonnellate di peso. Nel caso della seconda specie, la tartaruga liuto, si tratta della più grossa tartaruga vivente il cui peso può arrivare a 400 Kg. Se consideriamo il contenuto in carne anche di queste due specie, possiamo dire che l'equipaggio della nave aveva a bordo una grande quantità di proteine animali, questa considerazione unita ai dati forniti dagli archeologi come esiguità di pentolame da fuoco, mancanza di armi e presenza di strumenti da pesca, ci fa apparire plausibile l'ipotesi che si trattasse di una nave oneraria (Averdung & Pedersen, 2012). Da segnalare l'ulna di un grosso uccello attribuibile secondo Frost (1981) ad una cicogna bianca che, oltre ad essere stata tagliata in maniera netta, presenta ad una delle estremità due fori intenzionali (Figura 3) interpretata come strumento da pesca.

FIGURA 2

Dente di *Pseudorca crassidens* dalla nave punica di Marsala (TP).

Il relitto tardo-romano di Marausa-Trapani

Il relitto di Marausa fu scoperto nel 1999. Si tratta una grossa nave oneraria romana naufragata nel mare antistante il lido di Marausa tra la fine del III e gli inizi del IV secolo d.C. L'originaria morfologia della costa, caratterizzata da vasti arenili, era stata modificata dall'intervento dell'uomo per agevolare l'attracco di imbarcazioni da carico.

Questo scalo marittimo dovette avere lunga vita, a giudicare dalla presenza nell'area di abbondante ceramica pertinente ad epoche diverse. Lunga 20-25 metri e larga 9, l'imbarcazione doveva avere già alle spalle una lunga carriera a giudicare dalle numerose riparazioni subite dallo scafo e per la presenza di frammenti di lamine di piombo pertinenti a riparazioni, soprattutto interne. Data la vicinanza alla costa il carico dovette essere recuperato poco dopo il naufragio (Tusa, 2005, 2010, 2015).

Il carico era composto principalmente da anfore, alcune delle quali erano rivestite internamente da pece e, pertanto, adibite al trasporto di prodotti liquidi. Altre, prive di rivestimento, potevano essere state utilizzate per trasportare altre mercanzie come olive, pinoli, nocciole, mandorle, noci, pesche, pigne e fichi a giudicare da quanto è emerso dallo scavo (Tusa, 2010). Le anfore di forma cilindrica e di medie dimensioni erano di produzione romana dell'Africa settentrionale e in particolare dell'odierna Tunisia centrale, corrispondente alla provincia romana di Byzacena. Anche la ceramica fine da mensa era di produzione africana. Il relitto di Marausa ha restituito anche un certo numero di resti ossei animali provenienti principalmente da due Unità Stratigrafiche, US 2 e US5, rispettivamente paiolato e sentina. Il numero totale dei reperti esaminati è 102, di cui 53 determinati sia a livello anatomico che di specie e sono riconducibili a quattro taxa: *Sus domesticus*, *Ovis/Capra*, *Bos taurus* e *Gallus gallus,* (Tabella 1). La specie più rappresentata in base al Numero Minimo degli Individui (MNI) è il maiale con 4 esemplari, seguita dagli ovicaprini con 2 esemplari, mentre bue e pollame sono entrambi rappresentati da un esemplare per ciascuna specie. L'analisi della saldatura delle epifisi delle ossa lunghe documenta per gli ovicaprini un'età compresa tra 36 e 40 mesi. Per quanto riguarda i resti attribuiti ai maiali si può affermare che la scelta degli animali, era rivolta verso quegli individui con un contenuto in carne elevato. Infatti, tre tibie destre ed un calcagno attestano individui di età inferiore a 24 mesi, una tibia destra rinvenu-

FIGURA 3
Ulna di uccello e particolare dei fori dalla nave punica di Marsala (TP).

ta nella US 2 I 106/107 in fase di saldatura indica un'età di 24 mesi. Segni di taglio sono stati riscontrati su diverse porzioni anatomiche di maiale e di bue (Figura 4). I reperti riferiti agli ovicaprini non presentano tracce di macellazione e l'età adulta degli esemplari porta ad ipotizzare che questi animali fossero trasportati a bordo vivi per fornire latte all'equipaggio e/o per uso commerciale, così come il pollame, utilizzato anche per fornire uova e carne fresca. Da quanto sin qui esposto possiamo ipotizzare che gli animali a bordo da una parte venissero utilizzati per il commercio sotto forma di carni macellate ed essiccate, dall'altra venissero caricati a bordo vivi per l'approvvigionamento proteico destinato anche al sostentamento degli uomini dell'equipaggio.

CONCLUSIONI

La dimensione dei campioni faunistici analizzati non è elevata ma contribuisce, insieme con gli altri materiali rinvenuti, a ricostruire la complessa struttura della ricerca archeologica e ad ampliare il quadro generale relativamente allo studio dei relitti recuperati lungo le coste siciliane. Nel Mediterraneo su 1259 relitti censiti solo una ventina hanno restituito resti faunistici in quantità minima e non sempre adeguatamente analizzati (Parker, 1992). L'esiguità del numero di reperti è determinata dalla vita stessa di bordo: gli scarti generati dal consumo erano smaltiti gettandoli fuori bordo, di conseguenza ciò che abbiamo potuto analizzare, a seguito del naufragio, è la parte di carico ancora a bordo sotto

FIGURA 4
Tagli sui reperti rinvenuti nel relitto di Marausa. Dall'alto in basso: frammento di costola di bovino; frammento di bacino di maiale; frammento di tibia di maiale.

forma di dispensa o di animali vivi, oppure sotto forma di scarti finiti accidentalmente nella sentina. In generale si può ipotizzare che i resti riferiti a bovini e suini per le evidenti tracce di taglio riscontrate, fossero trasportati sotto forma di porzioni macellate per il sostentamento dell'equipaggio e/o per uso commerciale. In tal senso potevano essere stati sottoposti a trattamenti di tipo conservativo, quali ad esempio salagione e/o affumicatura come documentato nel contesto punico di Santa Gilla (Cagliari, V-IV sec. a.C.), dove le porzioni di carne furono rinvenute all'interno di anfore e per le quali è stata ipotizzata una conservazione sott'olio o sotto sale (Fonzo, 2005). Per gli ovicaprini, che non presentano tracce di macellazione e la cui età è superiore a tre anni, si ipotizza che questi fossero trasportati vivi come fonte di approvvigionamento di latte per l'equipaggio oppure a scopo commerciale. Per quanto riguarda i reperti della nave Punica possiamo dire che gli stessi rappresentano un caso unico nell'ambito delle analisi di resti faunistici rinvenuti all'interno di relitti. L'unicità del rinvenimento sta nel gran numero di specie identificate e nella presenza di specie marine di notevoli dimensioni e, a differenza degli altri insiemi faunistici analizzati nel presente lavoro, i reperti riferiti agli ovicaprini appartengono ad individui giovani e presentano tracce di macellazione; infine, si tratta dell'unico relitto, tra quelli noti per la Sicilia, in cui sono stati rinvenuti anche resti umani. Da quanto sin qui esposto, e in considerazione dell'ingente quantitativo di carne a bordo del relitto, ci appare plausibile che si tratti di una nave oneraria come sostenuto da Averdung & Pedersen (2012) sulla base della tipologia costruttiva.

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BIBLIOGRAFIA

AVERDUNG, D. & PEDERSEN, R.K. 2012: The Marsala Punic Warship. Reconsidering their Nature and the Function of the "Ram". *Skyllis* 12(2): 125–131.

BARONE, C. 1995: *Anatomia comparata dei mammiferi domestici*. Osteologia. Edagricole, Bologna 1, 1995: 1–690.

BERTOLDI, F. 2009: Determinazione del sesso e dell'età di morte. In: Mallegni, F. & Lippi, B. (eds.): *Non omnis moriar*: 31-57. Roma.

BORGOGNINI TARLI, M.S. & REALE, B. 1997: Metodo di analisi degli indicatori non metrici di stress funzionale. *Rivista di Antropologia* 75: 1-39.

CAPASSO, J.; KENNEDY, K.A.R. & WILCZAK, C.A. 1999: Atlas of occupational markers on human remains. *Journal of Paleontology* Monographic 3, Teramo.

DI PATTI, C. & PISCOPO, G. 2005: Risultati dell'indagine archeozoologica sui reperti provenienti dal fronte Ovest del Tempio della Vittoria di Himera (Termini Imerese-PA). *Atti del 4° Convegno Nazionale di Archeozoologia,* Quaderni del Museo Archeologico del Friuli Occidentale, Pordenone.

DI PATTI, C.; DI SALVO, R. & SCHIMMENTI, V. 2003: I reperti faunistici rinvenuti nei relitti di Gela. *Quaderni del Museo Archeologico Regionale "Antonino Salinas*" 7: 121-124.

DRIESCH, A. von den 1976: A Guide to the Measurement of Animal Bones from Archaeological Sites. *Bulletin of the Peabody Museum of Achaeology and Ethnolology, Harvard University* 1: 1–137.

FEREMBACH, D.; SCHWIDETZKY, I. & STOUKAL, M. 1979: Raccomandazioni per la determinazione dell'età e del sesso sullo scheletro. *Rivista di Antropologia* 60: 5-51.

FONZO, O. 2005: Conservazione e Trasporto delle carni a Cagliari in età punica (Stagno di Santa Gilla, V-IV secolo d. C. *Atti del 3° Convegno Nazionale di Archeozoologia:* 365-369. Istituto Poligrafico e Zecca dello Stato, Roma.

FROST, H. 1981: Lilybaeum (Marsala). The punic ship: final excavation report, Notizie degli Scavi di antichità. *Atti Accademia Nazionale dei Lincei*. XXX, 1976 supp.: 53-58.

GIGLIO, R. 1985: La nave da guerra punica esposta nel Museo di Marsala. *Antiqua* X 3/ 4, Roma.

GRIFFO, M.G.; 2007: La nave punica di Marsala. In: Il Museo Archeologico "Baglio Anselmi" Itinerari didattici: Dal Museo al Territorio, *Il Mare racconta* 1: 25-31. Palermo.

KIESEWALTER, J.K. 1888: *Skelettmenssungen an Pferden als Beitrang zur Theirutuschen Grundlage der Beurtelungslehre des Pferdes*. Leipzig.

LIPPI, B. 2009: Determinazione della statura in vita. *Non omnis moriar*: 121-148. Roma.

LORA, S. & BERTOLDI, F. 2009: Indicatori ergonomici. *Non omnis moriar*: 149-167. Roma.

LYMAN, R.L. 1994: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

MATOLCSI, J. 1970: Historische Erforschung der Korper grosse des Rindes auf Grund von ungarischem Knochenmaterial. *Zeitschrift* für *Tierzüchtung und Züchtungsbiologie* 87: 89–137.

OLIVERI, F. 2020: Antichi relitti di Sicilia, *Terracqueo*: 126-131. Fondazione Federico Secondo Editore 2. Palermo.

PALES, L. & LAMBERT, CH. 1971: *Atlas ostéologique des mammiferes*. Editions du Centre National de la Recherche Scientifique, Paris.

PANVINI, R. 2001: *La nave greca arcaica di Gela*. Salvatore Sciascia Editore, Caltanissetta.

PARKER, A.J. 1992: *Ancient Shipwreksof the Mediterranean and Roman Provinces*. B.A.R. (International Series) 580. Oxford.

SCHMID, E. 1972: *Atlas of Animal Bones. For Prehistorians, Archaeologist and Quaternary Geologist*. Elsevier Publishing Company, Amsterdam.

STANZANI, A.L. & PIERMAROCCHI, C. 1992: Cattura di alcuni individui di Pseudorca crassidens (Owen, 1846) in Adriatico. *Atti Società Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano* 133(7): 89-95.

TUSA, S. 2005: *Il mare delle Egadi: storia, itinerari e parchi archeologici subacquei*. In: Tusa, S.: 133-136. Palermo.

— 2010: Il relitto tardo romano di Marausa (Trapani). *Archeologia e storia nei mari di Sicilia*: 138-142. Udine.

— 2015: *Memorie di mare*. In: Tusa, S. & Agneto, F. (eds.): 66-67. Palermo.

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Resti faunistici dall'Edificio 1 del sito etrusco di Gonfienti

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RIASSUNTO: La seguente analisi zooarcheologica è stata condotta sul materiale faunistico proveniente dall'Edificio 1, una struttura costruita a partire dal VI secolo a.C. e utilizzata a più riprese fino all'epoca romana, e probabile residenza élitaria, portato alla luce nel sito etrusco di Gonfienti, situato nelle vicinanze della città di Prato. Essa costituisce uno studio pilota limitato ai resti rinvenuti all'interno dell'edificio e riferibili alla sua fase di massimo sviluppo.

Il campione faunistico è composto principalmente da resti di bovini e secondariamente di suini. Questi ultimi, insieme ai resti appartenenti alla selvaggina, costituiscono una parte importante della dieta degli abitanti dell'edificio.

I dati archeozoologici e le evidenze tafonomiche emersi dallo studio, uniti alle interpretazioni degli archeologi, contribuiscono alla comprensione delle strategie di sussistenza adottate dai residenti dell'edificio ed a indagare la funzione delle diverse stanze dell'Edificio 1. Inoltre, dal confronto con altri siti coevi emerge una ricostruzione delle condizioni ambientali che dominavano a Gonfienti durante questa specifica fase di occupazione etrusca.

PAROLE CHIAVE: GONFIENTI, ETRUSCHI, EDIFICIO 1, STRATEGIE DI SUSSISTENZA

ABSTRACT: This zooarchaeological study centers on the animal remains from Building 1 of the Etruscan site of Gonfienti, located near the modern city of Prato (Tuscany). This construction, built in the 6th century BC, apparently represented the residence of an élite group. Our study focuses on the remains from the time when the residence reached its zenith.

Cattle constitutes the bulk of the faunal assemblage, followed by suids, which, together with wild species, made up the majority of the animal diet. Zooarchaeological and taphonomical data, together with archaeological information, enhance our understanding of the economic strategies of the edifice's inhabitants, as well as the intended use of the various rooms from this building. Comparison with contemporary sites revealed the environmental conditions in the surroundings of Building1 during this phase of Etruscan occupation.

KEYWORDS: GONFIENTI, ETRUSCANS, BUILDING 1, SUBSISTENCE STRATEGIES

RESUMEN: Este estudio zooarqueológico se centra en los restos animales del Edificio 1 del yacimiento etrusco de Gonfienti, situado cerca de la actual ciudad de Prato (Toscana). Esta construcción, construida en el siglo VI a.C., aparentemente representaba la residencia de un grupo de élite. Nuestro estudio se centra sobre aquellos restos que coinciden con la época cuando la residencia alcanzó su apogeo.

El ganado constituye la mayor parte del conjunto faunístico, seguido por los suidos, quienes, junto con las especies salvajes, constituyeron la mayor parte de la dieta animal. Los datos zooarqueológicos y tafonómicos, junto con la información arqueológica, aumentan nuestra comprensión sobre las estrategias económicas de los habitantes del edificio, así como el uso previsto para las distintas estancias del mismo. La comparación con yacimientos contem-

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poráneos evidenció las condiciones ambientales en los alrededores del Edificio 1 durante esa fase de la ocupación etrusca.

PALABRAS CLAVE: GONFIENTI, ETRUSCOS, EDIFICIO 1, ESTRATEGIAS DE SUBSISTENCIA

INTRODUZIONE

Il sito di Gonfienti situato nell'omonima frazione di Prato, è stato scoperto a seguito della creazione di nuove infrastrutture, l'Interporto della Toscana Centrale ed il nuovo asse viario Firenze-Prato, alla metà degli anni Novanta del secolo scorso (Poggesi *et al*., 2005). Le prime indagini hanno messo in luce strutture murarie relative a un complesso abitativo pluristratificato fino a quel momento sconosciuto (Bocci & Poggesi, 2000). L'insediamento si colloca in un'area pedemontana, ai margini del bacino lacustro-fluviale di Firenze-Prato-Pistoia, leggermente degradante in direzione sud-ovest, verso il fiume Bisenzio. L'intera zona è soggetta ad un forte apporto idrico proveniente dal versante nord del sito; inoltre, Gonfienti è ubicato poco al di sopra della falda freatica che, nel periodo invernale, arriva a pochi centimetri dal piano di campagna. Questa caratteristica del territorio comporta allagamenti generalizzati che già in epoca etrusca si provò a regimentare con la creazione di una fitta rete di canali (Poggesi *et al*., 2006).

Dagli anni Duemila sono state portate avanti ricerche sistematiche che hanno evidenziato cinque settori distinti: Lotto 14, Lotto 15F, Villa Niccolini, Scalo Merci e Bacino di compenso. I resti faunistici, oggetto del presente studio, provengono da un edificio sito nel Lotto 14. Questo grande complesso (Figura 1), presenta una pianta regolare, con estensione complessiva di circa 1400 mq, orientamento NE-SW e, con ambienti disposti radialmente intorno a un cortile quadrangolare (Poggesi *et al*., 2005). Le prime fasi di vita della struttura sono databili, grazie ai reperti rinvenuti, intorno alla metà del VI secolo a.C.

Nel lato meridionale è stato individuato l'ingresso dell'edificio che si affaccia su una strada con orientamento NW-SE. Ai lati del vestibolo di ingresso sono stati identificati due grandi ambienti rettangolari, denominati S1 e S3, per i quali si ipotizzano funzioni commerciali correlate alla strada prospiciente. Una serie di vani di medie dimensioni si affacciano a est e a ovest del porticato. Nel lato occidentale sono stati individuati gli ambienti W1 con funzione di cucina e W2 adibito a dispensa (Millemaci & Pagnini, 2011). L'ultimo vano indagato è W3, al cui interno sono state rinvenute le strutture di copertura (Poggesi *et al*., 2006). Anche il settore orientale presenta tre vani (E1, E2 e E3). Dal primo ambiente proviene parte della campana di un forno; nei pressi del muro NE del vano E2 è stata identificata una buca rivestita di terracotta al cui interno è stata individuata un'olla rovesciata sull'ansa, presumibilmente riconducibile alla pratica di culti domestici (Poggesi *et al*., 2011). La lettura delle strutture e dei vani nella zona settentrionale, è resa difficile a causa dei tanti rimaneggiamenti che ha subito nel corso del tempo.

Il sito rimane attivo, in questa fase etrusca oggetto di studio, fino alla fine del V secolo a.C. quando, non bastò una serie di opere di canalizzazione, necessarie per far fronte, presumibilmente ad una serie di cambiamenti ambientali, e Gonfienti finì per andare incontro all'impaludamento[1].

METODI

Il materiale osteologico rinvenuto nell'Edificio 1 e conservato presso i Magazzini del Mulino di Gonfienti, è in buono stato di conservazione. La collezione osteologica di confronto Borzatti von Löwerstern del Museo di Storia Naturale dell'Università di Firenze ed alcuni manuali sono stati utilizzati per l'identificazione tassonomica e anatomi-

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[1] Studi su livelli cronologicamente di due siti vicini , il Porticus Pisanus (Kaniewski *et al*., 2018) e il bacino del Bientina (Andreatti, 1999) suggeriscono che l'area di Gonfienti abbia trascorso un lungo periodo di siccità, iniziato circa 3.200 anni fa, che ne avrebbe permesso l'utilizzazione fino al V secolo a.C.. Questa fase fu seguita da un periodo di forti precipitazioni e da un innalzamento della falda che portarono all'abbandono del sito.

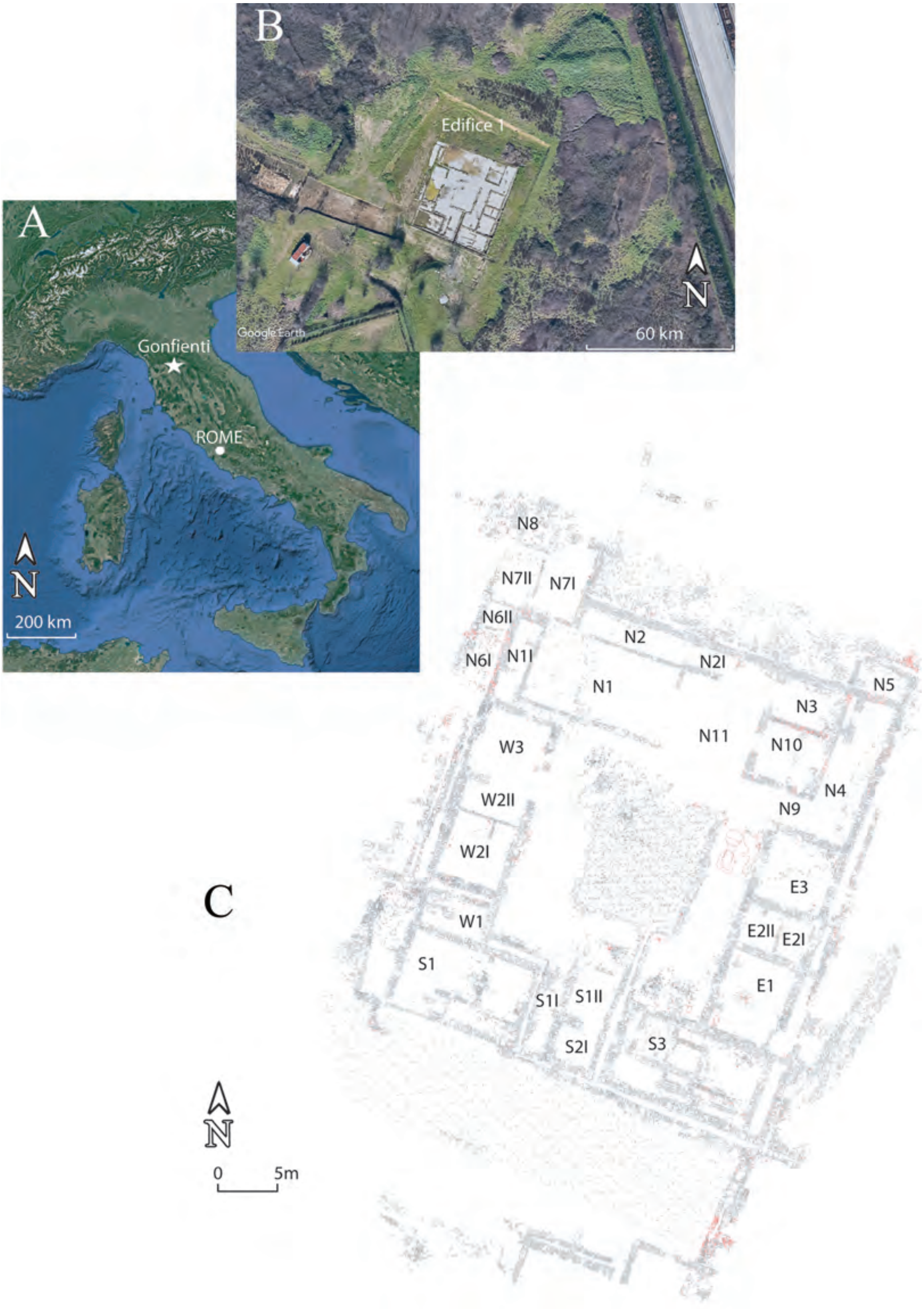

FIGURA 1

Ubicazione della città etrusca di Gonfienti (A), foto aerea dell'Edificio 1 di Gonfienti (B) e della pianta dell'edificio (C), con indicazione delle diverse stanza dell'area orientale (E1-3), meridionale (S1-3), occidentale (W1- 3) e settentrionale (N1-11) della struttura.

ca dei residui ossei. Tutti i resti (identificati e non) sono stati suddivisi in tre categorie dimensionali (<2.5 cm, 2.5-5 cm, >5cm). La quantificazione dei reperti è stata effettuata in base al NISP (numero di identificati), MNI (numero minimo di individui), quest'ultimo calcolato tenendo conto delle dimensioni, età, grado di ossificazione e stato di conservazione e MNE (minimo numero di elementi) ottenuto dopo aver associato fra loro i frammenti dei vari elementi anatomici rappresentati. La rappresentazione scheletrica è stata valutata confrontando le frequenze osservate (basate su valori MNE) e quelle attese (calcolate considerando i conteggi MNI). Seguendo le indicazioni fornite da Haynes (1983) e da Villa & Mahieu (1991), dalla morfologia di frattura è stato stimato lo stato fresco o secco delle ossa al momento della loro frammentazione. Durante lo studio sono state registrate anche tutte le modificazioni corticali pre- e post-deposizionali, analizzate con esame autoptico mediante l'ausilio di lenti a 10-20x, sia di origine biotica (e.s. corrosione umica o batterica, *trampling*, *root etching*, alterazioni patologiche, tracce di macellazione, presenza di segni di masticazione in base alle indicazioni date da Binford, 1981; Shipman *et al*., 1984; Shipman, 1988; David, 1990; Cilli *et al*., 2000; Karkanas *et al*., 2007; Braun *et al*., 2008) che di origine abiotica (e.s. *weathering*, corrosione chimica, abrasione/levigatura).

Queste osservazioni sono state quantizzate in termini di frequenza su base NISP. L'eventuale sfruttamento animale come fonte alimentare è stato indagato attraverso la correlazione fra la variazione delle frequenze scheletriche dei *taxa* più rappresentativi con l'indice di utilità generale modificato (MGUI) (Binford, 1978) e con l'indice di utilità alimentare standardizzato (sFUI) (Metcalfe & Jones, 1988). Questi indici misurano l'utilità, o il valore alimentare, dei tessuti molli associati agli elementi scheletrici dei vari differenti *taxa*, (Binford, 1981; Lyman, 1994; Rowley-Cowey *et al*., 2002). Questi valori sono stati incrociati con quelli di densità ossea degli stessi esemplari presi in esame, in quanto le regioni ossee più ricche di nutrienti sono generalmente quelle meno dense e porose. I valori di densità ossea dei diversi *taxa* sono stati anch'essi ricavati dalla letteratura (Ioannidou, 2003; Symmons, 2005). Altre indicazioni sullo sfruttamento della fauna sono riguardanti l'età e il sesso. L'età ontogenetica è stata stimata registrando il grado di ossificazione delle saldature epifisarie, l'eruzione e l'usura dentaria (Reitz & Wing, 2010). La relativa quantificazione delle classi di età rappresentate ha permesso di costruire i corrispondenti diagrammi di mortalità. Per quanto riguarda i caprini e i bovini sono stati utilizzati i metodi di Payne (1973), Grant (1982), l'ultimo proposto da Hambleton (2001). Per quanto riguarda i suidi invece è stato seguito il protocollo messo a punto da Lemoine *et al.* (2014). La stima del sesso è basata su caratteri di tipo morfologico e osteometrico; nel caso dei suini, la distinzione dei due sessi è stata fatta in base alla forma e alle dimensioni dei canini.

RISULTATI

I reperti animali provenienti dall'Edificio 1 di Gonfienti sono in totale 1354. Il 73% è stato identificato sia anatomicamente che tassonomicamente; 7 esemplari sono stati riconosciuti solo anatomicamente e 6 solo tassonomicamente. I resti indeterminati sono complessivamente 357, di cui l'81% ha dimensioni inferiori ai 2,5 cm, il 16% tra 2,5 e 5 cm e solo il 2% è superiore ai 5 cm.

Gli elenchi così come le quantificazioni, in termini di NISP, MNE e MNI, per i singoli vani dell'Edificio 1 sono sintetizzati nella Tabella 1. La distribuzione dei resti scheletrici all'interno dei vani risulta disomogenea, la maggior parte (28,6%) si trova all' interno del vano E1; il 14,5% è stato rinvenuto nel vano S1; il vano N1 ha restituito il 12,3% del campione. I vani W2, E3 e W1 hanno restituito rispettivamente l'8,5%, l'8,3% e il 7,2% dei resti.

I diagrammi relativi al confronto fra le frequenze osservate e quelle attese dimostrano che vi è una sotto-rappresentazione delle ossa presenti in uno scheletro rispetto a quelle trovate, particolarmente scarsi appaiono gli elementi dello scheletro assile.

Il campione è dominato dalla fauna domestica così suddivisa: bovini e caprini costituiscono il gruppo tassonomico più consistente (51,7%); seguito da quello dei suini (46%). Fra i domestici è presente anche il cane. I selvatici, invece, includono il cinghiale, il cervo, e la lepre, mentre figurano anche rari resti di orso bruno e di tasso. Oltre ai mammiferi, sono presenti pochi esemplari di avifauna, tra cui: gallo domestico, germano reale, strolaga mezzana e pittima reale. Le ultime specie sono tipiche di ambienti umidi, come i due esemplari di testuggine palustre europea e un esemplare di mollusco d'acqua dolce. Infine, si segnala il rinvenimento di due frammenti di ossa parietali

		Bos taurus	Bovinae	*Cervus elaphus*	*Ovis aries*	*Capra hircus*	Caprinae	*Sus scrofa*	*Sus* sp.	*Ursus arctos*	*Canis familiaris*	*Meles meles*	*Lepus europeus*	*Emys orbicularis*	Aves	*Gallus domesticus*	*Anas platyrhynchos*	*Gavia arctica*	*Limosa limosa*	Mollusca
N1	NISP	25	6		1		12		9		1				1		1	1	1	
	MNE	22	5		1		12		9		1				1		1	1	1	
	MNI	3	2		1		1		1		1				1		1	1	1	
N2	NISP	6					2		1											
	MNE	2					2		1											
	MNI	2					2		1											
N3	NISP						1		9											
	MNE						1		9											
	MNI						1		3											
N5	NISP	3			1	2	2													
	MNE	3			1	2	2													
	MNI	1			1	1	1													
N6	NISP	4					2													
	MNE	4					2													
	MNI	2					1													
N10	NISP								13											1
	MNE								13											1
	MNI								3											1
S1	NISP	30			1	4	45		55		3				2					
	MNE	27			1	4	42		53		3				2					
	MNI	2			1	1	4		7		1				2					
S1.I	NISP	5		1		1	5	3	8		2									
	MNE	2		1		1	4	3	6		2									
	MNI	1		1		1	1	1	2		1									
S1.II	NISP	15	3			1	4		11							1				
	MNE	7	3			1	4		10							1				
	MNI	2	1			1	1		2							1				
S2.II	NISP	10	2	1		1	3		22	1	1									
	MNE	9	2	1		1	3		20	1	1									
	MNI	9	2	1		1	2		4	1	1									
E1	NISP	94	13		9	21	39	23	86	1	6	1								
	MNE	77	11		9	14	34	11	64	1	6	1								
	MNI	10	1		4	4	7	3	9	1	2	1								

TABELLA 1

Rappresentazione dei taxa nei vari ambienti dell'Edificio 1 e relativi conteggi.

		Bos taurus	Bovinae	*Cervus elaphus*	*Ovis aries*	*Capra hircus*	Caprinae	*Sus scrofa*	*Sus* sp.	*Ursus arctos*	*Canis familiaris*	*Meles meles*	*Lepus europeus*	*Emys orbicularis*	Aves	*Gallus domesticus*	*Anas platyrhynchos*	*Gavia arctica*	*Limosa limosa*	Mollusca
E2.I	NISP	3	1		1	5			15		3									
	MNE	2	1		1	4			14		3									
	MNI	2	1		1	2			5		1									
E2.II	NISP	3			1		5		7											
	MNE	3			1		5		7											
	MNI	1			1		1		3											
E3	NISP	17	2	1		3	8	3	24				1	1						
	MNE	11	2	1		3	8	3	24				1	1						
	MNI	2	2	1		1	4	1	7				1	1						
W1	NISP	31	4	1		3	12	2	28		1			1						
	MNE	15	3	1		3	10	2	24		1			1						
	MNI	3	2	1		1	3	2	3		1			1						
W2	NISP	11	6		2		8	1	32											
	MNE	8	5		2		8	1	28											
	MNI	2	1		1		2	1	6											

TABELLA 1 (Continuazione)

umane, rinvenuti all'interno del vano S2.II, riconducibile a un individuo adulto e un frammento di omero appartenenti a un feto a termine proveniente dal vano E1. Da questo vano proviene anche uno strumento in fase di lavorazione, probabilmente destinato a ricoprire un manico.

Benché le analisi siano state condotte sui resti provenienti da ogni singolo vano, in questa sede presentiamo un quadro complessivo delle frequenze scheletriche dei gruppi tassonomici più rappresentativi (Figura 2) e delle evidenze tafonomiche (Figura 3) degli esemplari rinvenuti nell'insieme dei vani.

Sono presenti due gruppi di alterazioni: quelle pre-deposizionali riconducibili alle attività umane e quelle diagenetiche post-seppellimento.

Le morfologie di frattura denunciano frammentazioni sia allo stato fresco (62%) sia allo stato secco (38%). Una diffusa alterazione, che è stata riscontrata omogeneamente distribuita sulle superfici di tutti gli esemplari analizzati con frequenza variabile (30-100%), è la corrosione, sia umica che batterica. Diversi resti presentano anche incisioni di apparati radicali vegetali. Pochi, invece, mostrano evidenze di alterazione meteorica fino al 2° grado, sensu Behrensmeyer (1978). Non sono presenti alterazioni riconducibili a fluitazione, o graffi prodotti da sfregamento contro ghiaia. Le evidenze di calpestio, sono rinvenute solo sull'1,5% dei resti di suini.

La presenza di carnivori è rilevata anche dai segni di masticazione e di corrosione gastrica, queste evidenze sono presenti nel 11,6% degli resti di bovini, nel 20,78% dei resti di caprini e nel 15,3% dei resti di suini.

Sono stare riscontrate anche modificazioni antropiche che includono: fratture intenzionali, evidenziate sul 22,3% dei reperti di bovini e di suini e tagli di tipologia varia, identificati nel 17% nelle ossa di bovini, nel 12% in quelle di caprini e nel 13% in quelle di suini. Un taglio è stato identificato anche sul coracoide di un anatide.

Per quanto riguarda lo sfruttamento delle carcasse prendendo in esame solo i campioni statisticamente significativi, dal confronto tra le correlazioni di MGUI/MNE o sFUI/MNE e quelle di densità ossea/MNE emerge che i resti di bovini provenienti dai vani E1 e W1 presentano correlazione MGUI/MNE positiva e valori di densità intermedi. I resti di ovicaprini rinvenuti nel vano W2 sono caratterizzati da alta densità e basso valore

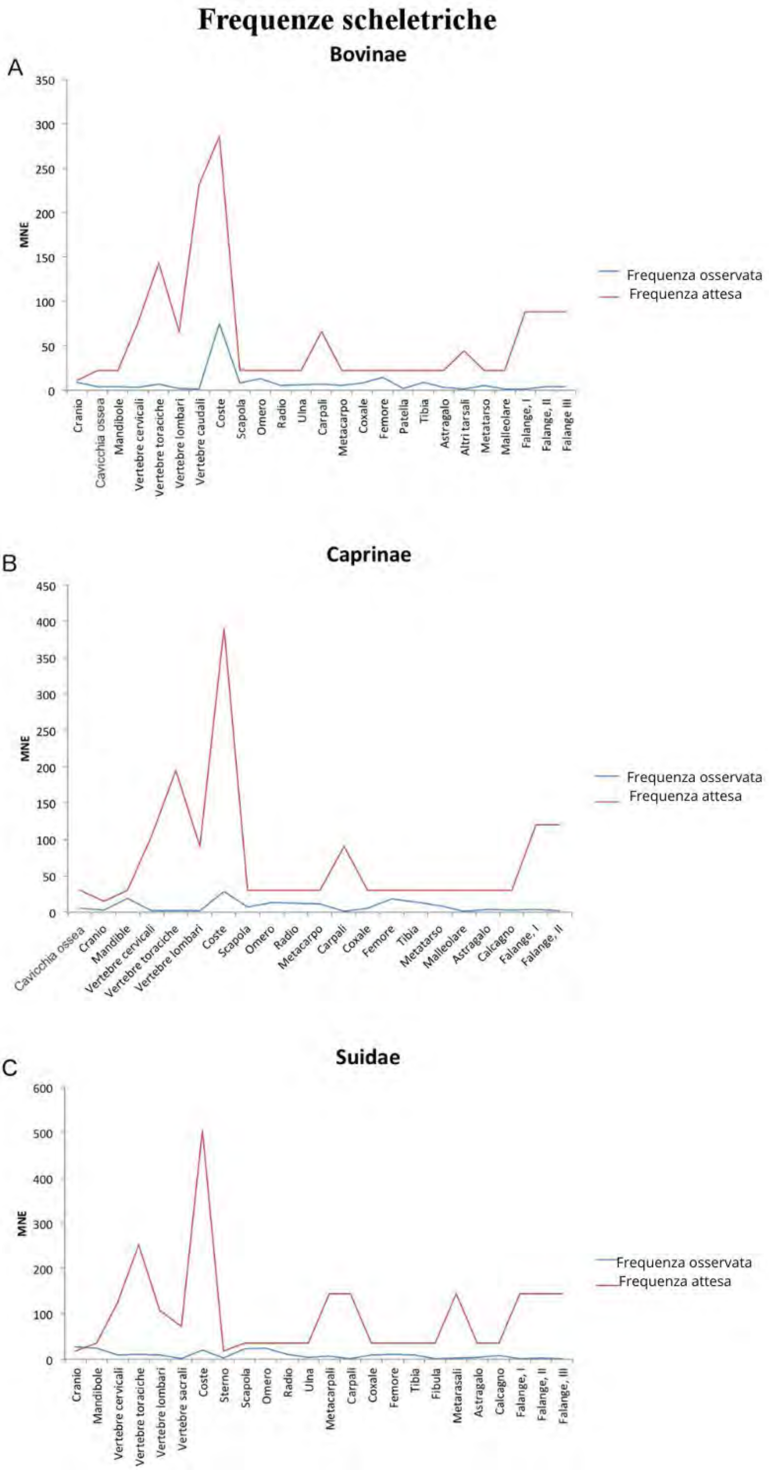

FIGURA 2

Frequenze scheletriche osservate rispetto a quelle previste su base MNI per Bovidae, Caprinae e Suidae.

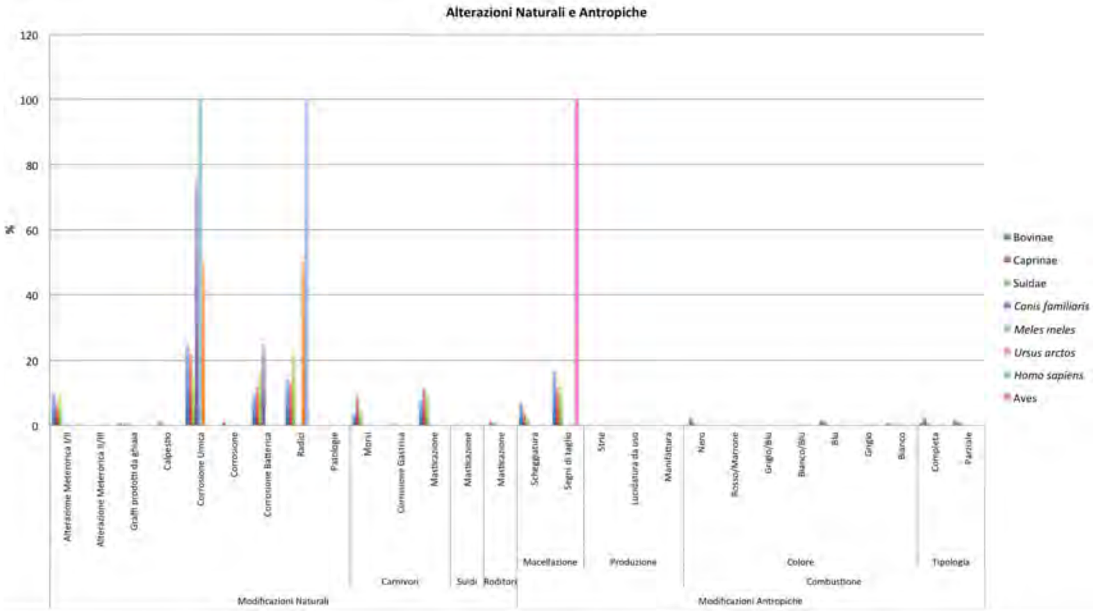

FIGURA 3

Alterazioni naturali e antropiche sul materiale osteologico.

nutritivo, mentre quelli rinvenuti nel vano E1 sono associati a valori nutritivi elevati.

Nel complesso una percentuale molto bassa (0,6%) di frammenti risulta combusta, la maggior parti di quali provengono dal vano E1 e secondariamente dal vano W1.

La struttura demografica dei *taxa* presenti nel campione evidenzia la presenza di individui adulti per quanto riguarda bovini e ovicaprini mentre per i suini si tratta perlopiù di soggetti giovani e subadulti. Il ritrovamento di canini di cinghiale suggerisce la presenza di suidi selvatici e domestici, in percentuali difficili da quantificare. Infine, sempre dall'analisi morfologica dei denti canini si evidenzia la presenza di entrambi i sessi.

DISCUSSIONE

Il campione osteologico proveniente dall'Edificio 1 mostra una predominanza di animali domestici. Inoltre le morfologie di frattura, la particolare sotto-rappresentazione di vertebre e coste (Figura 4), ed i risultati delle correlazioni tra gli indici di utilità e le distribuzioni della densità ossea (Figura 5), indicano che i resti di bovini rinvenuti nei vani W1 e E1 costituiscono sostanzialmente scarti di pasto. Infatti, si tratta di elementi ossei caratterizzati da densità, ma alto valore nutritivo. Un quadro sostanzialmente analogo emerge dagli ovicaprini rinvenuti nel vano E1, mentre i bassi valori nutritivi associati all'elevata densità ossea degli esemplari di caprini provenienti dal vano W2 caratterizzano questi resti come scarti di macelleria. I pattern di mortalità mostrati dai diagrammi relativi ai suini (Figura 6), che rivelano, fra l'altro, anche una marcata presenza di individui giovani e subadulti, suggeriscono, anche in questo caso, lo sfruttamento generalizzato per la carne. Il taglio di origine antropica osservato sul coracoide di anatide potrebbe suggerire lo sfruttamento alimentare di avifauna.

I resti di fauna selvatica, potrebbero testimoniare che la dieta dei residenti era integrata occasionalmente con selvaggina (Camporeale, 1984; Cocomazzi, 2008). Dai diversi dati si ipotizza che l'ala occidentale dell'Edificio 1 fosse deputata alla macellazione mentre il consumo si svolgesse sia in quest'ultima sia in quella orientale, probabilmente da parte di persone di diverso rango sociale. Le colorazioni dei reperti combusti sono compatibili con esposizioni a temperature elevate (>650°C) (Shipman *et al*., 1984) per brevi intervalli di tempo o con combustione prolungata a temperatura fino a 500°C (Karkanas *et al*., 2007).

La struttura di popolazione mostrata dai diagrammi di mortalità (Figura 6), che dimostra una

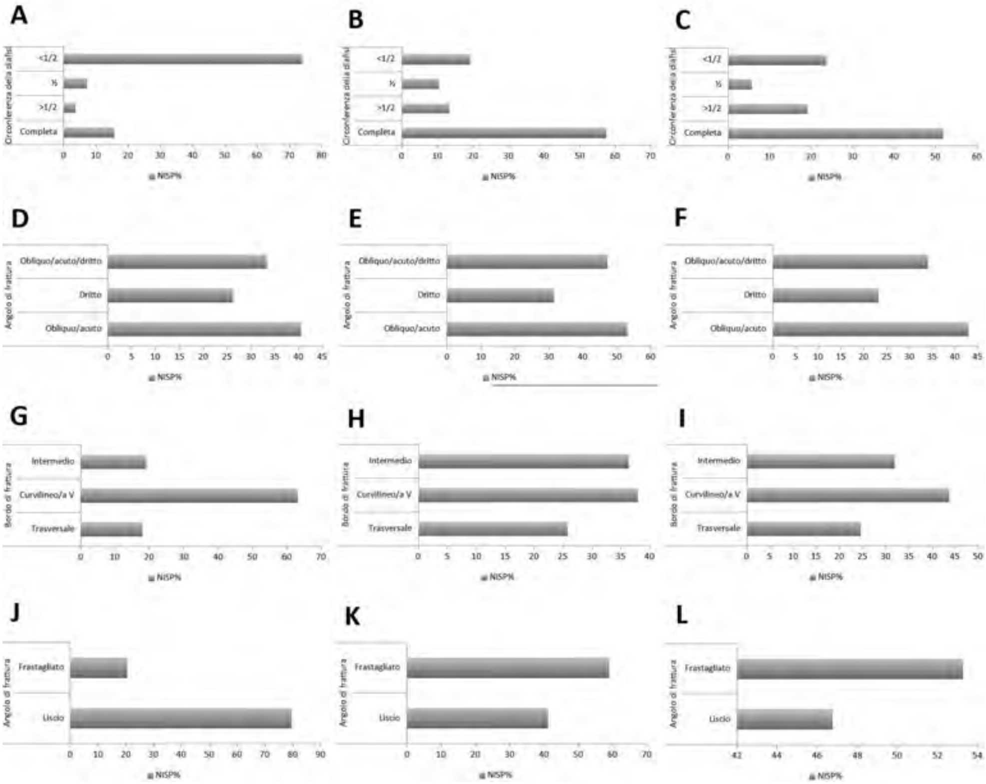

FIGURA 4

Frequenze relative degli angoli, ai contorni ed ai margini di frattura e alla completezza delle circonferenze della diafisi.

notevole abbondanza relativa di bovini e ovicaprini adulti, suggerisce un allevamento finalizzato, oltre che all'uso alimentare, anche all'approvvigionamento di prodotti secondari, come latte, lana e forza lavoro. L'impossibilità di discriminare i resti su base sessuale non consente di stabilire se a Gonfienti avvenissero abbattimenti differenziati dei bovidi. La presenza di una deformazione osseo-articolare a carico di una terza falange di bovino documenta lo sfruttamento come forza-lavoro. Le estese corrosioni delle superfici ossee e l'assenza, invece, di corrosione a carico dei denti indicano lo sviluppo di condizioni diagenetiche alcaline, probabilmente, dopo il definitivo seppellimento dei resti. Non possiamo escludere che tali condizioni chimiche si siano sviluppate negli interstizi dei sedimenti a seguito di locali risalite stagionali della falda freatica. A questo proposito, la presenza, su vari reperti, di erosioni da apparati radicali vegetali suggerisce che nel sedimento superficiale nel quale erano sepolti i reperti, in una certa fase, si sono realizzate le condizioni favorevoli allo sviluppo di un suolo. Un discorso a parte lo meritano i due frammenti ossei umani. Trattandosi di resti facilmente rimovibili da acqua corrente, non possiamo escludere che si tratti di frammenti rimossi da qualche sepoltura vicina e trasportati dall'acqua trattiva all'interno dell'Edificio 1 in un momento successivo al suo definitivo abbandono.

CONCLUSIONE

L'analisi condotta sui resti animali rinvenuti nell'Edificio 1 di Gonfienti rivelano vari aspetti, sia relativamente alla vita che si svolgeva all'interno dell'edificio, che al contesto locale in cui era inserita la struttura. I reperti esaminati indicano che una parte dell'Edificio 1, ubicato nell'ala occidentale del complesso, era adibito a cucina, dove probabilmente si trovava un forno e dove venivano elaborate processate parti di carcassa che poi venivano arrostite; un vano prospiciente la cucina era utilizzato per accogliere gli scarti di lavorazione delle

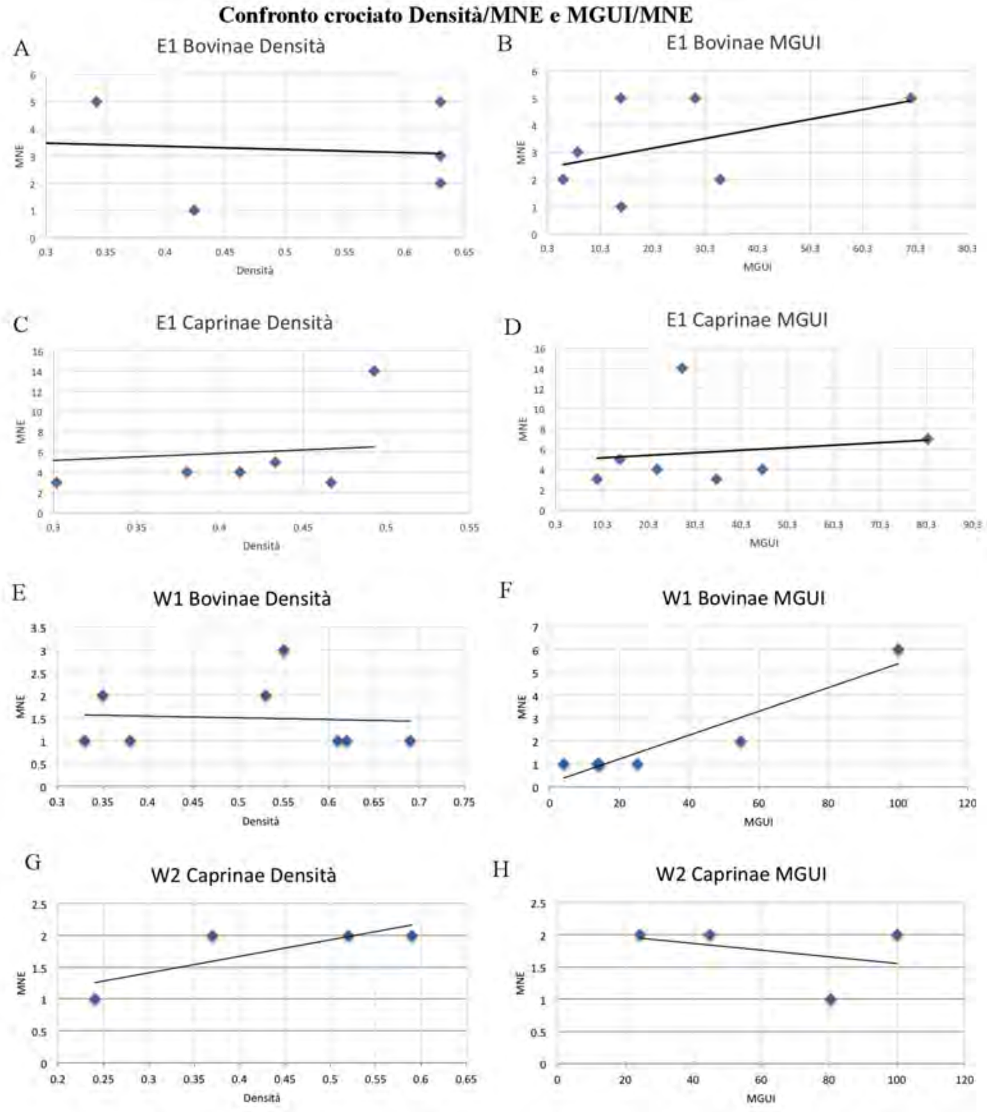

FIGURA 5

Grafici a dispersione dei valori MNE rispetto alla densità e ai valori MGUI.

carcasse. I pasti erano a base di carne soprattutto di ovicaprini e suini ma non mancavano i bovini. I pasti sembrano essere stati consumati in due ali separate, sia a occidente, in prossimità delle cucine, sia a oriente; si può ipotizzare che i vani a occidente fossero destinati ad un personale di servizio, mentre nella zona orientale venissero imbandite tavole riservate a persone di più alto rango. Tuttavia, l'età avanzata e l'evidenza di alterazioni ossee da lavoro suggeriscono che bovini e ovicaprini fornivano sia carne che derivati secondari e che venissero macellati solo al termine di tale periodo di sfruttamento. Interessante il ritrovamento nel contesto abitativo del Lotto 14 delle ossa di cane, in quanto le attestazioni in ambiente domestico non sono molte (Curci & Sertori, 2019). Più spesso, infatti, il cane viene ritrovato in siti di tipo funerario e cultuale, dove veniva utilizzato per molteplici scopi. Simile al caso di Gonfienti è il ritrovamento a Marzabotto nella Casa I, edificio a vocazione artigianale, oltre che residenziale. Su tre resti di cane di questo sito sono state riscontrate tracce riconducibili ad

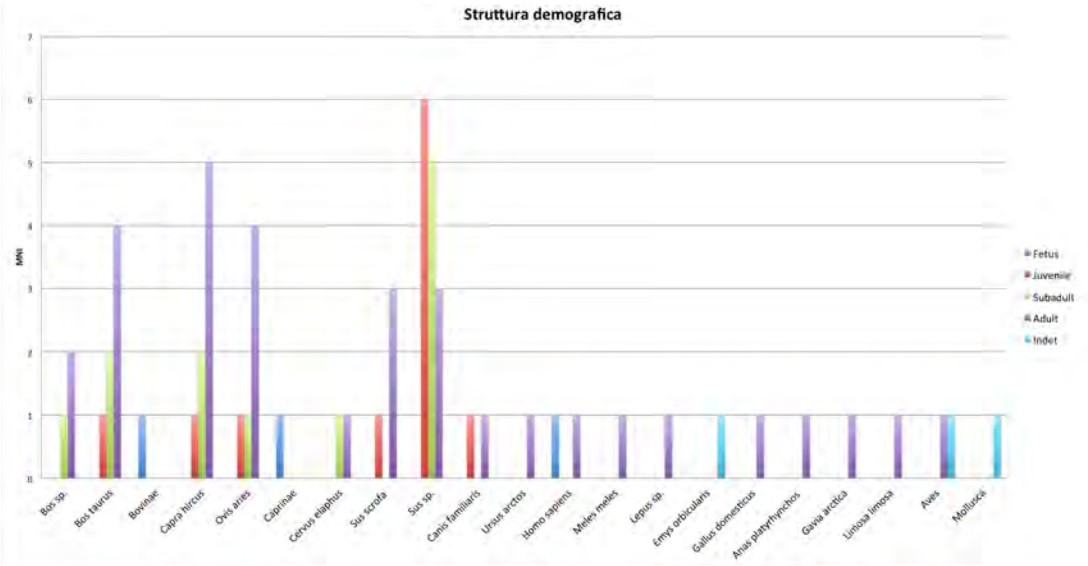

FIGURA 6
Struttura demografica dell'archeofauna di Gonfienti.

azioni volte al consumo della carne (Curci & Sertori 2019), non identificate nei resti di Gonfienti. Il rinvenimento di resti di animali selvatici, potrebbe testimoniare un'aggiunta alle diete dei proprietari dell'Edificio 1 di carne derivante da selvaggina anche se non possiamo escludere che i reperti siano semplicemente frutto di rimaneggiamento successivi alle fase di abbandono.

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BIBLIOGRAFIA

Andreatti, A. 1999: Il bacino del Bientina in età etrusca: paesaggi e risorse. In: Andreatti, A. & Ciampoltrini, G. (eds.): *Gli Etruschi del Bientina. Storie di comunità rurali fra X e V*, Buti: 13-23. Emme & Emme, Comune di Bientina.

Behrensmeyer, A.K. 1978: Taphonomic and ecologic information for bone weathering. *Paleobiology* 4: 150-162.

Binford, L.R. 1978: *Nunamiut Ethnoarchaeology*. Archeology Press, New York.

— 1981: *Bones: Ancient Men and Modern Myths*. Academic Press, San Diego.

Bocci, E. & Poggesi, G. 2000: Prato-Gonfienti: la ricerca archeologica nell'area dell'Interporto. In: Bettini, M.C. & Poggesi, G. (eds.): *Archeologia 2000. Un progetto per la provincia di Prato*: 58-59. Atti della Giornata di Studio, Carmignano, 29 aprile 1999, Montespertoli.

Braun, D.R.; Pobiner, B.L. & Thompson, J.C. 2008: An experimental investigation of cut mark production and stone tool attrition. *Journal of Archaeological Science* 35: 1216–1223.

Camporeale, G. 1984: *La caccia in Etruria*, vol.1. Giorgio Bretschneider, Roma.

Cilli, C.; Malerba, G. & Giacobini, G. 2000: Le modificazioni di superficie dei reperti in materia dura animale provenienti da siti archeologici. Aspetti metodologici e considerazioni tafonomiche. *Bollettino del Museo civico di Storia Naturale di Verona* 24: 73–98.

Cocomazzi, F.L. 2008: L'alimentazione degli Etruschi. In: Cocomazzi, F.L.; Meini, R.; Milano, S.; Perego, L.G. & Torretta, S. (eds.): *FLER. Moderne riflessioni su antiche questioni*: 5-31. Miano.

Curci, A. & Sertori, R. 2019: Il cane in Etruria Padana: usi domestici. In: De Grossi Mazzorin, J.; Fiore, I. & Minniti, C. (eds.): *Atti del 8º Convegno Nazionale di Archeozoologia (Lecce, 2015)*: 297-306.

David, B. 1990: How was the bone burnt? In: Solomon, S.; Davidson, I. & Watson, D. (eds.): *Problem Solving* *in Taphonomy*. *Tempus* 2: 65-70. Anthropology Museum, University of Queensland, Queensland.

Grant, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (British Series) 109. Oxford.

Hambleton, E. 2001: A method for converting Grant Mandible Wear Stages to Payne style Wear Stage in sheep, cow, and pig. In: Millard, A. (ed.): *Archaeological Sciences 1997*: 103-108. Proceedings of Conference Held at the University of Durham, 2–4 September 1997. B.A.R. (International Series) 939. Archaeopress, Oxford.

Haynes, G. 1983: Frequencies of spiral and green bone fractures on ungulate limbs bones in modern surface assemblages. *American Antiquity* 48: 102–114.

Ioannidou, E. 2003: Taphonomy of Animal Bones: Species, Sex and Breed Variability of sheep, cattle and pig bone density. *Journal of Archaeological Science* 30: 355-365.

Kaniewski, D.; Marriner, N.; Morhange, C.; Vacchi, M.; Sarti, G; Rossi, V.; Bini, V.; Pasquinucci, M.; Allinne, C.; Otto, T.; Luce, F. & Van Campo E. 2018: Holocene evolution of Portus Pisanus, the lost harbour of Pisa. *Sci*. *Rep*. 8 11625: 1-14.

Karkanas, P.; Shahack-Gross, R.; Ayalon, A.; Bar-Matthews, M.; Barkai, R.; Frumikn, A.; Gopher, A. & Stiner, M.C. 2007: Evidence for habitual use of fire at the end of the Lower Paleolithic: site formation processes at Qesem Cave. *Israel Journal of Human Evolution* 53: 197–212.

Lemoine, X.; Zeder, M.A.; Bishop, K.J. & Rufolo, S.J. 2014: A new system for computing dentition based age profiles in *Sus scrofa*. *Journal of Archaeological Science* 47: 179-193.

Lyman, R.L. 1994: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

Metcalfe, D. & Jones, K.T. 1988: A reconsideration of animal bodypart utility indices *American Antiquity* 53: 486–504.

Millemaci, G. & Pagnini, L. 2011: Gonfienti II, Lotto 14, Edificio 1. In: *Carta archeologica della provincia di Prato dalla Preistoria all'età romana*: 309-355. Borgo San Lorenzo, Florencia.

Payne, S. 1973: Kill-off patterns in sheep and goat: the mandibles drom Asvan Kale. *Anatolian Studies* 23: 281-30.

Poggesi, G.; Donati, L.; Bocci, E.; Millemaci, G.; Pagnini, L. & Pallecchi, P. 2005: Prato-Gonfienti: un nuovo centro etrusco sulla via per Marzabotto. In: Govi, E. & Sassatelli, G. (eds.): *Culti, forma urbana e artigianato a Marzabotto*. *Nuove prospettive di ricerca*: 267-300. Atti del Convegno di Studi di Bologna, S. Giovanni in Monte, 3-4 giugno 2003, Bologna.

Poggesi, G.; Pallecchi, P.; Bocci, E.; Millemaci, G. & Pagnini, L. 2006: Prato-Gonfienti. Interporto della Toscana Centrale: gli interventi nell'area dell'insediamento etrusco. *Notiz Soprint Beni Archeol Toscana* 2(2007): 68-75.

Poggesi, G.; Bocci, E.; Pagnini, L. & Lo Schiavo, F. 2011: Rapporti fra l'Etruria settentrionale interna e il territorio di Capua. I kyathoi con anse a corna tronche e cave. In: *Gli Etruschi e la Campania Settentrionale*: 167-180. Atti del XXVI Convegno di Studi Etruschi Italici (Caserta, Santa Maria Capua Vetere, Capua, Teano 2007), Pisa-Roma.

Reitz, E.J. & Wing, E.S. 2010: *Zooarcheology*. Cambridge Manuals in Archaeology, Cambridge University Press, Cambridge.

Rowley-Cowney, P.; Halstead, P. & Collins, P. 2002: Derivation and Application of a Food Utility Index (FUI) for European Wild Boar (Sus scrofa l.) *Environmental Archaeology* 7: 77-87.

Shipman, P. 1988: Actualistic studies of animal resources and hominid activities. In: Olsen, S.L. (ed.): *Scanning Electron Microscopy in Archaeology*: 261-285. B.A.R. (International Series) 4. Oxford.

Shipman, P.; Fosteer, G. & Scoeninger, M. 1984: Burnt bones and teeth: an experimental study of color, morphology, crystal structure and shrinkage. *Journal of Archaeological Science* 11: 307–325.

Symmons, R. 2005: New density data for unfused and fused sheep bones, and preliminary discussion on the modeling of taphonomic bias in archaeofaunal age profiles. *Journal of Archaeological Science* 32: 1691-1698.

Villa, P. & Mahieu, E. 1991: Breakage patterns of human long bones. *Journal of Human Evolution* 21: 27–48.

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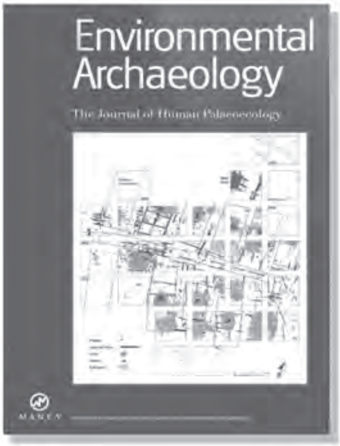

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Il contributo dell'archeozoologia alla conoscenza delle origini di Roma: nuovi dati dalle pendici nord-orientali del Palatino

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RIASSUNTO: Le indagini condotte a Roma, sulle pendici nord-orientali del Palatino tra il 2010 e il 2018 da Sapienza Università di Roma hanno portato alla luce i resti di alcune strutture abitative in uso tra le fasi laziali IIA-IIB1 (fine X-IX sec. a.C.) e III (VIII sec. a.C.). Lo studio dei resti animali contribuisce ad ampliare le conoscenze sull'economia e le finalità di sfruttamento degli animali delle comunità che occuparono l'area di Roma nel corso dell'età del Ferro. L'economia primaria doveva essere basata essenzialmente sull'allevamento delle principali specie domestiche (bovini, suini, ovini e caprini) e sullo sfruttamento delle specie selvatiche, in particolare cervo e cinghiale, anche se con ruolo marginale. Lo studio dei campioni del Palatino aggiunge ulteriori informazioni sul quadro economico e ambientale delle comunità dell'età del Ferro del territorio di Roma e dell'Italia centro-tirrenica.

PAROLE-CHIAVE: ROMA, PRIMA ETÀ DEL FERRO, RESTI ANIMALI, ALLEVAMENTO, AMBIENTE

ABSTRACT: The archaeological researches carried out in Rome, on the north-eastern slopes of the Palatine hill between 2010 and 2018 by the Sapienza University, brought to light the remains of some huts, dated from the Latial phases IIA-IIB1 (late 10th-9th century BC) to the III (8th century BC). The study of animal remains contributes to expanding our knowledge on the environment, the economy and the exploitation strategies of animals by the communities that occupied the area of Rome during the first Iron Age. Primary economy was to be essentially based on the husbandry of the main domestic species (cattle, pigs, sheep, and goats), although there is evidence of hunting, in particular towards red deer and wild boar, even if with a marginal role. The study of the animal remains from the north-eastern slopes of the Palatine adds further information on the economic and environmental picture of the Iron Age inhabitants of Roman territory and central Tyrrhenian Italy.

KEYWORDS: ROME, EARLY IRON AGE, ANIMAL REMAINS, HUSBANDRY, ENVIRONMENT

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INTRODUZIONE

Gli scavi archeologici condotti a Roma da Sapienza Università, sulle pendici nord-orientali del Palatino, hanno identificato nei livelli inferiori dei vani 10 e 11 del grande edificio con cortile di età classica tradizionalmente noto come Terme di Elagabalo, i resti di alcune strutture abitative riferibili all'età del Ferro (Quondam, 2011, 2019). Le fasi di vita sono state datate tra il IX e l'VIII sec. a.C., corrispondenti alle fasi II e III della cultura laziale. In questo arco cronologico il territorio di Roma fu interessato da un lungo processo evolutivo che comportò il passaggio da diversi nuclei abitativi pre-urbani a un unico insediamento proto-urbano e, successivamente, a un vero e proprio centro urbano (Benedetti *et al*., 2019; Guidi, 2019).

MATERIALI E METODO DI STUDIO

I resti animali provengono principalmente dai livelli riferibili alle fasi laziali IIA, IIB e IIIB. A questi tre gruppi si aggiungono pochi resti di età più recente e riferibili al periodo tardo antico e due resti di gallo domestico dai livelli datati alle fasi IIB2 e IIIB, il primo dei quali, ovvero un frammento di femore distale, va considerato intrusivo e proveniente dai livelli superiori di età imperiale, come indica la datazione calibrata effettuata con il metodo del radiocarbonio mediante la tecnica della spettrometria di massa ad alta risoluzione (AMS) presso il Centro di Datazione e Diagnostica Nucleare (CEDAD) dell'Università del Salento: 25AD-232AD al 95,4% di probabilità (Minniti *et al*., 2023).

I resti animali sono stati determinati per confronto diretto con collezione osteologica e con l'atlante di Schmid (1972). La nomenclatura scientifica delle specie segue Gentry *et al*. (2004). La distinzione tra pecora e capra segue i lavori di Boessneck *et al*. (1964), Payne (1985), Halstead *et al*.(2002). La determinazione dell'età segue le metodologie di Silver (1969) per i bovini, di Bullock & Rackham (1982) e Payne (1973) per gli ovicaprini e di Bull & Payne (1982) per i suini.

	NR	**NR**	**NR**	**NR**	**NR**	**NR**
Taxa	IIA1	IIA2	IIB1	IIB2	IIIB-IVA	Tardo Antico
Equus sp.	-	1	-	1	-	-
Equus caballus L.	-	-	2	-	1	-
Bos taurus L.	31	1	11	15	10	-
Ovis vel *Capra*	39	1	14	17	11	-
Ovis aries L.	5	-	2	4	1	-
Capra hircus L.	3	-	-	1	-	-
Sus domesticus Erx.	40	3	11	22	14	3
Canis familiaris L.	1	-	-	3	2	1
Cervus elaphus L.	-	1	-	-	1	-
Sus scrofa L.	2	-	-	2	-	-
Testudo hermanni Gml.	-	-	1	-	-	-
Totale identificati	**121**	**7**	**41**	**65**	**40**	**4**
Coste grandi	8	2	1	7	4	1
Coste medie	10		2	10	5	
Vertebre grandi	5		7	2	1	
Vertebre medie	5	-	-	1	4	1
Non identificabili	237	30	108	168	60	18
Totale complessivo	**386**	**39**	**159**	**253**	**114**	**24**

TABELLA 1

Palatino pendici nord-est, vani 10/11: elenco dei resti animali suddivisi per specie e fase.

RISULTATI

In tutti i campioni il maggior numero di resti appartiene alle principali categorie di animali domestici, tra queste prevalgono gli ovicaprini, seguiti dai suini e dai bovini (Tabella 1). Pochi resti appartenevano a cane e cavallo. Tra i selvatici sono stati identificati il cervo e il cinghiale, presenti in percentuali basse, indicando un ruolo marginale dell'attività venatoria.

Le greggi, formate prevalentemente da pecore, erano allevate sia per la carne che per i prodotti dell'animale vivente (latte, lana). Pochi sono i dati ricavabili dall'analisi della fusione delle epifisi articolari delle ossa lunghe: in tutte le fasi si registra la presenza di almeno un esemplare macellato entro il primo anno di vita, mentre la maggior parte delle ossa è riferibile a individui di età superiore ai 48 mesi (Tabella 2). Dati sulla mortalità ricavabili dalla dentizione per la fase IIA1 (Tabella 3, Figura 1) documentano soprattutto il consumo carneo (categorie C e D) e un discreto interesse per la produzione del latte, riflesso dagli animali abbattuti entro i 6 mesi di vita e indirettamente dalle femmine abbattute a causa della diminuzione della produzione di latte (categorie E e F). Scarso, seppure attestato, l'interesse alla produzione della lana (categorie G, H e I).

		IIA		IIB		IIIB-IVA	
Elemento anatomico	**Età**	**NF**	**F**	**NF**	**F**	**NF**	**F**
omero dist.	-12 m	0	0	1	0	0	0
radio pross.	-12 m	0	0	0	0	0	1
pelvi	-12 m	1	1	0	0	0	0
I falange pross.	14-35 m	0	0	1	1	0	0
tibia dist.	35 m	0	2	0	5	0	0
metatarso dist.	48 m	2	0	0	0	0	0
radio dist.	48-60 m	1	0	0	0	0	1
ulna pross.	48-60 m	0	0	0	0	0	0

TABELLA 2

Palatino pendici nord-est, vani 10/11: mortalità degli ovicaprini in base allo stato di fusione delle epifisi articolari (NF. Non fuso; F: fuso; pross.: prossimale; dist.: distale).

Categorie Payne (1973)	IIA		IIB	IIIB-IVA
	NR	**%**	**NR**	**NR**
A	0	0	0	0
B	0	0	0,5	0
C	1,4	9,6	1	0
D	5,7	38,0	0,5	1
E	2,5	16,4	2,2	0
F	4,4	29,2	0,2	0
G	0	0,0	0,2	0
H	1	6,7	0,2	2
I	0	0	0,2	0
Totale	**15**		**5**	**3**

TABELLA 3

Palatino pendici nord-est, vani 10/11: mortalità degli ovicaprini in base allo stato di dentizione.

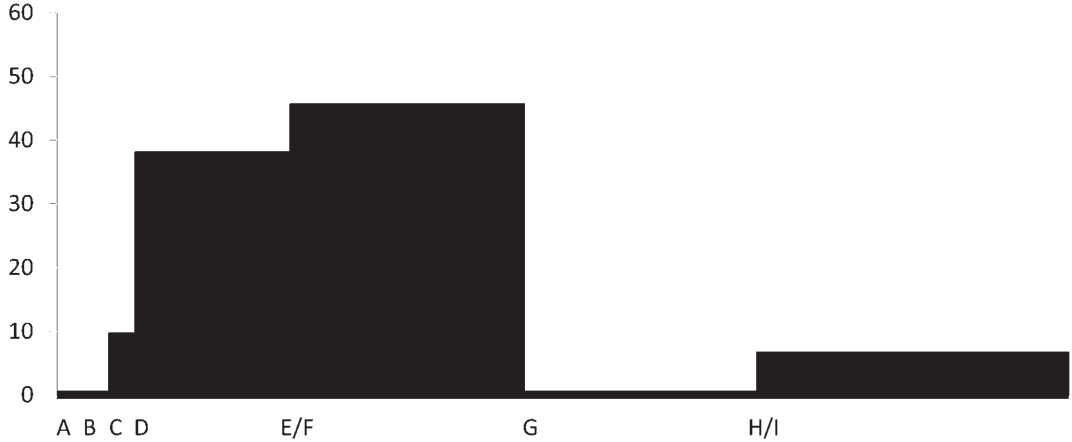

FIGURA 1
Mortalità degli ovicaprini di fase IIA in base al modello proposto da Helmer & Vigne (2004). Categorie di età in base a Payne (1973).

La maggior parte dei suini era macellata dopo i 30 mesi di vita oppure tra il primo e il terzo anno di vita (Tabelles 4-5). La morfologia dei denti canini e dei relativi alveoli documenta una prevalenza di verri rispetto alle scrofe e riflette una strategia conveniente nella macellazione degli animali da carne per eccellenza, in cui pochi maschi vengono mantenuti in vita a lungo per scopi riproduttivi.

I resti dei bovini sono riferibili principalmente ad animali adulti e senili, avviati al macello dopo essere stati usati soprattutto come forza lavoro e, solo in secondo luogo, ad animali sub-adulti, abbattuti direttamente per il consumo carneo (Tabella 6).

DISCUSSIONE E CONCLUSIONI

I dati esaminati in questa sede si aggiungono a quelli che fino ad oggi sono stati ricavati dagli studi

		IIA		IIB		IIIB-IVA	
Elemento anatomico	**Età**	**NF**	**F**	**NF**	**F**	**NF**	**F**
scapola dist.	7-11 m	0	1	0	0	0	0
pelvi	7-11 m	0	0	0	1	0	0
omero dist.	+11 m	0	1	0	0	0	1
II falange pross.	12-18 m	0	0	0	2	0	0
tibia pross.	19-23 m	0	0	1	0	0	0
I falange pross.	19-23 m	0	0	0	1	0	0
tibia dist.	19-23 m	2	1	1	0	0	0
metacarpo dist.	+ 23 m	0	0	0	0	0	1
fibula dist.	+ 23 m	0	0	0	0	1	0
femore pross.	31-35 m	0	0	0	1	0	0
femore dist.	+ 35 m	1	0	0	0	0	0
calcagno pross.	+ 35 m	1	1	0	3	0	0

TABELLA 4
Palatino pendici nord-est, vani 10/11: mortalità dei suini in base allo stato di fusione delle epifisi articolari.

	IIA	IIB	IIIB-IVA
Età (mesi)	**NR**	**NR**	**NR**
-7	1	-	-
7-11	1	-	-
19-23	3	2	-
24-30	-	-	1
31-35	3	3	-
+36	1	1	2
Totale	**9**	**6**	**3**

TABELLA 5

Palatino pendici nord-est, vani 10/11: mortalità dei suini in base allo stato di dentizione.

dei campioni faunistici messi in luce nell'area urbana di Roma. Il confronto con alcuni da contesti di tipo abitativo e cultuale del territorio di Roma e dell'Italia centro-tirrenica datati tra IX e V secolo a.C. conferma il ruolo centrale dell'allevamento e quello marginale della caccia nell'economia delle comunità dell'età del Ferro (De Grossi Mazzorin & Minniti, 2009; Minniti, 2012).

A Roma la percentuale degli ovicaprini varia tra il 21% e il 71% e le medie per secolo sembrano indicare una maggiore importanza nel IX e nel VI-V secolo a.C. Negli altri insediamenti dell'Italia centrale tirrenica si regista invece una concomitante progressiva riduzione.

La percentuale dei suini a Roma oscilla tra il 18% e il 60% ma fin dal IX secolo a.C. risulta comunque più alta di quella documentata in altri insediamenti coevi dell'Italia centrale tirrenica dove sembra aumentare soltanto a partire dal VI secolo a.C. I bovini mantengono una certa stabilità nel corso dei secoli nei siti dell'Italia centrale tirrenica con percentuali medie comprese tra il 28% e il 30%, mentre a Roma, dove oscillano tra l'1% e il 55%, sembrano subire un decremento progressivo nel corso dei secoli. La maggior parte dei suini era macellato nel periodo di massimo rendimento carneo; tuttavia, risulta alta in alcuni contesti, forse di natura cultuale, anche la percentuale di suini uccisi entro il primo anno di vita. Gli ovicaprini erano allevati sia per i prodotti secondari sia per la carne (Figura 1), mentre i bovini erano avviati al macello dopo essere stati usati come forza lavoro.

I selvatici, quando presenti in altri contesti dell'età del Ferro documentati nel territorio di Roma, sono rappresentati da pochi resti, soprattutto riferibili a cervo, del quale però sono attestati diversi frammenti di palco con evidenti tracce di lavorazione, che quindi potrebbero documentare la raccolta di palchi caduti naturalmente. Oltre a pochi resti di cinghiale e capriolo, sono stati identificati castoro e volpe, che potevano essere sfruttati per la pelliccia. Il castoro doveva essere comune sulle rive del Tevere, come documenta anche un altro rinvenimento dall'acropoli di Ficana (zona 3b-c) in livelli di VIII-VII secolo (De Grossi Mazzorin, 1997, 2022; Minniti, 2012). Anche il rinvenimento di resti di testuggine palustre

		IIA		IIB		IIIB-IVA	
Elemento anatomico	**Età**	**NF**	**F**	**NF**	**F**	**NF**	**F**
pelvi	7-10 m	0	2	0	0	0	0
omero dist.	12-18 m	0	3	0	1	0	0
radio pross.	12-18 m	0	2	0	0	0	0
I falange pross.	18 m	0	1	0	2	0	0
metacarpo dist.	24-30 m	0	2	0	1	0	0
tibia dist.	24-30 m	1	0	0	1	0	0
metapodio dist.	24-36 m	0	0	0	1	0	0
metatarso dist.	30-36 m	0	0	0	1	0	0
ulna pross.	42-48 m	0	0	1	0	0	1

TABELLA 6

Palatino pendici nord-est, vani 10/11: mortalità dei bovini in base allo stato di fusione delle epifisi articolari (NF. Non fuso; F: fuso; pross.: prossimale; dist.: distale).

a Roma nell'area sacra di S. Omobono trova una sua spiegazione nella vicinanza del contesto al fiume, mentre tutti gli altri resti di testuggine documentati sono riferibili a testuggine di terra. Numerosi sono i resti di uccelli appartenenti a diverse specie, tra le quali si segnala quella di avvoltoio grifone documentato al *Lapis Niger* e che in antico doveva essere diffuso su tutto il territorio peninsulare (Blanc & Blanc, 1958; De Grossi Mazzorin, 1990; Minniti, 2022), mentre poco attestati sono i resti di pesce, in genere dulciacquicoli e di molluschi marini (Minniti, 2012; De Grossi Mazzorin, 2022).

BIBLIOGRAFIA

BENEDETTI, F.; BUSSAGLIA, R.; FULMINANTE, F.; GUIDI, A. & STAMERRA, L. 2019: Rome: Old and New Data on the Birth and Development of the Protourban Centre. *Origini* XLIII: 171-208.

BLANC, G.A. & BLANC, A.C. 1958: Ossa di avvoltoio nella stipe sacrificale del Niger Lapis nell'area del Comitium al Foro Romano. *Archeologia Classica* 10: 41-49.

BOESSNECK, J.; MÜLLER, H.-H. & TEICHERT, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* L.) und Ziege (*Capra hircus* L.). *Kühn Archiv* 78: 1-129.

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphysial fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (International Series) 109. Oxford.

BULLOCK, D. & RACKHAM, J. 1982: Epiphysial fusion and tooth eruption of feral goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. B.A.R. (International Series) 109. Oxford.

DE GROSSI MAZZORIN, J. 1990: 38. Ossa di avvoltoio. In: Cristofani, M. (ed.): *La Grande Roma dei Tarquini. Catalogo della mostra:* 58. L'Erma di Bretschneider, Roma.

— 1997: Analisi dei resti faunistici dall'abitato di Ficana (zona 3b-c). In: Brandt, J.R. (ed.): *Ficana*: 405-423. Volume 2.1. Istituto Poligrafico e Zecca dello Stato/ Libreria dello Stato, Roma.

— 2022: Selvaggina, pesci e altri prodotti del mare. In: De Grossi Mazzorin, J. & Minniti, C. (eds.): *Gli animali a Roma. Tre millenni di interazione con l'uomo*: 89-132. Collana 5 Futuro anteriore. All'Insegna del Giglio, Firenze.

DE GROSSI MAZZORIN, J. & MINNITI, C. 2009: L'utilizzazione degli animali nella documentazione archeozoologica a Roma e nel Lazio dalla preistoria recente all'età classica. In: Drago Troccoli, L. (ed.): *Il Lazio dai Colli Albani ai Monti Lepini tra preistoria ed età moderna*: 39-68. Edizioni Quasar, Roma.

GENTRY, A.; CLUTTON-BROCK, J. & GROVES, C.P. 2004: The Naming of Wild Animal Species and their Domestic Derivatives. *Journal of Archaeological Science* 31: 645-651.

GUIDI, A. 2019: Rome: Old and New Data on the Birth and Development of the Protourban Centre and its Territory - The State of the Art. *Origini* XLIII: 161-170.

HALSTEAD, P.; COLLINS, P. & ISAKIDOU, V. 2002: Sorting the Sheep from the Goats: Morphological Distinctions between the Mandibles and Mandibular Teeth of Adult Ovis and Capra. *Journal of Archaeological Science* 29: 545-553.

HELMER, D. & VIGNE, J.-D. 2004: La gestion des cheptels de caprinés au Néolithique dans le Midi de la France. In : Bodu, P. & Constantin, C. (eds.): *Approches fonctionnelles en Préhistoire*: 397-407. Atti del XXV Congresso di Preistoria Francese (Nanterre, 24-26 novembre 2000). Parigi.

MINNITI, C. 2012: *Sussistenza e articolazione sociale nell'Italia centrale tra Bronzo medio e Primo Ferro*. B.A.R. (International Series) 2394. Oxford.

— 2022: Pratiche funerarie e sacrifici. In: De Grossi Mazzorin, J. & Minniti, C. (eds.): *Gli animali a Roma. Tre millenni di interazione con l'uomo*: 167-206. Collana 5 Futuro anteriore. All'Insegna del Giglio, Firenze.

MINNITI, C., PANELLA, C., PIZZA, M.C. & QUONDAM, F. 2023: *Aggiornamenti dal Palatino nordorientale: datazioni radiometriche e studio delle faune dalle stratigrafie del Primo Ferro, Scienze dell'Antichità, 29.1*, Fascicolo 1: 3-32.

PAYNE, S. 1973: Kill-off Patterns in Sheep and Goats: the Mandibles from Aşvan Kale. *Anatolian Studies* 33: 281-303.

— 1985: Morphological Distinctions between the Mandibular Teeth of Young Sheep, Ovis, and Goats, Capra. *Journal of Archaeological Science* 12: 139-147.

QUONDAM, F. 2011: Rinvenimenti di età protostorica sulle pendici nord-orientali del Palatino. *Scienze dell'Antichità1* 7: 621-641.

— 2019: L'abitato dell'età del Ferro sulle pendici nord-orientali del Palatino. In: Damiani, I. (ed.): *La Roma dei Re. Il racconto dell'archeologia*: 229-234. Catalogo della mostra. Gangemi Editore, Roma.

SCHMID, E. 1972: *Atlas of Animal Bones for Prehistorians, Archaeologists and Quaternary Geologists*. Elsevier Publishing Company, Amsterdam.

SILVER, I. 1969: The ageing of domestic animals. In: Brothwell, D. & Higgs, E.S. (eds.): *Science in Archaeology:* 283-302. Thames & Hudson Ltd, London.

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Taxonomic and taphonomic analysis of Level 7 lagomorphs (MIS 3) from Grotta Mora Cavorso (Jenne, Latium)

Analisi tassonomica e tafonomica dei lagomorfi del Livello 7 (MIS 3) di Grotta Mora Cavorso (Jenne, Lazio)

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ABSTRACT: This work presents the taxonomic and taphonomic study of Lagomorpha remains from Layer 7 of the archaeological deposit from Grotta Mora Cavorso (Jenne, Latium) referred to the MIS 3. The taxonomic analysis allowed the attribution of these remains to *Lepus corsicanus* (Italic or Apennine hare) with the presence of several specimens of considerable size. Therefore, this study provided new data on the sizes of *L. corsicanus* and on its geographic and ecological distribution in the Italian Pleistocene contest. The taphonomic observations excluded the anthropic action on the bones, but a large presence of gnawing traces, numerous pits and punctures and traces of digested was noted. Regarding the traces linked to the action of small carnivores, it's possible to hypothesize, measuring the distance between the traces of pits and punctures left by canines, that small mustelids should be the main accumulation agents of Lagomorpha bones from this layer. As for the traces of digested, predation by eagle owl is supposed.

KEYWORDS: TAXONOMY, TAPHONOMY, *LEPUS CORSICANUS*, BIRDS OF PREY, SMALL CARNIVORES

RIASSUNTO: In questo lavoro si presenta lo studio tassonomico e tafonomico dei resti di lagomorfi provenienti dal Livello 7 del deposito archeologico di Grotta Mora Cavorso (Jenne, Lazio), riferiti al MIS 3. L'analisi tassonomica ha permesso l'attribuzione dei suddetti resti a *Lepus corsicanus* (lepre italica o appenninica), con diversi esemplari di considerevoli dimensioni. Questo studio, pertanto, ha fornito nuovi dati sulla taglia di *L. corsicanus* e sulla sua distribuzione geografica ed ecologica nel quadro del Pleistocene superiore italiano. Le osservazioni tafonomiche hanno escluso l'azione antropica sulle ossa, ma si è notata la presenza di tracce di rosicchiamento, numerosi solchi, fori e tracce di digerito. Per quanto riguarda le tracce collegabili all'azione dei piccoli carnivori, è stato possibile ipotizzare, misurando la distanza tra le tracce di solchi e fori lasciati dai canini, che mustelidi di taglia piccola possano essere stati i principali agenti d'accumulazione dei resti di Lagomorfi di questo livello. Per quanto riguarda le tracce di digerito, è supposta una predazione da parte del gufo reale.

PAROLE CHIAVE: TASSONOMIA, TAFONOMIA, *LEPUS CORSICANUS*, UCCELLI RAPACI, PICCOLI CARNIVORI

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INTRODUCTION

Grotta Mora Cavorso (GMC) is located along the upper Aniene river valley, near Jenne (Latium, central Italy), within the Regional Natural Park of the Simbruini Mountains (Rolfo *et al*., 2016). Archaeological research from 2006 to 2016 investigated 8 digs and revealed a multi-layered deposit ranging from the Holocene (Layers 1-4) to the Late Pleistocene (Layers 5-7) (Figure 1). Layer 7 (L.7), with a variable thickness up to 120 cm, is between a wolf skeleton in anatomical connection and marmot and Apennine chamois specimens in partial anatomical connection and it is dated between >43500 BP (Rolfo *et al*., 2016; Salari *et al*., 2017) and 35000±870 BP (Nomade - 48126). L.7 is therefore referrable to Marine Isotope Stage (MIS) 3. Among the *taxa* found, lagomorphs are the most abundant in L.7 (Table 1S). The purpose of this paper is to determine whether one or more lagomorph species are present in this layer and to check whether the main accumulating agent was man or other predators.

MATERIALS AND METHODS

Each *taxon* of L. 7 was quantified in number of remains and in minimum number of individuals (Table 1S), calculated according to Bökönyi (1970). Taxonomic attribution of lagomorph remains was made according to Palacios (1996), Callou (1997) and Vismara (2012). Bone surface observations were performed with a 10x lens and a Leica S9i Stereomicroscope, with the support of Andrews (1990), Lloveras *et al*. (2009), Andrés *et al*. (2012), Fernández-Jalvo & Andrews (2016) and Romandini *et al*. (2018). The measurements of the distance between the apexes of upper and lower canines of extant carnivores from central-northern Italy stored in the Museum of Natural History of the University of Pisa (Calci, Pisa), the Regional Natural Park of the Simbruini Mountains (Jenne, Rome), the Museum of Natural History of the University of Firenze (“La Specola”, Florence) and the Laboratory of Prehistoric Archaeology of the University of Rome “Tor Vergata” were taken with a standard calliper and a 10x micrometer lens according to Fiore *et al*. (2018).

RESULTS AND DISCUSSION

The skeletal portions are all represented, but with a clear prevalence of the cranial fragments (especially the teeth) and the extremities of the limbs, but also the long bones of the limbs are well represented in the record (Table 2S). These skeletal remains are referable to almost 12 individuals, mainly adults (Tab. 3S). The morphological observations of upper incisor (I1), mandible, third lower premolar (p3) and anterior and posterior limb bones excluded the presence of the rabbit, *Oryctolagus cuniculus* (see Callou, 1997), highlighting that the record in analysis consist of only hares. The hare remains show rectangular I1 with the lateral width much more developed than the antero-posterior axis and p3 with medium-developed antero-flexid, non-prominent entoconid and massive protoconid, the lingual termination of the hypoflexid is symmetric and the edge of the hypoflexid slightly or not crenulated at all. These features exclude an attribution to *Lepus timidus* (see Callou, 1997; Vismara, 2012). Furthermore, p3 is without centroflexid in the anterior edge of the hypoflexid, the hypoconid is without crenulations and the antero-lingual edge of the tooth is without paraflexid. (Figure 1S). The above characters exclude *L. europaeus* and allowed to attribute the hare remains to *L. corsicanus* (see Palacios, 1996; Vismara, 2012). Moreover, some Italic hares from GMC show considerable size (e.g., humerus length between 100.5 and 102.1 mm; femur length: between 119.8 and 131.3 mm; tibia length 147.4 mm). Late Pleistocene remains attributed to *L. corsicanus* occur in several sites, particularly in central-southern Italy (Vismara, 2012; Boschin, 2019; Kotsakis *et al*., 2020).

As for the observation of bone’s surfaces, the absence of cut-marks and fractures attributable to human activity allowed to exclude the anthropic action on the bones. On the other hand, several traces of digestion and gnawing have been noted (Table 1; Figure 2S). As for the first, found on some finds, it is hypothesized a predation by nocturnal bird of prey, possibly the Eagle owl, *Bubo bubo* (see Lloveras *et al*., 2009), that, from a preliminary analysis of Aves remains, would be attested in L.7. As for the traces of gnawing, many hare bones would attest to the activity by small carnivores, such as holes due to pressure from canine teeth and in rare cases molars and premolars, wavy and rounded fracture margins, grooves due to the sliding of the teeth (Table 1). Often, different types of traces are combined on the same bone fragment. In particular, the distance between the centres of punctures probably left by pairs of

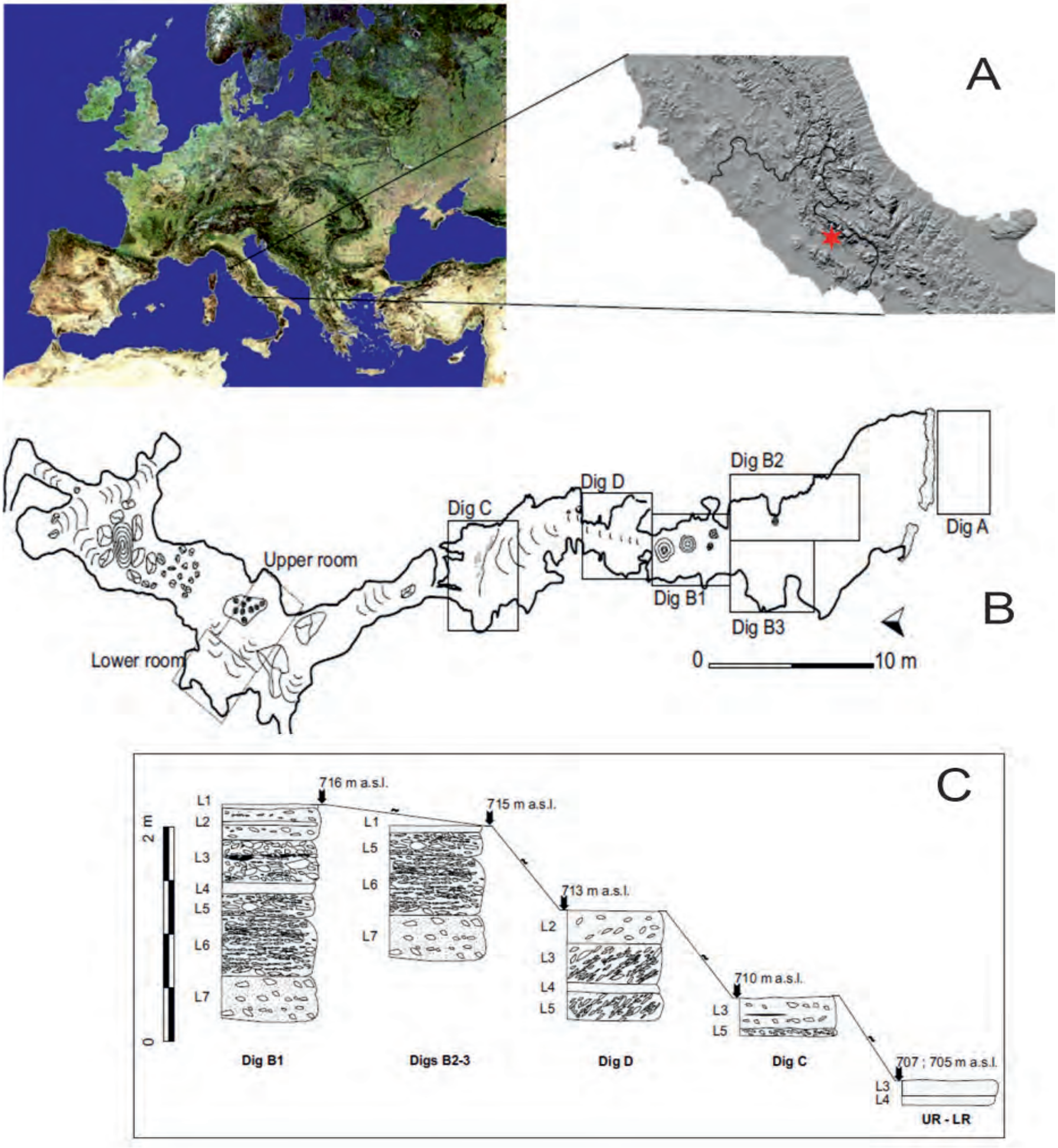

FIGURE 1

Grotta Mora Cavorso. A) Geolocalization; B) Map of the cave with indication of Digs; C) Stratigraphy of the Digs (by Salari *et al*., 2017, modified).

canines on a coxal was 5.7 mm and on a femur was 8.3 mm (Figure 2). These measures were compared with the distances between the apexes of canines of the current carnivores (Table 2). The distance measured from the femur is close to those from the lower canines of the European polecat, *Mustela putorius*, followed by the pine marten, *Martes martes*, while the one taken on the coxal perfectly fits within the range of upper canines of weasel, *Mustela nivalis* (Table 2). Small carnivores, probably mustelids, were recognized as main accumulation agents of hare and/or marmot bones in some Upper Palaeolithic sites of central Italy (Alhaique, 2003; Fiore *et al*., 2024).

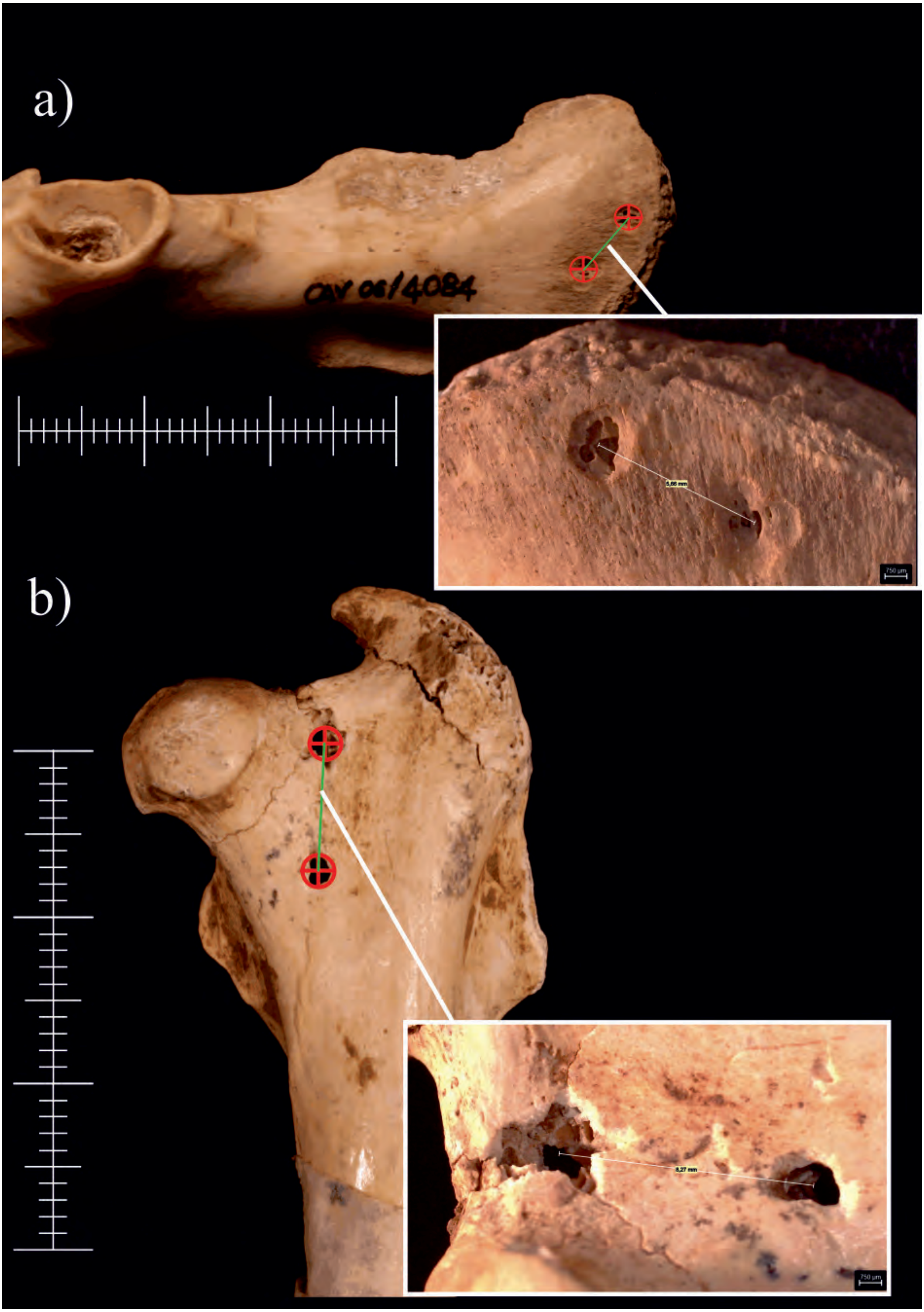

FIGURE 2

Coxal (a) and femur (b) of *Lepus corsicanus* from L. 7 of Grotta Mora Cavorso with *punctures*.

Today, the predation of Italic hare by pine marten in Sicily is recorded (Lo Valvo, 2007).

	NR	**%**
Total remains	336	100
Remains with alteration of surfaces	138	41,1
Patinas	32	23,2
Pits	1	0,7
Punctures	13	9,4
Chewing by small carnivores	101	73,2
Rodents gnawing	3	2,2
Digestion traces by birds of prey	12	8,7
Boluses by birds of prey	16	11,6

TABLE 1

Remains of *Lepus corsicanus* from L. 7 of Grotta Mora Cavorso with traces on the bone's surfaces.

Species	Upper			Lower		
	n.	mean	s.d.	n.	mean	s.d.
Canis lupus	5	43,5	4,53	4	36,4	4,01
Vulpes vulpes	12	20,1	2,82	10	18,9	3,05
Mustela erminea	1	4,4		1	4,2	
Mustela nivalis	10	5,3	0,59	9	4,6	0,53
Mustela putorius	10	11,8	1,26	9	10,0	1,26
Martes foina	8	12,9	1,49	9	11,6	0,98
Martes martes	13	11,5	0,85	10	10,4	0,72
Meles meles	10	24,0	1,58	10	23,7	1,78
Felis silvestris	3	17,4	0,59	3	14,4	0,40
Lynx lynx	3	25,0	1,52	2	21,9	0,42

TABLE 2

Distances between the apexes of upper and lower canines of the main species of small and medium sized Italian carnivores; n.: number of measurements, s.d.: standard deviation.

CONCLUSIONS

The taxonomic analysis allowed the attribution of hare remains from L. 7 of GMC, referrable to MIS 3, to *Lepus corsicanus*. Among these, there are several specimens of considerable size. Therefore, this study provided new data on the size of *L. corsicanus* and on its geographic and ecological distribution in the Italian Pleistocene contest. The taphonomic observations excluded the anthropic action on the bones, but a large presence of gnawing traces, numerous pits and punctures and traces of digestion was noted. As for the traces attributable to the action of small carnivores, it was possible to hypothesize its possible predators by measuring the distance between the traces of pits and punctures. The distance between the apexes of canines of the carnivores examined suggest that the predators of hares were small carnivores. As for the traces of digested, predation by eagle owl cannot be excluded.

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REFERENCES

Alhaique, F. 2003: The role of small carnivores in the accumulation of bones in archaeological deposits: the case of the Fucino Basin sites. *Archaeofauna* 12: 61-71. https://revistas.uam.es/archaeofauna/article/view/7472

Andrés, M.; Gidna, A.O.; Yravedra, J. & Domínguez-Rodrigo, M. 2012: A study of dimensional differences of tooth marks (pits and scores) on bones modified by small and large carnivores. *Archaeological and Anthropological Sciences* 4(3): 209-219. http://dx.doi.org/10.1007%2Fs12520-012-0093-4

Andrews, P. 1990: *Owls, caves, and fossils*. Natural History Museum, London.

Boschin, F. 2019: Exploitation of carnivores, lagomorphs and rodents at Grotta Paglicci during the Epigravettian: The dawn of a new subsistence strategy? *Journal of Archaeological Science: Reports, 26*, 101871, https://doi.org/10.1016/j.jasrep.2019.101871

Bökönyi, S. 1970: A new method for the determination of the number of individuals in animal bone material. *American Journal of Archaeology* 74(3): 291-292 https://doi.org/10.2307/503105

Callou, C. 1997: Diagnose différentielle des principaux éléments squelettiques du lapin (genre *Oryctolagus*) et du lièvre (genre *Lepus*) en Europe occidentale. *Fiches d'ostéologie animale pour l'archéologie* Série B *Mammifères* 8: 1-21 https://hal-mnhn.archives-ouvertes.fr/mnhn-02103216

Fernández-Jalvo, Y. & Andrews, P. 2016: *Atlas of taphonomic identifications: 1001+ images of fossil* *and recent mammal bone modification*. https://doi.org/10.1007/978-94-017-7432-1

Fiore, I.; Alhaique, F. & Tagliacozzo, A. 2018: Who ate whom? Carnivore tooth marks on animal bone remains. P*roceedings of 13th ICAZ International Conference, Ankara, Turkey, 2nd -7 th September.*

Fiore, I.; Achino, K.F.; Mussi, M.; Rolfo, M.F.; Salari, L. & Tagliacozzo, A. 2024: La marmotta nell'Epigravettiano in Italia centrale: Grotta Mora Cavorso (Lazio) e Grotta di Pozzo (Abruzzo). *Atti del 9° Convegno Nazionale di Archeozoologia, Ravenna 28 novembre - 1° dicembre 2018*: 29-32.

Kotsakis, T.; Pandolfi, L.; Maiorino, L.; Petronio, C.; Sansalone, G. & Salari, L. 2020: Small vertebrates from the Late Pleistocene Avetrana (Apulia, southern Italy) karst filling. *Estudios Geologicos* 76(e122): 1-23. https://doi.org/10.3989/egeol.43378.508

Lloveras, L.; Moreno-García, M. & Nadal, J. 2009: The eagle owl (*Bubo bubo*) as a leporid remains accumulator: taphonomic analysis of modern rabbit remains recovered from nests of this predator. *International Journal of Osteoarchaeology* 19(5): 573-592 https://doi.org/10.1002/oa.995

Lo Valvo, M. 2007: Status di *Lepus corsicanus* in Sicilia. In: De Filippo, G.; De Riso, L.; Riga, F.; Trocchi, V. & Troisi, S.R. (eds.): *Conservazione di* Lepus corsicanus *De Winton, 1898 e stato delle conoscenze*: 89-95. IGF, Napoli.

Palacios, E. 1996: Systematics of the indigenous hares of Italy traditionally identified as *Lepus europaeus* Pallas, 1778 (Mammalia: Leporidae). *Bonner Zoologische Beitrage* 46: 59-92.

Rolfo, M.F.; Achino, K.F.; Fusco, I.; Salari, L. & Silvestri, L. 2016: Reassessing human occupation patterns in the inner central Apennines in prehistory: the case-study of Grotta Mora Cavorso. *Journal of Archaeological Science: Reports* 7: 358-367. https://dx.doi.org/10.1016/j.jasrep.2016.05.005

Romandini, M.; Fiore, I.; Tagliacozzo, A.; PÉRez, A.; Lubrano, V.; Terlato, G. & Peresani, M. 2018: Late Neandertals and the exploitation of small mammals in northern Italy: fortuity, necessity or hunting variability? *Quaternaire*. *Revue de l'Association française pour l'étude du Quaternaire* 29(1): 61-67 https://doi.org/10.4000/quaternaire.8626

Salari, L.; Achino, K.F.; Gatta, M.; Petronio, C.; Rolfo, M.F.; Silvestri, L. & Pandolfi, L. 2017: The wolf from Grotta Mora Cavorso (Simbruini mountains, Latium) within the evolution of *Canis lupus* L., 1758 in the Quaternary of Italy. *Palaeogeography, Palaeoclimatology, Palaeoecology* 476: 90-105 http://dx.doi.org/10.1016%2Fj.palaeo.2017.03.023

Vismara, P. 2012: *Il genere* Lepus *in Italia: chiavi diagnostiche morfo-odontologiche e contributi paleobiogeografici*. PhD Thesis, Università degli Studi di Milano.

SUPPLEMENTARY MATERIAL

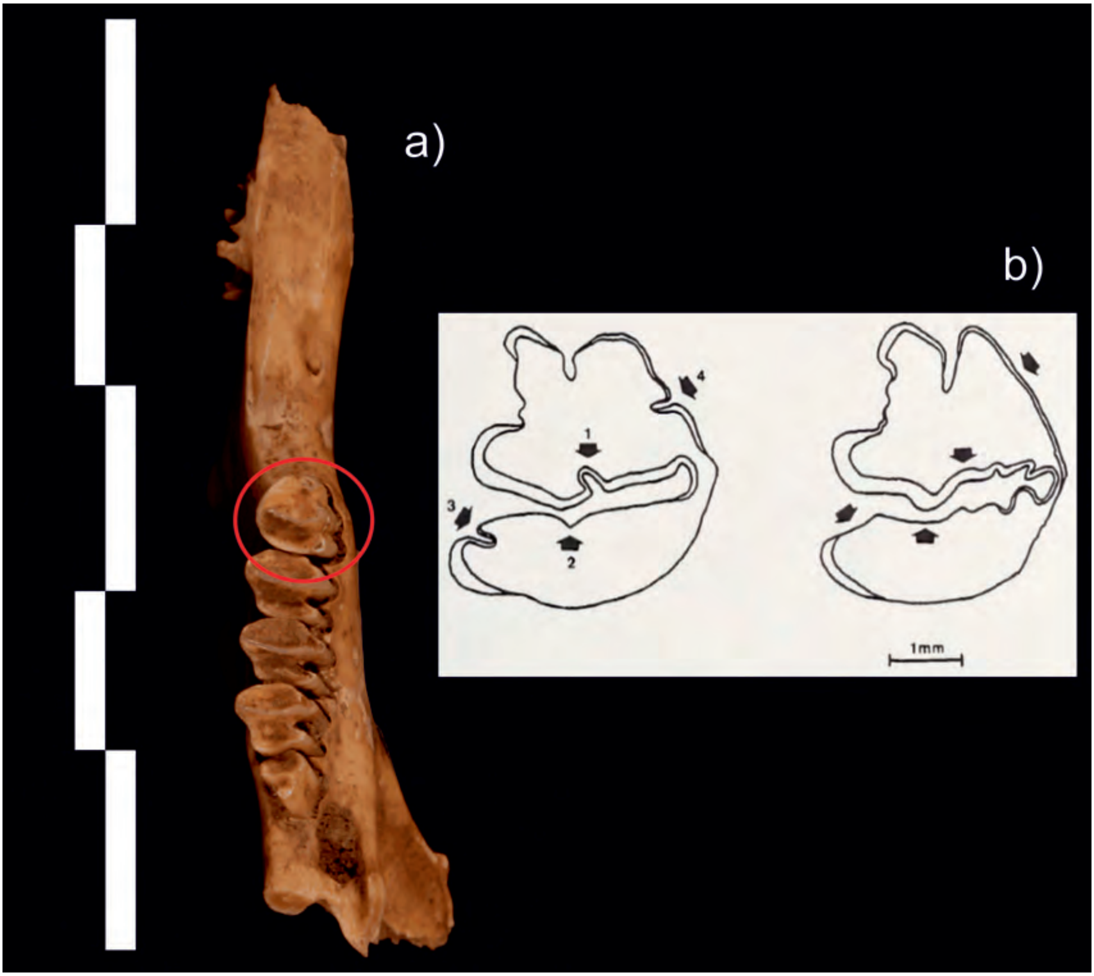

FIGURE 1S

a) Hemimandible of *Lepus corsicanus* with indication of third lower premolar (p3); b) morphological differences among p3 of L. *europaeus*, on the left, and L. *corsicanus*, on the right (elaborated from Palacios, 1996: 75, fig. 5c).

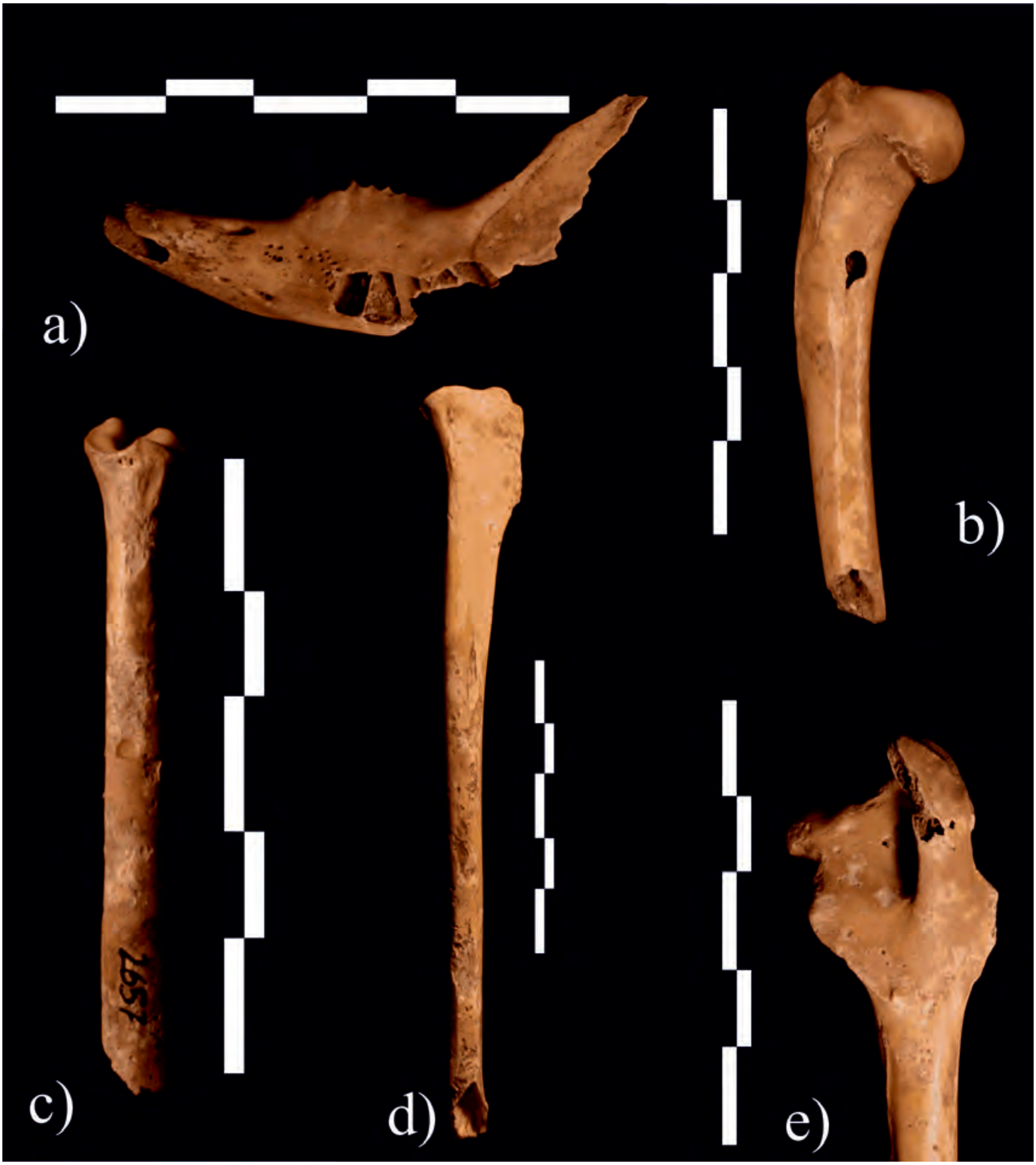

FIGURE 2S

Lepus corsicanus remains from L. 7 of Grotta Mora Cavorso showing traces on bone surfaces: a) hemimandible with gnawing; b) proximal humerus with a pit; c) proximal radius with digestion and roots acidity traces; d) tibia with gnawing; e) proximal femur with digestion traces.

Taxa	**NR**	**%**	**MNI**	**%**
Lepus corsicanus	336	35,9	12	28,6
Marmota marmota	153	16,4	4	9,5
Canis lupus	179	19,1	5	11,9
Mustela nivalis	3	0,3	1	2,4
Martes martes	1	0,1	1	2,4
Meles meles	1	0,1	1	2,4
Ursus arctos	19	2,0	3	7,1
Sus scrofa	18	1,9	2	4,8
Cervus elaphus	41	4,4	3	7,1
Capreolus capreolus	23	2,5	3	7,1
Capra ibex	26	2,8	2	4,8
Rupicapra pyrenaica ornata	123	13,2	4	9,5
Artiodactyla	12	1,3	1	2,3
TOTAL	**935**	**100**	**42**	**100**

TABLE 1S

Number of remains (NR) and Minimum Number of Individuals (MNI) from L.7 of Grotta Mora Cavorso.

Skeletal elements	n.
Skull	1
Maxillary	4
Upper teeth	17
Hemimandible	11
Lower teeth	20
Vertebrae	18
Scapula	5
Humerus	22
Radius	13
Ulna	8
Carpal bones	2
Metacarpus	33
Coxal	18
Femur	22
Tibia	24
Talus	6
Calcaneus	9
Metatarsus	51
Metapodial bones	15
Phalanx I	34
Phalanx II	2
Phalanx III	1
TOTAL	**336**

TABLE 2S

Distribution of anatomical elements of hares from L.7 of Grotta Mora Cavorso.

	n	**yy**	**y**	**y-a**	**a**	**o**
Lepus corsicanus	0	1	1	2	8	0

TABLE 3S

Age profiles of hares from L.7 of Grotta Mora Cavorso; n: foetus or newborn; yy: very young; y: young; y-a: young-adult; a: adult; o: very old.

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A chicken is good all year round. Seasonality of meat consumption in Renaissance cookbooks

Un pollo è per tutte le stagioni. La stagionalità del consumo di carne animale nei testi di cucina rinascimentale

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ABSTRACT: Seasonality studies have a long tradition especially for the Paleolithic and Mesolithic; the aim in these periods is, among the other things, to investigate hunter-gatherer mobility within a territory. When populations started to become sedentary and to breed animals, the meat of domestic animals became, in theory, available all year round, in contrast to plants that necessarily continued to follow seasonal cycles; therefore, investigations focusing on the season of death of the animals are usually lacking in the studies on later prehistoric periods or historical contexts. However, the reading of Renaissance cookbooks evidences that the season when it was preferable to consume the meat of different domestic and wild animals was still considered as very important in that period. The selection was based not only on taxonomy, but, within the same species, the age and sex of the individuals was taken into account. The seasonal choice was related to both practical and cultural-religious reasons. From a methodological point of view these Renaissance indications suggest that it would be useful to investigate the seasonal exploitation of animal resources in more recent contexts and interpret archaeozoological data also using this additional source of information.

KEYWORDS: SEASONALITY, RENAISSANCE COOKBOOKS, WRITTEN SOURCES, DOMESTIC ANIMALS, WILD ANIMALS

RIASSUNTO: Gli studi sulla stagionalità hanno una lunga tradizione specialmente per il Paleolitico e il Mesolitico; lo scopo in questi periodi è, tra le altre cose, quello di indagare la mobilità dei cacciatori-raccoglitori all'interno di un territorio. Quando le popolazioni hanno iniziato a diventare sedentarie e ad allevare gli animali, la carne delle specie domestiche è divenuta, in teoria, disponibile in tutto l'arco dell'anno, a differenza delle piante che comunque hanno necessariamente continuato ad avere dei cicli stagionali; di conseguenza le indagini incentrate sulla stagione di morte degli animali sono di solito assenti negli studi relativi alla preistoria recente e ai contesti di età storica. Tuttavia, la lettura di testi di cucina rinascimentali evidenzia come la stagione in cui era preferibile consumare la carne dei diversi animali, domestici e selvatici, fosse ancora molto importante in questo periodo. La selezione veniva fatta non solo su basi tassonomiche, ma anche, all'interno della stessa specie, in base all'età e al sesso degli individui. La scelta stagionale era legata sia a questioni pratiche, sia culturali-religiose. Da un punto di vista metodologico queste indicazioni rinascimentali suggeriscono come potrebbe essere utile cercare di indagare lo sfruttamento stagionale delle risorse animali pure in contesti più recenti ed interpretare i dati archeozoologici anche alla luce di queste ulteriori informazioni.

PAROLE CHIAVE: STAGIONALITÀ, RICETTARI RINASCIMENTALI, FONTI SCRITTE, ANIMALI DOMESTICI, ANIMALI SELVATICI

http://www.doi.org/10.15366/archaeofauna2025.34.1.031

INTRODUCTION

Investigations on the seasonal exploitation of food resources have a long tradition especially in researches about Paleolithic and Mesolithic hunter-gatherers; one of the goals of such studies is to investigate the mobility of these populations and therefore the exploitation of their territory. With the beginning of sedentarization and breeding practices, animals, especially domestic ones, may be, in theory, considered as a food source available all year round, in contrast to plants that necessarily continue to follow their seasonal cycles; as a consequence, studies on the season of death are not usually carried out in later prehistoric periods or in historical contexts.

However, from the analysis of some Renaissance cookbooks it is possible to observe that still in the 15th and 16th centuries the season when it was preferable to consume the meat, not only of wild animals, but also of domestic ones, was very important. The seasonal choice was related sometimes to physiological or practical reasons: for example, when the accumulation of body fat made the meat more palatable, or when a species was available only during specific periods of the year (e.g., migratory birds). In other cases, the selection was heavily influenced by cultural and religious factors: for instance, in the past abstinence from meat was not only during Lent but also for other religious holidays, and still in the 18th century, at least 155 days per year were considered as "lean days", not only for the clergy, but for the entire population in Rome (D'Amelia, 1975).

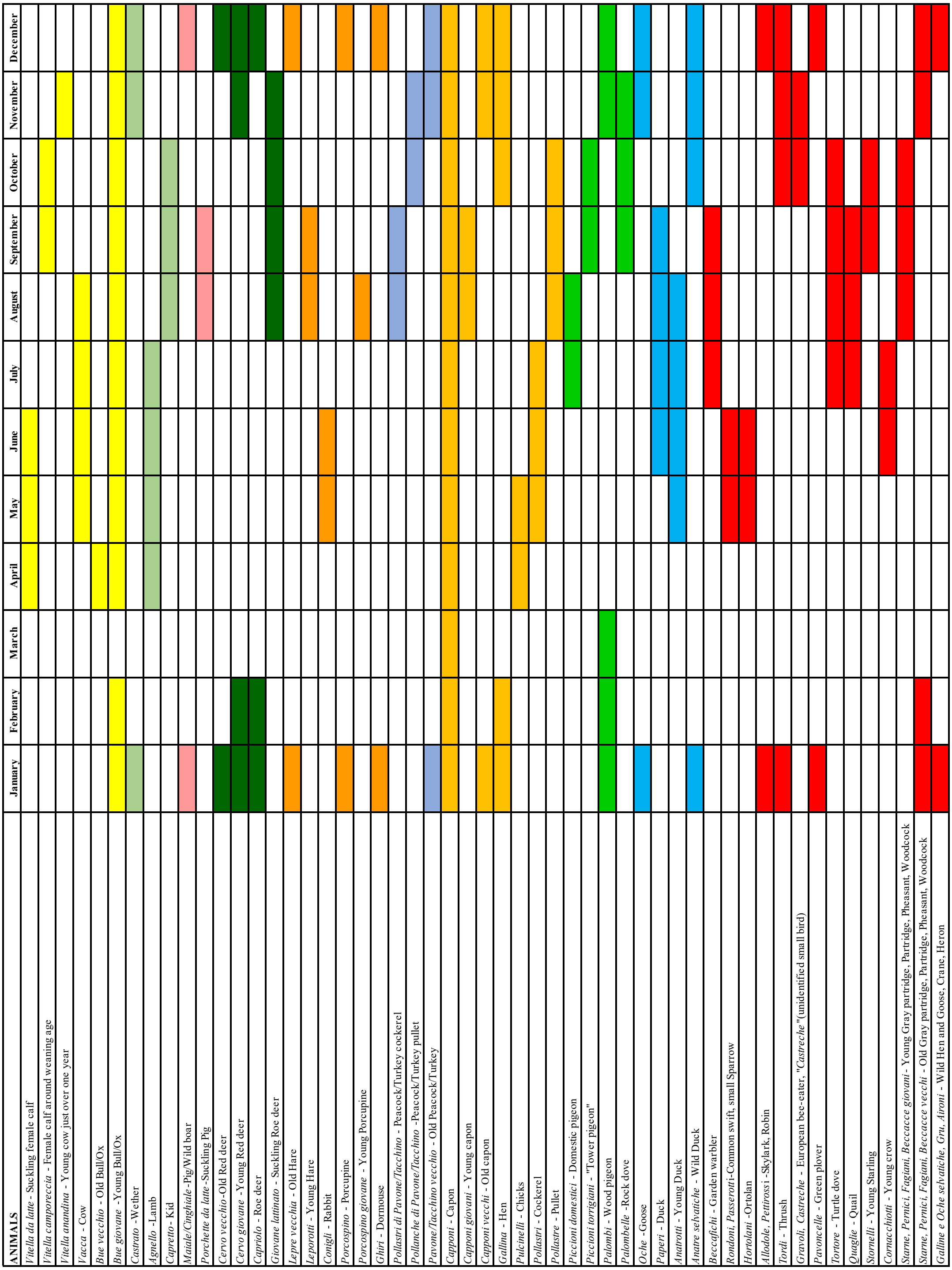
RESULTS AND DISCUSSION

In the *De Honesta voluptate e valetudine* ("On honest indulgence and good health", 1474?), Bartolomeo Platina provides only a few hints about what is better to eat in the different periods of the year:: "*….. come d'inverno conviene mangiare carni che diano calore, quali piccioni, tordi e merli, così d'estate è bene mangiare carni che rinfrescano, come capretti e pollastrelle; d'autunno carni calde e asciutte come coturnici e beccafichi; di primavera uccelletti presi dal nido non appena hanno messo le penne*" (Platina (1474?) in Faccioli, 1985: 96) ("…as in winter it is more convenient to eat meats that provide heat, such as pigeons, thrushes, and blackbirds, so during the summer it is good to eat refreshing meats, such as kids and pullets; in autumn warm and dry meats such as rock partridges and garden warblers;. in spring small birds taken from the nest as soon as they have their feathers").

Domenico Romoli (1560) gives much more space to food seasonality devoting the whole second and third books of his *Singolare dottrina* ("Singular Doctrine") respectively to the seasonality of mammals and birds, and of fish. From this text (Supplementary Table 1) it is possible to see that the selection was not based only on taxonomy. As a matter of fact, on one hand the meat of domestic mammals and birds was actually consumed all year round, except on abstinence days, on the other hand, within the same species, there was a seasonal choice based on the age and sex of the individuals. Furthermore, in Romoli's text, the fourth book describes the meals to be prepared in the different months of the year, listed day by day, always following seasonal indications.

In the *Opera* (1570) by Bartolomeo Scappi the seasonality of meat (Supplementary Table 2), although always reported, is mentioned within the various recipes: for example, the season for the "*Bove*" (bull/ox) goes from autumn to the end of February, while that of the "*Vaccina*" (cow) spans from the end of May to the end of September (Scappi, 1570; Book 2, Chapter 1) and that of the young cow "*…comincia nel mese di aprile per tutto luglio*" ("..starts in the month of April throughout July"; Scappi, 1570; Book 2, Chapter 23). In this case too, although with some variations compared to what was reported by Romoli (1560), the consumption of the meat of the main domestic mammals and birds, covers the whole year exploiting different ages and sexes according to the season.

Scappi sometimes provides even more details taking into account also the latitude: for example, "*…la stagion del porco…comincia al Nevembre et dura per mezo Febraro; benche in alcuni lochi più freddi, che Roma comincia da mezo Settembre*" ("…the season of the pig …starts in November and lasts until mid-February, but in places that are colder than Rome it starts in mid-September"; Scappi 1570, Book 2, Chapter 96). Furthermore, the different parts of the animals too, sometimes, have a specific seasonality: for instance "*La Zinna, o poppa, bisogna che sia piena di latte, ……e del mese di maggio sarà assai migliore*" ("The udder needs to be full of milk,...and in the month of May it will be at its best"; Scappi, 1570; Book 2, Chapter 17).



ANIMALS	January	February	March	April	May	June	July	August	September	October	November	December
Vitella da latte - Suckling female calf				■	■	■						
Vitella camporeccia - Female calf around weaning age									■	■		
Vitella anandina - Young cow just over one year											■	
Vacca - Cow					■	■	■	■				
Bue vecchio - Old Bull/Ox				■								
Bue giovane -Young Bull/Ox	■	■		■	■	■	■	■	■	■	■	■
Castrato -Wether	■										■	■
Agnello -Lamb				■	■	■	■					
Capretto - Kid								■	■	■		
Maiale/Cinghiale -Pig/Wild boar	■											■
Porchette da latte -Suckling Pig								■	■			
Cervo vecchio -Old Red deer	■											■
Cervo giovane -Young Red deer	■	■									■	■
Capriolo - Roe deer	■	■										■
Giovane lattinato - Suckling Roe deer								■	■	■	■	
Lepre vecchia - Old Hare	■											■
Leporotti - Young Hare								■	■			
Conigli - Rabbit					■	■						
Porcospino - Porcupine	■											■
Porcospino giovane - Young Porcupine								■				
Ghiri - Dormouse	■											■
Pollastri di Pavone/Tacchino - Peacock/Turkey cockerel								■	■			
Pollanche di Pavone/Tacchino -Peacock/Turkey pullet										■	■	
Pavone/Tacchino vecchio - Old Peacock/Turkey	■										■	■
Capponi - Capon	■	■	■	■	■	■	■	■	■	■	■	■
Capponi giovani - Young capon								■	■			
Capponi vecchi - Old capon	■										■	■
Gallina - Hen	■	■								■	■	■
Pulcinelli - Chicks				■	■							
Pollastri - Cockerel					■	■	■					
Pollastre - Pullet								■	■	■		
Piccioni domestici - Domestic pigeon							■	■				
Piccioni torrigiani - "Tower pigeon"									■	■		
Palombi - Wood pigeon	■	■	■								■	■
Palombelle -Rock dove									■	■	■	
Oche -Goose	■										■	■
Paperi - Duck						■	■	■	■			
Anatrotti - Young Duck					■	■	■	■				
Anatre selvatiche - Wild Duck	■									■	■	■
Beccafichi - Garden warbler							■	■	■			
Rondoni, Passerotti-Common swift, small Sparrow					■	■						
Hortolani -Ortolan					■	■						
Allodole, Pettirossi -Skylark, Robin	■											■
Tordi - Thrush	■									■	■	■
Gravoli, Castreche - European bee-eater, "*Castreche*"(unidentified small bird)										■	■	
Pavoncelle - Green plover	■											■
Tortore - Turtle dove							■	■	■	■		
Quaglie - Quail							■	■	■			
Stornelli - Young Starling									■	■		
Cornacchiotti - Young crow						■	■					
Starne, Pernici, Fagiani, Beccacce giovani - Young Gray partridge, Partridge, Pheasant, Woodcock								■	■	■		
Starne, Pernici, Fagiani, Beccacce vecchi - Old Gray partridge, Partridge, Pheasant, Woodcock	■	■									■	■
Galline e Oche selvatiche, Gru, Aironi - Wild Hen and Goose, Crane, Heron	■											■

SUPPLEMENTARY TABLE 1

Data on the best season for consuming different kinds of meat according to Romoli (1560).

ANIMALS	Gennaio	Febbraio	Marzo	Aprile	Maggio	Giugno	Luglio	Agosto	Settembre	Ottobre	Novembre	Dicembre
Bove - Bull/Ox	■	■							■	■	■	■
Vaccina - Cow					■	■	■	■	■			
Vitella - Female calf				■	■	■	■					
Castrato -Wether	■	■					■	■	■	■	■	■
Capra & Camozza - Goat & Chamois	■										■	■
Stambecco - Ibex						■	■	■	■	■	■	
Capretto - Kid	■	■	■	■	■	■						
Porchetto domestico e selvatico - Suckling Domestic & Wild Pig						■	■	■	■	■	■	
Ruffolotto - Young Pig/Wild boar	■	■						■	■	■	■	■
Cinghiale - Wild boar	■	■								■	■	■
Maiale - Pig	■	■									■	■
Caprioletti, Cervietti, Daini da latte - Sukling Roe, Red and Fallow deer					■	■	■					
Cervietto, Capriolo, Daino -Young Red deer and Roe deer, Fallow deer								■	■	■	■	■
Cervo - Red deer	■									■	■	■
Orso -Bear	■	■										■
Lepre -Hare	■	■						■	■	■	■	■
Coniglio - Rabbit					■	■	■	■				
Coniglio d'India - Rabbit of India (=Guinea pig)	■	■								■	■	■
Ghiri - Dormouse	■	■								■	■	■
Porcospino - Porcupine								■				
Riccio - Hedgehog				■	■	■	■	■	■	■	■	
Galline nostrali e d'India - Local Hen and Hen of India (=Turkey)	■	■	■								■	■
Pollanca - Pullet	■	■					■	■	■	■	■	■
Polletto - Cockerel					■	■						
Pavone nostrale - Local Peacock	■	■								■	■	■
Gallo e gallina d'India - Rooster and Hen of India (=Turkey)	■	■								■	■	■
Oca selvatica - Wild Goose	■	■										■
Oche domestiche vecchie - Old domestic Goose										■	■	■
Papari et Anatre picciole domestiche giovani - Young small domestic Ducks					■							
Papari et Anatre picciole domestiche più grosse - Young small domestic Ducks of larger size							■	■	■			
Piccioni domestici - Domestic Pigeon				■	■	■	■	■	■			
Piccioni di torre - "Tower Pigeon"	■	■	■	■	■				■	■	■	■
Piccioni di ghianda, Palombelle, Felicette, Beccaci, Garganelli - Wood pigeon, Rock dove, "*Felicette*" (unknown bird), Woodcock, Goosander or Teal	■	■							■	■	■	■
Tordi, Merli, Lodole - Thrush, Blackbird, Skylark	■								■	■	■	■
Passeri, Pettirossi e altri uccelletti giovani - Young Sparrow, Robin, and other small birds				■	■	■						
Passeri, Pettirossi e altri uccelletti vecchi - Old Sparrow, Robin, and other small birds	■	■										■
Beccafico - Garden warbler							■	■	■	■		
Ortolano - Ortolan	■	■								■	■	■
Rondone giovane - Young Common swift					■	■						
Fagiani selvatici o Galli di montagna - Wild Pheasant or Black grouse	■	■								■	■	■
Fagiani nostrali - Local pheasant	■	■								■	■	■
Cotorne, Starne vecchie, Frangolini - Rock partridge, Old Gray partridge, Francolin	■	■								■	■	■
Starnotti, Fagianotti, Perniconi giovani - Young Gray partridge, Pheasant, Partridge							■	■	■			
Starnotti, Fagianotti, Perniconi più grossi - Larger young Gray partridge, Pheasant, Partridge									■	■	■	
Gru - Crane	■	■								■	■	■
Cicogna - Stork								■	■	■		

SUPPLEMENTARY TABLE 2

Data on the best season for consuming different kinds of meat according Scappi (1570).

It is curious to note that also the consumption of exotic newly imported species such as the turkey and even the guinea pig follows the seasonal rules; these taxa are often associated to similar and/or better-known animals. In Italy, the turkey as a consumed bird appears for the first time in Romoli (1560), it is mentioned as "*Gallina/Gallo d'India*" ("hen/rooster of India") and related to the peacock, while in Scappi only ten years later it appears also by itself. The season, as in the case of other important food animals, is different according to the sex and age: "*Quando il pavone, et la Gallina d'India sono vecchie, sarà la carne loro più buona nel maggior freddo dell'anno. Et i pollastri loro nascendo di Marzo, saran buoni d'Agosto, et Settembre, perché voglion esser di quattro mesi almeno, ma le femine, cioè pollanche…vorranno haver cinque o sei mesi, et queste saranno eccellentissime*" ("When the peacock and the chicken of India are old their meat will be best during the colder months of the year. And the cockerels, being born in March, are good in August and September when they are at least four months old, but the females, pullets, will need to be five or six months old, and these will be very excellent"; Romoli, 1560; Book 2, Chapter 21). Guinea pig, defined as "*coniglio d'India*" ("rabbit of India"), is instead mentioned by Scappi (1570) and is grouped with the dormouse, sharing the same seasonality: "…*la sua stagione comincia dal mese d'Ottobre, et dura per tutto Febraro*" ("…its season starts in the month of October and lasts throughout February"; Scappi, 1570; Book 2, Chapter 95). Interestingly, its consumption in Italy was probably more widespread than we know from archaeozoological data (Moricca *et al*., 2018; Alhaique *et al*., 2021) since Scappi adds: "…*benchè in Roma, et in altri lochi d'Italia se ne trovano quasi tutto l'anno*" ("…although in Rome and in other places in Italy it is possible to find them almost all year round"; Book 2, Chapter 95).

The seasonality that we find on the tables reflects and originates from what happens at the beginning of the process, in the selection of the animals to be culled. For example, the data on the livestock sold for being butchered in 1459, 1461, and 1463 in Rome at *Campo Taurchiani* (Figure 1) follow a strict seasonal trend (Ait, 1981). Donkeys are clearly dominant between February and May; this species was the most frequently exploited, although probably mainly by lower classes, since they are not cited in the above-mentioned, as well as in other, high-status cookbooks. Cattle is more abundant between June and September,

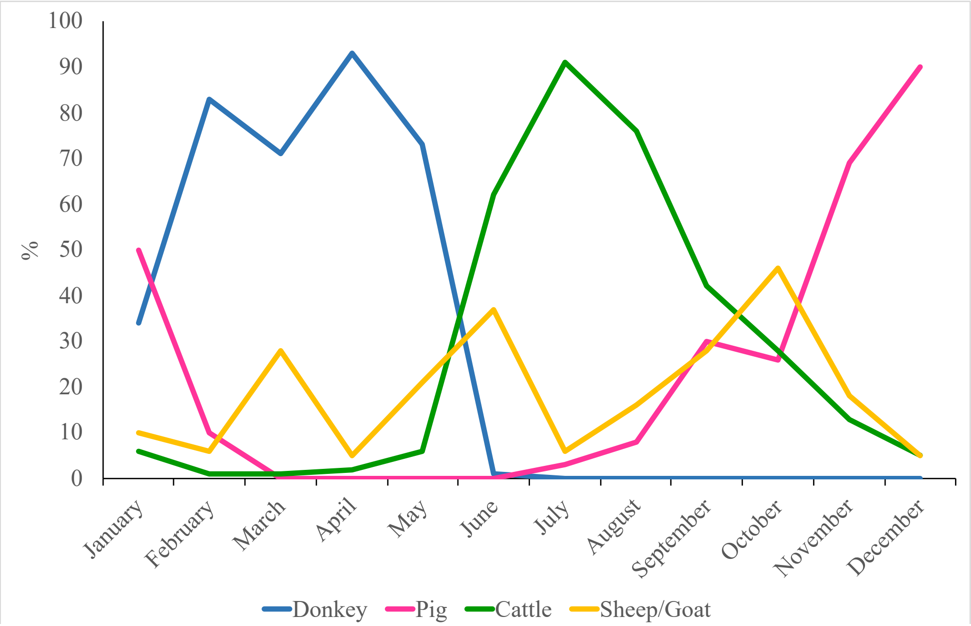


FIGURE 1

Monthly percent distribution of livestock availability on the market in Rome (average for the years 1459-1461-1463; data from Ait, 1981).

while sheep/goat are present all the time, with highs and lows, but always with relatively low percentages reaching a maximum of a mere 46% in October when they overcome the other taxa; such autumn "peak" could be related to killing of weak animals before the winter. Finally, the pig of course prevails in the coldest periods of the year, between November and January, with a peak in December as indicated also by iconographic representations where this month is symbolized exactly by pig butchery scenes. Similar seasonal culling practices are reported even later, in the 18th century, when the rules of the "*Dogana della Grascia*" in Rome indicated that the "*Agnellaura*" (lamb culling) was to be concentrated between Easter and St. John's day (June 24th), while cattle could be butchered between this latter day and Carnival, and finally pig between November and Fat Thursday (D'Amelia, 1975); the reference to Christian feasts evidences the extreme influence of religious rules on these seasonal choices.

CONCLUSIONS

The indications provided by Renaissance cookbooks and by documentary sources show very clearly that also in medieval and modern periods food seasonality, including the meat of domestic animals, was an important aspect of the culinary traditions and not only of that, and suggest the utility to investigate the seasonal exploitation of animal resources also in more recent contexts integrating this kind of information in the interpretation of archaeozoological data referred to historical periods (e.g., Alhaique, 2012).

REFERENCES

AIT, I. 1981: Il commercio delle derrate alimentari nella Roma del '400. *Archeologia Medievale* 8: 155-172.

ALHAIQUE, F. 2012: Ricette dal monastero. Cosa raccontano i resti faunistici dell'inizio del XVII secolo. In: Barelli, L. & Pugliese, R. (eds.): *Dal Cantiere dei SS. Quattro Coronati a Roma. Note di Storia e Restauro per Giovanni Carbonara*: 25-42. Viella, Rome.

ALHAIQUE, F.; MORICCA, C.; BARELLI, L.; MASI, A.; PUGLIESE, R.; SADORI, L.; ROMAGNOLI, G.; PIERMARTINI, L.; BRANCAZI, L.; GABBIANELLI, F.; CHILLEMI, G. & VALENTINI, A. 2021: Elite food between the late Middle Ages and Renaissance: some case studies from Latium. *Environmental Archaeology* 30(2), 89–103. DOI: 10.1080/14614103.2020.1867038.

D'AMELIA, M. 1975: La crisi di un mercato protetto: approvvigionamenti e consumo della carne a Roma nel XVIII secolo. *Mélanges de l'Ecole Française de Rome. Moyen Age, Temps Modernes* 87(2): 495-534.

MORICCA, C.; ALHAIQUE, F.; BARELLI, L.; MASI, A.; MORRETTA, S.; PUGLIESE, R. & SADORI, L. 2018 Early arrival of new world species enriching the biological assemblage of the Santi Quattro Coronati Complex (Rome, Italy). *Interdisciplinaria Archaeologica* 9(2): 191-203. DOI: 10.24916/iansa.2018.2.6

PLATINA, B. 1474?: *De honesta voluptate et valetudine* (*Il piacere onesto e la buona salute*). Italian Edition 1985: Faccioli, E. (ed.). Einaudi, Turin.

ROMOLI, D. 1560: *La singolare dottrina di M. Domenico Romoli sopranominato Panonto*. Venice.

SCAPPI, B. 1570: *Opera di M. Bartolomeo Scappi, cuoco secreto di Papa Pio V*. Venice.

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The exploitation of small game: new taphonomic data from the Mesolithic rock shelter of Galgenbühel/Dos de la Forca (South Tyrol – Italy)

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ABSTRACT: Galgenbühel/Dos de la Forca is an Early Mesolithic site located at Salorno (Province of Bolzano, Italy) and dated approximately between 8,500 and 7,500 cal. BC. The subsistence economy of the settlement relied on the exploitation of nearby wetlands and of the forested valley bottom; together with ungulates such as wild boar, red deer and chamois, the fauna comprises small carnivores and semi-aquatic mammals such as otter and beaver. The latter is the most abundant species, and a reasonable amount of its remains bear cut marks. Anthropic traces are also present on bones of wild cat, pine marten, badger and otter. We present a taphonomic study carried out on the bones belonging to small carnivores, rodents, and lagomorphs. A 3D digital microscope analysis was performed in order to distinguish the anthropic traces from non-anthropic modifications. Beside the results obtained from this exam, data from the evaluation of the cut mark positions on the bones and of the skeletal frequencies allowed the reconstruction of the methods adopted by hunter-gatherers in the treatment of beaver carcasses, and to understand the role of each species in their subsistence strategies.

KEY WORDS: GALGENBÜHEL/DOS DE LA FORCA, ALPS, BEAVER, CUT MARKS, 3D DIGITAL MICROSCOPE

RIASSUNTO: Galgenbühel/Dos de la Forca è un sito mesolitico situato a Salorno (Bolzano, Italia) e datato tra circa 8500 e 7500 a.C. cal. L'economia di sussistenza dell'insediamento si basava sullo sfruttamento delle vicine zone umide e del fondovalle boscoso. Insieme ad ungulati come cinghiali, cervi e camosci, la fauna comprende piccoli carnivori e mammiferi semiacquatici come la lontra e il castoro. Quest'ultimo rappresenta la specie più abbondante e una discreta quantità dei suoi resti presenta segni di taglio. Tracce antropiche sono presenti anche su ossa di gatto selvatico, martora, tasso e lontra. In questo lavoro presentiamo uno studio tafonomico riguardante i resti ossei appartenenti ai piccoli carnivori, ai roditori ed ai lagomorfi. L'utilizzo della microscopia digitale 3D ha avuto un ruolo chiave nel riconoscimento dei segni di taglio di origine antropica. Tali risultati, insieme alla valutazione delle posizioni dei *cut marks* sulle ossa e delle frequenze scheletriche di ogni specie indagata, hanno permesso di ricostruire i metodi adottati dai cacciatori-raccoglitori nel trattamento delle carcasse di castoro e di comprendere il ruolo di ogni *taxon* nelle strategie di sussistenza dei mesolitici.

PAROLE CHIAVE: GALGENBÜHEL/DOS DE LA FORCA, ALPI, CASTORO, *CUT MARKS*, MICROSCOPIA DIGITALE 3D

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INTRODUCTION

The Early Mesolithic rock shelter Galgenbühel/Dos de la Forca (Salorno, Bolzano), is located above a detrital cone at 225 m a.s.l. at the foot of a steep rock face that borders the Adige valley. Radiocarbon dates (between 8,425-8,089 BC cal. and 7,705-7,478 BC cal.) indicate the human frequentation of the shelter from the late Preboreal to the mid-Boreal (Figure 1). The recovered artefacts comprise lithic industry ascribable to the Sauveterrian technocomplex (Wierer, 2008). The site is remarkable for the exploitation of aquatic resources of the near wetland as fish, freshwater molluscs, pond turtles and semi-aquatic mammals. The macromammal assemblage comprises a variety of small game species, some of which are quite numerous (Wierer et al. 2018; Crezzini et al. 2014). Among these the beaver is the best represented species (Figure 2).

MATERIALS AND METHODS

The taphonomic examination of the mammal bone assemblage from Galgenbühel/Dos de la Forca revealed the presence of anthropic traces on the bones of *Castor fiber*, *Felis silvestris*, *Martes martes*, *Lutra lutra* and *Meles meles*. The investigation of these traces on the wild cat remains has demonstrated its exploitation not only for its fur but for nutritional purposes, too (Crezzini *et al.*,

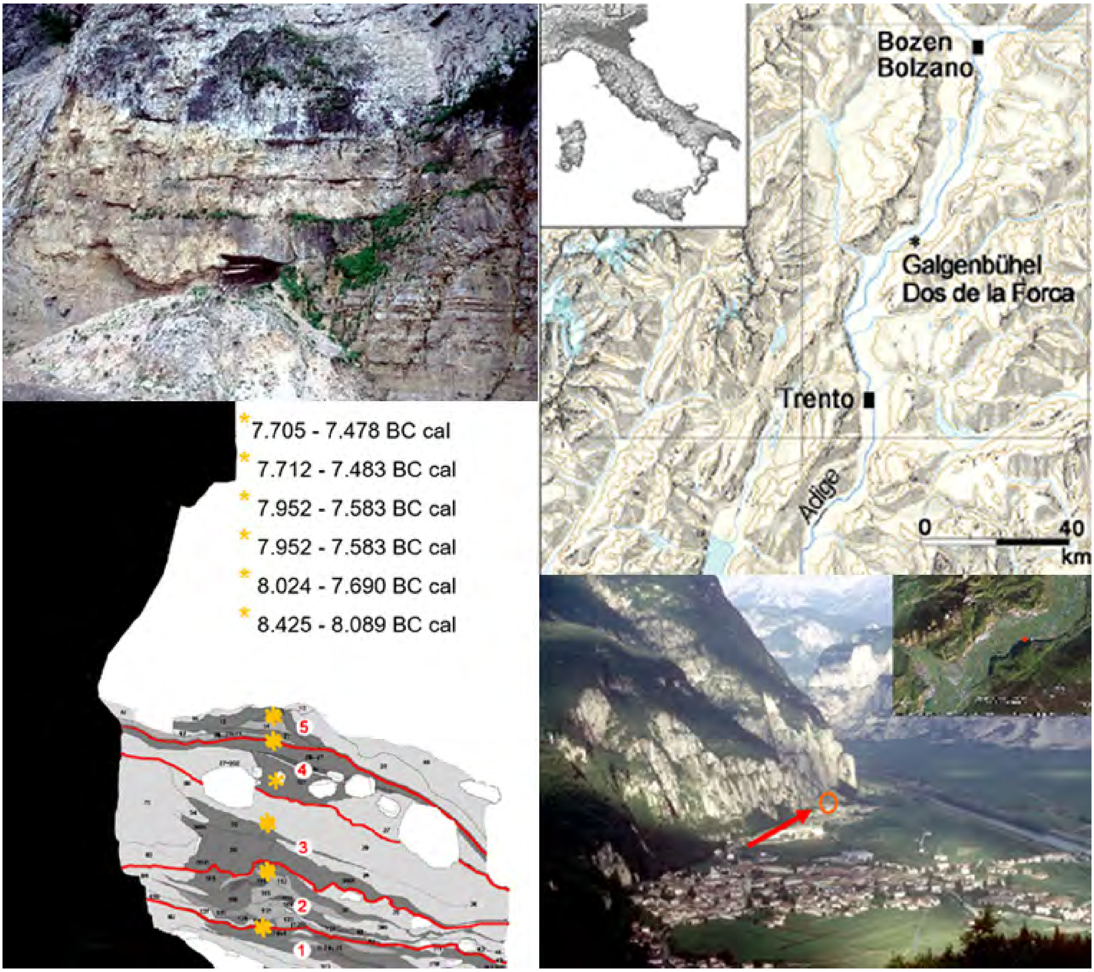


FIGURE 1

The location and the stratigraphy of the site.

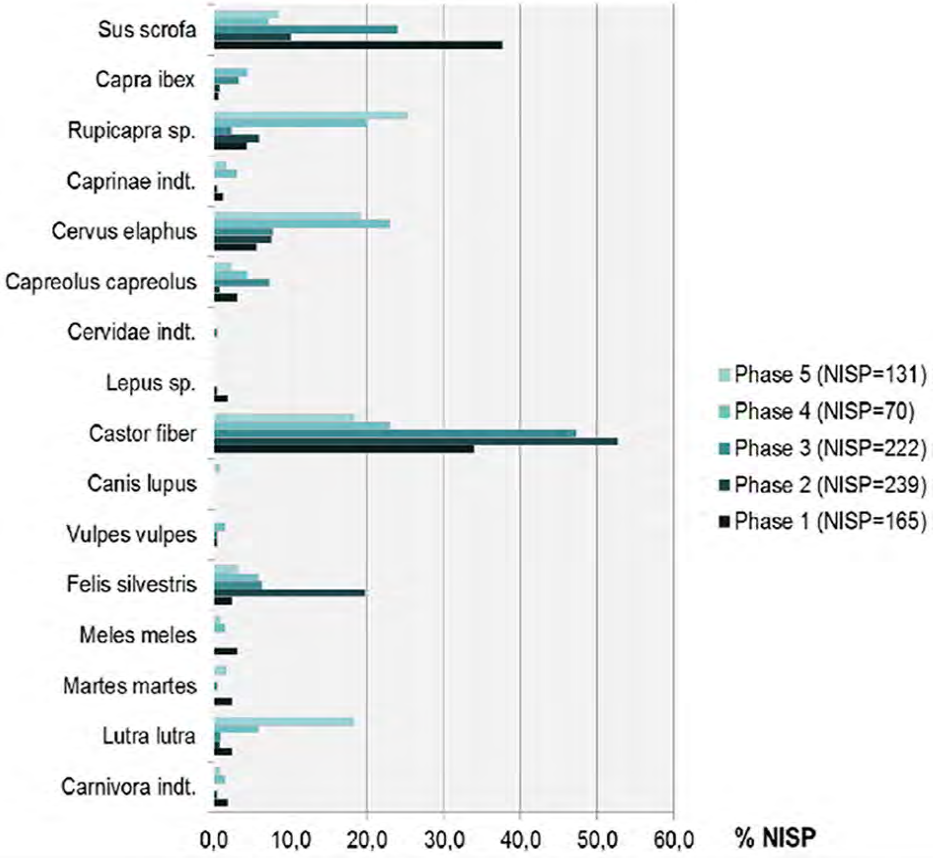


FIGURE 2

The macrofaunal association.

2014). In this work, we present the examination of the skeletal frequencies and the distribution of the anthropic traces on the bones belonging to the other small carnivores, rodents and lagomorphs. A 3D digital microscope analysis was performed in order to distinguish the anthropic traces from non-anthropic modifications (Boschin & Crezzini, 2012). The characteristic values of each of them (following Boschin & Crezzini, 2012) have been compared with an experimental database of cuts produced during butchering experiments on small mammal carcasses. These experiments were conducted using stone tools made from the same chert varieties of the archaeological artefacts.

RESULTS

The assemblage of the recovered beaver bones comprises elements from all body parts except for the vertebrae. Vertebrae are, on the other hand, well represented among the taxonomically unidentified bones. Cut marks have been detected on several bones. Surely, the high-quality pelt of the beaver explains for the skinning marks found on the lateral side of two mandibles. Disarticulation marks are found on the upper part of the skeleton, such as striae on two clavicles, both in similar positions (Figure 3). Cut marks on the medial side of a rib suggest the action of evisceration or filleting. Cut marks documented on the forelimbs are possibly evidence for the removal of muscles as shown by the distal cuts on the humerus (Figure 4) and by the disarticulation marks on an ulna and a radius. Much more numerous are the cut marks on the hindlimbs of the beaver, with signs of disarticulation on a tibia, on the metatarsals and on the phalanges (Figures 5 and 6) (Wierer *et al*., 2018).

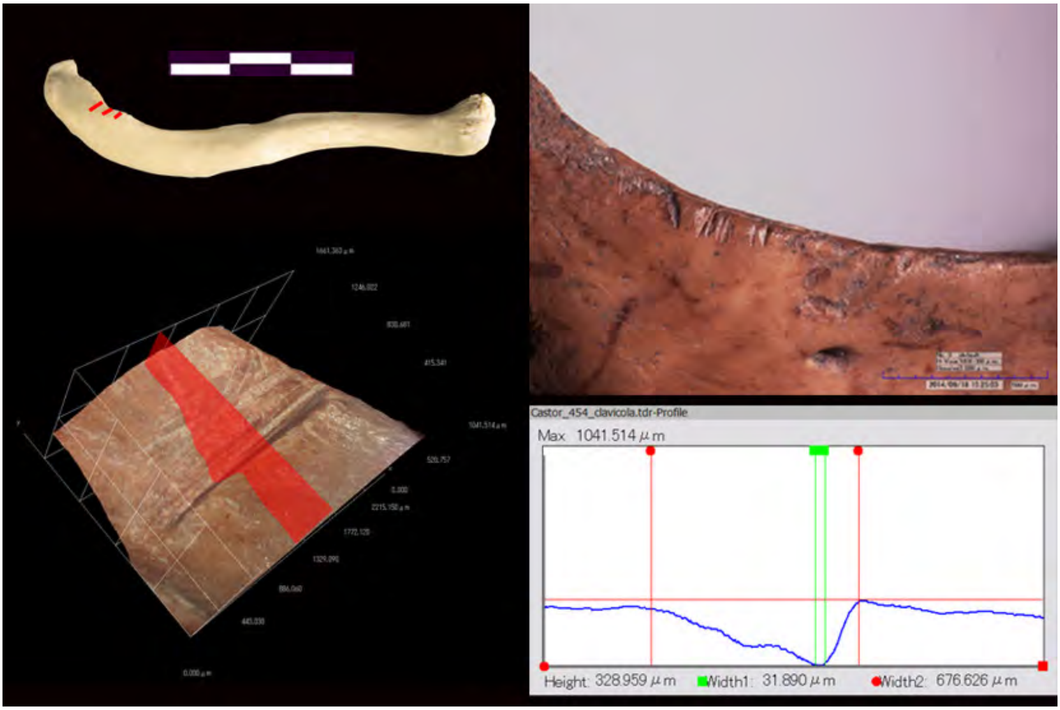


FIGURE 3

Castor fiber: Cutmarks on a clavicula (position of cut marks indicated on modern bone).

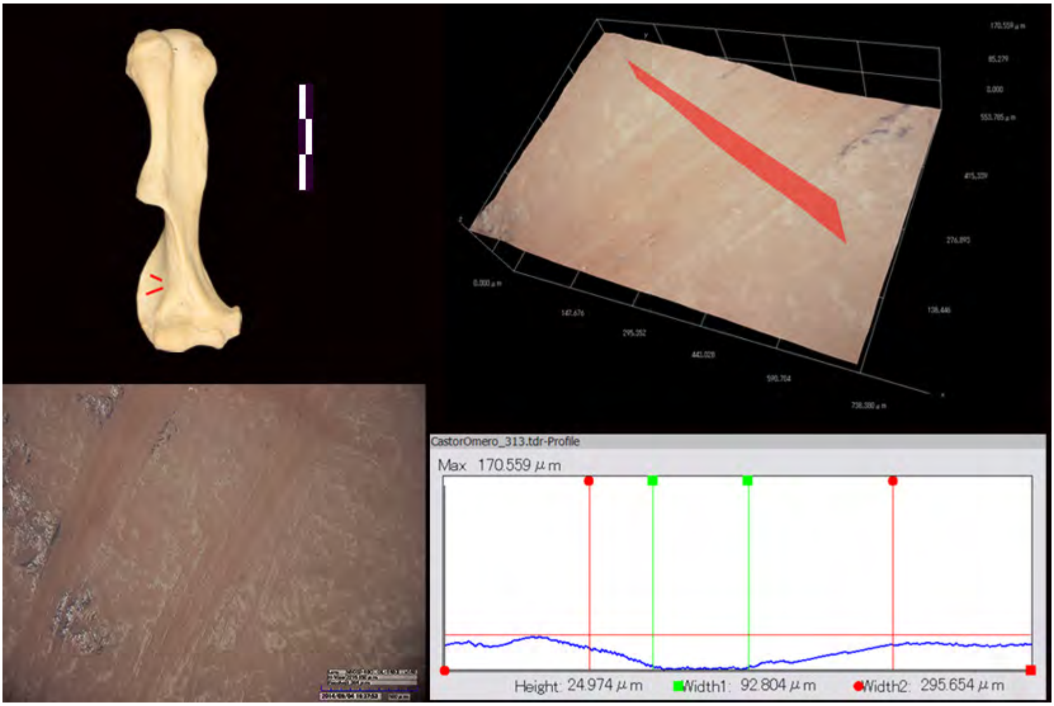


FIGURE 4

Castor fiber: Cutmarks on the distal part of a humerus.

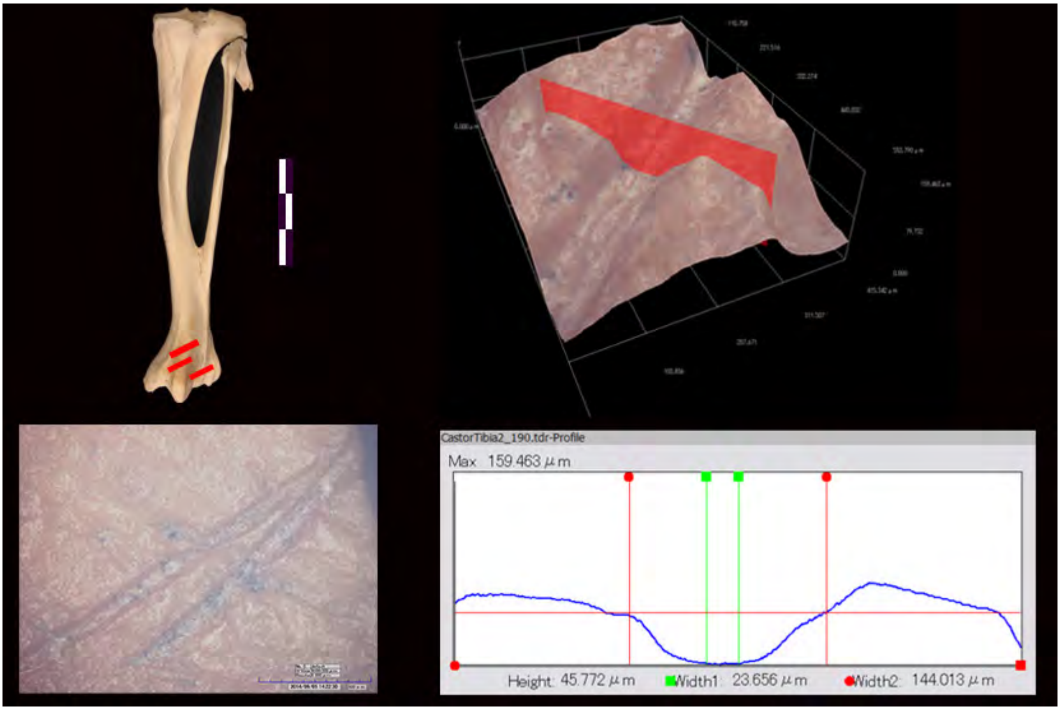


FIGURE 5
Castor fiber: Cutmarks on a tibia.

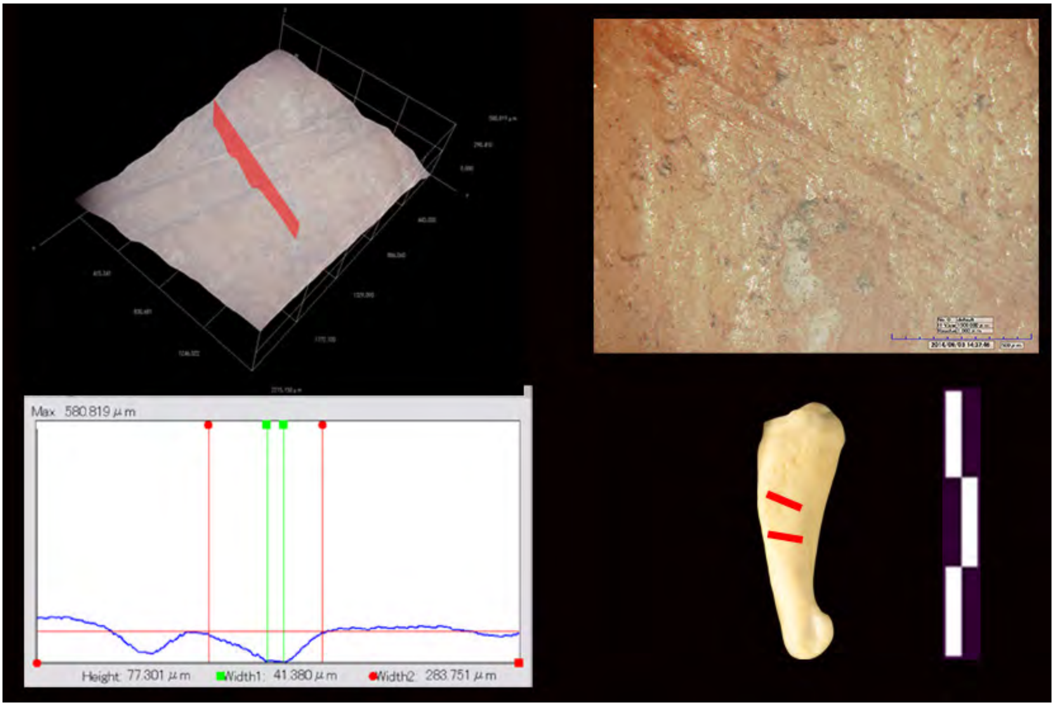


FIGURE 6
Castor fiber: Cutmarks on a first phalange.

The otter remains are represented mostly by cranial and limb bones. Three bones from the hindlimbs show cut marks located on the neck of the proximal articulation of a femur, on a tibia and on the ventral side of a metatarsal (Figure 7). They seem all related to the dismemberment, which could indicate meat consumption, besides the exploitation of the pelt. Regarding the badger, two of the few bones bear traces of human action. Due to their location on the maxilla and on the diaphysis of the metatarsal, both seem related to the skinning of the animal. The experimental butchering of a badger carcass produced similar marks on the maxilla during the skinning (Figure 8).

The only parts preserved from *Martes martes* are cranial bones and teeth. Figure 9 shows a cut on the medial side of a nearly intact mandible. Its location s nearly identical to the one detected on a mandible of *Felis silvestris* interpretable as disarticulation mark (Crezzini *et al*., 2014).

The evaluation of the morphometrical values related to some marks (sensu Boschin & Crezzini, 2012) on hare and fox bones excludes the anthropogenic origin of these modifications.

DISCUSSION AND CONCLUSIONS

The utilization of the 3D video microscope for the analyses of bone surfaces was of fundamental importance for the correct identification and the quantification of the *striae* produced on the bones of small game. The evaluation of the morphometric features of the traces allowed their more precise definition. A detailed comparative analysis of the marks found on small game species with those on the bones of larger mammals shows interesting differences. With respect to the parameter DC, which expresses the depth of the cut (Boschin & Crezzini, 2012), marks on the small game show a minor depth (Figure 10). They are indeed more "feeble", most probably by the lower force necessary for processing small carcasses. We also observed that the cut marks are less frequent on the bones of small mammals with respect to macromammals. This is probably due to the possibility to dismember small animals simply by "twisting" the bones in their joints (Figure 11). These results advise for caution in evaluating the degree of exploitation of the small game by a quantification of the marks and in evaluating the agent of accumulation on the base of the presence/absence of cut marks on small prey species in general.

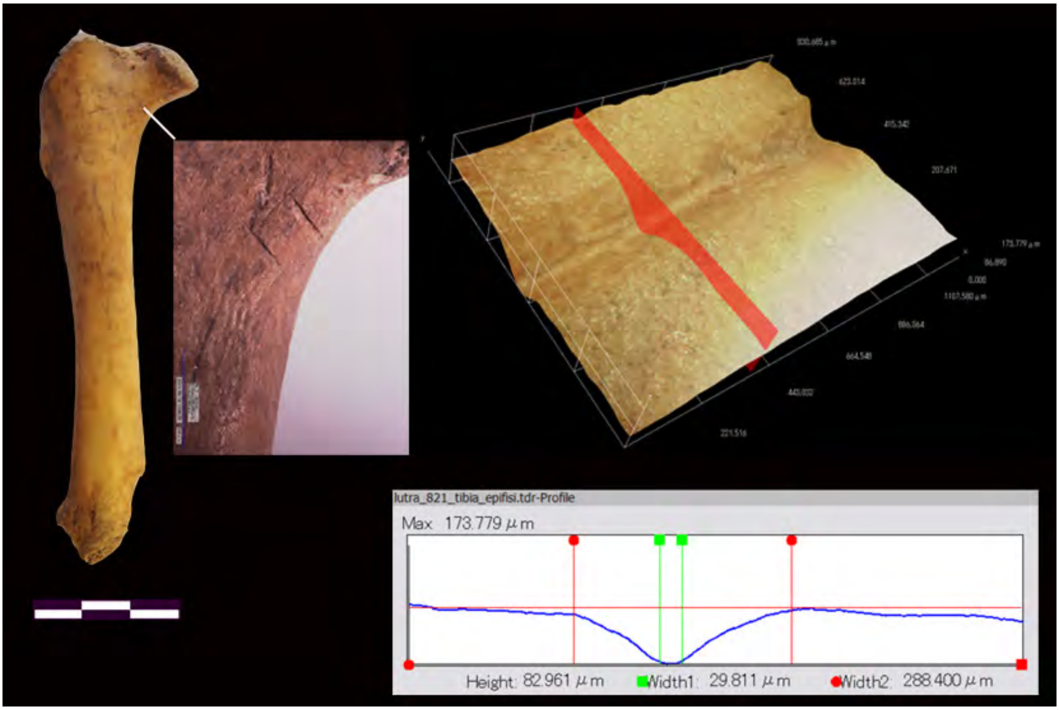


FIGURE 7

Lutra lutra: Cutmarks on a tibia.

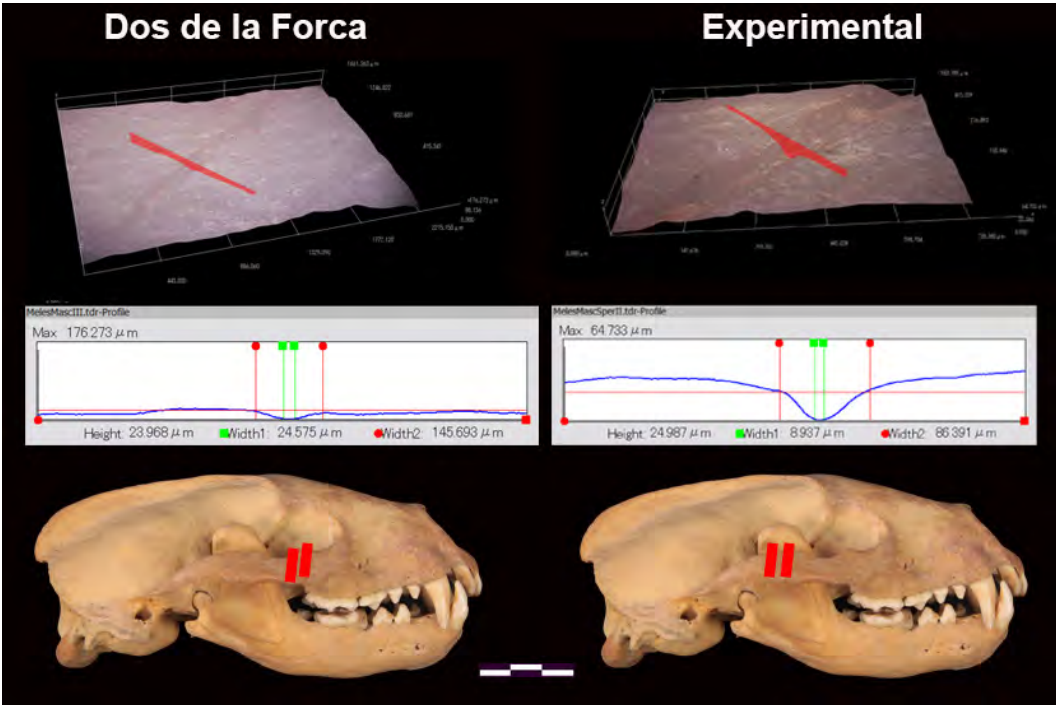


FIGURE 8

Meles meles: Cutmarks on the maxilla (position indicated on a modern cranium).

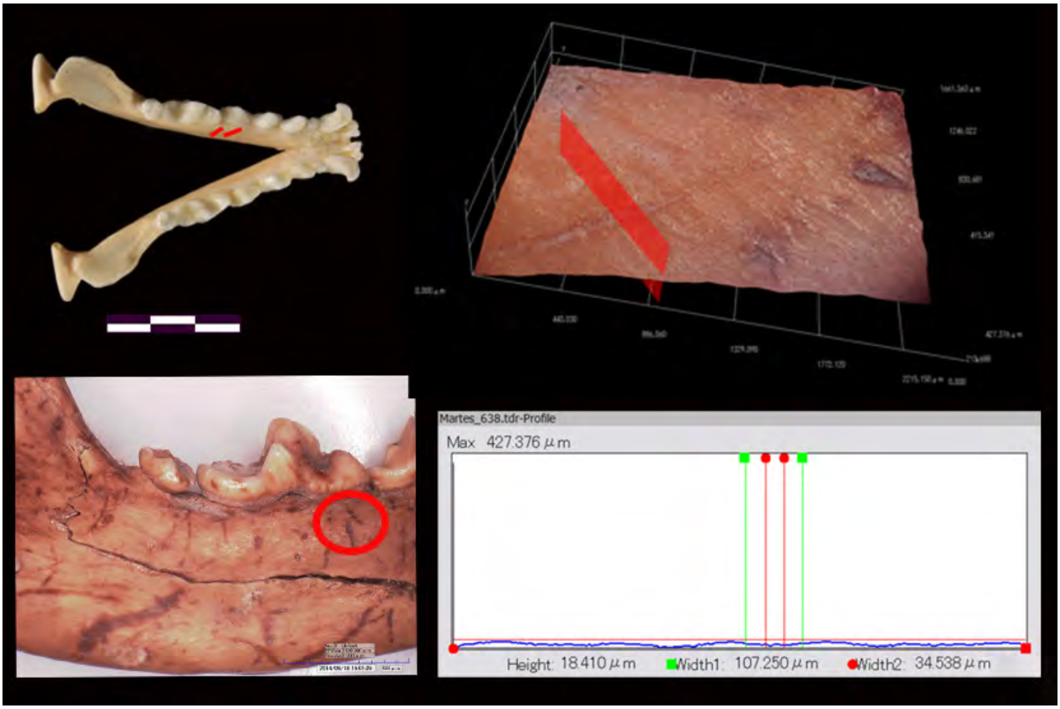


FIGURE 9

Martes martes: Cutmarks on the medial side of a nearly intact mandible.

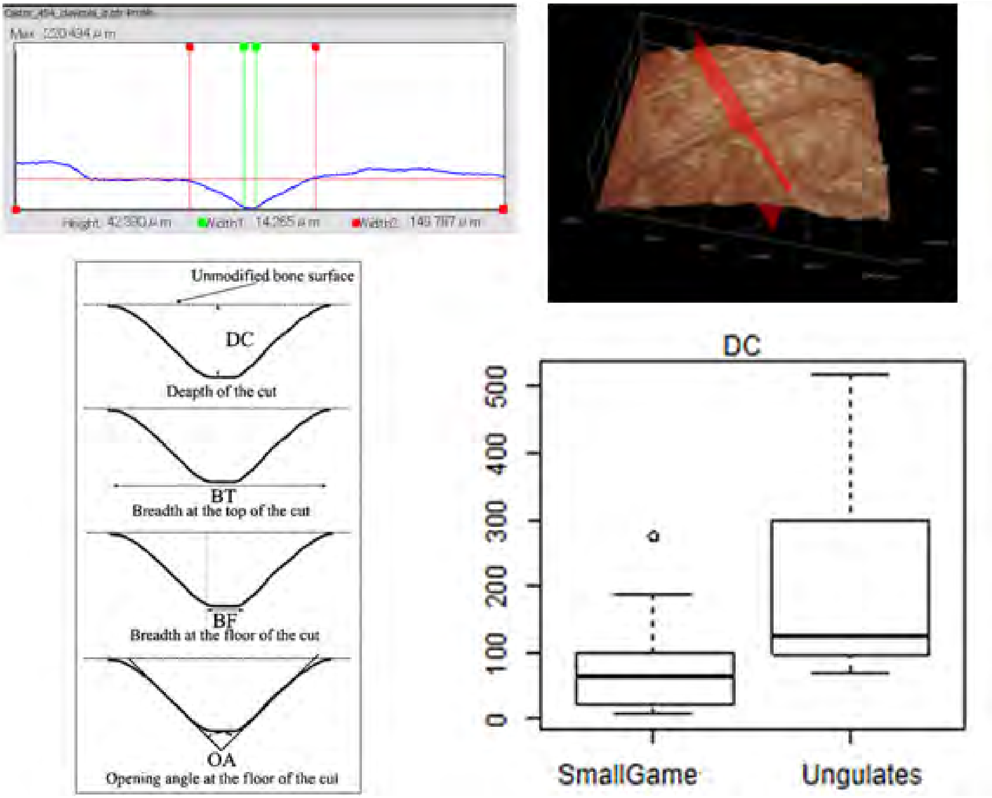
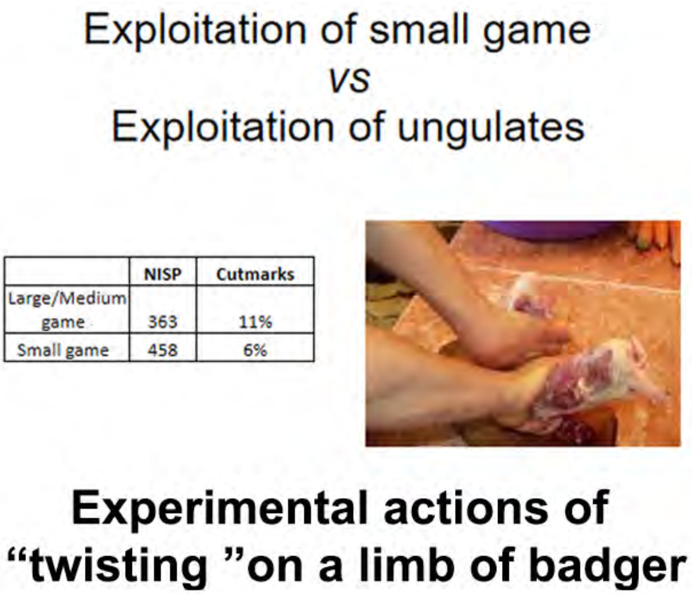


FIGURE 10

Comparison between the depth of cut marks (DC, *sensu* Boschin & Crezzini, 2012) recorded in small game and in the ungulate remains.



Exploitation of small game

vs

Exploitation of ungulates

	NISP	Cutmarks
Large/Medium game	363	11%
Small game	458	6%

Experimental actions of “twisting ”on a limb of badger

FIGURE 11

Percentage of large/medium and small game remains with cutmarks and experimental proofs of “twisting”.

This work is part of the research project "Leben am Wasser. Ressourcen, Technik und Mobilität im Mesolithikum am Beispiel der Fundstelle Galgenbühel in Salurn (Südtirol)" funded by the Autonomous Province of Bolzano/South Tyrol, Higher Education Support, University and Research Office. The project is headed by the South Tyrol Museum of Archaeology. Project partner is the Archaeological Heritage Office of Bolzano.

REFERENCES

BOSCHIN, F. 2020: Holocene macromammal remains from Grotta dell'Edera/Stenašca, Trieste Karst *Arheološki vestnik. Ljubljana, Slovenija* 71: 321-357.

Doi: 10.3986/AV.71.11.

BOSCHIN, F. & CREZZINI, J. 2012: Morphometrical analysis on cut marks using a 3D dgital microscope. *International Journal of Osteoarchaeology* 22: 549-562.

CREZZINI, J.; BOSCHIN, F.; BOSCATO, P. & WIERER, U. 2014: Wild cats and cuts marks: exploitation of *Felis silvestris* in the Mesolithic of Galgenbűhel/Dos de la Forca (South Tyrol, Italy. *Quaternary International* 330: 52-60. DOI: 10.1016/j.quaint.2013.12.056.

WIERER, U. 2008: Which blanks for which tools? Techno-typological analyses of the Sauveterrian industry at Galgenbűhel (Italy). In: Aubry, T.; Almeida, F.; Araújo, A.C. & Tiffagom, M. (eds.): *Space and Time: Which Diachronies, Which Synchronies, Which Scales/Typology Vs. Technology. Proceedings of the XV UISPP World Congress, Lisbon:* 197-206. B.A.R. (International Series) 1831. Oxford.

WIERER, U.; BETTI, L.; BOSCATO, P.; BAZZANELLA, M.; BOSCHIN, F.; CREZZINI J.; GALA, M.; GIROD, A. & TAGLIACOZZO, A. 2018: Living near the water. Environment, wetland economy and fishing techniques of the Mesolithicic site Galgenbühel/Dos de la Forca in the Adige Valley (South Tyrol, Italy) In: Cupillard, C.; Griselin, S. & Séara, F. (eds.): *Au coeur des sites mésolithiques: entre processus taphonomiques et données archéologiques. Actes de la table-ronde internationale de Besançon (F) 29-30 octobre 2013*: 241-257. Presses universitaires de Franche-Comté.

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Animals and Aristocracy from Etruscan Siena: Zooarchaeological Data

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RIASSUNTO: Questo contributo presenta una prima sintesi sui dati zooarcheologici provenienti dagli scavi effettuati presso il Complesso Museale del Santa Maria della Scala negli anni 1999-2000. Nel corso di queste indagini archeologiche fu individuata una struttura orientalizzante con due fasi principali, che costituisce la più importante testimonianza archeologica della prima *Saina*/Siena etrusca. Fu inoltre recuperato un piccolo, ma significativo, campione di ossa animali costituito principalmente da resti di ungulati domestici e cervidi. In questo lavoro si è proceduto al confronto di quest'ultimo con i campioni faunistici provenienti dagli edifici aristocratici coevi di Murlo/Poggio Civitate (Murlo-Siena).

PAROLE CHIAVE: SANTA MARIA DELLA SCALA, CACCIA, SIENA ETRUSCA, POGGIO CIVITATE, ETRURIA INTERNA SETTENTRIONALE

ABSTRACT: A preliminary report on the faunal remains discovered during the 1999-2000 excavations at Santa Maria della Scala in Siena is presented in this paper. During these excavations, an orientalizing hut with two main phases was identified; this constitutes the most significant archaeological evidence of the early Etruscan *Saina*/Siena. A small, but significant sample of animal remains, mainly consisting of domestic ungulates and cervids, was also recovered. In this paper we compare this evidence with the contemporary faunal sample from the aristocratic buildings of Murlo/Poggio Civitate (Murlo-Siena).

KEY WORDS: SANTA MARIA DELLA SCALA, HUNTING, ETRUSCAN SIENA/*SAINA*, POGGIO CIVITATE, NORTHERN INTERNAL ETRURIA

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INTRODUCTION

In the second half of the 8th century BCE, among the general process of reoccupation of the territory promoted by the proto-urban centre of Chiusi (see most recently Tabolli, 2022), the site of Siena - Etruscan *Saina* - was refunded on the same plateau that was probably occupied during the Late (Final) Bronze Age, and then had been abandoned at the beginning of the Early Iron Age. Evidence for the 8th century settlement comes mostly from the 1999-2000 excavations at Santa Maria della Scala, on the southern slope of the Colle del Duomo. On what should have looked like a vertical cliff, the excavation brought to light a series of cuts and terraces that created spaces for habitations, as we assume that the top hill of the Colle del Duomo (343 meters above the sea level) was densely occupied as well (Ciacci, 2000; Cantini *et al*., 2001; Bandinelli, 2003; Bartoloni, 2004; Pallecchi, 2006; Barbagli & Cianferoni, 2008; Cianferoni & Bandinelli, 2009; Acconcia, 2012; Tabolli, 2019).

Three major chronological phases can be referred to the early *Saina*. Phase 1 corresponds to a series of post-holes and a ditch that can probably be attributed to a wooden hut. On top of this earlier structure in the mid-7th century BCE (Phase 2) at least one structure was built with a stone foundation and mud-brick walls. Little is known about the life of this aristocratic residence, but a fire likely destroyed the entire area around 580 BCE (Phase 3) (Figures 1 and 2).

MATERIALS AND METHODS

The ongoing study of the 1999-2000 stratigraphy and finds allowed us to recover a small faunal sample from the archaeological layers associated with the life of the Orientalizing residence and its destruction. The anatomical and taxonomical identification of the animal bones was carried out by using the osteological reference collection of the University of Siena (Unità di Ricerca di Preistoria

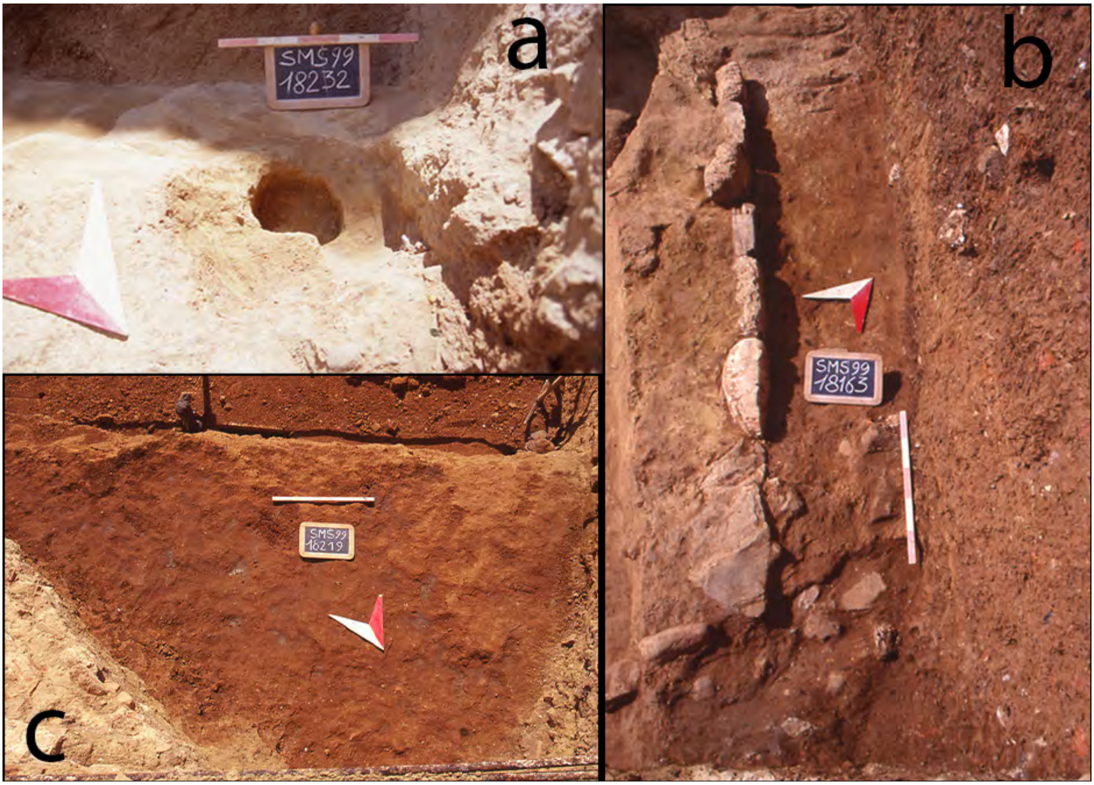

FIGURE 1

a) Phase I - Traces of the Early Iron Age Hut; b) Phase II - The Aristocratic Residence; c) Phase III - Abandonment layer with traces of burning.

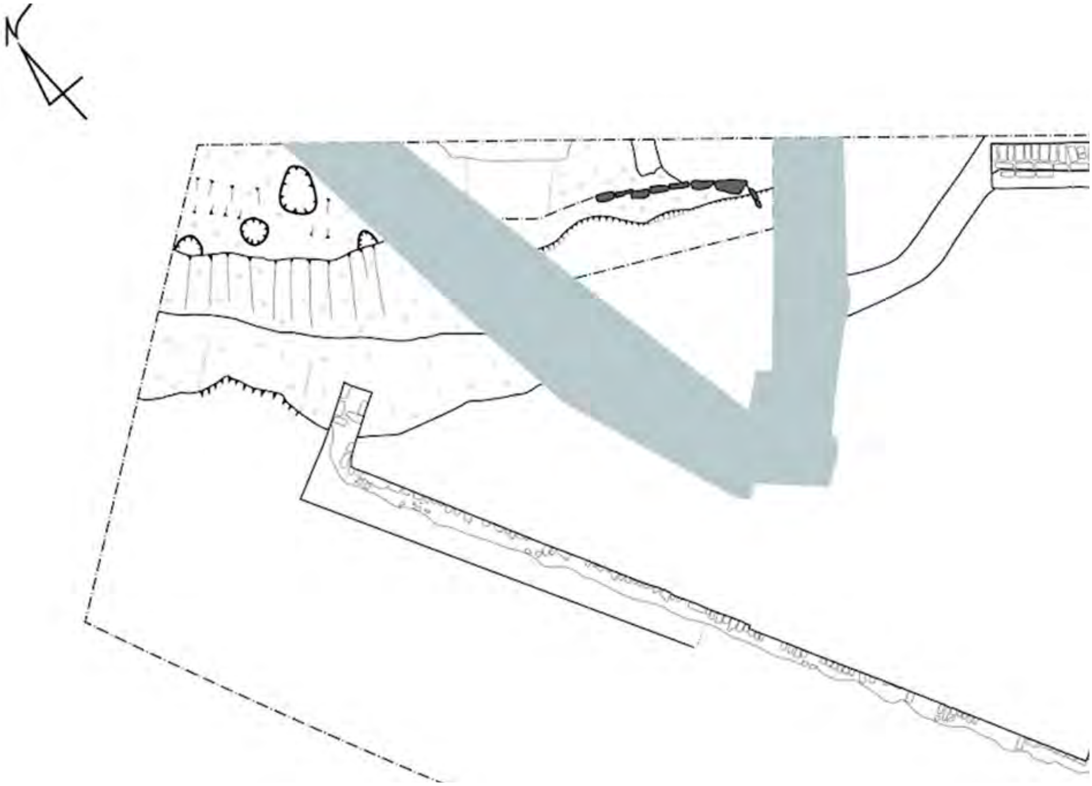

FIGURE 2
Plan of the investigated area (by J. Tabolli).

e Antropologia, Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente). In order to identify anthropic and non-anthropic modifications on the bone surfaces, an Hirox KH-7700 3D digital microscope was also used (Boschin & Crezzini, 2012; Crezzini *et al*., 2014).

RESULTS

The analysed faunal sample is composed of 37 macromammal remains including 26 taxonomically identified specimens (Table 1). The most abundant species are sheep/goat (*Ovis aries*/*Capra hircus*) and suids (*Sus* sp.), while cattle (*Bos taurus*) is only represented by two remains. Among wild animals, the red deer (*Cervus elaphus*) is the only identified species. Unfortunately, no animal remains were recovered from the earliest hut below the stone wall (Phase 1). On the contrary in Phase II and Phase III all the identified ungulates are present. The analysis of the fragmentation degree of the zooarchaeological material shows the prevalence of the smaller size specimens (between 1-3 and 3-6 cm). However, some fragments larger than 6 cm are also attested (Figure 3). The remains of sheep/goat recovered in Phase II and Phase III are represented by fragments of limb bones and by a portion of pelvis. The higher amount of these specimens come from the stratigraphic units of Phase III, and among these, two elements show evidence of cut marks: one portion of a radius and one of a metatarsal. Gnawing marks, probably caused by a small-medium size carnivore (dog, fox?), are also present on the bone surfaces of these elements and in a fragment of humerus. Suid remains from Phase II are exclusively represented by cranial elements: two emimandibles and two isolated teeth, belonging to a minimum number of two individuals. Suids from Phase III are represented by an atlas portion, an entire first phalanx and a fragment of radius with cut marks. The presence of the red deer is recorded in Phase II and Phase III, and it consists of a fragment of pelvis (Phase II) with cut marks (Figure 4), a distal-medial portion of a tibia with gnawing marks, and an apical fraction of antler (Phase III).

Taxa	NR
Bos taurus	2
Bos/Cervus	2
Cervus elaphus	2
Cervidae indt.	1
Ovis aries	1
Ovis/Capra	9
Sus sp.	9
Unidentified fragments	
Medium/Large Ungulate	4
Small Ungulate	7
Total	37

Table 1
Number of taxonomically identified and unidentified macromammal remains.

DISCUSSION AND CONCLUSIONS

Despite the small size of the excavation and the limited recorded evidence, Orientalizing high-quality ceramic and metal finds associated with Phase II suggest that, in this period, the "hut" of Santa Maria della Scala could be compared to contemporary aristocratic residences along the Ombrone River, such as Poggio Civitate at Murlo, Piano Tondo at Castelnuovo Berardenga, Poggio Castiglioni at Ambra and Le Carceri at Sinalunga (see Tabolli, 2020). These small aristocratic settlements shared "parallel lives" (Salvi & Tabolli, 2020). In particular, the analysis of the material culture testifies the direct economic and political link to the city of Chiusi/*Cleusi*, controlling the open frontier towards Volterra/*Velathri*. This faunal sample represents the first contribution to understanding the "life beyond pottery" of the Etruscans at Siena/*Saina*. The analysed sample, although small, can be compared to the large and well-known dataset of Poggio Civitate at Murlo (Kansa & MacKinnon, 2014; Tuck, 2018, 2021). OC1/Residence faunal assemblages, particularly red deer, wild boar, and other large wild mammals, indicate hunting and banqueting activities (Kansa & MacKinnon, 2014; Kansa & Tuck, 2022). These activities are often interpreted as elitist displays of wealth and power during the Etruscan period (MacKinnon, 2014; Trentacoste, 2014), and testify the high-status nature of the settlement. A similar interpretation might also apply to Siena/*Saina*. In fact, in the faunal assemblage analysed in this work attests for the presence of cervids. These animals were probably hunted or trapped in the woodlands surrounding the site, and then butchered inside the settlement, as indicated by the presence of cut marks on red deer pelvis. Among the suid remains, it was not possible to evaluate the presence of the wild boar, which one might expect in an environment where aristocratic hunting would have been prevalent. Further research and excavations of *Saina*'s earliest phases will provide new insights into the settlement developments and allow us to understand more fully the role played by animals in the Etruscan socio-cultural and economic dynamics.

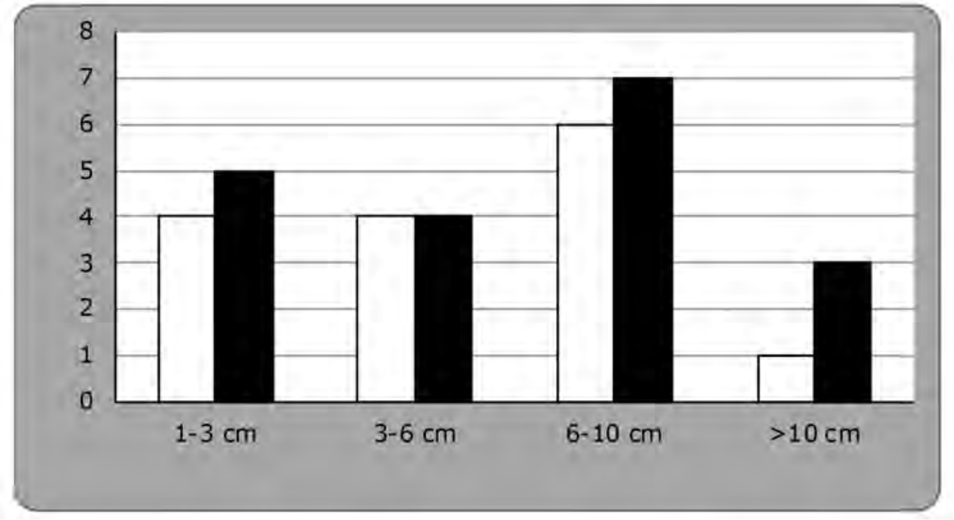

FIGURE 3
Fragmentation of the macromammal samples from the Phase II and the Phase III

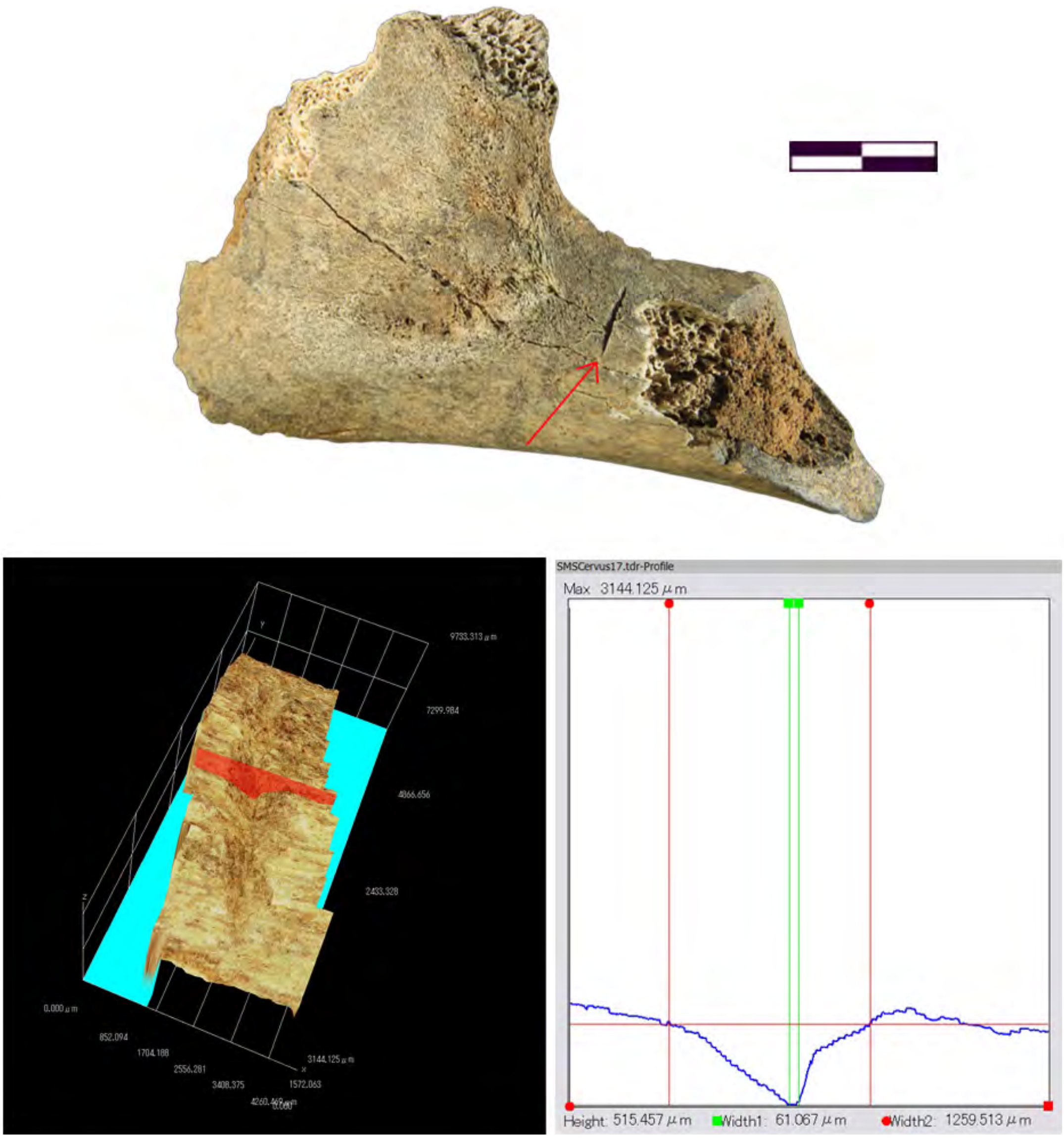

FIGURE 4

Cut mark on a fragment of a red deer pelvis from the Phase II (ph. Stefano Ricci and Jacopo Crezzini).

REFERENCES

ACCONCIA, V. 2012: Paesaggi etruschi in terra di Siena. L'agro tra Volterra e Chiusi dell'età del Ferro all'età romana. B.A.R. (International Series). Oxford.

BANDINELLI, G. 2003: Saena. *Studi Etruschi* LXIX: 287-288.

BARBAGLI, D. & CIANFERONI, G.C. 2008: Siena, Santa Maria della Scala. *Guida al Museo Archeologico*. Quasar, Roma.

BARTOLONI, G. 2004: Introduzione. Lo scavo di Campassini (Monteriggioni; SI). In: Ciacci, A. (ed.): *Monteriggioni-Campassini. Un sito etrusco nell'alta Va d'Elsa*: 11-23. All'Insegna del Giglio, Firenze.

BOSCHIN, F. & CREZZINI, J. 2012: Morphometrical analysis on cut Marks using a 3D digital microscope. *International Journal of Osteoarchaeology* 22: 549-562.

CANTINI, F.; GABBRIELLI, F.; PALLECCHI, S. & SAFFIOTI, C. 2001: La storia sotto il vecchio ospetale. *Archeo* 10: 34-43.

Ciacci, A. 2000: Un «principe» etrusco a Siena. Nuova luce sulle origini di Siena. *Il Carroccio* 90:18-20.

Cianferoni, G.C. & Bandinelli, G. 2009: Topografia della Val d'Elsa e dei dintorni di Siena. In: Barbanera, M. (ed.)*: L'occhio dell'archeologo: Ranuccio Bianchi Bandinelli nella Siena del primo '900*: 68-80. Cinisello Balsamo.

Crezzini, J.; Boschin, F.; Boscato, P. & Wierer, U. 2014: Wild cats and cut marks: Exploitation of *Felis silvestris* in the Mesolithic of Galgenbühel/Dos de la Forca (South Tyrol, Italy). *Quaternary International* 330: 52-60.

Kansa, S.W. & Mackinnon, M. 2014: Etruscan economics: forty-five years of faunal remains from Poggio Civitate. *Etruscan studies* 17(1): 63-87.

Kansa, S.W. & Tuck, A. 2022: Where the wild thing are: Etruscan hunting and trophy display at Poggio Civitate (Murlo). Italy. *European Journal of Archaeology*: 1-20.

Mackinnon, M. 2014: Fauna of the Ancient Mediterranean world: In: Campbell, G.L. (ed.): *The Oxford handbook of animals in classical thought and life*: 156-179. Oxford University Press, Oxford.

Pallecchi, S. 2006: Il palinsesto di una città medievale. Metodi e problemi dell'archeologia urbana a Siena. *Città e Storia* I (2): 583-594.

Salvi, A. & Tabolli, J. 2020: Spazi del potere ai confini di Chiusi: nuovi dati sulle residenze aristocratiche. Dinamiche e problematiche politiche, Poggio Civitate, Siena, Piano Tondo. In: Salvi, A.; Tabolli, J.; with the contribution of Bischeri, M.; Cuccuini, M.; Del Segato, V.; Pacifici, M.; Reconditi, G. & Savegnago, D. (eds.): *Ascesa e crisi delle aristocrazie arcaiche in Etruria e nell'Italia preromana*: 519-571. Annali della Fondazione "Claudio Faina" 27. Rome.

Tabolli, J. 2019: Il crollo dei modelli. Domande in cerca d'autore su Siena etrusca. In: Firmati, M. (ed): *Gli Etruschi tra Chianti e Monte Maggio* (proceedings of the conference): 23-30. Betti editore, Siena.

— 2020: Dinamiche e problematiche politiche, Poggio Civitate, Siena, Piano Tondo. In: Salvi, A.; Tabolli, J.; with the contribution of Bischeri, M.; Cuccuini, M.; Del Segato, V.; Pacifici, M.; Reconditi, G. & Savegnago, D. (eds.): *Ascesa e crisi delle aristocrazie arcaiche in Etruria e nell'Italia preromana*: 519-572, 519-521, 522-526, 529-530. Annali della Fondazione "Claudio Faina" 27. Rome.

— 2022: Review of Bettini, M.C.; Chiusi Villanoviana, Monumenti Etruschi 14 (Rome: Giorgio Bretschneider, 2021), ISBN 9788876893285, *Rhea Classical Review* (https://rheaclassicalreview.blogspot.com/2022/07/tabolli-on-bettini.html).

Trentacoste, A. 2014: *The Etruscans and their animals: the zooarchaeology of Forcello di Bagnolo San Vito (Mantova)*. University of Sheffield Available at: https://etheses.whiterose.ac.uk/6553/ Accessed October 1, 2022.

Tuck, A. 2018: The three phases domestic of elite domestic space at Poggio Civitate. *Annali Faina* 23: 301-317.

— 2021: *Poggio Civitate (Murlo)*. University of Texas Press, Austin.

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Nuovi dati sui resti delle teste di coccodrillo acquisiti nei tesori ecclesiastici e laici europei dal Medioevo all'Età Moderna

New data on crocodile head remains acquired in European ecclesiastical and secular treasures from the Middle Ages to the Modern Era

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RIASSUNTO: I coccodrilli conservati con tassidermia, o parti di questi rettili, sono tra i reperti naturalistici più ricercati nei tesori ecclesiastici e laici europei dal Medioevo all'Età Moderna. La presenza di questi animali esotici è ancora oggi documentata dai resti faunistici acquisiti all'interno di questo intervallo cronologico nei luoghi di culto e laici europei. La finalità di questo articolo è quella di fornire nuovi dati sui resti della teste di coccodrillo, mettendo in relazione lo studio delle fonti storiche con quello dei resti faunistici (osteologici o conservati con tassidermia), relativamente alle caratteristiche generali (identificazione della specie, luogo di acquisizione, stato di conservazione) e alle possibili origini (area di provenienza geografica e modalità di acquisizione) di questi reperti naturalistici.

PAROLE CHIAVE: COCCODRILLI, RESTI DELLA TESTA, TASSIDERMIA, TESORI ECCLESIASTICI E LAICI, MEDIOEVO-ETÀ MODERNA

ABSTRACT: Taxidermically preserved crocodiles, or parts of these reptiles, are among the most sought-after naturalistic finds in European ecclesiastical and secular treasures from the Middle Ages to the Modern Era. The presence of these exotic animals is still documented today by the faunal remains acquired within this time interval in European places of worship and secular contexts. The purpose of this paper is to provide new data on crocodile head remains by relating the study of historical sources with the analysis of faunal remains (whether osteological or preserved via taxidermy), with respect to the general characteristics (identification of the species, place of acquisition, and state of preservation) and possible origins (geographical area of origin and modes of acquisition) of these naturalistic finds.

KEYWORDS: CROCODILES, HEAD REMAINS, TAXIDERMY, ECCLESIASTICAL AND SECULAR TREASURES, MIDDLE AGES-MODERN ERA

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INTRODUZIONE

I coccodrilli conservati con tassidermia, o parti di questi rettili, sono tra i reperti naturalistici più ricercati nei tesori ecclesiastici e laici europei dal Medioevo all'Età Moderna (Pastoureau, 2005). Molti esemplari naturalizzati dell'Ordine Crocodylia sono tuttora esposti all'interno di chiese e santuari in Spagna, Portogallo, Francia e Italia. (Le Quellec, 1997; de Déu Domènech, 2000-2001; Bertelli, 2018). Le testimonianze italiane, identificate in gran parte come coccodrilli del Nilo (*Crocodylus cf. niloticus*/*suchus*), sono rappresentate da esemplari naturalizzati e resti della testa (Canna, 2024). La presenza di questi antichi reperti naturalistici è ancora oggi documentata non solo all'interno di contesti ecclesiastici, ma anche laici, in Italia e, più in generale, in Europa (Bertelli, 2018). La finalità di questo articolo è quella di fornire nuovi dati sui resti delle teste di coccodrillo acquisiti nei luoghi di culto e laici europei dal Medioevo all'Età Moderna.

MATERIALI E METODI

Nello studio dei resti delle teste di coccodrillo, vengono prese in esame le caratteristiche generali (identificazione della specie, luogo di acquisizione, stato di conservazione) e le possibili origini (area di provenienza geografica e modalità di acquisizione) di questi reperti naturalistici incrociando i dati provenienti dalle fonti storiche con quelli della documentazione faunistica giunta fino ai nostri giorni, costituita da resti osteologici o conservati con tassidermia.

DISCUSSIONE E RISULTATI

Caratteristiche generali

Sulla base dello stato attuale delle conoscenze, i resti delle teste di coccodrillo attualmente documentati all'interno di contesti ecclesiastici e laici, sono i seguenti: un cranio, privo della mandibola e dei denti, identificato come appartenente ad un coccodrillo del Nilo, esposto nel Convento della Selva, a Santa Fiora (Grosseto) (Garlaschelli, 2005) (Figura 1); una mandibola di coccodrillo, conservata con tassidermia, esposta nel Museo Scenografico del Convento di Santa Maria di Orsoleo, a Sant'Arcangelo (Potenza) (Lionetti, com. pers.) (Figura 2); un frammento di mascella di coccodrillo del Nilo e uno di cranio attribuibile alla stessa specie provenienti dalla collezione nobiliare del tardo Cinquecento-primo Seicento di Castel Rafenstein, presso Bolzano, il cui stato di conservazione è riconducibile ad un più tardo utilizzo della testa per farne medicinali (Eccher & Tecchiati, 2014)[1]; i resti craniali di coccodrillo del Nilo rinvenuti, nel 2018, dai volontari della Galleria Borbonica al di sotto della collina di Pizzofalcone, a Napoli, attribuibili ad una collezione nobiliare del XVII secolo (Minin, com. pers.). Tra le testimonianze europee va ricordata la testa di coccodrillo, attualmente custodita presso il "Musée de La Vie Montoise", a Mons, in Belgio, che dovrebbe comparire dal 1409 nell'inventario dei beni dell'Hotel Guglielmo IV di Baviera, conte di Hainaut, a Parigi (Bertelli, 2018). Sullo stato di conservazione di questa parte anatomica è bene ricordare che la testa, unitamente alle estremità degli arti e alla coda, è una delle parti più difficili da scarnificare nel processo di tassidermia (Gestro, 1925), specie se adottato con una tecnica rudimentale come quello ben documentato nei coccodrilli italiani naturalizzati (Canna, 2024). Ne consegue che, nel corso del tempo, queste parti vengono perdute o subiscono danni rilevanti, talvolta anche a causa dell'azione di agenti esogeni legati alle condizioni di esposizione di questi reperti naturalistici come nei coccodrilli di Napoli (Fioravanti *et al.*, 2020) e Varese (Marazzi, 2014). Sullo stato di conservazione del cranio di Santa Fiora, in particolare, è interessante notare quanto riportato da Santi alla fine del XVIII secolo: «Noi viddemo nella Libreria del Convento la parte superiore della testa di questo preteso orrido Serpente, che è in fondo la mascella superiore, e parte del cranio di un Coccodrillo vestito della sua pelle…» (Santi, 1795: 198).

Origini

Sulla possibile origine dei resti delle teste di coccodrillo, pur non potendo escludere del tutto che, in taluni casi, possa trattarsi dei resti di pelli o esemplari naturalizzati, è di particolare interesse

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[1] «L'impiego (delle ossa) di animali esotici era infatti a quanto pare pratica comune nelle farmacopee sei-settecentesche, e il coccodrillo imbalsamato era…comune emblema di ogni farmacia antica e simboleggiava i rimedi esotici da tutto il mondo» (Eccher & Tecchiati, 2014: 64).

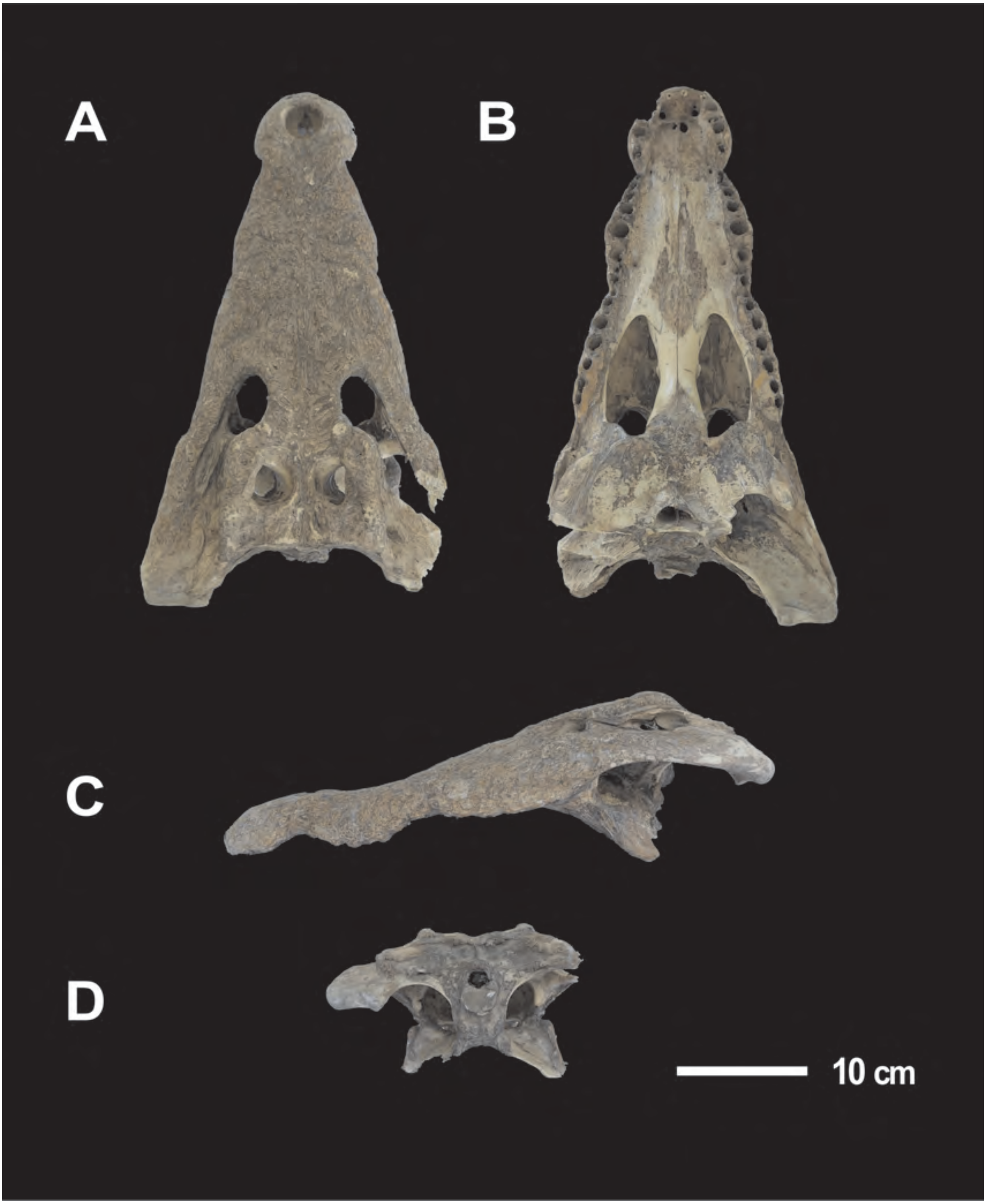

FIGURA 1
Cranio di Santa Fiora in visione dorsale (A), ventrale (B), laterale (C) e posteriore (D) (foto ed elaborazione grafica: Carlo Canna).

quanto riportato da alcune fonti storiche tra XVI e XVII secolo sulla selezione e l'utilizzo di questa parte anatomica. Il geografo arabo Leone l'Africano, riferendosi al coccodrillo del Nilo, nella sua *Della descrittione dell'Africa et delle cose notabili che ivi sono* pubblicata da Giovanni Battista Ramusio nel vol. I della raccolta *Delle Navigationi et Viaggi* (prima edizione 1550), riporta quanto

FIGURA 2

Mandibola di coccodrillo conservata con tassidermia (Museo Scenografico del Convento di Santa Maria di Orsoleo) (foto: Gianfranco Lionetti; elaborazione grafica: Carlo Canna).

segue: « Su le mura di Cana viddi più di trecento capi di questi animali appiccati con le bocche aperte, le quali erano tanto ampie e grandi che vi sarebbe entrata una vacca intera; i denti erano acuti e grandi. Tutti li pescatori delle terre d'Egitto hanno costume, come pigliano un cocodrillo, di tagliargli il capo e attaccarlo alle mura, come fanno li cacciatori li capi delle fiere» (Ramusio, 1554: 101). Quanto riportato da Leone l'Africano, sembra trovare conferma nello stato di conservazione delle emimandibole del coccodrillo di Orsoleo, che mostrano il distacco netto del processo retroarticolare (Figura 2), diversamente dalle pelli in cui viene preservato l'intero cranio nel processo di tassidermia, come si evince chiaramente dall'indagine tomografica condotta nel 2018 da Damiano Gelmi, coordinatore tecnico di radiologia presso la CDC San Francesco di Bergamo, sul coccodrillo del Nilo di Ponte Nossa[2] (Figura 3). Il dato del geografo arabo, riferito all'antica città egiziana, viene riportato successivamente anche dal medico francese De Bremond (1679: 116-117) che sui coccodrilli aggiunge: « se ne vede gran quantità in un'isola, vicino a Cana, che è nel mezzo del Nilo, ove stanno stesi volteggiandosi al sole». Le fonti storiche ci informano che l'Egitto fu certamente un'area del Mediterraneo dalla quale potevano essere acquisite in Europa le «pelli essiccate» di coccodrillo del Nilo, a partire almeno dal Quattrocento (Canna, 2024), un dato che, relativamente alla provenienza egiziana, in anni recenti sembra essere stato confermato anche dall'analisi genetica condotta sul C. niloticus di Napoli (Fioravanti *et al*., 2020) e che può essere messo in relazione con quanto riportato dalle fonti storiche citate non solo sulla possibile area di provenienza geografica, ma anche sulle modalità di acquisizione dei resti delle teste di coccodrillo. Le «teste» collocate sulle porte della città fortificata di Rodi tra XVII e XIX secolo, attribuite dal folclore ad un drago leggendario che infestava l'isola dell'Egeo, sono identificabili con i resti di un coccodrillo o una balena (Hasluck, 1914). In conclusione, i dati esposti inducono ad ipotizzare una possibile diffusione di tali reperti esotici attraverso il bacino del Mediterraneo orientale per essere acquisiti nei tesori ecclesiastici e laici europei.

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[2] Si tratta del coccodrillo che si conserva nella chiesa di Santa Maria Annunciata in Campolongo, a Ponte Nossa (Bg), oggetto, nello stesso anno (2018), di un intervento di restauro effettuato da Luciana Maver, Preparatore di Zoologia dei Vertebrati del Museo Civico di Scienze Naturali "E. Caffi" di Bergamo (Maver, com. pers.).

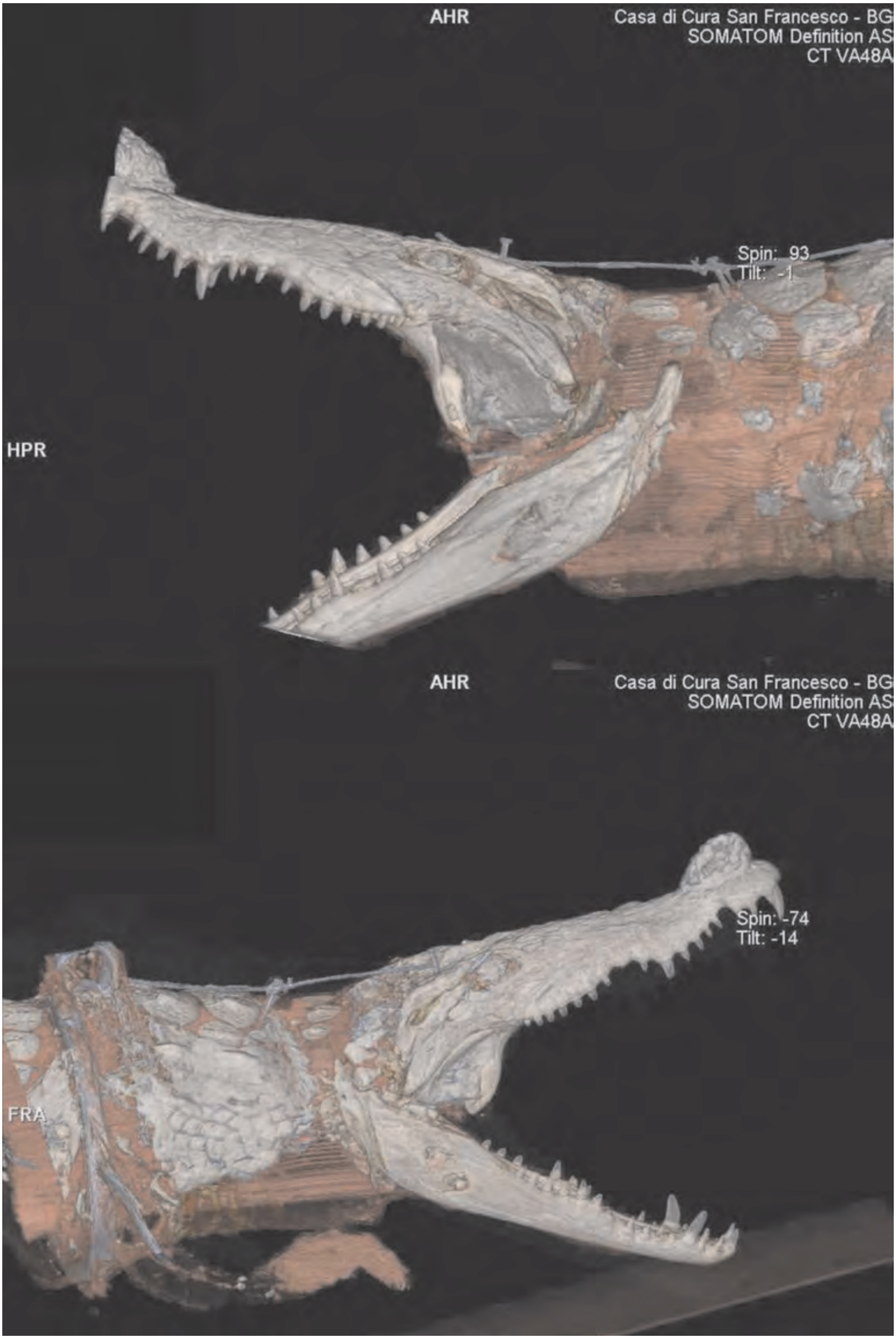

FIGURA 3

Indagine tomografica computerizzata condotta sul coccodrillo di Ponte Nossa (CDC San Francesco di Bergamo; Museo di Scienze Naturali di Bergamo).

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BIBLIOGRAFIA

Bertelli, B. 2018: *La Vergine e il drago. Lo strano caso dei coccodrilli nei santuari mariani*. Universitas Studiorum, Mantova.

Canna, C. 2024: Ipotesi sull'origine geografica e le modalità di trasporto dei resti di coccodrilli acquisiti nei luoghi di culto italiani tra basso medioevo ed età moderna. In: *Atti del 9° Convegno Nazionale di Archeozoologia, Ravenna, 28 novembre-1 dicembre 2018*.

De Bremond, G. 1679: *Viaggi fatti nell'Egitto superiore, et inferiore: nel monte Sinay, e luoghi più cospicui di quella regione*. Paolo Moneta Eccher, Roma.

De Déu Domenèch, J. 2000-2001:Cocodrils i balenes a les eglésies. *Locvs Amoenvs* 5 (2000-2001): 253-275.

Eccher, S. & Tecchiati, U. 2014: Resti faunistici (tra cui un mascellare di *Crocodylus niloticus* Laurenti 1768) da Castel Rafenstein presso Bolzano (XVII-XVIII sec.). Economia e aspetti storico-culturali di un insediamento produttivo alpino di età moderna. *Ann. Mus. Civ. Rovereto, Sez.: Arch.,St., Sc. nat*. 30: 61-203.

Fioravanti, T.; Casafredda, E.; Splendiani, A. & Caputo Barucchi, V. 2020: The stuffed crocodile of "Castel Nuovo" in Naples (Italy): new insights from ancient DNA and radiocarbon. *The European Zoological Journal* 87(1): 452-458.

Garlaschelli, L. 2005: L'ultimo drago del Medioevo. In: Albini, A. (ed.): *Animali del mistero. Creature leggendarie, mostri e meraviglie della natura: un'indagine scientifica*: 46-55. I Quaderni del CICAP 6. Padova.

Gestro, R. 1925: *Il Naturalista Preparatore (Tassidermista)*. Ulrico Hoepli, Milano.

Hasluck, F.W. 1914: Dieudonné de Gozon and the Dragon of Rhodes. *Annuario della British School di Atene* 20: 70-79.

Le Quellec, J.L. 1997: La naturalisation du dragon en Europe. *Cahiers Internationaux de Symbolisme* 86-88: 177-212.

Marazzi, L. 2014: Il "mostro" del Museo Baroffio e del Santuario. *Il Nostro Sacro Monte* XXII(61): 25-27.

Pastoureau, M. 2005: *Medioevo simbolico*. Laterza, Bari.

Ramusio, G.B. 1554: *Delle Navigationi et Viaggi*.). Seconda edizione. Stamperia de Giunti, Venezia.

Santi, G. 1795: *Viaggio al Monte Amiata* I. Prosperi, Pisa.

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A study of the zoomorphic representations in the symbology of the Contradas of Siena. A zooarchaeological approach

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ABSTRACT: Among the Contradas that still take part in the Palio of Siena today, 15 out of 17 have kept the same animal in their symbology for centuries. In many cases, however, the faunistic subject has undergone significant variations over time, consisting of small morphological and/or chromatic changes, or even producing the representation of different *taxa*. Scholars and enthusiasts of the Palio have advanced numerous hypotheses, sometimes contrasting and difficult to verify, to explain the reasons for these changes. We present a case study where the results of a systematic review of the iconographic and written documentation preserved in the historical archives of the City and the Museums of the Contradas have been compared with the data present in the zooarchaeological literature. Finally, we propose a hypothesis regarding to the identification at specific level of the zoomorphic figure represented in the oldest document found to date in which the symbolism of the *Contrada della Pantera* is represented by a felid.

KEY WORDS: CONTRADAS, SIMBOLOGY, PALIO, SIENA, ZOOMORPHIC FIGURES

RIASSUNTO: Tra le Contrade che ancor oggi prendono parte al Palio di Siena, 15 su 17 hanno mantenuto per secoli lo stesso soggetto animale nella propria simbologia. In molti casi, tuttavia, l'animale rappresentato ha subìto sensibili variazioni nel corso del tempo, rappresentate da modifiche morfologiche e/o cromatiche, finanche a figurare *taxa* diversi. Studiosi e appassionati della Festa hanno avanzato numerose ipotesi, talora contrastanti e difficilmente verificabili, per spiegare le ragioni di questi cambiamenti. In questo lavoro viene presentato un caso studio in cui i risultati di un sistematico riesame della documentazione iconografica e scritta conservata negli archivi storici della Città e nei Musei delle Contrade sono stati confrontati con i dati presenti nella letteratura zooarcheologica. È stato così possibile avanzare un'ipotesi sull'identificazione specifica della figura zoomorfa rappresentata nel più antico documento fino ad oggi ritrovato nel quale la simbologia della Contrada della Pantera è rappresentata da un felide.

PAROLE CHIAVE: CONTRADE, SIMBOLOGIA, PALIO, SIENA, FIGURE ZOOMORFE

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INTRODUCTION

Most of the Contradas that still participate in the Palio of Siena (15 out of 17) have maintained the same animal subject in their symbology for centuries. Often however, the zoomorphic figures have undergone considerable variations over time, consisting of morphological and/or chromatic modifications, even to the point of including different *taxa*.

The exotic symbolism of the *Contrada della Pantera*, for instance, has been characterised, over the centuries of its history, by numerous varieties of representations of the large felids. The iconographic documentation concerning the zoomorphic subject represented by the people of the *Pantera* includes felines with a vaguely lion-like appearance up to animals like a tiger (Ceppari Ridolfi *et al*., 2003). All these symbologies have, however, always been accompanied by the name *Pantera* (Panther) (Leoncini, 1995) (Figure 1).

FIGURE 1
The actual symbology of the *Contrada della Pantera*.

MATERIALS AND METHOD

In our research the iconographic and written documentation preserved in the historical archives of the City and the Contradas Museums have been compared with the data present in the zooarchaeological literature. Aim of this study was to determine whether and in what cases the representation of the zoomorphic figures in the symbology of the Contradas can be linked to the interaction between the Sieneses and the illustrated animal.

Here, we present a study case regarding what is recognised as one of the oldest documents of the *Contrada della Pantera* so far found: it is a small woodcut depicting a felid drawn on the frontispiece of a pamphlet (Figure 2) (Grassi, 1972; Leoncini, 1995). The pamphlet illustrates the representation dedicated by this Contrada to the *Contrada della Lupa*, for the Palio organised by the latter on 16 August 1599. The full title of the pamphlet is "*Stanze Cantate in nome degli asiatici cacciatori"* ("Sung Stanzas in the name of the Asian Hunters"). It describes the *Inventione* that the people of the *Pantera* prepared for the customary parade before the race. The imaginary gift of a panther to the people of the *Lupa* by hunters from Asia was staged. A rhyming composition and a letter describing the performance for the judges, both written by the poet Bellisario Bulgarini, accompanied this *Inventione* (Fiorini, 2009).

RESULTS AND DISCUSSION

The zoomorphic figure in the woodcut analysed in this work represents a spotted felid. Its analysis reveals numerous features that can be attributed to *Acynox jubatus* rather than *Panthera pardus*. The body of the animal is in fact slender with a thin abdomen (the individual has been represented with a clearly visible lateral series of 5 udders), the hind limbs are larger and longer than the fore ones. The tail is narrow, the head small in relation to the body, with rounded, not protruding ears. The line marking the mouth continues to the sides of the snout to form a sort of "smile" of the animal. These lateral developments may have been realised to reproduce (albeit incompletely) the characteristic line running across the cheetah's muzzle from the eyes to the lips, which is absent in leopards.

It is well known that the cheetah was exploited until the late 16th century in Europe as a hunting animal (Masseti, 2017), a curious use imported by the Turks (De Germiny, 1934). The Italians would have been the first and the main responsible of

STANZE
Cantate in nome
DEGLI ASIATICI CACCIATORI,
Rappreſentati dalla Contrada
della PANTERA:
Donando la detta Belua alla generoſa
Contrada della LVPA,
Colonia Romana in Siena;
Per correrſi il Palio nella ſua nobil Feſta,
il dì 16. d'Agoſto 1599.

FIGURE 2

Frontispiece of *"Stanze cantate a nome degli Asiatici Cacciatori"* (left) and detail of the zoomorphic figure (right). Biblioteca Comunale di Siena.

the spread of such use of the cheetah in the West (Masseti, 2017). From the Norman kings of Sicily, through the Este and Visconti families, to the French kings Charles VIII, Henry II, and Charles X, all adopted the animal for hunting local game (Masseti, 2017). The identification of a cheetah in the zoomorphic figure drawn on the *Pantera*'s pamphlet proposed above through an iconographic analysis could be corroborated by the zooarchaeological data just mentioned. In Siena at the end of the 16th century, the use of cheetahs in the hunting activities must have been well known, since its wide diffusion among the Italian noble families. In the years in which the pamphlet was written the city of Siena was administered by the Medici, who had learned about this peculiar exploitation of *Acynox jubatus* during their visit to Constantinople (Masseti, 2017). We hypothesize therefore that the *Inventione* of the *Pantera* had as its main theme the gift of a 'hunting' cheetah to the *Lupa* by a group of Asian hunters, the first importers of this hunting method. An analysis of the content of the rhyming composition written by Bellisario Bulgarini provides further interesting information on the donated animal. In fact, one passage reads:

> "*Qual dona a' giochi vostri, indrizza al corso, Ove ogn'altro animal vince spedita; Nè, perchè al laccio presa, or tenga il morso, Ha l'alta sua virtù punto smarrita*"

("As a gift to your games, where every animal wins quickly. Despite being tied to a rope or bitten, it does not lose its high virtues")

These words suggest that the felid donated by Asian hunters to the *Contrada della Lupa* is not a prey, a victim of the hunt, but an animal that, even if kept in captivity, maintain its predatory characteristics, those characteristics that human has exploited for hunting in the past.

CONCLUSION

In this work, for the first time, the study of an historical iconographic document related to the

Palio di Siena was realized through the consultation of zooarchaeological data. This allowed a detail exam of the zoomorphic figure in one of the most ancient documents of the *Contrada della Pantera*. The possible depiction of a cheetah in this document represents an interesting data regarding the interaction between the Sieneses and this *taxon* and the first zooarchaeological exam of the great variety of "felids" including in the complex and varied symbology of the *Contrada della Pantera*.

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REFERENCES

Ceppari Ridolfi, M.A.; Ciampolini, M. & Turrini, P. 2003: Atlante Storico Iconografico. In: Ceppari Ridolfi, M.A.; Ciampolini, M. &Turrini, P. (eds.): *L'immagine del Palio. storia, cultura e rappresentazione del rito di Siena. Monte dei paschi Siena, Nardini, Firenze.*

De Germiny, G. 1934: Le guépard compagnon des chevaliers. *La Terre et La Vie, Revue d'Histoire naturelle* 4(7) 1934: 400-408.

Fiorini, A. 2009: *Bestiario senese. Simbologia e storia degli animali totemici delle Contrade*. Il Leccio, Siena.

Grassi, V. 1972: *Le Contrade di Siena e le loro Feste. Il Palio attuale*. Vol. 2. Siena.

Leoncini, A. 1995: *La Pantera. Storia della Contrada*. Nuova Immagine, Siena.

Masseti, M. 2017: Fiere esotiche e Selvaggina Nostrana. La raffigurazione zoologica dell'Adorazione dei Magi tra il Tardo Gotico ed il primo Rinascimento italiani con particolare riferimento alle opere di Gentile da Fabriano e di Benozzo Gozzoli. In: Panaino, A.; Bedini, A.; Macchia, G.; Ognibene, P. & Piras, A. (eds.): *La Luce della Stella. I Re Magi fra arte e storia*: 119-176. Indo-Iranica et Orientalia. Series Lazur Volume 17, Mimesis, Milano-Udine.

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From the hunts to the Palio "alla tonda". Zooarchaeology of a Feast

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ABSTRACT: The horse race held in the "tufo" ring of Piazza del Campo is only the most recent form of competition through which the Contradas of Siena have challenged each other over the centuries. In fact, the Palio has taken on different forms in various phases of its centuries-old history. The first written sources concerning the Feast, dated to the 14th century, speak of *pugne*, a sort of brawls, periodically organised by the city government. Only from the 16th century begins the use, never abandoned, of the animals. From that moment onwards, the Palio will be represented, in different periods, by hunts, races on donkey-back or on buffalo-back (called *asinate* and *bufalate* respectively), bullfights and, finally, horse races, disputed first *alla lunga*, run across the whole city, then *alla tonda* in the Campo. In this preliminary work, through the examination of iconographic and written sources, we intend to reconstruct the different methods of exploitation of the animals adopted by the Sieneses in the Palio.

KEY WORDS: HUNTS, PALIO, BULLFIGHTING, SIENA, ZOOARCHAEOLOGY

RIASSUNTO: La corsa di cavalli disputata nell'anello di tufo di Piazza del Campo è solo la forma più recente di gara attraverso la quale le Contrade di Siena si sono sfidate nel corso dei secoli. Il Palio, infatti, ha assunto forme diverse nelle varie fasi della sua storia centenaria. Le prime fonti scritte che riguardano la Festa, datate al XIV secolo, parlano di "pugne" organizzate periodicamente dal governo della Città. Solo a partire dal XVI secolo comincia l'utilizzo, mai più abbandonato, degli animali. Da quel momento il Palio sarà rappresentato, nei differenti periodi, da cacce, asinate, bufalate, tauromachie e, infine, corse di cavalli, disputate prima "alla lunga", per le vie del Centro, poi "alla tonda" in Piazza. In questo lavoro preliminare, attraverso l'esame di fonti iconografiche e scritte, si intende ricostruire i diversi metodi di sfruttamento degli animali adottati dai senesi in occasione del Palio.

PAROLE CHIAVE: CACCE, PALIO, TAUROMACHIA, SIENA, ZOOARCHEOLOGIA

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INTRODUCTION

In the course of its centenary history, the Palio of Siena has taken on different forms. The protagonists of the feats and the way in which the games were held, have varied over the centuries (Balestracci, 2019). The most ancient documentary evidence about the ludic events held in the Piazza del Campo until today, dates to the first half of the 14th century, speaks of *pugne* among the Sienese youth, sometimes resulting in deaths and compromising of the public order. For this reason, the government of the city soon committed itself to putting an end to such challenges. Nevertheless, although with a minor frequency and often transformed into less violent *pallonate*, similar activities survived for many decades. Besides the latter, from the 16th century, begins the use, never abandoned, of the animals in the ludic events of Siena. Many local and exotic species have been used in the city hunts and in the animal races as in the parades that preceded or followed the challenges. This paper represents the first step in reconstructing the different methods of exploitation of the animals adopted by the Sieneses in the Palio, through the examination of iconographic and written sources (Ascheri, 2003; Turrini, 2003).

RESULTS AND DISCUSSION

Until the 1560s, regular bullfighting events, called *cacce*, were held (Mazzini, 2003). These events took place inside the Piazza del Campo, surrounded by wooden fences covered in laurel, where the men of the Contradas, protected by wooden animal shaped machines (which represented the animals of the Contradas), fought against the bulls. Around the Fonte Gaia (an historical fountain located in Piazza del Campo) was also reproduced a small wood with other wild animals such as hares, foxes, porcupines but also deer and wild boars (Figure 1). The communities of the countryside surrounding the city were obliged to provide such game “abundant and alive”, while the bulls came from the farms of the Maremma (Anonymous, 1505-1519). From the description of the

FIGURE 1

Rustici V. (1556-1632), View of the Piazza del Campo during the bullfight of the 15th August 1546, oil on canvas – Museo San Donato – Banca Monte dei Paschi di Siena, Property of the Gallerie Fiorentine (inv. 1890 n. 2599, ph. 327064, 536413, OA 09/00742856).

feast of 15 August 1546, dedicated by Cecchino Libraro to the “*nobilissima e honorata Madonna Gentile Tantucci*” (Cecchino Libraro, 1546), we can appreciate the liveliness of the hunt, which was followed by an equally lively bullfight. A bear was also present in the centre of the scene tied to a long rope “...which was harassed by putti or dogs and performed infinite bizarre and ridiculous acts”. In another manuscript by an anonymous Florentine poet, discovered only recently, there is a rich description of the festival that anticipated the day of the hunt by one, on August 15th, 1506 (which was then held on August 16th due to bad weather) (Anonymous, 1506; Catoni & Leoncini, 1994). In the parade described in this document we can find the wild game (transported on carts) which will be used as the prey for the hunt, as well as Barbary macaques and baboons on the backs of mules and a trained bear held on a leash by an elderly member of the *Contrada dell’Oca*. The Florentine poet also reports a *menu* of the dinner organised for this “vigil” all based on fish from the Sienese fish market, which was regulated in the city since the 13th century. From 1590, following the Council of Trent, the bull hunts, which were also held in the rest of Italy, were abolished. From then on, the Contradas (already defined and recognised as city entities) promoted buffalo, horse, and donkey races, accompanied by magnificent processions (Ascheri, 2003). The *bufalate* were buffalo races that took place around the perimeter of the square in anti-clockwise direction, exactly the opposite of what happens today with horses. The buffalos had to complete three laps. Each animal was ridden by a *buttero* and followed by a group of *pungolatori* whose job it was to intervene if the animal went off the track or lagged behind (Figure 2). While donkey races were never a great success in Siena, horse races were the highlight of the most important religious celebrations. These events took place *alla lunga* (i.e., along a linear route): the start was fixed at a point close to one of the city entrances and the finish was in front of the parvis of the Cathedral. The prize was a long cloth of fine fabric; the *palio*, both the race and the whole event were called *“*Palio*”*. The *Palio* in honour of Our Lady of the Assumption, which takes place every year on August 15th, was the most important festival in the Republic of Siena and attracted thousands of visitors. The steeds that competed in these events - especially during the Renaissance - were the racehorses of the great Italian Lords. During the 15th century, the horses of such personalities as Sigismondo d’Este, the Gonzagas of Mantua, the Malatestas of Cesena, Isotta Malatesta, wife of Sigismondo, Antonio di Nanni Todeschini, nephew of Pope Pius II, Cesare Borgia, known as the *Valentino*, and Cardinal Colonna were all registered (Turrini, 2003). But on 15 August 1633, the race was run around the ring of Piazza del Campo (clockwise, as it is today) and participated in by the Contradas. This race is recognised today as the first Palio *alla tonda*. In this year, as in 1631 and 1632, the most famous Italian families did not send the usual number of horses suitable for the “long” race. Due to the plague epidemic that was spreading through Italy, the *Balia* (one of the most authoritative administrative institutes in Siena at the time and responsible for the running of the Feast) prohibited the entrance of these animals and their companions into the city (Turrini, 2003). Horses used in the daily activities of innkeepers, bakers and coachmen were therefore

FIGURE 2

Gregori A. (1612), Parade of the Contradas in the Piazza del Campo – Siena, Palazzo Pubblico (detail of the painting).

used, with a sturdier structure and better suited to the more tortuous route of the Piazza del Campo.

CONCLUSION

The analysis of the historical written/iconographic sources highlight the possibility to realize interesting research concerning the exploitation of animals in the Palio di Siena. A preliminary consultation of these documents indicate that a wide variety of *taxa* were involved in the last centuries. Moreover, it's possible to note that the choices regarding the animals used in the Feast were often influenced by social and economic changes occurred in and out the city. Unfortunately, at this date, no archaeological faunal remains related to the animals used in the Palio are available. The primary aim of this preliminary paper is to encourage the adoption of a zooarchaeological approach in the study of the Palio in order to provide important information related to the relationship between the Sieneses and the animals during the Late Middle Ages and the Renaissance.

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REFERENCES

ANONYMOUS 1505-1519: Archivo Storico di Siena, Concistoro 2382. Siena.

ANONYMOUS 1506: *La festa che si fece in Siena a dì XV di aghosto MDVI*, Siena, Simone di Niccolò di Nardo, Biblioteca Comunale di Siena. Siena.

ASCHERI, M. 2003: Contrade: lo sviluppo storico e l'intreccio col Palio. In: Ceppari Ridolfi, M.A.; Ciampolini, M. & Turrini, P. (eds.): *L'immagine del Palio. storia, cultura e rappresentazione del rito di Siena*. Monte dei paschi Siena, Nardini, Firenze.

BALESTRACCI, D. 2019: *Il Palio di Siena. Una festa Italiana*. Edizione Laterza, Bari.

CATONI, G. & LEONCINI, A. 1994: *Cacce e Tatuaggi. Nuovi ragguagli sulle contrade di Siena*. Protagon Editori Toscani, Siena.

CECCHINO LIBRARO 1546*: La magnifica* et *honorata festa fatta in Siena per la Madonna d'agosto del 1546*. Archivo Storico di Siena*,* Balia 132. Siena.

MAZZINI, G. 2003: Organizzazione e radicamento delle Contrade nella partecipazione alle cacce del toro. In: Ceppari Ridolfi, M.A.; Ciampolini, M. & Turrini, P. (eds.): *L'immagine del Palio. storia, cultura e rappresentazione del rito di Siena*. Monte dei paschi Siena, Nardini, Firenze.

TURRINI, P. 2003: I fili della storia. Contrade e Palio nelle fonti documentarie In: Ceppari Ridolfi, M.A.; Ciampolini, M. & Turrini, P. (eds.): *L'immagine del Palio. storia, cultura e rappresentazione del rito di Siena:* 291-296. Monte dei paschi Siena, Nardini, Firenze.

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The dog of Tassignano (Capannori, Lucca): a possible Roman Age foundation ritual

Il cane di Tassignano (Capannori, Lucca): un possibile rito di fondazione di Età Romana

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ABSTRACT: In 2018, in the locality of Tassignano (Capannori, LU) the skeleton in anatomical connection of a dog was discovered during the excavation of a rural building, whose frequentation lasted from the 2nd/1st century BC to the 6th/7th century AD. A structure interpreted as a *balneum* was brought to light, equipped with a brick floor (*opus figlinum*) and a small basin. A perimeter wall of this room, dismantled by a late antique spoliation, originally covered the remains of the animal: these, intercepted following the emptying of the spoliation pit, lay partially below the brick floor. The dog is an adult male and its skeleton is complete, except for part of the neurocranium and some cervical vertebrae, probably destroyed by the spoliation trench. The fragmented skull did not allow in-depth morphological analysis, while it was possible to make some comparisons based on the mandible. The taphonomic study revealed the presence of butchering marks, linked to skinning, on the dorsal surface of a metatarsus, indicating that the carcass had been treated before deposition. This evidence, together with the context of its deposition, would lead to the hypothesis that the carcass was used as part of a foundation ritual of the building.

KEYWORDS: FOUNDATION RITUAL, DOG, ROMAN AGE, TAPHONOMY, TUSCANY

RIASSUNTO: Nel 2018, in località Tassignano (Capannori, LU) è stato scoperto lo scheletro in connessione anatomica di un cane durante lo scavo di un edificio rurale, la cui frequentazione si è protratta dal II/I secolo a.C. al VI/VII secolo d.C. In particolare, è stato messo in luce un ambiente interpretato come *balneum*, dotato di pavimento in commesso laterizio (*opus figlinum*) e di una piccola vasca. Un muro perimetrale di tale ambiente, smantellato da una spoliazione di epoca tardoantica, copriva in origine i resti dell'animale: questi, intercettati in seguito allo svuotamento della fossa di spoliazione, giacevano parzialmente al di sotto del pavimento in laterizio. Si tratta di un individuo adulto di sesso maschile il cui scheletro è quasi completo: mancano solo parte del neurocranio e alcune vertebre cervicali, probabilmente distrutte dalla trincea di spoliazione. Il cranio frammentato non ha permesso approfondite analisi morfologiche, mentre è stato possibile eseguire alcuni confronti sulla base della mandibola. La presenza di tracce di macellazione, legate allo spellamento, sulla superficie dorsale di un metatarso, indicano un trattamento della carcassa prima della deposizione. Questa evidenza, unita al contesto di giacitura, porterebbe a ipotizzare l'uso della carcassa nell'ambito di un rito di fondazione dell'edificio.

PAROLE CHIAVE: RITO DI FONDAZIONE, CANE, ETÀ ROMANA, TAFONOMIA, TOSCANA

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INTRODUCTION

In 2018, a rural building was excavated in the locality of Tassignano (Capannori, LU), the frequentation of which lasted from the 2nd/1st century B.C. to the 6th/7th century A.D. The excavation was carried out under a ministerial concession for excavation and archaeological research, granted to the Gruppo Archeologico Capannorese, under the scientific direction of one of the authors (A.G.) and the supervision of the Heritage Office. The territory is that pertaining to the Latin colony of Lucca, founded in 180 BC. The excavation uncovered a room interpreted as *balneum*, equipped with a brick floor (*opus figlinum*) and a small basin. The perimeter walls of that room were dismantled by a spoliation trench dated to the late antique/early medieval period, the excavation of which revealed the soil layers beneath the building. Partially below what remained of the building, the carcass of a dog (*Canis familiaris*) was found. One of the authors (A.G.) organised the removal of the entire block of soil containing the animal's skeleton (Figure 1).

METHODS

Careful excavation of the block of soil was performed in the laboratory, which allowed the recovery, restoration, and thus the study of the osteological material. Skeletal elements were measured according to Driesch (1976), with the addition of a skull measurement from Wagner (1930) to allow comparisons with dogs of known breeds. Taphonomy was carried out by means of a Hirox KH-7700 digital microscope; metrical data of cut marks were collected on a median cross-section following Boschin & Crezzini (2012). Withers height was estimated following

FIGURE 1

The skeleton after a first cleaning.

Harcourt (1974). Statistics were performed using the PAST software (Hammer *et al*., 2001). All raw data are reported in the Supplementary Materials.

RESULTS

The body laid in a twisted position: it rested on the belly at the lumbar level and on the left side at the level of the rib cage. The neck was folded forward, the innominate was highly sloped while the left hind limb had a verticalized tibia and the autopodium at a higher level than the rest of the skeleton (Figure 1); this could be due to the restricted size of the pit in which the animal was buried. The skeleton was found in anatomical connection, although the bones show some dislocations: this is the case, for example, of the right femur and the *baculum*. The excavation of the Late Antique trench partially destroyed the neurocranium and the first cervical vertebrae. Close examination of bone surfaces revealed the presence of some butchering marks on the dorsal portion of a metatarsal (Figure 2) and on the innominate. The ratio between the breadth at the top and the breadth at the floor of the cuts (RTF index, Boschin & Crezzini, 2012) is fully compatible with a metal blade (Supplementary Material 3).

The individual is a medium-sized dog, with a height at withers of just under 60 cm. The restoration allowed the collection of some biometric data related to the splanchnocranium and the mandible. The data were processed through a Principal Component Analysis (PCA) and results can be seen in Figure 3. About 92 % of the sample's variability is explained by PC 1, which appears to be related to the "size" parameter. Small breeds are well noticed at low values and large breeds at high values. PC 2 describes 6.9% of the variability and is more related to skull morphology: breeds characterized by a shortened muzzle are distributed around higher values (e.g., boxers) while greyhounds are distributed around lower values. The Tassignano individual has an elongated muzzle and is close to greyhounds and other hunting dogs.

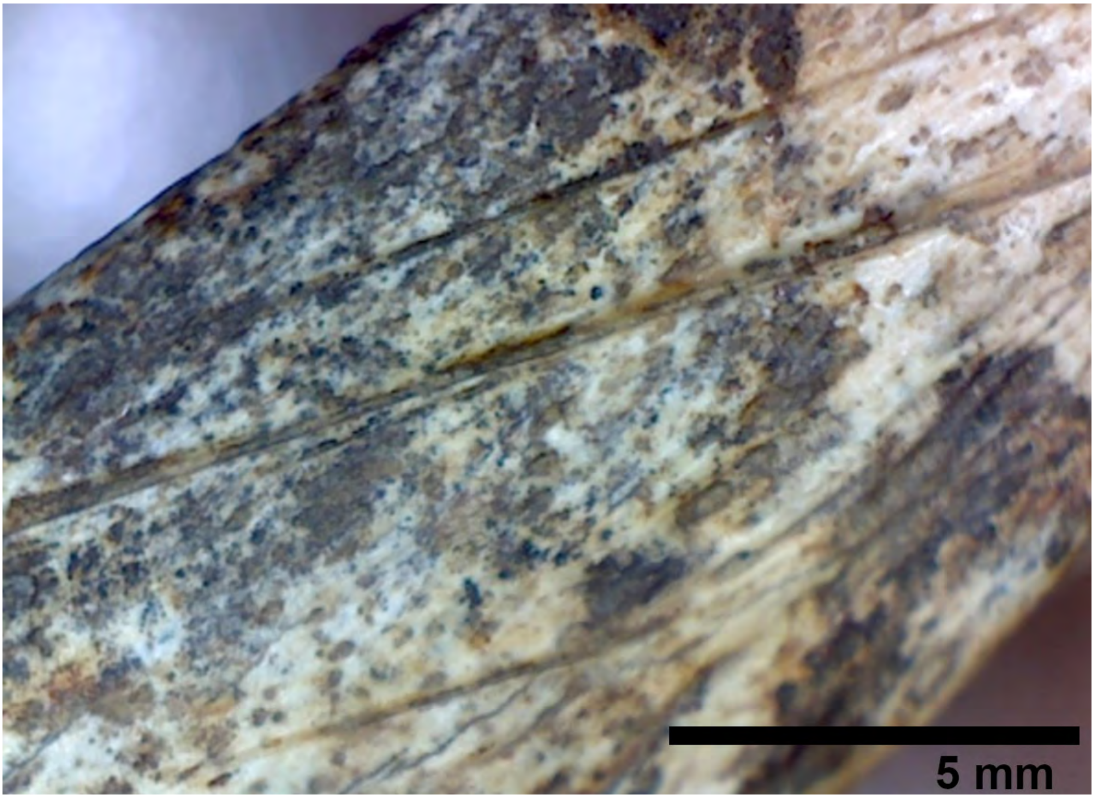

FIGURE 2
Cutmarks on the right third metatarsal

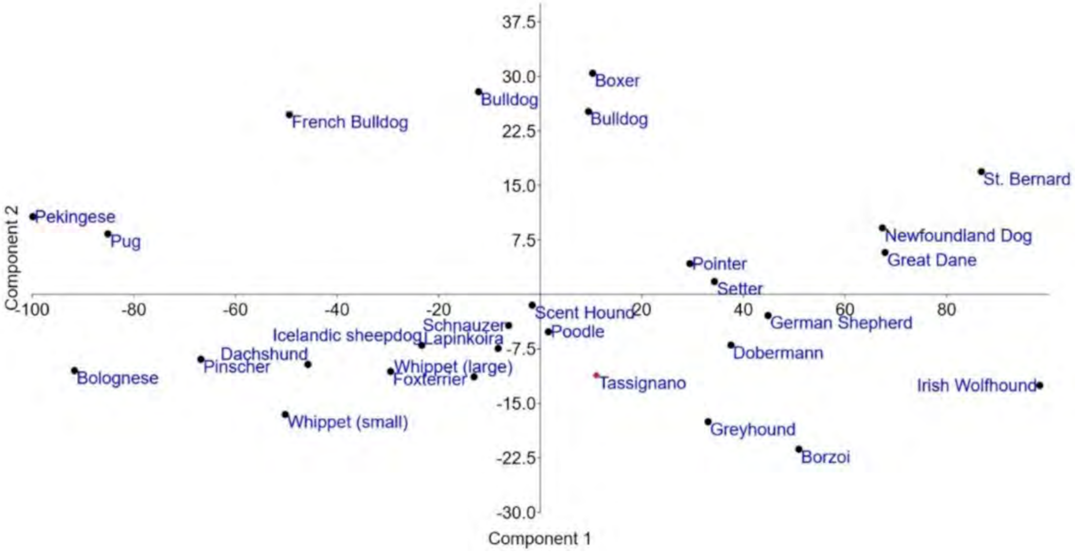

FIGURE 3

Scatterplot of a PCA carried out on cranial and mandibular measurements.

DISCUSSION AND CONCLUSIONS

The location of the carcass under the floor of the building, coupled with the skinning action, suggests a ritual burial, perhaps related to the foundation rite. However, the way the dog was killed remains unresolved. Although dog sacrifices are not uncommon in the Italian archaeological record, the Tassignano specimen represents one of the few Roman-age foundation rites involving dogs discovered in Italy so far (De Grossi Mazzorin & Minniti, 2006). Even if dogs are present in Italy since pre-Neolithic times (Boschin, 2020; Boschin *et al*., 2020), reliable selection for breeds is reported only from the Iron Age onwards (De Grossi Mazzorin & Tagliacozzo, 2000). Biometry of the Tassignano dog, considering limitations due to comparison with current breeds, indicate an individual morphologically like hunting dogs, such as greyhounds. It fits well into the wide variability that dogs acquired in Roman times due to increasingly stringent selective processes, which led to the breeding of specialised dogs for hunting, guarding, fighting or coursing (e.g., De Grossi Mazzorin & Tagliacozzo, 2000; Schoenebeck *et al*., 2020; Bennet & Timm, 2021).

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REFERENCES

Bennet, D. & Timm, R.M. 2021: The dogs of Roman Vindolanda, Part IV: Large sighthounds and guard and utility dogs. *Archaeofauna* 30: 185-216. DOI: 10.15366/archaeofauna2021.30.010.

Boschin, F. 2020: Holocene macromammal remains from Grotta dell'Edera/Stenašca, Trieste Karst (excavations in 1990–2001). *Arheološki vestnik* 71: 321–357. DOI: 10.3986/AV.71.11

Boschin, F. & Crezzini, J. 2012: Morphometrical Analysis on Cut Marks Using a 3D Digital Microscope. *International Journal of Osteoarchaeology* 22: 549-562. DOI: 10.1002/oa.1272.

Boschin, F.; Bernardini, F.; Pilli, E.; Vai, S.; Zanolli, C.; Tagliacozzo, A.; Fico, R.; Fedi, M.; Corny, J.; Dreossi, D.; Lari, M.; Modi, A.; Vergata, C.; Tuniz, C.; Moroni, A.; Boscato, P.; Caramelli, D. & Ronchitelli, A. 2020: The first evidence for Late Pleistocene dogs in Italy. *Scientific Reports* 10: 13313. DOI: 10.1038/s41598-020-69940-w.

De Grossi Mazzorin, J. & Minniti, C. 2006: Dog Sacrifice in the Ancient World: A Ritual Passage? In: Snyder, L.M. & Moore, E.A. (eds.): *Dogs and People in Social, Working, Economic or Symbolic Interaction*: 62-66. Oxbow books, Oxford.

De Grossi Mazzorin, J. & Tagliacozzo, A. 2000: Morphological and Osteological changes in the dog from the Neolithic to the Roman period in Italy. In: Crockford, S.J. (ed.): *Dogs through time: An archaeological perspective*: 141-161. B.A.R. (International Series) 889. Oxford.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from Archaeological Sites*. Peabody Museum, Harvard University, Cambridge. MA.

Hammer, Ø.; Harper, D.A.T. & Ryan, P.D. 2001: PAST: Paleontological Statistics software package for education and data analysis. *Paleontologia Electronica* 4(1).

Harcourt, R.A. 1974: The dog in prehistoric and early historic Britain. *Journal of Archaeological Science* 1: 151-175.

Schoenebeck, J.J.; Hamilton-Dyer, S.; Baxter, I.L.; Schwarz, T. & Nussbaumer, M. 2020: From head to hind: Elucidating function through contrasting morphometrics of ancient and modern pedigree dogs. *The Anatomical Record* 304: 63-77. DOI: 10.1002/ar.24412.

Wagner, K. 1930: *Rezente Hunderassen. Eine Osteologische Untersuchung*. Skrifter utgitt av Det Norske Videnskaps Akademi, Oslo.

SUPPLEMENTARY MATERIAL 1

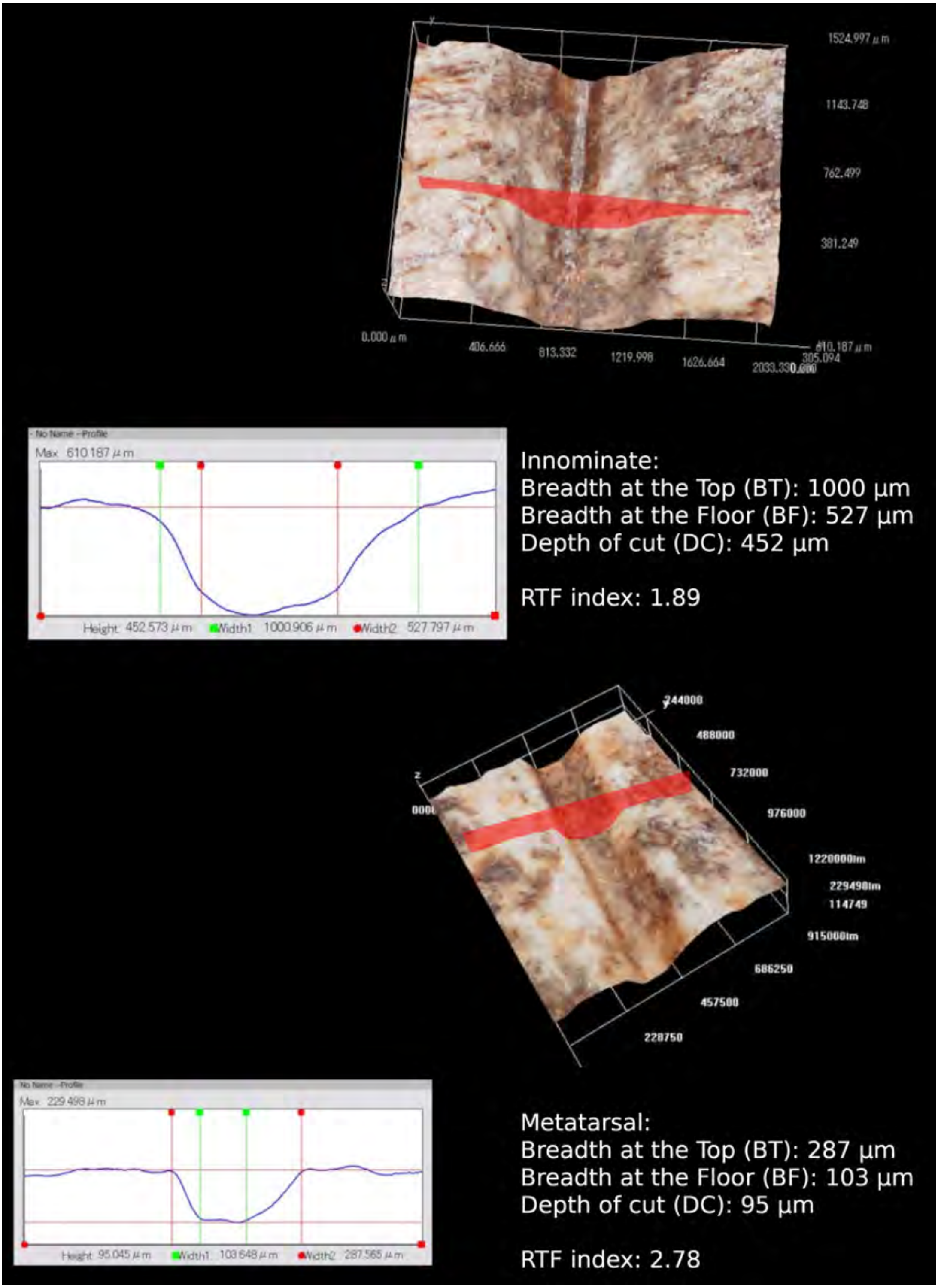
Element	**Position**	**Side**	**Digits**																							
Measurement				**8**	**9**	**15**	**16**	**17**	**19**	**22**	**32**	**33**	**34**	**35**	**36**	**37**	**41**									
Skull				94,2	108	64,7	16,7	53,2	18,6	24,3	47,4	35	61	37	34	26,3	42									
Measurement				**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13L**	**13B**	**14**	**15L**	**15B**	**16L**	**16B**	**17**	**18**	**19**	**20**
Mandible				141,3	138,9	132,5	125	118,1	125,3	82,6	74,4	70	34,2	42,3	36,3	21,8	9	21	8,8	6,4	4	4,3	12,3	56,5	22	19
Measurement				**GL**	**PL**	**GB**	**BFcr**	**HFcd**																		
Sacrum				43	37,4	48,2	25,1	11,5																		
Measurement				**GLP**	**LG**	**BG**																				
Scapula		Right		31,2	25,6	19																				
Measurement				**GL**	**LAR**	**SH**	**Lfo**	**SH**	**SB**																	
Innominate		Left		153,7	23,8	8,7	28,3																			
Innominate				154,7	24,3	8,5	27																			
Measurement				**GL**	**GLC**	**DP**	**SD**	**Bd**																		
Humerus		Right		172,1	165	43,1	13,4	33,1																		
Humerus		Left		171,4	165,2	43,5	13,5	32,9																		
Measurement				**GL**	**Bp**	**SD**	**Bd**																			
Radius		Right		175,4	19	12,8	24,7																			
Radius		Left		174	19	12,8	24,7																			
Measurement				**DPA**	**SDO**	**BPC**																				
Ulna		Right		24,8	23																					
Ulna		Left		24,4	22,6	19																				
Measurement				**GL**	**Bd**																					
Metacarpal I		Right		21,7																						
Metacarpal I		Right		22																						
Metacarpal II		Right		58	9,5																					
Metacarpal II		Left		58	9,5																					
Metacarpal III		Right		66	9,4																					
Metacarpal III		Left		66,1	9,4																					
Metacarpal IV		Right		6	9																					
Metacarpal IV		Left		65																						
Metacarpal V		Right		56,4	9,5																					
Metacarpal V		Left		56,6	9,9																					
Measurement				**GLC**	**BP**	**DC**	**SD**	**Bd**																		
Femur		Left			40	19,5	13,6	32,8																		
Femur		Right		188,6	41,6	19,6	13,9	31,8																		
Measurement				**GB**																						
Patella		Left		10,6																						
Patella		Right		10,4																						
Measurement				**GL**	**Bp**	**SD**	**Bd**																			
Tibia		Left			35,1	13,4																				
Tibia		Right		192,2	35,1	13,6	23,3																			

Measurement				**GL**																						
Talus		Left		27,7																						
Talus		Right		27,7																						
Calcaneum		Left		48,7																						
Calcaneum		Right		48,3																						
Measurement				**GL**	**Bd**																					
Metatarsal II		Left		65,6	9,3																					
Metatarsal III		Left		73,9	9																					
Metatarsal IV		Left		75,1	8,4																					
Metatarsal V		Left		66,8	9,2																					
Metatarsal II		Right		65,2	9,1																					
Metatarsal III		Right		72,6	9,2																					
Metatarsal IV		Right		74,6	8,4																					
Metatarsal V		Right		67,4	8,9																					
				101,6																						
Measurement				**GL**	**Bp**	**SD**	**Bd**																			
Phalanx 1	anterior	Left	II	23,4	9	6,2	7,8																			
Phalanx 1	anterior	Left	III			6	7,6																			
Phalanx 1	anterior	Left	IV			6	7,5																			
Phalanx 1	anterior	Left	V	23,7	8,7	6,3	7,5																			
Phalanx 1	anterior	Right	II	23,1	9	6	7,6																			
Phalanx 1	anterior	Right	III			6	7,6																			
Phalanx 1	anterior	Right	IV		9	9,2																				
Phalanx 1	anterior	Right	V	23,1	9	6	7,7																			
Phalanx 1	posterior	Left	II		8,4	5,3																				
Phalanx 1	posterior	Left	III	28	8,7	6	7,5																			
Phalanx 1	posterior	Left	IV	28,2	8,6	6	7,4																			
Phalanx 1	posterior	Left	V	23,6	8	5	7																			
Phalanx 1	posterior	Right	II			5,2	7,1																			
Phalanx 1	posterior	Right	III	28	8,8	5,9	7,4																			
Phalanx 1	posterior	Right	IV		6	7,4	7,5																			
Phalanx 1	posterior	Right	V	23,6	8	5,3	7,1																			
Phalanx 2	anterior	Left	V	13,7	8,4	6,5	8																			
Phalanx 2	anterior	Left	II	14,2	8,3	6,8	8																			
Phalanx 2	anterior	Right	III	18,8	8,1	6	8,3																			
Phalanx 2	anterior	Right	IV	19,1		6,1	8,3																			
Phalanx 2	anterior	Right	V	14	8,6	6,7	8,2																			
Phalanx 2	posterior	Left	II	14,3	8	6,1	7,6																			
Phalanx 2	posterior	Left	III	20,1	8	5,7	8,3																			
Phalanx 2	posterior	Left	IV	19,7	8	5,5	7,8																			
Phalanx 2	posterior	Left	V	14,7	8	6,1	7,4																			
Phalanx 2	posterior	Right	II	14,1	8,2	5,7	7,3																			
Phalanx 2	posterior	Right	III	19,6	8	5,5	7,8																			
Phalanx 2	posterior	Right	IV		8	5,6																				
Phalanx 2	posterior	Right	V	14,1		5,6	7																			

SUPPLEMENTARY MATERIAL 2

Measurement number (Wagner, 1930)	**1**	**8**	**9**	**23**	**24**	**26**	**27**	**28**	**29**	**32**
Measurement number (Driesch, 1976)	**1**	**9**		**32**	**33**	**34**	**35**	**36**	**22**	**15**
Tassignano	141,3	108	87	47,4	35	61	37	34	24,3	64,7
Deutsche Dogge	178,5	136,2	102,6	69,2	48,4	78	43,3	48,3	25,8	75,2
Schaefer	162,9	125,1	97,7	62,5	42,2	70	37,6	41,9	23,5	72,7
Bulldog	135,8	81,9	57,5	63,7	43,8	74,6	37,9	42,5	22,3	51,1
Dachs	103,7	81,8	57,3	43,3	28,8	51,7	25,7	28	17,5	50,3
Setter	160,2	115,6	90,4	59	43,4	69,8	37	41,8	24	69
Boxer	149	93,8	67,1	68,8	46,2	80,7	43,4	46,2	23,1	56,8
Irischer Wolfshund	198	161	118	70	37	77	34	49	28	83
Bernhardiner	192,2	142	107,2	75,5	53	86,3	50,3	56,8	27,2	76,8
Neufundlander	180,1	133,3	101,3	71	49	79,2	43,1	48,4	26	76,4
Barsoi	166,1	135,5	104,6	55,5	38,5	62,5	29,6	34,5	26,5	78,6
Englischer Windhund	154,7	124,7	95,7	54,7	38,2	60,3	29,8	33,2	24,5	72,5
Dobermann-Pinscher	158,5	122,1	95,8	58,3	41	67,4	34,6	38,8	23,6	72,8
Pointer	157,5	112,5	87	57,1	40,7	73,2	38,1	42,2	22,8	71,7
Bulldog alter typus	144	96,8	70,5	70,8	48,5	75,4	40,1	46,4	22,6	58,6
Dingo	141	109,2	83,3	51,3	35,8	59,8	30,7	35	24,8	67
Pudel	134,2	104,9	77,5	53,3	36,2	62,8	31,8	35,6	21,7	62,8
Norwegischer Hasenhund	132	100,6	76,8	51,5	34,7	62,6	32	45,8	21,1	64,1
lappenhund	129	99,8	73,5	49,3	34,8	59	30	34	20	62,3
Grosser Whippet	124,8	99	73	49	33	55,8	28	31,2	20	59
Islaendischer hund	117,9	91,6	68	48,6	33	56,4	28,4	32,8	20	57
foxterrier	113,4	90,7	65,6	44,5	29,6	55,8	27,7	30,2	18,6	56,1
Franzosische Zwergbulldog	108,6	66	41,8	54,6	37,8	67,2	35,6	40	18,8	36,6
Whippet	101,8	80,5	57,6	38,6	26,6	46,7	22,2	24,9	18,2	51,4
Ratle-pinscher	91,9	69,3	47,1	39,6	27,1	46,9	22,4	25,7	17,9	43,3
Mops	82,3	52,6	33,5	43,9	28,1	52,2	27,5	29,3	17,2	34
Bolognese	74,2	57,2	37,6	37	24,4	40,8	19,8	21,8	15	36
Pekinese-Tshin	75,5	41,2	27	45,5	27,2	48	25	26	15	29
Schnauzer	130	99,8	73,8	51,5	34	62	32	35,3	21	62,5

SUPPLEMENTARY MATERIAL 3



Innominate:
Breadth at the Top (BT): 1000 µm
Breadth at the Floor (BF): 527 µm
Depth of cut (DC): 452 µm

RTF index: 1.89

Metatarsal:
Breadth at the Top (BT): 287 µm
Breadth at the Floor (BF): 103 µm
Depth of cut (DC): 95 µm

RTF index: 2.78

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New excavations at Grotta Guattari. Humans and carnivores: preys and bone surface modifications

Nuovi scavi a Grotta Guattari. Uomo e carnivori: le prede e le tracce sulle superfici ossee

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ABSTRACT: New investigations at Grotta Guattari (San Felice Circeo, Latina, central Italy) were carried out by the "Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina" in collaboration with archaeologists from the University of Rome "Tor Vergata". The new archaeological investigation inside the cave, in the *Antro del Laghetto*, revealed a portion of paleosurface correlatable to the one already known since 1939. In addition, the excavation of the external cave shelter revealed an interesting stratigraphy with layers showing traces of human activity also referable to Neanderthal man. On one side, the preliminary taphonomic study, based on bovid remains found within the cave, revealed large carnivores' modifications. The long limb bones lack epiphyses and trabecular tissue, clearly indicating that these were gnawed to access bone marrow, confirming the results of the 1990s study. On the other side, the bone assemblage found outside the cave mainly shows defleshing marks and intentional impact fractures on fresh bones referable to human activities. In addition to the exceptional nature of the discovery, the taphonomic analysis will be particularly useful to compare two fossil assemblages accumulated by different taphonomic agents.

KEYWORDS: *HOMO NEANDERTHALENSIS*, GNAWING TRACES, BUTCHERY MARKS, SKELETAL PORTIONS, LARGE UNGULATES

RIASSUNTO: I nuovi scavi a Grotta Guattari (San Felice Circeo, Italia centrale), effettuati dalla Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina, con la collaborazione degli archeologi dell'Università degli Studi di Roma "Tor Vergata" hanno messo in luce una nuova paleosuperficie all'interno della grotta, nell'*Antro del Laghetto*, correlabile a quella già nota dal 1939. Lo scavo all'esterno della grotta ha messo in luce, invece, una serie di livelli con frequentazione antropica riferibili anch'essi all'uomo di Neanderthal. Lo studio tafonomico preliminare dei reperti ossei di bovidi, provenienti dall'interno della grotta, evidenzia la presenza di modificazioni tipiche dovute prevalentemente all'attività di grossi carnivori, confermando i risultati degli studi condotti negli anni '90 del secolo scorso. Sono state rinvenute ossa lunghe degli arti con estremità epifisarie mancanti e con tracce evidenti di rosicchiatura. Di-

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versamente, i resti ossei rinvenuti all'esterno della Grotta Guattari conservano tracce riferibili prevalentemente ad attività antropica, costituite da tagli da scarnificazione e da punti d'impatto. Oltre all'eccezionalità della scoperta, l'analisi tafonomica sarà particolarmente importante per il confronto tra due accumuli fossili dovuti ad agenti tafonomici differenti.

PAROLE CHIAVE: *HOMO NEANDERTHALENSIS*, TRACCE DI ROSICCHIATURA, TRACCE DI MACELLAZIONE, PORZIONI SCHELETRICHE, UNGULATI GROSSA TAGLIA

INTRODUCTION

Grotta Guattari (San Felice Circeo, central Italy) is one of Italy's best-known prehistoric sites due to the discovery in 1939 of a well-preserved Neanderthal skull, which is now stored within the "Museo delle Civiltà" in Rome. New excavations inside Grotta Guattari (carried out by the "Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Frosinone e Latina in collaboration with the University of Rome 'Tor Vergata") for the creation of a new visitor itinerary have brought to light a portion of the deposit that had never been investigated before. The palaeosurface of the *Antro del Laghetto* (Supplementary materials Figure 1) is followed by two layers with abundant faunal remains slightly older than those investigated since 1939 (Salari *et al.* in this volume and references therein).

The excavation of the shelter outside the cave (Supplementary materials Figure 1) revealed instead a complex stratigraphy, significantly older than that from inside the cave, including layers of Neanderthal occupation.

The preliminary observations presented here refer to a small sample of remains from the external areas and the Area 1 of *Antro del Laghetto* inside the cave. The latter preserved evidence of frequentation by hyenas, already documented by previous studies of other areas of the cave (Piperno & Giacobini, 1991; Stiner, 1991a, b).

The faunal assemblage of Area 1 consists of over 3500 bone remains, of which about 350 have been taxonomically determined (i.e., over a third of the entire *Antro del Laghetto*; Supplementary materials Table 1). The presence of numerous human remains referred to *Homo neanderthalensis* is particularly important.

The most common species from Area 1 is *Cervus elaphus* followed by *Bos primigenius*, *Crocuta spelaea* and at least other 15 *taxa*, including some never found before such as *Equus hydruntinus* and *Rupicapra* sp. (Petronio *et al.*, 2021; Salari *et al.* this volume and references therein).

METHODS AND MATERIAL

The study presented here refers to aurochs remains from a restricted area of the cave (Area 1 of the *Antro del Laghetto*) and some diaphysis fragments of medium-sized ungulates from excavations outside the cave. The selection was carried out to verify the origin of the faunal assemblages, whether anthropogenic or due to other accumulation agents. The preliminary taphonomic observations were carried out with the aid of a 10X optical lens and a Dino-Lite Edge microscope, albeit bones were often covered by hard concretions, which in some cases prevented the analysis of the original surface. Detailed studies were conducted directly on the remains with a SEM of the Microscopy Laboratory of the "Museo delle Civiltà" in Rome. Particular importance was given to the missing portions of the bones, the type and intensity of modifications (grooves, holes, etc.) in addition to their position on the anatomical element (Fernández-Jalvo & Andrews, 2016 and references therein).

PRELIMINARY TAPHONOMIC STUDIES

THE CAVE SHELTER

The deposit outside the cave is formed by the oldest levels of the site. One of these shows a significant evidence of anthropic frequentation consisting of lithic industry and fragmentary and partly burnt faunal remains. Traces of anthropogenic origin are evident in the bones, consisting of defleshing cuts on long bone diaphyses, some partially burned. The bones show fracture types comparable to those made on fresh bones with impact points. A *C. elaphus* tibia displaying traces of use comparable to those found on lithic retoucher is a key find, since there are no similar tools published from the other caves of the Circeo (Figure 1: *1, 2A-3A, 4B*). This is a fragment of diaphysis (No. 3412) consisting of the anterior face of a proximal portion of a left tibia, preserving the tibial crest (length 96 mm; width ca. 32 mm). The fragment shows edge patterns typical of a fresh bone fracture, and the brown colour is probably an indication of exposure to fire. The anthropic traces are located on the medial face and refer to different types of lithic cuts:

– transverse arcuate striae on the proximal margin, probably from butchering;
– long and rectilinear striae affecting almost the entire surface, probably due to bone cleaning (Figure 1: *4B*);
– linear and punctiform stigmata concentrated towards the distal part of the fragment are due to repeated contact with a lithic tool. Therefore, we can define this specimen as a retoucher (Figure 1: *2A-3A*).

The diaphysis shows traces of preparation for use represented by the long striae, probably pro-

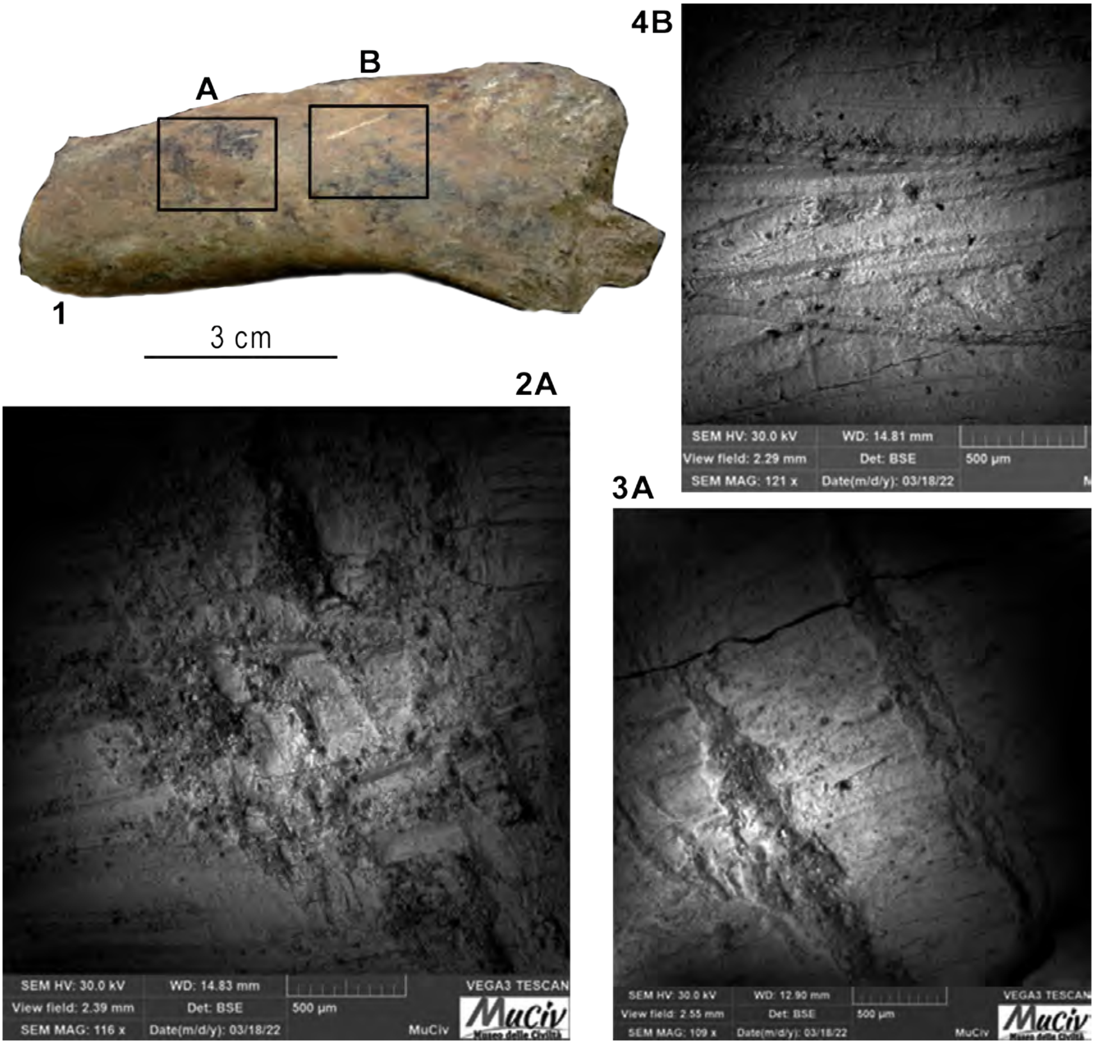

FIGURE 1

Guattari shelter (San Felice Circeo, central Italy): retoucher on cervid tibia. 1, diaphysis of tibia with the localisation of traces from lithic tools. 2A, stigmata concentration area, 3A, detail of two linear marks (Photos SEM). 4B, scraping striae from cleaning the bone surface (SEM detail).

duced to scrape off residual organic matter. In fact, the retouching traces overlap with the scraping marks. The fragment was probably used only once, given that the traces are about 30 and sparse.

One of the main criteria for identifying retouching marks is the presence of perpendicular micro-striations inside the marks, and there is also an extensive bibliography on similar elements (Patou-Mathis, 2002; Daujeard *et al*., 2014).

THE CAVE INTERIOR - “THE ANTRO DEL LAGHETTO”

The bone remains found within Grotta Guattari are often covered by a hard concretion that, in several cases, prevents the analysis of the original surface.

Modifications due to the activity of large carnivores are the most evident traces on bone fragments and fallen cervid antlers. The epiphyseal ends of the long bones have been removed by the chewing activity of a large carnivore (i.e., cave hyena), as can be deduced from the irregular, rounded fracture margins in a zig-zag pattern (ragged-edged chewing); in some cases, the margins also retain the hollow left by tooth contact and traces of gnawing. Carnivores mainly gnaw the epiphyseal and trabecular ends by removing part of the tissue (scooping out) to reach the epiphyseal and diaphyseal bone marrow. Traces of gnawing were also found on a human femur (Fiore, 2021).

As a case study, we present data from the taphonomic analysis of *B. primigenius*.

THE AUROCHS

The aurochs, *B. primigenius*, is the most common ungulate in the *Antro del Laghetto* after red deer. The remains analysed in this study are 45 and refer to at least 4 individuals due to the presence of 4 right talus bones. The ages at death are 2 young adults, due to the presence of slightly worn molars and some unfused epiphyses, and 2 adults due to the numerous long limb bones with fused epiphyses.

All the elements, except some teeth, present traces of gnawing: holes, grooves, and ragged edges (Table 1, Figure 2). The long limb bones and scapulae show the greatest damage with large portions of bone destroyed. The long bones of the limbs show variable degrees of gnawing: absence of one or both epiphyses, absence of the metaphyses up to preserving only small portions of the diaphysis.

Bos primigenius	NISP	Gnawed
Teeth	4	
Mandible	3	3
Vertebrae	3	3
Scapula	5	5
Humerus	4	4
Radius	3	3
Metacarpus	2	2
Femur	3	3
Tibia	2	2
Talus	6	6
Calcaneus	2	2
Scafocuboid	3	3
Metatarsus	5	5
Total	**45**	**41**

TABLE 1

Ratio of anatomical elements of aurochs to those with traces of gnawing.

The short bones of the tarsus are generally intact, but show holes, furrows and small lacunae of bone, while the calcaneus has invasive gnawing on the caput. The gnawing is therefore concentrated in the areas richest in organic substances (e.g., fat, cartilage and ligaments), which are abundant on the epiphyses. This sample of gnawed but still identifiable remains probably reflects the initial stages of gnawing. Conversely, the most destructive activity is evidenced by the hundreds of indeterminate diaphyseal remains under 5 cm in size (many fragments are comparable in size and thickness to aurochs bones), which display traces and types of fracture relatable to large carnivore activity.

The auroch skeleton is represented by only a few anatomical elements, others are under-represented compared to the NMI. Hyenas can carry whole carcasses of small and medium-sized preys[1], but only distinct body parts of the aurochs could be transported (see wither heights data in Salari *et al*. this volume).

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[1] https://www.shutterstock.com/image-photo/hyena-prey-216385873

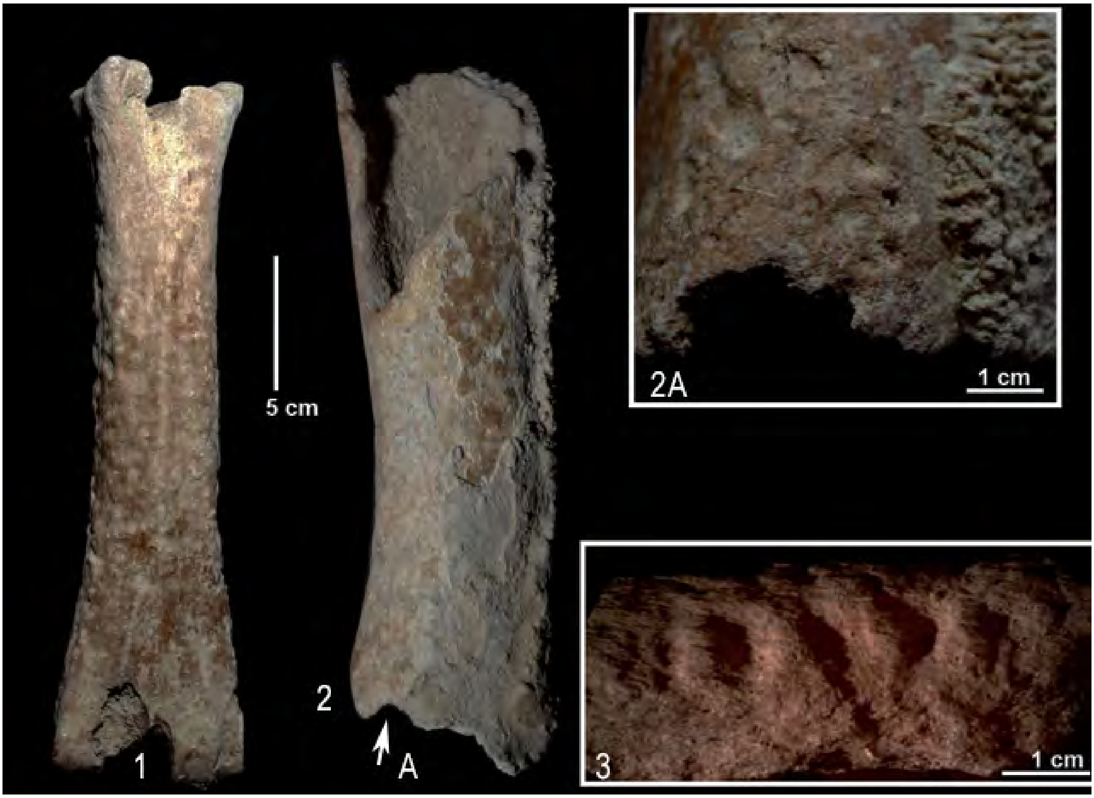

FIGURE 2

Guattari cave (San Felice Circeo, central Italy): aurochs bones with traces of hyena gnawing. 1, metatarsus with gnawing on proximal and distal epiphyses. 2, diaphysis of humerus with both epiphyses removed by gnawing, 2A, detail of the gnawed margin of the humerus. 4, detail of gnawing on a scapula.

CONCLUSIONS

Preliminary taphonomic data of the aurochs from Area 1 of the *Antro del Laghetto* confirm that the bone accumulation appears to be mainly due to cave hyena activity. The carnivore is well represented with 72 remains, most of which are isolated teeth, referable to at least 4 individuals of different ages. Hyena remains, including some teeth, show traces of gnawing activity reflecting cannibalistic behaviour (Diedrich, 2020).

The modifications found on the aurochs remains confirm the typical action of the hyena. They primarily gnaw the epiphysis and trabecular ends, removing some parts of the bone tissue to reach the marrow contained within the long bones. The powerful jaws allow these carnivores to gnaw until the long bones are almost completely destroyed, saving only small fragments of diaphysis. Their strong and stubby teeth with sharp edges are specialised to crush bones.

Significant evidence of the use of the cave as a den is the finding of nibbling sticks, these are bone fragments intensively chewed by juvenile hyenas for nutrition and teething (Diedrich & Žák, 2006).

Only portions of the carcasses of the large aurochs were transported into the cave. Present-day spotted hyenas commonly transport within the den only portions of large preys, such as the heads[2] sometimes with part of the cervical vertebrae, limbs without the girdles[3], and portions of the ribcage (see also Pokines *et al*., 2007; Egeland *et al*., 2008; Lansing *et al*., 2009, Diedrich, 2010). In contrast, the bone fossils found outside the cave mainly display defleshing marks and intentional impact fractures on fresh bones referable to human activities.

[2] https://www.africa-wildlife-detective.com/hyena.html

[3] https://static.wikia.nocookie.net/animalian/images/a/a7/Spotted-hyena.jpg/revision/latest?cb=20170529210447

This work represents only a preview of the information that the study of the internal and external areas of Grotta Guattari can add to our knowledge of the prehistoric Circeo. This is particularly desirable for the external area, which is highly anthropised.

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REFERENCES

Daujeard, C.; Moncel, M.-H.; Fiore, I.; Tagliacozzo, A.; Bindon, P. & Raynal, J.-P. 2014: Middle Paleolithic bone retouchers in South-eastern France: variability and functionality. *Quaternary International* 326-327: 492-518.

Diedrich, C. 2010: Specialized horse killers in Europe: Foetal horse remains in the Late Pleistocene Srbsko Chlum-Komın Cave hyena den in the Bohemian Karst (Czech Republic) and actualistic comparisons to modern African spotted hyenas as zebra hunters. *Quaternary International* 220: 174–187.

— 2020: Eating head first-When European Ice Age spotted hyenas crushed their own to pieces. *Acta Zoologica* 2021(102): 143–164. https://doi.org/10.1111/azo.12323

Diedrich, C.G. & Žák, K. 2006: Prey deposits and den sites of the Upper Pleistocene hyena Crocuta crocuta spelaea (Goldfuss, 1823) in horizontal and vertical caves of the Bohemian Karst (Czech Republic). *Bulletin of Geosciences* 81(4): 237–276.

Egeland, S.G.; Egeland, C.P. & Bunn, T.H. 2008: Taphonomic Analysis of a Modern Spotted Hyaena (*Crocuta crocuta*) Den From Nairobi, Kenya. *Journal of Taphonomy* 6(3-4): 275-299.

Fernández-Jalvo, Y. & Andrews, P. 2016: *Atlas of Taphonomic Identifications. 1001+ Images of Fossil and Recent Mammal Bone Modification*. Springer, Amsterdam. https://doi.org/10.1007/978-94-017-7432-1

Fiore, I. 2021: Tracce sulle ossa: una lettura interessante. *Archeologia Viva* 210: 64-65.

Lansing, S.w.; Cooper, S.w.; Boydston, E.e. & Holekamp, K.E. 2009: Taphonomic and zooarchaeological implications of spotted hyena (*Crocuta crocuta*) bone accumulations in Kenya: a modern behavioral ecological approach. *Paleobiology* 35(2): 289–309.

Patou-Mathis, M. 2002 (ed.): *Compresseurs, percuteurs, retouchoirs. Industrie de l'os préhistorique*. Cahier X, Société Prehistorique Française.

Petronio, C.; Rolfo, M.F.; Ceruleo, P.; Di Mario, F.; Ferracci, A.; Fiore, I.; Gatta, M. & Salari, L. 2021: Preliminary report on the new faunal remains from Grotta Guattari (Late Pleistocene, San Felice Circeo, Latium). *Bulletin of Regional Natural History* 1(4): 29-38.

Piperno, M. & Giacobini, G. 1991: A taphonomic study of the paleosurface of Guattari Cave (Monte Circeo, Latina, Italy). *Quaternaria Nova* 1 (1990/91): 143-161.

Pokines, J.T. & Kerbis-Peterhans, J.C. 2007: Spotted hyena (*Crocuta crocuta*) den use and taphonomy in the Masai Mara National Reserve, Kenya. *Journal Archaeological Science* 34: 1914–1931.

Salari, L.; Ceruleo, P.; Di Mario, F.; Ferracci, A.; Fiore, I.; Gatta, M.; Petronio, C.; Salari, L. & Rolfo, M.F. this volume: Late Pleistocene faunal remains from new investigations at Grotta Guattari (San Felice Circeo, Latium): preliminary considerations on climate and environment. *Atti del 10° Convegno Nazionale di ArcheoZoologia*, Siena, 3-6 novembre 2021.

Stiner, M.C. 1991a: The Guattari faunas then and now. *Quaternaria Nova* 1 (1990/91): 163-192.

— 1991b: The faunal remains from Grotta Guattari: a taphonomic perspective. *Current Anthropology* 32: 103-117.

https://www.shutterstock.com/image-photo/hyena-prey-216385873

https://www.africa-wildlife-detective.com/hyena.html

https://static.wikia.nocookie.net/animalian/images/a/a7/Spotted-hyena.jpg/revision/latest?cb=20170529210447

SUPPLEMENTARY MATERIAL 1

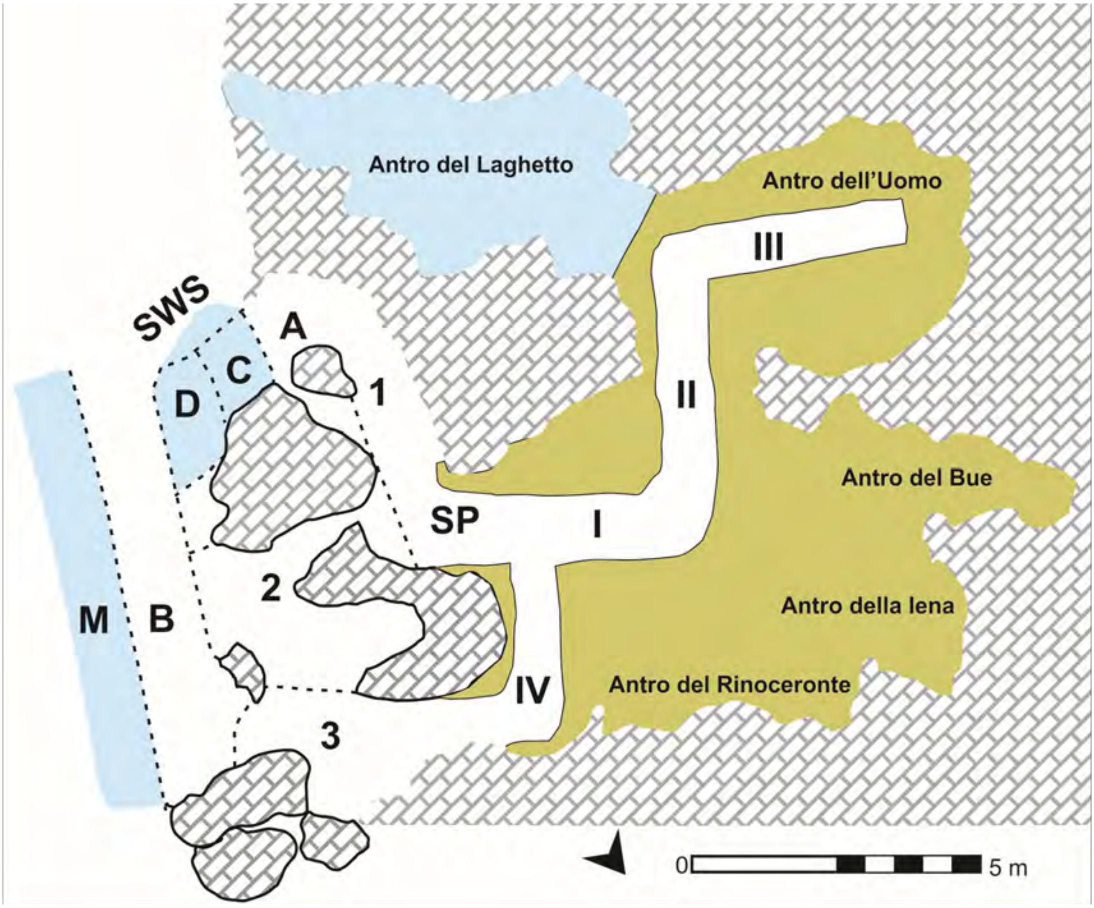

FIGURE S1

Grotta Guattari (San Felice Circeo, central Italy): plan of the site; the areas of excavation of the years 1939-50 (white) and 2019-23 (sky blue). The excavation of the external area (the cave shelter) is indicated by the letters M-D-C-SWS.

SUPPLEMENTARY MATERIAL 2

Taxon	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Total
Testudinata				1				1
Aves			3					3
Lepus sp.	2	1	1	1	1			6
Canis lupus	1		5	4				10
Vulpes vulpes	5	4	6	6	1			22
Ursus spelaeus	3							3
Ursus arctos	11	4	9	6				30
Mustelidae			1					1
Felis silvestris		1		1				2
Panthera spelaea			1	1				3
Panthera pardus			1	1	1			3
Crocuta spelaea	72	42	59	90	14	2	9	287
Palaeoloxodon antiquus	1	2		3				6
Elephantidae	1		7	1				9
Stephanorhinus cf. *S. hemitoechus*		2		1				3
Rhinoceratidae	2		3					5
Equus ferus	14	12	27	16	4	3	4	80
Equus hydruntinus	1			1	1	5		8
Sus scrofa	8	15	39	13	9	9		93
Megaloceros giganteus	13	3	17	15			3	51
Cervus elaphus	96	44	111	67	10	4	12	344
Dama dama dama	13	13	8	17	4		5	60
Capreolus capreolus	2	2		2				6
Cervidae	25	3	16	13	1	2	3	63
Bos primigenius	72	31	55	58	1	1	15	229
Capra ibex			1	1	1			3
Rupicapra sp.	1							1
Caprinae	2		1					3
Total identified specimens	345	179	371	319	48	26	51	1339
Indeterminate bones	3212	1015	1142	2233	80	39	235	7956
TOTAL	3557	1194	1513	2552	128	65	286	9295

TABLE S1

Grotta Guattari (San Felice Circeo, central Italy): number of faunal remains from *Antro del Laghetto*, by excavation area.

Archaeofauna 34(1) (2025): 383-388

L'arvicola acquatica europea, *Arvicola amphibius* (Linnaeus 1758), nuove evidenze dalla Sicilia arcaico-classica, Selinunte (Trapani)

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RIASSUNTO: Le analisi archeozoologiche condotte sul campione osteologico proveniente dal santuario urbano sull'acropoli di Selinunte hanno permesso l'identificazione di alcuni resti ossei riconducibili ad arvicola acquatica, *Arvicola amphibius* (Linnaeus 1758). Nonostante la documentazione inerente alla presenza di questo roditore in Sicilia sia molto scarsa, è possibile tracciare un quadro cronologico che vede l'arvicola presente sull'isola dalla fine del Paleolitico Superiore fino all'Antica Età del Bronzo, periodo dopo il quale risulta estinta. La recente scoperta in livelli di periodo arcaico/classico (VI-V sec. a.C.) sembrerebbe posporre di circa due millenni la data di estinzione di questo particolare roditore, la cui ecologia è strettamente legata a particolari habitat come fiumi, canali, specchi d'acqua dolce e stagni salmastri, peculiarità che un tempo caratterizzavano l'area dove sorgeva l'antica città di Selinunte.

PAROLE CHIAVE: ARVICOLA ACQUATICA, SICILIA, PERIODO CLASSICO, SELINUNTE, ESTINZIONE

ABSTRACT: The zooarchaeological analyzes carried out on the faunal assemblage from the urban sanctuary on the acropolis of Selinus, allowed the identification of some remains belonging to the water vole, *Arvicola amphibius* (Linnaeus 1758). Although the Sicilian zooarchaeological record referred to this rodent is scarce, it is possible to cautiously trace the history of its population. Indeed, the *Arvicola amphibius* has been part of the Sicilian fauna for a relatively brief period, starting from the Final Upper Palaeolithic to the end of Ancient Bronze Age. Therefore, the recent discovery in archaic/classical archaeological contexts (6th-5th century BCE) postpones of almost two millennia the date of extinction of this rodent, providing also fundamental information on the reconstruction of the natural environments surrounding the ancient poleis, as its ecology is closely connected to well-defined habitats such as rivers, canals, expanses of freshwater and brackish ponds.

KEYWORDS: WATER VOLE, ANCIENT SICILY, CLASSICAL PERIOD, SELINUNTE, EXTINCTION

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INTRODUZIONE

Le campagne di scavo condotte dall'Institute of Fine Arts della New York University e dalla Università Statale di Milano, si avvicendano da circa un decennio presso alcuni dei santuari urbani presenti sull'acropoli di Selinunte, una delle più importati città ellenistiche della Magna Grecia e della Sicilia sud-occidentale. L'indagine archeozoologica condotta sul campione osteologico proveniente dal Tempio R, ha permesso l'identificazione di alcuni resti ossei riconducibili ad arvicola acquatica, *Arvicola amphibius* (Linnaeus 1758). Fra le indagini archeozoologiche, un ruolo sempre più importante viene svolto dalle analisi riferite alle microfaune; tale ambito di ricerca è stato lungamente relegato ai margini delle usuali analisi faunistiche a causa di procedure di scavo che privilegiavano una raccolta selettiva dei resti animali e che non sempre prendevano in considerazione tecniche come la setacciatura e la flottazione che costituiscono i fondamentali sistemi di recupero delle microfaune provenienti dallo scavo. I resti in esame, malgrado le loro piccole dimensioni, si presentano ben conservati ed in buone condizioni strutturali. A tal proposito, viste le ideali condizioni tafonomiche dei resti, su alcune mandibole è stato possibile effettuare un' indagine preliminare mirata alla misurazione degli spessori dello smalto del primo molare inferiore tramite il protocollo di tecnica di misura ed elaborazione per la definizione dell'SDQ (Schmelzband Differenzierungs Quotient) in accordo con (Heinrich,1990), per poter comparare i campioni siciliani con un data-set di valori prelevati su animali provenienti da diversi contesti cronologici dell'Europa e Italia peninsulare. Malgrado la documentazione archeozoologica in merito la presenza di questo roditore in Sicilia sia molto limitata, riguardante solamente la porzione occidentale dell'isola, è possibile tracciare un quadro cronologico abbastanza chiaro che vede l'arvicola presente dalla fine del Paleolitico Superiore fino all'Antica Età del Bronzo, periodo dopo il quale risulta estinta, (Figura 1).

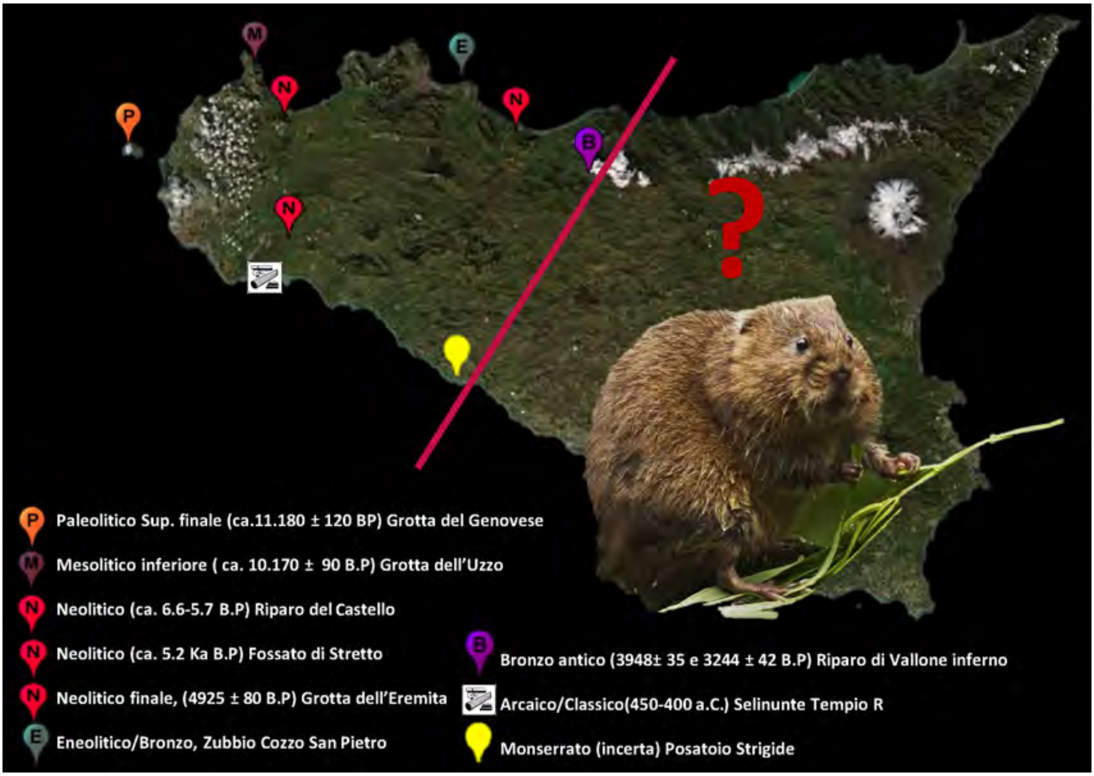

FIGURA 1

Ubicazione e cronologia di tutti i siti da cui provengono resti di Arvicola acquatica; mod. da Arvicola acquatica europea foto di T. Whittaker fonte https://pin.it/6AHDOKe); immagine satellitare della regione Sicilia fonte, https://visibleearth.nasa.gov/images/140308/sicily).

MATERIALI E METODI

Le analisi, archeozoologiche condotte sul campione osteologico proveniente dal Tempio R hanno riguardato un totale di quasi 20.000 reperti faunistici di cui 7459, pari al 37% del totale del campione, attribuiti a livello specifico. Il 5% della frazione identificata pari a 390 reperti si riferiva esclusivamente a microfaune, di cui il 3%, pari a 12 reperti è rappresentato da Arvicola acquatica europea, *Arvicola amphibius* (Linnaeus1758), (Figura 2). Una prima indagine riguardante gli spessori dello smalto del primo molare inferiore, è stata condotta sulle mandibole provviste di M1, seguendo un protocollo

FIGURA 2

Lo specimen selinuntino, i distretti scheletrici identificati riguardanti l'Arvicola acquatica.

di tecnica di misura ed elaborazione per la definizione dell'SDQ (Schmelzband Differenzierungs Quotient), in accordo con Heinrich (1990). Le fotografie dei campioni e le misure lineari, A (Lunghezza anteroconide), L (lunghezza totale) ed i relativi spessori dello smalto relativi all'M1 inferiore sono state acquisite tramite l'utilizzo di un microscopio USB Dino-Lite modello AM4815ZT, 20→220X, ris. 1280 x 1024 pixel, ad un ingrandimento di 60 x utilizzando il software Dino capture 2.0. I dati sono stati analizzati utilizzando il software PAST (Hammer *et al*., 2001), (Figura 3).

RISULTATI E DISCUSSIONI

I valori SDQ ottenuti ed i valori di A/L sono stati comparati tramite un'analisi statistica, PCA, con un date-set di valori disponibili da (Masini *et al*., 2020). I valori calcolati sui campioni selinuntini si posizionano esattamente fra valori medi dei campioni peninsulari di *A. amphius*, (Figura 4). Il rinvenimento in livelli di periodo arcaico/classico (VI-V sec. a.C.) prolunga la presenza di questo particolare roditore sull'isola. Nell'accumulo di microfaune, in associazione con resti di rapaci notturni e relative tracce di digestione identificate soprattutto sui denti (Andrews, 1990)**,** (Figura 5), è possibile identificare il posatoio di uno strigide, e sostenere che nel periodo identificato dalla datazione radiometrica (450-400 a.C.) degli strati interessati, corrispondente agli anni in cui Selinunte cadde sotto il predominio cartaginese (nel 409 a.C.), sia avvenuto l'abbandono o possibilmente il riutilizzo dell'edificio che fino a quel momento era stato adibito esclusivamente ad attività cultuale.

L'Arvicola acquatica era nota in Sicilia fino a livelli preistorici riferiti dal Paleolitico Superiore all'Età del Bronzo antico, presso il sito di Vallone Inferno (López-García *et al*., 2013), dopo di che risultava estinta a causa probabilmente del deterioramento climatico che seguiva l'*optimum* climatico Olocenico tra i 9 e 5 ka cal B.P, (Incarbona *et. al*., 2010). La presenza di questo Arvicolide

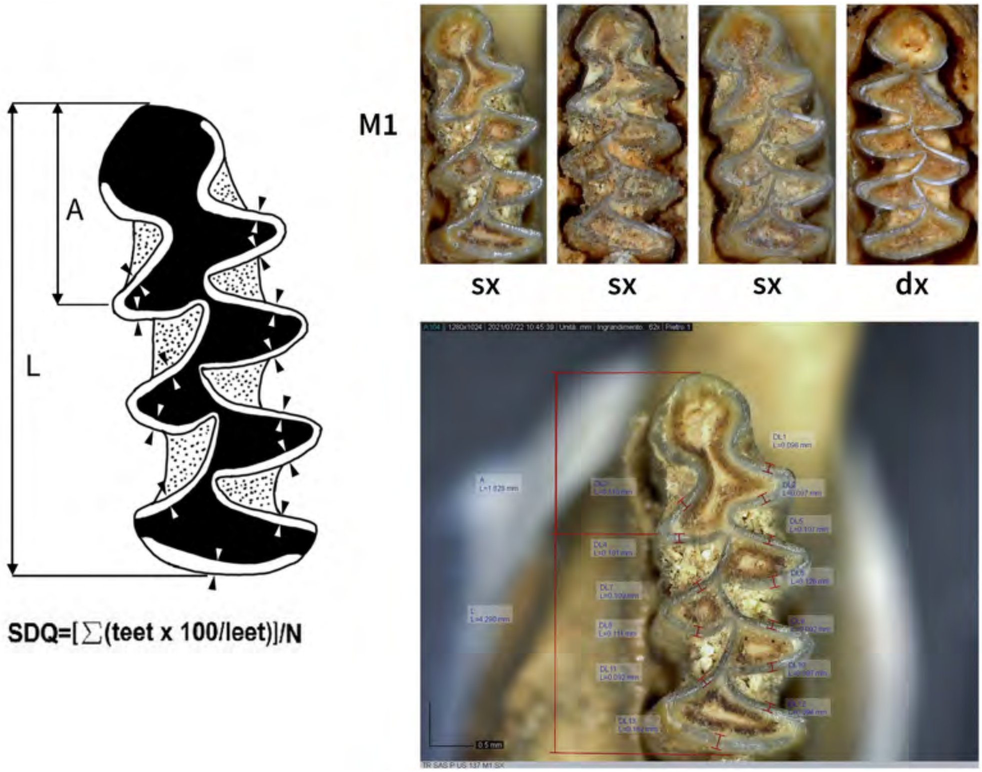

FIGURA 3

Il protocollo di misurazione applicato sul primo molare inferiore per il calcolo dell'SDQ in accordo con (Heinrich,1990), disegno della superficie occlusale del primo molare inferiore (M1) del campione Laura Schepis.

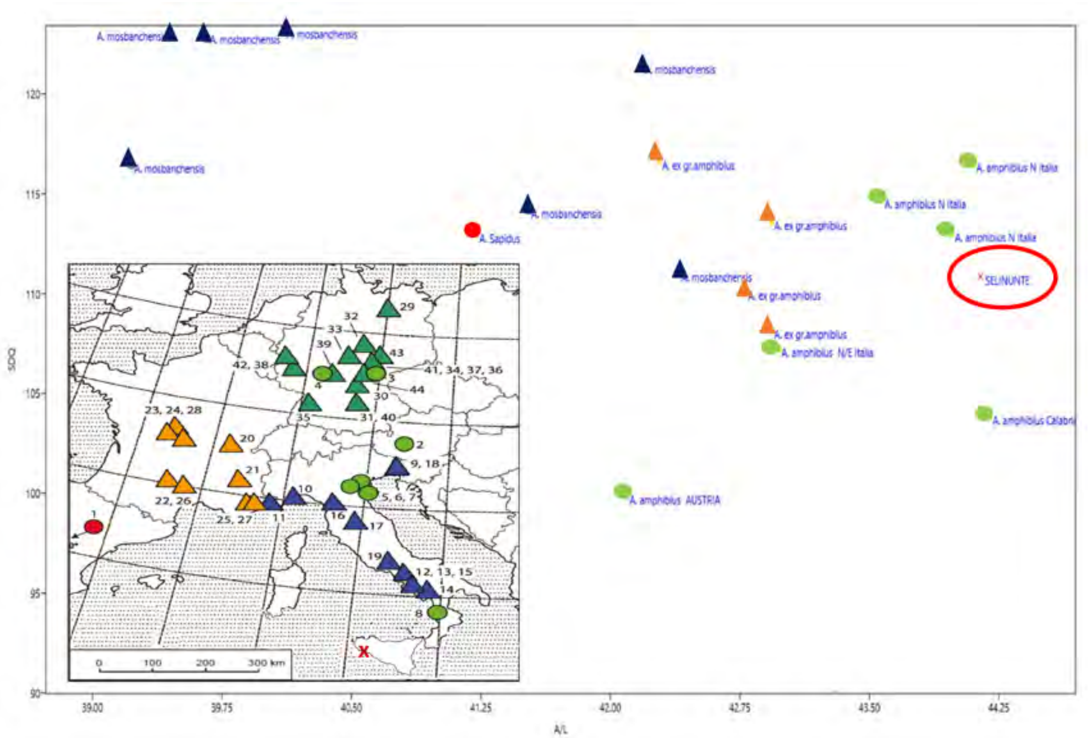

FIGURA 4

Diagramma a dispersione per M1 medie dei valori A/L vs SDQ confrontati con un dataset di valori di Arvicole europee pleistoceniche provenienti da diversi siti europei. (mod. da Masini *et al*., 2020).

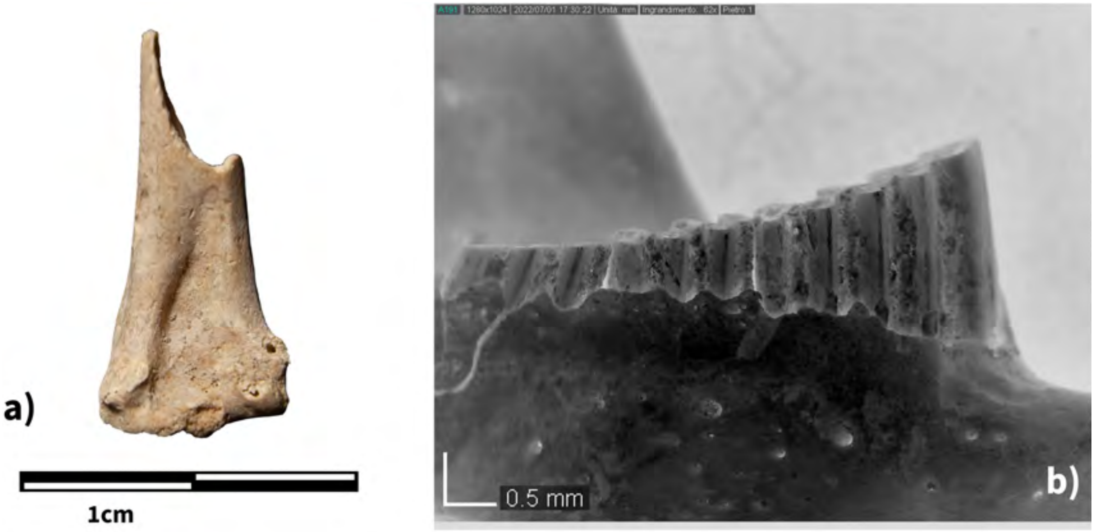

FIGURA 5

a) porzione distale di omero sinistro di Allocco (*Strix aluco*); b) segni di digestione su molari.

nel deposito esaminato, riferibile di periodo arcaico/classico (VI-V sec. a.C.) allunga il suo periodo di sopravvivenza dalle età dei metalli e pospone di circa due millenni, per il momento, la sua estinzione in Sicilia. In considerazione di tale evidenza la causa d'estinzione non può più essere attribuita ad un motivo climatico, ma alla particolare ecologia di questo particolare roditore (Petruso *et al*., 2011), la quale essendo strettamente legata a particolari habitat come fiumi, canali, pantani e stagni salmastri, peculiarità che un tempo caratterizzavano l'area dove sorgeva l'antica città di Selinunte. Probabilmente la perdita di habitat, legata alla progressiva bonifica delle sponde dei due fiumi che cingevano Selinunte e la conversione delle aree umide in aree dedite all'agricoltura abbiano generato un tale impatto ecologico da causare l'estinzione, da una delle ultime roccaforti siciliana, per questo particolare roditore.

CONCLUSIONI

Sulla base delle preliminari indagini morfometriche riguardanti i valori inerenti allo spessore dello smalto del primo molare inferiore, lo specimen siciliano si posiziona fra le medie dei campioni peninsulari di *A. amphius*, tuttavia, trattandosi di campioni insulari l'indagine verrà implementata includendo, oltre la morfologia della mandibola e del terzo molare inferiore (M3), delle analisi genetiche. Al giorno d'oggi appare ancora più importante colmare tale ritardo nella ricerca archeologica in quanto alle microfaune è stato riconosciuto non solo un ruolo chiave nelle ricostruzioni paleo ambientali di un sito, ma anche un interessante contributo funzionale alla corretta interpretazione crono-stratigrafica associata al giacimento archeologico.

BIBLIOGRAFIA

Andrews, P. 1990: *Owls, Caves and Fossils: Predation, Preservation and Accumulation of Small Mammal Bones in Caves, with an Analysis of the Pleistocene Cave Faunas from Westbury-Sub-Mendip, Somerset*. University of Chicago Press, Chicago.

Hammer, O.; Harper, D.A.T. & Ryan, P.D. 2001: Paleontological statistics software package for education and data analysis. *Palaeontol. Electron*. 4(1): 9.

Heinrich, W.D. 1990: Some aspects of the evolution and biostratigraphy of Arvicola (Mammalia, Rodentia) in the Central European Pleistocene. In: Fejfar, O. & Heinrich, W.D. (eds.): *International symposium evolution, phylogeny, and biostratigraphy of arvicolids (Rodentia, Mammalia)*: 165-182. Pfeil-Verlag, Munchen.

Incarbona, A.; Agate, M.; Arisco, G.; Bonomo, S.; Buccheri, G.; Di Patti, C.; Di Stefano, E.; Greco, A.; Madonia, G.; Masini, F.; Petruso, D.; Sineo, L.; Sprovieri, R.; Surdi, G. & Giuseppe Zarcone, G. 2010: Ambiente e clima della Sicilia durante gli ultimi 20 mila anni. *Italian Journal of Quaternary Sciences* 23(1): 21-36.

López-García, J.M.; Blain, H.A.; Pagano, E.; Ollè, A.; Vergès, J.M. & Forgia, V. 2013: The small mammals (insectivores, bats and rodents) from the Holocene archaeological site of Vallone Inferno (Scillato, Lower Imera Valley, Northwestern Sicily). *Rivista italiana di paleontologia e stratigrafia* 119: 229–244.

Masini, F.; Maul, L.M.; Abbazzi, L.; Petruso, D. & Savorelli, A. 2020: Independent water vole lineages in italy and central Europe. *Fossil imprint* 76(1): 59–83. Praha. ISSN 2533-4050 ISSN 2533-4069. https://doi.org/ 10.37520/f.2020.005

Petruso, D.; Sarà, M.; Surdi, G. & Masini, F. 2011: Le faune a mammiferi delle Sicilia tra il tardo glaciale e L'olocene. *Biogegrafia* 30: 27-39.

Archaeofauna 34(1) (2025): 389-396

Collection and modification of *Glycymeris* shells during the Bronze Age. A case study from Larda I and Larda II (Rovigo, North-eastern Italy)

Raccolta e lavorazione delle conchiglie di *Glycymeris* nell’Età del Bronzo. Il caso studio di Larda I e Larda II (Rovigo, Italia nord-orientale)

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ABSTRACT: The Palaeolithic saw the first use of marine molluscs as ornaments, representing one of humankind’s first forms of symbolic material culture.

The earliest evidence of a deliberate collection of *Glycymeris* shells as ornaments comes from Middle Paleolithic sites. This trend is well documented during the Upper Paleolithic, becoming particularly widespread in the late prehistoric contexts of Northern Italy.

This study aims at investigating the modalities of collection, modification and use of perforated *Glycymeris* shells from the Bronze Age sites of Larda I and Larda II, in the eastern area of Polesine (southern Veneto).

Taphonomic analyses carried out on the shell assemblages allowed us to identify a natural origin for almost the totality of the holes, suggesting opportunistic exploitation of naturally perforated shells.

KEYWORDS: SHELLS, BRONZE AGE, GLYCYMERIS, ORNAMENTS, MANUFACTURING

RIASSUNTO: L’utilizzo ornamentale delle conchiglie marine è documentato a partire dal Paleolitico, costituendo una delle più antiche forme di comportamento simbolico.

Le prime evidenze della raccolta di conchiglie appartenenti al genere *Glycymeris*, per la realizzazione di oggetti ornamentali o simbolici, risalgono al Paleolitico medio. Questa tendenza si consolida nel corso del Paleolitico superiore ed è particolarmente frequente nei contesti protostorici dell’Italia settentrionale.

Il presente lavoro si propone di indagare le modalità di raccolta, lavorazione e utilizzo delle conchiglie forate rinvenute nei siti dell’Età del Bronzo di Larda I e Larda II, situati nel Polesine orientale (Veneto meridionale).

L’analisi tafonomica ha permesso di riconoscere un’origine naturale per la quasi totalità dei fori, suggerendo uno sfruttamento opportunistico di esemplari naturalmente forati in corrispondenza dell’umbone.

PAROLE CHIAVE: MALACOFAUNA, ETÀ DEL BRONZO, GLYCYMERIS, ORNAMENTI, LAVORAZIONE

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INTRODUCTION

The exploitation of seashells to be used as decoration form an integral part of modern humans' material culture. This tradition starts with the Palaeolithic and continues throughout the Holocene, improving the processing techniques, and giving rise to new trends.

A modest collection and use of shells belonging to the genus *Glycymeris* is well documented in Mediterranean, Near Eastern and Atlantic archaeological sites since the Middle Palaeolithic (Sivan *et al*., 2006; Bar-Yosef Mayer, 2007; Bar-Yosef Mayer *et al*., 2009; Colonese *et al*., 2011; Douka, 2011; Bosch *et al*., 2015; Cabral & Martins, 2016). However, it was during the Early Bronze Age that they occurred in large quantities.

Valves of *Glycymeris* played a multi-functional role during Prehistory: not only they were used for decoration purposes (i.e., pendants or bracelets), but they also served as functional tools (i.e., containers for dye, scrapers, burnishing tools for pottery decoration, filling material for floor foundations, temper in pottery) (Cabral & Martins, 2016).

The use of *Glycymeris* valves for ornament production represents a real trend in northern Italy during the Bronze Age. *Glycymeris* shells are very common in sandy bottoms of the Adriatic Sea, where sometimes they can be found very beach worn and already holed at the umbo due to marine abrasion. Human groups from northern Italy usually collected naturally perforated valves as ready-to-use ornaments, allowing an easier suspension of the shells with no need for anthropic intervention (Del Lucchese, 1984; Bernabò Brea & Cremaschi, 2004; Miari *et al*., 2009).

The present paper focuses on taphonomic and techno-functional analyses conducted on perforated *Glycymeris* valves retrieved in the Bronze Age sites of Larda I and Larda II, in north-eastern Italy. This study contributes to reconstructing new strategies of shell exploitation adopted by Bronze Age people, shedding light on shared trends and trading networks developed in a period marked by vast changes in technology and social organisation.

THE SETTLEMENTS

The discovery of Middle and Recent Bronze Age settlements like Larda I and Larda II provided a wealth of information concerning the social and economic organisation of the territory between the Adriatic Sea and the Valli Grandi Veronesi (Bellintani, 2000; Peretto & Salzani, 2004; Mischiatti *et al*., 2011).

These sites both lie on small higher ground zones within a low wet area. They are situated in the locality of "Larda", not far from the present town of Gavello, about 15 km south-east of Rovigo (Bellintani, 2000; Peretto & Salzani, 2004; Mischiatti *et al*., 2011). They are located along the main rivers of northern Italy such as the palaeo-Po ("Po di Adria"), its tributary, the Tartaro River, and the northern branch of the Po River, which have suffered important hydrographic changes during the Holocene (Veggiani, 1972; Marcolongo & Zaffanella, 1987; Piovan, 2008; Piovan *et al*., 2010). The site of Larda I was interpreted as a village endowed with a bank. The field excavations (1998-1999 and 2002-2004) highlighted two main settlement stages, dated between the Middle and the Recent Bronze Age (Peretto & Salzani, 2004).

Larda II is located only a few hundred metres west of Larda I. During rescue excavations (2006-2007) two different settlement phases were recognized for the Late Bronze Age I (Mischiatti *et al*., 2011). From a typological point of view, the potsherds found in the two sites reveal a correlation with the sub-Apennine facies rather than the "Terramare" culture (Mischiatti *et al*., 2011; Peretto & Salzani, 2004).

The faunal assemblages from both sites are characterised by the predominance of domestic animals (83.1%) over the wild. The zooarchaeological record shows significant percentages of goat, sheep and pig remains, which implies an important agro pastoral component of the economy, including the exploitation of both primary and secondary products (Bertolini & Thun Hohenstein, 2016). The economy of the meat resources is similar to that of known sites in the region, with the majority of domestic share supplemented by the consumption of red deer, roe deer and wild boars. Other species, such as fish, birds and pond tortoises, were also regularly consumed in smaller numbers.

Rich malacological assemblages were found in the Bronze Age deposits during different field campaigns (1999, 2003, 2006 and 2007). Among the most abundant molluscs are *Unio*, a very common genus of medium-sized freshwater mussels, and *Glycymeris*, a genus of saltwater clams, of which the primary species identified in the archaeological record include *G. nummaria*.

MATERIALS AND METHODS

A systematic study of marine mollusc remains has examined a total of 177 remains, which have been identified at the lowest possible taxonomic level (Table 1). On a total of 144 identified *Glycymeris* remains (81.4%), 18.1% are perforated (LI = NISP 21; LII = NISP 5).

Malacological remains were quantified using standard zooarchaeological methods: to estimate the abundance of each species, we calculated the Number of Identified Specimens (NISP) and the Minimum Number of Individuals (MNI), which served as a proxy for biomass (Chaix & Méniel, 1996). MNI calculations were achieved according to the combination method (Chaplin, 1971): the frequency of Non-Repetitive Elements (NREs) is combined with laterality, morphology, size and age differences. For bivalves, pair-matching is included in MNI estimates by adding unpaired left and right elements and subtracting the number of matched pairs. For example, if the MNI count was three lefts and four rights, and no match can be established between pairs due to symmetry, the MNI would be estimated as follows: three unpaired left valves + four unpaired right valves = MNI of seven, rather than the traditional MNI count of four, taken from the maximum NRE given by the right side (Poplin, 1976). Refitting exercises were carried out to match pairs of left and right valves that might represent the same individuals. Fragments for which side could not be determined were not included in the final MNI. count.

A comparison between archaeological and modern dead specimens accumulated on beaches, retrieved in the vicinity of Larda (50 km ca.), allowed us to identify the origin of perforations (natural *vs* man-made holes).

	LARDA I			**LARDA II**		
TAXA	**NISP**	**%NISP**	**MNI**	**NISP**	**%NISP**	**MNI**
BIVALVIA						
Glycymeris nummaria	95	57.6	94 (50)	3	25	3 (2)
Glycymeris sp.	36	21.8	26 (16)	8	66.7	2 (2)
Glycymeris glycymeris	2	1.2	2 (2)	-	-	-
Arca noae	1	0.6	1 (1)	-	-	-
Chamelea gallina	2	1.2	1 (1)	-	-	-
Cerastoderma glaucum	9	5.5	9 (6)	-	-	-
Acanthocardia tuberculata	2	1.2	1 (1)	-	-	-
Pinna nobilis	1	0.6	1 (1)	-	-	-
Mactra stultorum	3	1.8	2 (2)	-	-	-
Pecten sp.	1	0.6	1 (1)	-	-	-
Flexopecten glaber	2	1.2	2 (2)	-	-	-
GASTROPODA						
Bolinus brandaris	7	4.2	7	1	8.3	1
Cerithium vulgatum	3	1.8	3	-	-	-
CEPHALOPODA						
Sepia sp.	1	0.6	1	-	-	-
TOTAL	**165**	**100**	**145 (94)**	**12**	**100**	**6 (5)**

TABLE 1

Taxonomic composition (NISP and MNI) of the marine shell assemblages from Larda I and Larda II. Traditional MNI estimates are reported in parentheses.

Holes were observed at both low and high magnification. We used a stereomicroscope Leica S6D Greenough (magnification ranging from 0.75x to 70x), also employed for capturing images (camera EC3). Some transparent positive replicas made by casting epoxy resin (Araldite ® LY554, Hardener HY956) in the mold (Provil Novo ® Fast Light Set, Heraeus Kulzer) were observed with a Scanning Electron Microscope (SEM Zeiss EVO 40) to better identify technological and use-wear traces around the holes. Diffused surface modifications due to post-depositional processes, such as decalcification, prevented the traceological analysis of a total of seven perforated valves.

A morphometric description of the perforations was achieved by measuring the diameter and height of the hole, following Bar-Yosef *et al*. (2009).

The main morphological types of perforations were identified according to the typological classifications established by Cabral & Martins (2006).

RESULTS AND DISCUSSION

All the perforated *Glycymeris* bear a hole at the umbo. Table 2 includes more detailed information about perforations. Apart from three exceptions, none of the analysed shells shows detectable signs of human intervention, suggesting that the umbo holed by natural processes of abrasion (LI, 71.4%; LII, 60%) (Figure 1). This is a very common mechanic process that affects the most prominent regions of the valves.

Human groups from Larda I and II must have reached the coast a few dozen kilometres from the sites to collect the valves. The shells were likely collected dead on the foreshore and do not probably derive from recycling previously consumed molluscs.

As observed from the reference collection, the most distinctive features of naturally perforated umbos are their flat baseline, regularity, and diffused smoothing developed around the margins. Moreover, holes caused by natural processes of abrasion are usually associated with a general worn appearance of the shell.

Two different perforation techniques were identified for human-made holes at Larda I: (1) abrasion, suggested by the presence of parallel striations located in the hole region (Figure 2 A-B); and (2) indirect percussion from the internal part of the valve, most likely using an anvil as support. The latter is mainly proved by the presence of very irregular margins associated with external detachments. The use-wear analysis allowed us to identify modifications related to the suspension of the valves.

The presence of lateral notches and polished areas observed around the holes can easily be interpreted as evidence of friction from a string, suggesting that several valves were suspended for ornamental purposes. Some shells show signs of pronounced use-wear on the lower margin of the perforation, which may indicate the existence of a cord attaching the shells around the hinge (Figure 2 C-D).

No evidence of accidental breakage due to the very prolonged use of the ornaments was noted. The ratio between perforated and unperforated *Glycymeris* valves is quite different at the two sites, indicating a higher proportion of perforated shells at Larda II (45.5%), while only 15.8% of *Glycymeris* valves are perforated at Larda I (Figure 3). The presence of both perforated and unperforated shells belonging to the same species may suggest that only part of the collected valves served as decoration. It is therefore possible to hypothesise that non-perforated valves were considered as a stockpiling of materials waiting for processing.

Concerning the metrical data, we measured the holes in the Larda *Glycymeris* valves and found that natural holes are within the same size range as the anthropic perforations. A complete information set of the entire sample is presented in Table 2.

Finally, it was noted that three natural perforations were further enlarged by means of pointed and/or sharp-edged instruments.

CONCLUSION

The predominance of regular, smooth holes with flat baselines indicates that most of the *Glycymeris* valves retrieved at both Larda sites were collected already dead from nearby sandy beaches, where their umbos were already holed due to natural abrasion. This reveals opportunistic exploitation of naturally perforated shells aimed at the suspension of the valves without the need for a consuming procedure. Only a few specimens show clear signs of human activity on the umbonal region of the shell, indicating the will to imitate natural holes, both in shape and localization.

ID	Site	Level	Species	Diameter (mm)	Height (mm)	Morphology	Margin (profile)	Type (Cabral & Martins, 2006)	Detachments	Hole origin
3	Larda I	102A	*Glycymeris* sp.	3.8	2.3	Sub-circular	Irregular	D18	NO	Natural
312	Larda I	300	*Glycymeris nummaria*.	3.5	2.9	Circular	Irregular	D16	NO	Natural
74	Larda I	103	*Glycymeris nummaria*	3.8	2.6	Circular	Irregular	D16	NO	Natural
208	Larda I	104	*Glycymeris nummaria*	3.7	3.2	Circular	Irregular (above)+rounded (below)	D16	NO	Natural
207	Larda I	104	*Glycymeris nummaria*	4.7	3.3	Circular	Irregular (above)+rounded (below)	D16	NO	Natural
179	Larda I	104	*Glycymeris nummaria*	5.1	3.9	Circular	Irregular (above)+rounded (below)	D16	NO	Natural
176	Larda I	104	*Glycymeris nummaria*	6.1	6.4	Irregular	Irregular (above)+rounded (below)	-	NO	Natural (further enlarged)
177	Larda I	104	*Glycymeris nummaria*	6.7	4	Elongated	Rounded	D06	NO	Natural
178	Larda I	104	*Glycymeris* sp.	3.5	2.5	Elongated	Rounded	D06	NO	Natural
175	Larda I	104	*Glycymeris* sp.	5.9	3.5	Elongated	Rounded	D05	NO	Natural
180	Larda I	104	*Glycymeris nummaria*	7.1	4.6	Elongated	Rounded	D06	NO	Natural
213	Larda I	104	*Glycymeris nummaria*	6.1	3	Elongated	Irregular (above)+rounded (below)	D15	NO	Natural
101	Larda I	104	*Glycymeris nummaria*	3.5	2	Elongated	Not identified	D06	NO	Natural
189	Larda I	104	*Glycymeris nummaria*	1.8	1.1	Elongated	Exfoliated	D03	NO	Natural
60	Larda I	103	*Glycymeris nummaria*	3.1	4.3	Irregular	Rounded	D18	NO	Natural (further enlarged)
338	Larda I	216	*Glycymeris* sp.	4.1	6.2	Irregular	Irregular	-	YES	Anthropic (percussion)
314	Larda I	202	*Glycymeris nummaria*	4.6	4.9	Irregular	Irregular	D18	YES	Anthropic (percussion)
194	Larda I	104	*Glycymeris* sp.	5.9	2.8	Elongated	Exfoliated	D06	NO	Natural
339	Larda I	216	*Glycymeris* sp.	2.8	1.8	Irregular	Exfoliated	-	NO	-
93	Larda I	103	*Glycymeris glycymeris*	2.7	2.2	Circular	Exfoliated	D16	NO	Natural
375	Larda I	104	*Glycymeris nummaria*	3.4	3.4	Circular	Rounded	D16	NO	Anthropic (abrasion)
758	Larda II	132	*Glycymeris* sp.	4.4	2.8	Elongated	Irregular (above)+rounded (below)	D12	NO	Natural
158	Larda II	66 A/B	*Glycymeris* sp.	6	4.9	Sub-circular	Exfoliated	D04	NO	Natural
875	Larda II	303	*Glycymeris nummaria*	2.2	2.8	Circular	Irregular	-	NO	-
312	Larda II	303	*Glycymeris* sp.	4.8	2.6	Elongated	Exfoliated	D08	NO	Natural
1124	Larda II	510	*Glycymeris nummaria*	5	5.8	Irregular	Irregular	-	NO	Natural (further enlarged)

TABLE 2

Specific features of Larda I and Larda II *Glycymeris* shells by level.

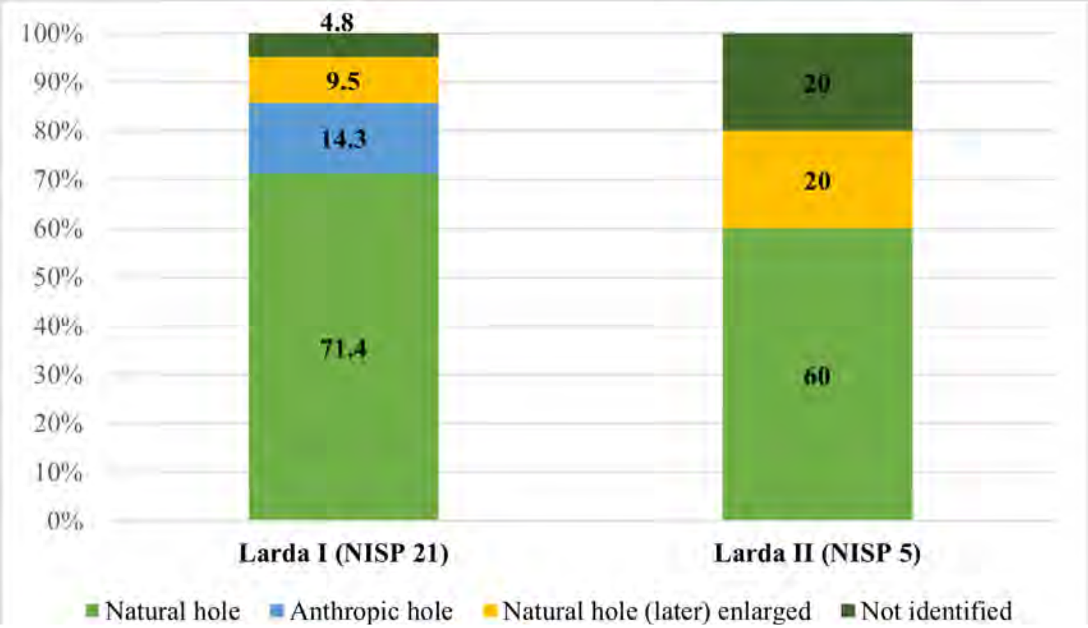

FIGURE 1

Origin of perforations at the umbo of *Glycymeris* from Larda I and Larda II.

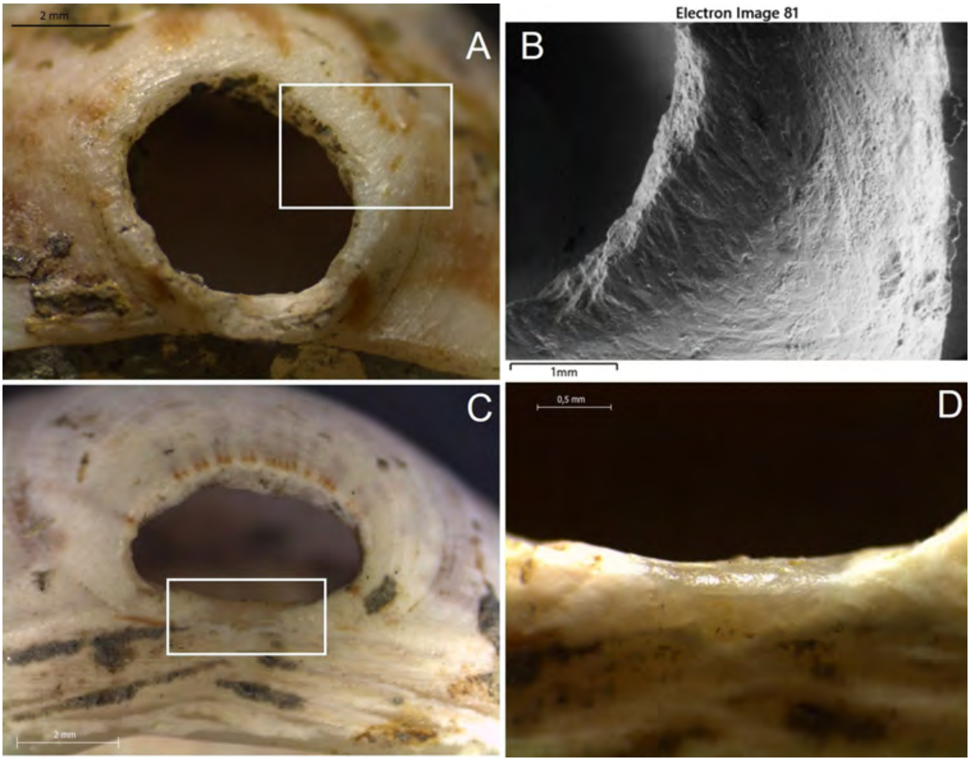

FIGURE 2

G. nummaria (ID:375) anthropic hole made by abrasion (A), SEM images allow the identification of parallel striations around the hole (B), *G. nummaria* (ID: 213) naturally perforated (C) and details of use-wear traces on the lower margin of the perforation (D). Specimens from Larda I.

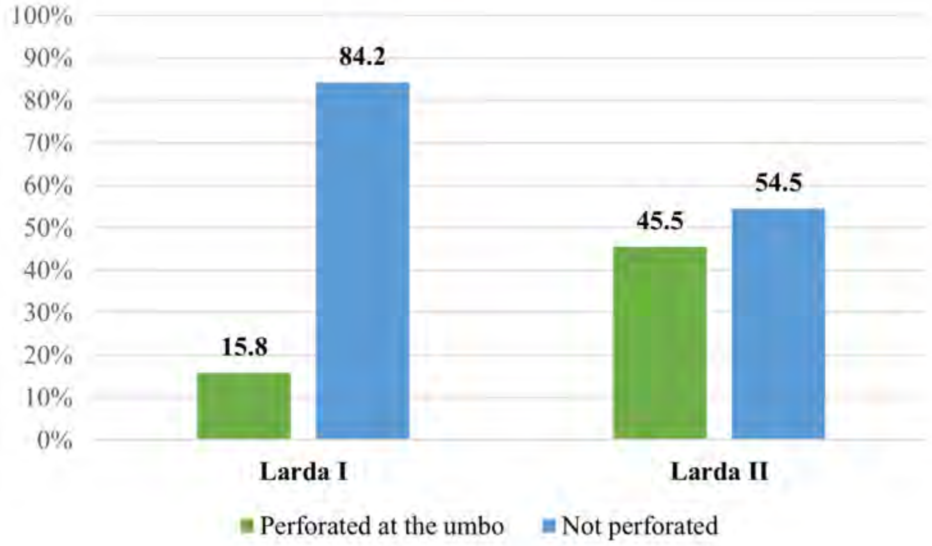

FIGURE 3

%NISP of perforated and unperforated *Glycymeris* shells at Larda I and Larda II.

It was concluded that human groups from Larda I and Larda II have widely exploited marine resources for symbolic purposes, suggesting a strong relationship between local settlements with both the rivers and the coastline that surrounded the sites.

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REFERENCES

Bar-Yosef Mayer, D.E. 2007: Archaeomalacology research in Israel: the current state of research. *Israel Journal of Earth Sciences* 56: 191-206.

Bar-Yosef Mayer, D.E.; Vandermeersh, B. & Bar-Yosef, O. 2009: Shells and ochre in Middle Paleolithic Qafzeh Cave, Israel: indications for modern behaviour. *Journal of Human Evolution* 56: 307-314. DOI: http://doi.org/10.1016/j.jhevol.2008.10.005.

Bellintani, P. 2000: Il medio Polesine tra la tarda Età del Bronzo e l'inizio dell'Età del Ferro. In: Harari, M. & Pearce, M. (eds.): *Il Protovillanoviano al di qua e al di là dell'Appennino*: 47-84. Atti della giornata di Studio, Pavia, Collegio Ghislieri, 17 giugno 1995. Editions New Press, Como.

Bernabò Brea, M.A. & Cremaschi, M. 2004: *Il Villaggio Piccolo della Terramara di Santa Rosa di Poviglio. Scavi 1987- 1992*. Istituto Italiano di Preistoria e Protostoria, Firenze.

Bertolini, M. & Thun Hohenstein, U. 2016: Management and exploitation of animal resources during the Bronze Age in Polesine: recent excavations at Larda and Campestrin (Rovigo). In: Thun Hohenstein, U.; Cangemi, M.; Fiore, I. & De Grossi Mazzorin, J. (eds.): *Atti del 7° Convegno Nazionale di Archeozoologia:* 93-102. Ferrara 22-23 novembre 2012. Annali dell'Università degli Studi di Ferrara, Museologia Scientifica e Naturalistica, 12/1.

Bosch, M.D.; Wesselingh, F.P. & Mannino, M.A. 2015: The Ksâr 'Akil (Lebanon) mollusc assemblage: zooarchaeological and taphonomic investigations. *Quaternary International* 390: 85-101. DOI: https://doi.org/10.1016/j.quaint.2015.07.004.

Cabral, J.P. & Martins, J.M.S. 2016: Archaeological *Glycymeris glycymeris* shells perforated at the umbo: Natural or man-made holes? *Journal of Archaeological Science: Reports* 10: 474-482. DOI: http://dx.doi.org/10.1016/j.jasrep.2016.11.008.

CHAIX, L. & MÉNIEL, P. 1996: Éléments *d'archéozoologie*. Éditions Errance, Paris.

CHAPLIN, R. 1971: *The study of animal bones from archaeological sites*. Seminar Press, New York.

COLONESE, A.C.; MANNINO, M.A.; BAR-YOSEF MAYER, D.E.; FA, D.A.; FINLAYSON, J.C.; LUBELL, D. & STINER, M.C. 2011: Marine mollusc exploitation in Mediterranean prehistory: an overview. *Quaternary International* 239: 86–103. DOI: https://doi.org/10.1016/j.quaint.2010.09.001.

DEL LUCCHESE, A. 1984: Resti di sepolture dell'Antica Età del Bronzo nella Caverna dell'Acqua o del Morto (Finale Ligure - SV). *Preistoria alpina* 20: 155-168.

DOUKA, K. 2011: An Upper Paleolithic shell scraper from Ksar Akil (Lebanon). *Journal of Archaeological Science* 38: 429-437. DOI: https://doi.org/10.1016/j.jas.2010.09.026.

MARCOLONGO, B. & ZAFFANELLA, G.C. 1987: Evoluzione paleogeografica della pianura veneta atesino-padana. *Athesia* 1: 31-67.

MIARI, M.; VALLI, E.; BAZZOCCHI, M.; BESTETTI, F.; DEL GATTO, L.; MAZZANTI, C.; PADONELLO, S. & TAGLIANI, L. 2009: L'insediamento del Bronzo antico di Cattolica (RN). Notizie preliminari. *IpoTESI Di Preistoria* 2: 37–74. DOI: https://doi.org/10.6092/issn.1974-7985/1597.

MISCHIATTI, F.; MARITAN, L.; MAZZOLI, C.; SALZANI, L. & SARACINO, M. 2011: Analisi tipologica e archeometrica degli elementi di presa dell'abitato di Larda 2 di Gavello (RO). *Padusa* XLVII: 7-50.

PERETTO, R. & SALZANI, L. 2004: Prime indagini nel sito di Larda di Gavello (Rovigo). In: Cocchi Genick, D. (ed): *L'età del Bronzo recente in Italia:* 520-521. Atti del congresso nazionale di Lido di Camaiore, 26-29 ottobre 2000, Lucca.

PIOVAN, S. 2008: *Evoluzione paleoidrografica della pianura veneta meridionale e rapporto Uomo-Ambiente nell'Olocene*. Dipartimento di Geografia "G. Morandini", Università di Padova, Padova.

PIOVAN, S.; MOZZI, P. & STEFANI, C. 2010: Bronze Age Paleohydrography of the Southern Venetian Plain. *Geoarchaeology: An International Journal* 25: 6-35.

POPLIN, F. 1976: A propos du Nombre de Restes et du Nombre d'Individus dans les échantillons d'ossements. *Cahiers du centre de recherches préhistoriques de l'université de Paris* I(5): 61-74.

SIVAN, D.; POTASMAN, M.; ALMOGI-LABIN, A.; BAR-YOSEF MAYER, D.E.; SPANIER, E. & BOARETTO, E. 2006: The *Glycymeris* query along the coast and shallow shelf of Israel, Southeast Mediterranean. *Palaeogeography, Palaeoclimatology, Palaeoecology* 233: 134-148. DOI: https://doi.org/10.1016/j.palaeo.2005.09.018.

VEGGIANI, A. 1972: Il ramo del Po di Adria nella tarda età del Bronzo. *Padusa* III-IV: 123-136.

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Gli uccelli a Shahr-I Sokhta (Iran): buoni da mangiare, buoni per lavorare

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RIASSUNTO: Nell'ambito del nuovo progetto MAIPS (Multidisciplinary Archaeological Italian Project at Shahr-I Sokhta) che dal 2017 vede coinvolta l'Università del Salento in collaborazione con l'Iranian Center for Archaeological Research (ICAR), le recenti analisi archeozoologiche hanno permesso di rilevare un importante ruolo degli uccelli nell'economia del sito durante l'Età del Bronzo.

Sebbene l'apporto alimentare risulti essere marginale, con la presenza prevalente della folaga (*Fulica atra*), del moriglione (*Aythia ferina*) e di vari Anseriformi, le ossa lunghe dei grandi uccelli a Shahr-i Sokhta venivano utilizzate nella produzione di particolari strumenti dalla forma allungata e dalle estremità appuntite o arrotondate, rinvenuti sia in ambito urbano che funerario, identificati come *versatoi* e il cui utilizzo potrebbe essere legato alla sfera della decorazione vascolare. Il rinvenimento non solo degli strumenti, ma anche degli scarti di lavorazione, ci permette di approfondire l'aspetto legato alle tecniche di produzione di questi strumenti.

Il rinvenimento in contesto urbano di ossa di cormorano (*Phalacrocorax carbo*), una specie di uccello non commestibile, permette inoltre di ipotizzare una rudimentale domesticazione dell'animale, utilizzato per le attività di pesca dagli abitanti di Shahr-I Sokhta nei bassi fondali del delta del fiume Helmand.

PAROLE CHIAVE: SHAHR-I SOKHTA, ETÀ DEL BRONZO, VERSATOI, STRUMENTI IN OSSO, CORMORANO

ABSTRACT: As part of the new MAIPS project (Multidisciplinary Archaeological Italian Project at Shahr-I Sokhta) which, since 2017, has involved the University of Salento in collaboration with the Iranian Center for Archaeological Research (ICAR), recent archaeozoological analyzes have detected an important role of birds in the economy of Shahr-I Sokhta during the Bronze Age.

Although the food supply is marginal, with the prevalent presence of the coot (*Fulica atra*), the pochard (*Aythia ferina*) and various Anseriformes, the long bones of large birds were used in the production of particular tools characterized by an elongated shape and pointed or rounded ends. They were found in both urban and funerary contexts and are identified as *pouring sticks*. Their use could be linked to the pottery decoration. The discovery of these bone tools and the identification of particular working marks on other bird remains that can be interpreted as processing waste allowed us to understand all aspects related to the working process.

Of interest is also the discovery of cormorant (*Phalacrocorax carbo*) bones in domestic contexts. The meat of this bird species is not good to eat, but their exploitation could suggest a rudimentary domestication of the animal by the inhabitants of Shahr-I Sokhta, maybe due to fishing activities in the shallow waters of the Helmand River delta.

KEYWORDS: SHAHR-I SOKHTA, BRONZE AGE, POURING STICK, BONE TOOLS, CORMORANT

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INTRODUZIONE

L'insediamento di Shahr-I Sokhta, la *"città bruciata"* che sorge alla foce dell'antico corso del fiume Helmand in Iran sudorientale, a pochi Km dal confine con Pakistan e Afghanistan, è stato oggetto di importanti scavi tra il 1967 e il 1978, ad opera dell'ISMEO. Dal 2017, la collaborazione tra Italia e Iran sul sito è stata rinnovata con la creazione del progetto MAIPS, un'indagine di studio multidisciplinare che coinvolge: Ministero Italiano degli Affari Esteri e della cooperazione Internazionale; Università del Salento; R.I.C.H.T., Research Institute of Cultural Heritage and Tourism; I.C.A.R., Iranian Center for Archaeological Research (Ascalone, 2019).

Il sito, considerato il principale snodo commerciale del sudest iranico tra la fine del IV e gli inizi del II millennio a.C., è stato oggetto sin da subito di indagini archeozoologiche approfondite (Caloi & Compagnoni, 1977; Bökönyi & Bartosiewicz, 2000; Minniti, 2019; Potenza & Minniti, 2022) e, nell'ambito del progetto MAIPS, le nuove ricerche stanno fornendo interessanti dati circa il ruolo degli animali all'interno della comunità di Shahr-i Sokhta[1].

Un ruolo importante era sicuramente detenuto dagli uccelli, che non solo completavano l'alimentazione animale in un'economia di allevamento basata principalmente sullo sfruttamento di bovini e ovicaprini, ma che venivano utilizzati anche in attività produttive.

I nuovi dati integrano e implementano i principali studi sull'avifauna di Shahr-i Sokhta (Cassoli, 1977; Cassoli *et al*., 2013; Gala & Tagliacozzo, 2014). Le più recenti ricerche sono incentrate sullo studio dell'avifauna rinvenuta all'interno di due aree specifiche dell'insediamento di Shahr-i Sokhta: il Workshop 33 (Ascalone & Sajjadi, 2019, 2022), scavato dalla missione archeologica italiana nel progetto MAIPS a partire dal 2017 e ad oggi in corso di indagine, e il Building 1, scavato agli inizi del ventunesimo secolo dalla missione archeologica iraniana (Sajjadi & Moradi, 2015). I due edifici si trovano nella zona residenziale nord-orientale dell'intera area archeologica.

MATERIALI E METODI

Nello studio dell'avifauna proveniente dal Workshop 33 e dal Building 1 sono stati identificati, laddove possibile, i resti di tutti gli uccelli rinvenuti. Per la determinazione delle specie è stata utilizzata la collezione di confronto presente all'interno del Laboratorio di Archeozoologia dell'Università del Salento (LaZUS), integrandola con le indicazioni dei manuali di riferimento (Cohen & Serjeantson, 2015). Per la quantificazione dei resti e per un'esaustiva determinazione dell'avifauna a Shahr-i Sokhta, sono state riprese le tabelle dei precedenti studi (Gala & Tagliacozzo, 2014).

Nello studio dei versatoi, successivamente alla determinazione della porzione ossea si è proceduto all'individuazione, laddove possibile, delle tracce di produzione e di uso. Queste sono state fotografate con microscopio digitale *RoHS* a risoluzione ottimale di 640x480 pixel e a risoluzione massima di 500X. Le tracce individuate sono state determinate e classificate in base alla tipologia di intervento sull'osso: tracce di produzione; abrasioni; tracce d'uso; rosicchiature (De Grossi Mazzorin, 2008).

RISULTATI

Le nuove ricerche hanno permesso di determinare complessivamente 91 resti riferibili ad avifauna: 33 resti, pari al 4% dell'intero campione faunistico determinato, provengono dal Workshop 33 (Tabella 1); 58 resti (1,5% del campione) provengono dal Building 1 (Tabella 2). In tutte le fasi di occupazione del sito gli uccelli hanno completato la dieta delle popolazioni locali: il rinvenimento dei loro resti ossei in ambiente urbano lascia ipotizzare che la caccia all'avifauna avesse uno scopo prevalentemente alimentare. La folaga (*Fulica atra*) e in generale gli anseriformi, insieme al moriglione (*Aythya ferina*), risultano essere sempre le specie più rappresentate.

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[1] Si veda, all'interno del presente volume, il contributo: Potenza A., *Economia di sussistenza nel sudest iraniano tra IV e II millennio a.C. Nuovi dati archeozoologici da Shahr-I Sokhta (Iran) nell'ambito del progetto MAIPS*, presentato con comunicazione orale al X Convegno AIAZ, Siena 3-6 Novembre 2021. E' inoltre in corso il Progetto di ricerca dell'autore del presente contributo, presso l'Università del Salento, nell'ambito del Dottorato in Scienze del Patrimonio Culturale, XXXV Ciclo, dal titolo *"Lo studio dei resti animali di Shahr-i Sokhta per una ricostruzione dell'economia primaria in Asia centrale tra la metà del IV e la fine del III millennio a.C."*.

Workshop 33	**Periodo II**		**Periodo III**	**Tot.**	**%**
Uccelli	**Fase 6**	**Fase 5**	**4-3**		
Oca selvatica - *Anser anser*		1		1	3,03
Moriglione . *Aythya ferina*	7	5	2	14	42,42
Cormorano - *Phalacrocorax carbo*	1			1	3,03
Pellicano - *Pelecanus crispus*		1		1	3,03
Airone cenerino - *Ardea cinerea*	1			1	3,03
Folaga - *Fulica atra*	9	2	2	13	39,39
Aves sp.			2	2	6,06
TOT.	**18**	**9**	**6**	**33**	**100,00**

TABELLA 1
Shahr-i Sokhta, Workshop 33: resti di uccelli divisi per fase.

Building 1	**Periodo II**		**II-III**	**Periodo III**		**Tot.**	**%**
Uccelli	**Fase 6**	**Fase 5**		**4-3**	**Fase 2**		
Oca selvatica - *Anser anser*		1		1	2	4	5,17
Oca indiana - *Anser indicus*		4	2	2	1	9	17,24
Cigno - *Cignus olor*			1	1	4	6	10,34
Moriglione . *Aythya ferina*	2	1	2	1	3	9	15,52
Anas sp.		1				1	1,72
Cormorano - *Phalacrocorax carbo*			1	1	1	3	5,17
Pellicano - *Pelecanus crispus*	1					1	1,72
Airone cenerino - *Ardea cinerea*	1		1	3		5	8,62
Avvoltoio monaco - *Aegypius monachus*				1		1	1,72
Folaga - *Fulica atra*		1	3	7	2	13	22,41
Aves sp.		1	1	4		6	10,34
TOT.	**4**	**9**	**11**	**21**	**13**	**58**	**100,00**

TABELLA 2
Shahr-i Sokhta, Building 1: resti di uccelli divisi per fase.

Nella totalità del campione faunistico rinvenuto nelle precedenti campagne di scavo (Tabella 3), si può notare una enorme varietà di specie faunistiche: la maggioranza di queste specie, a carattere migratorio, è tipica di ambienti lagunari e palustri, esattamente in linea con le caratteristiche ambientali del delta del fiume Helmand durante il III millennio a.C.

Il rinvenimento di frammenti ossei di specie non commestibili come pelicaniformi, suliformi e accipitriformi, suggerisce invece uno sfruttamento più ampio dell'avifauna, rivolto anche ad altre attività di tipo produttivo. Tale ipotesi è avvalorata dal rinvenimento di alcuni tagli netti e profondi all'altezza delle estremità di ossa lunghe (principalmente l'ulna) di uccelli dalle dimensioni notevoli, quali avvoltoio, pellicano e cigno (Figura 1): la porzione diafisaria diveniva la parte ossea utilizzata per la produzione di strumenti, mentre le epifisi venivano scartate. Si ottenevano così dei versatoi, strumenti lunghi e cavi, dalla sezione semicircolare, con estremità che potevano essere appuntite o arrotondate (Figure 2).

Avifauna rinvenuta a Shahr-i Sokhta nelle diverse fasi di occupazione (da Cassoli, 1977; Gala & Tagliacozzo, 2014)			
Anseriformi (926; 32,51%)			
Anser albifrons	Oca lombardella (7)	*Anas clypeata*	Mestolone (3)
Anser anser	**Oca selvatica** (29)	*Netta rufina*	Fistione turco (31)
Anser indicus	**Oca indiana** (129)	***Aythya ferina***	**Moriglione** (482)
Cignus olor	**Cigno reale** (23)	*Aythya nyroca*	Moretta tabaccata (52)
Nettapus coromandelianus	Oca pigmea (16)	*Aythya fuligula*	Moretta eurasiatica (27)
Aix galericulata	Anatra mandarina (116)	*Melanitta* cf. *nigra*	Orchetto marino (1)
Anas platyrhynchos	Germano reale (8)	*Mergellus albellus*	Pesciaiola (2)
Galliformi (15; 0,52%)			
Ammoperdix griseogularis	Pernice gola grigia (15)		
Podicipediformi (25; 0,87%)			
Tachybaptus ruficollis	Tuffetto (5)	*Podiceps nigricollis*	Svasso piccolo (4)
Podiceps cristatus	Svasso maggiore (16)		
Fenicotteriformi (1; 0,03%)			
Phoenicopterus roseus	Fenicottero rosa (1)		
Suliformi (76; 2,75%)			
Phalacrocorax carbo	**Cormorano** (68)	*Phalacrocorax pygmaeus*	Cormorano pigmeo (1)
Phalacrocorax nigrogularis	Cormorano Socotra (7)		
Pelicaniformi (23; 0,81%)			
Pelecanus* cf. *crispus	**Pellicano crespo** (17)	***Ardea cinerea***	**Airone cenerino** (6)
Accipitriformi (27; 0,94%)			
Milvus migrans	Nibbio bruno (10)	*Aquila nipalensis*	Aquila delle steppe (2)
Aegypius monachus	**Avvoltoio monaco** (9)	*Aquila heliaca*	Aquila imperiale orientale (4)
Accipiter nisus	Sparviero (1)	*Aquila chrysaetos*	Aquila reale (1)
Otidiformi (1; 0,03%)			
Chlamydotis macqueenii	Ubara asiatica (1)		
Gruiformi (1752; 61,23%)			
Amaurornis phoenicurus	Gallinella petto bianco (1)	*Grus leucogeranus*	Gru siberiana (2)
Porphyrio porphyrio	Pollo sultano (2)	*Grus grus*	Gru cenerina (12)
Fulica atra	**Folaga** (1735)		
Pterocliformi (2; 0,07%)			
Pterocles senegallus	Grandule di Senegal (1)	*Pterocles orientalis*	Ganga (1)
Columbiformi (4; 0,14%)			
Columba livia	Piccione selvatico (3)	*Streptopelia orientalis*	Tortora orientale (1)
Piciformi (1; 0,03%)			
Picus viridis	Picchio verde (1)		
Passeriformi (2; 0,07%)			
Corvus corax	Corvo imperiale (1)	*Hirundo rustica*	Rondine comune (1)
TOTALE: 2875; 100,00%			

TABELLA 3

Elenco delle specie di uccelli rinvenuti a Shahr-i Sokhta durante le precedenti campagne di scavo (da Gala & Tagliacozzo 2014: 322-323, tab. 1. Tra parentesi il numero dei resti e le percentuali di rinvenimento; in grassetto le specie rinvenute nel Workshop 33 e nel Building 1).

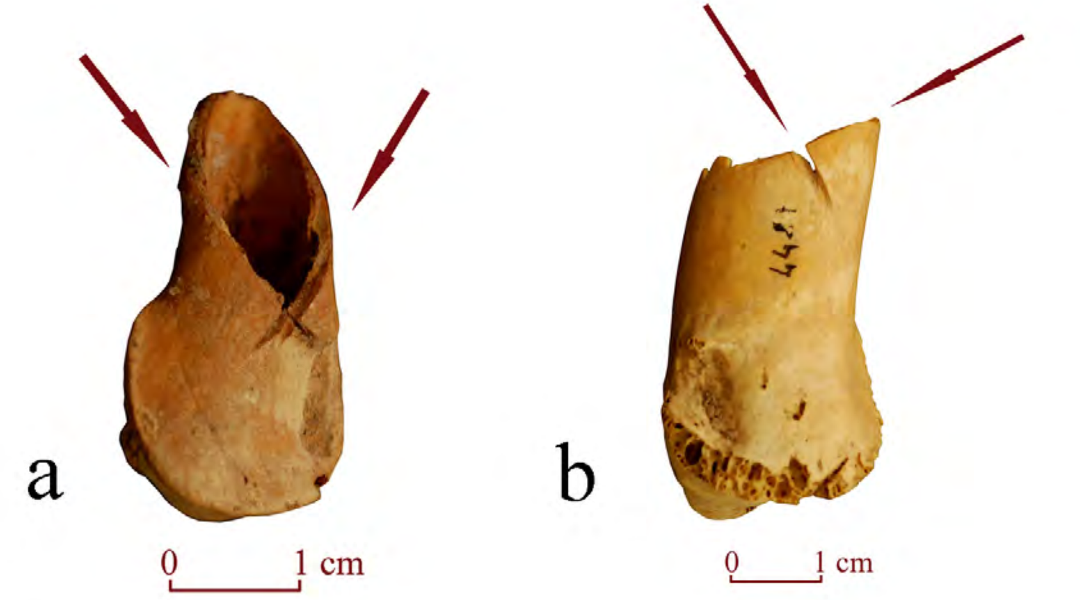

FIGURA 1

Shahr-i Sokhta, Building 1: ulna distale destra di *Aegypyus monachus* (a) e ulna distale sinistra di *Cignus olor* (b) con tracce di taglio finalizzate a prelevare la diafisi.

DISCUSSIONE

L'economia di sussistenza a Shahr-i Sokhta si basava prevalentemente sull'utilizzo alimentare di ovicaprini e bovini. Tuttavia, un ruolo importante era rivestito sicuramente dallo sfruttamento degli uccelli, che completavano la dieta carnea della popolazione e non solo: la produzione di versatoi ottenuti su diafisi di ossa lunghe di uccelli lascia intendere uno sfruttamento più ampio degli animali.

I versatoi sono stati rinvenuti quasi esclusivamente in contesto sepolcrale, a corredo di tombe: probabilmente legati esclusivamente alle pratiche funerarie, sono oggetti quasi sempre abbinati ad inumati maschi adulti, in sepolture che variano dall'assenza totale di corredo alla presenza di corredi ricchissimi (Sajjadi, 2003; Piperno & Salvatori, 2007; Sajjadi *et al*., 2007, 2009). Si rinvengono quasi sempre all'altezza delle ossa carpali degli inumati, quindi si ipotizza venissero inseriti tra le mani serrate dei defunti durante la loro deposizione. La loro reale funzione è ancora incerta, questo lascia spazio a differenti ipotesi interpretative: data la fragilità dello strumento e la forma particolare, si ipotizza fossero delle piccole canne utilizzate per versare liquidi o sostanze coloranti verso l'estremità, al fine di decorare gli oggetti in argilla, i tessuti, le pelli o il corpo umano; l'ipotesi che potessero essere strumenti per incidere materiali morbidi, come ad esempio l'argilla cruda, sembrerebbe azzardata in considerazione della fragilità degli strumenti stessi; infine, il rinvenimento pressoché esclusivo all'interno di sepolture potrebbe anche lasciar spazio all'ipotesi che tali strumenti non fossero legati a reali pratiche lavorative, ma che avessero un ruolo esclusivamente simbolico, destinati ad accompagnare i defunti nella vita oltre la morte (Potenza, 2019, cds). Allo stato attuale della ricerca non si conoscono confronti in tutta l'area dell'Asia Media: gli unici oggetti che potrebbero ricordare la forma dei versatoi sono manufatti in avorio rinvenuti all'interno della "tomba dei preti" ad Altyn Depe, o alcune stecche in avorio rinvenute nelle tombe 3245 e 3325 di Gonur Depe (Masson, 1988), databili alla fine del III millennio a.C., la cui funzionalità rimane comunque ignota (Figura 3). La differenza del materiale di produzione (avorio anziché osso) e la presenza di decorazioni finissime, li allontana tuttavia sensibilmente dai versatoi di Shahr-i Sokhta, nonostante fossero anche questi a corredo di sepolture.

Le specie di uccelli rinvenute suggeriscono la presenza di un ambiente di tipo lagunare, così

FIGURA 2
Shahr-i Sokhta, Building 1: due esempi di versatoi ottenuti su diafisi di osso lungo di uccello.

FIGURA 3

Shahr-i Sokhta, versatoi ottenuti su diafisi di osso lungo di avifauna (in alto), confrontati con gli strumenti in avorio di Altyn Depe e Gonur Depe (Turkmenistan). Immagini dei confronti rielaborate da Masson (1988: 65, Pl. XIX) e da Frenez (2018: 27, fig. 13).

come doveva presentarsi il delta dell'Helmand durante tutte le fasi di occupazione di Shahr-i Sokhta.

Una considerazione a parte merita il cormorano. Questo animale, dalla carne dura, dal sapore sgradevole e maleodorante, non è commestibile. Tuttavia, l'elevata quantità di ossa rinvenute lascia supporre uno sfruttamento dell'animale a Shahr-i Sokhta. Un'ipotesi plausibile è che il cormorano venisse addestrato, in uno stato di semidomesticità, per coadiuvare l'uomo nelle attività di pesca (Jackson, 1997): tale pratica si può ancora oggi osservare in molte popolazioni mediorientali e orientali (Figura 4). La pesca con il cormorano, al giorno d'oggi, viene ormai praticata soltanto in alcune aree della Cina sudoccidentale e del Giappone: essa prevede che i pescatori leghino una trappola vicino alla base della gola dell'uccello per impedirgli di ingoiare i pesci più grandi, che vengono così trattenuti temporaneamente nella loro gola; quando un cormorano ha preso un grosso pesce, il pescatore riporta l'uccello sulla barca e gli fa rigurgitare il pesce (Manzi & Comes, 2010). L'ipotesi che già nel III millennio venisse praticata tale tecnica di pesca è altamente suggestiva e i dati archeozoologici sembrerebbero poterla confermare, retrodatando al III millennio a.C. quella che in epoca storica diventerà una tecnica tradizionale.

CONCLUSIONI

L'analisi archeozoologica facente parte integrante del progetto MAIPS è in continua evoluzione. Lo studio dell'avifauna, parte integrante dell'intero progetto, è fondamentale non solo per capire le strategie alimentari della popolazione, ma anche per comprendere le dinamiche di interazione tra l'uomo e il paesaggio circostante, dinamiche che hanno comportato la nascita, la trasformazione e lo sviluppo di una delle più antiche città del sud-est asiatico.

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FIGURA 4

Esempio di pesca con l'ausilio del cormorano in Asia orientale.

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BIBLIOGRAFIA

Ascalone, E. 2019: Il "Progetto Archeologico Multidisciplinare Internazionale a Shahr-i Sokhta (MAIPS)", Università del Salento, dal 2017. In: Callieri, P.F.; Nokandeh, J.; Rossi, A.V. & Sajjadi, S.M.S. (eds.): *Iran and Italy: 60 Years of Collaboration on Cultural Heritage*: 59-61. National Museum of Iran, RICHT, ISMEO, Tehran.

Ascalone, E. & Sajjadi, S.M.S. 2019: *Scavi e ricerche a Shahr-i Sokhta, 1 (=ERSS 1)*. Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

— 2022: *Excavations and Researches at Shahr-i Sokhta, 2 (=ERSS 2*). Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

Bökönyi, S. & Bartosiewicz, L. 2000: A review of animal remains from Shahr-i Sokhta (Eastern Iran). In: Mashkour, M.; Choike, A.M.; Buitenhuis, H. & Poplin, F. (eds.): *Archaeozoology of the Near East*: 116-152.Vol. IV B. ARC – 32, Gronigen.

Caloi, L. & Compagnoni, B. 1977: I mammiferi. In: Tucci, G. (eds): *La Città Bruciata del Deserto Salato*: 77-113. Ed. Erizzo, Venezia.

Cassoli, P.F. 1977: L'avifauna. In: AA.VV. (eds): *La città bruciata del deserto salato*: 173-182. Ed. Erizzo, Venezia.

Cassoli, P.F.; Gala, M. & Tagliacozzo, A. 2013: Gli uccelli di Shahr-i Sokhta (Sistan, Iran): nuovi dati ecologici e paleo economici. In: Cerasetti, B.; Genito, B.; Lamberg-Karlovsky, K. & Marchesi, G. (eds): *My life like the summer rose. Maurizio Tosi e l'archeologia come modo di vita*: 83-104. B.A.R. (International Series). Oxford.

Cohen, A. & Serjeantson, D. 2015: *A manual for the identification of bird bones from archaeological sites*. Archetype publications, London.

De Grossi Mazzorin, J. 2008: *Archeozoologia. Lo studio dei resti animali in archeologia*. Editori Laterza, Roma-Bari.

Frenez, D. 2018: Manufacturing and trade of Asian elephant ivory in Bronze Age Middle Asia. Evidence from Gonur Depe (Margiana, Turkmenistan). *Archaeological Research in Asia* 15: 13–33.

Gala, M. & Tagliacozzo, A. 2014: The role of birds in the settlement of Shahr-I Sokhta (Sistan, Iran) during the 3rd Millennium BC. *International Journal of Osteoarcheaology* 24: 319-330.

Jackson, C.E. 1997: Fishing with cormorants. *Archives of Natural History* 24(2): 189-211.

Manzi, M. & Comes, O.T. 2010: Cormorant Fishing in Southwestern China: A Traditional Fishery Under Siege. *The Geographical Review* 92(4): 597–603.

Masson, V.M. 1988: *Altyn Depe*. University Museum, monograph 55, Philadelphia.

Minniti, C. 2019: Risultati preliminari dello studio dei resti animali provenienti dal sito di Shahr-i Sokhta, Iran: nuove ricerche. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Scavi e ricerche a Shahr-i Sokhta*: 209-220. I.C.A.R.

Piperno, M. & Salvatori, S. 2007: *The Shahr-I Sokhta Graveyard (Sistan, Iran). Excavation campaigns 1972-1978*. Istituto Italiano per l'Africa e l'Oriente, Napoli.

Potenza, A. 2019: Gli strumenti in materia dura di origine animale provenienti da Shahr-i Sokhta: analisi preliminare. In: Ascalone, E. & Sajjadi, S.M.S. (eds.): *Scavi e ricerche a Shahr-i Sokhta*: 221-244. Tehran.

— cds: Lo studio dei resti animali di Shahr-i Sokhta per una ricostruzione dell'economia primaria in Asia centrale tra la metà del IV e la fine del III millennio a.C. Tesi di dottorato in Scienze del Patrimonio Culturale, XXXV Ciclo, Università del Salento, Lecce.

Potenza, A. & Minniti, C. 2022: New data on animal exploitation at Shahr-i Sokhta (Iran). Preliminary results from the analysis of animal remains found in Area 33. In: Ascalone, E. & Sajjadi, S.M.S. (eds): *Excavations and Researches at Shahr-i Sokhta, 3 (=ERSS 3)*: 645-668. Studies and Publications Institute, University of Salento and Iranian Center for Archaeological Research, Pishin Pajouh, Tehran.

Sajjadi, S.M.S. 2003: Excavations at Shahr-i Sokhta. First preliminary report on the excavations of the graveyard, 1997-2000, Iran. *Journal of the British Institute of Persian Studies* 41: 21-97.

Sajjadi, S.M.S.; Foruzanfar, F.; Shirazi, R. & Zaruri, R.M. 2007: Excavations at Shahr-i Sokhta. Graveyard 1997-2000. Preliminary Report 1. Cultural and Communication vise Directorate Central Office of Cultural Affaires, Tehran. [In persiano].

— 2009: Excavations at Shahr-i Sokhta. Graveyard 2001-2003. Preliminary Report 2. Iranian Center for Archaeological Research. Cultural Heritage, Handicrafts & Tourism Organization of Sistan & Baluchistan, Tehran. [In persiano].

Sajjadi, S.M.S. & Moradi, H. 2015: Excavation at Buildings Nos.1 and 20 at Shahr-i-Sokhta. *International Journal of the Society of Iranian Archaeologists* 1(1): 35-49.

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New approaches on the studies of Neanderthal dwelling space use: bone refits at units A9 and A5-A6 of Fumane Cave (Verona, Italy)

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ABSTRACT: This contribution forms part of a larger project entitled “Attesting Neanderthal Dwelling Space Use (ANDSU): effects of human occupations in the Middle Palaeolithic record of Fumane cave”. It focuses on the spatial organization of Neanderthal dwelling units in Fumane cave (units A9, A5-A6), using a mixed methodology approach. The project aims to gain insights into assemblage formation processes, post-depositional dynamics, settlement patterns, and the integrity of stratigraphic units. Bone refits, spatial and exploratory statistical analysis, and 3D reconstructions are used to achieve these goals. Refitting studies provide valuable data, while 3D scan acquisition of refitted bones enables the development of computerized analytical methods. These methods can make refit semi-automatic or automatic.

The project shows the importance of integrating innovative methods from other disciplines to understand the diversity of occupational patterns in Middle Palaeolithic records.

KEYWORDS: BONE REFIT, METHODOLOGY, NEANDERTHAL, FUMANE CAVE, UNIT A9, SPATIAL ANALYSIS, MULTIVARIATE STATISTIC TECHNIQUES

RIASSUNTO: Questo contributo fa parte di un più ampio progetto intitolato “*Attesting Neanderthal Dwelling Space Use (ANDSU): effects of human occupation in the Middle Palaeolithic record of Fumane cave*”, che affronta l’organizzazione spaziale delle occupazioni Neandertaliane nelle unità A9 e A5-A6 della grotta di Fumane.

Con una metodologia che integra rimontaggi ossei, statistica spaziale e modellazione 3D, ci si aspetta di fornire nuovi dati su questo argomento. L’applicazione dei rimontaggi fornisce dati preziosi per interpretare i processi di formazione degli assemblaggi, le dinamiche post-deposizionali, i modelli di insediamento, la definizione e l’integrità delle unità stratigrafiche, mentre l’analisi dei modelli tridimensionali dei rimontaggi, permette di sviluppare metodi analitici computerizzati, che potrebbero sviluppare, in futuro, un metodo automatico o semi-automatico per l’analisi degli stessi.

I dati ottenuti mostrano l’importanza di approcci integrati e innovativi per comprendere l’uso degli spazi abitativi dei Neanderthal.

PAROLE CHIAVE: RIMONTAGGIO OSSEO, METODOLOGIA, NEANDERTHAL, GROTTA DI FUMANE, UNITÀ A9, ANALISI SPAZIALI, TECNICHE STATISTICHE MULTIVARIATE

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INTRODUCTION

Spatial studies applied to Middle Palaeolithic contexts are essential to interpret site formation processes, lifeways, and Neanderthal occupational patterns. The diversity of archaeological assemblages results from multiple overlapping occupations and events, known as palimpsests (Bailey, 2007). In this sense, refits provide a glimpse into the temporal scale of archaeological units. Their distribution, orientation and distance combined with anthropic and post-depositional taphonomy allowed the diagnosis of anthropic redistribution of remains across distinct household units (Cziesla, 1990), addressing the challenge of contemporaneity-diachronicity between archaeological events. Therefore, they represent an essential tool for understanding site formation processes and the lifeways of ancient humans.

Initially applied to lithics, this method has become an essential technique in Zooarchaeology (Fernández-Laso, 2010; Rosell *et al*., 2012, 2019; Gabucio, 2014; Modolo, 2017; Modolo & Rosell, 2017).

The site under study is the cave of Fumane, located in the Lessini Mountains at 350 m a.s.l. (Verona, Italy). The excavations produced one of the European most significant Middle and Upper Palaeolithic stratigraphic records (Peresani, 2022): numerous layers and lenses comprise the topmost Mousterian deposits organized into nine stratigraphic units, from A13 to A5. The study focuses on units A9 and A5-A6 (>47.6; 44.8-42.2 ky cal BP): bone fragments, lithics, charcoals, and hearth structures indicate an intensive anthropic accumulation, making them an ideal case study.

MATERIALS AND METHODS

The sample used for bone refits is a subset of the total fragments recovered from units A9 and A5-A6, whose zooarchaeological and taphonomic data are provided in several papers (Nannini, 2012; Romandini, 2012; Romandini *et al*., 2014).

For refitting protocol, we adhere to Todd (1983) and Lyman (1994, 2008) nomenclature and Fernández-Laso (2010) and Modolo refitting methods (Modolo, 2017; Modolo & Rosell, 2017; Rosell *et al*., 2019). Three typologies of refits have been identified: mechanical, anatomical, and bilateral pairings. The distance between them and taphonomic alterations, particularly those resulting from human activities, has been documented. Due to their spatial and technical value, tiny bone flakes from purposeful breaking (< 3 cm) have also been incorporated into the study to pinpoint activity areas where bones were shattered. In contrast, spongy fragments were discarded because they were unsuitable for refitting. All identifiable specimens were compared with unidentifiable fragments of the same size class.

3D coordinates of each bone were used to create a systematic series of vertical plots with R software and generate high-density maps. Refits connection lines were established for the contacting surfaces, and the length of each connection line was computed using QGIS. We also determined the movements' directions when possible, to ascertain their origins and the butchering processes.

As the image quality of the NextEngine laser scanner was insufficient, we switched to David LaserScanner 3D. One hundred thirty-three refits were scanned, representing an adequate sample number for applying the proposed methodology and achieving comparable results (Delpiano & Peresani, 2017). Utilising Artifact3-D software, accurate measurements such as orthogonal distances, surface area, volume, edge angles, asymmetry, and fracture plans were obtained (Grosman *et al*., 2022).

Unit A9, covering an area of 68 m^2, consists of layers with a 15-20 cm thickness and has yielded 111,841 bone fragments. The excavations revealed fifty structures, including hearths and toss-zones, mainly towards the cave's entrance. Mid-shaft pieces characterise remains, whereas low-density portions (ribs, vertebrae, pelvis) and spongy epiphyses are rare, suggesting post-depositional processes modifications and the possibility they were used as fuel (Nannini, 2012; Romandini *et al*., 2014).

A sample of 2,933 bones (2.60% of the total) was carefully selected for the refitting program, producing 79 refits, 105 connecting lines, and 180 conjoined bones. Of these, 65 are composed of two elements; nine of three; three of four; one of five; and one of six. Involved taxa include red deer (17), roe deer (4), auroch and giant deer (2), auroch/bison (1), elk/giant deer (1), elk (1), chamois (1), marmot (1), and weasel (1). The size-class mammals documented ungulates (9), cervids (7), and unidentified fragments (31). The shortest distance between connection lines is approximately 5 cm (medium-sized mammals), while the longest is 7.50 m (red deer) (Figure 1).

The excavation of units A5, A5+A6, and A6 registered 171,257 bones in around 30 m^2. The layer thickness ranges from 10 to 20 cm. Seven structures were found in A5, one in A5+A6, and twenty-two in A6. In unit A6, numerous hearths were concentrated in the central-western region, whereas those in unit A5 were scattered (Peresani *et al*., 2011; Marcazzan *et al*., 2022). The flat and overlapping combustion structures suggest a diachronic settlement of the natural shelter, and their number, a decreasing settlement intensity during the late Middle Palaeolithic.

The study examined a sample of 4,267 bones (2.49% of the total), resulting in 59 refits and 77 connection lines, divided as follows: red deer (27); roe deer and chamois (2), Alpine ibex (1); ungulates (8); cervids (2) and unidentified fragments (14). Connection lines over short and long distances involve anatomical (mandibles and teeth) and mechanical refits, regardless of their size. Even if not directly associated with hearth structures, a sizeable proportion display cooking-related levels of combustion (Figure 1).

To summarise data, only unit A9 yielded mechanical and anatomical refits for all connection distances. Most refits are the result of human activity during butchering processes, except two refits of post-depositional nature. Red deer is the most represented taxa for the number of remains and refits. Although poorly represented, rodents and mustelids documented two anatomical refits.

The same is evident for units A5 and A6, with local refits exhibiting post-depositional alterations and long-distance refits showing intentional fracture by percussion. What should be highlighted is the presence of vertical inter-levels refits (A6 with A5+A6 and A6 with A7), that are the result of human action, except in one case.

All units documented mechanical, anatomical (mandible/maxilla with teeth, dental series), and a few bilateral pair refits (articulated elements) (Figure 2).

In all analysed units, weight-size classes fragments recorded refits over short distances, except two on long (5; 2,84 m). Carnivore interventions are poor, with only five refits attesting some marks in unit A9.

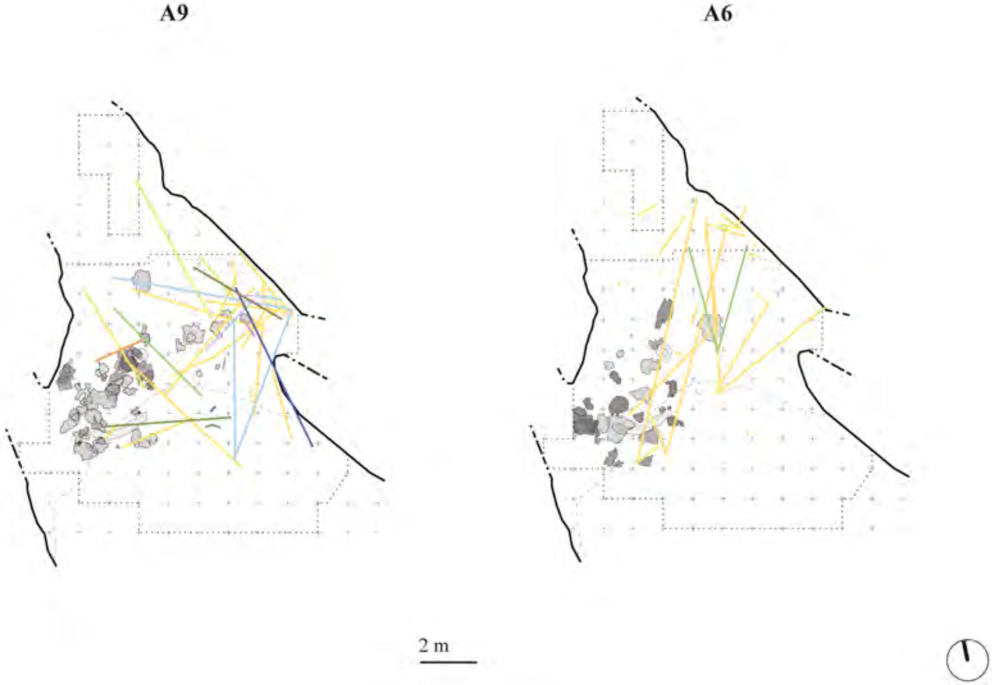

FIGURE 1

Spatial distribution of units A9 and A6 with some connection lines. Colour legend for unit A9: red deer (yellow), roe deer (light blue), chamois (green). Colour legend for unit A6: red deer (yellow), giant deer (orange), roe deer (light blue), chamois (green), marmot (dark green), weasel (grey), auroch (purple), cf. elk/giant deer (blue), Bos/Bison (brown).

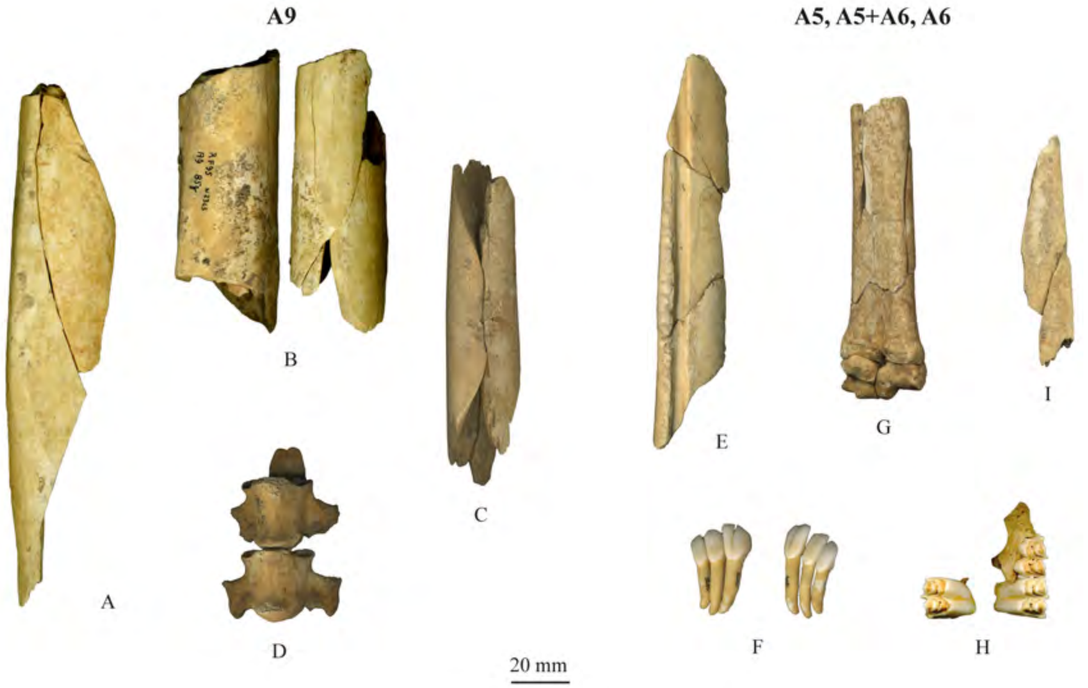

FIGURE 2

Examples of refitted bones from units A9 and A6.

A) Red deer: diaphysis of left tibia with impact point (long distance).
B) Red deer: diaphysis of right tibia with cut-marks (detachment of muscle mass) and a percussion cone (short + long distance).
C) Giant deer: diaphysis of right radius with impact point, cut marks, trampling, fluitation and carnivore tooth-marks (long distance).
D) Roe deer: anatomical refit on thoracic vertebra (medium distance).
E) Red deer: diaphysis of metatarsal with cut-marks, rodent marks, and post-depositional damages (roots and weathering) (long distance).
F) Red deer: anatomical refits on teeth (adult - 5 years) (short distance).
G) Roe deer: diaphysis of right metacarpal + epiphysis; cut marks and anthropic fractures (short distance); post-depositional agents (exfoliation and roots).
H) Chamois: anatomical refits on teeth (long distance).
I) Ungulata: shaft of metapodial with anthropic fracture (short distance); post-depositional damages (roots).

DISCUSSION AND CONCLUSIONS

Due to ongoing statistical studies and 3D computerisation, these results must be considered preliminary. Units A5 and A6 are characterised by short-distance connections, except for the red deer, influenced by higher elements mobility. In contrast, there are no significant variations between short and long connections in unit A9. In all stratigraphic units, most refits are located towards the cave's North-Est wall, indicating a correlation between long connections and combustion structures.

In general, humans were the principal agents in remains' dispersal. The ongoing research will give further evidence regarding the space use at Fumane cave, enhancing our understanding of Neanderthal intra-settlement dynamics.

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REFERENCES

Bailey, G. 2007: Time perspectives, palimpsests and the archaeology of time. *Journal of Anthropological Archaeology* 26: 19-223. doi.org/10.1016/j.jaa.2006.08.002.

Cziesla, E. 1990: On refitting of stone artefacts. In: Cziesla, E.; Eickhoff, S.; Arts, N. & Winter, D. (eds.): *The Big Puzzle*. *International Symposium on Refitting Stone Artefacts*: 9-44. Studies in Modern Archaeology 1, Bonn.

Delpiano, D. & Peresani, M. 2017: Exploring Neanderthal skills and lithic economy. The implication of a refitted Discoid reduction sequence reconstructed using 3D virtual analysis. *Comptes Rendus Palevol* 16.8: 865-877. doi.org/10.1016/j.crpv.2017.06.008.

Fernández-Laso, M.C. 2010: *Remontajes de restos faunísticos y relaciones entre* àreas *domésticas en los niveles K, L y M del Abric Romaní (Capellades, Barcelona, España)*. Universidad Rovira i Virgili, Tarragona.

Gabucio, M.J. 2014: *Spatiotemporal study of a palimpsest: Zooarchaeological and taphonomical analysis of level O of the Abric Romaní (Capellades, Barcelona, Spain)*. University Rovira i Virgili, Tarragona.

Grosman, L.; Muller, A.; Dag, I.; Goldgeier, H.; Harush, O.; Herzlinger, G.; Nebenhaus, K.; Valletta, F.; Yashuv, T. & Dick, N. 2022: Artifact3-D: New software for accurate, objective and efficient 3D analysis and documentation of archaeological artefacts. *PLoS ONE* 17(6): e0268401. doi.org/10.1371/journal.pone.0268401.

Lyman, R.L. 1994: *Vertebrate taphonomy*. Cambridge University Press, Cambridge.

— 2008: (Zoo)Archaeological refitting a consideration of methods and analytical search radius. *Journal of Anthropological Research* 64: 229-248. doi/abs/10.3998/jar.0521004.0064.203.

Marcazzan, D.; Miller, C.e.; Ligouis, B.; Duches, R.; Conard, N.J. & Peresani, M. 2022: Middle and Upper Paleolithic occupations of Fumane Cave (Italy): a geoarchaeological investigation of the anthropogenic features. *Journal of Anthropological Sciences* 100: 37 - 62. doi: 10.4436/JASS.10002.

Modolo, M. 2017: *Just two questions. Where and why? Reconstruction of Neanderthal occupational patterns in the mis 3*. University Rovira i Virgili.

Modolo, M. & Rosell, J. 2017: Reconstructing occupational models: bone refits in level I of Abric Romaní. *Quaternary International* 435: 180-194. doi.org/10.1016/j.quaint.2015.12.098.

Nannini, N. 2012: *Studio archeozoologico del complesso faunistico delle unità musteriane A8 e A9. Approfondimenti tafonomici sulle modalità di sussistenza degli ultimi discoidi di Grotta di Fumane (VR)*. University of Ferrara.

Peresani, M. 2022: Inspecting human evolution from a cave. Late Neanderthals and early sapiens at Grotta di Fumane: present state and outlook. *Journal of Anthropological Sciences* 100: 71-107. doi.org/10.4436/JASS.10016.

Peresani, M.; Fiore, I.; Gala, M.; Romandini, M. & Tagliacozzo, A. 2011: Late Neanderthals and the intentional removal of feathers as evidenced from bird bone taphonomy at Fumane Cave 44 ky BP, Italy. *Proceedings of the National Academy of Sciences* 108(10): 3888-3893. doi.org/10.1073/pnas.101621210.

Romandini, M. 2012: *Analisi archeozoologica, tafonomica, paleontologica e spaziale dei livelli Uluzziani e tardo-Musteriani della Grotta di Fumane (VR). Variazioni e continuità strategico-comportamentali umane in Italia Nord-Orientale: i casi di Grotta del Col della Stria (VI) e Grotta del Rio Secco (Pn)*. University of Ferrara.

Romandini, M.; Nannini, N.; Tagliacozzo, A. & Peresani, M. 2014: The ungulate assemblage from layer A9 at the Grotta di Fumane, Italy: a zooarchaeological contribution to the reconstruction of Neanderthal ecology. *Quaternary International* 337: 11-27. doi.org/10.1016/j.quaint.2014.03.027.

Rosell, J.; Blasco, R.; Fernández-Laso, M.C.; Vaquero, M. & Carbonell, E. 2012: Connecting areas: Faunal refits as a diagnostic element to identify synchronicity in the Abric Romaní archaeological assemblages. *Quaternary International* 252: 56-67. doi.org/10.1016/j.quaint.2011.02.019.

Rosell, J.; Modest-Mata, M.; Fernández-Laso, M.C.; Modolo, M. & Blasco, R. 2019: Refitting bones to reconstruct the diversity in Middle Palaeolithic human occupations: the case of the Abric Romaní site (Capellades, Barcelona, Spain). *Archaeological and Anthropological Sciences* 11(9): 4601-4619. doi.org/10.1007/s12520-019-00887-4.

Todd, L.C. 1983: Taphonomy: fleshing out of the dry bones of plains prehistory. *Wymonig Archaeological* 26(3-4): 36-46.

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Right to replicate? A preliminary comparative experimental approach to the use of replicas in taphonomic analyses using the scanning electron microscope

Diritto di replica? Un approccio sperimentale preliminare comparativo all'uso delle repliche nelle analisi tafonomiche mediante il microscopio elettronico a scansione

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ABSTRACT: This paper presents the preliminary results of an experimental project aiming at the optimization of the procedures for observing and identifying archaeological bone modifications by means of microscope analysis.

The protocol includes different phases: the first one starts with the experimental production of traces on hard animal tissues (bones, teeth, ivory, antler, etc.) using different kinds of tools made of various materials (flint, obsidian, bronze, iron, etc.) and performing different actions (e.g., cutting, scraping) or collecting modifications made by different non-human agents (e.g., carnivores, rodents). During the second phase resin replicas of such traces will be prepared testing different molding and casting materials, and then both original experimental specimens and replicas will be analyzed with the microscope (especially SEM). Furthermore, SEM parameters (low vacuum or high vacuum, beam intensity, backscattered or secondary electrons, etc.) will be varied. In the final phase the obtained results will be applied to the archaeological materials.

In particular in this research there is a focus on the reliability of resin replicas for correctly identifying and attributing bone modifications because, although now with the recent SEM such replicas are not necessarily required, there are situations (physical or logistical) when they are still needed.

KEY WORDS: SCANNING ELECTRON MICROSCOPE (SEM), TAPHONOMY, BONE SURFACE MODIFICATIONS, BONE SURFACE REPLICAS, EXPERIMENTATION

RIASSUNTO: In questo breve articolo si presentano i risultati preliminari di un progetto sperimentale volto all'ottimizzazione delle procedure di osservazione e identificazione delle modificazioni ossee archeologiche mediante analisi al microscopio.

Il protocollo prevede diverse fasi: la prima prevede la realizzazione di tracce sperimentali su elementi in materia dura animale (ossa, denti, avorio, palchi, ecc.) utilizzando diversi tipi di strumenti, fatti con materiali diversi (selce, ossidiana, bronzo, ecc.) e compiendo diverse azioni (taglio, raschiatura, ecc). È compreso anche il recupero di reperti ossei con tracce prodotte da altri agenti non antropici (carnivori, roditori, ecc). La seconda fase è dedicata alla realizzazione di repliche in resina di tali tracce fatte testando diversi tipi di materiali per i negativi e i positivi;

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verranno successivamente analizzati al microscopio (in particolare al SEM) sia le ossa sperimentali originali sia le repliche. Le osservazioni verranno inoltre effettuate variando i parametri del SEM: basso o alto vuoto, intensità del fascio, elettroni retro-diffusi o secondari, ecc. Nella fase finale ci sarà l'applicazione dei risultati ottenuti sperimentalmente ai materiali archeologici.
In particolare, questa ricerca ha lo scopo di testare l'affidabilità delle repliche in resina per la corretta identificazione e attribuzione delle modificazioni ossee perché, anche se ora, con le nuove tecnologie SEM tali repliche non sono sempre necessarie ci sono situazioni (fisiche o logistiche) in cui sono indispensabili.

PAROLE CHIAVE: MICROSCOPIO ELETTRONICO A SCANSIONE (SEM), TAFONOMIA, MODIFICAZIONI DELLE SUPERFICI OSSEE, REPLICHE DI SUPERFICI OSSEE, SPERIMENTAZIONE

INTRODUCTION

Since the beginning of the '80s, the need to use the scanning electron microscope (SEM) to investigate bone surface modifications on archaeological and/or paleontological remains, led to development of equipment increasingly suitable for analyzing samples of different chemical nature, size and morphology (Cilli *et al*., 2000). In the past, high magnification analysis with the SEM required metallization of the specimen surfaces, such coating would have damaged permanently the bone element and was therefore unsuitable for remains of particular archaeological interest. For this reason, the practice of using molds of the surfaces made from high-definition silicone rubbers, from which resin casts were obtained that were then metallized, had become widespread. The preparation of the casts is long, complex, expensive and the result is not always acceptable (e.g., presence of bubbles in the silicone or resin that compromise observation). Although with limitations in the rendering of dimensional and morphological characteristics, casts have nevertheless represented for decades a good diagnostic compromise (Bello *et al*., 2011; Camarós *et al*., 2016). Currently, the new equipment allows analyzing even non-conductive specimens without the metallization of the surfaces, operating in low vacuum mode and using specific detectors for image processing. However, even now the use of resin replicas may be necessary, for example, when the specimen is too large to fit the SEM chamber, or when it is not possible, for logistical or administrative reasons, to physically move the object to the laboratory where the microscope is located.

In order to verify the reliability of the taphonomic information obtained from replicas compared to the original specimens and therefore optimize the choice of the modes for the observation of surface modifications, we started an experimental protocol (Figure S1) with the aim of comparing image resolutions obtained employing different instrumental parameters (e.g., observations made in low vacuum vs. high vacuum, using the detectors for secondary or backscattered electrons), different types of bone modifications (e.g., experimental and archaeological, stone or metal tool cut-mark, scrape marks, striae produced by carnivore teeth), and different materials used to obtain the replicas.

MATERIALS AND METHODS

Within the first phase of this experimental protocol three different types of traces have been produced on a pig rib using an obsidian tool (Figure 1, 1-3).

A - Unidirectional cut

B - Bidirectional cut

C - Scrape mark

Replicas of the portion of bone surface bearing such traces have been prepared (Figure 1, 2) using a silicone elastomer (Provil Novo) for the mold and an epoxy resin (Araldite LY-554 with hardener Hy 956) for the cast. These are high precision replicas reproducing details smaller than 1 mm.

Observations at low and medium magnification have been carried out with a Dino-Lite Edge microscope while for the high magnification ones a stereomicroscope (Nikon SMZ 1000) and a SEM (Tescan VEGA 3) have been used; the two latter instruments were available at the Analytical Microscopy Service of the Museo delle Civiltà in Rome.

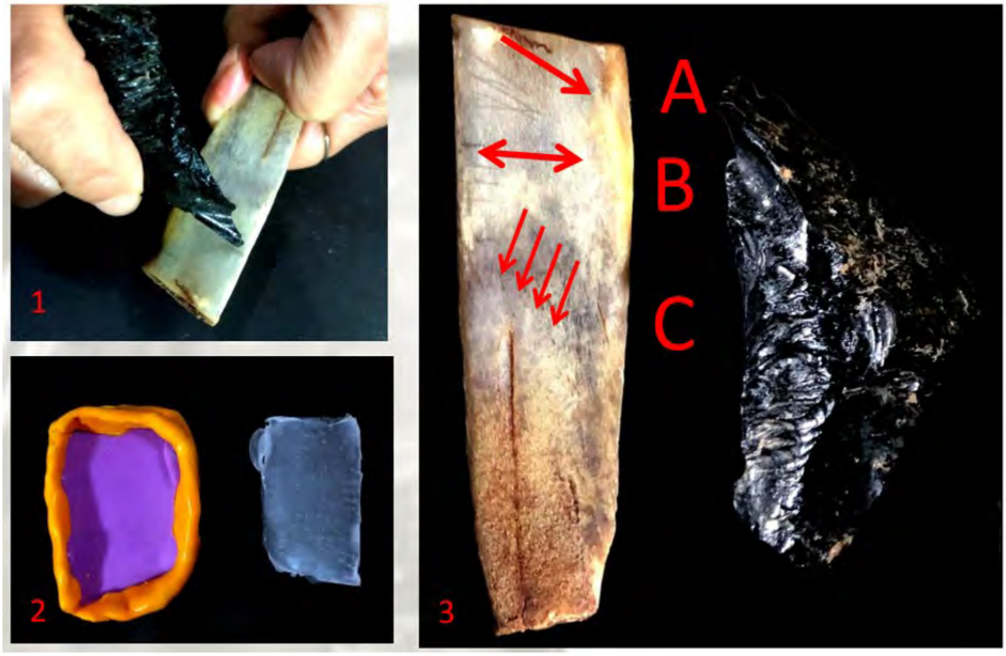

FIGURE 1

1) preparation of the sample. 2) silicone mold and Araldite cast. 3) Localization and orientation of the striae and obsidian tool. (A - unidirectional cut; B - bidirectional cut; C - scrape marks).

During this first phase the setting parameters of the SEM have been kept constant: Beam intensity 16.45 - HV 20.00.

These first observations have been performed in low vacuum and with backscattered electrons both in a “standard” mode and simulating an oblique lighting. Magnifications were 100x and 300x. The profiles of the striae have been obtained from the highest magnification images.

A similar procedure was followed for preparing and observing unidirectional and bidirectional cuts made with a flint tool; in this case the replica was observed also under the stereomicroscope.

DISCUSSION AND CONCLUSIONS

Cut marks produced with obsidian and flint tools were observed.

The mode simulating an oblique lighting was the best for the observation of the striae. The comparison between the SEM images of the traces on the specimen and those on the Araldite replica (not metallized) (Figures 2-5) evidenced some differences.

On the replica the features of the striae (bottom, secondary striations, section of the cut) appear more opaque and blunted, the asperities are smoother as evidenced also by the differences between the profiles (Figures 2-3).

Considering the preliminary results obtained we decided it was unnecessary to metallize the specimens and the replicas.

- The obsidian cut marks (Figures 2-4). The secondary striations, even the smaller ones, are emphasized on the real specimen by a greater brightness (Figure 2, 1; 3, 1; 4, 1). On the replica the sharpness of the edges and of the bottom of the deepest striae appears more defined (Figure 2, 2; 3, 2; 4, 2).
- The flint cut marks (Figure 5). These cuts compared to those made with obsidian were observed with the SEM (Beam intensity 15 - HV 25.00). As with obsidian, the secondary striations, even the smallest ones, are emphasized on the real specimen by greater brightness (Figure 5, 1). On the replica, observed under the stereomicroscope, the sharpness of the edges and background of the deeper striations appears well defined (Figure 5, 2), while using SEM there is a considerable loss of information, the secondary striations remain scarcely visible and the cut has lost its depth (Figure 5, 3).

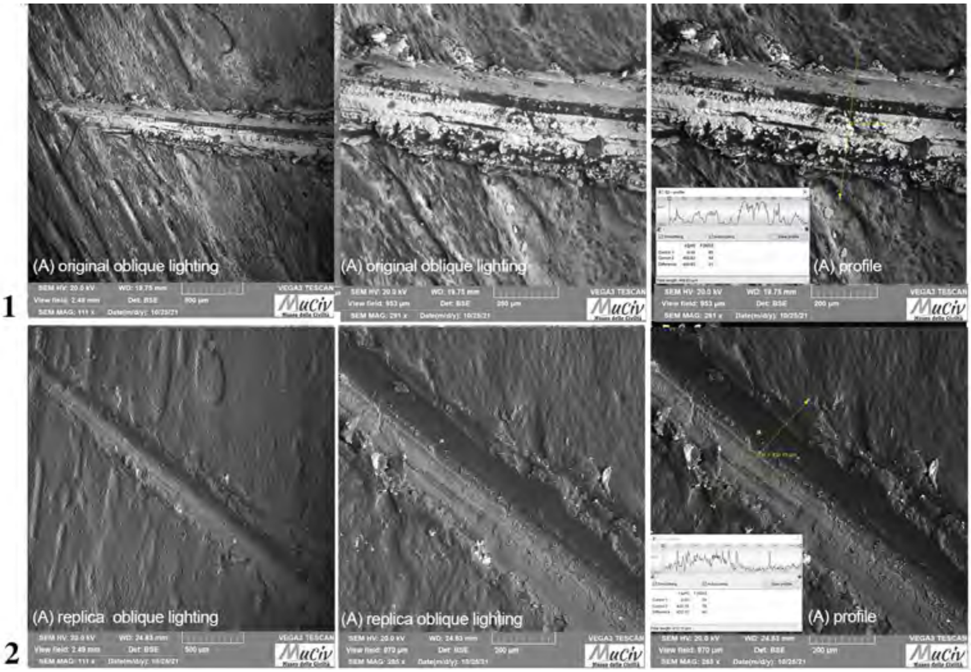

FIGURE 2

Obsidian. A) unidirectional cut. 1, SEM analysis of the traces directly on the specimen with different magnifications and profile of the striae. 2, SEM analysis of the traces on the replica with different magnifications and profile of the striae.

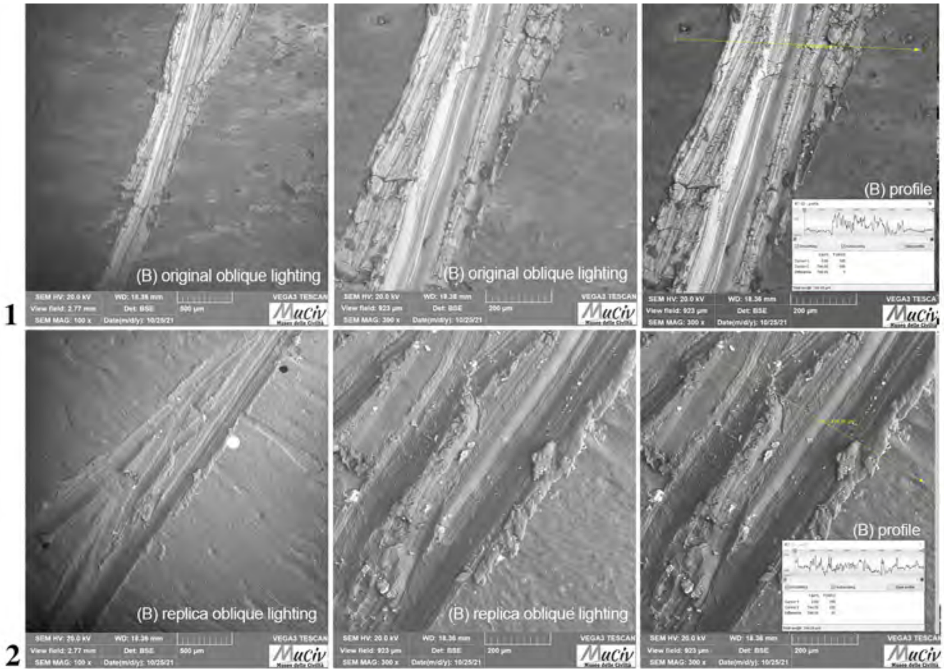

FIGURE 3

Obsidian. B) bidirectional cut. 1, SEM analysis of the traces directly on the specimen with different magnifications and profile of the striae. 2, SEM analysis of the traces on the replica with different magnifications and profile of the striae.

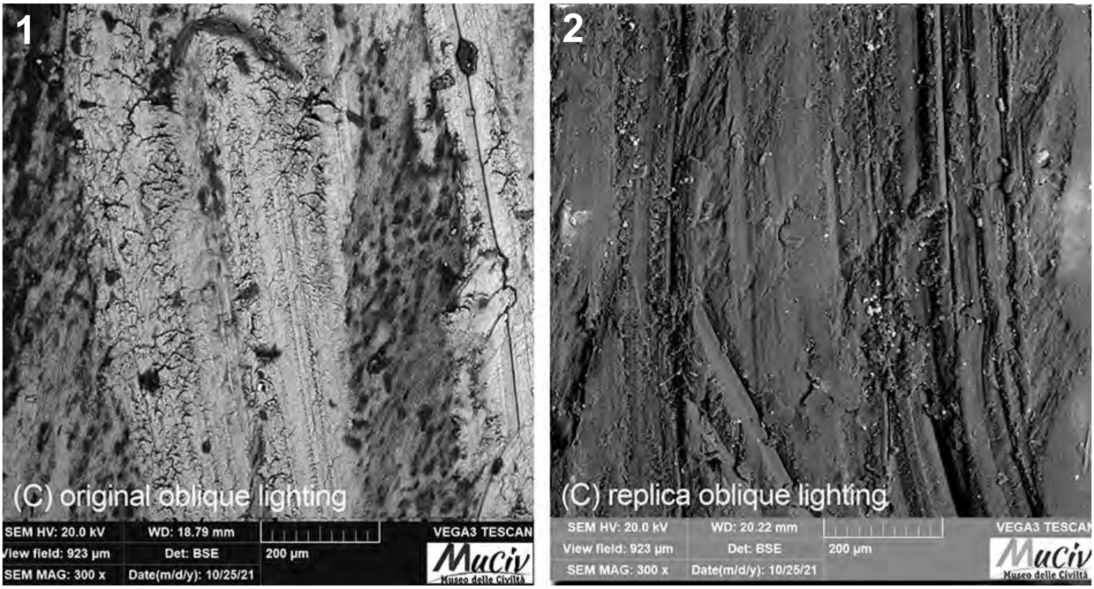

FIGURE 4

Obsidian. C) scrape marks. 1, SEM analysis of the traces directly on the specimen. 2, SEM analysis of the traces on the replica.

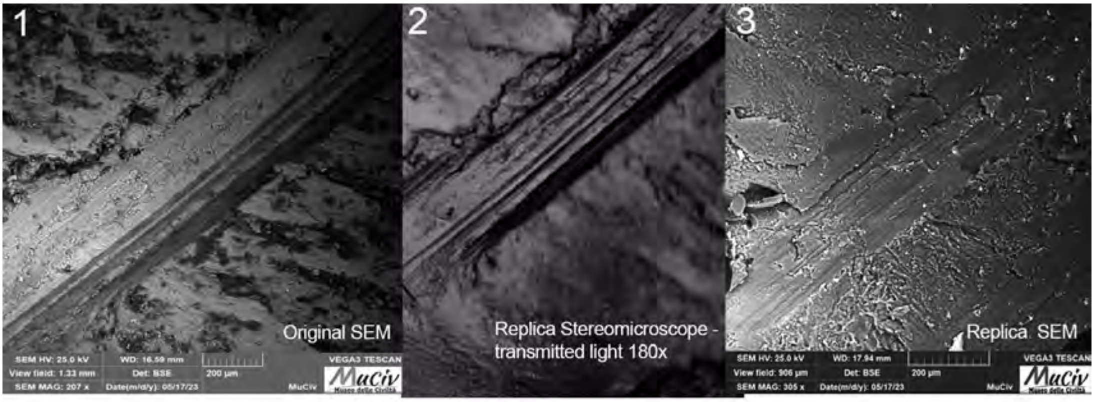

FIGURE 5

Flint. Unidirectional cut, 1, SEM analysis of the traces directly on the specimen. 2 Stereomicroscope analysis of the traces on the replica. 3, SEM analysis of the traces on the replica.

There are clear differences in the micromorphology of the traces from flint and obsidian, with the latter showing more damage due to the microasperity of the cutting edge of obsidian, which has a glassy texture and is easier to flake off during use.

In general, however, the replica seems to preserve all the main morphological features that allow identifying the traces produced by lithic tools as well as the different movements, therefore from these preliminary experiments it appears that the use of replicas, although with all the necessary caution, does not undermine the correct identification and attribution of the striae. Fundamentals are the SEM parameters that can affect the performance of the replica, very good results were obtained using the stereomicroscope with transmitted light. Nevertheless, it is necessary to consider that the bone surfaces observed so far were not affected by post depositional processes and thus the conclusions of these preliminary observations may have been biased.

Obviously, the data presented here are just preliminary and part of a much wider project. The continuation of the experimental protocol will include, besides the observation of experimental traces produced by tools made of different materials (other kinds of stone, different typesof metal), by other types of agents (animals, sediments) as well as equivalent modifications on archaeological specimens, in order to evaluate if and how the post-depositional alterations may influence the SEM observation of the replicas. Furthermore, we plan to try different kinds of silicone elastomers and resins as well as different parameters of the SEM.

REFERENCES

Bello, S.M.; Verveniotou, E.; Cornish, L. & Parfitt, S.A. 2011: 3-Dimensional microscope analysis of bone and tooth surface modifications: comparisons of fossil specimens and replicas. *Scanning* 33: 316-324.

Camarós, E.; SÁNchez-HernÁNdez, C. & Rivals, F. 2016: Make it clear: molds, transparent casts, and lightning techniques for stereomicroscopic analysis of taphonomic modifications on bone surfaces. *Journal of Anthropological Sciences* 94: 1-8. DOI: 10.4436/JASS.94023.

Cilli, C.; Malerba, G. & Giacobini, G. 2000: Le modificazioni di superficie dei reperti in materia dura animale provenienti da siti archeologici. Aspetti metodologici considerazioni tafonomiche. *Bollettino del Museo Civico di Storia Naturale di Verona* 24: 73-98.

SUPPLEMENTARY MATERIAL 1

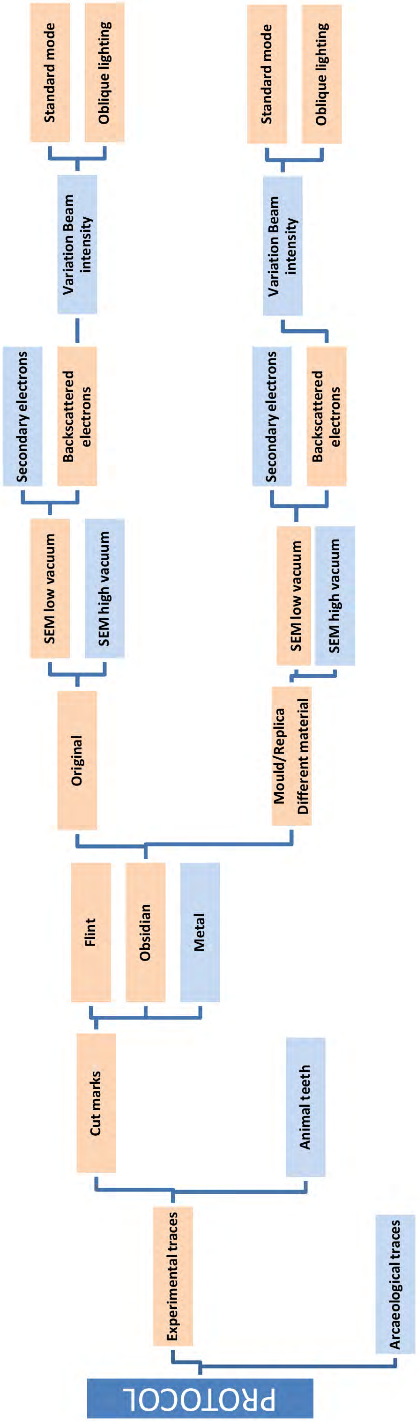

FIGURE S1

Simplified diagram of the experimental protocol adopted. In pink what has been performed during this first phase.

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Rofalco nella Selva del Lamone (Farnese, VT), i resti faunistici

Rofalco nella Selva del Lamone (Farnese, VT), faunal remains

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RIASSUNTO: L'insediamento fortificato di Rofalco si trova sul margine sud-orientale del pianoro tufaceo della selva del Lamone (Farnese, VT), in epoca etrusca sotto il controllo della potente Vulci, sita a circa 20 km a nord.

Adibito a controllo militare del territorio e immagazzinamento di derrate alimentari, l'abitato venne distrutto e abbandonato in seguito alla conquista romana dell'area, avvenuta sul finire del IV e gli inizi III secolo a.C.

Nel corso di una serie quasi ininterrotta di campagne di scavo, effettuate dal 1996 al 2018, sono stati rinvenuti un discreto numero di resti faunistici, un totale di 2798 resti in massima parte frammentati anche in porzioni molto piccole. Di questi sono stati identificati 376 resti.

I resti faunistici provengono in massima parte da battuti e strati pavimentali presenti in tutte le aree in cui è stato suddiviso l'insediamento, in particolare dagli strati di vita e di abbandono. Non sono stati rinvenuti butti veri e propri, ciò spiega l'estrema frammentarietà che caratterizza il campione osseo.

Sono state riconosciute le tre principali specie di mammiferi domestici. Pochi i resti di mammiferi selvatici.

Da un'area produttiva provengono alcuni resti di palco di cervo con tracce di lavorazione.

Dall'interno di una cisterna colmata, in strati di abbandono, provengono alcuni scheletri quasi completi di carnivori selvatici e numerosi resti di anfibi.

Nonostante il ritrovamento di resti ceramici attinenti ad alcuni *gliraria*, non sono stati rinvenuti nel campione resti ossei pertinenti a ghiri.

Le indagini archeologiche nel sito sono tutt'ora in corso.

PAROLE CHIAVE: ROFALCO NEL LAMONE, SITO ETRUSCO, RESTI FAUNISTICI, PALCO DI CERVO, TRACCE DI LAVORAZIONE

ABSTRACT: The fortified settlement of Rofalco is located on the south-eastern edge of the tufaceous plateau of the Lamone forest (Farnese, VT).

During the Etruscan period it was part of the territory controlled by Vulci, a powerful village located some 20 km north.

Used as military control of the territory and storage of foodstuffs, the village was destroyed and abandoned following the Roman conquest of the area in the late 4th-early 3rd century BC.

During an almost uninterrupted series of archaeological excavation campaigns, carried out from 1996 to 2018, were found a good number of faunal remains, a total of 2798 remains of which a few whole and mostly fragmented even in very small portions: 376 remains have been identified.

No real ditches have been found, the faunal remains mostly come from beaten and floor layers widespread in all the areas into which the settlement was divided. Particularly inside archaeological layers of living periods and their eventual abandonment.

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This may explain the extreme fragmentation that characterizes the bone sample.
The three main species of domestic mammals have been identified. Few are the faunal remains of wild mammals. Some remains of a deer stage with traces of processing come from a production area of the site.
Inside a filled cistern, in a layer that attests to the abandonment of the site, have been recovered some almost complete skeletons of wild carnivores and many remains of amphibians.
Despite the finding of ceramic remains relating to some *gliraria,* no bone remains attributable to the dormouse were found in the sample.
Archaeological research on the site are still in progress .

KEYWORDS: ROFALCO NEL LAMONE, ETRUSCAN SITE, FAUNAL REMAINS, DEER HORN, TRACES OF PROCESSING

INTRODUZIONE

Il sito fortificato di Rofalco si trova sul margine sud-orientale del pianoro tufaceo della selva del Lamone. L'area in epoca etrusca insisteva nel territorio di Vulci che si trova ad una distanza di circa 20 km (Figura 1).

Il sito ebbe importanza strategica per il controllo della valle del fiume Olpeta, via di transito da Vulci verso il lago di Mezzano e dunque Bolsena e Volsini (Cerasuolo, 2019).

Le prime ricerche sul sito vennero condotte negli anni Sessanta da Ferrante Rittatore Von Willer, attraverso la realizzazione di un saggio di dimen-

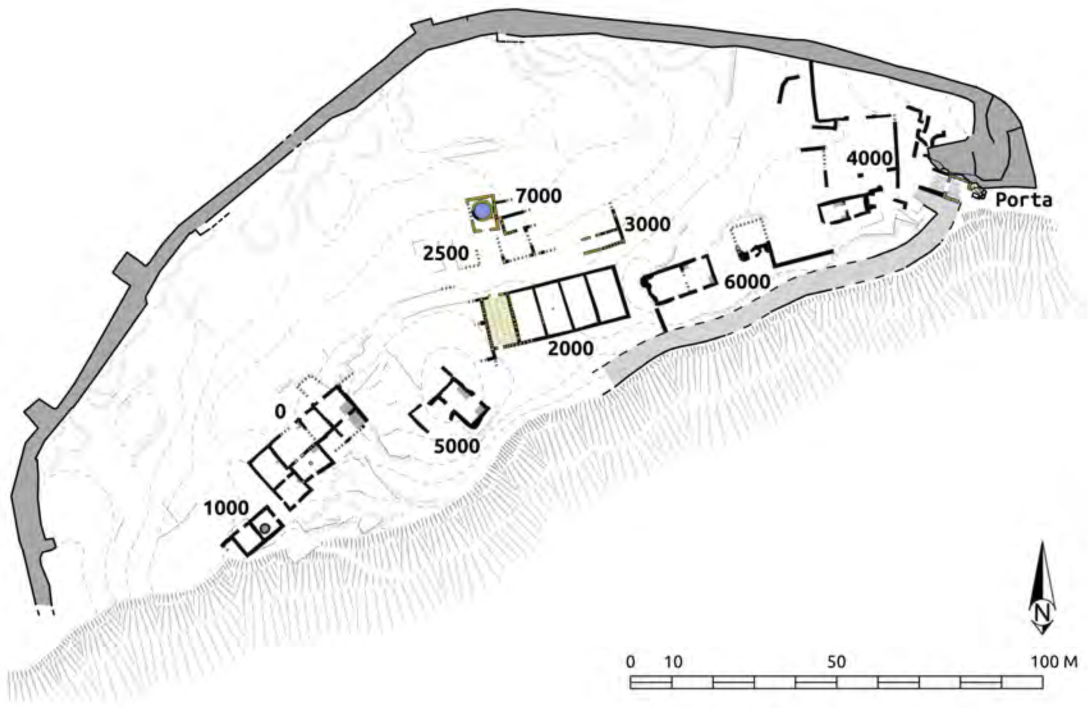

FIGURA 1
Pianta dell'abitato etrusco di Rofalco (elaborazione di O. Cerasuolo).

sioni limitate; Mauro Incitti, che riprese le attività di ricerca dal 1993 al 2003, precisò la cronologia del sito. Tuttora l'interesse per l'insediamento prosegue grazie a campagne di indagine annuali svolte da parte del gruppo archeologico romano.

All'interno dell'abitato sono state identificate aree adibite ad usi diversi, tra cui magazzini e abitazioni.

Atto al controllo militare del territorio e all'immagazzinamento di derrate alimentari, l'abitato venne distrutto e abbandonato in seguito alla conquista romana dell'area sul finire del IV-inizi III secolo a.C. (Cerasuolo & Pulcinelli, 2018).

METODI E MATERIALI

La raccolta del campione faunistico, in totale 2798 resti ossei, è stata effettuata in modo molto accurato, attraverso la raccolta anche dei frammenti ossei di più minute dimensioni tramite setacciatura manuale effettuata con setaccio a maglie di 1 cm per lato.

L'identificazione è stata effettuata tramite l'ausilio di manuali specifici (Prummel & Frisch, 1986; Barone, 1995; Bailon, 1999; Zeder & Lapham, 2010; Zeder & Pilaar, 2010; Cornevin & Lesbre, 2018) e, ove necessario, attraverso confronto diretto con la collezione osteologica "Borzatti" presso l'Università degli Studi di Firenze.

Il calcolo degli indici quantitativi NR, NME ed in particolare il NMI è stato determinato considerando il lato destro e sinistro in rapporto all'età rilevata (Payne, 1973; Bull & Payne, 1982; Grigson, 1982; Grant, 1982).

Il calcolo della resa in carne per ciascuna delle specie di mammiferi domestici principali è stato effettuato moltiplicando il numero minimo di individui per gli indici forniti da Flannery, Vigne e Delussu (Flannery, 1969; Vigne, 1991; Delussu, 1997): il dato finale è stato quindi ricavato attraverso la media aritmetica dei valori ottenuti attraverso l'applicazione degli indici indicati dai tre studiosi.

Le misurazioni degli elementi ossei interi e frammentati sono state condotte considerando le indicazioni fornite da Driesch (1976).

Le tracce, sia di natura antropica che dovute all'azione di carnivori e roditori, che dovute all'esposizione al fuoco, sono state identificate con un esame visivo macroscopico e l'ausilio di lenti d'ingrandimento.

È stato effettuato un primo confronto con siti coevi (La Civita, Tarquinia, Narni) e simili per caratteristiche sia in area Laziale che nel resto della penisola alla ricerca di possibili indicazioni per le future ricerche: l'analisi è in corso di studio.

ANALISI DEL CAMPIONE FAUNISTICO

Nel corso di una serie quasi ininterrotta di campagne di scavo, effettuate dal 1996 al 2018, sono stati rinvenuti strutture relative all'abitato, materiali archeologici e un numero non esiguo di resti faunistici per un totale di 2798 resti interi e frammentati (Tabella 1, Figura 2).

Di questi ne sono stati identificati a livello tassonomico 566, di cui 376 come specie e genere.

Sono presenti 369 resti appartenenti a Mammalia; 22 resti appartenenti a Reptilia (in particolare a Testudinidae); 143 resti appartenenti a Amphibia, ordine Anura; 11 resti di uccelli, Aves, tra cui un omero di cornacchia nera, (*Corvus corone*) e 6 resti di gallo (*Gallus gallus*), 4 di questi ultimi rinvenuti all'interno del *dolium* nell'area 1000 (Tabella 1).

La maggioranza dei resti, a causa dell'estrema frammentarietà riscontrata, è stata inserita nel calcolo degli elementi ossei indeterminabili, in massima parte attribuibili a Mammalia.

Sono presenti le tre specie principali di mammiferi domestici: il maiale (*Sus domesticus*) con 172 resti, i caprovini (*Ovis* vel *capra*) con 97, e il bue (*Bos taurus*) con 37 resti.

Tra i caprovini 24 resti sono stati attribuiti alla capra (*Capra hircus*) e 4 alla pecora (*Ovis aries*).

Allo stato attuale della ricerca non è stato possibile accertare la presenza del cinghiale, sebbene considerando la morfologia territoriale sia molto probabile che la suddetta specie fosse presente; è analogamente plausibile ipotizzare la pratica dell'allevamento allo stato semilibero dei maiali domestici, adoperata tutt'oggi in aree del sud della penisola e della Sardegna.

È stato identificato un frammento di astragalo di cavallo (*Equus caballus*).

Sono stati individuati 8 resti appartenenti a un canide, di cui 5 nell'area 1000.

Cinque resti ossei di volpe (*Vulpes vulpes*) rivenuti nella area 7000 appartengono a un unico individuo, probabilmente morto per una caduta accidentale all'interno della cisterna (US 15 e US 16).

AREA	**0**	**1000**	**2000**	**2500**	**3000**	**4000**	**5000**	**6000**	**7000**	totale
Bos taurus	1	22	0	0	0	6	1	0	7	37
Sus domesticus	17	104	0	4	1	9	1	0	36	172
Ovis vel capra	2	50	0	0	0	4	3	0	10	69
Ovis aries	1	2	0	0	0	0	0	0	1	4
Capra hircus	1	17	0	0	0	0	0	0	6	24
Equus caballus	0	1	0	0	0	0	0	0	0	1
Vulpes vulpes	0	1	0	0	0	0	0	0	5	6
Cervus elaphus	0	6	0	0	0	0	0	0	0	6
Martes foina	0	0	0	0	0	0	0	0	12	12
Meles meles	0	0	0	0	0	0	0	0	14	14
Mammalia	0	12	0	0	0	1	0	0	2	15
Canidae	0	5	0	0	0	0	0	0	3	8
Reptilia	0	3	0	0	0	0	0	0	19	22
Aves	0	8	0	0	0	1	0	0	2	11
Anfibiae	0	1	0	0	0	0	0	0	142	143
IND	99	1554	1	2	1	186	3	2	406	2254
totale	121	1786	1	6	2	207	8	2	665	2798

TABELLA 1

NR dei *taxa* rinvenuti nel sito etrusco di Rofalco.

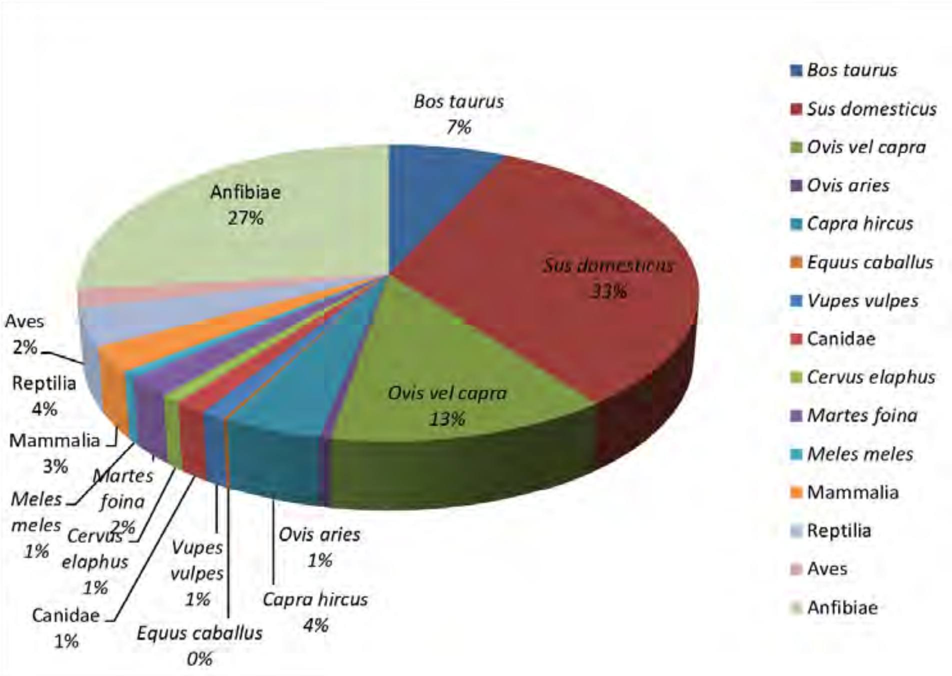

FIGURA 2

Frequenza del NR dei *taxa* rinvenuti nel sito di Rofalco.

Identificati 6 elementi di cervo (*Cervus elaphus*) due dei quali con abbondanti tracce di manipolazione antropica al fine di ottenere manufatti: due parti terminali di palco (pugnale) rinvenuti entrambi nell'area 1000. Si tratta di probabili immanicature per coltelli o punteruoli, non portati a completamento presumibilmente a causa della rottura accidentale della materia prima in fase di esecuzione. I due manufatti recano analoghe tracce di lavorazione ottenute anche tramite l'uso di sega.

Sono presenti numerosi resti di tasso (*Meles meles*) appartenenti ad un unico individuo e numerosi resti di un unico individuo di faina (*Martes foina*), entrambi rinvenuti nelle UUSS 14-15-16 dell'area 7000

(all'interno della cisterna): in assenza di tracce di lavorazione antropica, è possibile ipotizzare una morte per causa naturale, non correlata allo sfruttamento per scopo alimentare o simile da parte dell'uomo.

Tra i resti di maiale (NR 173) il 55% (96) sono resti appartenenti all'apparato craniale, comprendente 38 denti mascellari e 35 denti mandibolari; il 27% agli arti superiori (46); il 6% agli arti inferiori; il 5% alle falangi.

Tra gli elementi riconosciuti risultano assenti vertebre e costole, i cui minuscoli frammenti, sono stati conteggiati nel numero degli elementi indeterminati.

Per quanto riguarda il NMI (numero minimo individui) del maiale, calcolato sull'intero sito, tenendo separate le diverse aree, i resti appartengono a 19 animali (Tabella 2, Figura 4). Sono rappresentate tutte le classi di età con prevalenza degli animali uccisi entro i primi tre anni di vita (70 %) e con la presenza di alcuni individui più anziani (Payne, 1973; Bull & Payne, 1982). Il calcolo è stato effettuato considerando i molari, in particolare il M2, ovvero l'elemento più rappresentato nel campione osseo (Figura 5).

Area	*Bos taurus*	*Sus domesticus*	*Ovis aries*
0	1	3	1
1000	2	8	8
2000	0	0	0
2500	0	1	0
3000	0	1	0
4000	1	2	1
5000	1	1	1
6000	0	0	0
7000	1	3	4
totale	6	19	15

TABELLA 2

NMI di Bos, Sus e Ovis nelle diverse aree del sito di Rofalco.

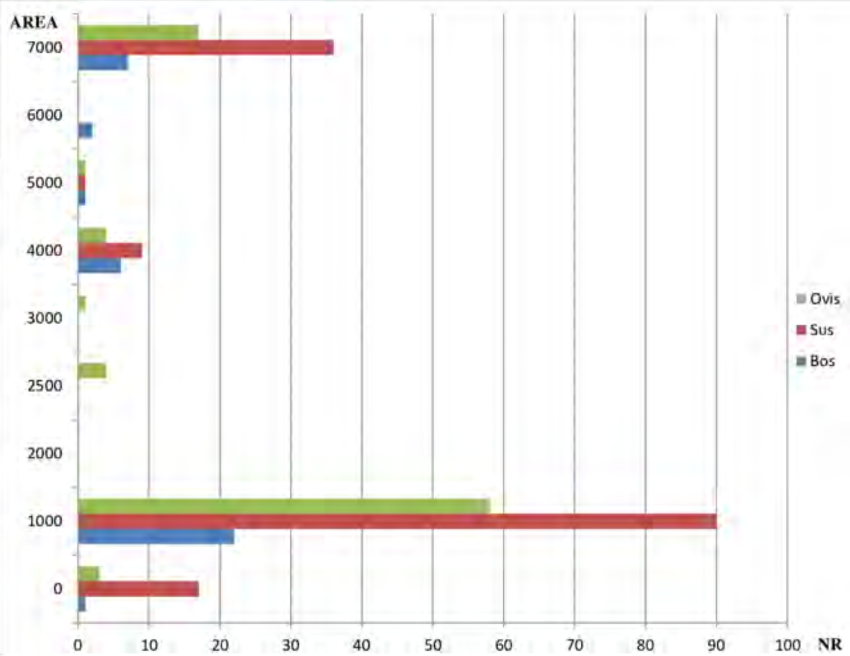

FIGURA 3

Frequenza del NR di *Ovis*, *Sus* e *Bos* nelle diverse aree di Rofalco.

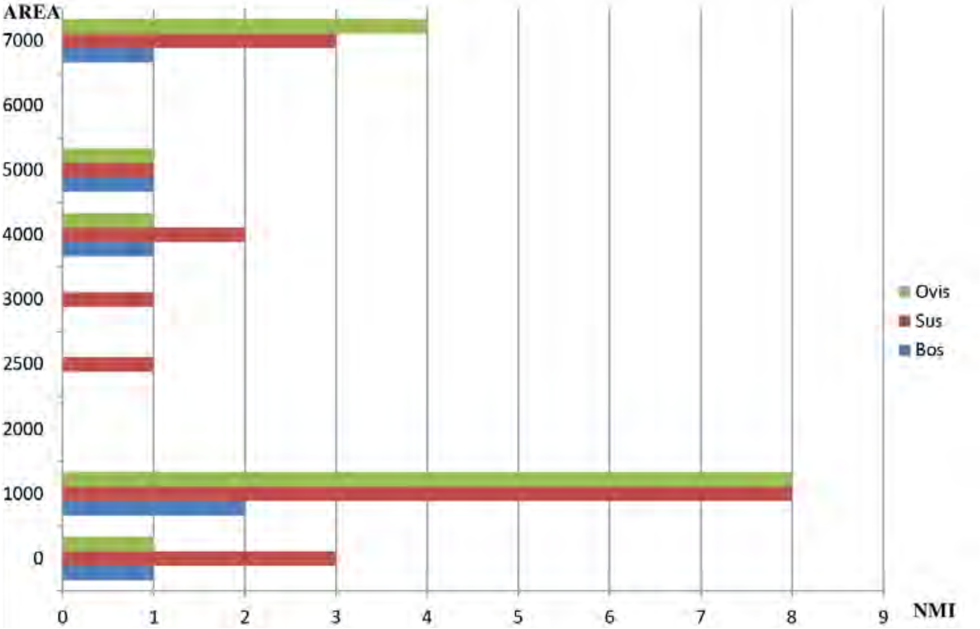

FIGURA 4
Frequenza del NMI dei tre principali animali domestici nelle diverse aree di Rofalco.

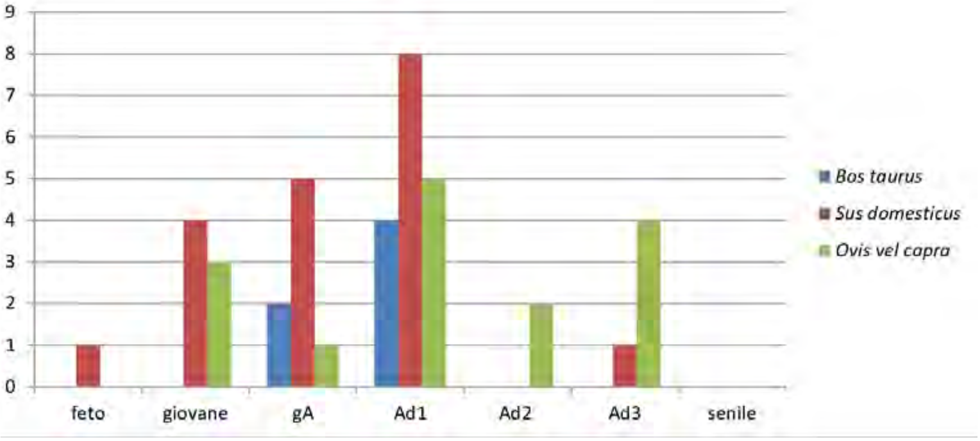

FIGURA 5
Mortalità per *Bos*, *Sus*, *Ovis* nel sito di Rofalco (Payne, 1973; Grigson, 1982; Bull & Payne 1982).

La presenza di caprovini (NR 99) è attestata con il 72% dei resti (71 resti) appartenente all'apparato craniale, con il mascellare testimoniato dalla presenza di denti (40) e il mandibolare (31 resti) con frammenti ossei e con 27 denti singoli.

Tra i resti identificati di caprovini, l'11% (11) degli elementi appartiene agli arti superiori; il 10% dei resti appartiene ad arti inferiori (10 resti) ed il 6% è costituito da falangi (6 resti).

Anche in questo caso sono attestate in numero esiguo frammenti di vertebre e costole, confluite nei frammenti indeterminati.

Per quanto riguarda il calcolo del NMI dei caprovini inerente l'intera area di scavo, i resti appartengono a 15 individui (Tabella 2, Figura 4) ascrivibili in base allo stato di usura dentaria di M1 ed M2, a tutte le classi di età (Payne, 1973; Bull & Payne, 1982) (Figura 5).

Il bue (NR 37) è attestato soprattutto per la presenza di resti appartenenti all'apparato craniale, rappresentato quasi esclusivamente dal ramo mandibolare con 17 resti, ovvero il 42% del totale; il 16% dei resti (7 resti), appartiene agli arti superiori, il 27 % appartiene agli arti inferiori (10 resti) e 3 prime falangi integre (gli unici elementi interi del campione).

I resti di bue appartengono a sei individui (Tabella 2, Figura 4): il calcolo del NMI è stato effettuato su M2 e M3,gli elementi maggiormente presenti nel campione (Payne, 1973; Bull & Payne, 1982) (Figura 5).

RISULTATI E DISCUSSIONI

Risulta evidente l'estrema frammentarietà del campione e la grande quantità di denti integri o frammentari, con 151 resti appartenenti alle specie domestiche presenti. Tale peculiarità può trovare giustificazione nella particolare giacitura e nella formazione del deposito.

I resti sono stati rinvenuti per la massima parte in ambienti a carattere residenziale o impiegati a fini produttivi in strati sotto pavimentali o battuti di piano da calpestio, o in strati formatisi in seguito all'abbandono del sito. Allo stato attuale delle indagini archeologiche non è stato rinvenuto un vero e proprio "butto" o un immondezzaio che avrebbe potuto fornire maggiori informazioni in merito allo sfruttamento delle risorse animali, sebbene i dati finora raccolti consentano di ottenere un primo quadro sull'alimentazione degli abitanti dell'insediamento.

Il rapporto delle tre specie domestiche principali nelle diverse aree dell'insediamento risulta abbastanza evidente con una prevalenza del maiale seguito dai caprovini e dal bue (Figura 3). L'area 1000 ha restituito il maggior numero dei resti rinvenuti.

Considerando il numero minimo degli individui NMI in tutta l'area del sito risulta prevalere il maiale, seguito dai caprovini e dal bue (Figura 4, Tabella 2). I dati delle analisi dei campioni provenienti dalle singole aree individuate sono riportati in Supplementary material 1.

Molto interessante la presenza di alcuni accumuli di materiale osseo nell'area 1000 ritenuti indizi di attività rituali all'interno dell'insediamento e quindi considerati contesti chiusi come l'US 1068, probabile fossa rituale, il dolio, e gli strati sottostanti l'edificio 2, probabili accumuli di fondazione (Cerasuolo, 2019; Papa, 2019-2020).

Il maggior contributo carneo è fornito dal maiale, animale di facile allevamento, dal bue e in minima parte dai caprovini (Tabella 3).

Tra i caprovini è maggiormente rappresentata la capra sebbene sia presente anche la pecora: oltre il 60% degli animali è stato abbattuto nei primi tre anni di vita, principalmente per lo sfruttamento carneo ma con un discreto interesse per i prodotti secondari, quali ad esempio latte e lana nel caso della pecora.

Quasi nullo il contributo di specie selvatiche attestate attraverso alcuni resti di cervo.

Importante è la presenza di resti di volatili attribuibili al gallo domestico.

La presenza di resti di testuggine terrestre *Testudo hermanni,* in massima parte appartenenti allo scheletro, è giustificabile ipotizzando lo sfruttamento alimentare di questo animale probabilmente catturato nei dintorni dell'insediamento.

Le analisi tafonomiche dei resti ossei hanno contribuito a formulare alcune considerazioni.

Su 22 elementi ossei appartenenti soprattutto alle tre specie domestiche principali sono state individuate tracce di intervento umano con tagli singoli e ripetuti per ottenere lo spellamento e le recisione dei tendini nonché fendenti per depezzare le carcasse. Il maiale sembra aver subito la maggiore opera di lavorazione con frequente presenza di chop marcks sulle parti mirate al depezzamento delle carcasse e riduzione in porzioni più piccole;

Resa in carne	**Flannery 1969**		**Vigne 1991**		**Delussu 1997**		**media**	
	Kg	%	Kg	%	Kg	%	Kg	%
Bos taurus	2000	54	1600	41	800	36	1466,7	45
Sus domesticus	1330	36	1900	48	1140	52	1456,7	44
Ovis vel *capra*	375	10	450	11	270	12	365	11
totale	3705	100	3950	100	2210	100	3288,3	100

TABELLA 1

Resa in carne dei tre principali domestici nel sito di Rofalco.

rare tracce di analoga natura sono state individuate su resti di caprini e bue.

Su 21 frammenti, tra i quali anche il frammento di astragalo di cavallo, si riscontrano evidenze di biancastre e nerastre dovute all'azione del fuoco.

Nella considerazione che l'insediamento sia stato interpretato quale luogo di immagazzinamento e stoccaggio alimentare (Cerasuolo, 2019; Papa, 2019-2020), è possibile ipotizzare che soltanto una parte della carne abbia subito una prima manipolazione *in loco* per il consumo degli abitanti e che la restante parte (presumibilmente la maggior quantità), venisse trattata, inviata e consumata altrove all'interno dell'area vulcente, alla quale il sito di Rofalco era collegato.

Soltanto su un frammento indeterminato di osso piatto si riscontrano tracce di rosicchiature: l'assenza di azioni di animali commensali sui resti ossei evidenzia la veloce obliterazione dei resti, evidentemente non abbandonati o non facilmente raggiungibili da roditori o carnivori.

CONCLUSIONI

Alla luce dei dati a nostra disposizione possiamo affermare che la maggioranza dei resti faunistici rinvenuti appartiene alle tre specie domestiche principali, cioè a maiale, caprovini e bue. Tra i caprovini la maggioranza degli animali era abbattuta in età adulta, per lo sfruttamento carneo ma anche per la produzione di prodotti secondari.

Sono resti appartenenti in maggioranza all'apparato craniale e appendicolare in particolare per le specie di media grandezza come i suini e i caprovini. Tale dato potrebbe indicare che gli animali giungessero interi nell'insediamento dove venivano manipolati per essere consumati dagli abitanti o porzionati, trasportati e consumati all'esterno dell'insediamento.

L'ipotesi di una fase intermedia di sistemazione dell'insediamento (Cerasuolo, 2019) attraverso la regolarizzazione del piano roccioso con l'uso di grandi quantità di terra riportata, sembrerebbe giustificare l'estrema frammentarietà dei resti ossei, presumibilmente prelevati insieme alla terra da apposite aree di immondezzaio ed adoperati per il livellamento delle superfici.

I mammiferi selvatici risultano essere assenti ad esclusione di pochi resti appartenenti al cervo, tra cui frammenti di palco lavorati.

L'area più importante dal punto di vista dell'abbondanza e della diversità dei resti è l'area 1000 (soprattutto l'ambiente 1) dove si concentrano, negli strati interessati da attività di vita e costruzione, la maggior parte dei resti rinvenuti e da dove provengono anche i due frammenti di palco con tracce di sega e taglio.

Da evidenziare in quest'area l'US 1068, interpretata come probabile fossa rituale, dove sono attestate le tre specie domestiche principali ed una serie di UUSS che colmavano e appiattivano l'area 1000: strati di fondazione per gli ambienti sovrastanti (Papa, 2019-2020), dove si concentrano la maggior parte dei resti faunistici rinvenuti e che costituiscono la testimonianza più precoce di occupazione della zona (Supplementary material 1).

Interessante anche l'area 7000 in cui i resti si concentrano negli strati archeologici dovuti a attività di abbandono e distruzione dove sono stati rinvenuti all'interno della cisterna tre individui quasi completi appartenenti a carnivori di medio-piccole dimensioni (tasso, volpe, martora) finiti forse accidentalmente all'interno di essa e resti appartenenti ad anfibi, probabili indizio di abbandono dell'area abitata.

Si attende il proseguimento delle indagini per acquisire ulteriore documentazione e contribuire a chiarire nuovi aspetti della vita all'interno dell'insediamento.

BIBLIOGRAFIA

BAILON, S. 1999: Différenciation ostéologique des Anoures (Amphibia, Anura) de France. In: *Fiches d'Ostéologie Animale pour l'Archéologie*. Centre National del la Recerche scientifique (CNRS). Editions APDCA, Juan-les-Pins.

BARONE, R. 1995: *Anatomia comparata dei mammiferi domestici*. 1, Osteologia (Italian edition by R. Bortolani, E. Callegari). Il Sole 24 Ore - Edagricole, Bologna.

BULL, G. & PAYNE, S. 1982: Tooth eruption and epiphyseal fusion in pigs and wild boar. In: Wilson, B.; Grigson, G. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. B.A.R. (International Series). Oxford.

CERASUOLO, O. 2019: Fortificazioni di epoca tardo etrusca nel territorio vulcente. Vulci, Ghiaccio Forte e Rofalco. In: Cardosa, M. (ed.): *Le Antiche Mura "Etrusche" di Orbetello. Atti della Tavola Rotonda*: 173-190. Effigi, Arcidosso.

CERASUOLO, O. & PULCINELLI, L. 2018: The Etruscan fortress of Rofalco. Twenty years of excavation and outreach activities. In: *The Archaeology of Death. Papers in Italian Archaeology* VII: 172-180. Archaeopress, Oxford.

CORNEVIN, CH. & LESBRE, F.X. 2018: Caractères ostéologiques différentiels de la chèvre et du mouton. *Bulletin de la Société d'anthropologie de Lyon*.

DELUSSU, F. 1997: Le faune dell'età del Bronzo del nuraghe Miuddu. *Rassegna di Archeologia* 14: 189-204.

DRIESCH, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletins, Harvard University. MA.

FLANNERY, K.W. 1969: Origin and ecological effect of early domestication in Iran and near East. In: Ucko, P.J. & Dimbleby, G.W. (eds.): *The Domestication and Exploitation of Plants and Animals*: 73-100. London.

GRANT, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 91-108. B.A.R. (International Series). Oxford.

GRIGSON, C. 1982: Sex and age determination of some bones and teeth of domestic cattle: a review of literature. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*,: 7-23. B.A.R. (International Series). Oxford.

PAPA, C.M. 2019-2020: *L'abitato etrusco di Rofalco nel territorio di Vulci: aspetti funzionali di alcuni ambienti nella zona occidentale dell'insediamento*. Tesi di laurea, Sapienza Università di Roma, Roma.

PAYNE, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 33: 281-303.

PRUMMEL, W. & FRISCH, H.J. 1986: A guide for the distinction of species, sex and body side in bones of sheep and goat. *Journal of Archaeological Science*: 567-577.

VIGNE, J.D. 1991: The meat and offal weight (MOW) method and the relative proportion of ovicaprine in some ancient meat diets of the north-western Mediterranean. *Rivista di Studi Liguri* 57: 21-47.

ZEDER, M.A. & LAPHAM, H.L. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science*: 1-19.

ZEDER, M.A. & PILAAR, S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science*: 225-242.

MATERIALE SUPPLEMENTARE I

IL CONTESTO ARCHEOLOGICO

Il sito etrusco di Rofalco è un insediamento fortificato dotato di cinta muraria difensiva costituita da grandi blocchi litici irregolari, corredata di tre torri difensive a pianta quadrangolare. All'interno dell'abitato sono state identificate alcune aree interpretate come ambienti con usi specifici, tra cui magazzini e abitazioni (Figura 1).

Avamposto militare nel territorio vulcente, atto al controllo del territorio e all'immagazzinamento di derrate alimentari, l'abitato venne distrutto e abbandonato in seguito alla conquista romana dell'area sul finire del IV-inizi III secolo a.C. (Cerasuolo & Pulcinelli 2018).

LE AREE E I RESTI FAUNISTICI

Nel corso delle lunghe campagne di scavo archeologico il sito è stato suddiviso in aree di scavo denominate con un numero progressivo. All'interno di ogni area e di ogni ambiente rintracciato all'interno della stessa, sono state riconosciute le unità stratigrafiche, lo studio delle quali, divise in base ai rapporti tra le stesse e ai materiali rinvenuti all'interno, ha condotto all'individuazione di tre fasi di frequentazione: di costruzione, vita e abbandono dell'abitato.

L'analisi faunistica ha contribuito all'interpretazione, ove possibile, dello sfruttamento degli spazi insediativi.

L'area 0 (Figura 1), interpretata quale zona abitativa, ha restituito un numero esiguo di resti faunistici, 22 identificati e 99 indeterminati tutti appartenenti alla classe dei Mammalia (Tabella 1).

Nell'ambiente 7 sono stati rinvenuti la maggior parte degli elementi ossei interi e frammentari, negli strati relativi a fasi di costruzione e di vita (UUSS 40-48-53-109-259-263).

In particolare sono attestati: il maiale (*Sus domesticus)* con 17 resti, i caprini (*Ovis* vel *capra*) con 3, di cui uno di capra e il bue (*Bos taurus*) con un resto.

I resti ossei di maiale appartengono a tre individui (Tabella 2) di cui uno di età inferiore ai 12 mesi, uno di 18/24 mesi e uno di 4/6 anni.

I caprini sono rappresentati da un individuo adulto di età superiore ai 4 anni ed il bue da un individuo adulto di età superiore ai due anni.

L'area 1000, interpretata quale zona abitativa, è l'area che ha restituito il maggior numero di resti ossei: 232 resti faunistici identificati e 1554 indeterminati appartenenti a Mammalia (Tabella 1), ovvero 104 resti (cranio ed arti) di maiale (*Sus domesticus*) di varie età, tra cui due elementi con tracce di lavorazione; 69 resti di caprini (*Ovis vel capra*), appartenenti ad apparati craniale e appendicolare e soltanto un frammento di diafisi di metatarso con un taglio trasversale; 22 resti di bue (*Bos taurus*) appartenenti a denti ed arti.

Sono presenti anche un astragalo combusto di cavallo (*Equus caballus*) e 6 resti di cervo (*Cervus elaphus*), tra cui due porzioni di pugnale, sezionate, con tracce di lavorazione, entrambe rinvenute nell'ambiente uno.

L'ambiente 1 è l'ambiente che ha restituito il più alto numero di resti identificati per un totale di 151. L'ambiente 2 ha restituito 34 resti. L'ambiente 3, 20 resti di cui la zona 3F, 11 resti. L'ambiente 4 soltanto 3 resti.

Si è proceduto ad ulteriore analisi dei resti considerando le differenti attività a cui è possibile riferire le UUSS identificate in fase di scavo archeologico, collocandole in due gruppi: il primo comprendente le tre attività di vita zero, vita e costruzione, preponderanti in quest'area; il secondo comprendente le due attività di distruzione e abbandono (Papa, 2019-2020).

Sono state identificate, all'interno del primo gruppo di attività, alcune UUSS, in particolare la 1068 (amb.2) ovvero fossa rituale di fondazione, e le UUSS 35, 59, 65, 70, 73, 75, concentrate al di sotto dell'ambiente (amb.1), interpretabili quali riporto di terra (probabilmente prelevata presso un antecedente accumulo di materiali di scarto) realizzato per livellare la zona propedeuticamente all'uso successivo della superficie ottenuta. Si tratta delle UUSS in cui si concentra la maggior parte dei resti peraltro eterogenei, interpretabili quali le più antiche attestazioni di frequentazione dell'abitato.

Nell'US 1068 (amb.2) nel riempimento di una fossa interpretata quale rituale, oltre a resti ceramici e ad un peso da telaio con iscrizione, sono stati rinvenuti 346 resti faunistici di cui 33 identificati.

Sono presenti soltanto le tre specie domestiche principali, bue (*Bos taurus*) con 2 resti, maiale (*Sus scrofa*) con 18 e i caprini (*Ovis* vel *capra*) con 13. Considerando la fossa come contesto chiuso il NMI (Payne 1973) vede la presenza di un individuo di bue giovane e di un adulto di 2/3 anni, tre di capra di cui un giovane di 6/12 mesi, un giovane adulto di 12/24 mesi, e un adulto di 3/6 anni e tre maiali di cui uno molto giovane, un giovane di 12/15 mesi e un adulto di 20/24 mesi (il calcolo del numero minimo di individui è stato effettuato per ogni specie a partire dall'elemento anatomico più rappresentato, tenendo conto di ogni altro dato discriminante come l'età, il sesso e le dimensioni).

Le UUSS 35, 59, 65, 70, 73, 75, qui considerate per la loro condizione di giacitura secondaria (riporto di terra per livellamento) come un unico contesto, hanno restituito tra gli altri materiali archeologici 748 resti ossei di cui 107 identificati. Sono presenti il maiale (*Sus domesticus)* con 57 resti (5 animali, un giovane, un giovane adulto, due adulti di prima, un adulto di seconda e dall'analisi dei canini un maschio e una femmina); i caprini (*Ovis* vel *capra*) con 30 resti (1 giovane di età minore di 12 mesi, 3 adulti di 2-3 anni e 1 di 4-6 anni), 6 resti appartengono a capra; il bue *(Bos taurus*) con 18 resti (3 animali, uno giovane, un giovane adulto, un adulto di prima) e 5 resti di un canide, un resto di cervo e 3 frammenti attribuiti a Reptilia.

Dall'ambiente 1 provengono i resti rinvenuti all'interno di un dolio seminterrato (US 1071): si tratta di 6 resti ossei appartenenti a un individuo di maiale adulto (esclusivamente resti craniali), di una porzione di metapodio di capra, di quattro metapodi di gallo e resti di roditore (probabilmente intrusivi).

La deposizione di tipo rituale dell'anforetta (US 1003) all'interno della nicchia nel muro (US 1010) è accompagnata dall'offerta di resti animali: un frammento di cranio di maiale adulto e due frammenti di cranio di un caprino adulto (3-6 anni).

La restante stratigrafia all'interno dell'area 1000 ha restituito 46 resti identificati, comprendenti due denti di bue, uno di un giovane e uno di adulto di prima; il maiale con resti appartenenti a un feto, a un giovane e a un adulto di prima; i caprini con un giovane, un giovane adulto (1-2 anni) e tre di seconda (3-4 anni) di cui capra con un giovane adulto e uno di seconda.

Le aree 2000-2500-3000 sono state considerate nell'insieme come aree adibite a magazzini ed hanno restituito scarsi resti di fauna (Tabella 1). Tra i taxa identificati nel totale del campione è presente soltanto il maiale (*Sus domesticus*).

L'area 2500 ha restituito 4 resti di maiale (pelvis, scapola, tibia, cranio) appartenenti a un grande individuo adulto di 2/3 anni, sui quali sono assenti tracce di lavorazione.

L' area 3000 ha restituito soltanto un premolare deciduo di maiale appartenente a un giovane di età inferiore ai 12 mesi.

L'area 4000, l'area intorno alla porta nord-est dell'insediamento, ha restituito 21 resti identificati di mammiferi e 186 indeterminati (Tabella 1).

Sono presenti il maiale (*Sus* domesticus) con 9 resti, il bue (*Bos taurus*) con 6 resti, i caprini (*Ovis* vel *capra*) con 4 resti e la cornacchia nera (*Corvus corone*) con 1 solo resto.

Dall'ambiente 6 provengono la maggior parte dei resti, 12 dei quali identificati; dall'ambiente 1 provengono 4 resti di bue: un premolare, un carpale e due falangi. Anche per questa area seppur scarsamente rappresentata dal punto di vista dei resti faunistici, si è proceduto ad ulteriore analisi dei resti considerando le differenti attività a cui è possibile riferire le UUSS identificate, inserendole in due gruppi: il primo con attività di vita, costruzione e vita zero; il secondo gruppo con attività di distruzione e abbandono.

Le UUSS 10-13-15-30-33 appartenenti al primo gruppo, hanno restituito la maggior parte dei resti faunistici.

I resti ossei di maiale appartengono a due individui di cui uno giovane adulto di 12- 24 mesi e un adulto di 2/3 anni; i resti ossei di caprini appartengono ad un individuo adulto di 2/3 anni e quelli di bue a un individuo adulto di 24-36 mesi di età (Tabella 2).

Nell’area 5000 sono stati rinvenuti resti ossei di bue appartenenti ad un individuo di 24/36 mesi; i resti di suino di un giovane adulto di 2/3 anni e i resti di caprini appartenenti ad un individuo di 3/4 anni di età (Tabella 1).

L’area 7000, area in cui insiste la cisterna in blocchi litici, ha restituito 94 resti identificati a livello di specie di mammiferi e 406 indeterminati.

Tra i determinati 19 resti di Reptilia, in massima parte appartenente a tartaruga terrestre, 142 resti di anfibi, dell’ordine Anura, nonché 2 resti di uccelli (Tabella 1).

Tra i mammiferi provenienti dalle UUSS 11,13,14,15, sono stati identificati il maiale (*Sus domesticus*) attestato con 36 resti (alcuni con presenza di tracce di tagli e fendenti), i caprini (*Ovis* vel *capra*) con 14 resti ed il bue (*Bos taurus*) presente con 7 resti, recanti tagli e tracce di lavorazione. I resti ossei del maiale appartengono a 3 individui, uno di età inferiore a 12 mesi, uno di 24-28 mesi, uno di 30-40 mesi; di caprini a 4 individui, due di 2-3 anni, uno di 3-4 anni e uno di 18-20 mesi; di bue a un individuo adulto di 20-30 mesi di età (Tabella 2).

All’interno dell’US 49, sono stati rinvenuti 4 resti di mandibola e alcuni frammenti di diafisi di omero, radio e tibia, di un individuo giovane di ovicaprino tutti con ampie tracce di combustione.

Il gallo (*Gallus gallus*) è stato identificato attraverso una epifisi distale di femore rinvenuta nel US 3.

All’interno dell’UUSS 13,14,15,16 (cisterna) sono presenti 79 resti di tasso (*Meles meles*) e nel US 15, sono presenti 59 resti ossei appartenenti ad uno scheletro quasi completo di faina (*Martes foina*). Nell’interno dell’ US 16 sono stati rinvenuti resti di un canide, tra cui 3 vertebre, associati a 5 resti di volpe (*Vulpes vulpes*).

E’ molto probabile che si tratti di animali caduti accidentalmente o gettati all’interno della cisterna: sui resti ossei di questi esemplari non sono state rinvenute tracce di intervento umano di alcun tipo.

Dall’interno della cisterna, provengono resti di Anura rinvenuti in gran quantità (142): la rana esculenta (*Pelophilax esculenta*), e il rospo smeraldino (*Bufo viridis*), il discoglosso sardo (*Discoglossus sardus*).

Si è proceduto ad ulteriore analisi dei resti considerando le differenti attività a cui è possibile riferire le UUSS identificate, ascrivendole a due gruppi, attestanti le attività di vita, di costruzione e vita zero e attività di distruzione e abbandono. La maggior parte delle unità stratigrafiche dell’area appaiono riferibili alle fasi di distruzione e abbandono dell’insediamento.

La cisterna è stata colmata in più fasi da un interro formatosi durante le fasi di distruzione di abbandono del sito.

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Note on the Roman non-volant vertebrates (1st century A.D. - 4th century A.D.) of the Italian presidential preserve of Castelporziano (Rome)

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ABSTRACT: We conducted an analysis in April 2000 on a sample of osteological remains (258 cranial bones and teeth and 15 fragments of plastrons) of non-volant vertebrates recovered from the Roman site of *Vicus Augustanus* (1st century A.D. - 4th century A.D.) within the area of the extant presidential preserve of Castelporziano (Rome). Domestic mammals (96%) represent most of the identified remains (n=242). Among wild vertebrates we determined the presence of tortoises, hares, and red deer. Some of these species were also confirmed by MacKinnon in two unpublished reports of 2004 and 2010. We have compared the data obtained with those relating to the wild vertebrates currently present in the preserve.

KEY WORDS: *VICUS AUGUSTANUS*, HARE, DEER, WILD BOAR, TORTOISE, OSTEOLOGICAL REMAINS

RIASSUNTO: Un campione di resti osteologici (258 ossa craniche e denti e 15 frammenti di piastrone) di vertebrati non volatori recuperati nel sito romano di *Vicus Augustanus* (I secolo d.C. – IV secolo d.C.) all'interno dell'area dell'attuale riserva presidenziale di Castelporziano (Roma) è stato analizzato nell'aprile 2000. I mammiferi domestici (96%) costituiscono la maggior parte dei resti identificati (n=242). Tra i vertebrati selvatici abbiamo determinato la presenza di testuggini, lepri e cervi. Alcune di queste specie sono state confermate anche da MacKinnon in due rendiconti non pubblicati del 2004 e del 2010. Abbiamo messo in relazione i dati ottenuti con quelli relativi ai vertebrati selvatici attualmente presenti nella riserva.

PAROLE CHIAVE: *VICUS AUGUSTANUS*, LEPRE, CERVIDI, CINGHIALE, TESTUGGINE, RESTI OSTEOLOGICI

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The presidential preserve of Castelporziano (6.039 ha) is about 25 km from the centre of Rome. It is a unique area of high naturalistic value due to the elevated level of biodiversity and constitutes perhaps the most important coastal lowland forest in all of Italy, representing the last relict of the plant formation that dominated the area from Civitavecchia to the Monti Ausoni (Giordano *et al*., 2016). Within this preserve the small ancient Roman settlement of *Vicus Augustanus* rose in the Imperial Age and remained alive until Late Antiquity and the early Middle Ages. Environmental reconstructions for this site do not show any spread of woodland vegetation within the coastal strip of Castelporziano (Claridge, 2021). Throughout the Middle Ages and until today, a more natural landscape evolved in the area, gradually and partially replacing the previous landscape particularly affected by anthropic activities (Bellotti *et al*., 2018). *Vicus Augustanus* was excavated by a team from the Institute of Archaeology of Oxford, coordinated by Amanda Claridge. The osteological material collected during the 1986-2002 excavations has been recorded by Michael MacKinnon of the University of Winnipeg in two unpublished reports (2004 and 2010).

Our study aims to contribute to the knowledge of the non-volant vertebrates of the Roman age between the 1st century and the 4th century A.D. in the area of Castelporziano, and to compare our data with the extant fauna.

We have examined a sample of the whole faunal material collected in *Vicus* which has been made available to us by the Institute of Archaeology of Oxford. This sample consists of plastrons and mammal cranial bones and teeth, a type of remains generally more diagnostic to species level than post-cranial elements. The bulk of this faunal material (95%) derived from a massive dump located across Via Severiana, outside *Vicu*s, and from excavations within a building. Much smaller materials were excavated from a fountain within *Vicus*. The faunal material was principally retrieved by hand and sieving was no extensively employed. According to MacKinnon (2004) recovery biases have not significantly skewed the sample. The *taxa* were counted using NISP (number of identifiable specimens) and the data are reported in Table 1. This method counted individual teeth within mandibles or maxillae. Thus, a mandible fragment with 3 teeth provides a NISP count of “4” (i.e., 3 teeth, plus mandible piece itself, equals a total of “4”).

	Phase I	**Phase II**	**Phase III**
Domestic mammals			
Cattle		13	
Sheep/goat	5	55	4
Pig	8	125	21
Dog	1		
Wild mammals			
Red deer		6	
Wild boar or pig		2	
Hare	1	1	
Reptiles			
Tortoise		10	5
Unindentified	2	11	3
Total	17	223	33

TABLE 1

Teeth, cranial bones and plastrons from *Vicus Augustanus* (Castelporziano, Rome) in relation to the three recognised chronological phases. The number of identified remains (NISP) is reported per *taxa*.

Survey and excavation have established an overall chronology for the site and its physical development, from its foundation to its abandonment (Claridge, 2021). The osteological remains (Table 1) can be grouped into the following three phases: I - early Imperial phase (early 1st c. A.D.); II - Imperial phase (1st to 3rd c. A.D.) and III - late Antiquity phase (late 3rd to 4th c. A.D.). Phase II clearly dominates, representing 82% of all the osteological remains. The mammalian finds generally consist of remains of domestic animals (96%). Most of them are pigs, followed by domestic caprines. Remains of a small number of cattle, and a single dog were also found. According to MacKinnon (2004), few butchery marks were reported on domestic mammal remains while no signs of slaughter were found on those of the wild mammals. The low frequency of wild vertebrates (9%) is in stark contrast to the current ecological conditions of the preserve characterised by a high biodiversity. However, this low value is typical of other urban sites in central Italy during Imperial times. Similar values are noted for some near sites such as Ostia, Capua, and Cosa (MacKinnon, 1999).

We identified the following wild vertebrates.

Hermann tortoise *Testudo hermanni* Gmelin, 1789 - This species is regarded as the only tortoise native to the Italian peninsula (Masseti, 2011). Its occurrence is documented by 15 fragments of plastrons found in the ruins of a building, in a fountain and in the dump of Via Severiana. Currently the distribution of the species in continental Italy is less wide than in the past and more fragmented. Castelporziano represents one of the areas where the largest populations are found (Cheylan *et al.*, 2011).

Hare, *Lepus* sp. L., 1758 - A mandible fragment and one lower incisive have been referred to the genus *Lepus*. These remains did not allow us to proceed with the identification of the species as they do not show any diagnostic character (cf. Palacios, 1996; Riga *et al.*, 2001). According to the natural hare distribution in Italy, the brown hare *L. europaeus* Pallas, 1778 occupied the northern part of the peninsula while the Italian hare *L. corsicanus* De Winton, 1898, was dispersed in the southern mainland territories and Sicily (Trocchi & Riga, 2005). The latter has been introduced into Corsica and Elba in historical times (Palacios, 1996). The distribution of the two species overlapped in a wide area of central Italy between Siena and Rome up to the end of the 19th century (Palacios, 1996). Because of brown hare restocking programs that have released thousands of specimens into the wild over the last 50 years, currently *L. corsicanus* often coexists in sympatry with *L. europaeus*. This is not the case of the Castelporziano preserve, where only the Italian hare is present (Trocchi & Riga, 2001). Hare remains found in *Vicus Augustanus* were attributed by MacKinnon (2010) to *L. europaeus*. In our opinion these remains, as others of *Lepus* sp., need a complete systematic revision.

Wild boar or pig, *Sus scrofa* L., 1758 - Two very large canines were present in the sample. These teeth may have belonged to wild boar. Actually, also some adult pigs - sometimes even females - can show an exaggerated development of the tusks, as in the case of the "macchiaiola maremmana" breed still reared in the region of Monte Amiata (Grosseto), not so far from Castelporziano. The archaeozoological distinction between pigs and wild boars is a problem. Crossbreeding between the wild and the domestic form and the occurrence of feral populations add further difficulties. MacKinnon (2010) reports some osteological remains as belonging to wild boar but also suggests a depositional mixing due to the contamination of ancient contexts with more modern materials. Therefore, these remains should be considered as intrusive. Nowadays, the only form occurring within the presidential preserve is the wild one (Imperio *et al.*, 2012). Together with other Mediterranean populations, the wild boars of Castelporziano show a remarkable proportion of endemic genetic variation (Scandura *et al.*, 2022).

Red deer *Cervus elaphus* L., 1758 - Six permanent molars were found. Archaeozoological data indicate that this species is quite common in rural sites as well as in small settlements in Roman Italy (MacKinnon, 1999). Red deer are still present in the preserve today. The species has been reintroduced together with nilgai *Boselaphus tragocamelus* Pallas 1776, in 1889, when the estate was a hunting ground of the Italian royal family (Masseti, 2003). During the last World War the preserve was occupied by the German army for about six months. In this period all these ungulates completely disappeared (Emiliani, 1995). In 1948, Castelporziano became a hunting reserve for the President of the Italian Republic. In 1958, red deer were reintroduced again, some of these individuals were from the Piedmont reserve of La Mandria, where wapiti was introduced during the 19th century (Masseti, 2003). The new population of red deer was no longer subject to hunting (Imperio *et al.*, 2010).

The sample we examined contained no remains of roe deer *Capreolus capreolus* (L. 1758), a cervid today common at Castelporziano. MacKinnon (2004) reported only a mandible of this species with several deciduous teeth. Due to its good taphonomic condition, he hypothesised that this osteological fragment is a modern contaminant. If not, this would be the oldest specimen of the species discovered in the archaeological exploration of *Vicus Augustanus*. It cannot be excluded that it is also the oldest evidence so far available of *C. c. italicus*, the so-called Italian roe deer. Festa (1925) described this subspecies on the base of the examination of 7 specimens (3 males, 2 females and 2 subadults) obtained from the presidential preserve. This *taxon* is characterised by distinct morphology (Montanaro *et al.*, 2003) and unique genetic variants at both mitochondrial and nuclear markers (Lorenzini *et al.*, 2002; Mucci *et al.*, 2012).

It may also be interesting to note the absence of osteological remains of the common fallow deer *Dama dama dama* (L., 1758) from the sample we examined. This species is the deer today most widespread in Castelporziano. The oldest information available on its presence in the area of the extant preserve dates back to the beginning of the Late Middle Ages: "*The dammae of this Italian game park were reportedly appreciated in the twelfth century by Richard, the Lionheart, when he* *stopped there on his way back from Jerusalem"* (Masseti, 1996).

Archaeozoological data indicate that roe and fallow deer were not so common as red deer in rural sites as well as in small settlements in Roman Italy (MacKinnon, 1999). Probably for this reason remains of these species currently quite common in the presidential preserve have not been found in *Vicus Augustanus*.

The analysis of Roman osteological materials conducted at Castelporziano confirmed the results described by MacKinnon (2004, 2010). Domestic mammals tend to predominate over the wild ones as in other Roman archaeozoological assemblages of Italian sites. Red deer, hares and probably wild boars are represented by single elements accounting 4% of the total number of the identified specimens. It is worth noting that no osteological fragment has been referred to the common fallow deer or the Italian roe deer, the species most present today in the preserve. Future studies could investigate the occurrence of wild boar, Italian roe deer, common fallow deer and Italian hare among the mammalian material, and the genetic differences between the populations of the Roman period and those of present time.

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REFERENCES

BELLOTTI, P.; DAVOLI, L. & SADORI, L. 2018: Landscape diachronic reconstruction in the Tiber delta during historical time: a holistic approach. *Geografia Fisica e Dinamica Quaternaria* 41(1): 3-21.

CHEYLAN, M.; CORTI, C.; CARPANETO, G.M.; MAZZOTTI, S. & ZUFFI, M.A.L. 2011: *Testudo hermanni* Gmelin, 1789. In: Corti, C.; Capula, M.; Luiselli, L.; Razzetti, E. & Sindaco, R. (eds.): *Fauna d'Italia*. Vol. XLV. Reptilia: 188-199. Calderini-Edizioni Calderini de Il Sole 24 Ore S.p.A., Milano.

CLARIDGE, A. 2021: Il *Vicus Augustanus* e la questione dell'insediamento coloniale del Laurentino. In Il sistema ambientale della Tenuta presidenziale di Castelporziano: Ricerche sulla complessità di un ecosistema forestale costiero mediterraneo. *Accademia nazionale delle scienze detta dei XL. Scritti e documenti* 62(3): 889-992.

EMILIANI, G. 1995: La tenuta di Castelporziano. Cenni storici. Unpub. MS for Segretariato Generale per la Presidenza della Repubblica, Tenuta di Castelporziano.

FESTA, E. 1925: Il capriolo dell'Italia centrale (*Capreolus capreolus italicus* ssp. nov.). *Bollettino del Museo di Zoologia e Anatomia Comparata Università di Torino* 40: 1-2.

GIORDANO, E.; RECANATESI, F. & SCRINZI, G. 2016: La biodiversità forestale della Tenuta Presidenziale di Castelporziano. *Rendiconti Accademia Nazionale delle Scienze detta dei XL. Memorie di Scienze Fisiche e Naturali* 134, XL(II): 261-271.

IMPERIO, S.; FERRANTE, M.; GRIGNETTI, A.; SANTINI, G. & FOCARDI, S. 2010: Investigating population dynamics in ungulates: do hunting statistics make up a good index of population abundance? *Wildlife Biology* 16(2): 205-214.

IMPERIO, S.; FOCARDI, S.; SANTINI, G. & PROVENZALE, A. 2012: Population dynamics in a guild of four Mediterranean ungulates: density-dependence, environmental effects and inter-specific interactions. *Oikos* 121(10): 1613-1626.

LORENZINI, R.; LOVARI, S. & MASSETI, M. 2002: The re-discovery of the Italian roe deer: genetic differentiation and management implications. *Italian Journal of Zoology* 69: 367-379.

MACKINNON, M.R. 1999: Animal production and consumption in Roman Italy: the zooarchaeological and textual evidence. PhD thesis. University of Alberta, Canada.

— 2004: Castelporziano: Faunal Report – Years 1986-2002. Unpub report. Winnipeg University. 42 pp.

— 2010: Castelporziano: Report on Faunal Remains – 2004-2009 years. Unpub report. Winnipeg University. 19 pp.

MASSETI, M. 1996: The Postglacial diffusion of the genus *Dama* Frisch, 1775, in the Mediterranean region. *Supplemento alle Ricerche di Biologia della Selvaggina* 25: 7-29.

— 2003: *Fauna toscana. Galliformi non migratori, Lagormorfi e Artiodattili*. Agenzia Regionale per lo Sviluppo e l'Innovazione nel settore Agricolo-forestale (ARSIA)/Regione Toscana, Firenze.

— 2011: I rettili e l'uomo: elementi di archeozoologia ed etnologia. In: Corti, C.; Capula, M.; Luiselli, L.; Razzetti, E. & Sindaco, R. (eds.): *Fauna d'Italia*. Vol. XLV. Reptilia: 67-94. Calderini-Edizioni Calderini de Il Sole 24 Ore S.p.A., Milano.

Montanaro, P.; De Marinis, A.M.; Riga, F.; Focardi, S. & Toso, S. 2003: Variabilità craniometrica in alcune popolazioni italiane di capriolo. *Proceedings of the 4th Italian Conference of Theriology*, Riccione, Italy 6–8 November 2003.

Mucci, N.; Mattucci, F. & Randi, E. 2012: Conservation of threatened local gene pools: Landscape genetics of the Italian roe deer (*Capreolus c. italicus*) populations. *Evolutionary Ecology Research* 14: 897-920.

Palacios, E. 1996: Systematics of the indigenous hares of Italy traditionally identified as *Lepus europaeus* Pallas, 1778 (Mammalia: Leporidae). *Bonner Zoologische Beiträge* 46: 59-92.

Riga, F.; Trocchi, V.; Randi, E. & Toso, S. 2001: Morphometric differentiation between the Italian hare (*Lepus corsicanus* De Winton, 1898) and the European brown hare (*Lepus europaeus* Pallas, 1778). *Journal of Zoology* 253(2): 241-252.

Scandura, M.; Podgórski, T.; Vicente, J. & Iacolina, L. 2022: Wild Boar *Sus scrofa* Linnaeus, 1758. In: Corlatti, L. & Zachos, F. (eds.): *Terrestrial Cetartiodactyla, Handbook of the Mammals of Europe*: 1-27. Springer International Publishing, Cham.

Trocchi, V. & Riga, F. (eds.) 2001: Piano d'azione nazionale per la Lepre italica (*Lepus corsicanus*). Min. Ambiente - Ist. Naz. Fauna Selvatica. *Quaderni di Conservazione della Natura* 9.

— (eds.) 2005: I lagomorfi in Italia. Linee guida per la conservazione e la gestione. Min. Politiche Agricole e Forestali - Ist. Naz. Fauna Selvatica. *Documenti Tecnici* 25.

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The faunal remains in the Amphitheatre of Aquileia

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ABSTRACT: During the 2017 excavation season at the amphitheatre of Aquileia, carried out by the University of Verona, several faunal remains were recovered; these belonged, especially for US 147 and 153, to animals that were used in *venationes*, the hunting shows that took place in amphitheatres in Roman times. The faunal remains were characterised by a high degree of post-depositional fragmentation and, for this reason, in the Laboratory of Archaeozoology and Taphonomy of the University of Ferrara, they were patiently refitted. These remains were quantified, identified, measured and taphonomically analyzed. The process of identification of the faunal remains established the presence of domestic and wild fauna, such as bears, leopards and deer. These animals are commonly mentioned and depicted in literary and iconographic sources and have also been found in other amphitheatres where archaeozoological analyses were implemented. Animals from far away were used at Aquileia, with enormous expenses for capture, transport, and maintenance.

KEYWORDS: AMPHITHEATRE, AQUILEIA, *VENATIONES*, HUNTING SHOWS

RIASSUNTO: Durante le indagini di scavo del 2017 nell'anfiteatro di Aquileia, condotte dall'Università di Verona, sono stati rinvenuti dei resti faunistici che sembrano, soprattutto per quanto riguarda le UUSS 147 e 153, riconducibili agli animali che venivano impiegati nelle *venationes*, gli spettacoli di caccia che si svolgevano negli anfiteatri in epoca romana. I reperti erano caratterizzati da un'elevata frammentazione post-deposizionale, per questo, nel Laboratorio di Archeozoologia e Tafonomia dell'Università di Ferrara, sono stati sottoposti a un paziente lavoro di ricostruzione, che ha consentito la loro determinazione tassonomica, l'analisi osteometrica e tafonomica. La determinazione dei resti faunistici ha permesso di stabilire la presenza di faune domestiche e selvatiche, quali orso, leopardo e cervo. Animali che sono citati e raffigurati comunemente nelle fonti letterarie e iconografiche, e che sono stati trovati anche in altri anfiteatri oggetto di attente ricerche e analisi archeozoologiche. Evidentemente anche ad Aquileia arrivavano animali da lontano, con spese enormi per la cattura, il trasporto e il mantenimento.

PAROLE CHIAVE: ANFITEATRO, AQUILEIA, *VENATIONES*, SPETTACOLI DI CACCIA

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INTRODUCTION

Extensive research into literary sources[1], as well as iconographic sources, provides a great deal of information on the type of animals used in the *venationes*[2] and the methods adopted by the Romans for their capture (SI Figures 1, 2), which took place using nets, cages with bait and pits, and their transport (SI Figures 3, 4), which was done by means of cattle- or mule-drawn carts and sailing or rowing boats. Tame animals travelled simply tied, while the dangerous ones were put in cages with iron bars.

The iconographic sources depict not only scenes of the capture and transport of animals, amply described in the famous mosaic of the Great Hunt in the Villa del Casale in Piazza Armerina (Sicily, Italy), but also scenes of *venatio* (SI Figures 5, 6). The literary sources also provided significant information on the housing and number of animals used.

From 2015 to 2017, the University of Verona conducted archaeological excavations in the area of the amphitheatre of Aquileia (northeast Italy), within the state-owned land located at Palazzo Brunner (Basso, 2018). The overall dimensions and position of the public building within the urbanistic framework of Roman Aquileia were generally known, thanks to information from a series of excavations conducted in the eastern sector of the building from the 18th century until the 1940s. The excavations carried out by the University and the analyses conducted made it possible to reconstruct the general plan of the building and its history through time (Figure 1).

During the 2017 excavation season, several faunal remains were recovered. This paper presents the results of the archaeozoological and taphonomic analyses carried out on the faunal assemblage found at the amphitheatre of Aquileia.

MATERIALS AND METHODS

The faunal remains under consideration, especially those from US (stratigraphic units) 147 and 153, belonged to animals that were used in *venationes*, the hunting shows that took place in amphitheatres in Roman times. US 147, which yielded the largest amount of remains compared to the other US (76, 148, 151, 152 e 153), coincides with a level of abandonment found above the floor (US 153) of one of the radial rooms of the inner ray system of the amphitheatre. This room, characterised by a sandy beaten floor, seems to have been used as a *carcer* due to its location in the structure, or as one of the small enclosed rooms of the amphitheatres where animals were kept before being released into the arena, as confirmed by the discovery of faunal remains (Basso, 2018).

The iconographic data, together with those obtained from the archaeozoological analyses of faunal remains found in the Colosseum, in the amphitheatre of Viruno (Austria), and in other similar contexts (i.e., amphitheatre of San Benedetto ai Marsi, Abruzzo, central Italy and in that one of Serdica, Bulgaria) were compared with the animals recovered at Aquileia, highlighting the similarities and specificities of this case study.

The faunal remains found at Aquileia were characterized by a high degree of post-depositional fragmentation and, for this reason, they were patiently refitted; a large part of the specimens could be reconstructed, considerably reducing their number to a total of 163 (Table 1).

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[1] Apul. met. 4, 72; Calp. ecl. 7, 3; 23-84; Cass. Dio. 39, 38, 2; 43, 22-23, 1-3; 44, 26; 51, 22, 5; 53, 27; 54, 26, 1; 55, 10, 7-8; 56, 7; 60, 7; 62, 15, 5; 63, 9, 1; 66, 25, 4; 68, 15, 1; 72, 10, 3; 72, 18, 1; 72, 19, 1; 75, 16, 5; 77, 6, 2; 79, 9, 2; Caes. civ. 6, 28; Cic. fam. 7, 1, 3; 8, 8, 10; 8, 9, 3; Claud. carm. 3, 272-273; 305; 322; 325; 332; 339; 341; rapt. Pros. 3, 263-8; Cod. Theod. 15, 11, 2; Chrysost. hom. 59; Dig. 31, 1, 40-42; Diod. 1, 35, 5; 3, 36-37; 17, 90; Eliano 13, 10; 14, 10; 17, 26; Erodiano 1, 15, 2-6; Eutr. 7, 21, 4; Giov., *Saturae*, 4, 99; 12, 100-107; His. Aug. Aur. 17; Aurelian. 33-34; Carac. 5, 5, 9; Comm. 8-9; 12-13; 15, 3; Gall. 3; Gord. 3; 33, 1-3; Hadr. 3, 7; Pius. 10, 9; Prob. 19, 2-7; Sept. Sev. 14; Liban. oratione ad Artemis 14; Lucan. 10, 445-446; Liv. 39, 22, 2; 44, 18, 8; Mart., 1, 6; 14-15; 22-23; 28; 48-49; 51; 60; 104; epigram. 4; 8-14; 17-19; 26; 31; 35; 100; Nemes. cyn. 55-56; 307; Oppiano cyn. 1, 70-71; 1, 304; 1, 307; 1, 414; 3, 184; 3, 263; 4, 21; 4, 77-111; 4, 115; 4, 124; 4, 171-229; 4, 354-424; 4, 448; 9, 11-19; Or. carm. 3, 5, 32; Ov. met. 2, 187; 7, 701; Paus. 10, 13, 2; Plaut. Persa 199; Plin. epist. 6, 34, 3; Plin. nat. 8, 1-9; 8, 7, 20-22; 8, 17; 8, 20, 53; 8, 21; 8; 24, 64; 8, 25, 65; 8, 27, 69; 8, 28, 70; 8, 29, 71; 8, 30; 8, 34, 84; 8, 40, 96; 8, 44; 8, 50; 8, 52-53; 8, 70, 182; 8, 78-79; 8, 114; 19, 4; 36, 3, 45; 36, 40; Procop. 1, 22, 10; 23, 13-23; Senofonte cyn. 9, 11-19; Svet. Iul. 39, 4; Dom. 4, 1-2; Tit. 7, 3; Symm. epist. 2, 76; 7, 122; 9, 117; Tert. mart. 5; Varro. rust. 3, 13, 3; Vell. 2, 56.

[2] The literary sources are discordant regarding the term *venatio*, which can indicate fighting between animals, hunting by carnivores or by humans, and in some cases even the simple parade or exhibition of animals.

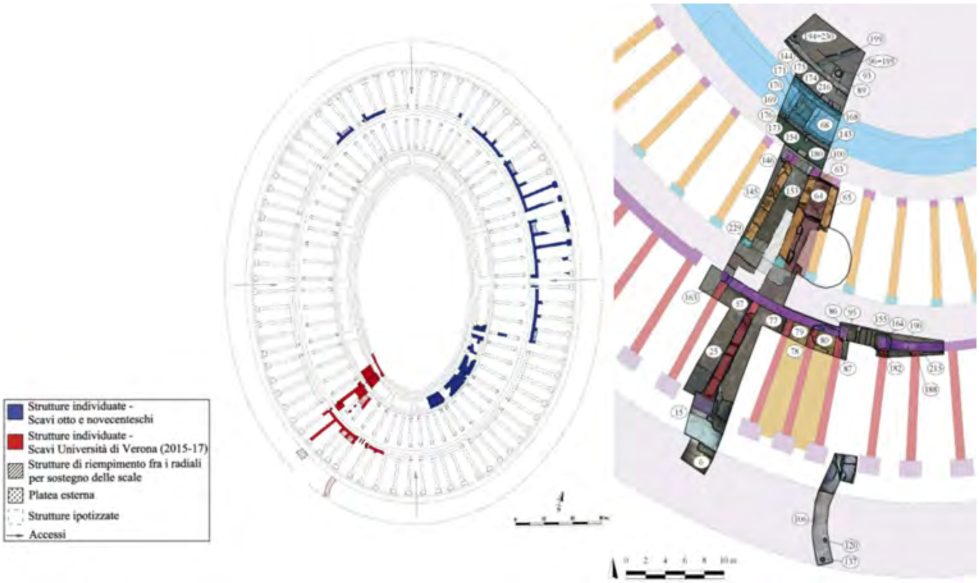

FIGURE 1

Plan of the amphitheatre and delimitation of the excavation area.

US	Taxa	NISP/NR	MNI
76	Cattle (*Bos taurus*)	4	1
	Goat (*Capra hircus*)	1	1
	Wild boar/pig (*Sus* sp.)	1	1
	Chicken	1	1
	Unidentified	3	-
	TOTAL	**10**	**4**
147	Horse (*Equus caballus*)	26	3
	Dog (*Canis familiaris*)	10	1
	Red deer (*Cervus elaphus*)	**2**	**1**
	Cattle (*Bos taurus*)	2	1
	Bear (*Ursus arctos*)	**2**	**1**
	Sheep/goat (*Capra/Ovis*)	11	2
	Wild boar/pig (*Sus* sp.)	2	1
	Unidentified	71	
	TOTAL	**126**	**10**
148	Horse (*Equus caballus*)	3	1
151	**Bear (*Ursus arctos*)**	**8**	**1**
	Horse (*Equus caballus*)	2	1
	Leopard (*Panthera pardus*)	**1**	**1**
	Dog (*Canis familiaris*)	2	1
	Unidentified	1	1
	TOTAL	**17**	**6**
152	Unidentified (TOTAL)	5	-
153	Cattle (*Bos taurus*)	1	1
	Unidentified	1	-
	TOTAL	**2**	**1**

Table 1

Composition of the faunal assemblages by stratigraphic unit, Number of Identified Specimen (NISP), Number of Remains (NR), and Minimum Number of Individuals (MNI). Wild animals in bold.

Bone remains were washed, marked and identified using the comparative collection of the University of Ferrara's Archaeozoology and Taphonomy Laboratory, as well as osteological atlases and reference literature (Pales & Lambert, 1971; Schmid, 1972; Barone, 1975; Hillson, 1996; Gentry *et al*., 2004). The faunal remains were quantified, using NISP and MNI indexes, and measured following Driesch (1976) and Eisemann *et al*. (1988).

As far as taphonomic analyses are concerned, the identification of traces was conducted by observation under a reflected light optical stereomicroscope (Leica MZ6) with photographic documentation (Lyman, 1994). The identification of wear traces was carried out according to Bendrey (2007 a, b) and Bendrey *et al*. (2013).

RESULTS

The identification of the faunal remains established the presence of wild taxa, such as bear, leopard and red deer, and domestic animals, such as dog, cattle, sheep/goat and horse. The most represented taxa are ungulates and carnivores (Table 1).

In US 76, traces of butchery were found on two remains of cattle and one horn core of goat in order to extract the horn (Figure 2).

In US 147, on the other hand, evident traces

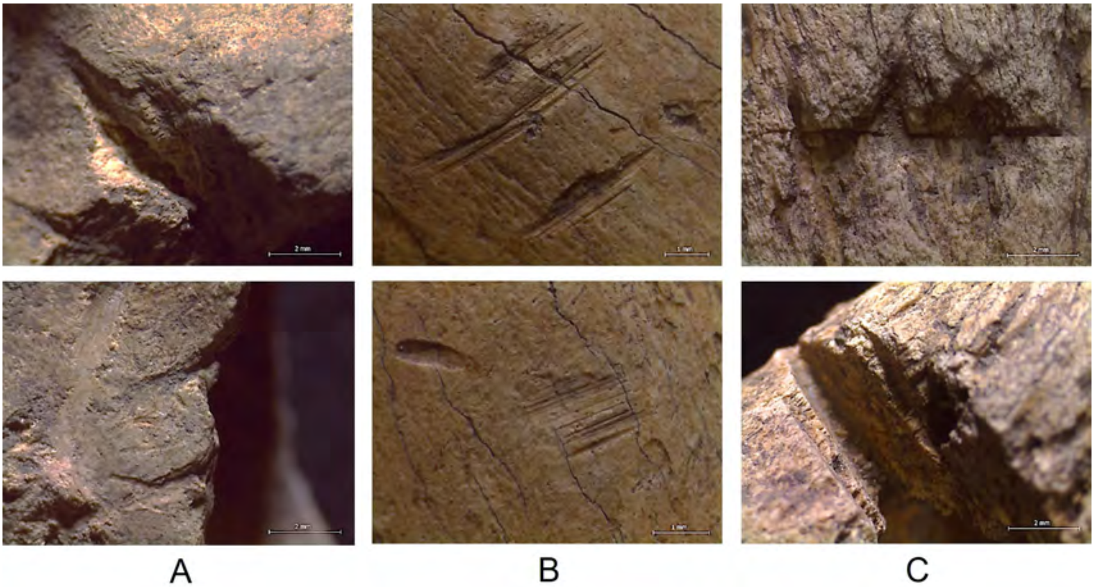

FIGURE 2

US 76. Butchery marks. A) Clean and fairly deep cuts on a first phalanx of cattle (*Bos taurus*); B) Series of short and deep striations on a cattle metacarpal; C) Chop-marks on a horn core of goat (*Capra hircus*).

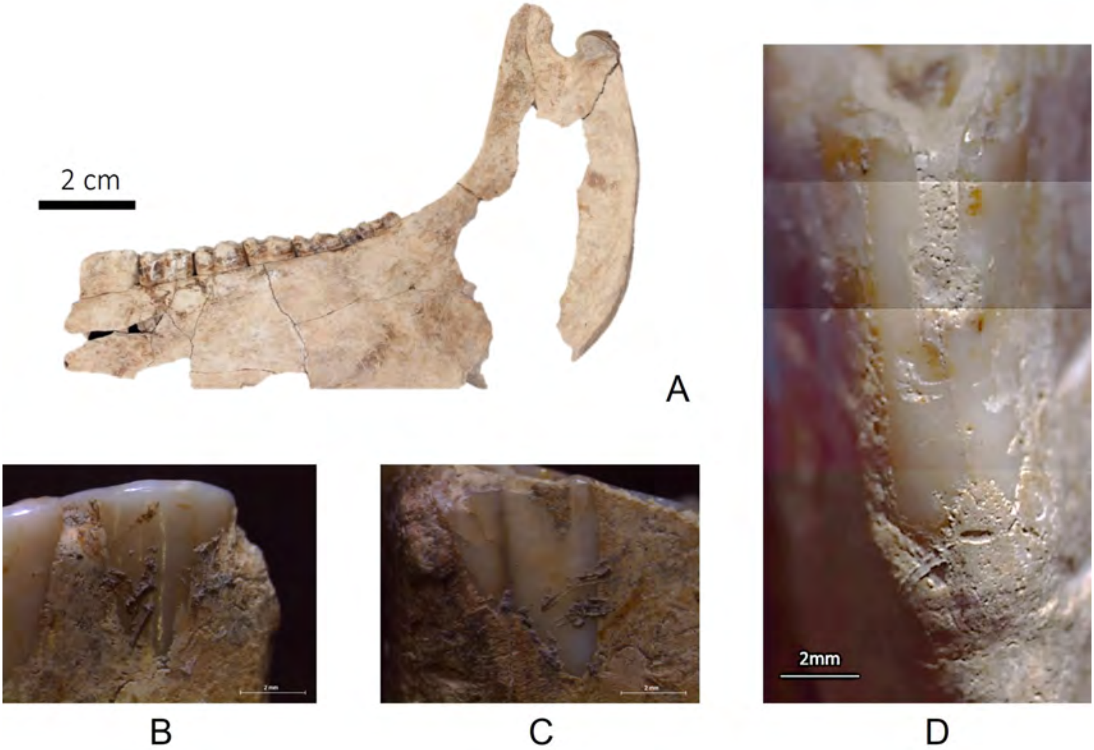

FIGURE 3

US 147. Traces of dental wear. Haemimandible of *Equus caballus* (A) with evident traces of use wear produced by the use of the bit in lingual view on the second lower premolar (B, C). In the front view, the exposure of the enamel resulting from the bit damage is evident.

of use-wear were found on a right haemimandibula of horse (Figure 3a) produced by the use of the bit. They are visible in lingual view on the second lower premolar (Figure 3b, c). In the anterior view, the exposure of the enamel resulting from the damage of the bit is evident (Figure 3d). It was also possible to establish that the horse was a male of 8-9 years of age. In the same US, some remains of a sub-adult dog were found, as can be seen from the unfused epiphyses, and two remains of a young individual of *Sus* sp. In US 153, a remain of a large individual of cattle was found.

Two fragments of distal epiphysis belonging to a bear left humerus were recovered from US 147 (Figure 4a), proving that the remains of the animals used in the *venationes* remained in circulation after the end of the shows (Table 2). The size of the bear remains found in US 147 suggests that it was a female individual (Figure 4b). In the same US a right calcaneus of leopard (*Panthera pardus*) was recovered (Figure 4c).

FIGURE 4

US 151. Left humerus (A) and haemimandible (B) of *Ursus arctos*. C) Right calcaneus of *Panthera pardus*.

US	Context	Faunal remains
76	Level with domestic waste, pertinent to the settlement phases of the area after the abandonment of the amphitheatre (mid-6th – early 7th century AD).	Meal remains or evidence of breeding activities.
148	Post-disuse filling of two water drainage channels (dating not determined).	Little material, mostly unidentified.
152		
153	Beaten floor (by the end of the 1st century AD) of a room hypothesized to be a *carcer* (4th century AD).	Animals used in venationes.
147	Level of abandonment of a room hypothesized to be a *carcer* (4th century AD).	
151	Dumping of domestic waste during the Late Antique settlement phase of the area (dubious date, possibly second half of the 5th century AD).	The presence of bear and leopard bones could attest to the fact that remains of animals used in the *venationes* were still circulating in the area, although the shows had long since ceased to be practiced.

TABLE 2

Description of the stratigraphic unit and interpretation of faunal remains.

DISCUSSION AND CONCLUSIONS

Bear, leopard, and red deer are animals commonly mentioned and depicted in literary[3] and iconographic[4] sources (Figure 5) and have also been found in other amphitheaters where archaeozoological analyses were implemented; indeed, all three animals are attested in the Colosseum, and bear and red deer were found in the amphitheatre of Viruno, Austria (Rea, 2001a, b; De Grossi Mazzorin *et al*., 2003; Muñoz-Santos, 2016). Bear remains have also been found in the amphitheatre of San Benedetto ai Marsi, Abruzzo, central Italy (Di Stefano *et al*., 2008-2009) and in that one of Serdica, Bulgaria (Velichkov, 2009).

Wild animals such as the locally-sourced bear and deer were used at Aquileia, but also exotic ones, such as the leopard; this latter would have been brought from Africa or Asia, with considerable expenses for its capture, transport, and maintenance.

REFERENCES

Barone, R. 1975: *Anatomia comparata dei mammiferi domestici, vol. 1: Osteologia*. Vigot Freres Editeurs, Paris.

Basso, P. 2018: *L'anfiteatro di Aquileia. Ricerche d'archivio e nuove indagini di scavo*: 230. SAP edizioni, Quingentole (Mantova).

Bendrey, R. 2007a: New methods for the identification of evidence for biting on horse remains from archaeological sites. *Journal of Archaeological Science* 34: 1036-1050.

— 2007b: Work and age related changes in an Iron Age horse skeleton from Danebury hillfort, Hampshire. *Archaeofauna* 16: 97-108.

Bendrey, R.; Thorpe, N.; Outram, A. & Van Wijngaarden-Bakker, L.H. 2013: The Origins of Domestic Horses in North-west Europe: new Direct Dates on the Horses of Newgrange, Ireland. *Proceedings of the Prehistoric Society* 79: 91-103.

De Grossi Mazzorin, J.; Minniti, C. & Rea, R. 2003: De ossibus in anphitheatro Flavio effossis: 110 anni dopo

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[3] **Bear**: Calp., *op. cit*., 7, 66; Cass. Dio., *op. cit*., 63, 9, 1; 72, 10, 3; 18, 1; 19, 1; 75, 16, 5; His. Aug. Gord. 3, 6; His. Aug. Prob. 19, 7; Liv., *op. cit*., 44, 18, 8; Mart. epigram., 1, 15; 23; 31; 104. **Leopard**: Cass. Dio., *op. cit*., 72, 10, 3; 18, 1; 19, 1; His. Aug. Gord. 33, 1; His. Aug. Prob. 19, 7; Mart. epigram. 1, 15; 104. **Deer**: His. Aug. Gord 3, 7; His. Aug. Prob. 19, 4; Mart. epigram. 1, 104; 17, 19.

[4] **Bear**: mosaics of: "House of Bacchus" (Thysdrus); "Peacock House" (Carthage); Castelporziano; "Judgement of Paris" (Coo); "Great Hunt" ofVilla del Casale (Piazza Armerina, Sicily); Khanguet-el-Hadjaj; Saint Bibiana (now at Centrale Montemartini, Rome); villa of Bad-Kreuznach; villa of Nennig; villa of Rades; villa of Vallon; riliefs from: Civic Museum of Rieti; National Archaeological Museum of Istanbul; National Archaeological Museum of Sofia; Torlonia (Savelli Collection, Rome). **Leopard**: mosaics of: Carthage-Dermech; "Great Hunt" of Villa del Casale; "House of Dionysus" (Pafos); "*domus* of Isguntus" of *Hippo Regius* (now at Museum of Annaba); Smirat (now at the Susa Archaeological Museum); villa of Nennig; villa of Vermicino-Quarto della Giostra; and wall painting of the "Hunting Baths" (*Leptis Magna*). **Deer**: mosaics of: Castelporziano; "Judgement of Paris" (Coo); "Great Hunt" of Villa del Casale; *Maison de la Ferme Hadj Ferjani Kacem* (now at the El Jem Museum); Sicca Veneria (now at Bardo National Museum, Tunisi); villa of Bad-Kreuznach; villa of Dar Buc Ammera (Zliten); villa of Rades; villa of Vallon; villa of Vermicino-Quarto della Giostra.

FIGURE 5

Scenes of *venationes*. A) *Venatores* against a deer and other animals, detail of the floor mosaic from the Roman villa of Vermicino-Quarto della Giostra, along the via Casilina, Italy - today at the Borghese Gallery in Rome. Dating: 3_{rd}-4_{th} century A.C.; B) *Venator* against a leopard, detail of the floor mosaic of the Roman villa in Bad-Kreuznach, Germany. Dating: 3rd century AD - C) *Venatores* against a bear, detail of the floor mosaic of the Roman villa in Nennig, Germany. Dating: 230-240 A.C.

i rinvenimenti di Francesco Luzy. In: Malerba, G. & Visentini, P. (eds.): *Quaderni del Museo Archeologico del Friuli Occidentale, Atti del 4° Convegno Nazionale di Archeozoologia* vol. 6: 337-347.

Di Stefano, V.; Leoni, G.; Letta, C. & Villa, D. 2008-2009: Marruvium: nuove ricerche nell'anfiteatro romano. In: *Notizie degli Scavi* IX(19-20): 49-141.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites. Peabody Museum Bulletins* 1. Cambridge University Press, Cambridge. MA.

Eisenmann, V.; Alberdi, M.t.; De Giuli, C. & Staesche, U. 1988: *Studying fossil horses, vol. 1: Methodology*. Leiden.

Gentry, A.; Clutton-Brock, J. & Groves, C.P. 2004: The naming of wild animal species and their domestic derivates. *Journal of Archaeological Science* 31: 645-651.

Hillson, S. 1996: *Mammal Bones and Teeth, An Introduction Guide to Methods of Identification*. University College London, London.

Lyman, R.L. 1994: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

Muñoz-Santos, M.E. 2016: Animales in harena. Los animales en los espectáculos romanos. *Mastia. Revista del Museo Arqueológico Municipal de Cartagena, Los anfiteatros de Hispania en el siglo XXI* 15(2020):104-107.

PALES, L. & LAMBERT, C. 1971: *Atlas osteologique pour servir à la identification des mammiferes du Quaternaire*. Paris.

REA, R. 2001a: Gli animali per la venatio: cattura, trasporto, custodia. In: La Regina, A. (ed.): *Sangue e Arena*: 245-274. Milano.

— 2001b: Il Colosseo, teatro per gli spettacoli di caccia. In: La Regina, A. (ed.): *Sangue e Arena*: 223-242. Milano.

SCHMID, E. 1972: *Atlas of Animal Bones, For Prehistorians, Archaeologists and Quaternary Geologists*. Elsevier Publishing Company, Amsterdam.

VELICHKOV, Z. 2009: *The Amphitheatre of Serdica, Sofia, Bulgaria*. In: Wilmott, T. (ed.): *Roman Amphitheatres and Spectacula: a 21st century perspective*: 119-125. Oxford.

SUPPLEMENTARY MATERIAL

SI FIGURE 1

Scene of capture of animals for *venationes*. Six hunters with dogs catching three bears, a wild boar and three deer with nets and a cage. Mosaic from the church of Santa Bibiana (Rome), now at the Centrale Montemartini in Rome, Italy. Dating: early 4th century AD.

SI FIGURE 2

Scene of capture of animals for *venationes*. Three hunters on horseback and one on foot catching a lion, a lioness, three leopards and other animals with nets and cages. Mosaic from the *domus* of Isguntus (*Hippo Regius*), now at the Museum of Annaba, Algeria. Dating: 310-330 AD.

SI FIGURE 3

Scene of transport of animals for *venationes*. An antelope, three ostriches and a boar transported on a rowing boat, detail of the Great Hunt mosaic of the Villa del Casale in Piazza Armerina, Italy. Dating: 315-330 AD.

SI FIGURE 4

Scene of transport of animals for *venationes*. An ox-drawn wagon for transportation of captured animals, detail of the Great Hunt mosaic of the Villa del Casale in Piazza Armerina, Italy. Dating: 315-330 AD.

SI FIGURE 5

Scene of *venatio*. *Venatores* against panthers, detail of the floor mosaic from the Roman villa of Vermicino-Quarto della Giostra, along the via Casilina, Italy – today at the Borghese Gallery in Rome, Italy. Dating: 3rd-4th century AD.

SI FIGURE 6

Scene of *venatio*. *Venatores* against leopards, floor mosaic from Smirat, now at the Sousse Archaeological Museum, Tunisia. Dating: 235-250 AD.

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Una zanna lavorata di cinghiale dal villaggio nuragico di Lu Brandali (Santa Teresa di Gallura, SS), probabile elemento di elmo miceneo

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RIASSUNTO: Il rinvenimento nel villaggio nuragico di Lu Brandali (Santa Teresa di Gallura, SS), di una zanna di cinghiale lavorata che presenta caratteri dimensionali ben superiori a quelli dei cinghiali sardi del periodo, fa pensare di essere in presenza di un oggetto di importazione dal continente europeo. La tipologia e il tipo di lavorazione ricordano le placche in canino inferiore di cinghiale degli elmi micenei e ben si inquadrano nell'ambito dei noti rapporti tra la Sardegna nuragica e il mondo miceneo. L'arco temporale della produzione degli elmi micenei a zanne (XV-XIV sec. a.C.), è compatibile con quella del sito di rinvenimento frequentato dal XVI al X sec. a.C.

La zanna appartenente ad un elmo ritrovata a Lu Brandali, rappresenta il primo caso rinvenuto nel Mediterraneo occidentale ed il rinvenimento miceneo più settentrionale della Sardegna.

PAROLE CHIAVE: CANINO INFERIORE, CINGHIALE, SARDEGNA, MICENEI, ELMO

ABSTRACT: A carved wild boar tusk from the nuragic village of Lu Brandali (Sardinia), probable element of a Mycenaean helmet.

The discovery in the nuragic village of Lu Brandali (Santa Teresa di Gallura, SS), of a worked wild boar tusk (lower canine) much larger in size than the Sardinian wild boars of the time, suggests that we are in the presence of an object imported from the European continent. The typology and processing are similar to the lower canine plates of wild boar from the Mycenaean helmets and fits well within the well-known relationships between Nuragic Sardinia and the Mycenaean world. The time span of the production of the Mycenaean tusk helmets (15th-14th century BC) is compatible with that of the site frequented from the 16th to the 10th century BC. The tusk belonging to a helmet found in Lu Brandali represents the first case found in the western Mediterranean and the northernmost Mycenaean find in Sardinia.

KEYWORDS: LOWER CANINE, WILD BOAR, SARDINIAN, MICENAEANS, HELMET

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INTRODUZIONE

"Merione diede a Odisseo arco e faretra e spada, e in capo gli pose un casco fatto di cuoio, con molte corregge, dentro era intrecciato ben saldo e di fuori denti bianchi di verro, candida zanna, fitti, lo coprivano di qua e di là, bene e con arte; in mezzo era aggiustato del feltro" (Omero, Iliade X, 260-265).

Così Omero descrive il copricapo dei guerrieri micenei caratterizzato da una serie di zanne di cinghiale, documentato in quanto tale in ambiente greco continentale e sulla costa del Mar d'Azov (Markiewicz & Diakowski, 2016) e, per zanne smembrate, in varie località dell'Europa orientale e databile, sulla base dei rinvenimenti e delle raffigurazioni, almeno sin dall'inizio dell'epoca micenea fino al TE IIIA- B compreso (Papadopulos, 2008-2009). L.L.

MATERIALI E METODI

Alla fine del Pleistocene, in Sardegna non sono presenti suini, che saranno introdotti allo stato domestico nel Neolitico antico. Si suppone che, dai primi maiali importati in questa fase, ancora poco differenziati dalla forma selvatica, si siano originati gruppi di individui sfuggiti al controllo dell'uomo e tornati allo stato selvatico (Wilkens, 2012). Sono stati trovati resti di *Sus scrofa*, nei livelli del Neolitico antico della grotta Filiestru di Mara (SS), della grotta Corbeddu di Oliena (NU) e della grotta Su Coloru di Laerru (SS). Mentre per il caso della grotta Filiestru non è stata tentata una divisione tra domestici e selvatici, nella grotta Corbeddu (Sanges, 1987) sono state riconosciute le due forme, domestica e selvatica, pur senza indicare i criteri di distinzione né fornire foto, informazioni che invece si hanno dalla grotta Su Coloru (Masala, 2001-2002). Successivamente è stata osservata la presenza dei due gruppi nei livelli eneolitici di Monte d'Accoddi, mentre più spesso viene identificata solo la forma domestica. Comunque, data la vicinanza tra le due forme in Sardegna, è possibile che parte dei resti di cinghiale di taglia più piccola non vengano distinti dai maiali e solo i grossi maschi siano più chiaramente identificabili. Nei siti dell'età del Bronzo il cinghiale è riconoscibile per le dimensioni maggiori rispetto alla forma domestica, la maggiore robustezza di tutto lo scheletro e canini maschili più sviluppati. Per l'età del Bronzo la presenza del cinghiale è stata rilevata a Madonna del Rimedio di Oristano, Nuraghe Miuddu (Birori, NU), Lu Brandali (Santa Teresa di Gallura, SS) e, per il Bronzo/Ferro a Is Paras di Isili (CA) e Monte Sant'Antonio di Siligo (SS). Nonostante le caratteristiche citate e pur raggiungendo dimensioni superiori a quelli del maiale, i resti attribuiti al cinghiale restano di taglia molto inferiore a quella riscontrata per i cinghiali "continentali" che non avevano subito alcun processo di domesticazione. L'insediamento di Lu Brandali, Santa Teresa di Gallura (SS), abitato senza soluzione di continuità dal XVI al X sec. a.C., venne edificato a breve distanza dalla linea di costa, ed in esso trovano spazio una serie di capanne, raggruppate in isolati, che si affacciano su cortili lastricati comuni. Il rinvenimento è occorso durante la pulizia di superficie di un'area poi rivelatasi, nel prosieguo dello scavo, un vano forse utilizzato come deposito di derrate alimentari. B.W.

Per lo studio di questi reperti è stata utilizzata la collezione di confronto di una delle autrici (B.Wilkens), nonché i resti di cinghiali sardi studiati in precedenza e conservati presso i depositi della Soprintendenza Archeologica, belle arti e paesaggio per le province di Sassari e Nuoro.

L'oggetto, dopo un primo esame macroscopico, è stato osservato al microscopio, con attrezzature di proprietà di una delle scriventi (B.Wilkens). B.W.

RISULTATI

Lo studio dei resti faunistici di Lu Brandali, Santa Teresa di Gallura (SS) (Cosso, 2019), ha messo in evidenza la presenza di numerose specie di mammiferi domestici e selvatici, e tra questi sono stati identificati anche vari canini inferiori maschili di *Sus scrofa* attribuiti in parte al maiale e in parte al cinghiale (Cosso, 2019) (Figuras 1-4). Tuttavia il frammento lavorato in questione, pur non essendo misurabile a causa della frammentarietà, supera di molto, le dimensioni fino ad oggi riscontrate nei siti archeologici sardi e fa supporre la sua introduzione dall'esterno, probabilmente come oggetto lavorato ricavato da un animale estraneo alla fauna dell'isola. Il dente risulta tagliato longitudinalmente in modo da isolare lo smalto della superficie buccale, ricavandone una lamina curvilinea che è stata anche forata ad una estremità. Il foro ha un andamento obliquo dall'esterno verso l'interno. Lungo i margini la lamina mostra segni di taglio e lisciatura. L'oggetto è stato ritrovato, durante l'ultima indagine archeologica condotta nel 2016 e si trovava

FIGURA 1
Canino inferiore di cinghiale lavorato, lato esterno, da Lu Brandali, Santa Teresa di Gallura (SS).

FIGURA 2
Canino inferiore di cinghiale lavorato, lato interno, da Lu Brandali, Santa Teresa di Gallura (SS).

FIGURA 3
Canino inferiore di cinghiale lavorato (al centro) tra due canini inferiori di maiale da Lu Brandali, Santa Teresa di Gallura (SS).

FIGURA 4
Canino inferiore di cinghiale locale da Lu Brandali, Santa Teresa di Gallura (SS).

sotto uno strato di *humus*, poco distante dalle radici di un olivastro che gravava sul perimetro murario dell'ambiente in corso di indagine.

DISCUSSIONE

La frequentazione micenea della Sardegna, che inizia nel XIV sec. a. C., è in genere connessa in letteratura al commercio dei metalli, ed è testimoniata dalla presenza di svariati oggetti di importazione, prevalentemente ceramici, distribuiti su una vasta area del territorio isolano, e con maggiore incremento nel settore meridionale, che attestano rapporti di scambio sia commerciali sia culturali con le popolazioni nuragiche (Ferrarese Ceruti *et al*., 1987). Tra i rinvenimenti più significativi vanno ricordati quelli del nuraghe Antigori, Sarroch (CA) (Ferrarese Ceruti *et al*., 1987), che ha restituito un nutrito gruppo di ceramiche sia di importazione sia di imitazione locale e l'*alabastron* del nuraghe Arrubiu, Orroli (SU) (Lo Schiavo & Sanges, 1994), che ad oggi resta il più antico oggetto ceramico miceneo della Sardegna. Non si può poi non segnalare l'ultimo rinvenimento in ordine di tempo, ovvero i frammenti fittili di Bia 'e Palmas, Selargius (CA) (Manunza *et al*., 2016). Ben confrontabile con il reperto oggetto di questo contributo è poi il frammento di testina di guerriero miceneo in avorio di ippopotamo che indossa un elmo a zanne di cinghiale, proveniente da una raccolta di superficie, risalente al 1984, presso il sito di Mitza Purdia, Decimoputzu (SU) (Vagnetti & Poplin, 2005).

L'oggetto è probabilmente pertinente ad intarsi inseriti su manufatti di legno, così come ipotizza per la testina di Enkomi (Cipro) (Krziszkowska, 1991), molto simile all'esemplare sardo; questi due sono gli unici rinvenimenti di questa categoria di oggetti effettuati al di fuori della zona di origine.

Per quanto concerne la cronologia, l'arco temporale della produzione e circolazione degli elmi micenei a zanne, che giunge fino al XV-XIV sec. a.C., è del tutto compatibile con quella del sito di rinvenimento frequentato dal XVI al X sec. a.C. Nel villaggio è inoltre presente la classe di ceramica nuragica cd "grigio-ardesia", attestata in alcuni casi negli strati nei quali si trovano ceramiche di importazione micenea, come documentato sia nel nuraghe Antigori sia in quello di Domu e s'Orku, Sarroch (CA). L.L.

CONCLUSIONI

La presenza del foro, il tipo di lavorazione, la pertinenza ad un cinghiale molto probabilmente non sardo e il confronto formale con le zanne degli elmi micenei non lascia dubbi sull'attribuzione a questi caschi del nostro manufatto.

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BIBLIOGRAFIA

Cosso, A. 2019: Resti faunistici dal sito protostorico di Lu Brandali, Sardegna. *Atti dell'8° Convegno Nazionale di Archeozoologia*: 115-119. Lecce.

Ferrarese Cerruti, M.L.; Vagnetti, L. & Lo Schiavo, F. 1987: Minoici, Micenei e Ciprioti in Sardegna alla luce delle più recenti scoperte. In: Balmuth, M.S. (ed.): *Studies in Sardinian Archaeology III. Nuragic Sardinia and the Mycenaean World*: 7-38. B.A.R. (International Series) 387. Oxford.

Krzyszkowska, O.H. 1991: The Enkomi Warrior Head Reconsidered. *The annual of the British School of Archaelogy at Athens* 86: 107-120.

Lo Schiavo, F. & Sanges, M. 1994: *Il nuraghe Arrubiu di Orroli*. Guide e Itinerari, Sardegna Archeologica 22, Sassari.

Manunza, M.R. *et al*. 2016: Manufatti nuragici e micenei presso Bia 'e Palma (Selargius-CA). *Quaderni della Soprintendenza per i Beni Archeologici per le province di Cagliari e Oristano* 27: 147-199.

Markiewicz, J.E. & Diakowski, M. 2016: The Wild Boar at the Oder Shore: on a Boar's Tusk Ivory Plate from the Early Bronze Age Found in Bytomin (Woj. Dolnoslaskie/PL). *Archaologisches Korrespondenzblatt* 46(1): 43-56.

Masala, S. 2001-2002: *Lo studio della fauna per la ricostruzione economica e ambientale: il casp della grotta su Coloru*. Tesi di Laurea inedita, Sassari.

Omero: *Iliade, X, 260-265*. Ed. 1997, Newton, Roma.

Papadopulos, A. 2008-2009: *The distribution of the late Helladic IIIA-B Ivory Helmeted Heads*. Talanta 2008/2009.

Sanges, M. 1987: Gli strati del Neolitico antico e medio nella grotta Corbeddu di Oliena (Nuoro). Nota preliminare. In: *Atti della XXVI Riunione Scientifica "Il Neolitico in Italia", Firenze 7-10 novembre 1985:* 825-830.

Vagnetti, L. & Poplin, F. 2005: Frammento di applique raffigurante un elmo a denti di cinghiale da Mitza Purdia-Decimoputzu (Cagliari). In: Vagnetti L.; Bettelli M. & Damiani, I. (eds.): *L'avorio in Italia nell'età del Bronzo*: 111-114. CNR, Roma.

Wilkens, B. 2012: *Archeozoologia Il Mediterraneo, la storia, la Sardegna*. EDES, Sassari.

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Animal bone remains from the temple on a podium at Saepinum (South Italy)

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ABSTRACT: The town of Sepino (Campobasso, Molise) is located in the Tammaro valley along the 'tratturo Pescasseroli-Candela.' The animal bone comes from the temple on a podium found in the south-eastern urban quadrant, in levels dated to the first half of the first century AD. Only domestic ungulate species have been identified, among which pigs and cattle are prevalent, whereas *Ovis/Capra* and horse remains are very rare. Bone remains derive in general from portions of the carcass with little flesh (skull and lower limb). In the lower levels of preparation of the podium floor, bone remains associated with the coin deposit were recovered: a left portion of a skull with the horn core and a whole scapula, with different types of butchery marks, belonging to a cattle and a scapula fragment of an adult pig.

The bones, suggesting an animal sacrifice, were probably part of complex ritual practices that could be linked to foundation rites (defunctionalization/purification) of the temple building.

KEYWORDS: TRANSHUMANCE, DOMESTIC ANIMALS, BUTCHERY, SACRIFICE, FOUNDATION RITUAL

RIASSUNTO: In questo breve articolo si presenta l'analisi dei resti ossei faunistici provenienti dal tempio su podio della città di Sepino da contesti stratigrafici datati al I sec. d.C. Sono state identificate esclusivamente specie domestiche riferibili a ungulati, tra i quali sono prevalenti maiali e buoi, mentre sono molto rari i resti di pecora/capra e cavallo. Gli elementi anatomici si riferiscono a porzioni con poca carne (cranio e estremità degli arti). Particolarmente interessante il rinvenimento nei livelli inferiori al piano pavimentale del podio di resti ossei animali con tracce di macellazione associati alla deposizione intenzionale di monete. Sono una porzione di cranio e una scapola di bue e un frammento di scapola di maiale.

I resti ossei, indizio di sacrificio animale, probabilmente facevano parte di complesse pratiche rituali che potrebbero essere legate a riti di fondazione (defunzionalizzazione/purificazione) dell'edificio templare.

PAROLE CHIAVE: TRANSUMANZA, ANIMALI DOMESTICI, MACELLAZIONE, SACRIFICIO, RITI DI FONDAZIONE

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INTRODUCTION

The site of Sepino (Campobasso, Molise) is located in the Tammaro valley along the tratturo Pescasseroli-Candela. The location on the sheep-track was decisive for the development of a town as a resting and trading place in connection with the seasonal migration of the flocks.A Samnite settlement already existed in the area in an elevated position. When the area was conquered by the Romans, they founded the town of *Sepinum* in the valley, which saw its greatest development in the Augustan period. In 2017, the Soprintendenza Archeologia Belle Arti e Paesaggio del Molise resumed excavations in the city, uncovering a temple on a podium. The temple is located in the south-east urban quadrant and can be dated to the first half of the first century AD. All that remains of the temple is the basement; it included two rectangular rooms through which it was possible to access to a restricted room located under the *pronaos*, where an intentional deposit (antefixes and *balsamarium*) was found (Cinquantaquattro & Sica, 2019: 320-321).

Here, in the lower levels of preparation of the podium floor animal bone remains associated with a coin deposit were recovered: a portion of skull with the horn and a cattle scapula as well as a fragment of a pig scapula. These animal remains are of particular importance as they are associated with votive material in a foundation level as a result of a founding ritual.

METHODOLOGY

The scientific nomenclature of domestic animals follows Gentry *et al*. (2004). The age at death was established based on the fusion of the epiphyses of long bones according to Silver (1969) for cattle, Bullock & Rackham (1982) for sheep/goat and Bull & Payne (1982) for pigs. For sheep/goat and pigs, epiphyseal ossification data were supplemented with more precise data from the analysis of tooth eruption and wear, according to the method developed by Payne (1973) and Bull & Payne (1982). Sex discrimination was possible for pigs by recording the morphology of canine teeth.

ANIMAL BONE REMAINS

A total of 98 animal remains were recovered from the temple levels and 43 of them could be assigned taxonomically. Only domesticated species referable to ungulates have been identified and, among them pigs and cattle are dominant; bone remains of sheep/goat and equids are instead very rare (Table 1).

The estimate of the minimum number of individuals (MNI), calculated for each Stratigraphic Unit, reveals a total of 22 individuals. Cattle and pigs are documented by the same number of individuals (MNI 9), followed by sheep/goat (MNI 3) and equids (MNI 1).

Taxa	**US 87**	**US 120**	**US 121**	**US 131**	**US 134**	**US 135**	**US 178**	**US 311**	**Total**
Bos taurus	2		5	2	1	3	2	2	17
Ovis/Capra	1							2	3
Sus domesticus	2	12	1	1		2	1	3	22
Equidae		1							1
Total NISP	**5**	**13**	**6**	**3**	**1**	**5**	**3**	**7**	**43**
	14		6	2		4			26
Totale Unidentified	**14**	**0**	**6**	**2**	**0**	**4**	**0**	**0**	**26**
Total Remains	**19**	**13**	**12**	**5**	**1**	**9**	**3**	**7**	**69**

Taxa	**US 87**	**US 120**	**US 121**	**US 131**	**US 134**	**US 135**	**US 178**	**US 311**	**Total**
Bos taurus	2		1	1	1	1	1	2	9
Ovis/Capra	1							2	3
Sus domesticus	1	2	1	1		1	1	2	9
Equidae		1							1
NMI	**4**	**3**	**2**	**2**	**1**	**2**	**2**	**6**	**22**

TABLE 1

Determined and undetermined bone remains and minimum individual number of animal remains from the temple on podium.

Cattle were predominantly killed when adult and senile (five adults and two senile individuals), more rarely in juvenile and young-adult age.

Pigs are represented mainly by juvenile animals (one juvenile and six young-adults), including at least one male (juvenile lower canine from SU 121). Remains of adult pigs are rare and include a minimum of one female (worn upper canine from SU 120).

Sheep/goats are present with one juvenile and two senile individuals, while the only equid was an adult animal.

Overall, the bone fragments are mainly represented by skulls and the lower limb elements. Fragments of ribs and vertebrae are also well represented, mainly deriving from large animals (probably cattle), but due to their fragmentary nature it is not possible to assign them with certainty to species. SU 120 is particularly interesting (Figures 1-2) because, in addition to the presence of the only equid specimen (a proximal right metatarsus of an adult with traces of disarticulation), portions of articulated fore and hind limb of a pig were also found (fore leg: right metacarpal III, IV and phalanx I of a young adult; hind leg: left tibia, talus and calcaneus of a young adult). It is well known from ancient sources that distal limb elements of sacrificed animals were the portions usually offered to deities, therefore the finding at this site of such articulated bones may be the archaeological evidence for this custom.

Many remains showed traces of butchery such as cut and chop marks. The cut marks are due to disarticulation and defleshing, while chop marks were inflicted to dismember the anatomical elements and obtain smaller portions of meat. Traces of burning were found on a single proximal cattle metacarpal from SU 131. Two elements from SU 87 and SU 135 show evidence of carnivore gnawing.

In general, the bone remains derive from portions of the carcass with little meat (skull and lower limb), but more valuable portions are also documented in the form of fragments of ribs and vertebrae as well as upper limb bones, such as humerus and tibia. Some cattle and sheep/goat individuals were slaughtered at an old age, as evidenced by very worn teeth, probably at the end of their working/productive life. Pigs were culled at a young adult age when they provided a greater quantity and better quality of meat.

FIGURE 1

Portion of a cattle skull with horn, with placement on reference skull.

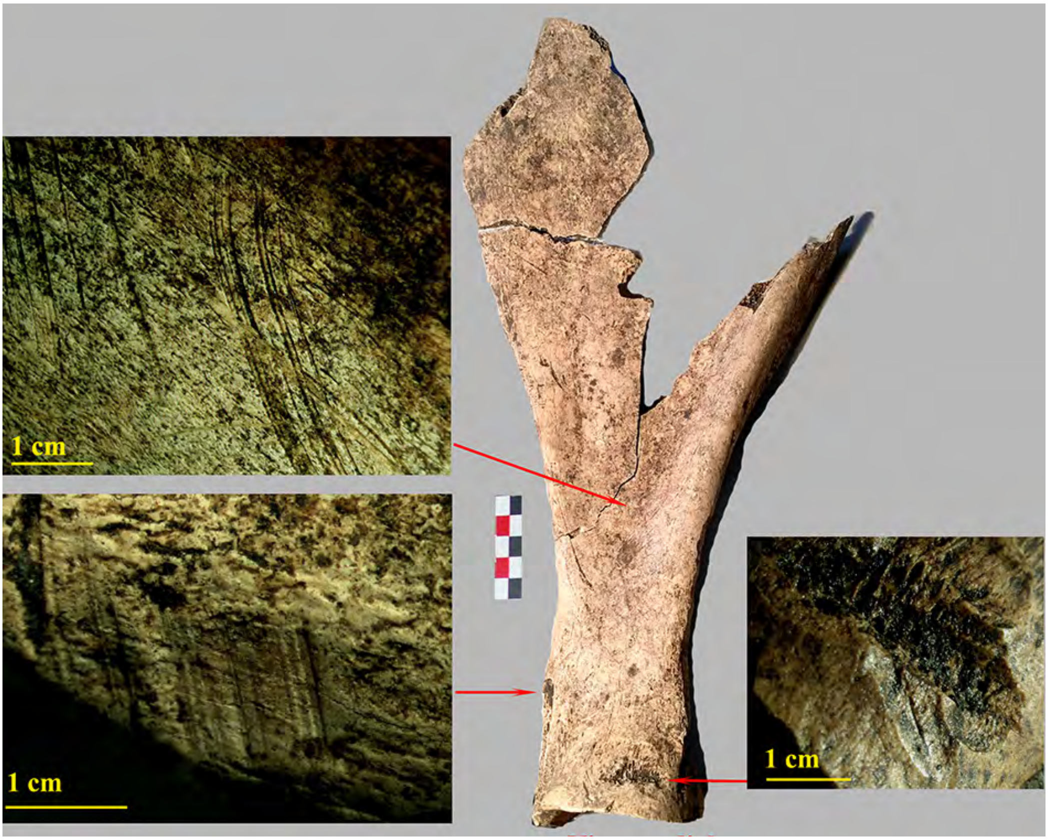

FIGURE 2
Cattle scapula with traces of butchery.

THE TEMPLE AND ANIMAL SACRIFICE

The remains are probably part of banquets and ritual offerings related to the construction of the podium. Particularly significant are the remains found in the ritual deposit under the podium floor that were recovered in association with a coin deposit. They are represented by a fragment of a left skull with horn and a whole scapula (with different types of butchery marks) of an adult cattle and a scapula fragment of an adult pig, which will be described in detail below:

a) skull fragment of an adult cattle with horn, probably dissected longitudinally along the major axis of the skull (Figure 1); the bone is fragmented, crushed and poorly preserved (Figure 1). A specimen similar to the one presented here is the cattle skull found inside the sanctuary of San Leucio in Canosa in the podium of the temple and referable to the time of the 're-foundation' of the sacred area during the Late Republican or Early Imperial period (D'Alessio, 2009). Cattle sacrifices are also pictured on several red and black-figure pottery: *Hydria,* Paris, M. Louvre, inv. F 10; Kylix Florence, Museo Archeologico, inv. 81600; *Stamnos, Paris,* M. Louvre, inv. C10754 (Sassu, 2018).

b) fragment of a left scapula of a probably adult pig with deep cut marks.

c) fragment of a right scapula of an adult cattle, reassembled from three fragments. The element is incomplete, the lacunae are attributable to slaughtering activity (Figure 2). Numerous butchery traces were found, consisting of chop marks, cuts and scrapings (Figure 2). It appears to be a precise and intense butchery intervention; the various traces can be attributed to disarticulation and defleshing depending on the type and localisation.

Domestic taxa (cattle, pig, sheep/goat) were the animals most frequently used in sacrifices by the Romans. The practice of placing objects in pits linked to *piaculum* and propitiation rituals are attested by ancient authors (Varro 1, I, v. 157); *piacuala* rites understood as animal sacrifices are mentioned by Cato in *De agri cultura* (148 and 150. 4). *Piacula operis faciendi* are special situations that involved expiatory acts with which one tended to repair any activity that compromised a previous status. They were reparatory sacrifices aimed at obtaining the gods' consent and neutralising possible vengeance (Cinquantaquattro & Sica, 2019).

CONCLUSION

Only domesticated species referable to ungulates were identified, among them pigs and cattle are dominant, while sheep/goat and equid remains are very rare. Bone remains refer 'in general' to portions of the carcass with little meat (skull and limb ends), but there are also rare valuable portions documented by trunk and proximal limb bone fragments.

The bone remains, evidence of animal sacrifice, were probably part of complex ritual practices that could be linked to temple building foundation rites, in particular the animal bones in the temple foundation levels could be linked to the purification and expiation rituals known as *piaculum* (for a detailed discussion see Cinquantaquattro & Sica, 2019).

REFERENCES

Bull, G. & Payne, S. 1982: Thooth eruption and epiphysial fusion in pigs and wild boar. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 55-72. BA.R. (British Series) 109. Oxford.

Bullock, D. & Rackam, J. 1982: Epiphysial fusion and tooth eruption of feral goats from Moffatdale, Dumfories and Galloway. In: Wilson, B.; Grigson, C. & Payne, S. (eds.): *Ageing and Sexing Animal Bones from Archaeological Sites*: 73-80. BA.R. (British Series) 109. Oxford.

Cinquantaquattro, T.E. & Sica, M.M. 2019: Saepinum, Architettura templare, decorazione architettonica e forme di ritualità. Le nuove indagini (2017). In: Lulof, P.; Manzini, I. & Rescigno, C. (eds.): *Deliciae Fictiles V. Networks and Workshops: Architectural Terracottas and Decorative Roof Systems in Italy and Beyond*. Oxbow Books, Oxford. https://doi.org/10.2307/j.ctvpmw48c.

D'Alessio, A. 2009: Le testimonianze del culto e la cultura materiale. In: Pensabene, P. & D'Alessio, A. (eds.): *Da Minerva a San Leucio. Parco archeologico e antiquario a San Leucio a Canosa. Comune di Canosa di Puglia*: 73-75.

Gentry, A.; Clutton-Brock, J. & Groves, C.P. 2004: The naming of wild animal species and their domestic derivatives. *Journal of Archaeological Science* 31: 645-651.

Payne, S. 1973: Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. *Anatolian Studies* 33: 281-303.

Sassu, R. 2018: Lo spazio dell'azione sacrificale nel santuario greco. In: Il sacrificio. Forme rituali, linguaggi, strutture sociali. *Scienze dell'Antichità* 23.3, 2017 [2018]: 189-206.

Silver, I.A. 1969: The Ageing of Domestic Animals. In: Brothwell, D. & Higgs E.S. (eds): *Science in Archaeology*: 283-302. Thames and Hudson, London.

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I resti faunistici dell'edificio suburbano di Via Tommaso Gar a Trento: analisi archeozoologica e tafonomica

Faunal remains from the suburban building of Tridentum: archaeozoological and taphonomic analyses

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RIASSUNTO: Lo scavo, svoltosi nel 2009 presso il sito di Via Tommaso Gar a Trento sotto la direzione della Soprintendenza per i Beni Culturali per la Provincia Autonoma di Trento, ha restituito una cospicua quantità di materiale faunistico, sulla quale è stata condotta un'analisi archeozoologica e tafonomica. Il materiale proviene da un edificio situato nell'area suburbana della *Tridentum* di epoca romana, la cui fase d'uso relativa all'insieme faunistico analizzato è databile al I-II secolo d.C. Lo scopo della ricerca è stato quello di indagare le abitudini alimentari e di sussistenza della popolazione locale, nonché verificare la presenza di attività produttive *in situ* per quanto riguarda l'industria su osso.

PAROLE CHIAVE: *TRIDENTUM*, ARCHEOZOOLOGIA, TAFONOMIA, MACELLAZIONE, FAUNA DOMESTICA

ABSTRACT: During the excavation carried out in 2009 at the site of Via Tommaso Gar in Trento, under the direction of the *Soprintendenza per i Beni Culturali per la Provincia Autonoma di Trento*, an abundant assemblage of faunal remains was recovered and analyzed. The material comes from a building located in the suburban area of *Tridentum* (the Roman name of Trento), dated to the 1st-2nd century AD. This study aims to investigate dietary habits and subsistence of the local population, and to verify the presence *in situ* of a bone workshop.

KEYWORDS: *TRIDENTUM*, ARCHAEOZOOLOGY, TAPHONOMY, BUTCHERY ACTIVITIES, DOMESTIC FAUNA

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INTRODUZIONE

Il presente studio analizza il materiale faunistico proveniente dal contesto di epoca romana di Via T. Gar a Trento, indagato nel 2009 dalla Soprintendenza per i Beni Culturali della Provincia Autonoma di Trento ed è stato oggetto di una tesi di laurea magistrale (Corazza, 2021-2022). Il sito (Figura 1) consiste in un complesso edilizio di epoca romana, interpretato come la *pars fructuaria* di un edificio suburbano, per il quale si sono riconosciute almeno sei diverse fasi di frequentazione, che dalla metà del I sec. a.C. (momento della fondazione del *municipium* di *Tridentum*) giungono sino alla Tarda antichità, quando sui resti dell'edificio romano si installa un'area necropolare. Il contesto archeologico di via Tommaso Gar è situato nell'area suburbana di *Tridentum,* appena al di fuori delle antiche mura urbiche, a sud-ovest della città. Ancora incerta risulta la destinazione d'uso dei territori collocati in quest'area, anche se le indagini archeologiche sembrano suggerire la presenza di zona dedicata ad attività agricole e/o produttive (Baroncioni, 2012; Bassi, 2015).

L'area indagata presenta un'estensione di circa 3.000 mq, suddivisa, in fase di scavo, in quattro settori (Nord; Ovest; Centrale; Est). L'edificio è costituito da otto vani definiti da lettere dalla A alla H, per i quali si sono attestate, nel corso del tempo, molteplici modificazioni nella planimetria e nella destinazione d'uso (Relazione tecnica S.A.P., 2009; Relazione tecnica P.E.T.R.A., 2009).

MATERIALI E METODI

I reperti faunistici, presentati in questo lavoro, provengono dalle US di epoca romana, in particolare sono state considerate le fasi di utilizzo dell'edificio romano (Tabella 2) escludendo quelle relative all'impianto della necropoli (fase VI). I materiali sono stati analizzati per fase d'uso ma i risultati verranno qui trattati complessivamente come un unico insieme per questione di sintesi.

Per l'identificazione tassonomica si è fatto ricorso all'impiego di manuali (Schmid, 1974; Driesch, 1976; Wilson *et al*., 1982; Barone, 2010), e alla collezione osteologica di confronto presente nel Laboratorio di Archeozoologia dell'Università degli Studi di Ferrara. Per la quantificazione dei reperti faunistici sono stati impiegati i principali indici: Numero dei resti (NR), Numero dei resti identificati (NRDt/NISP), Numero Minimo degli Individui (NMI) di combinazione (Lyman, 1994; Reitz & Wing, 2008). È stato impiegato l'NMI di combinazione per unità stratigrafiche (UUSS) appartenenti alla medesima fase d'uso. Per la discriminazione di capra e pecora, ove possibile, si è utilizzata la letteratura nota (Boessneck, 1969; Payne, 1973; Zeder & Lapham, 2010; Zeder & Pilaar, 2010; Salvagno & Albarella, 2017). Nei casi in cui non è stato possibile distinguere i reperti a livello specifico si sono utilizzate categorie tassonomiche sovraordinate alla specie. Per quanto riguarda l'analisi tafonomica è stata utilizzata la letteratura di riferimento per la discriminazione delle tracce antropiche da quelle edafiche (Behrensmeyer, 1978; Lyman, 1994; Fernández-Jalvo & Andrews, 2016).

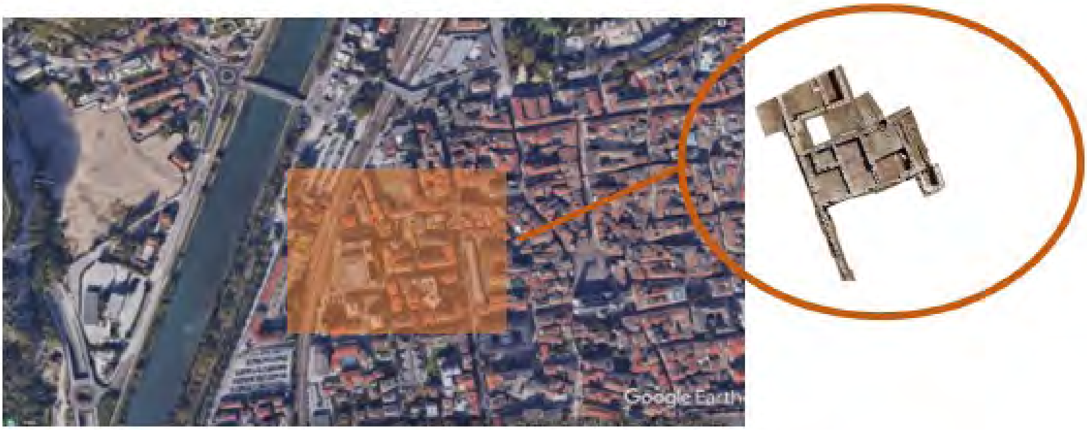

FIGURA 1
Localizzazione dell'area scavata e fotogrammetria dell'edificio (modificata da Corazza S.).

Taxa	NISP	%NISP	NMI	%NMI	NME
Bos taurus	337	40,0%	22	58,2%	62
Capra vel *Ovis*	303	36,0%	24	30,8%	91
Sus domesticus	135	16,0%	18	23,1%	37
Equus caballus	17	2,0%	3	3,8%	5
Gallus gallus	23	3,0%	4	5,1%	5
Canis familiaris	17	2,0%	1	1,3%	1
Totale *taxa* domestici	**832**	**99%**	**72**	**93,3%**	
Sus scrofa	1	0,1%	1	1,3%	1
Cervus elaphus	1	0,1%	1	1,3%	1
Ursus arctos	2	0,2%	1	1,3%	2
Vulpes vulpes	4	0,4%	2	2,6%	4
Castor fiber	2	0,2%	1	1,3%	2
Totale *taxa* selvatici	**10**	**1%**	**6**	**7,7%**	

TABELLA 1

Rappresentazione complessiva dei taxa identificati secondo rispettivi NISP; NMI e NME.

FASE DI FREQUENTAZIONE							
SETTORE	**I**	**II**	**II/III**	**III**	**IV**	**V**	**Totale complessivo**
CENTRALE		13	62			55	130
NORD	51	456			1		508
OVEST	6			8			14
EST (EDIFICIO)		46		20	185	75	373

TABELLA 2

Distribuzione del campione faunistico di Via Gar (Trento), suddivisa per settore di scavo.

L'analisi delle tracce è stata svolta con il supporto di uno stereomicroscopio ottico Leica MZ6 corredato di telecamera digitale EC3, con cui si sono acquisite le immagini delle tracce riscontrate sulle superfici ossee.

RISULTATI E DISCUSSIONE

I reperti faunistici ammontano complessivamente a 1.306 resti, di cui 1.278 determinati (98%) e 28 indeterminati (2%). L'insieme faunistico è principalmente composto da animali domestici (NISP=832; 99%) e in minor misura da selvatici (NISP=10; 1%) (Tabella 1).

Nettamente prevalente si mostra la fauna di tipo domestico (*Capra* vel *Ovis, Bos taurus, Sus domesticus, Equus caballus Canis familiaris*), mentre alquanto più sporadiche risultano le specie selvatiche (*Cervus elaphus, Sus scrofa, Ursus arctos, Castor fiber*; Tabella 1). Per quanto riguarda la stima dell'età di morte, ove si è potuta effettuare, il campione risulta essere composto principalmente da individui adulti (Figura 2).

Il campione analizzato si trova in buono stato conservativo, con la quasi totale assenza di *weathering* (NR=322; 26,8%) che, nei casi in cui risulta attestato, si manifesta solamente al primo grado di degradazione superficiale (Tabella 3). Solamente un'esigua quantità di ossa si presenta in stato integro (NR= 130; 10,2%) e la frammentazione è principalmente imputabile a fattori post-deposizionali. Le tracce di macellazione sono piuttosto scarse e sono individuabili in maggiore quantità sui resti di *Bos taurus* (NR=35; 10,4%), dove sono localizzate con maggiore frequenza sulle diafisi di coste, bacino e, sporadicamente, sulla mandibola e sulle ossa lunghe quali radio-ulna e metapodiali (Figura 3).

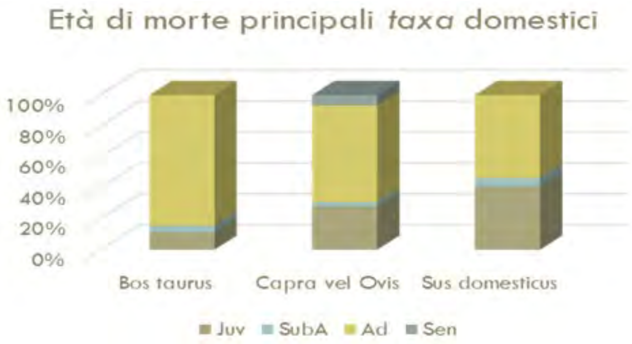

FIGURA 2

Classi di età per i tre principali taxa domestici dal settore dell'edificio.

TAXON	Weathering	Manganese	Radici	Carnivori
Bos taurus	125	388	319	305
Capra vel *Ovis*	125	370	374	302
Sus domesticus	41	147	152	128
Gallus gallus	3	28	25	23
Equus caballus	5	15	20	14
Canis sp.	1	12	7	7
Cervus elaphus	1	2	1	1
Castor fiber	0	5	3	2
Ursus arctos	0	3	4	2
Vulpes vulpes	0	5	4	4

TABELLA 3

Frequenza delle modificazioni edafiche e biologiche sui resti dei vari taxa.

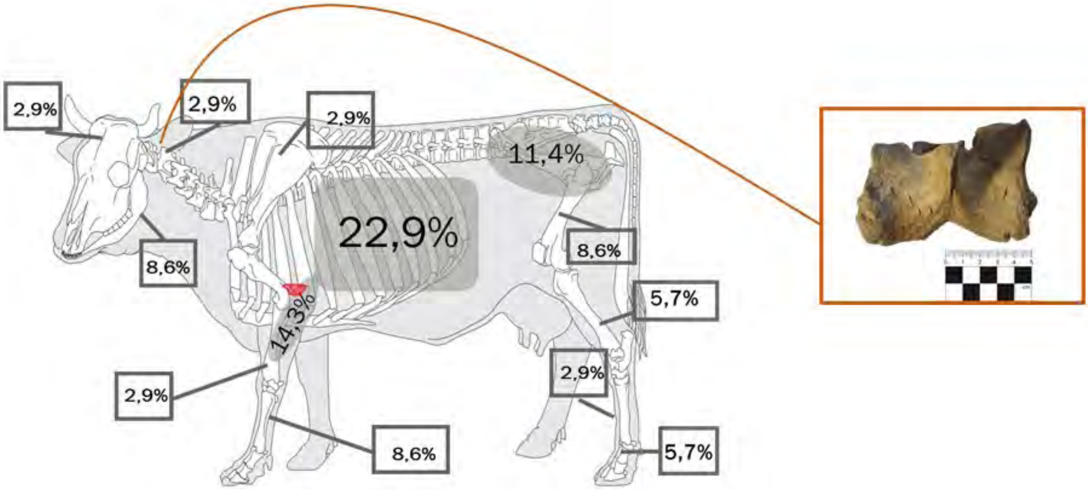

FIGURA 3

Distribuzione delle tracce di macellazione negli elementi di *Bos taurus*. Nel dettaglio, Atlante di *Bos taurus* con tracce di macellazione. La percentuale maggiore di strie di macellazione e fendenti sono legate alla disarticolazione del radio dall'ulna (14,3%) e del femore dal bacino (11,4 %); e al porzionamento delle coste (22,9) (totale NR= 185).

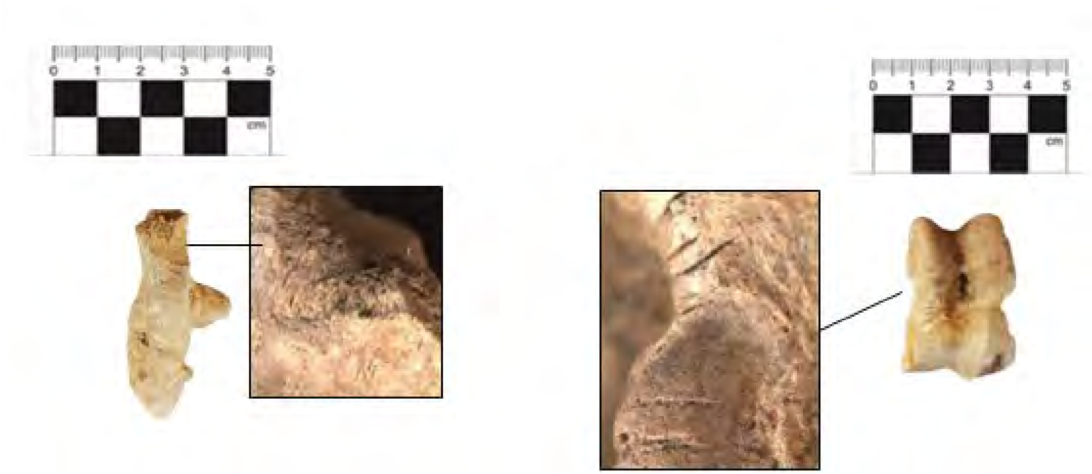

FIGURA 4

Calcagno di *Capra* vel *Ovis* e astragalo di Sus domesticus recanti tracce di macellazione.

ELEMENTO ANATOMICO	***Bos taurus***	***Capra* vel *Ovis***	***Sus domesticus***
	FaT-FiA-S	**FaT-FiA-S**	**FaT-FiA-S**
Cranio	3-4-2	1-1-0	\
Mandibola	4 4 2	2-2-0	2-2-0
Mascella	1-0-0	\	\
Atlante	0-1-0	\	0-1-0
Epistofeo	1-1-0	\	\
Vertebra toracica	0-1-1	0-1-1	\
Costa	29-12-14	1-2-0	5-0-1
Scapola	0-3-2	2-0-1	2-1-0
Omero	1-3-2	0-3-1	\
Radio	4-1-3	2-1-0	\
Ulna	5-6-0	\	\
Falange I	0-1-1	\	\
Metacarpo	8-8-4	2-1-0	\
Bacino	5-5-0	1-1-2	0-1-0
Femore	4-4-4	\	1-0-0
Tibia	5-7-5	4-4-1	1-1-0
Astragalo	\	0-1-0	0-0-1
Calcagno	\	0-0-1	\
Tarsali	\	\	0-0-1
Metatarso	2-1-0	2-0-0	\
TOTALE	**79-65-41**	**17-17-7**	**11-14-3**

TABELLA 4

Localizzazione delle tracce di macellazione sui resti di animali domestici (FaT: Fendenti a Termine-FiA: Fendenti in arresto- S Strie di macellazione).

Anche sui resti di caprovini si sono riscontrate tracce di sfruttamento della carcassa animale (Tabella 3; Figura 5). Un cospicuo numero di ossa lunghe (principalmente metapodiali) di bovini e caprovini si presenta privo delle porzioni epifisarie a causa dell'attività di carnivori per l'estrazione e il consumo del midollo. Questo è in accordo con la presenza di *Canis familiaris* nell'insieme faunistico.

CONSIDERAZIONI FINALI

Quanto emerge dallo studio in corso, si mostra perfettamente in linea con quanto riscontrato in analoghi siti in Trentino (Riedel & Scarpa, 1988; Riedel & Rizzi-Zorzi, 1994; Marconi, 2006). La predominanza di fauna domestica e la scarsità di tracce di macellazione portano a ipotizzare uno sfruttamento della risorsa animale come ausilio nelle attività produttive o come fonte di prodotti secondari (Buonopane, 2000), dato che è confermato anche dalla predominanza di individui il cui abbattimento è avvenuto in età adulta. Nello specifico, tra la fauna domestica, gli caprovini risultano predominanti in quasi tutte le fasi d'uso (NMI=24, 30,8%; Tabella 1).

La presenza di caprovini doveva essere per la maggior parte legata allo sfruttamento di prodotti secondari (ad esempio della lana). Questa ipotesi è avvalorata dalla predominanza di individui abbattuti in età adulta e senile oltre che dalla localizzazione delle tracce di macellazione (Tabella 4), tipica di azioni legate allo scuoiamento dell'animale per lo sfruttamento del pellame. Lo stesso dato circa la stima dell'età di morte è stato restituito anche dallo studio dei resti di *Bos taurus,* che appartengono principalmente a individui adulti. Dal momento che la maggior parte dei resti proviene dalle aree esterne all'edificio e appartengono alla fase in cui l'area venne bonificata e riconvertita in terreno agricolo, risulta plausibile che si sfruttasse questo animale come forza-lavoro nelle attività agricole.

La presenza di suini all'interno dello spettro faunistico si può giustificare come mera fonte alimentare, dato confermato dall'abbondanza di individui abbattuti in giovane età (NMI=6; 33%) e dalla localizzazione delle tracce di macellazione (Tabella 4; Figura 4).

RINGRAZIAMENTI

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BIBLIOGRAFIA

Baroncioni, A. 2012: *La città di Trento tra Tardo Antico e Alto Medio Evo: la genesi della città medievale e lo spazio del sacro*. Dottorato di ricerca in Archeologia XXIV Ciclo, Alma Mater Studiorum, Bologna.

Barone, R. 2010: *Anatomia comparata dei mammiferi domestici - Vol. 1, parte I Osteologia*, a cura di Bartolami R.

Bassi, C. 2015: Trento, Via Tommaso Gar (p.ed. 1661 C.C.Trento). In: Nicolis, F. (ed.): A.d.A.-*Archeologia Delle Alpi 2015*: 85-96. Provincia Autonoma di Trento, Soprintendenza Per I Beni Culturali.

Corazza, S. 2021-2022: Tesi di laurea magistrale *Analisi archeozoologica degli insiemi faunistici da due contesti romani del Trentino: l'edificio suburbano di Via T. Gar (Trento) e la necropoli di S. Cassiano presso Riva del Garda*. Università degli Studi di Ferrara, Università degli Studi di Trento, Università degli Studi di Verona, Università degli Studi di Modena-Regio Emilia.

Behrensmeyer, A.K. 1978: Taphonomic and ecologic information from bone weathering. *Paleobiology* 4(2): 150-162.

Boessneck, J. 1969: Osteological differences between sheep (*Ovis aries Linné*) and goat (*Capra hircus Linné*). In: Brothwell, D. & Higgs, E. (eds.): *Science in Archaeology. A Comprehensive Survey of Progress and Research:* 331-358. Thames and Hudson, London.

Buonopane, A. 2000: Società, economia, religione. In: Buchi, E. (ed.): *Storia del Trentino- L'età romana*: 140-190. Vol.II. Il Mulino.

Driesch, A. von den 1976: *A guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletins, Harvard University. MA.

Fernández-Jalvo, Y. & Andrews, P. 2016: Atlas of Taphonomic Identifications, Vertebrate Paleobiology and Paleoanthropology. Springer Dordrecht, Berlin.

Lyman, R.L. 1994: *Vertebrate Taphonomy*. Cambridge Manuals in Archaeology. Cambridge University Press, Cambridge.

Marconi, S. 2006: I resti faunistici di epoca romana rinvenuti nel corso delle campagne di scavo a San

Candido – Cantiere Böden (BZ). In: Tecchiati, U. & Sala, B. (eds.): *Archaeozoological studies in honor of Alfredo Riedel*: 217-230. Ripartizione Beni Culturali, Ufficio Beni Archeologici, Bolzano, Italia.

Payne, S. 1973: Kill-off Patterns in Sheep and Goats: The mandibles from Asvan Kale. *Anatolian Studies* 33: 65-81.

Reitz, E.J. & Wing, E.S. 2008: *Zooarchaeology*. Cambridge University Press, Cambridge.

Riedel, A. & Scarpa, G. 1988: Resti animali di un complesso produttivo di età Tardoromana a Volano. *Annali del Museo Civico di Rovereto* IV*:* 37-54.

Riedel, A. & Rizzi -Zorzi, J. 1994: Resti faunistici domestici e selvatici: produzione e consumo. In: Cavada, E. (ed.): *Archeologia a Mezzocorona. Documenti per la storia del popolamento rustico di età romana nell'area atesina*: 233-247. Arti grafiche La Commerciale, Bolzano.

Salvagno, L. & Albarella, U. 2017: A morphometric system to distinguish sheep and goat postcranial bones. *PLoS ONE* 12(6): 1-37. DOI: https://doi.org/10.1371/journal.pone.0178543.g014.

Schmid, E. 1974: *Atlas of Animal Bones: For Prehistorians, Archeologists and Quaternary Geologists*. Elsevier Publishing Company, Amsterdam.

Wilson, B.; Grigson, C. & Payne, S. 1982: Ageing and Sexing Animal Bones from Archaeological Sites. B.A.R. (British Series) 109. Oxford.

Relazione tecnica S.A.P. *Relazione sulle indagini archeologiche di via T. Gar avvenute nel cantiere per la costruzione della nuova sede della Facolta' di Lettere dell'Universita' di Trento Gennaio-Agosto 2009*.

Relazione tecnica P.E.T.R.A. *Trento, via T. Gar Intervento archeologico 2009 RELAZIONE TECNICO – SCIENTIFICA*.

Zeder, M.A. & Lapham, H.A. 2010: Assessing the reliability of criteria used to identify postcranial bones in sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 37: 2887-2905.

Zeder, M.A. & Pilaar, S.E. 2010: Assessing the reliability of criteria used to identify mandibles and mandibular teeth in sheep, *Ovis*, and Goat, *Capra*. *Journal of Archaeological Science* 37: 225-242.

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Markers of social differences in Tuscany from the 14th to the 20th century: The villa Medicea of Cafaggiolo (Barberino del Mugello, Florence)

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ABSTRACT: In the mid-14th century, the villa of Cafaggiolo became a property of the Medici family. The structure, strategically located on the road connecting Florence to Bologna, was an important economic centre and a place for rest away from city life. Cosimo I promoted the construction of an enclosed hunting reserve near to the villa where rare animals were kept. The villa then passed to the Lorraine family and in 1864 it was acquired by the Borghese Princes.

Faunal remains have been recovered from 15th-20th century contexts; however, most remains are dated between the mid-18th century and 1822. In total, 888 fragments were analysed which included mammals, birds, reptiles, amphibians, fish and marine shells. Cattle, sheep/goat and pig, raised in the surroundings of the villa, were the main source of meat. The presence of young and sub-adult individuals of wild mammals and birds and of marine fauna attests the consumption of high-level food which was sometimes hard to acquire.

The study of the Cafaggiolo assemblage provides important information about indicators of social differences in food consumption of the high-status community living in the villa between mid-18th century and 1822.

KEYWORDS: HIGH STATUS FOOD, HUNTING, TUSCANY, 18TH CENTURY-1822

RIASSUNTO: A metà del XIV secolo, la villa di Cafaggiolo divenne proprietà della famiglia Medici. La struttura, posta strategicamente sulla via di collegamento tra Bologna e Firenze, è stata un centro economico importante e luogo di riposo e svago dalla vita cittadina. Cosimo I promosse la realizzazione di un "Barco" murato con animali rari nei boschi circostanti la villa. La villa passò in seguito ai Lorena e nel 1864 fu venduta ai principi Borghese.

Resti faunistici sono stati recuperati da contesti di XV-XX secolo; di questi, la maggior parte è cronologicamente compresa tra la metà del XVIII secolo ed il 1822. In totale sono stati analizzati 888 frammenti. I resti identificati appartengono a mammiferi, uccelli, rettili, anfibi, pesci e bivalvi marini. Buoi, caprini e maiali allevati nei dintorni della villa rappresentavano la principale fonte di approvvigionamento carneo. La presenza di individui giovani o subadulti, mammiferi e volatili selvatici e taxa marini attesta il consumo di alimenti raffinati a volte difficilmente reperibili.

Lo studio dei resti faunistici della villa di Cafaggiolo ha restituito importanti informazioni circa indicatori di differenziazione sociale facendo luce sui consumi di un gruppo socialmente privilegiato che abitò la villa tra la metà del XVIII secolo ed il 1822.

PAROLE CHIAVE: ALIMENTAZIONE DELL'ÉLITE, CACCIA, TOSCANA, XVIII SECOLO-1822

http://www.doi.org/10.15366/archaeofauna2025.34.1.050

INTRODUCTION

The villa of Cafaggiolo is located north of Florence in the Barberino del Mugello municipality (Italy). Its primary building, which developed around a primitive castle of the Florentine Republic, was transformed around the mid-15th century into a fortified palace by Cosimo il Vecchio of the House of Medici. The structure was an important economic centre, strategically located on the road connecting Florence to Bologna, and a place for rest away from city life.

The villa was surrounded by woodlands which were largely exploited by the villa's inhabitants for hunting activities. Indeed, in 1537 Cosimo I promoted the construction of a '*Barco*', an enclosed hunting reserve, near to the villa where rare animals were kept. During the Lorraine family's rule in Tuscany the villa became one of their estates and was also used for the rising postal service. In 1864 it was acquired by the Borghese Princes (Lapi Ballerini, 2003).

Between the end of the 15th and the beginning of the 17th century, the villa area hosted one of the most famous pottery factories of the Renaissance. From 1999 to 2001 the Department of Historical and Geographic Studies of the University of Florence (Professor Guido Vannini) in collaboration with the Barberino del Mugello municipality, the Earthwatch Institute and the owners of the villa itself, archaeologically investigated the pottery production area near the villa. The faunal remains recovered during the archaeological investigation range from the 15th to the 20th century and came from three chronological periods: 15th century -1629; mid 18th century -1822 and 1822 - 20th century.

This study is aimed at investigating the high-status diet of a noble family in Tuscany during the mid 18th - beginning of 19th century through the analysis of the faunal remains collected from this wealthy rural villa.

MATERIALS AND METHODS

In total 888 bone fragments were collected. Most of them belong to the mid 18th century-1822 contexts when the villa was a property of the Lorrain family who were the Grand Dukes of Tuscany at that time.

Animal bones were identified to taxon level using the reference collections of the Department of Biology at the University of Florence, the Museum of Civilization (Rome), and the Italian Institute of Human Palaeontology (Anagni, FR). The distinction between sheep and goat was based on criteria available in literature where possible (Boessneck *et al*., 1964; Payne, 1985).

The number of identified specimens (NISP) and minimum number of individuals (MNI) were analysed to assess the relative abundances of different taxa. MNI count was obtained taking ontogenetic age and size into account (Bökönyi, 1970). The age at death of mammals was estimated using the degree of tooth eruption and wear (Grant, 1982; Hambleton, 2001) and long-bone epiphyseal fusion (Reitz & Wing, 1999). Sex attribution of pig was based on the shape of canines and for chickens on the presence or absence of a spur on the tarsometatarsi. Though spurs are usually present in males, they can occur in females with defective ovaries, but this is rare (West, 1982).

RESULTS AND DISCUSSION

In total 224 faunal remains were identified. Mammals, birds, amphibians, reptiles, fish and marine shells are all included in the sample (Table 1). Sheep/goat, pig/wild boar and cattle dominate the samples from all periods and were probably reared in the territories pertaining to the villa. In the 15th century – 1629 period a major consumption of pig/wild boar compared to sheep/goat is argued, although the sample is quite limited. In contrast, from the mid 18th century onwards sheep/goat are dominant. Chicken, pigeon, goose and mallard may have been kept in the villa area, although at least some of them, particularly goose and mallard, could be wild. The presence of wood pigeon, deer and hare indicates hunting activities while harrier, frog and toad remains are probably a natural occurrence in the assemblage. Indeed, the environment around the villa, located near the Sieve River, may have favoured their presence. However, we cannot completely rule out the consumption of frog, though butchery or cooking marks are absent on its bones. The tortoise may also have been consumed as its meat was prized at that time (De Grossi Mazzorin & Minniti, 2000). The fish remains consist of the dermal denticles of raja. The sample also includes marine shells, two

		XV - 1629		XVIII -1822		1822 - XX	
		NISP	MNI	NISP	MNI	NISP	MNI
Mammiferi	Maiale/Cinghiale (*Sus scrofa/domesticus*)	8	1	43	4	7	1
	Bue (*Bos taurus*)			47	4	4	1
	Pecora (*Ovis aries*)			3	2		
	Capra/Pecora (*Capra hircus/Ovis aries*)	3	1	57	5	11	1
	Cervo (*Cervus elaphus*)			1	1		
	Cane (*Canis familiaris*)			1	1		
	Lepre (*Lepus europaeus*)			3	2		
Uccelli	Gallo domestico (*Gallus domesticus*)			17	2		
	Colombaccio (*Columba palumbus*)			2	1		
	Piccione/colombella (*Columba livia/oenas*)			1	1		
	Oca (*Anser* sp.)			1	1		
	Germano reale (*Anas platyrhynchos*)			1	1		
	Albanella reale (*Circus cyaneus*)					1	1
Rettili e anfibi	Testuggine (*Testudo* sp.)			2	1	1	1
	Rana (*Rana* sp.)			1	1		
	Rospo (*Bufo bufo*)			1	1		
Pesci e bivalvi marini	Razza (*Raja* sp.)			1	1		
	Ostrica (*Ostrea edulis*)			2			
	Vongola (*Chamelea gallina*)			4		1	1
	TOTALE	11		188		25	

	Taxa	15th c. - 1629		mid 18th c. -1822		1822 - 20th c.	
		NISP	MNI	NISP	MNI	NISP	MNI
Mammals	Pig/wild boar (*Sus domesticus/scrofa*)	8	1	43	4	7	1
	Cattle (*Bos taurus*)			47	4	4	1
	Sheep (*Ovis aries*)			3	2		
	Sheep/Goat (*Ovis aries/Capra hircus*)	3	1	57	5	11	1
	Deer (*Cervus elaphus*)			1	1		
	Dog (*Canis familiaris*)			1	1		
	Hare (*Lepus europaeus*)			3	2		
Birds	Chicken (*Gallus domesticus*)			17	2		
	Wood pigeon (*Columba palumbus*)			2	1		
	Pigeon/stock dove (*Columba livia/oenas*)			1	1		
	Goose (*Anser* sp.)			1	1		
	Mallard (*Anas platyrhynchos*)			1	1		
	Royal harrier (*Circus cyaneus*)					1	1
Amphibians and reptiles	Tortoise (*Testudo* sp.)			2	1	1	1
	Frog (*Rana* sp.)			1	1		
	Toad (*Bufo bufo*)			1	1		
Fish and marine molluscs	Raja (*Raja* sp.)			1	1		
	Oyster (*Ostrea edulis*)			2			
	Venus clam (*Chamelea gallina*)			4		1	1
	TOTAL	11		188		25	

TABLE 1
NISP and MNI frequencies.

oysters and one venus clam which attest to contacts with the coast.

In the mid 18th- 1822 period, anatomical frequencies show an almost equal distribution of all anatomical elements of pig/wild boar with a slightly higher presence of radius and pelvis (Table 2). Of interest is the complete absence of femurs, it is likely that this part was removed before consump-

		Skull	Ma	Sc	Hu	R-U	CB	Mc	Cx	Fe	Ti	TB	Mt	Ph
Pig/wild boar	15th c. - 1629			1							1			1
	mid 18th c. -1822	1		1	1	4	1		4		1		1	1
	1822 - 20th c.			1		1					1			
Cattle	15th c. - 1629													
	mid 18th c. -1822	2	2	1	3	1	2		8	1	2	2	1	4
	1822 - 20th c.	1							1				1	
Sheep/goat	15th c. - 1629										1			
	mid 18th c. -1822	1	5	2	4	3			1	1	6	2	2	
	1822 - 20th c.													1

TABLE 2

Anatomical frequencies of pig/wild boar, cattle and sheep/goat based on NISP (Ma=mandible; Sc=scapula; Hu=humerus; R-U= radius and/or ulna; CB= carpal bones; Mc=metacarpus; Cx= pelvis; Fe= femur; Ti= tibia, TB= tarsal bones; Mt= metatarsus; Ph= phalanges).

tion. Cattle display higher frequencies of pelvis and humerus fragments, while tibia and humerus are the most frequent anatomical elements of sheep/goat. In general, metapodials and phalanges are rare or completely absent. The data indicates that these animals were likely slaughtered elsewhere and that the collected remains come from food consumption.

Chicken is represented by almost all anatomical elements (1 scapula, 2 coracoid, 1 humerus, 4 radius, 2 ulna, 1 carpometacarpus, 4 femur, 1 tibiotarsus, 1 tarsometatarsus), particularly favouring the meat bearing ones.

One male canine was identified among the pig/wild boar sample. Evidence of a spur, likely indicating a male, was recorded on one chicken tarsometatarsus.

The ontogenetic ages of the three main domesticates show young individuals mainly slaughtered before they reach two years (Table 3). These animals were likely dedicated to the production of good quality meat. Chickens are represented by both adult and young individuals although the latter with lower frequencies (4 young and 13 adult elements).

Butchery marks are present in all periods. They concentrate on pig/wild boar, cattle and sheep/goat with only one evidence on hare. Combusted remains of pig/wild boar and sheep/goat have been noted in the 18^{th}- 1822 period sample.

CONCLUSIONS

During the Lorrain family period of the villa the three main domestic mammals, sheep/goat, pig/wild boar, and cattle, were raised in the surroundings of the villa and were the main source of meat. The predominance of young and sub-adult individuals indicates a preference for high quality rather than quantity in meat consumption.

The woodlands surrounding the villa were rich in wild animals, as suggested by a number of representations in the Cabreo (list of assets) of Cafaggiolo dated to 1625 (Campidori, 2006). The occurrence of wild mammals and birds in this assemblage suggests that hunting was practiced on

		Months					
		< 6	**<12**	**>12**	**<24**	**>24**	**<36**
Pig/wild boar	15th c. - 1629					1	
	mid 18th c. -1822	1	1	1	2		
	1822 - 20th c.					1	1
Cattle	15th c. - 1629				1		
	mid 18th c. -1822				1	1	
	1822 - 20th c.				1		
Sheep/goat	15th c. - 1629		3		3		
	mid 18th c. -1822	2					
	1822 - 20th c.		1				

TABLE 3

Ontogenetic data.

site, allowing game to be served at luxury banquets. The marine fauna indicates long distance food provisioning and the consumption of high-status and easily perishable food.

The analysis of the faunal remains from Cafaggiolo disclosed important information about markers of social differences in the diet of the high-status people who frequented the villa between mid-18th century and 1822.

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REFERENCES

Boessneck, J.; Müller, H.H. & Teichert, M. 1964: Osteologische Unterscheidungsmerkmale zwischen Schaf (*Ovis aries* L.) und Ziege (*Capra hircus* L.). *Khün-Archiv* 78: 1-29.

Bökönyi, S. 1970: A new method for the determination of the number of individuals in animal bone material. *American Journal of Archaeology* 74(3): 291-292.

Campidori, P. 2006: *Cafaggiolo poderi e fornace 1625*. Tipolitografia Toccafondi, Firenze.

De Grossi Mazzorin, J. & Minniti, C. 2000: Alimentazione e pratiche religiose: il caso di due contesti monastici a Roma tra il XVI e il XVIII secolo. *Atti del II Convegno Nazionale di Archeozoologia*: 327-338. ABACO Edizioni - M.A.C. Srl, Forlì.

Grant, A. 1982: The use of tooth wear as a guide to the age of domestic ungulates. In: Wilson, R.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing animal bones from archaeological sites*: 91-108. B.A.R. (British Series) 109. Oxford.

Hambleton, E. 2001: A method for converting Grant mandible wear stage to Payne style wear stages in sheep, caw and pig. In: Millard, A. (ed.): *Archaeological Sciences '97. Proceedings of the Conference Held at the University of Durham 2nd- 4th September 1997*: 103-108. B.A.R. (International Series) 939. Oxford.

Lapi Ballerini, I. 2003: *Le ville medicee. Guida completa*. Giunti Editore, Florencia.

Payne, S. 1985: Morphological distinctions between the mandibular teeth of young Sheep, *Ovis*, and goats, *Capra*. *Journal of Archaeological Science* 12: 139-147.

Reitz, E. & Wing, E. 1999: *Zooarchaeology*. Cambridge University Press, Cambridge.

West, B. 1982: Spur development: recognising caponised fowl in archaeological material. In: Wilson, R.; Grigson, C. & Payne, S. (eds.): *Ageing and sexing animal bones from archaeological sites*: 255-262. B.A.R. (British Series) 109. Oxford.

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