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ORNITHOARCHAEOLOGY: THE VARIOUS ASPECTS OF THE CLASSIFICATION OF BIRD REMAINS FROM ARCHAEOLOGICAL SITES

ARTURO MORALES MUÑIZ
Laboratorio de Arqueozoología. Depto. Biología.
Universidad Autónoma de Madrid
28049 Madrid. España.

ABSTRACT: Bird remains are regular, though not always abundant, elements in faunal assemblages of archaeological nature. The paper is a theoretical discussion on the importance of these remains from the standpoint of two aspects of their research: feasibility of their identification and reliability of use as palaeoenvironmental indicators.

KEYWORDS: ARCHAEOZOOLOGY, BIRDS, ANALYSIS, IDENTIFICATION, PALAEOENVIRONMENTAL INDICATORS, EUROPE

RESUMEN: Los restos aviares suelen ser componentes regulares, si bien casi nunca abundantes, de las asociaciones faunísticas de naturaleza arqueológica. Este trabajo medita, desde una perspectiva teórica, acerca de dos aspectos relacionados con su estudio: la viabilidad de las identificaciones y su operatividad como indicadores paleoambientales.

PALABRAS CLAVE: ARQUEOZOOLOGIA, AVES, ANALISIS, IDENTIFICACION, INDICADORES PALEOAMBIENTALES, EUROPA

INTRODUCTION: BIRDS AS ARCHAEOLOGICAL TOOLS

Ornithoarchaeology is a promising field of archaeozoological research. Up until the present few bone reports have been exclusively devoted to bird remains and, when so, emphasis was seldomly laid on the non-biological aspects of the assemblages (Bochenski, 1974; Mourer-Chauviré, 1975; Elorza, 1990). One of the reasons for this is the fact that, of all the disciplines that have converged on the analysis of birds from archaeological sites, paleontology is undoubtedly the one with the most pervasive influence. There are historical reasons for this state of affairs. Among these, the restriction of good reference collections to paleontological research units or institutes, either independent or within a museum's superstructure, has played a decisive role in making paleontology such a prominent science within ornithoarchaeology.

Bird remains are not abundant elements of vertebrate taxocenosis and the exceptions known (La Fage, Binagady, Rancho la Brea, etc...) tend to confirm this pattern (Behrensmeyer et al., 1992). On the other hand, birds and their products have been, and still are, locally important resources for hunter-gatherer types of strategies and many species have been raised to symbolic status or regarded as sources of wisdom, courage or beauty. In due time many bird species turned into domesticates (Mason, 1985).

It was the realization of the potential usefulness of these cultural aspects which gave the impetus to ornithoarchaeological research within the last decade or so (Vilette, 1985). Having had no formal training in this field but ample experience in ornithology, I would like to comment upon two mainly biological problems of ornithoarchaeological studies (identification and paleoecological inference of bird remains) from the perspective of an uninitiated, culturally oriented, researcher.

BIRD BONES: A CASE STUDY IN IDENTIFICATION

In principle, the taxonomic determination of bird remains is not different from that of other animal groups and constitutes, contrary to what some authors openly state[1], a complex, non-quantifiable process which not only requires a more or less automatic matching between objects, but also demands a careful evaluation of intraspecific vs. interspecific variability plus a knowledge of the reliability of particular osteological features as specific discriminators (Morales, 1989). As is the case with all archaeozoological materials, a comparative collection is absolutely necessary to carry out meaningful work in ornithoarchaeology, and the scarceness in the past of good reference collections has forced many people to either build their own or else turn to another subject[2]. Worse still, the lack of comparative material has also delayed the publication of atlases which, for the European bird faunas, started as late as 1967 (Munich's first thesis on the comparative osteology of European families; see, for a non-exhaustive list of papers, some of the references at the end of this work). Atlases, however, are not a good solution in the case of bird bone identification since, on top of their general drawbacks (i.e. a typological approach to the identification of natural objects, a preferential use of whole bones rather than fragments, etc...), they add new ones which render them impractical.

These additional drawbacks relate to the particulars of avian osteology and avian assemblages. For one thing, though never too abundant, bird assemblages are indeed diverse, in terms of total number of remains per species and, occasionally, in terms of total number of species. This statement is, of course, only meaningful when one compares, for any one site, these two parameters with their equivalent ones in other animal groups (in particular, mammals and molluscs), especially when sediments have been water-sieved or floated. One can readily check this by examining regional studies involving the analysis of many sites (Baird, 1989; Mourer-Chauviré, 1975; Vilette, 1983). Why this pattern is so prevalent is still open to debate, but perhaps the mobility of birds influences the degree to which their capture is unpredictable by comparison with that of less mobile groups. Birds, moreover, are also the most diverse group of terrestrial vertebrates. These contingencies mean that, in order for an atlas of bird bones to be useful, it would either have to include a far higher number of species than is the case for mammals or else specialize itself in single bones, regions or taxonomic groups[3].

The second drawback, avian osteology, is an equally serious one, for in many large groups of birds (i.e., passerines, ducks, etc...) anatomical features tend to be rather homogeneous. In order to resolve a determination one needs to have a minimum acquaintance with the lability or stability of particular features and this, naturally, implies turning away fromtypological classification as much as possible[4].

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(1) - Estévez (1991:61), for example, writes that "The task of taxonomic classification in essentially a mechanical process which only requires a good reference collection ... and to know and compare the relevant features of the item" ("La tarea de clasificación taxonómica es en esencia un proceso mecánico para el cual sólo es preciso tener una buena colección de referencias ... y conocer y comparar los caracteres significativos de la pieza").

(2) - Mourer-Chauviré describes a most common pattern for birds specialists, having started work with a collection (Milne-Edward's) in a very poor state of preservation, then shifting to a more reliable one (Regalia's) before finally deciding to build her own one at Lyon (Mourer-Chauviré, 1975:12).

(3) - This is, in fact, what happens in many cases. Munich's thesis (see bibliography) or works such as that of Moreno (1985, 1986, 1987) concentrate on bird families or orders while works like those of Selstam & Selstam (1975) concentrate on particular bones. The most usual approach is a combination of these two (Miles-Gilbert et al., 1985).

(4) - This being of the reasons why we are so reluctant to acept Bochenski & Tomek's recently defended idea that, in order to identify a bird remain, on most occassions, one specimen is often enough (Bochenski & Tomek, in press).

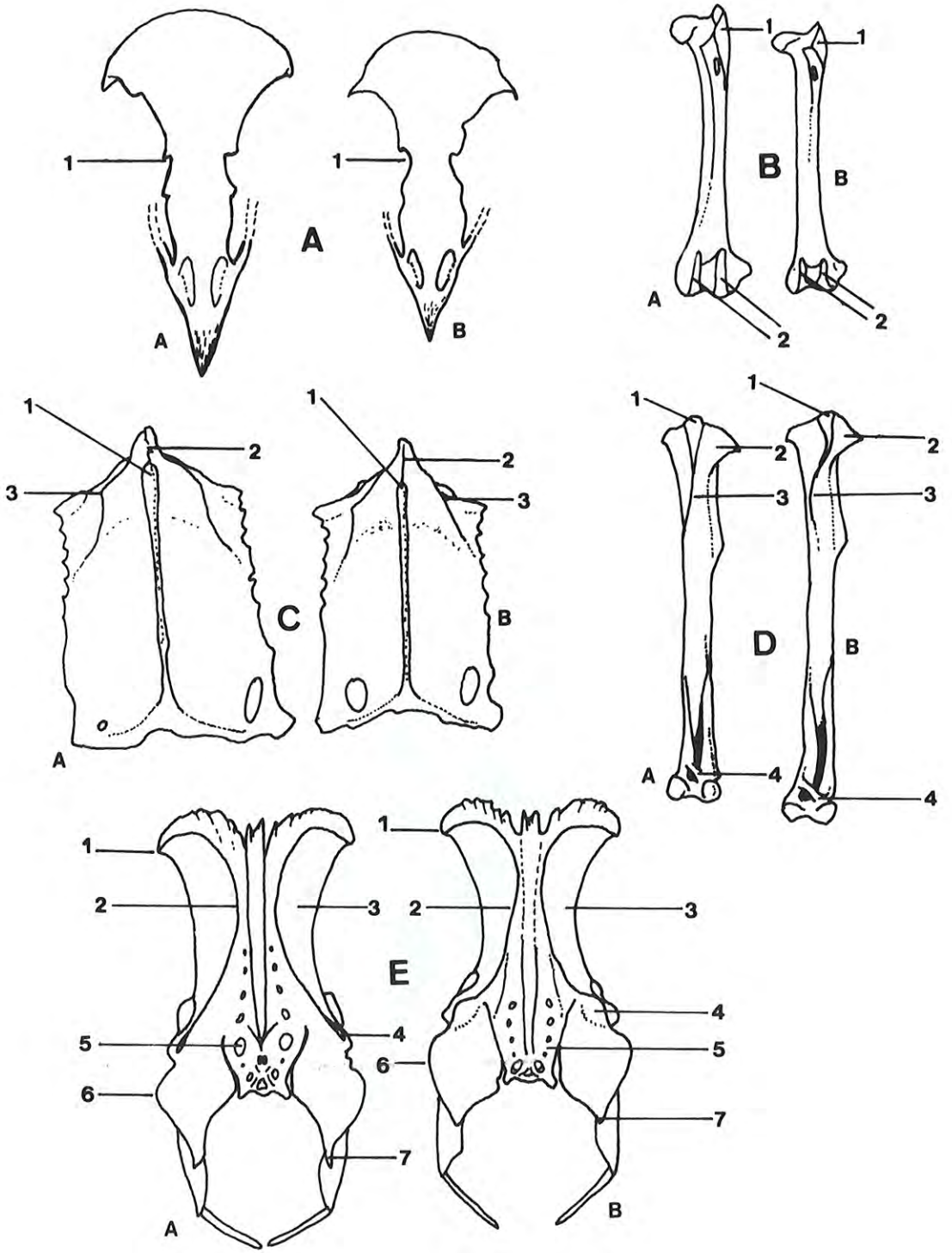


FIGURE 1 - Diagnostic features on the skulls (A), femora (B), sterna (C), tibiotarsii (D) and sinsacra (E) of red kite (*Milvus milvus*, A) and black kite (*Milvus migrans*, B). Data taken from Otto (1981) and Schmidt-Burger (1982) with modifications.

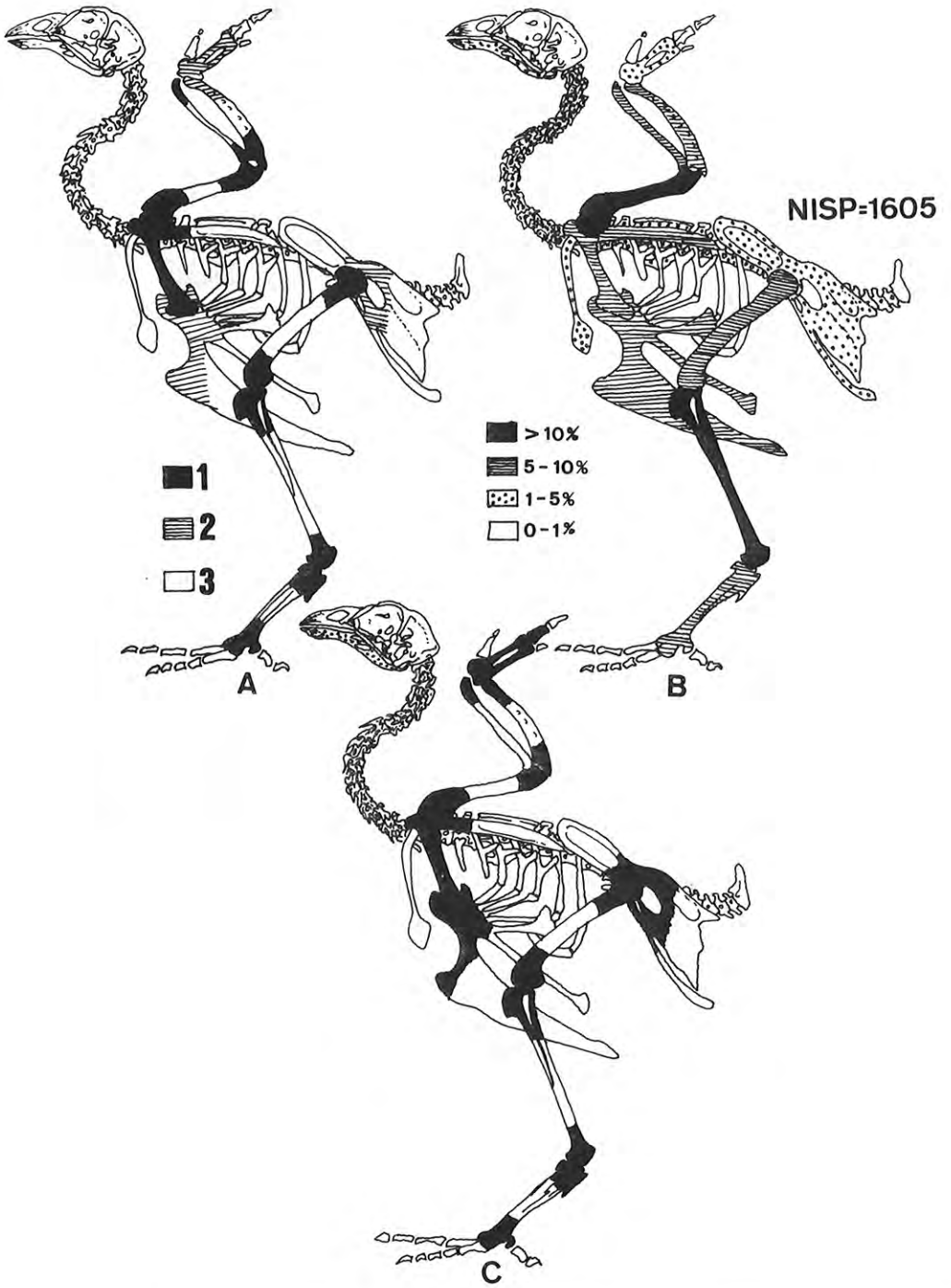


FIGURE 2 - A three-category scale of usefulness of different bone portions from the avian skeleton (1: diagnostic and very frequent element or portion; 2: diagnostic element or portion; 3: neither .... nor ...) (A) based on a combined value of skeletal frequencies from Spanish archaeological assemblages (B) and a qualitative estimation of the most diagnostic osteological elements in birds (C).

Perhaps an example can be more illustrative of this situation. For many years we tended to consider most of the osteological differences between our single comparative specimens of black kite (*Milvus migrans*) and red kite (*Milvus milvus*) as rather good discriminators. Later came the works of Otto (1981) and Schmidt-burger (1982) which considerably reduced our number of discriminant features (Figure 1). Finally we decided to build up our own comparative series for both species realizing then that even some of the characters provided by these two authors can be often shaky. Nowadays most of our kite remains come up in the bone reports as unspecified *Milvus sp.*. To the eyes of the unexperienced observer we have grown clumsier with time!. This example will be also taken in the following section but its lesson is clear enough: beware of character lability even when identifying low-diversity bird taxa!.

When one is not fully aware of these drawbacks, strange things may happen. Thus, while agreeing with Baird's statement that numbers of species identifications in birds in general are higher than is the case with other proxy indicators of environment (he refers to microfloral and micromammalian assemblages in Australia, providing a figure of 64% NISP-identified to species level in birds), one can't help feeling depressed to see that on many French sites 100% of all the bird remains have been classified to species level! (Mourer-Chauviré, 1975; Vilette, 1983). For one thing, not all bird bones are equally "informative" nor are different bone portions (Figure 2). In other cases depression gives way to suspicion. How can one accept the simultaneous occurrence of all three species of buzzards of the genus *Buteo* in a Basque prehistoric site, or that of the rock partridge (*Alectoris cf. graeca*) and the barbary partridge (*A. barbara*) in early postglacial sites in Catalonia, without a single reference in the text to such a peculiar association? (Elorza, 1990; Vilette, 1983). These cases, together with similar ones (i.e. systematic identification of thrushes (*Turdus sp.*) to species level, etc...) make one wonder if other researchers have been misled by intraspecific variation of bird bones to the extent that we have been in some instances.

With atlases or with reference collections, the fact remains that some species can be anatomically identified with almost any element in their skeleton (i.e. gannet (*Sula bassana*) while many others (i.e. ducks, passerines) can, with difficulties, be classified down to species level with much fewer whole bones (i.e. humerus, coracoid). From this perspective it would be methodologically unsound to evaluate an assemblage's diversity by simple, unponderated, calculation of NISP and still more dangerous to turn these NISP into MNI and consider these modified NISP (or, worse still, their percentages) as measures of abundance in order to infer hunting strategies, paleoenviroments, etc... . This is a point which many authors who regularly use MNI do not comment upon, but which could lead to a lot of erroneous hypothesizing as so many authors, have repeatedly stressed (Mourer-Chauviré, 1975; Vilette, 1983; Grayson, 1984; Estévez, 1991).

Anatomical and taxonomical determination is a time-consuming process. If one does not know where to place emphasis, the analysis might require an effort which, in terms of the quality of information retrieved, might not be worth the trouble. Hesse & Wapnish (1985:69) provide some guidelines which should help people in organizing themselves. Two of their recomendations [no. 3 (i.e. "several taxa might tell the same tale") and no. 4 (i.e. "general categories may be adequate for estimating diversity")] are invoking the phenomenon of partial (i.e. incomplete) identification as a means of sparing needless (or, at least, not so productive) effort and deserve some coment from the standpoint of ornithoarchaeological analysis.

In the case of diversity estimation, one should always bear in mind that bird remains are usually scarce in anthropic sites (thus with a very low NISP/MNI ratio) and very seldom appear as

whole skeletons (Figure 2; but see also Figure 3). In such instances the chances are high that different species will have different skeletal spectra and that, for any single bone category, few species will coincide (Mourer-Chauviré, 1983; Ericsson, 1987; Livingston, 1989). How then would one possibly know if a raptor scapula belongs to the same taxon of a raptor coracoid if it was not by identifying both bones all the way down to species (or, perhaps, genus) level? "general categories" (i.e. raptors, waterfowl, etc...) are of little use in measurements of diversity, and the same applies if by general categories one is referring to the upper levels of the taxonomic hierarchy (i.e. families and orders). Even if one could sort out 5 morphotypes of raptor scapulae, chances are that one would need to check whether these corresponded to intraspecific or interspecific variability cases. Estimating diversity with taxa of unknown identity is only acceptable where unknown taxa are, at least, positively known to be something different from the remaining ones. To establish that 5 taxa of raptors are present on a site is probably not such a long way from establishing that those 5 taxa correspond to 5 different species/genera even though some of these remained unknown (providing you're working with a reference collection!)[5].

If one now entertains the idea that "several taxa might tell the same tale" one rapidly discovers that life is never so easy, at least for an ornithoarchaeologist. Most biological "tales" are far from a straightforward "all or none" business, so, that when Hesse & Wapnish write that a few species of migratory ducks may document the season of occupation of a site "without laborious examination of all avian bones" one can't help thinking about contexts and the species involved. Would these belong to the group of partial or facultative migrants? where is the site located and how old is it? if the species are not target species, unequivocal indicators of migration having taken place, there would be a need to contrast these results with concordant data in other groups of fauna, birds included. In anthropic sites, moreover, one has to account for human interference (i.e. perhaps birds had been transported from somewhere else; perhaps people were just collecting and using their feathers and bones came as an occasional by-product of the activity of skinning carcasses, etc...). All this leads us into another facet of archaeozoological identification.

From the strictly anthropological standpoint, as important as the anatomical/taxonomical determination of the remains would be a taphonomical classification of the specimens. Gautier's "taphonomic groups" provide a useful framework of research but small samples might provide us with, at best, a rough determination of groups (domestic, commensal, hunted, etc...) (Gautier, 1987). Larger samples, on the other hand, usually offer the possibility of checking for signs which will allow a more precise classification of bones according to their taphonomic histories. When this possibility is enhanced by the use of complementary data, one can sometimes witness the extent to which conventional (i.e. anatomical/taxonomical) determinations disagree with taphonomical ones (Figure 3). In the case of the medieval site of Calatrava, for example, it was very clear that domestic fowl (*Gallus gallus*) belonged to different categories according to their taphonomy: (1) consumed specimens (burned, with intentional fracturing, cutmarks and gnaw marks) and (2) corpses (articulated skeletons with no manipulative traces whatsoever) indicating a rapid episode of killing and burial which, with the help of documentary evidence, we believe can be traced back to the storming of the Muslim city by Christian troops in August 1212 AD (Morales et al., in prep.).

Obviously, there is more to archaeozoological determination than just taxonomy and anatomy. For the reasons previously outlined, a good reference collection needs something more than just

(5) - There are, of course, more sound "ecological" reasons for rejecting the argument that "general categories may be adequate for estimating diversity" (Magurran, 1988).

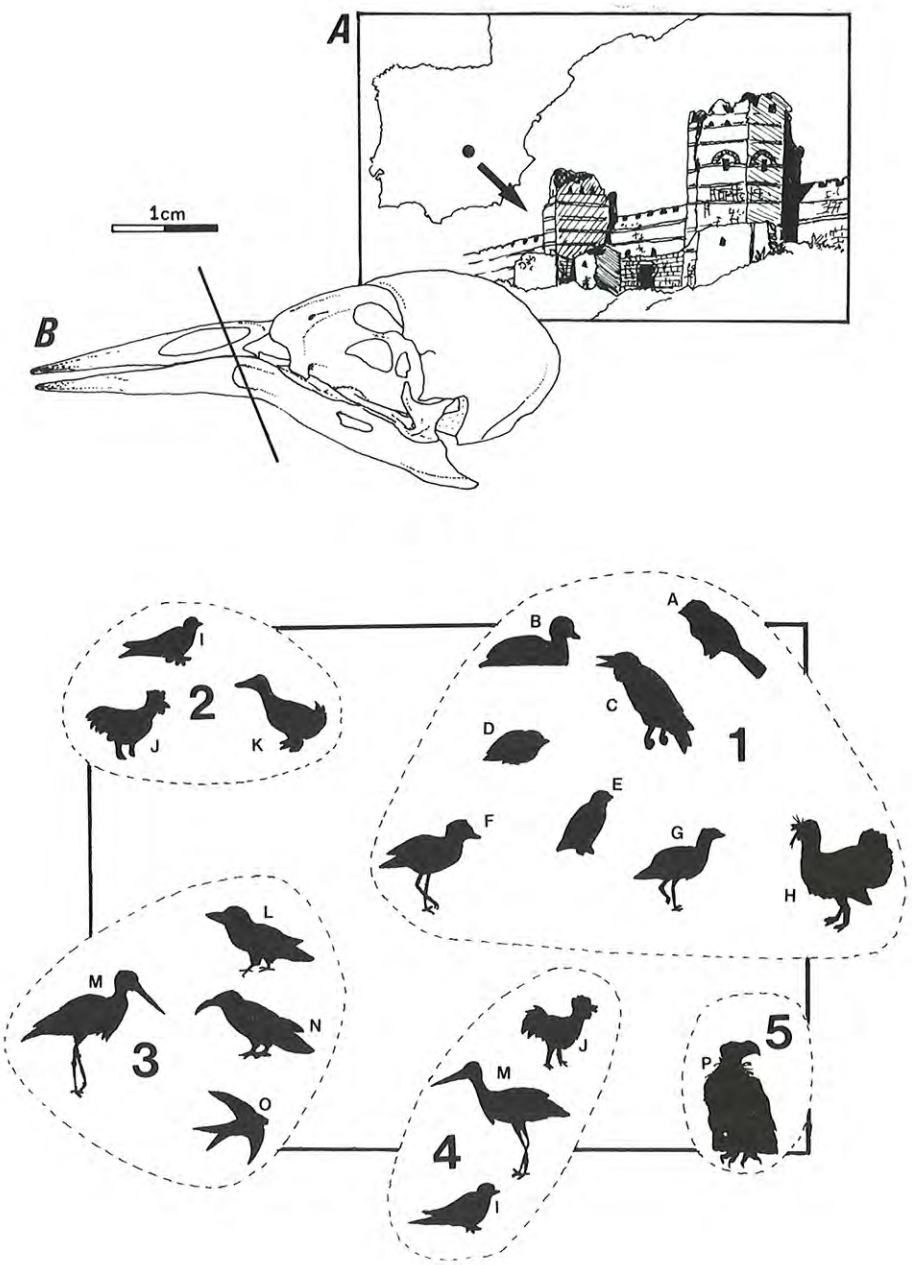


FIGURE 3 - A taphonomical classification of the bird assemblage from the Muslim city of Calatrava La Vieja (prov. Ciudad Real, Southern Spain) (A). 1: hunted taxa; 2: domesticates; 3: urban birds; 4: corpses; 5: taxa of uncertain taphonomic origin. Taxa codes are as follows: A: *Miliaria calandra*; B: *Fulica atra*; C: *Sturnus spp.*; D: *Coturnix coturnix*; E: *Alectoris rufa*; F: *Burhinus oedicnemus*; G: *Tetrax tetrax*; H: *Otis tarda*; I: *Columba livia*; J: *Gallus gallus f. domestica*; K: *Anas platyrhynchos f. domestica*; L: *Corvus monedula*; M: *Ciconia ciconia*; N: *Pyrrhocorax pyrrhocorax*; O: *Hirundo rustica*; P: *Aegypius monachus*. Though the assignment of certain taxa to a particular taphonomic group is, in view of scarce or conflicting osteological information, occasionally uncertain, the taphonomical analysis reveals data of unusual relevance in taxonomical/anatomical determinations. In Calatrava, for example, industrial processing of starlings is revealed by a series of specific fractures of the skeleton such as the systematic oblique chopmarks to remove their bills (B). Data taken from Aguilar (1991) and Morales et al. (in preparation).

complete adult specimens of a selection of species. All the possible species must be available for comparisons, if trustworthy identifications are to be made. In the case of avian remains, the osteological sample should require the presence of males and females, chicks and juvenile birds (occasionally the target groups of human exploitation) as well as bones of animals which have been naturally or experimentally cut, fractured, burned, chewed, preyed upon or digested. Whole and broken eggshells[6] and loose feathers would also be welcome items. Unfortunately, most official reference collections are not interested in such a wide array of "leftovers". Bad news for ornithoarchaeologists! .....

BIRDS AS PALEOECOLOGICAL INDICATORS

The use of birds as paleoecological indicators is based upon the concept of modern analogues and constitutes another way of classifying them. The fragmentary nature of most anthropic assemblages precludes the retrieval of complete avian communities, so ornithoarchaeologists must work only with partial analogues (i.e. the combined environmental data provided by the taxa recovered). The feasibility of paleoenvironmental reconstructions will thus directly depend on the number of partial analogues involved and on the quality and quantity of the information provided by them (Baird, 1989).

Though partial analogues will be unable to determine a series of features of former environments (i.e. trophic chains, population densities, etc...), ornithoarchaeologists are more specifically concerned with certain aspects of the interrelationship between man and birds (i.e., changes in geographical ranges, cropping strategies, habitats exploited, etc...).

In principle, birds constitute optimum subjects for paleoecological analysis. This is so, among other things, because:

(1) birds are a highly diversified group with good chances of coming up in archaeological sediments (despite normally low NISP numbers). The number of partial analogues one can potentially take into account is high and this, in turn, gives strength to the inferential process.

(2) The biology of birds is usually well known, even in the case of many exotic species, insuring a degree of confidence in the reconstruction of environments unmatched in the remaining groups of the animal kingdom[7].

(3) The degree of precision in the identification of avian remains is rather high, with 60-100% of all items being classified down to species level (Baird, 1989; Morales & Hernández, unpubl. data; but see comments on this point in the previous section). Since similar species often exhibit different biological habits, this point is of utmost importance and stresses the need for a precise taxonomical determination of the remains.

When relying on analogues, the most important assumption one probably has to make is that: "... the modern distribution of a species indicates all the possible combinations of environmental factors, both physical and biological, that the species can tolerate" (Lundelius, 1983:126). In the view

(6) - see the paper by Sidell in this same volume on the possibilities of eggshell identification.
(7) - Baird claims that this amount of knowledge is possible because: "... the limits of species in birds may be clearly perceived by humans because both taxa are visually-auditory oriented" (Baird, 1989:242). But there might be equally important reasons for this being so (i.e. possibility of studing animals in their natural surroundings).

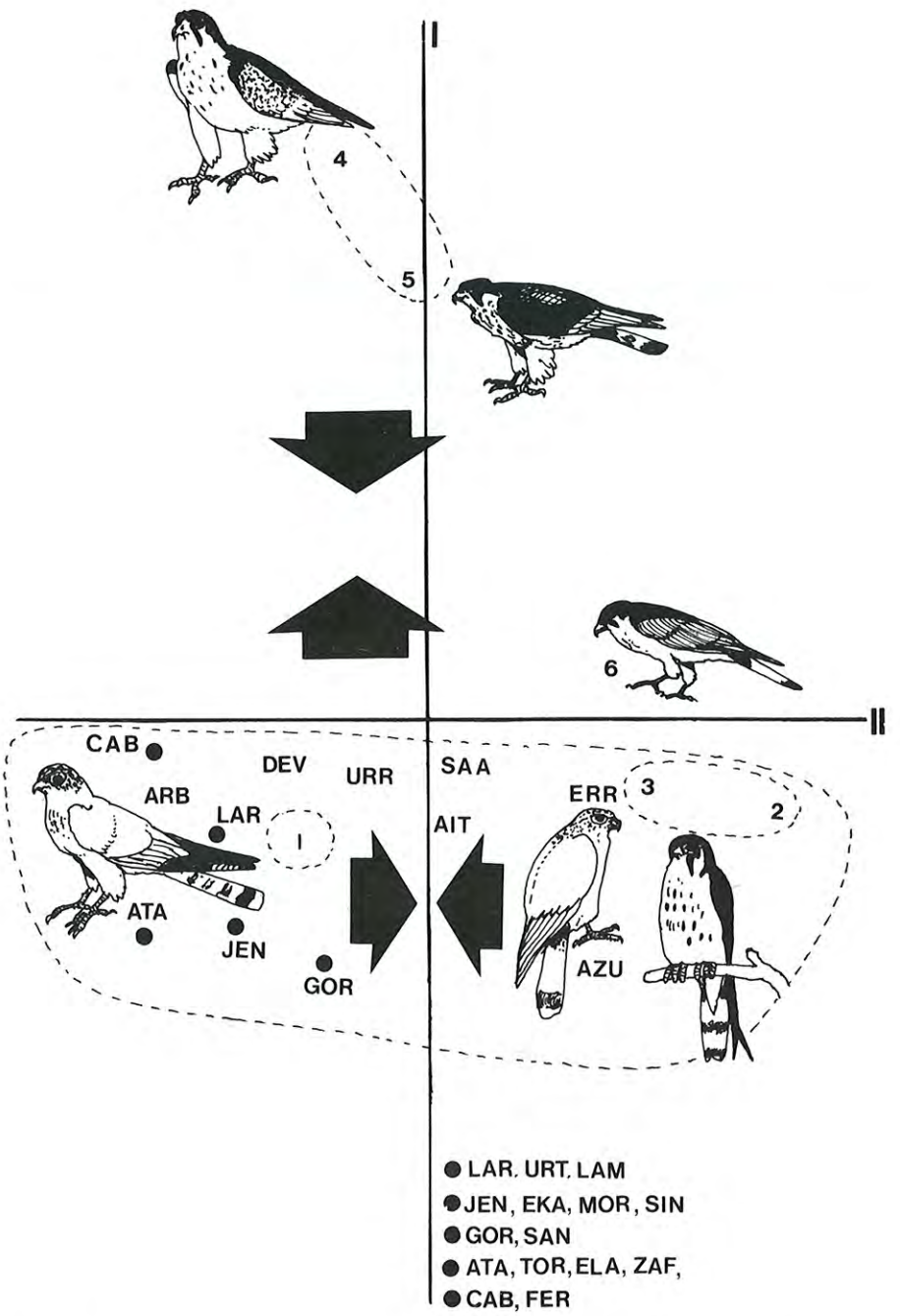


FIGURE 4 - Results from a correspondence analysis confronting taxa from the genus *Falco* with the sites where they have been retrieved. The main confrontation (big arrows) occurs along the first axis (I) between anthropophylous (1: *F. tinnunculus*; 2: *F. naumanni*; 3: *F. subbuteo*) and anthropophobous (4: *F. rusticolus*; 5: *F. peregrinus*) species. A second-order confrontation, along the second axis (II) (smaller arrows) segregates year-long residents (1) from aestival breeders (2 & 3) which associate themselves with some paleolithic summer camps (ERR, AZU). Merlins (*F. columbarius*, 6) do not take part in any association due possibly to their low retrieval frequencies. Multiple-points, with several sites included, are indicated by black dots (taken, with modifications, from Hernández & Aguilar, in press, where site codes are explained).

of man's impact on the distribution of many species we now know this might not always be the case. Assumptions on the correlation of distribution and structure of the vegetation and concordant changes of vegetation with macroclimate might also be important in this context (Kikkawa, 1968; Nix, 1982; Baird, 1989).

All this theoretical framework is not devoid of drawbacks (we have already mentioned some) but, of course, the most important point is that animals do not behave as automatons. Thus, though most species have preferences for a particular set of environmental parameters, there normally exists a wide range of variation which precludes automatic assignment to, say, a taxonomically specific type of vegetation. Being quite mobile endotherms, birds can change habits and ranges quite fast, sometimes instantaneously (Morales, 1990). Migration is one of the habits that seems to have undergone dramatic changes in the recent past. In fact, many biologists now believe that the whole Holarctic-Ethiopian-neotropical bird migration system is a recent event in the geological history of the planet, dating back to the start of the Pleistocene glaciations (i.e. 1-1.5 million years) though some authors believe it to be as recent as 10,000-5,000 years (Bernis, 1966; Alerstam, 1990). But we need not go so far back in time: it is within the last 8 years that populations of white storks (*Ciconia ciconia*) have become year-round residents in the Iberian Peninsula (Lázaro, 1984; Bernis, 1988). The Sahelian drought as well as the habit of seeking food in refuse dumps have a lot to do with such a change (refuse heaps have become a major source of food in the last 20 years for no less than 20 species of Iberian birds including many gulls and raptors) (Berthold et al., 1992). Even circadian rhythms can change quickly: some kestrel (*Falco naumanni*) populations in Andalusia (S. Spain) forage insects with bats during night hours around the well-lighted monuments of Sevilla (Andrana & Franco, 1974).

All this plasticity casts some doubts on the apparently sensible ecological classifications of avifaunas made by different authors (Voous, 1960).

The problem we can run into is not just one of consistent application of standards nor one of methodological misdoing, but, rather one of adequacy of the inferential basis and one of whether one can, or cannot, test the validity of this inferential basis with the data at hand. The suggestions of the different authors on how to deal with migratory species (discussed in the previous section) exemplify these constraints very clearly (Mourer-Chauviré, 1975:23; Vilette, 1983:62).

It should be obvious that in order to obtain an appropiate paleoenvironmental reconstruction and to reckon ecological features in a bird assemblage in addition to the highest number of reliable items (i.e. taxa)[8] one should also try to obtain as much complementary information as possible. Only from the confrontation of a high number of variables can we hope to see patterns emerging, even though in order to do so one might need the help of multivariate statistics (Figure 4). Pattern interpretation should come afterwards, despite what some authors state (Torres, 1988; Estévez, 1991).

It is hoped that, in the future, we will be able to refine some inferential techniques; however, the refinement of the analogue theory through the analysis of species' ranges, in order to obtain more reliable estimates of rainfall, temperature and vegetation by defining the "bioclimatic envelopes" proposed by Baird (1989:243), is still conditioned by the quality and quantity of the information provided by the partial analogues available today.

(8) - When one looks at the number of "indicator" species (sensu Vilette, 1983; "target" species sensu Baird, 1989) in the European avifauna one is indeed shoked to discover their appallingly low number. Most European birds can characterize biotopes only in the coarsest of ways (i.e. "woodland", "marine environment", etc...) and, if their distributions correlate with vegetation, they usually do so on a physiognomic basis rather than on a taxonomic one.

CONCLUSIONS

Ornithoarchaeology has a good chance of developing into a separate subdiscipline of archaeozoological studies. Ornithologists have already done an enormous amount of work in describing and quantifying the biology, evolution and behaviour of many species of birds, and many of their theories will have a perfect testing ground in the temporal perspective provided by subfossil samples.

Ornithoarchaeology can not only benefit from this knowledge but can also design a coordinated program of research to create data bases on the distribution of species in the recent past, the impact of human activities on avian populations and the ways in which these activities have shaped the recent microevolutionary dynamics of birds. Such knowledge might prove invaluable for programs of conservation in the future.

It is hoped that the problems outlined in previous parragraphs will contribute to stimulate students and to create the sense of cooperative work for whom this meeting has been a first step.

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Archaeofauna 2 (1993): 15-19

TWENTY-EIGHT BIRD BRISKETS IN A POT; ROMAN PRESERVED FOOD FROM NIJMEGEN

ROEL C.G.M. LAUWERIER
Rijksdienst voor het Oudheidkundig Bodemonderzoek (ROB)
Kerkstraat 1, NL-3811 CV Amersfoort.
The Netherlands

ABSTRACT: In a military settlement in Roman Nijmegen, the Netherlands, a cork urn was found containing bird bones. A combination of archaeological, petrological and archaeozoological information leads to the conclusion that this cork urn had been used to transport a delicacy, preserved briskets of song thrushes, from the Ardennes or Eifel to Nijmegen. This find is a new indication that animal food products were imported from elsewhere. This find is also another link in the investigation of the function of cork urns, a type of pottery belonging to the group known as Gallo-Belgic wares. Roman literary sources make clear that thrushes were a profitable delicacy and give indications for the possibility that these types of pots were sealed with pitch and gypsum to preserve their contents.

KEYWORDS: THE NETHERLANDS, NIJMEGEN, MILITARY SETTLEMENT, ROMAN PERIOD, ARCHAEOZOOLOGY, PRESERVED FOOD, IMPORT OF FOOD, FOOD TRADE, BIRDS, SONG THRUSH, *Turdus philomelos*

RESUMEN: En el asentamiento militar romano de Nijmegen (Holanda), se recuperó una urna de corcho repleta de huesos de ave. La información combinada de la arqueología, petrología y arqueozoología, indica que el recipiente sirvió para transportar una golosina gastronómica, pechugas en conserva de zorzales, desde las Ardenas o Eifel a Nijmegen. El hallazgo es un indicador de la importación de productos de origen animal de zonas distantes. Al mismo tiempo, constituye un dato adicional para los estudios acerca de la funcionalidad de las urnas de corcho, un tipo de cestería incluida dentro del grupo de las denominadas manufacturas galo-belgas. Las fuentes bibliográficas romanas indican que los zorzales eran un bocado apetecible y rentable y proporcionan datos sobre la posibilidad de que este tipo de cestos fuesen sellados con brea y yeso para preservar su contenido.

PALABRAS CLAVE: PAISES BAJOS, NIJMEGEN, CAMPAMENTO MILITAR, ROMANO, ARQUEOZOOLOGIA, ALIMENTO EN CONSERVA, COMERCIO ALIMENTARIO, AVES, ZORZAL, *Turdus philomelos*

INTRODUCTION

During excavations in Nijmegen, the Netherlands, in 1992 by the *Rijksdienst voor het Oudheidkundig Bodemonderzoek* (ROB), a pot was found containing bird bones (Figures 1 & 2). The pot, a so-called 'cork urn' was found in a latrine within the military settlement at the '*Kopse Hof*' (find no. 417-2-77). It has been preliminary dated between 10 BC and AD 70 (pers. comm. Van Enckevort, ROB). This single find is interesting since on the one hand it gives information about trade and the import of delicacies and on the other, it is a new link in the investigation of the function of this type of pottery.

CORK URNS

Cork urns, a type of pottery belonging to the group known as Gallo-Belgic wares, have recently become a topic of research for colleagues in the ROB (Kars et al., in prep.). The cork urns, of which different forms exist, are handmade vessels made from a cork-like fabric. The cork-like



FIGURE 1 - Cork urn with bird bones, found in a latrine of a military settlement at Nijmegen. Height of the pot: 10,2 cm.

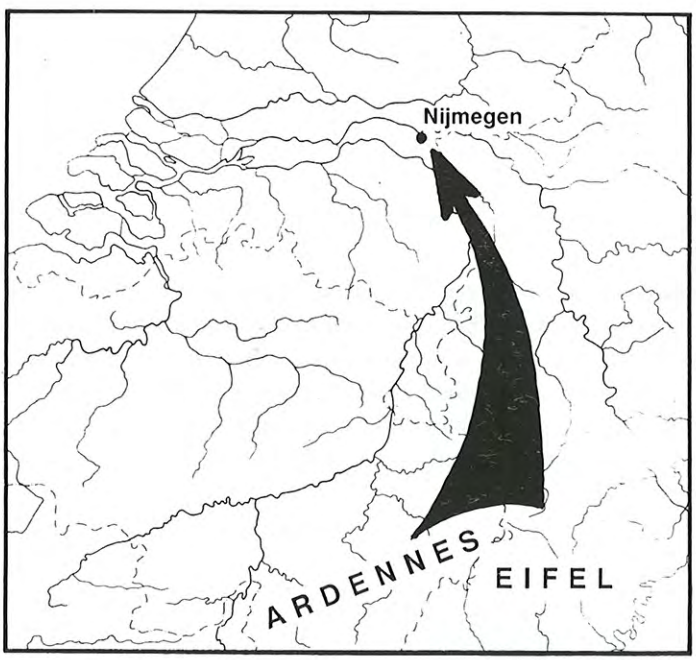


FIGURE 2 - Map of parts of the Netherlands, Belgium and Germany with the situation of Nijmegen and the transport route from the Ardennes and Eifel.

surface is caused by the burning out of small parts of carbonate within the clay during kiln-firing. For Roman standards, the pots are of throw-away quality and were probably cheap to produce. They often have pitch on the rim. Until recently this type of pot found in Nijmegen (Holwerda, 1941, type 94), was regarded as a normal cooking vessel. There are, however, now doubts about this being its primary function. Due, in particular, to the occurrence of the sometimes thick layers of pitch, researchers now rather think that the pots were primarily used as hermetically sealed containers, for example, to enable the storage and transport of food.

Because the pottery did not appear to have been made in the vicinity of Nijmegen, the fabric was petrologically investigated. The results of this research suggest that these pots were made in the Ardennes or the Eifel and transported to Nijmegen (Figure 2) (Kars et al., in prep.).

THE BIRD BONES

The contents of the cork urn found in the latrine were archaeozoologically investigated. They were sieved using a 0.5 mm sieve and were found to contain the bones of almost thirty song thrushes (*Turdus philomelos*). The identification of the bones was verified by means of the reference collections of the *Biologisch-Archaeologisch Instituut* (BAI) in Groningen and the *Instituut voor Pre-en Protohistorische Archeologie* (IPP) in Amsterdam. The presence of particular skeletal elements is very characteristic: 25 sterna, 26 right coracoids, 28 left coracoids, numerous furculae, four scapulae and the proximal ends of four broken left and four broken right humeri (Figure 3). As is clear from the list above, the pot only contained the skeletal elements of the breast and the shoulder. If we reconstruct the flesh on the bones, then at least 28 bird briskets were stored in the pot. The reason why the eight humeri were broken, and only the proximal parts remain, is that in the process of preparing the birds, the wings would have been cut off first.

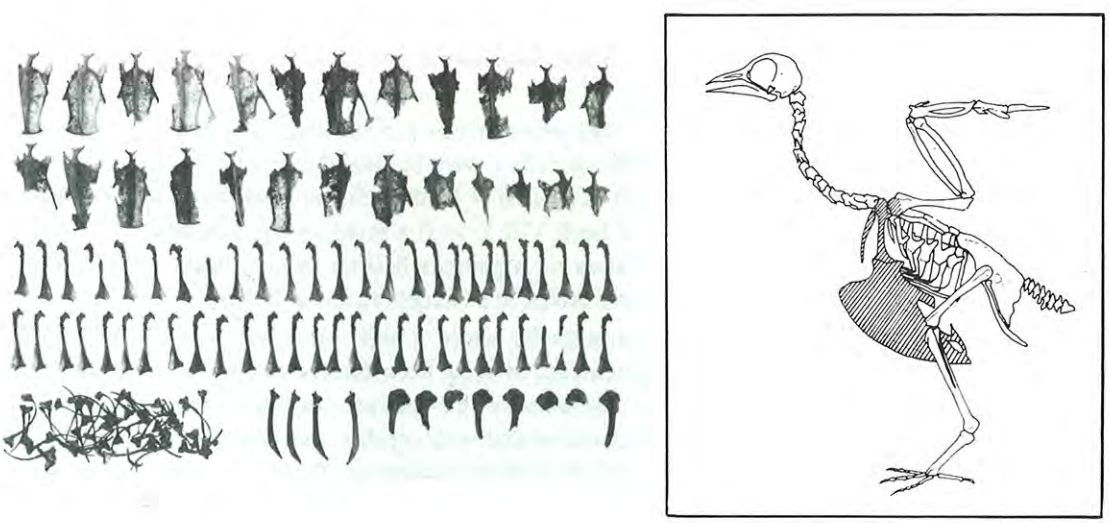


FIGURE 3 - Bones (left) and position of the bones (right) of song thrushes found in the pot.

DISCUSSION AND CONCLUSIONS

The find from the *Kopse Hof*, that is both the pot and its contents, confirms the speculation arising from the archaeological study of this type of pottery, i.e. that cork urns served as containers for preserved food.

Naturally, the 28 briskets could have been put in the vessel in Nijmegen, but it would seem more obvious to suggest that the meat was preserved in the place of origin of the pots. If this was so, we can than conclude that most probably, cork urns were used to transport preserved briskets of song thrushes, among other things, from the Ardennes or Eifel to the Roman settlement at Nijmegen. There are further indications for the importation of animal food products to Nijmegen. In particular, these are concerned with fish preserved in pickle, *muria*, or fish sauce, *allec* (Curtis, 1991). In another early Roman latrine on the *Kopse Hof* a concentration of fish bones have been found, the bones of the Spanish or chub mackerel (*Scomber japonicus*) (identification F.J. Laarman (ROB) & D.C. Brinkhuizen (BAI)), that are probably the remains of fish sauce. On the same site, Laarman and Brinkhuizen identified three complete, probably salted, specimens of this species in a pot. This species, remains of which have also been found at Roman Velsen, must have been imported from southern coastal areas (Brinkhuizen, 1989). An exotic fish, belonging to the genus *Sphyraena* (Lauwerier, 1988: 148-150) which was found in a fourth-century context at Nijmegen, would also have come from a southern region. The briskets of song thrushes were possibly preserved with salt in the same way as fish. Another possibility is that the meat of these birds was covered with honey, as is described in the cookery book of the well-to-do gastronome Apicius from the 1st century AD (Flower & Rosenbaum, 1974): 'How to keep meat fresh as long as you like without pickling. Cover meat that you wish to keep fresh with honey, (...) This is better in winter; in summer it will keep in this manner only a few days. You can use this method also with cooked meat.' (book I, recipe 1).

Roman sources, like Pliny's *Naturalis Historia*, state that pitch was indeed used for waterproofing pottery (Forbes, 1964:52) and that wine amphorae were sealed by means of gypsum (Forbes, 1965:10). Apicius, in a recipe for preserving oysters, also suggests that pitch was used to prepare pots (book I, 2): '... wash a receptacle treated with pitch with vinegar and place the oysters in it.' In another recipe for keeping grapes fresh he relates how a pot can be sealed (book I, 1): 'Treat the receptacle with pitch and seal with gypsum, ...'.

Thrushes were a delicacy for the Roman palate. Varro (15-16) states that they were fattened up for sale, and that they were very profitable since they were in great demand for banquets. Apicius also mentions thrushes several times. In recipes 2 and 8 of book V they are mentioned as ingredients used in the preparation of peas, and in 14 of book VIII to stuff a suckling-pig. Macrobius (3, 13,12) tells that Lentullus offered his guests thrushes on asparagus besides oysters, hare, fattened fowl cooked in pastry and boar's head, among other things, at a banquet in about 70 BC.

While thrushes were considered delicacies for which a good price was payed, it was most probably profitable to import these small amounts of food from further away. The song thrushes found in Nijmegen were probably trapped in the woods of the Ardennes or Eifel. After preserving the briskets in the pot, possibly treated with pitch and sealed with gypsum, this delicacy was transported to Nijmegen and sold for a festive occasion in the military settlement. By opening the pot, the meat may well have seemed to be contaminated and was immediately thrown away, pot and all, down the latrine.

ACKNOWLEDGEMENTS

I am grateful to my colleagues Henk Kars, Robert van Dierendonck, Harry van Enckevort and Katja Zee (ROB) for providing additional information and Maaike Verhagen for a second opinion on the bone determination. Karen Waugh corrected the English.

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Archaeofauna 2 (1993): 21-31

ON THE UTILIZATION OF THE DOMESTIC FOWL IN CENTRAL EUROPE FROM THE IRON AGE UP TO THE MIDDLE AGES

NORBERT BENECKE
Deutsches Archäologisches Institut. Arbeitsbereich
Ur- und Frühgeschichte. Leipziger Str. 3-4.
D - (O) - 1086 Berlin. Deutschland.

ABSTRACT: On the basis of fowl bone finds from 43 sites in Central Europe, using data on the age structure, the sex ratio and the intensity of sexual dimorphism as evidenced in the skeleton of prehistoric fowl populations, the author investigates the development of the use of domestic chicken.

KEYWORDS: ARCHAEOZOOLOGY, DOMESTIC FOWL, CENTRAL EUROPE, IRON AGE - MIDDLE AGES, UTILIZATION

RESUMEN: El trabajo investiga el tipo de explotación que podemos inferir se llevaba a cabo con las gallinas de Europa Central a partir de datos de 43 yacimientos arqueológicos en donde se estudia la estructura de edad de las poblaciones, la relación de sexos y el grado de dimorfismo sexual evidenciado en las osamentas.

PALABRAS CLAVE: ARQUEOZOOLOGIA, GALLINA, CENTROEUROPA, EDAD DEL HIERRO - EDAD MEDIA, APROVECHAMIENTO

INTRODUCTION

The fowl is the oldest domestic animal from the group of birds. It is descended from the red junglefowl (*Gallus gallus* Linné, 1758) which is widely spread in East and Southeast Asia (Herre & Röhrs, 1983, 1990). The oldest traces of its keeping were found in early Neolithic layers in Northeast China, e.g. in Cishan (Province of Hebei) and Peiligan (Province of Henan) which date both from the 6th millenium B.C. (Chow, 1981, 1984). In the following millennia domestic fowl spread from East Asia to Central Asia and then to the Near East and, from the late Bronze Age, to Europe (cf. West & Zhou, 1988). The earliest archaeozoological evidence of fowl keeping in Central Europe comes from settlements and from graves of the late Hallstatt Age (Phase C and D). Among them there are bone finds of the domestic fowl from Nersingen, Wallerfangen, Schirndorf and from the Heuneburg (Germany), from Kotlin and Supca (Poland) as well as from Tešetice (Bohemia) and Nové Košariska (Slovakia; cf. Benecke, 1992, Table 27). Data indicating the existence of domestic fowl in the early Hallstatt Age (Phase A, "Urnenfelderkultur") in Central Europe (Jockenhövel & Ostoja-Zagorski, 1987) have to be assessed carefully until new finds confirm the early dating of the fowl remains from Loviky (Moravia).

During the pre-Roman Iron Age fowl keeping in Central Europe did not developed very much. Among bone finds of the domestic animals, chickens are normally represented in that period with only about 0,3% (Figure 1). In some regions like the coastal areas of the North and the Baltic Seas they were distributed only sparsely during that time, since in many sites of the coastal zone - which were particulary rich in bone materials - fowls have not been found at all. In contrast, the wild bird fauna had plenty of different species in that region so that one can get the impression that in

these areas there might not have been a special need for adopting the habit of fowl keeping. A main reason for that could have been the climatic conditions of the coastal region which might have been detrimental to fowl keeping. It became popular there only in Roman Times. As Figure 1 shows, keeping of fowls increased its importance progressively in Central Europe during the following centuries.

Some indications on the practice of fowl keeping from the Iron Age period up to the Middle Ages can be taken from fowl bones found in settlements of that time. Relevant clues can be drawn, in particular from data concerning the age structure, the ratio between the sexes and the phenotype of the fowl population. Based on such data this paper provides a short survey on the development of the use of domestic chicken in Central Europe from the beginnings of fowl keeping in the early Iron Age up to the Middle Ages.

MATERIAL AND METHODS

This study is based on published archaeozoological data of fowl bones from 43 different sites or occupation phases. As regards their dating the sites include 3 Iron Age, 14 Roman Times and 26 Middle Ages samples. For reasons of space it is not possible to present the sites in detail (cf. Benecke, in press, catalogue). The age-determination criteria, i.e. the classification into juvenile or adult animals according to the bone structure (ossification) or the degree of joint formation, follow the appropriate data of the authors who published the bone finds. The results of determining the sex by using the tarsometatarsi have been also adopted. For those samples providing individual

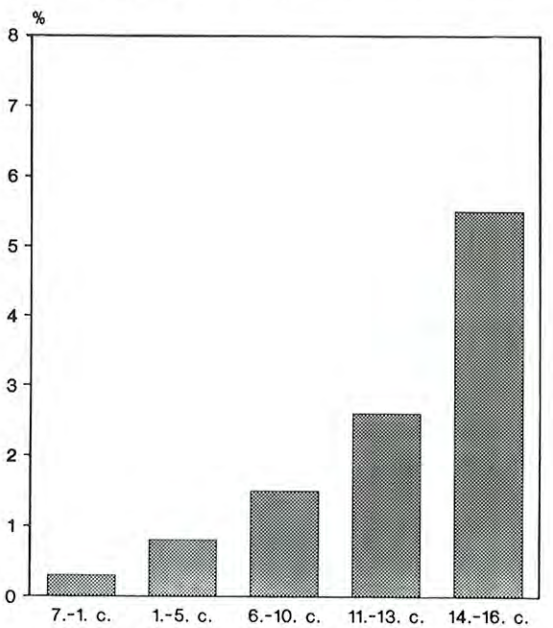


FIGURE 1 - The frequency of chicken in the bone finds of domestic animals from the Iron Age up to the Late Middle Ages. Calculated on the basis of archaeozoological data from 364 sites in Central Europe.

measurements, sex determinations were also estimated with other bones of the postcranial skeleton using multivariate analyses, thus increasing the number of sex-determined bones (on the methods cf. Benecke, 1989). Both types of results were then combined with each other.

In this study we have also examined to what extent data on the intensity of sexual dimorphism in the fowl skeletons indicated a preferential use of a population. For this purpose, skeletons of recent fowl breeds of known use were examined for a possible covariance of parameters. The material analyzed comprised 198 skeletons from recent breeds. The intensity of sexual dimorphism was estimated for different elements as the metrical distance (Mahalanobis D^2) between cocks and hens using the basic length and width measurements (for calculation cf. Weber, 1980). As can be seen in Figure 2, the heavy breeds, used mainly for meat production, show the greatest amount of sexual dimorphism in the postcranial skeleton, being even greater than in the wild form (Bankiva). The dwarf breeds, mainly kept as pets, exhibit the lowest D^2-values. Sexual dimorphism in the light fowl breeds, mainly those with a double use (eggs, meat), falls between the dwarf breeds and the wild Bankiva fowls. Altogether these data indicate that in recent fowl breeds the intensity of sexual dimorphism as reflected on the skeleton does seem to have a certain degree of correlation with the main use of the breed.

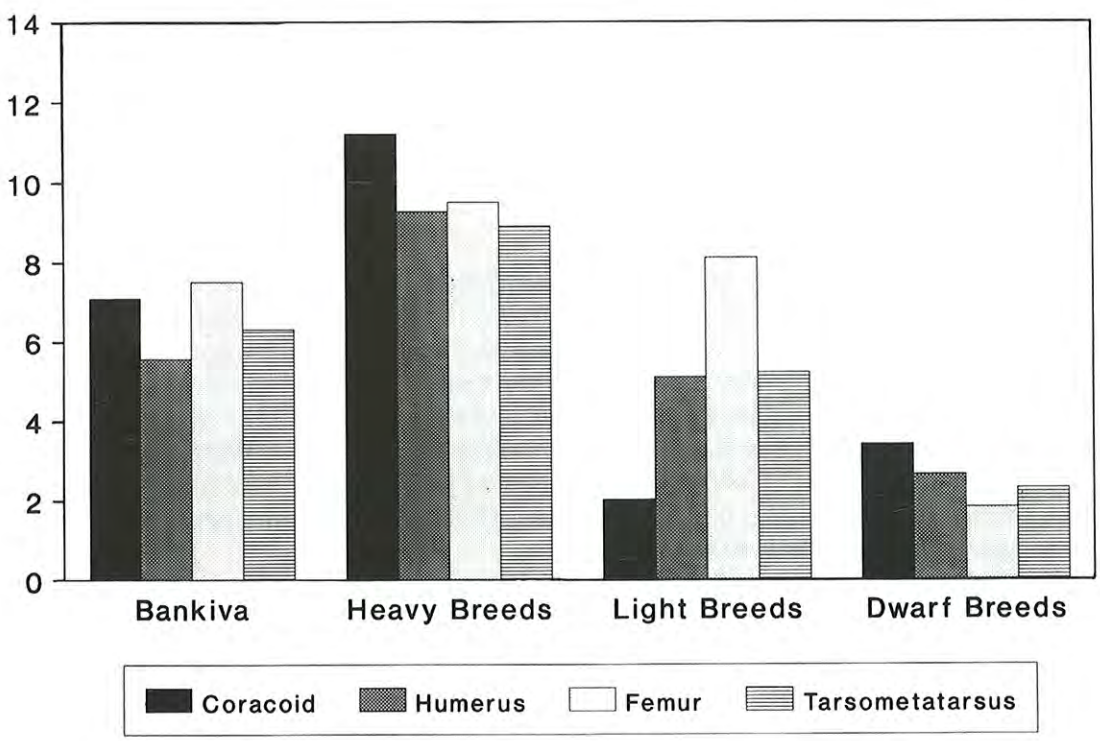


FIGURE 2 - Sexual dimorphism in the postcranial skeleton of recent chicken breeds calculated as Mahalanobis distances (D^2) between the sexes for four elements (basic measurements).

RESULTS AND DISCUSSION

Iron Age

As bone finds indicate, fowl keeping in Central Europe had only a limited importance within the food production squeme in the centuries of pre-Roman Iron Age. In relation to other domestic animals (cattle, pigs, sheep/goat and horse) the proportion of domestic fowl is, on the average, 0,3% of the NISP. Regional differences could not be detected as the following data on the mean percentage of domestic chickens show[1]: Southern Germany 0,1 % (n = 9), Oder region 0,1 % (n = 4), Central Germany 0,6 % (n = 8), Lower Vistula region 0,4 % (n = 4), Kujavia 0,2 % (n = 9), Bohemia/Moravia 0,4 % (n = 4) and Switzerland 0,1 % (n = 8).

From the period between the 7th and the 1st century B.C. there are only statistically meaningful data for three sites on the age composition and the sex ratio of the domestic fowl. In the oldest of these three settlements, on the Heuneburg near Hundersingen (dated to the early Latène Period), the ratio between hens and cocks is about 1:3, whereas adult animals are the dominating cohort. These data indicate a predominant use of the chickens for meat production. The egg yield of hens probably was so low that - except for some breeding stock - they were slaughtered as young animals. The two other sites dating back to the late Latène Period evidence some changes towards an increased egg yield. Whereas in Altenburg-Rheinau the ratio of sexes was still balanced, the proportion of hens in Manching is already 62,5%. In both settlements the percentage of young animals is relatively high, amounting to 42,9 and 43,8% respectively. Altogether, these results point towards a dominant use of meat and a more intense egg production compared with the early Latène Period.

Roman Period

Fowl keeping in Central Europe gained an even more significant role in the first centuries after Christ compared with the Iron Age (Figure 1). This development had more influence on the region of the Roman provinces on the Rhine and the Danube (Germania romana) than on the Germanic region (Germania libera). Whereas in the Roman provinces - except the province of Germania inferior - poultry keeping was mainly restricted to domestic fowl, in Germania libera geese keeping was the typical form of poultry farming (cf. Table 1). As the archaeozoological data show, the contribution of domestic poultry (fowls, geese) to the overall production of food in the Roman provinces was three times higher than in the Germania libera region. The percentage of poultry in the Roman province of Pannonia is remarkably high.

From 14 sites inferences can be made on the ratio between meat production and egg yield in Roman fowl keeping by using the data on the age structure and the proportions of both sexes[2].

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(1) - In brackets - number of sites taken into consideration.

(2) - Basically it should be kept in mind that bone finds come mainly from military facilities (castellum, garrison, camp village) as well as from Roman towns. Until now there are no comparable representative results from country estates (Villa rustica) or other rural settlements, which are the main places of Roman animal production and, thus, of poultry keeping. For the first types of settlements, it is difficult to assess to what extent were domestic chickens kept within the settlements, or to what extent fowls were exclusively brought there as a commercial product. At least for the military settlements it is assumed that the soldiers based there practised fowl keeping (cf. Prummel, 1989).

Region (number of sites)	Sum	chicken	goose	percentage of poultry
North Sea, coastal region (5)	116	51,7	48,3	1,5
Baltic Sea, Gotland (2)	502	64,3	35,7	0,6
Lower Rhine Valley, Germania inf. (8)	497	79,5	20,5	2,0
Lower Saxonia, southern part (4)	41	78,0	22,0	0,2
Brandenburg (5)	36	83,3	16,7	0,3
Kujavia (3)	98	62,2	37,8	0,9
Upper Rhine Valley, Germania sup. (9)	1319	94,6	5,4	0,7
Danube region, Raetia/Noricum (15)	1240	95,5	4,5	2,1
Pannonia sup. et inf. (8)	2433	86,8	13,2	4,4

TABLE 1 - The ratio of domestic chickens and geese and the percentage of domestic poultry in different regions of Central Europe during the Roman Period.

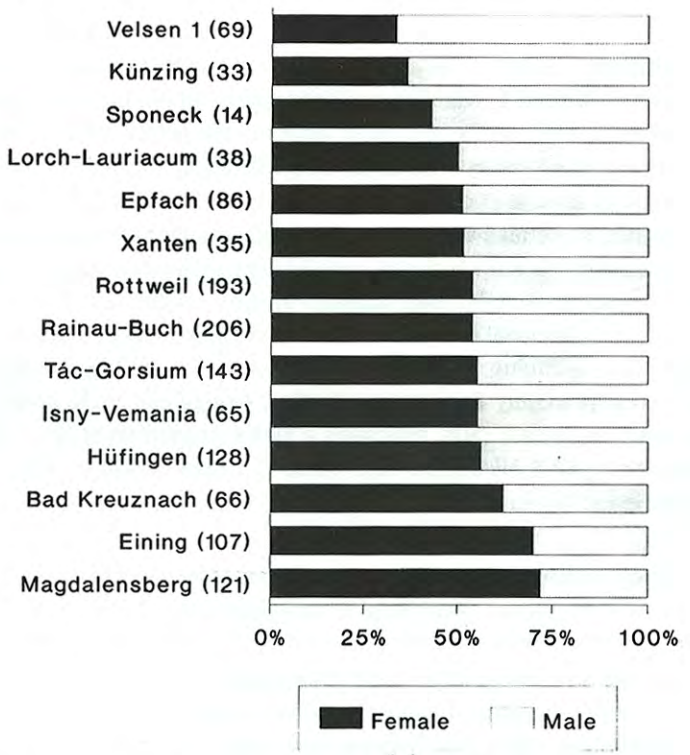
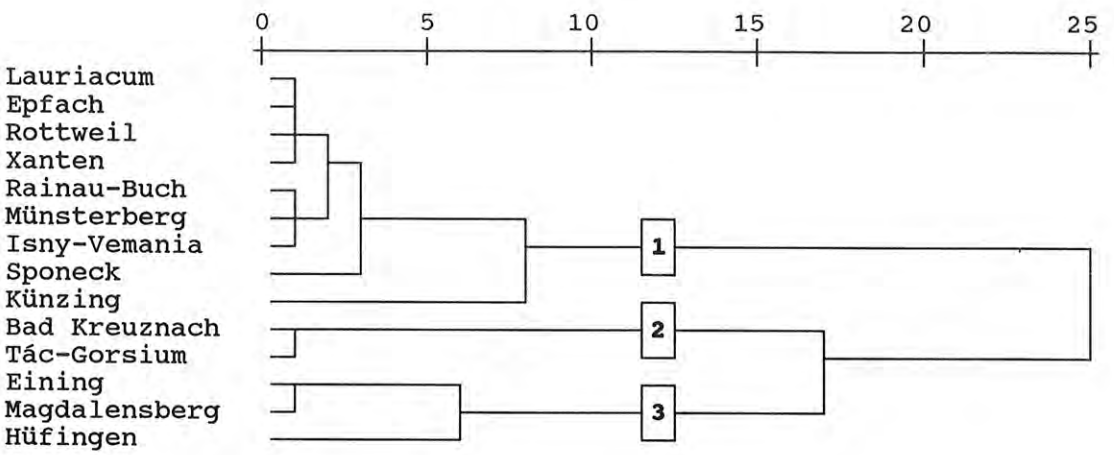


FIGURE 3 - The ratio of hens to cocks in Roman sites from Central Europe. The numbers of the sex-determined bones are given in brackets.



Cluster	Number	juvenil	adult	Number	male	female
1	773	17.3	82.7	663	48.0	52.0
2	203	37.4	62.6	209	42.6	57.4
3	1337	14.3	85.7	356	34.3	65.7

FIGURE 4 - Cluster analysis of data on the age structure and on the sex ratio for domestic chickens from Roman sites in Central Europe.

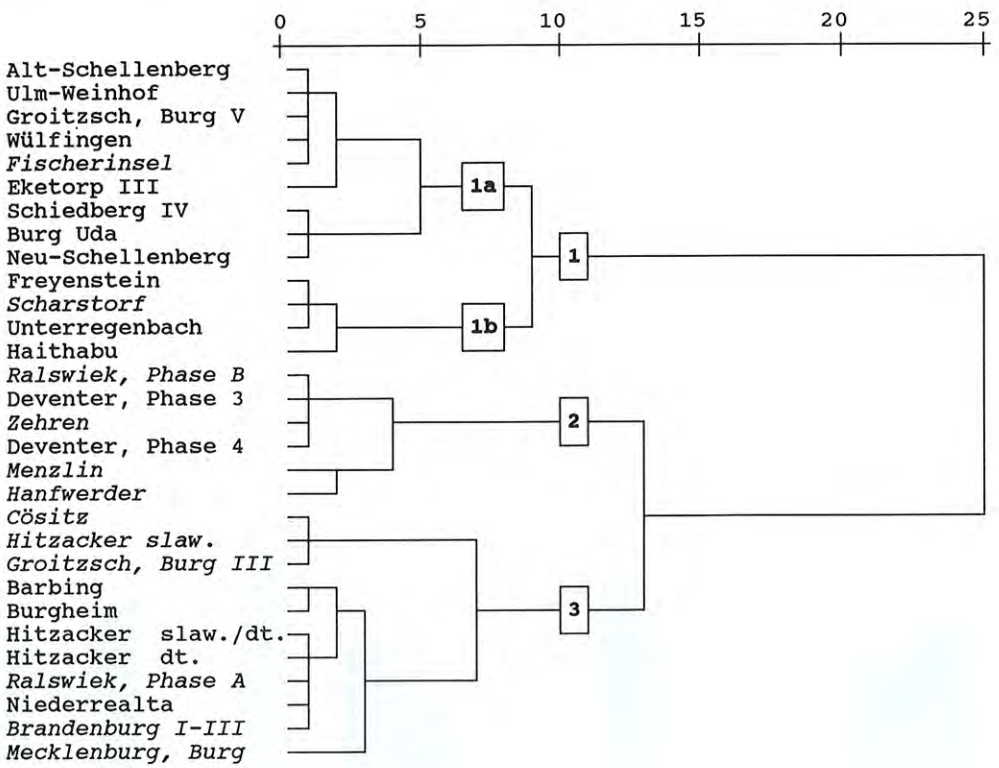
As shown in Figure 3, most of the sites indicate a balanced ratio of sexes between hens and cocks of about 1:1. Just in Velsen 1, Künzing and Sponeck do the finds show a dominance of cocks. These settlements were castellums. On the other hand, in the palace villa of Bad Kreuznach, the camp village of Eining and the Roman town on the Magdalensberg, hens dominate. But even in these settlements the 5:1 ratio of hens to cocks, recommended by COLUMELLA (VIII, 2) for the Roman fowl breeding, is not met. If we take the results of the age structure into consideration, we come up with the following picture on the ratio between meat and egg production in the Roman provinces (cf. Figure 4): A high percentage of male, adult animals in most of the sites (clusters 1 and 2) points towards a main use of fowls for meat production, since it is rather evident that adult cocks have much more meat than hens. Also in Eining, Hüfingen and in the town on the Magdalensberg (subcluster 3), fowls might have been kept mainly for meat production, though egg yield possibly played a much greater role as the results on the sex ratio, indicating a higher proportion of hens, show. According to Roman written sources (e.g. COLUMELLA VIII, 4 and 5), Romans tried to increase the egg yield by extending the laying period by means of feeding special fodder (among others, semi-boiled barley mixed with clover).

The present study indicates that in the sites analyzed domestic chickens were mainly used for meat production. Obviously, capons were kept for this purpose (PLINIUS X, 25; COLUMELLA VIII, 2 and VARRO III, 9) and chickens were crammed for this same reason (COLUMELLA VIII, 7; VARRO III, 9). Among the bone finds, large-sized tarsometatarsi, where a spur epiphysis in the form of a porous bone layer or the spur consisting of a loose osseous substance, are assigned to capons (e.g. Dräger, 1964; Lipper, 1986; Johansson, 1987). Such types of bones have been retrieved, among others, from the Magdalensberg, Lorch-Lauriacum, Breisach-Münsterberg, Eining, Bad Kreuznach and from

Tác-Gorsium. Except for Tác-Gorsium, where the frequency of capons among the sex-determined tarsometatarsi is relatively high (amounting to 17,5%, Bökönyi 1984), they are rare occurences.

Apart from their food production use, domestic chickens fulfilled some other functions. They produced feathers and downs which were used in a versatile form as stuffing material. It is known that cocks were used for cock-fights (e.g. PLINIUS X, 24) and fowls in general were used as oracular birds and as meals for the deceased (cf. Lauwerier, 1988; Kokabi, 1988). The keeping of small breeds is known just as a kind of hobby (COLUMELLA VIII, 2).

From the Germanic region, representative archaeozoological data on the utilization of domestic fowls are only known from Eketorp II (Öland). The fact that 90,7% of the bones belonged to adult animals and a 3:2 sex ratio favoured hens, indicates -by analogy to most of the Roman province sites- a dominant use of meat as compared with the egg production in the keeping of chickens.



Cluster	Number	juvenil	adult	Number	male	female
1	6961	9.6	90.4	1805	44.6	55.4
1a	4004	9.5	90.5	755	29.1	70.9
1b	2957	9.8	90.2	1050	55.7	44.3
2	448	41.5	58.5	217	52.5	47.5
3	664	47.6	52.4	374	25.4	74.6

FIGURE 5 - Cluster analysis of data on the age structure and on the sex ratio for domestic chickens from medieval sites in Central Europe. Names of Slavonic sites are written in italics.

Middle Ages

Poultry keeping comprising fowls, geese, pigeons and, during the Middle Ages, also ducks, served mainly like in previous centuries to produce food such as meat and eggs. Fowls and geese contributed to that more than any other group. According to our results, there was a continuously growing importance of the domestic fowl for the supply of meat during the Middle Ages. Thus, its mean percentage in the bone samples of the domestic animals increased from 1,5% in the period from the 6th to the 10th c. up to 2,6% in the period from the 11th to the 13th c. and to a still higher frequency of 5,5% in the late Middle Ages and, Early Modern Times (14th - 16th c.) respectively.

The data on the age structure and the sex ratio of domestic chickens from these 26 sites indicate differences in the importance and aims of the medieval times fowl keeping strategy. A cluster analysis essentially revealed three basic patterns (Figure 5). A larger group of sites, which includes mainly Slavonic settlements, is characterized by a high percentage of young animals (47,6%) as well as a hen to cock ratio of about 3:1 (Cluster 3 in Figure 5). There was no evidence for such a flock structure in previous periods. It first occurs in fowl keeping during the Early Middle Ages. Those results taken together speak in favour of a fowl farming strategy with a major emphasis on egg yield. The regulation of the stock which was necessary for that was obviously done through a continuous slaughtering of mainly young surplus cocks and, to a minor extent, of young hens incapable of breeding. This would explain the relatively high proportion of juvenile chickens. Another group of sites which includes many settlements of the Frankish-German region, is

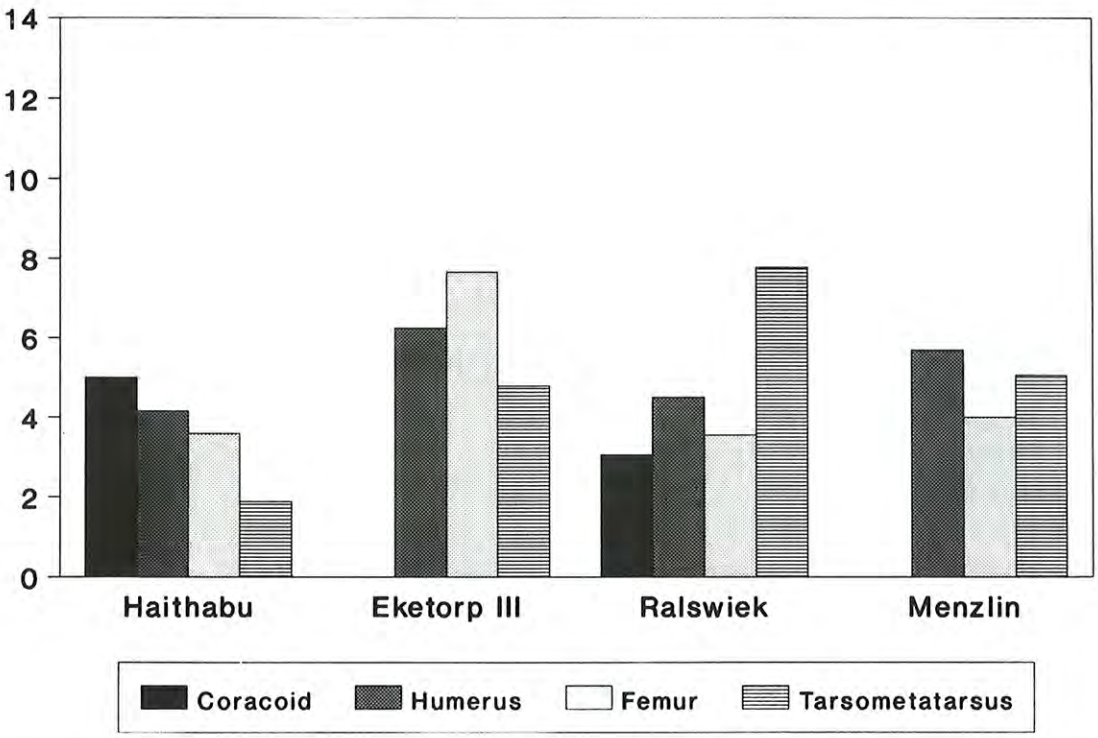


FIGURE 6 -Sexual dimorphism in the postcranial skeleton of medieval fowl populations (Haithabu, Eketorp III, Ralswiek, Menzlin) calculated as Mahalanobis distances (D^2) between the sexes for four elements (basic measurements).

characterized by a majority of adult animals (90,4%) and a relatively balanced sex ratio (Cluster 1 in Figure 5), whereas two other groups can be divided in relation to the last feature (Subcluster 1a and 1b). For these settlements it can be assumed that fowl keeping aimed at a predominance of meat production with a varying importance given to egg yield. The age composition of the sites clumped into cluster 2 is similar to that of the sites from cluster 3 whereas the cock: hen ratio is similar to the one characterizing sites in cluster 1. For this reason these sites, where meat production again seems to by the prioritarian objetive of fowl keeping, take an intermediate position among the whole sample.

Studies on the intensity of sexual dimorphism among four series (Haithabu, Eketorp II, Ralswiek, Menzlin) do not reveal significant differences (Figure 6). The D^2-values calculated for four elements are within the same order as those calculated for recent light breeds (cf. Figure 2). Thus, Middle Age domestic chickens can be best compared with multi-use fowls (combining meat and egg production). The specialization into meat and egg laying breeds probably began not before the turn from Late Middle Ages to Early Modern Times. It would be obviously useful to continue studies on the sexual dimorphism from bone remains of domestic fowls from sites of the 14th up to the 17th century.

SUMMARY

As conclussions of our analysis we can now summarize the following:

1. Domestic fowl are a part of the Central European fauna of domestic animals since the Late Hallstatt Age (Ha C/D). In the coastal regions of the North Sea and the Baltic Sea fowl keeping prevailed only at the time of transition from the Late Latène to the Roman Period.

2. From the Iron Age up to the Late Middle Ages the importance of domestic fowl within the food production strategy continuously increased. Its frequency in the bone samples of domestic animals of this time rose from 0,3% to 5,5%.

3. During the Iron Age results indicate that domestic fowl was mainly used in meat production.

4. Most of the settlements from the Roman Period are characterized by a balanced sex ratio and a majority of adult animals. Obviously, domestic chickens in Roman towns and military stations were kept mainly for their meat. Data from villae rusticae sites are lacking for the moment.

5. In the area of the Roman provinces archeozoological data and written sources indicate the use of domestic fowl, for other types of activities e.g. the keeping of fighting cocks, use of oracular birds and as meals for the deceased.

6. The medieval sites show a great diversity in the relation between meat and egg production. In many settlements, specially in the Slavonic region, the egg yield had a great importance in the keeping of fowl.

7. According to the intensity of sexual dimorphism, as evidenced by the postcranial skeleton, domestic chickens from the medieval sites of Haithabu, Ralswiek, Menzlin and Eketorp III can be best compared with multi-use fowls (i.e., those combining meat and egg production).

ACKNOWLEDGEMENTS

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AVIAN OSTEOPATHOLOGY AND ITS EVALUATION

DON BROTHWELL
Institute of Archaeology, University College.
London WC 1H OPY

ABSTRACT: Pathological evidence in skeletal remains from archaeological sites is to be found in bird remains as well as mammals. However, avian osteopathology may well have been neglected in the past, and there seems to be a need to call attention to the range of pathology which might turn up in bird bones. Survival of disease evidence may be particularly likely in captive and domestic birds. The author reviews the major categories of disease which may result in bone changes in birds, where possible giving archaeological examples. Congenital abnormality, bone pathology resulting from environmental stresses, joint diseases, neoplasms, and a range of infections, are considered in turn. It was concluded from the known archaeological cases of bird bone pathology, together with the more recent veterinary descriptions of other bone pathology, that there are certainly prospects for further discoveries and research in this field of avian zooarchaeology.

KEYWORDS: BIRD BONES, OSTEOPATHOLOGY, CONGENITAL ABNORMALITY, TRAUMA, ENVIRONMENTAL STRESS, NEOPLASMS, ARTHROPATHIES, INFECTIONS

RESUMEN: Las aves, al igual que los mamíferos, presentan evidencias de patologías óseas en los restos que de las mismas se recuperan en yacimientos arqueológicos. A pesar de ello, ha existido hasta ahora un cierto desinterés en este tipo de fenómenos por lo que resulta necesario hacer una llamada de advertencia para el futuro de esta disciplina. Las pruebas de enfermedades son particularmente frecuentes en aves domésticas y de jaula. El trabajo describe las principales categorías de enfermedades susceptibles de provocar cambios en los huesos de aves, mostrando, en los casos que ello resulta posible, pruebas de naturaleza ornitoarqueológica. Las anormalidades congénitas, las patologías óseas resultado de situaciones ambientales de stress, las enfermedades articulares, los neoplasmas y las infecciones son descritas secuencialmente. Con los casos detectados en yacimientos arqueológicos, junto con descripciones veterinarias más recientes de otros tipos de patologías óseas, parece evidente la existencia de un amplio campo de investigación dentro de esta rama de la ornitoarqueología.

PALABRAS CLAVE: HUESO, AVES, OSTEOPATOLOGIA, ANORMALIDAD CONGENITA, TRAUMA, STRESS AMBIENTAL, NEOPLASMA, ARTROPATIA, INFECCIONES

INTRODUCTION

It seems pertinent at this first ICAZ meeting on Avian zooarchaeology to consider what evidence of disease can be found in bird remains, and how relevant the study of this kind of information is for archaeological interpretation. It may be that some aspects of disease have no relevance for archaeology at all, and clearly there is a constant need for an appraisal of the evidence being collected. Survival in wild birds, long enough for disease to leave a skeletal marker is usually considered a rare thing (Parmalee, 1977). Captive and domestic birds are considered more likely to show pathology (Gilbert, Martin & Savage, 1985). What I plan to do here is briefly review the range of bird pathology which seems to me to have significance for us, and consider where appropriate a number of archaeological examples.

CONGENITAL ABNORMALITY

In the scheme shown in Table 1, I have greatly condensed the range of diseases and pathology which can be found in some if not most bird species. Group A are the congenital defects, some having a genetic basis and others probably not. There are a number which leave skeletal changes,

(A) Genetic/congenital malformation
1)Polydactyly, brachydactyly
2)Spondylolithesis
3)Chondrodystrophy, dyschondroplasia
4)Cerebral hernia
5)Rumpless
6)Dwarfism

(B) Environmentally influenced conditions
1)Anaemia
2)Vitamen deficiency, rickets
3)Trave element deficiency, zinc, manganese

(C) Trauma
1)Fractures, joint stress
2)"Cannibalism"

(D) Arthropathies
1)Gout
2)Osteoarthritis (?traumatic)
3)Infectious arthritis

(E) Neoplasms
Benign and malignant (Uncommon)

(F) Infections
1)Avian leucosis. Possible limb paralysis
2)Avian osteopetrosis
3)Most high mortality infections without skeletal involvement.
Some (salmonellosis, avian tuberculosis, psittacosis) are zoonoses.

(G) External parasites
Scaly leg (mites) - can be severe, with secondary infection.

TABLE 1 - Bird pathology of potential archaeological significance.

some of which may have archaeological relevance. Conditions such as polydactyly (Figure 1.J) and brachydactyly (extra or reduced digits) are only likely to be identified in fairly complete bird burials. Columella was aware of polydactyly, and says they made the best breeds - good evidence perhaps of actual selection for "abnormality" in the past. The so-called "fifth toe" is now widely known in domestic fowls and has become a breed characteristic in Dorkings, Houdans, Silkies and others. Examples of such abnormality would certainly help to establish a history for these varieties. "Kinky back" (spondylolisthesis), the subluxation or downward rotation of the 4th thoracic vertebral body (Pattison, 1986; Duff, 1990), is well known in modern poultry husbandry, and its common

occurrence in an ancient sample might be used to indicate that particular domestic fowl stocks were small inbred groups. Chondrodystrophy, with leg weakness, short, thick and often misshapen bones, and dyschondroplasia (with bowing of the proximal tibiotarsus), might in certain circumstances again say something about inbreeding, as they may well have a genetic basis (Pierson & Hester, 1982). At times, abnormality may have become established as a pleiotropic effect, secondary to the selection of some primary variable. This was the case with cerebral hernia, which is associated with head feather cresting, caused by an incompletely dominant gene (Hutt, 1949). Although further studies are needed on the degree of cranial variation occurring in cerebral hernia -especially in mild form, nevertheless it has been clearly demonstrated in a Roman fowl from south-west England (Brothwell, 1979). It should be noted that a form of cresting also occurs in ducks, and can again result in skull modification with herniation.

A few centuries ago, Aldrovandus was aware of another skeletally modifying congenital defect known as "rumpless". In this condition, 2 sacro-caudal vertebrae are missing, as well as the pygostyle and caudal vertebrae (Stevens, 1991) (Figure 1, K,L). Today it is known to have genetic and environmentally-induced forms, but both produce modifications in the synsacral area. Although I have seen synsacral abnormality in archaeological material, this particular condition has not come to my attention as yet.

Other congenital conditions which could conceivably occur in archaeological material include sex-linked dwarfism (Zlochevskaya & Penionzhkevich (1973), abnormal tibio-metatarsal joints, supernumerary ribs, "crooked neck", "crooked keel" and kyphoscoliosis (Somes, 1990). It seems unlikely that severe conditions, such as "wingless" would have survived to become mature birds.

Lastly, it should perhaps be mentioned that spurs in *Gallus* females might be considered to be a congenital anomaly. As a result of breeding studies, the spurs seem more likely to have a genetic basis than an environmental one (Tandon & Iyer, 1954).

DISEASE AND ENVIRONMENT

Environmentally influenced diseases (group B, Table 1), include a number of different conditions which can leave their mark on bones, and might be used to indicate poor animal husbandry, or at least environmental stress (Hungerford, 1969). Anaemia and zinc deficiency can result in defective growth. Perosis, another deficiency condition, usually indicating a lack of manganese or B vitamins, but at times other imbalances, leads to slipped tendons, joint involvement and eventual bowing of long bones. Severely restricted rearing conditions could have resulted in bone thinning and fragility, somewhat like the so-called "Cage fatigue" of modern broiler fowls. Similarly, under extreme feeding conditions, severe stunting, or rickets in the young and osteomalacia in the older bird, may have commonly developed, as in recent domestic and captive birds (Hamerton, 1933; Horrox, 1989). Where growth alone is retarded (Dickerson & Mc Cance, 1964) without obvious shape abnormality, it may not be easy to distinguish from normal small body size. It is thus clearly important to be alert to the possibility of environmental stress of this kind. Archaeologically, bowed long bones have been noted, which might be indicative of rickets. Coy (1981) for instance, notes two Saxon fowls which displayed curved tibia shafts. A bent sternum from medieval Nantwich, in Britain has also been linked to a deficiency condition (Baker, 1986).

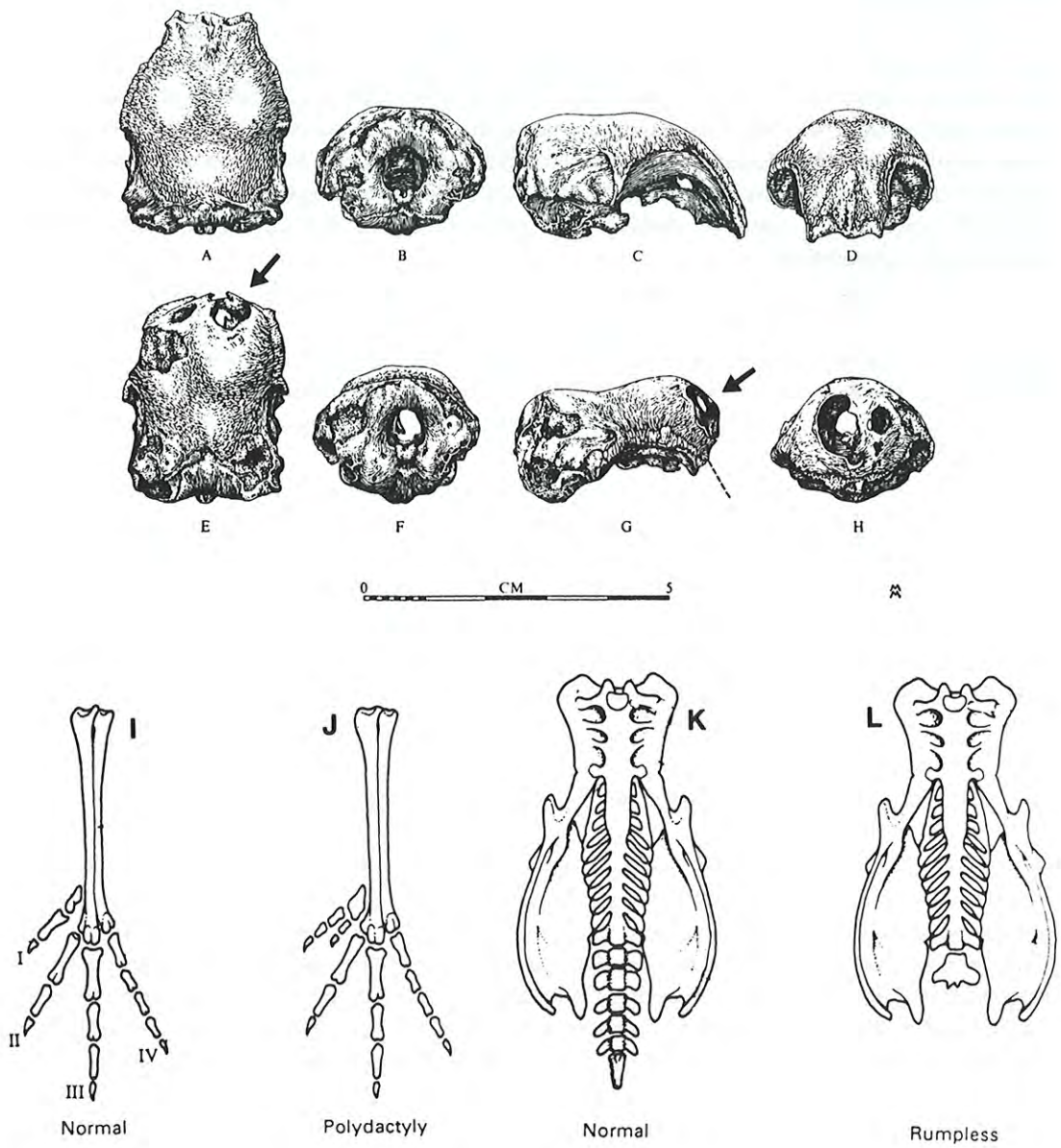


FIGURE 1 - A - H. Calvaria of two Roman fowls, comparing top (A,E), posterior (B,F), lateral (C,G) and front (D,H) views of a normal form (A-D) and an abnormal (E-H) form displaying cerebral hernia. From Brothwell (1979). **I - J.** Diagrams of a normal and polydactylous foot. **K - L.** Diagrams of the pelvis and posterior vertebrae in normal and rumpless fowls. I - L after Stevens (1990).

TRAUMA

Trauma (group C) can obviously occur throughout the life of a bird, and may not be the result of human activity at all. Boev (1986) found that half the abnormalities found in a sample of 127 heron skeletons, were indicative of trauma. Although for most of the time, damage to bones can be recognised for what they are, there may be questionable cases. In particular, can we always distinguish bones cut and used culturally (Ubelaker & Wedel, 1975) from butchery marks or cuts received at the kill or capture? In Birkhead's (1973) study of deformed Corvid skulls, for instance where 8% were abnormal in a sample of 186, he did not find it easy to distinguish congenital abnormality from old healed wounds. At the other extreme, though rarely, the nature of the trauma - arrow or whatever - may still be very much in evidence (Schutz, 1969).

Excluding injury received in the wild, birds are most likely to display evidence of trauma as a result of hunting, catching, keeping or handling. In large enough samples, trauma may thus reflect on human behaviour. A good example of this is surely the study by Hargrave (1970) of Mexican macaws from sites in Arizona. Of the 145 skeletons studied, 20 cases (that is 13%) displayed healed trauma (Figure 2B), in particular of the sternum and humerus. These birds were of ritual value, and I would like to suggest on the new evidence of turquoise trade between Arizona and New Mexico with Mexico, that stone went in a southerly direction and macaws were transported north. Trundling the birds over long distances would surely explain not only these clear instances of trauma, but also what appear to be stress arthropathies in 8 of the birds as well.

An unusual form of trauma in long legged waders, resulting in the partial loss of a limb has been described by Dobney (1993). Constriction of blood supply and eventual loss of a foot appears to have occurred as a result of the accidental tight binding of the leg by wool (Figure 4), picked up in pastures.

Another form of trauma, which should be mentioned even though I know of no convincing archaeological case as yet, is normally termed "cannibalism". Fifty years ago it was not uncommon in poorly managed, and often restricted, poultry runs to have widespread aggressive pecking. Flesh, feathers and eggs could all come under attack, and with secondary infection, bone may well have been involved at times. The cause of pecking is believed to be multifactorial, with housing, group size and strain differences all being contributive factors (Duncan & Hughes, 1973). In 1200 Peruvian fowls, a Third World sample studied specifically for cause of death, mortality from various causes affected 137, of which 37% (lower left total) in figure were the result of cannibalism (Ploog, pers comm.). Clearly we should therefore look for any evidence of this behaviour in ancient samples.

JOINT DISEASES

In comparison with humans and other mammals the arthropathies (joint diseases) of birds may not have such a complex story to tell. Of the three major divisions of joint disease, gout in fowls and turkeys is not uncommon, but may not be skeletal and has not been identified in archaeological material to my knowledge. As in other species, the urates at the joints are unlikely to survive, but it is possible that erosive changes at the legs and feet might occur. Articular gout can have a genetic background, but high protein diets can also be a predisposing factor (Pierson & Hester, 1982).

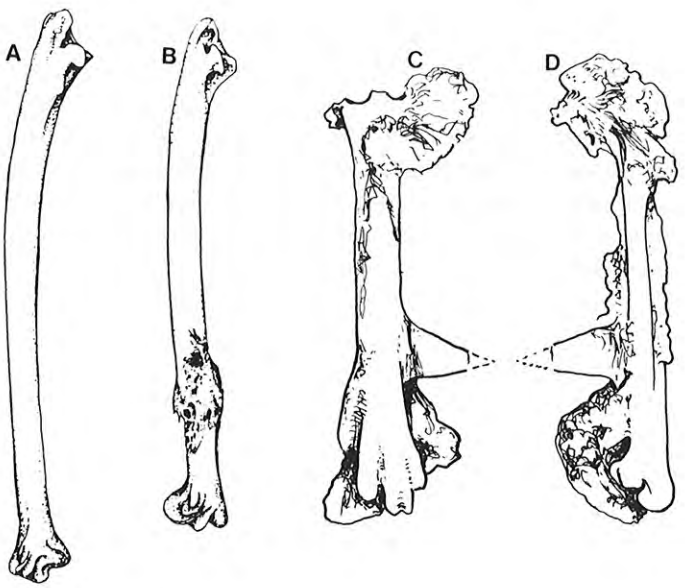


FIGURE 2 - A and **B.** Right ulnae from archaeological macaws, one being normal and the other displaying a healing shaft fracture. After Hargrave (1970). **C** and **D.** Chicken bones from Bristol Castle, displaying age-related new bone formation of unknown aetiolgy. Adapted from Baker and Brothwell (1980).

Viral and bacterial forms of arthritis can result in lameness, and should be identifiable as minor inflammatory change or even osteomyelitis. Probably the tibiometatarsal area is most frequently involved. Bumble foot is the bird equivalent of foul in the foot of cattle, and could leave its mark. Marginal lipping and eburnation (joint polishing), suggestive of an osteoarthritis, certainly appears in archaeological material, but as yet its occurrence has not been associated with age, trauma or joint stress as in mammals. Osteochondrosis, a disturbance of endochondral ossification (Duff, 1990) can produce various lesions.

NEOPLASMS

Tumours (group E) can certainly affect the skeleton, but uncommonly. They are more likely to occur in domesticated than wild species (Keymer, 1958). There are benign and malignant forms, the latter being able to produce destructive changes which can sometimes mimic post-mortem decay. In a detailed study of 586 tumours in gallinaceous birds (Conceicao, 1965), it was found that 45% were benign and the rest were malignant, so destructive lesions or extra bone can be expected. However, even when identified, their archaeological - as opposed to veterinary - value may be



FIGURE 3 - **A**. Part of a Roman scapula from Uley, displaying marginal "lipping" indicative of arthropathic changes. **B.** An ulna, humerus and tibiotarsus shaft from Roman Colchester, displaying dense new bone indicative of osteopetrosis. **C.** X-ray detail of five long bones from Roman Colchester, displaying varying degrees of additional bone development indicative of osteopetrosis. Note that the new bone extends into the interior of shafts.

limited. It is worth noting here that pseudo-tumours in the form of multiple exostoses and extra bone on the legs have been found by Harcourt (1971) and others in archaeological bone (Figure 2, C.D.). The aetiology is uncertain, but appears to be linked to age changes in old fowls. We need to know more about this pathology.

INFECTIONS

Infectious disease (group F) is a major category in the study of bird health. Unfortunately, fowl typhoid, fowl cholera, hepatitis and numerous other conditions do not leave skeletal markers. Some infections are of course zoonoses, and for instance the outbreak of psittacosis in the Faroes in 1930 (Rasmussen, 1938) resulted in deaths in the human inhabitants who had plucked and dressed fulmar petrels as food. The transmission of tuberculosis is a more complex phenomenon, with little

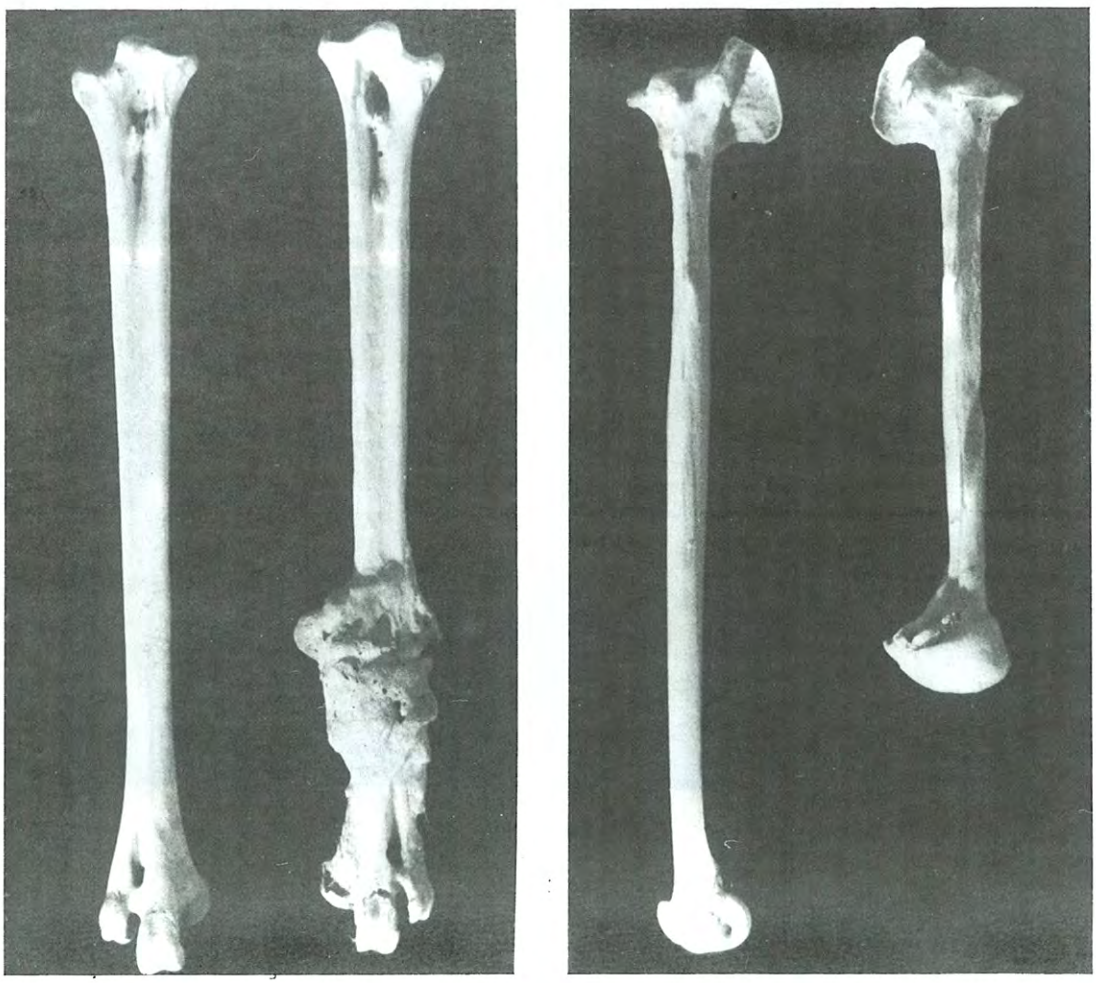


FIGURE 4 - Unusual results of trauma in long legged waders, following constriction of the soft tissue by sheeps' wool. Photographs courtesy of Keith Dobney.

detailed information on skeletal changes in avian tuberculosis. Captive birds can certainly be seriously affected by tuberculosis, and this disease was a primary cause of death in 641 seaducks studied by the Wildfowl Trust (Hillgarth & Kear, 1979). Avian tuberculosis can occasionally be passed to humans, and indeed birds can be carriers for other forms of tuberculosis. For instance, some time ago it was found that on farms in one area where pigs had tuberculosis, about 14% of the sparrows in the vicinity were also affected with the same mycobacteria (Plum, 1942).

The most interesting of all the infections, because it leaves its very characteristic mark on bones and can reach epidemic proportions, is avian osteopetrosis. It is caused by a virus which stimulates the proliferation of osteoblasts and massive swelling in the long bones of chickens (Boyde, Bames, Billaman & Mechanic, 1978). Anaemia may develop in advanced cases as a result of the occlusion of the marrow cavities (Payne, 1990). In view of the swollen dense long bones in this condition, it has been identified in archaeological material from a number of sites (Baker & Brothwell, 1980; Luff & Brothwell, 1992). At the site of Velsen, in Holland, about one percent of the domestic fowl displayed the condition (Prummel, 1987). If this was searched for systematically in *Gallus* samples and reported on in all dated cases, then it should be possible to build up an epidemiological history of this virus disease, at least since Roman time. There is also some evidence from British sites that it was more of a health threat in some flocks, and again we need more precise information on numbers of bones affected in earlier samples, which bones, and the degree of development of the osteopetrosis. It was certainly far more of a health hazard in Roman Colchester in East Anglia, for instance, than it was in Roman Uley, in the West Country.

Finally a very brief comment on external parasites (Table 1, group G). There may be a time in the future when mites and other less perishable external parasites are commonly identified on archaeological sites. Indeed, the bed bug has been identified, and it is possible that it may have adapted to humans in Roman times (Busvine, 1976), having first associated with domesticated pigeons and doves (*Cimex columbarius* is very similar to the human bed bug). Similarly, feather mites (Analgesidae have been found on Dutch archaeological feathers (Schelvis, 1992). But to return to bones; scaly leg, caused by another genus of mite (*Cnemidocoptes mutans*) can become very common where flock hygiene is poor. Infestation is mainly in domestic poultry, but can be found in other kept birds. The lower legs and feet may become severely affected, and the swollen crusty scabs may become infected secondarily, leading to periostitis. So even mites may potentially leave their mark at a skeletal level!

This has of necessity been a brief survey of the potential in avian palaeopathology. Certain lines of evidence already seen in archaeological material, suggest that prospects for further research are promising. There is also a need to clarify exactly which bird diseases may leave their mark on bones (and relatively how often). I hope by calling your attention to this area of comparative palaeopathology, that it may lead to further disease identifications and descriptions in future avian zooarchaeology.

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A METHODOLOGY FOR THE IDENTIFICATION OF AVIAN EGGSHELL FROM ARCHAEOLOGICAL SITES

ELIZABETH J. SIDELL
33 Patmore Unk Road, Helmel Hempstead HP24PX, England

ABSTRACT: Eggshell is often found on archaeological sites, yet is rarely identified. The potential information which could be gained from analysis is outlined, covering questions of economy, e.g. diet, and ecology, such as the distribution of breeding grounds. A methodology for the identification of eggshell using a combination of structural characteristics is given, the basis of which is the comparison of the archaeological material with a modern reference data and photographic collection. A seven step process is outlined, referring to both macro- and microscopic analysis. A brief introduction to previous application of the technique is presented and some of the results which have so far been obtained. This study highlights the questions which may be studied following identification of eggshell, and presents a methodology for carrying out the identifications.

KEYWORDS: EGGSHELL, SCANNING ELECTRON MICROSCOPY, MAMMILLAE, RESOURCE EXPLOITATION, ENVIRONMENTAL RECONSTRUCTION

RESUMEN: Las cáscaras de huevos de ave se recuperan con frecuencia en yacimientos arqueológicos aunque raras veces se identifican. En este estudio comentamos la información potencial que su estudio puede proporcionar y que incluye tanto cuestiones de economía (por ejemplo, dietas) como de ecología (distribución de áreas de cría). Proporcionamos asimismo una metodología para la identificación de cáscaras sobre la base de una combinación de características estructurales y la ayuda de material fotográfico y de comparación reciente. Se describe un proceso de siete pasos referido tanto al análisis macroscópico como al microscópico. También se valoran sucintamente aplicaciones previas de la técnica así como algunos de los resultados obtenidos con ella hasta la fecha. Nuestro estudio enfatiza las cuestiones susceptibles de abordarse con un estudio de cáscaras y presenta una metodología para llevar a cabo la identificación.

PALABRAS CLAVE: CASCARA DE HUEVO, MICROSCOPIA ELECTRONICA DE BARRIDO, MAMILA, EXPLOTACION DE RECURSOS, INFERENCIA AMBIENTAL

INTRODUCTION

The uses of eggshell identification.

Several types of information may be gleaned from the identification of eggshell. The most obvious use is to study past diet and resource exploitation. Other points include seasonality of site occupation and egg exploitation, evidence of breeding and also reconstruction of the palaeoenvironment.

If it can be determined that the eggshell derives from food waste, which may be possible from a study of the deposit and context type, then inferences may be made concerning the role of eggs in past diet. It should also be possible to look at the use made of domesticated stock and the degree of fowling carried out. Additionally, from urban sites, there is the possibility that exotic eggs were imported, as found in Spitalfields, London (Sidell, 1991). However, in all these cases, it is practically impossible to approach the study quantitatively. It is not even possible to calculate a 'Minimum Number of Individuals' due to the nature of eggs which have no distinguishing features, but are uniform across the surface. One possible approach would be to weigh all the recovered fragments, but this incurs all the problems of incomplete preservation and retrieval as well as the weight variation of eggshell within species.

Eggshell found on occupation sites may also be derived from breeding waste. It is possible to detect this from modification of the internal microstructure (Simons, 1971). Unfortunately, this may also be mimicked by abrasion caused in the deposition matrix, and so may be extremely difficult to recognise. However, if it can be identified, then the breeding of birds is a further area of study. The potential for tracking the introduction of domestic stock is also obvious.

Once the eggshell has been identified, studying the behavioural patterns of the particular species will generate further information. This requires the extrapolation of modern analogue data to the past, which can be problematical. However, if it is done with caution and awareness of the difficulties, then it is a valid attempt to gain more information. From such studies it is possible to look at the months of the year when eggs would have been available, and therefore when the eggs were supplementing diet. This naturally only applies to wild birds.

The nesting preferences of birds may also help in local environmental reconstruction. It is likely that if eggs were only being used as a dietary supplement, people would not travel far to collect them. Therefore, the habitat types represented may well have been local to the occupation site.

A further use of eggshell identification is the tracking of past breeding distribution. Very little is known about this; reliable records do not stretch far back in time. Studies using bird bones to look at breeding distribution are likely to be unreliable because birds may travel great distances in flight. Therefore it is from the actual by-product of breeding that the most reliable information may be obtained. One example of the application of this is the identification of Fulmar (*Fulmarus glacialis*) from the Norse and pre-Norse levels at Freswick Links, Caithness (Sidell, forthcoming). Previously this species was only known to have nested on St Kilda and the island of Grimsey (north of Iceland) prior to A.D.1750 (Serjeantson, 1988)

Therefore the potential uses of identifying eggshell include study of past diet and resource exploitation, breeding of birds, determination of the season of occupation and exploitation, reconstruction of palaeoenvironment and the tracking of breeding and domestication. Other possibilities include a study of material culture; e.g. the ostrich eggshells which were used at the site of 'Deir 'Ain 'Abata, Jordan as artefacts in a church (Sidell, forthcoming b).

STRUCTURE

Eggshell may be divided into two principle components: organic and inorganic (see Figure 1). When the shell is fresh, it will have an organic coating on both the internal and external surfaces. Eggshell has two keratin membranes which lie between the albumen and the 'true shell'. The inner 'egg' membrane surrounds the albumen and rests on the outer 'shell' membrane which is so firmly attached to the shell that it can only be removed chemically. The cuticle is the organic covering of the external surface of the shell. It is mostly proteinaceous. Not all species have an organic cuticle; some have a 'chalky' cover, e.g. the gannet (*Sula bassana*).

The inorganic part of the shell consists of several distinct layers.

1. The mammillae layer. This is attached to the shell membrane. As the membrane develops inside the bird, small crystalline cells develop upon it, known as the centres of crystallization (Tyler & Fowler, 1978), from which roughly hexagonal calcite crystals grow upwards and outwards,

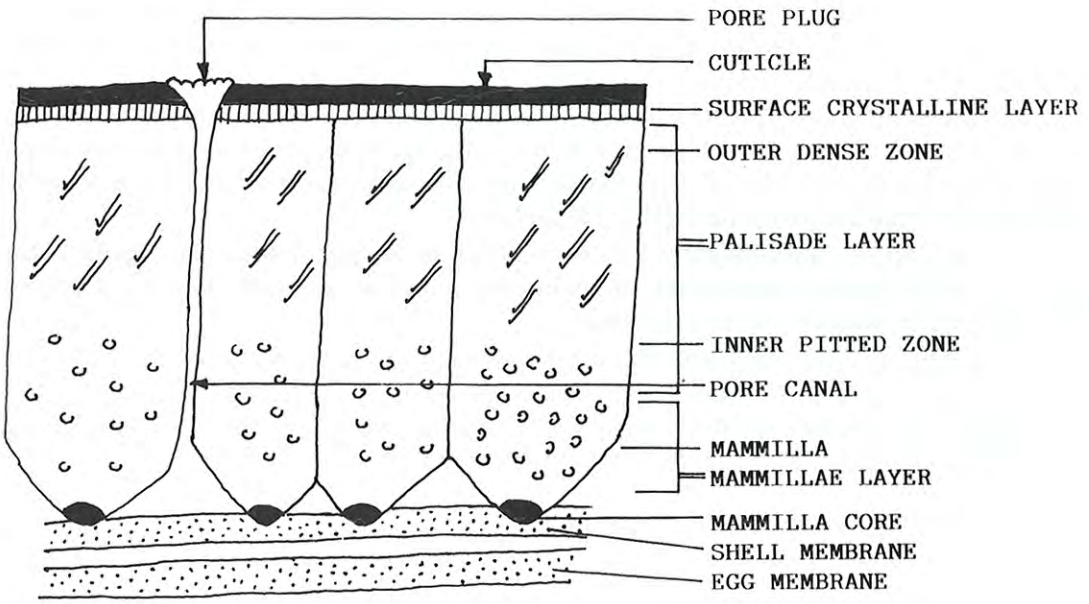


FIGURE 1 - Cross section of eggshell

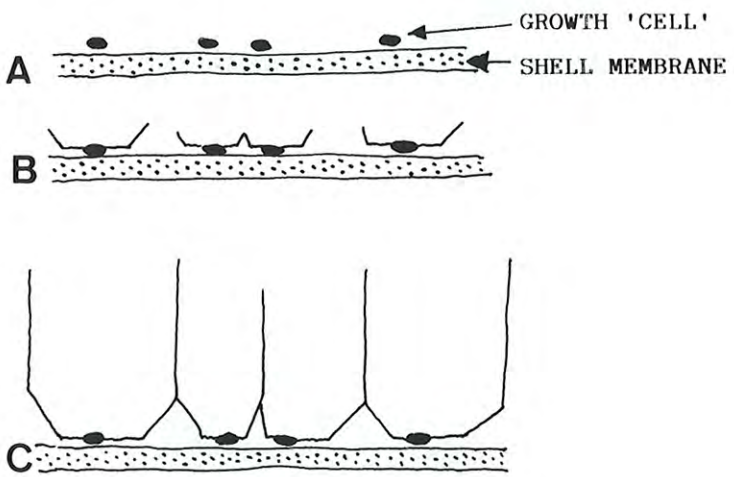


FIGURE 2 - Growth stages of mammillae. a) Cells on membrane; b) beginnings of crystal development with early fusion on two mammillae; c) completion of mammillae layer with two "simple" mammillae and one "compound" mammilla

forming the mammillae. As they grow, they will eventually touch and fuse (see Figure 2). The spacing is generally irregular and so the mammillae will be either 'simple' or 'compound' depending on the initial spacing. When they have all fused, and the entire shell is sheathed in calcite, the mammillae layer terminates (see plate 1).

2. The palisade layer. The name derives from the elongated palisade-like crystals which form the majority of this layer (Tyler & Fowler, 1978). Two zones are visible; an outer dense zone, and an inner zone containing vesicular pits. The palisade layer is the main area of calcification, confirming the shape of the egg and giving it its rigidity and strength.

3. The surface crystalline layer. This is mentioned by Keepax (1981) as an extremely thin layer of crystals running perpendicular to the external surface of the shell. However, it is very difficult to see and may only be one micron thick.

The entire structure is perforated by pores for the transfer of gases and water vapour.

One major problem in reporting on eggshell is the absence of a standardised terminology for the internal surface features. In light of this, it was necessary to create some simple descriptive terms for the diagnostic characteristics (Sidell, 1991b). (See Plates 2 and 3).

Gaps between the mammillae -'fissures'

Joins of the mammillae in the fissures -'sutures'

Sculpturing on the mammillae surface -'membrane facets'

Marks left by the membrane -'membrane tracks'



PLATE I

IDENTIFICATION TECHNIQUES

Generally when eggshell is recovered from archaeological deposits, it will have lost its colour and be in small fragments. This renders the application of the gross physical characteristics unuseable for identification, with the exception of shell thickness. Size, shape and colour may not be used, although occasionally some pigment may remain if the material has been waterlogged. This was found at the Iron Age site of Haddenham Delphs where the colour persisted, aiding identification to mute swan (*Cygnus olor*) (Sidell, forthcoming c). Thickness is used, although the possibility of post-depositional damage exists, however,this has not yet been noted to a significant degree. Without the survival of the characteristics used in studies of modern shells, it was necessary to find some new criteria of identification. This was done by a study of inter-specific variation in the microstructure.

The basis of this method is the comparison of archaeological material with a modern reference collection. The assumption has to be made that eggshell characteristics have not altered since the archaeological period in question. The identifications are made using a combination of several characteristics.

1. Colour. Although this disappears in the majority of cases, some burial conditions will preserve it, i.e. waterlogging. If present, the colour is compared to modern specimens. Colour may also be used in the initial stages to separate the material into superficial types.

2. Thickness. This is measured with a binocular microscope using an eyepiece graticule. Several measurements are taken from each specimen, which are then calibrated and given as a range of values in millimetres, which are then compared to a table of modern eggshell thickness ranges.

3. Pores. The pore openings on the external surface vary in number and shape between species. There are generally less pores per unit area in the eggs of larger species. A count is made with a binocular microscope using a gridded eyepiece graticule. The result is given as number of pores per square millimetre.

4. Mammillae. These vary within species, following no apparent pattern related to size or thickness. The variation is sufficient for use as a diagnostic characteristic. A count is carried out under Scanning Electron Microscope (SEM) at a magnification of two hundred times. Every whole mammilla on the screen is counted, including individual elements of compound mammillae. Twenty counts are taken across the surface of the specimen, and a mean is calculated. The result is given as number of mammillae per square millimetre.

5. Vesicular pits. This is a difficult count to carry out, due to the small size of the pits, which require a magnification of five thousand times to see. The count is carried out using SEM in the same way as the mammillae count is made. The result is presented as number of vesicular pits per square millimetre.

6. Ratio of the mammillae to palisade layer. These layers vary in thickness between species and so provide a diagnostic characteristic. The measurement is either carried out directly on the SEM screen, or from electron micrographs.

7. Surface description. This gives an account of the size, shape and spacing of the mammillae and the surface sculpturing. The depth of the fissures and the quality of the fusion is also noted, as are any peculiar characteristics.





PLATES II and III

From these methods, a catalogue of modern data has been compiled and counts, measurements, descriptions and photographs are compared to this body of data in order to make an identification.

APPLICATION

Practical experience has shown that some material from archaeological sites will not be identifiable. This is generally due to the internal surface being obscured, whether from mineralization or damage to the surface. Without analysis of the internal surface, it would be unwise to attempt identification. Insufficient reference material can potentially be a problem, particularly in the case of exotics.

Eggshell has now been studied from a number of sites, from the Bronze Age to the Post-Medieval period, and from urban sites to cliff-side ones. Good results have been obtained in the majority of cases.

One example is the site of Norton Folgate, Spitalfields, London (Sidell, 1991). The breakdown of identification is as follows:

64% was firmly identified

24% was inconclusive between several species due to mineralization.

12% was unidentified due to extreme mineralization and the presence of an exotic.

At this stage the most interesting results have come from the site of Freswick Links, Caithness, Scotland (Sidell, forthcoming). Sixteen wild species have been identified from this site, and several domesticates. From the species list, it was possible to study the diet of the inhabitants of the site, their fowling activities, the seasonality of wild egg consumption, the proportions of wild versus domestic eggs. It was also possible to make an attempt at reconstruction of the local

palaeoenvironment. However, the major contribution that this study made was to highlight the potential for study of the distribution of past breeding grounds. From the Norse and pre-Norse levels, egsshell was found of the Fulmar, (*Fulmarus glacialis),* in sufficient number to assume that the birds were breeding, rather than chance finds or imported eggs.

From this study, the potential of eggshell studies is revealed. Until now, very little research has been carried out, and generally excavators will discard eggshell if it has been recovered. However, the initial work has demonstated the possibility of identification to species level, leading to impications for the study of site economy and ecology.

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THE PLEISTOCENE AVIFAUNAS OF EUROPE

CÉCILE MOURER-CHAUVIRÉ
Centre de Paléontologie stratigraphique et Paléoécologie,
associé au CNRS (URA 11),
Université Claude Bernard, Lyon 1,
27-43 Boulevard du 11 novembre, 69622 Villeurbanne Cedex, France.

ABSTRACT: The Pleistocene avifaunas from Europe include a few Tertiary relicts which progressively vanish during the Lower Pleistocene and the beginning of the Middle Pleistocene. These forms are mainly *Pavo* and *Palaeocryptonyx* in Western Europe, and *Francolinus* in Central Europe. During the Middle Pleistocene the characteristic association in Western Europe is *Perdix palaeoperdix - Corvus antecorax*, while in Central Europe the most characteristic elements are the Tetraoninae. In the Upper Pleistocene the cold elements become more and more abundant, in Western Europe as well as in Central Europe, and are mainly represented by *Lagopus lagopus, L. mutus, Nyctea scandiaca*, and *Pyrrhocorax graculus*. The avifaunas of the Mediterranean islands do not include a large number of endemic extinct forms, and among them, the most numerous so far known belong to the Strigiformes. The study of the frequency of the different parts of the avian skeleton recovered in the fossiliferous localities gives information about the agent responsible for the accumulation of the material.

KEYWORDS:FOSSIL BIRDS, UPPER PLIOCENE, PLEISTOCENE, WESTERN EUROPE, CENTRAL EUROPE, MEDITERRANEAN, EVOLUTION, BIOSTRATIGRAPHY, PALEOBIOGEOGRAPHY

RESUMEN: Las avifaunas pleistocénicas europeas incluyen una pequeña serie de relictos terciarios que desaparecen progresivamente durante el Pleistoceno inferior y principios del Pleistoceno medio. Los elementos más representativos de esta fauna son *Pavo* y *Palaeocryptonix* en Europa occidental y *Francolinus* en Centroeuropa. Durante el Pleistoceno medio la asociación característica en Europa occidental es la formada por *Perdix palaeoperdix - Corvus antecorax* mientras que en Centroeuropa los elementos más característicos son los tetraoninos. En el Pleistoceno superior los elementos fríos se van haciendo cada vez más abundantes en todo el subcontinente y vienen representados por especies tales como *Lagopus lagopus, L. mutus, Nyctea scandiaca* y *Pyrrhocorax graculus*. Las avifaunas de las islas mediterráneas no incluyen gran número de formas endémicas extinguidas y, entre éstas, las más numerosas conocidas hasta el momento son estrigiformes. Los análisis de frecuencias de porciones esqueléticas recuperadas en los yacimientos proporcionan información acerca del agente responsable de la acumulación del material.

PALABRAS CLAVE: AVES FOSILES, PLIOCENO SUPERIOR, PLEISTOCENO, EUROPA OCCIDENTAL, CENTROEUROPA, MEDITERRANEO, EVOLUCION, BIOESTRATIGRAFIA, PALEOBIOGEOGRAFIA

INTRODUCTION

The Pleistocene avifaunas of Europe have been extensively studied since the 1950s, mainly in Central Europe, with the works of M. Kretzoi on the material from Betfia, in Rumania, but specially with the works of D. Janossy, who studied, as well as the Hungarian faunas, a certain number of faunas from Czechoslovakia, Austria, Poland, and from ex-Eastern Germany. A first biostratigraphical scheme on the European avifaunas from the Miocene to the Pleistocene was given by Janossy (1974a) in his work on the Middle Pleistocene avifauna of Hundsheim, in Austria. The whole of the studies on the Pliocene and Pleistocene avifaunas from the Carpathian Basin led up to a synthesis, published in six parts by Janossy (1976a, 1976b, 1977, 1979a, 1979b, 1980). These works have been continued in Poland by Bochenski (1989, 1991). Numerous new, extinct species or subspecies of birds have been described in the Pliocene and in the Lower and Middle Pleistocene.

In Western Europe the studied avifaunas mainly concern the Middle and Upper Pleistocene periods (Mourer-Chauviré, 1975a; Sánchez Marco, 1987a, 1987b). A few elements, however, are

known from more ancient localities, from the Pliocene or the Lower Pleistocene, and a certain amount of new material from these old periods has not yet been described due to a lack of time.

The chronological framework used in Central Europe is different from that of Western Europe and, in the present paper, I have tried to place all the fossiliferous avian localities in the same chronological sequence, using for the Pliocene the MN (Mammal Neogene) zones, defined by Mein (1976, 1990), and for the Pleistocene the MNQ (Mammal Neogene-Quaternary) zones, defined by Guérin (1982), slightly modified. The MNQ zones are also tentatively correlated with the Alpine glacial chronology. To place the Central European localities together with the Western European ones, I have used the works of Chaline (1986), and Chaline et al. (1985). The sequence so defined is only a tentative outline and will probably be modified as the progress of biostratigraphical studies continues (Table 1).

THE DISAPPEARANCE OF TROPICAL ELEMENTS AND TERTIARY RELICTS

The Tertiary avifaunas include numerous elements which belong to families whose present-day distribution is tropical, for example Secretary-birds, Colies, Parrots, Trogons, Turacos and so on... Most of these tropical elements disappear at the end of the Pliocene but some of them are still present at the beginning of the Pleistocene and progressively vanish during this period.

In Western Europe the main tropical elements of the end of the Tertiary are the Peafowls and the Junglefowls. The extinct species *Pavo bravardi*, which is very close to the Recent species *Pavo spiciferus*, the Green Peafowl, is present in France in the localities of Perpignan (MN 15), Ardé in the Perrier Mountain (MN 16), Saint-Vallier (MN 17), and Senèze (MN 18) (Mourer-Chauviré, 1989a, 1990). The locality of Senèze is now considered Upper Pliocene (Mein, 1990) and therefore one may consider that, in Western Europe, the Peafowls did not persist beyond the Plio/Pleistocene boundary.

The Recent genus *Gallus*, the Junglefowl, is represented by four species which live in India and South East Asia (Peters, 1963). One species of *Gallus* is present in the Pliocene of Perpignan (MN 15) (Depéret, 1897; Mourer-Chauviré, 1989a), and another species, *Gallus beremendensis*, has been described in the Pliocene of Beremend 5 (MN 16), in Hungary (Janossy, 1976b).

Another tropical element is the extinct genus *Palaeocryptonyx*, described in Perpignan (Depéret, 1897), which is also found in the Upper Pliocene of Montoussé 5 (MN 18) (Clot et al., 1976a) and of Cova de Ca Na Reia, at Ibiza (Alcover, 1989), and in other still unpublished localities such as Tourkobounia 1, in Greece, and Cava Sud, at Soave, in Italy. *Palaeocryptonyx* is a small partridge, which could not have been very different from the Recent genus *Rollulus*, the Roulroul or Crested Wood-Partridge, from South East Asia. In France this genus does not persist beyond the Plio/Pleistocene boundary, but in Italy it may have persisted somewhat longer because, according to Chaline (1986), the locality of Cava Sud, at Soave, is correlated with the biozone of Les Valerots (MNQ 20) and corresponds to the end of the Menapian cold phase.

In Central Europe, the tropical elements are mainly represented by the Francolins. The Recent genus *Francolinus* lives in the temperate and tropical regions, from the Middle East to the South of China, and in the whole of Africa (Peters, 1963). During the European Pliocene and Pleistocene, Francolins are represented by the following forms:

	Western Europe	Characteristic forms	Central Europe	Characteristic forms
MNQ zones				
26	La Colombière	* *Lagopus lagopus*	Palank	* *Lagopus lagopus*
"Würm"	Gigny-sur-Suran	* *Lagopus mutus*	Pilisszanto	* *Lagopus mutus*
			Istalloskö	* *Lyrurus tetrix*
25	Fontéchevade	* *Tetrao urogallus*	K. Lambrecht Cave	* *Tetrastes bonasia*
"Riss-Würm"		* *Lyrurus tetrix*	Varbo	* *Tetrao urogallus*
			Süttö	
24	La Fage	*Corvus antecorax*	Solymar	* *Lagopus lagopus*
"Riss"	Orgnac III (d-h.sup)	*P. palaeoperdix*	Castellum	* *Lagopus mutus*
	Atapuerca-La Galeria			
23	Lunel-Viel	*Corvus antecorax*		
"Mindel-Riss"	Orgnac III (h. inf-j)	*P. palaeoperdix*		
		* *Tetrao urogallus*		
		* *Lyrurus tetrix*		
22	St-Estève-Janson	* *Nyctea scandiaca*	Uppony	* *First T. urogallus*
"Mindel"		* *Pyrrhocorax graculus*	Vértesszöllös	* *First L. tetrix*
	Montoussé 3	* *Tetrastes praebonasia*	Tarkö	
		* *Tetrao urogallus*	Prezletice	• *Last F. capeki*
		* *Lyrurus tetrix*		
21	Cromer Forest Bed		Betfia 5	* *Lagopus lagopus*
"Gunz-Mindel"			Kozi Grzbiet	* *Tetrao praeurogallus*
				* *Tetrastes praebonasia*
20	Soave	• *Palaeocryptonyx*	Templomhegy	• *Francolinus capeki*
"Gunz"	Bourgade	* *First N. scandiaca*	Méhész	* *Tetrao praeurogallus*
	Les Valerots	* *First L. lagopus*	Zalieski 1A	
19	Mas Rambault	*Perdix palaeoperdix*	Betfia 2	• *Francolinus capeki*
		Corvus antecorax	Osztramos 2 & 8	* *Lyrurus partium*
			D. Altenburg 4B	
MN Zones				
18	Montoussé 5	• *Palaeocryptonyx*	Osztramos 3	• *Francolinus capeki*
	Senèze	• *Pavo bravardi*	Villany 3 & 5	• *Francolinus minor*
		* *Lyrurus cf. partium*		
17	Chilhac	• *Pavo bravardi*	Osztramos 7	• *Francolinus capeki*
	Saint-Vallier	*Corvus antecorax*		• *Francolinus minor*
				* *Tetrao (L.) conjugens*
16	Perrier	• *Pavo bravardi*	Rebielice Krolewskie	• *Francolinus capeki*
			Beremend 5	• *Francolinus minor*
				* *Lagopus atavus*
				• *Gallus beremendensis*
15	Perpignan	• *Pavo bravardi*	Weze	* *Tetrao (L.) conjugens*
		Corvus praecorax	Csarnota 2	* *Tetrao macropus*
		• *Palaeocryptonyx*		* *Lagopus sp.*

TABLE 1 -Comparison between the Western European and Central European avifaunas during the Plio-Pleistocene. MN and MNQ zones after Mein (1990) and Guérin (1982). For Western Europe, position of the sites after Chaline et al. (1985) and Chaline (1986) and characteristic forms after Depéret (1897), Clot et al. (1976a, 1976b), Mourer-Chauviré (1975a, 1980, 1989a, 1989b, 1990), and Sánchez Marco (1987a). For Central Europe, position of the sites and characteristic forms after Janossy (1974b, 1976a, 1976b, 1986) and Bochenski (1991). The black dots correspond to the Tertiary relicts and the asterisks to the cold elements.

Francolinus capeki, which goes from the Perpignan zone (MN 15) to the substage of Tarköwhich corresponding to the Lower part of the Mindelian glacial stage (MNQ 22), with three successive subspecies, *F. capeki wenzensis, F. capeki villanyensis*, and *F. capeki capeki*; *Francolinus minor*, Pliocene age (MN 15 and 16); *Francolinus subfrancolinus*, Pliocene age (MN 17 and 18) (Janossy, 1986). The genus *Francolinus* disappears from Europe during the Mindelian glacial stage (MNQ 22), between the Tarkö and the Vértesszöllös substages (Janossy, 1986). The westernmost occurrence of this genus in the European Pleistocene is in the rich *Hippopotamus* locality of Untermassfeld, near Meiningen, in Germany, dating from the Lowest Biharian (MNQ 19 or 20) (Janossy, pers. comm.).

Other tropical elements that have been found in Central Europe are large storks, such as *Pelargosteon tothi*, which is related to Marabou Storks from Africa. *Pelargosteon tothi* has been described in the Early Middle Pleistocene of Betfia 5 (MNQ 21) in Rumania (Kretzoi, 1962). One element, designated as cf. *Pelargosteon tothi*, has also been found in the locality of Budapest-Varhegy, dating back to the Mindel (Tarkö substage, MNQ 22) (Janossy, 1979b), and another giant stork has been identified by Janossy (1965), in the locality of Voigtstedt, in Germany, also dating from the Mindel, and is considered by Janossy as a Tertiary relict. However it is difficult to be more precise about the affinities of these Ciconiidae, because they are represented by very fragmentary remains, mainly phalanges.

Tadorna tadorna, the Shelduck, can also be considered a Tertiary relict. At the present time its distribution is typically discontinuous. In Europe it breeds on the coasts of the North Atlantic, while in Central Asia it breeds on the shores of salt or brackish inland lakes, in the steppes, between latitudes of about 40° and 50° North (Voous, 1960). In the past it must have been widely and continuously distributed. It has been found in the Upper Pliocene at Chilhac, in the centre of France (MN 17) (Boeuf & Mourer-Chauviré, 1992), at Villany 3, in the South of Hungary, where it is very abundant (MN 18) (Mlikovsky, 1982), and its distribution was probably still continuous during the Middle Pleistocene; at that time it has been found at Voigtstedt, in Germany, and at Stranska Skala, in Czechoslovakia (MNQ 22) (Janossy, 1965, 1972).

In conclusion, some tropical elements, or Tertiary relicts, persisted in Europe as recently as the Middle Pleistocene, in the Mindel glacial stage.

THE TYPICAL AVIFAUNAS OF THE LOWER AND MIDDLE PLEISTOCENE AND THE APPEARANCE OF THE "COLD ELEMENTS" (ZONES MNQ 19 TO 24)

In Western Europe the typical elements of the Lower and Middle Pleistocene are *Corvus antecorax*, a primitive form of Raven, and *Perdix palaeoperdix*, a primitive form of Grey Partridge, which appear together in France, during the Lower Pleistocene, in the locality of Mas Rambault (MNQ 19) and persist until the end of the Middle Pleistocene (MNQ 24) (Mourer-Chauviré, 1975a). They are also known in Spain, in the locality of Atapuerca (Sánchez Marco, 1987a, 1987b).

In the meantime, in Central Europe, the avifaunas are dominated by the Tetraoninae, which appear as early as the Lower Pliocene, Perpignan zone (MN 15), at Weze, in Poland (Janossy, 1974b; Bochenski, 1991). All the Tetraoninae have shortened and feathered tarsi and are adapted to rather

cold climates. Janossy (1974), and Bochenski (1991) have defined a succession of different species of Tetraoninae, which evolved and gave rise to the Recent European forms:

In the lineage of *Tetrao urogallus*, the Capercaillie, the first known ancestor is *Tetrao macropus*, in the Pliocene (MN 15 and 16), then *Tetrao praeurogallus* from the Late Pliocene (MN 18) to the Early Middle Pleistocene (MNQ 22, Tarkö substage), and, finally, *Tetrao urogallus*, from the Middle Pleistocene (MNQ 22, Vértesszöllös substage) to the Present.

In the lineage of *Lyrurus tetrix*, the Black Grouse, the first known ancestor is *Tetrao (Lyrurus) conjugens* in the Pliocene (MN 15 to 17), then *Lyrurus partium* from the Late Pliocene (MN 18) to the Early Middle Pleistocene (MNQ 22, Tarkö substage), and, finally, *Lyrurus tetrix* from the Middle Pleistocene (MNQ 22, Vértesszöllös substage) to the Present.

In the lineage of *Lagopus lagopus* and *L. mutus*, the Willow Grouse and the Ptarmigan, the earliest form, *Lagopus* sp., appears in the Lower Pliocene (MN 15), at Weze, in Poland (Janossy, 1974b; Bochenski, 1991), then *Lagopus atavus* is found in the Upper Pliocene (MN 16 and 17). The extant species *Lagopus lagopus* first appears in France, in the locality of Les Valerots, and in Poland, in the locality of Kozi Grzbiet, at about the same time (MNQ 20-21). The formation of the Recent species *Lagopus mutus* probably took place by isolation in mountainous regions during the Mindel-Riss interglacial (MNQ 23), since both Recent species, *L. lagopus* and *L. mutus*, occurred together, in the same localities, since the Riss glacial stage (MNQ 24). They are found during the Riss in the localities of La Fage, in France (Mourer-Chauviré, 1975a), and Hunas, in Germany (Janossy, 1976a). *Tetrastes praebonasia*, the ancestor of the Recent Hazel Hen, *Tetrastes bonasia*, is known both in Central and Western Europe, in the localities of Hundsheim, Austria (Janossy, 1974a), Tarkö, Hungary (Janossy, 1976a), Kozi Grzbiet, Poland (*T.* cf. *praebonasia*, Bochenski, 1989), and Montoussé 3, France, in the Pyrénées mountains (Clot et al., 1976b), in the Early Middle Pleistocene (MNQ 21 and 22). The Recent form is only known from the Riss-Würm interglacial (MNQ 23) in Central Europe (Janossy, 1976a) and in France it appears only during the Holocene (Figure 1).

The Tetraoninae are always present in the avifaunas of Central Europe during the Lower and Middle Pleistocene, while in Western Europe they just appear briefly from time to time, for example *Lyrurus* cf. *partium* at Senèze, in the center of France (MN 18) (Stehlin, 1923), *Lagopus lagopus* at Les Valerots, in Burgundy (MNQ 20) (Chaline et al., 1985), *Tetrao urogallus, Lyrurus tetrix* and *Tetrastes praebonasia*, at Montoussé 3, in the Pyrénées (MNQ 22) (Clot et al., 1976b), but they do not become settled at this time. For example, they are totally missing in the very rich and very cold avifauna of Saint-Estève-Janson, in the Durance Valley (MNQ 22) (Mourer-Chauviré, 1975a).

In Western Europe the Tetraoninae became settled only in Southern France at the time corresponding to certain layers of Orgnac 3, which are attributed to the Mindel-Riss interglacial (MNQ 23), and where they are associated to forest forms (Mourer-Chauviré, 1975a). They became more frequent only during the Riss glacial stage (MNQ 24), and, afterwards, both species of Grouse, *Lagopus lagopus*, the Willow Grouse, and *Lagopus mutus*, the Ptarmigan, become the most common elements of the Würmian avifaunas (MNQ 26) (Figure 1).

In Western Europe, one of the most frequent elements is *Corvus corax*, the Raven, either represented by its ancestral form, *Corvus antecorax*, or by its Recent form. Strangely enough this lineage is very poorly represented in Central Europe. *Corvus* cf. *corax* is quoted by Janossy (1986) at Tarkö, but in his previous works, he considered the large corvid from Tarkö as belonging to the extinct species *Corvus pliocaenus janossyi*. The Recent form, *Corvus corax*, is only known in a few Würmian localities (Janossy, 1979a).

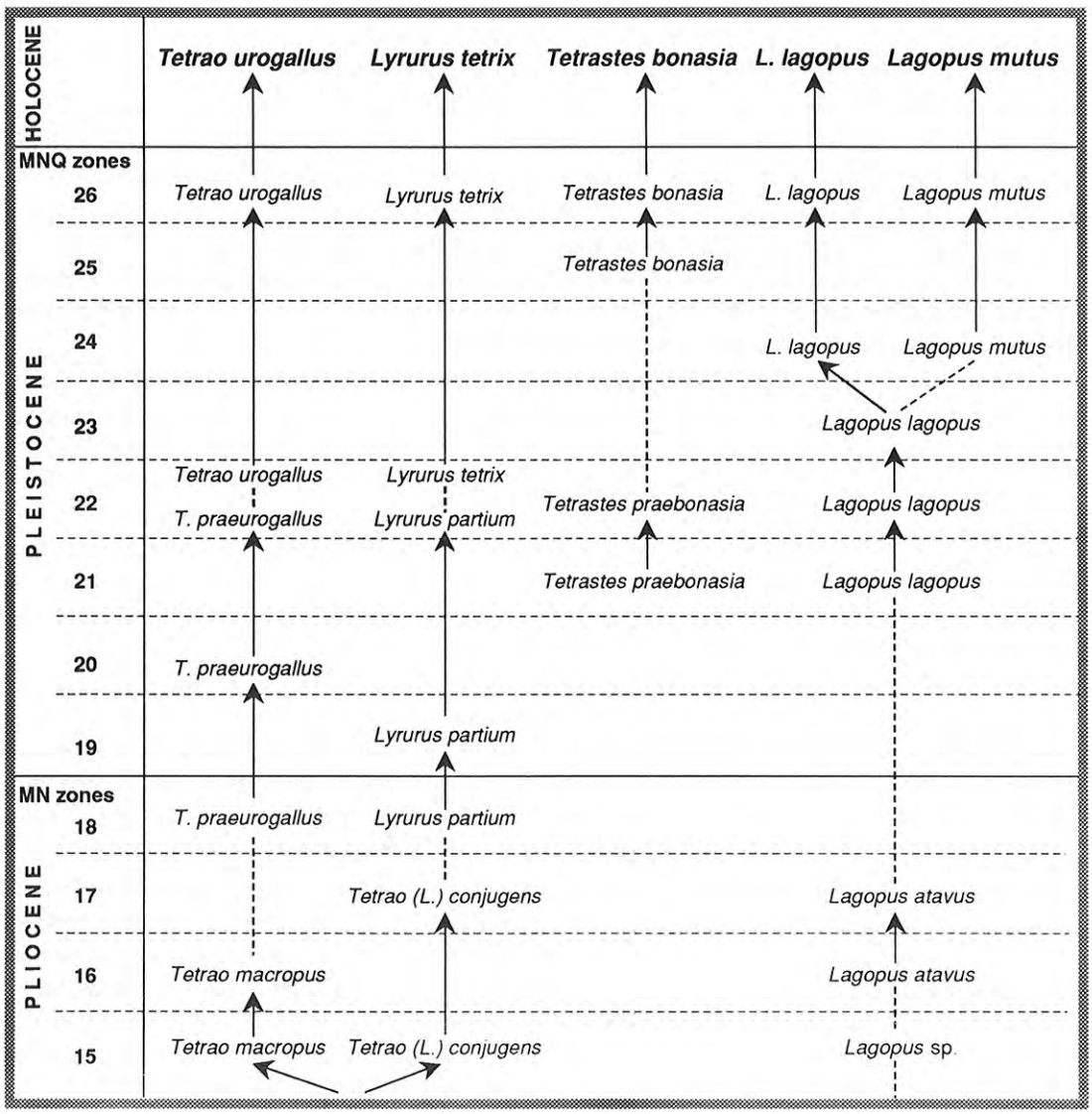


FIGURE 1 - Evolution of the different lineages of Tetraoninae in Europe after Bochenski (1991), Chaline et al. (1985), Clot et al. (1976b), Janossy (1976a, 1986), Mourer-Chauviré (1975a), replaced in the chronological framework of the MN (Mein, 1990) and MNQ (Guérin, 1982) zones.

Among the cold elements which appear as early as the first cooling stages, is the Snowy Owl, *Nyctea scandiaca*. It has been known in France since the Lower Pleistocene, at Bourgade, near the Mediterranean shore (Gunz glacial stage, MNQ 20) (Mourer-Chauviré, 1980). Later it is very abundant in Saint-Estève-Janson, during the Mindel glacial stage (MNQ 22). Among the material from Saint-Estève-Janson, there are subadult bones, and it is therefore probable that it was nesting at this time in the Durance valley (Mourer-Chauviré, 1975a). It is found again during each glacial stage

and during the Würm it is very abundant in South West France, for example in the locality of Le Morin, in the Gironde department (Mourer-Chauviré, 1975a). It is also known in Spain, in Erralla Cave (Eastham, 1985), in Gibraltar (Eastham, 1968), and it reached the extreme South of Italy, in the locality of Romanelli, Terra d'Otranto (Cassoli et al., 1977). Curiously, it is very rare in Central and Eastern Europe, where it only appears at the end of the Riss-Würm in Kalman Lambrecht Cave, in Hungary, (Janossy, 1963) and in the beginning of the Würm in Binagady, Azerbaïdjan (Burchak-Abramovitch, 1975); after that it is only known in Central Europe from a few Würmian localities (Janossy, 1977).

Another cold element is the Alpine Chough, *Pyrrhocorax graculus*, which is very abundant in the Mediterranean cold avifaunas. At present it breeds in the mountains above altitudes of 1400 m (Voous, 1960), but during the glacial stages it probably lived at lower altitudes, probably down to sea-level. In Central Europe it is known as early as the Pliocene, in Csarnota 2 (MN 15), and during the Lower and Middle Pleistocene (Betfia 2: MNQ 19, Méhész: MNQ 20, Betfia 5: MNQ 21, Tarkö, Hundsheim, Stranska Skala: MNQ 22) (*Pyrrhocorax* aff. *graculus* and *Pyrrhocorax graculus vetus*) (Kretzoi, 1962; Janossy, 1972, 1974a, 1979a). But in Western Europe it seems to appear only during the Middle Pleistocene, in particular in the locality of Saint-Estève-Janson (Mindel, MNQ 22), where it is extremely abundant (Mourer-Chauviré, 1975a).

THE GREAT DEVELOPMENT OF THE COLD AVIFAUNAS

It is mainly during the last glacial stage, Würmian or Weichselian (MNQ 26), that avifaunas which include a great majority of cold forms are to be found. The most widespread are *Lagopus lagopus*, the Willow Grouse, *Lagopus mutus*, the Ptarmigan, *Nyctea scandiaca*, the Snowy Owl, and *Pyrrhocorax graculus*, the Alpine Chough. During the cold stages, the other Tetraoninae such as *Tetrao urogallus*, the Capercaillie, and *Lyrurus tetrix*, the Black Grouse, decrease, to increase again at the end of the Würm or during the Holocene.

During the Middle Würm, Ptarmigans prevailed in Hungary (Istallosko, Janossy, 1986), as well as in France (Gigny-sur-Suran, layers XX to IX, Mourer-Chauviré, 1989b), then Willow Grouse prevailed in Hungary (Pilisszanto, Janossy, 1986), as in France (Gigny-sur-Suran, layers VII to V, Mourer-Chauviré, 1989b) or Belgium (Coléoptère cave, Mourer-Chauviré, 1983a), corresponding to a colder climate, which was similar to the boundary between the taòga and the tundra zones. Then Ptarmigans and Black Grouse become prevalent again, for example in Szekszard-Palank, in Hungary (Janossy, 1986).

During this period all the northern part of Europe was covered by a very large ice-cap. The marine species which at present nest in this area, such as the Fulmars (*Fulmarus glacialis*), Long-tailed Ducks (*Clangula hyemalis*), Scoters (*Melanitta fusca* and *nigra*), Eiders (*Somateria mollissima*), Brent and Red-Breasted Geese (*Branta bernicla* and *ruficollis*), some shorebirds, Phalaropes (*Phalaropus*), Skuas (*Stercorarius*), Gulls (*Larus*), Little Auks (*Plautus alle*) etc ... at that time probably nested far southwards, along the Atlantic coasts, from the South of Great Britain to Gibraltar and on the northern shores of the Mediterranean.

The extinct Great Auk, *Pinguinus impennis*, which disappeared during the XIXth century, nested along the Atlantic and Mediterranean coasts of the Iberian Peninsula and Italy at that time. During the Pleistocene it has been found at Figueira Brava, in Portugal (Mourer-Chauviré et al., 1991), Gibraltar (Bate, 1928; Eastham, 1968), Cueva of Nerja, in Spain (Boessneck et al., 1980; Eastham, 1986), the Arene Candide (Cassoli, 1980), Archi (Ascenzi et al., 1971), and Romanelli (Blanc, 1927; Cassoli et al., 1977), in Italy. It is therefore not very suprising that Paleolithic rock paintings of the Great Auk have been recently found in the submarine Cosquer Cave, near Marseille (Clottes et al., 1992). It has also been found at Porto Santo, in the Madeira Archipelago (Pieper, 1985).

In the Figueira Brava Cave, in Portugal, other species which at present nest in the tundra and winter at sea, (such as Red-throated Diver, *Gavia stellata*, Common Scoter, *Melanitta nigra*, Velvet Scoter, *Melanitta fusca*, Long-tailed Duck, *Clangula hyemalis*, and the Razorbill, *Alca torda* (Mourer-Chauviré et al., 1991) have been also identified. The Gannet, *Sula bassana*, which nests farther to the South, and an extinct species of shearwater, *Puffinus holei*, recently described from the Pleistocene of Canary Islands (Walker et al., 1990), were also present in Figueira Brava.

THE MEDITERRANEAN INSULAR AVIFAUNAS

The Mediterranean Islands are not located very far from the mainland and that is probably the reason why they do not have a great number of endemic extinct species. A synthetic work on these avifaunas, by Alcover et al., was published in 1992. Some extinct species, or subspecies, have already been described and more will be probably found in the future. The extinct forms known at present are the following:

Procellariiformes:
- *Puffinus nestori*, Upper Pliocene of Cova de Ca Na Reia, Ibiza (Alcover, 1989).

Anseriformes:
- *Cygnus equitum*, the Giant Maltese Swan, Upper Pleistocene of Malta (Bate, 1916; Northcote, 1988, 1992).
- *Cygnus falconeri*, the Dwarf Maltese "Swan-Goose", Upper Pleistocene of Malta (Lydekker, 1890; Bate, 1916; Northcote, 1982b).

Accipitriformes:
- *Aquila chrysaetos simurgh*, a large form of Golden Eagle, Pleistocene of Crete (Weesie, 1988).
- *Gyps melitensis*, a large form of Vulture, Pleistocene of Malta and Crete (Lydekker, 1890; Bate, 1916; Weesie, 1988). This form, described in Malta, has also been found in the Middle and Upper Pleistocene of the european mainland.

Gruiformes:
- *Grus primigenia*, a large form of crane, similar in size to the Sarus Crane, Pleistocene of Majorca and Ibiza (Northcote et al., 1988; Florit et al., 1989). This form is known from a few Upper Pleistocene localities on the continent.
- *Grus melitensis*, a large form of crane, Upper Pleistocene of Malta (Lydekker, 1890, 1891; Northcote, 1982a, 1992).

Strigiformes:
- *Tyto melitensis*, a presumed large form of Barn Owl, Upper Pleistocene of Malta (Lydekker, 1890,

1891; Bate, 1916). This form does not actually differ very much from the Recent Barn Owl, *Tyto alba* (Mourer-Chauviré et al., 1980).
- *Tyto balearica*, a large form of Barn Owl, Upper Pliocene of Majorca and Menorca (Mourer-Chauviré et al., 1980). This form, however, was not endemic to the Balearics, since a bird of comparable size was living on the mainland during the same period (Mourer-Chauviré et al., 1988).
- *Bubo insularis*, a dwarf form of Eagle Owl, Pleistocene of Sardinia and Corsica (Mourer-Chauviré et al., 1986).
- *Athene cretensis*, a large form of the Little Owl, Pleistocene of Crete and Armathia (Weesie, 1982; Alcover et al., 1992).

Among the Passeriformes a new subspecies of *Corvus antecorax* occurred in Ibiza as late as the Holocene; a new species of Fringillidae appears in Majorca, and possibly a new subspecies of *Garrulus glandarius*, the Jay, in Crete. All these forms are still undescribed (Weesie, 1988; Alcover et al., 1992).

Among the forms which no longer, or very rarely, occur on these islands, *Otis tarda*, the Great Bustard, has been found in Malta (Bate, 1916), Ibiza (Florit et al., 1989), and was extremely abundant in the Upper Pleistocene of Cyprus (Simmons, 1991; Mourer-Chauviré, in preparation).

With the exception of the quail, *Coturnix coturnix*, which is the only migratory phasianid, and of *Palaeocryptonyx* sp. in the Upper Pliocene of Ibiza, the insular avifaunas of the Mediterranean are characterized by the lack of Phasianidae. This absence stands in sharp contrast with the mainland avifaunas, where the Phasianidae are often the most abundant elements.

THE RELATIVE ABUNDANCE OF SKELETAL ELEMENTS

During the course of my research on Pleistocene birds from both archaeological and non-archaeological sites, I realized that the distribution of the main long bones was not always related only to their robustness. In the case of medium-sized birds, such as Willow Grouse, Ptarmigans, Partridges, hunted by large nocturnal birds of prey such as Eagle Owls or Snowy Owls, there is an over-representation of the tarsometatarsi and, to a lesser extent, of the carpometacarpi. This had already been reported by Dupont (1872), Boessneck et al. (1973), then by myself (1975a, 1975b, 1983b), Vilette (1983), and recently again by Baales (1992).

In the case of cave sites, it is necessary to distinguish between those birds which were living in situ, in the rocky cliffs surrounding the caves, such as *Columba livia*, the Rock Dove, or *Pyrrhocorax graculus*, the Alpine Chough, and species which had been brought to the site by predators. In the first instance, the different skeletal elements have an almost homogeneous representation. It is only in those birds which did not live in the cliffs and were not hunted by Man, that an over-representation of tarsometatarsi and, secondarily, of carpometacarpi is to be found. This has been recorded in the medium-sized Galliformes, which are often the most abundant items, but also in Anseriformes, Accipitriformes, Charadriiformes, and the Strigiformes, as in the localities of Orgnac 3 (Mourer-Chauviré, 1975a), or La Fage (Mourer-Chauviré, 1975b). It is also necessary to group birds according to size. This over-representation is observed only in medium-sized birds.

When birds were hunted and brought into the cave by Man, there is ussually, an over-representation of humeri and femora in the medium-sized Galliformes, whereas the

tarsometatarsi are often the least abundant bones. The bones can also present cut or burn marks. In the case of large-sized birds, such as the Great Bustards from Cyprus, there is a strong over-representation of the scapular part of the coracoid, which is also the most robust part of the skeleton, and in this site many of the bones are burnt.

CONCLUSIONS

Although there are differences in the faunal composition between the Western European and the Central European avifaunas, extinct forms which are common for these two areas have also been found, and thus make it possible to bring to the fore evolutionary phenomena which occurred at the scale of the whole european subcontinent. These common extinct species or subspecies are:

Strix intermedia Janossy, a form that is intermediate between the Recent *Strix aluco* and *Strix uralensis*. It has been found in four localities in Hungary, Czechoslovakia, Austria, and in France at Saint-Estève-Janson; for all these localities, age MNQ 22 (Janossy, 1974a, 1977; Mourer-Chauviré, 1975a).

Tetrastes praebonasia Janossy, an ancestor of the Recent *Tetrastes bonasia* (already indicated in paragraph III). It has been found in three localities in Hungary, Poland, Austria and in France at Montoussé 3, in the Pyrénées; age MNQ 21 - MNQ 22 (Janossy, 1974a, 1976a; Clot et al., 1976b; Bochenski, 1989).

Falco antiquus Mourer-Chauviré, a form that is intermediate between the Recent *Falco rusticolus* and *Falco cherrug*. It has been found in France, at La Fage (Mourer-Chauviré, 1975a) and in Hungary, at Horvölgy (*Falco* aff. *antiquus*, Janossy, 1977, 1980); age MNQ 24.

Falco tinnunculus atavus Janossy, a subspecies slightly larger than the Recent *Falco tinnunculus*. It has been found in five localities in Austria, Czechoslovakia, Rumania, Hungary (Janossy, 1977, 1981), age MNQ 19 to MNQ 22, and in six localities in France (Mourer-Chauviré, 1975a; Chaline et al., 1985), age MNQ 20 to MNQ 24.

Corvus pliocaenus (Portis) and *Corvus pliocaenus janossyi* Mourer-Chauviré, found in Rumania and Hungary (Janossy, 1979a, 1980; Jurcsak et al., 1988), age MNQ 21 and MNQ 22. It was much more frequent in Western Europe being known in Italy (Regalia, 1902), in Spain, in Majorca (Mourer-Chauviré et al., 1977), in France from seven localities (Mourer-Chauviré, 1975a, 1981, Philippe et al., 1980), and in Greece (unpublished data), age MNQ 18 to MNQ 24.

Pica pica major Janossy, a subspecies slightly larger than the Recent *Pica pica*. It has been found in six localities in Hungary, Austria, Czechoslovakia (*P. pica major* and *P.* aff. *pica major*, Janossy, 1972, 1974a, 1979a), age MN 15 to MNQ 22, and in France in two localities (Mourer-Chauviré, 1975a), age MNQ 22 and MNQ 23.

Pyrrhocorax graculus vetus Kretzoi, a subspecies slightly smaller than the Recent *Pyrrhocorax graculus*. Described by Kretzoi (1962) in Betfia 5, Rumania (MNQ 21), it has been found in France in nine localities (Mourer-Chauviré, 1975a; Clot et al., 1976b), age MNQ 22 to MNQ 24.

Statistical comparisons of the dimensions of the main long bones between fossil and Recent populations, however, show that the variations are not always related to evolutionary phenomena

occurring in a continuous way in the same direction, but can be punctual responses of certain populations to particular ecological conditions, restricted in space and time.

It will be necessary to continue these studies to obtain a more precise knowledge of the evolution of these Plio-Pleistocene European avifaunas.

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FOWLING IN THE DUTCH NEOLITHIC AT INLAND AND COASTAL SITES

JØRN T. ZEILER & ANNEKE T. CLASON
Biologisch-Archaeologisch Instituut, Groningen, The Netherlands.

ABSTRACT: This article deals with the analysis of bird remains from four Neolithic sites in the western and central parts of the Netherlands. For the site of Bergschenhoek only the preliminary results are discussed. There is a striking difference between the inland sites of Swifterbant and Hazendonk and the coastal site of Kolhorn, both in number of remains and number of species.

KEYWORDS:FOWLING, NEOLITHIC, INLAND SITES, COASTAL SITES

RESUMEN: Este artículo trata del análisis de los restos de aves procedentes de cuatro yacimientos neolíticos, situados en el oeste y centro de Holanda. Del yacimiento de Bergschenhoek sólo se discuten los datos provisionales. Existe una notable diferencia entre los yacimientos interiores de Swifterbant y Hazendonk y el yacimiento litoral de Kolhorn, tanto en número de restos como en número de especies.

PALABRAS CLAVE: CAZA DE AVES, NEOLITICO, YACIMIENTOS INTERIORES, YACIMIENTOS LITORALES

INTRODUCTION

Location of the sites (Figure 1)

The inland site of Swifterbant, S3, was located on a low-lying levee alongside a creek. During the period of habitation (5400-5300 B.P.) the area was dissected by a system of creeks, that developed around 6000 B.P. . Along the borders river dunes were found. These dunes were permanently dry, while the levees could become flooded during highwater periods. In the extensive backswamps behind the levees, an open-marshland vegetation and willow carr were found (Casparie et al., 1977; van Zeist & Palfenier, 1981). The deciduous forest growing on the levees and dunes seems to have been quite dense (Zeiler, 1992). In the course of time the conditions in the area became gradually wetter as a result of the rising sea level; around 5000 B.P. the system became totally submerged (Deckers et al., 1980).

In the same period that the Swifterbant site was occupied, habitation started on the second inland site, the river dune of Hazendonk. Louwe Kooijmans (1987) mentions seven phases of Neolithic habitation between 5400 and 3700 B.P. These phases alternate with periods in which the dune was not occupied. The majority of the bone material comes from the third phase of habitation (Hazendonk-3, c. 5000 B.P.) and from the fifth and seventh phase (Vlaardingen-1b, 4450-4350 B.P. and Vlaardingen-2b, 4100-3850 B.P.). Like Swifterbant, Hazendonk was located in a freshwater area. The reconstruction of the landscape made by van der Woude (1983) shows a sequence of different types of landscape between 7400 B.P. and 3000 B.P.: expansion of the lakes and disappearance of part of the swamp forest, alternating with a lowering of the water depth and expansion of the forest.

The coastal settlement of Kolhorn (c. 4140 B.P.) was located in a tidal flat area on a low sandridge alongside a creek, near a saltwater lagoon. The landscape was open and devoid of trees.



FIGURE 1

The settlement was divided into a southern and a northern site (van der Waals, 1989). It is not clear whether the two sites differ in time and/or use.

At the time people were present at the site of Bergschenhoek (5600 B.P.) the area was covered by peatbogs, with many small and large freshwater lakes, small rivers and creeks. The site was located on a peat at the edge of a freshwater lake; the sea was not far off. (Louwe Kooijmans, 1987).

Nature of the sites

It is still not clear whether the Swifterbant site S3 was inhabited throughout the year or only during part of the year. The conditions for winter occupation seem to have been unfavourable. The

sections showing thick layers of reed and willow wood that must have served to insulate the damp subsoil and to raise the ground level, indicate that the conditions on the levee must have been quite wet. Furthermore, there are indications that a part of the site was washed away during the period of occupation (Deckers et al., 1980). The absence of house structures pleads against permanent occupation, but, on the other hand, it is clear from the small cemetery on the neighbouring site S2 that S3 was occupied by men, women and children. To make things more complicated, the archaeozoological data suggest human activities on a year-round basis. Probably during some years the conditions were more favourable, so that there could have been an alternation between seasonal and year-round occupation (Zeiler, 1992).

As for Hazendonk, it is easier to imagine a permanent occupation in view of the natural conditions. Hazendonk was a permanently dry place in a wet landscape, unlike the levee of S3. However, it remains unclear the reasons for the site being abandoned and recolonized several times. Also here no house structures have been found.

In the case of Kolhorn it is still unclear whether we are dealing with a year-round or a seasonal occupation, although the presence of a man-made well in the southern site indicates that the site was at least visited over a longer period of time. In any case, none of these sites was a short-term camp for fishing, hunting and fowling, as was, without any doubt, the case with Bergschenhoek. For a period of c. 20 years this site was visited from eight to eleven times.

RESULTS

The species in relation to the landscape

The difference in composition of the species spectrum between the sites (Tables 1 and 2) can partly be explained by the different environmental conditions. As for Swifterbant and Hazendonk, the extensive backswamps and (mostly shallow) lakes must have been very attractive for waterfowl, especially for ducks of the genus *Anas*, swans and the Grey Lag-Goose, as well as for the Bittern. Also for the other bird species, such as the Cormorant, the White-tailed Eagle, the Eagle Owl and the Jay, the wooded, wet landscape around the sites must have been very suitable. The Carrion Crow may have taken advantage of the presence of man.

The species composition at Kolhorn is quite different, and reflects the open, wet environment with a maritime influence. Here we find species that are characteristic of a coastal environment, such as the Dunlin, the Knot, the Gannet and the Brent Goose. The open character of the landscape is reflected by species such as the Quail, the Golden or Grey Plover, the Ruff, the Marsh Harrier and the Blue-headed Wagtail. It seems that especially ducks, such as Mallard and the small *Anas*-species (Teal and Garganey), were very abundant in the area. The occurrence of Greater Flamingo may be related to the fact that the climate during the Subboreal was warmer than it is nowadays. Moreover, the saltwater lagoon that at that time was found in the vicinity of the site could have been an attractive habitat for the species. As in Swifterbant and Hazendonk, the Carrion Crow may have taken advantage of the presence of man.

Although at present the analysis of the bone material from Bergschenhoek has not been finished yet, some preliminary results can be presented here (Clason & Brinkhuizen, in prep.).

Species	SW	HA
Cormorant (*Phalacrocorax carbo*)	2	-
Bittern (*Botaurus stellaris*)	1	-
Mute Swan (*Cygnus olor*)	1	1
Mute or Whooper Swan (*C. olor/C. cygnus*)	4	8
Grey Lag-Goose (*Anser anser*)	-	11
Anser sp.	-	11
Goose (*Anser/Branta* sp.)	4	4
Mallard (*Anas platyrhynchos*)	102	15
Tufted Duck (*Aythya fuligula*)	1	-
Pochard (*Aythya ferina*)	1	-
Anas sp.	15	4
Shelduck (*Tadorna tadorna*)	1	-
Duck (Anatidae sp.)	498	13
(cf.)White-tailed Eagle(*Haliaëtus albicilla*)	6	1
Small wader	1	-
Herring Gull (*Larus argentatus*)	1	-
Eagle Owl (*Bubo bubo*)	-	2
Jay (*Garrulus glandarius*)	1	-
Carrion Crow (*Corvus corone*)	3	1
Total wild birds, identified	**642**	**71**
Wild birds, indet.	775	61

TABLE 1 -Number of bird remains from Swifterbant (SW) and Hazendonk (HA).

As in Kolhorn, the species list reflects the wet environment with a maritime influence. The Long-tailed Duck, the Eider and the Scaup are characteristic of a coastal environment. The area must have been very attractive also for other waterfowl like Mute and Bewick's Swans, Mallard, Teal, Garganey, Wigeon, Tufted Duck, Goldeneye and Goosander, as well as for Cormorant, Bittern and White-tailed Eagle.

The role of birds in the food economy

Apart from the different species composition, the most striking difference between the sites lies in another aspect. In the Hazendonk material, both the number of species and the number of remains are conspicuously low in view of the fact that the total period of habitation was far longer than it was either at Swifterbant or Kolhorn, and that the landscape was more or less comparable to that of Swifterbant. Sieving took place at all three sites, so the low numbers of remains and species at Hazendonk cannot be explained by a difference in retrieval methods. In most habitation phases of Hazendonk the total number of bird remains is less than 20; only in the last Neolithic phase (Vlaardingen-2b) does the number of remains increase considerably to over 90. All but one are from

ducks, geese and swans. The proportion in the total bone weight of identified remains (birds and mammals) is, however, almost the same as in the Hazendonk-3 period, so that it is questionable whether the higher number of bird remains in Vlaardingen-2b really indicates a change in the hunting habits of the Hazendonk people. Both in Hazendonk and Swifterbant the average percentage of bird remains in the total bone weight does not exceed 2%, so the higher number of bird remains in the Swifterbant material does not mean that fowling was more important than it was in Hazendonk.

Some of the remains of ducks and Mute Swan in the Hazendonk material were burned, which indicates that they had been eaten. Furthermore, a claw of White-tailed Eagle was burned. This could mean that this bird was also eaten. It is remarkable that in Swifterbant none of the bird remains were burned. It can nevertheless be assumed that most birds were eaten, especially the ducks, geese and swans.

In Kolhorn we find the highest numbers of both remains and species, as well as the highest percentage of bird remains in the total bone weight. This indicates not only the abundance of birds in this area, but also that most birds seem to have played a role in the meat supply of the inhabitants, compared to those of Hazendonk and Swifterbant. In the southern site the average percentage of bird remains in the total bone weight is 7.6%, while in the northern site it is 4.3%. A considerable number of ducks remains, as well as some of Brent Goose, Quail, Golden or Grey Plover, Dunlin, Knot, Ruff and Herring Gull are burned. This indicates that at least these species were eaten. Just as in the Hazendonk material, a claw of White-tailed Eagle was burned, as was one from a harrier.

At present no data on the number and the weight of the bird remains from Bergschenhoek are available. In any case we can say that the number of species is comparable to that of Swifterbant. In view of the character of the site the hunters will have taken most of the catch back to their homes. However, some of the birds caught were eaten at the spot, as is evidenced by the burning, traces and cut marks on some of the bone fragments. A special find was that of a nearly complete rump skeleton of a Bewick's Swan: vertebrae (including those of the tail), ribs, coracoids, scapulae, furculae, the proximal part of the humeri, breastbone, pelvis and ribs. The ribs were cut midway. Their ends, as well as those of the humeri, were burned, which indicates that the swan was halved and roasted over a fire (Clason & Brinkhuizen, in prep.).

Possible seasons of fowling

The bird species found in Swifterbant and Hazendonk give no indication of the season(s) in which they were caught. All species could have been present in the vicinity of the sites the year round, with the probable exception of the swans. The majority of the recent Mute Swan population in Western Europe are descended from birds that escaped or that were released from captivity. Until some 50 years ago they were breeding almost exclusively in Eastern and Northern Europe. At that time the Mute Swan was a characteristic species of very cold winters (Bekhuis et al., 1978).

As for Kolhorn, in some cases the bird remains could tell us something about the time of year during which certain species were caught. Of course we cannot be completely sure whether the migratory birds had the same behaviour during the Neolithic as they have nowadays, so some caution is necessary in this respect. According to the inventory maps of the SOVON atlas of Dutch birds (Bekhuis et al., 1978), at least three species found in Kolhorn must have been caught between spring

Species	KS	KN
Black-throated Diver (*Gavia arctica*)	-	1
Black- or Red-throated Diver (*Gavia arctica/G. stellata*)	1	1
Great Crested Grebe (*Podiceps cristatus*)	-	1
Gannet (*Sula bassana*)	-	1
Greater Flamingo (*Phoenicopterus ruber*)	-	1
Swan (*Cygnus* sp.)	-	2
Brent Goose (*Branta bernicla*)	1	10
Branta sp.	-	2
Grey Lag-Goose (*Anser anser*)	1	1
Mallard (*A. platyrhynchos*)	94	97
Gadwall (*A. strepera*)	1	-
Wigeon (*A. penelope*)	-	1
Shoveler (*A. clypeata*)	2	1
Teal (*Anas crecca*)	25	7
Garganey (*Anas querquedula*)	2	4
Teal/Garganey(*A. crecca/A. querquedula*)	194	368
Anas sp.	240	308
Red-crested Pochard (*Netta rufina*)	1	-
Aythya sp.	-	1
Duck (Anatidae)	385	546
Marsh Harrier (*Circus aeruginosus*)	-	1
Harrier (*Circus* sp.)	1	1
cf. White-tailed Eagle (*Haliäetus albicilla*)	1	3
Bird of prey, indet.	-	1
Quail (*Coturnix coturnix*)	2	-
Golden Plover/Grey Plover (*Pluvialis apricarius/P. squatarola*)	2	1
Dunlin (*Calidris alpina*)	-	31
Knot (*Calidris canutus*)	-	8
Calidris sp.	1	-
Ruff (*Philomachus pugnax*)	-	10
Herring Gull (*Larus argentatus*)	3	-
Blue-headed Wagtail (*Motacilla flava*)	-	1
Carrion Crow (*Corvus corone*)	-	1
Total wild birds, identified	**957**	**1411**
Wild birds, indet.	6585	8409

TABLE 2 - Number of bird remains from Kolhorn, southern site (KS) and northern site (KN).

and late summer or early autumn. The Garganey can be found in the Netherlands between March and September, while the Blue-headed Wagtail arrives in March or April, depending on the weather conditions, and stays until October. The first Quails arrive in April, though most arrive in May and June; they leave in September.

The Brent Goose and the Black-throated Diver, and probably also the swans, indicate fowling between autumn and early spring. The first Brent Geese arrive in October and leave for their breeding grounds at the end of April or the beginning of May, although regularly small groups stay in the Netherlands during the summer. The Black-throated Diver can be found in the Netherlands almost exclusively from November to the end of March.

In the case of Bergschenhoek we can also draw some (cautious) conclusions about the time of year in which certain species were caught. According to the SOVON atlas mentioned above, the Garganey indicates fowling between spring and late summer, while Bewick's Swan and the Long-tailed Duck must have been caught between October and the end of April.

CONCLUSIONS

In the sites of Swifterbant and Hazendonk birds seem to have played a minor role in the meat supply of the inhabitants. The data from Kolhorn suggest that fowling here was more important. As in Bergschenhoek, the hunters will have taken most of their catch back to their homes, so nothing can be said about the importance of fowling for their meat supply.

In some cases the bird remains indicate in which season they were caught. It must be stressed that this does not provide an answer to the question whether in Swifterbant, Hazendonk and Kolhorn we are dealing with a seasonal or a year-round occupation. Indications of human activities during a specific season do not exclude occupation during the rest of the year.

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BIRD REMAINS IN ROMAN GRAVES

ROEL C.G.M. LAUWERIER
Rijksdienst voor het Oudheidkundig Bodemonderzoek (ROB)
Kerkstraat 1, NL-3811 CV Amersfoort
The Netherlands

ABSTRACT: In burials dating to the Roman period birds, as well as other animals, are found included as grave goods. Such birds are mainly domestic fowl and were often prepared as a meal for the dead. Any relationship between such gifts of food and the terracotta or metal bird figurines that have also been found in graves, is suggested to be unlikely. The fact that chickens are, after pig, the most frequently recovered animals from grave deposits, may well give a totally wrong impression as to the original animal composition of the food given to the deceased. In general, grave gifts of domestic fowl were given to both men and women in similar quantities. The suggestion that chicken was used as a feminine symbol within the burial ritual, must be rejected.

KEYWORDS: ROMAN PERIOD, CEMETERY, ARCHAEOZOOLOGY, BURIAL PRACTICE, GRAVE GIFT, BIRDS, DOMESTIC FOWL

RESUMEN: En enterramientos de época romana se recuperan aves, además de otros animales como ofrendas. La mayoría de las aves son gallinas que se preparaban normalmente como alimento funerario. Parece poco probable la relación que se ha llegado a postular entre estas ofrendas culinarias y las figuras aviares metálicas o de terracota también recuperadas en tumbas. El hecho de que las gallinas, sean, trás el cerdo, la especie animal más frecuente en estas tumbas posiblemente no sea más que una evidencia engañosa de lo que en realidad ocurría. En general, las ofrendas de pollo parecen haberse dado a varones y hembras por igual. Carece de base, por tanto, la hipótesis de que los restos de gallina servirían como símbolos femeninos en los rituales funerarios.

PALABRAS CLAVE: PERIODO ROMANO, CEMENTERIO, ARQUEOZOOLOGIA, PRACTICAS FUNERARIAS, OFRENDAS FUNERARIAS, AVES, GALLINA

INTRODUCTION

Animal bones are found in human graves in almost every excavation of a Roman cemetery. A large number of these bones are from birds (Figure 1). In this article, an attempt has been made to answer some of the questions concerning both the occurrence and the role of these birds within the burial context. For instance, which birds were deposited as grave gifts and what, if any, was the relationship between these birds and the bird-shaped figurines that have also been found in graves.

The validity of two statements in particular concerning the role of chicken in the food offering given to the deceased will be considered. Firstly, that domestic fowl were the second most important animal to be included in graves and secondly, that because domestic fowl is more frequently associated with female graves, it should be interpreted as a feminine symbol.

BIRDS IN ROMAN GRAVES

There are two different kinds of birds that are found in Roman graves: the real birds and the figurines. Since a relationship between the two has been suggested, the latter will also be briefly discussed below.



FIGURE 1 - Terra sigillata (Semian Ware) dish from a 4th century cemetery at Nijmegen, containing the articulated skeleton of a domestic fowl.

In several cemeteries, metal or terracotta animal figurines have ben found deposited in graves. Van Boekel (1986), who surveyed the evidence for terracotta figurines in the Netherlands, mentions that, besides mammals such as lion, horse, sheep and dog, bird figurines have also been retrieved. These birds include cocks and hens, as well as doves and other bird-like figurines. One of Van Boekel's conclusions, based on the study of Dutch and other material, is that the different types of animal terracottas cannot be interpreted as indicators for the age and sex of the deceased. Their function is uncertain. The figurines may well have been placed in the graves as offerings to the deities of whom they were symbolic, perhaps as a substitute for a living sacrifice. The dove, for instance, is associated with the goddess Venus and the cock with the god Mercury, the guider of the spirits of the deceased to the Underworld (Van Boekel, 1986: 155, 163; Toynbee, 1973: 257). Another assumption is that the statuettes of animals were used as cheaper substitutes for the food that was normally given to the dead to aid their journey to the Underworld (Van Boekel, 1983: 239; 1986: 155). In both cases, either as the substitute for a sacrifice, or the substitute for a meal, there remains a link with the remains of real animals found in the burials. If this statement was true, then we should expect terracotta images of pigs as well as those of sheep and birds, since pig bones are frequently found in graves. This, however, is not the case. On the contrary, there are animal species represented

amongst the terracotta figurines, such as dog and horse, that were hardly ever, if at all, used as sacrificial animals in the Roman period, nor as animals for consumption. For dogs, there is certainly no evidence to suggest they were used as such. As far as the horse is concerned, there is very little conclusive evidence that it was ever eaten, even on a moderate scale (Luff, 1982: 248). Indications that horses were used as offerings are also rare and rather insubstantial (Kyll, 1966). Even though horse remains are being found in Roman cemeteries, they were probably never generally part of the funeral ritual (Lauwerier & Hessing, 1993). The conclusion must therefore be that in regard to pigs, dogs and horses, no relationship exists between the terracottas and the real animals found in graves. The terracotta figurines of horses and dogs must have fulfilled some other function than that represented by pig meat. Following on from this, it would seem equally unlikely that any relationship existed between terracottas of birds and real birds. The conclusion must be that the bird figurines also fulfilled another function in the burial ritual and were no substitutes for sacrificial animals or for the meals comprising fowl.

There are several different situations in which the remains of real birds, like those of other animals, occur in cemeteries. Firstly, there are burnt animal remains that were cremated with the human remains on the pyre and afterwards collected for deposition in the grave (e.g. Mackensen, 1978). Wether the collection of these animal bones was intentional or not, is uncertain. The articulated remains of unburnt animals were certainly intentionally interred. These occur both in cremation and inhumation graves (e.g. Grünewald, 1990: 65, 77). Clearly buried as grave gifts are the bones found in vessels. Whenever bones are found loose in the grave, there is always the possibility that they were not the remains of meat given to the dead, but were rather scattered bones that had accidentally fallen into the grave during the digging of the pit (e.g. Wahl & Kokabi, 1988).

Where bird bones from burials have been identified, they are mostly from domestic fowl (Lauwerier, 1983; 1988: Philpott, 1991). Only in exceptional cases are other species found, such as woodcock at Milland (Jones, 1978), three geese at Oudenburg (Mertens & Van Impe, 1971), one goose at Stettfeld (Wahl & Kokabi, 1988), a goose and a song bird at Courrox (Kaufman, 1976; Martin-Kilcher, 1976: 77), an eider duck at Neuss (Härke, 1980; Reichstein, 1980) and a small corvid at Avenches (Olive, 1987). The species composition of birds found in graves resembles those from settlements: mainly chicken, with some goose, duck or other birds, like song birds.

It is an arguable question wether the bones are the remnants of meat given to the deceased to feed the dead body, or if they only had a symbolic meaning in feeding the immortal soul, but in either case the form is most probably a meal. In the case of cremated remains, the interpretation of the bones as a meal is not so clear, since the bones would have been collected together with the human remains, thereby removing them from their original position in the grave ritual. Besides this, the bones were often only collected just partly. In most of the above-mentioned publications, the indications that point to the bones representing meals is fairly clear. In most cases the bones are found arranged as if representing a normal dish on vessels that are often found together with other pottery vessels and flagons. In many cases the meatless feet of the chicken have been cut off (e.g. Keller, 1971, 1979; Lauwerier, 1988; Wahl & Kokabi, 1988). Evidence is sometimes found for cut marks on the distal ends of the tibiotarsi that indicate the removal of the feet (e.g. Wahl & Kokabi, 1987). Often the head is cut off (e.g. Lauwerier, 1988). This removal of feet and head is done in the same way as we would do nowadays with our fried chicken. A picture of fowl prepared in this way can be seen on the decorated bronze lid from Mundelsheim, dating to the 2nd or 3rd century AD (Paret, 1938).

BIRDS AND THE MEAL OF THE DECEASED

Animal remains in graves are interesting because they give an insight into the way in which men perceived the after-life. The presence of a meal in the grave suggests that the deceased, or his immortal soul, had such a form that it had to be fed, at least symbolically. Apart from this aspect, the bones are also interesting from a culinary point of view.

The bones of domestic fowl are the second most frequently-occurring animal bones in human graves, both in Britain and on the Continent (Philpott, 1991; Lauwerier, 1988). From this fact, it can be concluded that the meat of domestic fowl should have been, after that of pig, the second most important within the burial ritual. Another conclusion would be that the dead were given other food than the more mundane everyday food of the living (Lauwerier, 1988; Olive, 1987), or even that, with pork and chicken, the deceased were given more luxurious food (Lauwerier, 1988). Whether these are valid conclusions, or whether the animal bones give a realistic impression of the meal given to the deceased, must be analysed.

Figure 2 illustrates chicken as the second most important meat in cemeteries. The first two categories of data used in this diagram come from 30 settlements and 15 cemeteries within the Roman Empire (Lauwerier, 1988: 82-83). In the graves, pig can be seen to be the most important

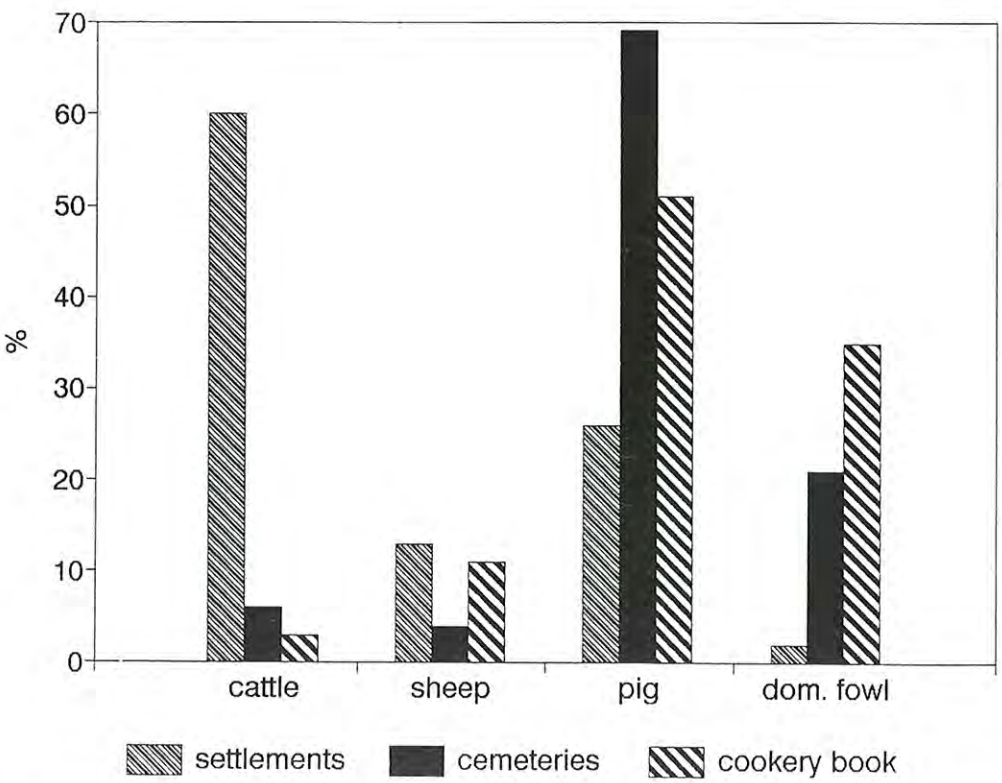


FIGURE 2 - Frequency distribution of cattle, sheep/goat, pig and domestic fowl in settlements, cemeteries and the cookery book of Apicius. The percentages are based on numbers of fragments for the settlements, the frequency of occurrence for the cemeteries and the number of times a species is mentioned in the cookery book.

meat, followed by chicken. Cattle and sheep are the most uncommonly found species. The settlements on the other hand, give a totally different picture, with cattle as the most commonly occurring animal, fewer pigs and even fewer domestic fowl. Chicken represents only 2% in the assemblages found in settlements, against 35% in the cemeteries.

One explanation for this result could be that the cemeteries have been excavated more meticulously, so that species with smaller bones are more likely to be recovered. This would, however, not lead to such big differences, especially since pig as well as chicken score higher.

Another explanation can be taken from the cookery book, originating from the 1st-century AD, of the well-known gastronome Apicius (Flower & Rosenbaum, 1974). In Figure 2, data from the cookery book are entered as the third category. The percentages worked out are based on the number of times different species are mentioned in recipes. Such a comparison can be seen to be interesting, even though the different sets of data are of a completely different nature. If we compare, in a general way, the data from the graves with that from the settlements and that from the cookery book, we could conclude that the reason so many chicken bones are found in graves (as with pig) is because the meat spectrum present in the graves compares most readily with that used in a luxurious cookery book.

Another explanation for the fact that so many chicken (and pigs) are found in cemeteries is perhaps more obvious. Except for when a fillet or ragout of chicken is put in the grave, the meat would normally always still be on the bone. The same can be said for pork, the top scorer in the cemeteries. Many recipes using pork include the bone. Recipes made of sucking pig, regularly found in graves, always contain bone and by so doing, always leave evidence. Recipes using beef are, however, totally different. In contrast to pig and chicken, the meat is cut off the bones, thereby leaving no remains in a grave if the beef was placed on a plate (cf. Mackensen, 1978: 173).

The frequent occurrence of chicken and pig bones in graves may well, therefore, give a false picture of past reality. It is not unlikely that the empty or half empty plates found in graves may have contained beef. The information from the plates seems to be very clear, but the rubbish pits in the settlements, containing the offal and discarded remains of meals, give a much more reliable picture of the consumption pattern of the living, than do the plates and dishes in the graves for the "consumption" pattern of the deceased.

FOWL AND FEMALE

One of the initial questions of this paper was whether or not the domestic fowl should be seen as a feminine symbol in Roman graves. One idea, suggested by Martin-Kilcher (1976: 77) and based on the data from Courroux, is that chicken are a female attribute and are deposited more frequently in female than male graves. Wahl and Kokabi (1987, 1988) make the same suggestion. The main argument is based on the fact that more chicken have been recovered from graves anthropologically identified as female rather than male. If this can be confirmed, then we could use the occurrence of chicken as a grave good as an indication for the sex of the deceased.

However, if the data upon which this suggestion is made is studied in more detail, doubts begin to arise. Martin-Kilcher's statement is based on the fact that only 2 out of 23 female graves contained the remains of domestic fowl as opposed to none of the 20 graves anthropologically identified as male. In the case of the Stettfeld (Wahl & Kokabi, 1988), a cemetery dating to the 2nd

and 3rd centuries AD and associated with a small, rural settlement, 11 out of 70 male graves as well as 14 out of 95 female graves were found to contain the remains of fowl. This represents 16% and 15%. Further chicken bones were found in 7 out of the 92 graves of unidentified adults, 4 out of 39 children's graves and in 4 out of 11 double graves. In Wahl and Kokabi's conclusion (1988: 280), it is correctly stated that when relating the information from the graves of adults whose sex could be anthropologically identified, neither of the sexes are especially well-provided with domestic fowl. It is clear that the expectation of sex specificity is high, since the authors continue to suggest that, when the information from unidentified (!) persons is included, the inclusion of chicken bones amongst grave goods is more specifically associated with females. How such a strong prejudice continues to work is seen in the publication of late Roman remains from Konstanz by the same authors, where they refer to the Stettfeld publication with the erroneous remark that the remains of domestic fowl are more frequently found in female rather than male graves (Wahl & Kokabi, 1987). Philpott's study (1991) mentions relatively more male than female cremations associated with unburnt chicken remains. He also states that the percentage of male inhumations associated with fowl is also higher than those of females. On the other hand, the percentage of female cremations associated with burnt chicken appears to be higher than that of male cremations. The main problem is, however, that for all the cemeteries mentioned in this study, the actual numbers of graves involved are low. The restraints of such data are well-illustrated in the publication of the cemetery in the Jacobstraße in Cologne (Friedhoff, 1991). Herein is stated that there is no sex-specific pattern in the food grave gifts, even though 13 female graves contain chicken as oposed to only 2 male graves. Quite rightly though, account is made of the fact that out of 327 graves, only 25 contained chicken and that the sex of individuals could only be established for 59 graves: 51 females and 8 males. This suggests that when considering both the female and males, only one in four was found with chicken.

There is, therefore, no proof for the suggestion that chicken was in fact used as a feminine symbol within the burial ritual. On the contrary, the available data would suggest that, in general, domestic fowl were given to both males and females to the same extent. The most one might be able to say is that there may have existed local preferences for attributing fowl to males or females, but sufficient evidence for this is lacking.

CONCLUSIONS

To summarize, we arrive at the following conclusions:

Bird remains from Roman graves show the same species spectrum as is known from settlements: mostly chicken, sometimes alternated with goose, duck or other fowl. If the bones are well-preserved and are found lying in their originally-deposited position, then they often indicate prepared food. As grave gifts then, the bird remains were intended as food for the deceased, either literally or in a more symbolic sense. Any functional relationship between these meals and the metal or terracotta bird figurines that have also been found in graves, seems unlikely.

The data from cemeteries, where both archaeozoological and anthropological information is available, in general shows no difference in the frequencies of the occurrence of chicken in female or male graves. There is therefore no reason to suspect that domestic fowl should have been used as a feminine symbol within the burial ritual.

It is not possible to come to any quantitative conclusions concerning the status of birds within the food donations based on bone assemblages alone, since not all types of meat left evidence in the

form of bones. If we, as archaeozoologists, want to know more about the role of chicken and other food in Roman grave assemblages, then we must stop writing appendices and start to do research directly integrated with the anthropological research and the archaeological study of ceramics from a cemetery, for example. Not only the bones have to be studied, but also the empty dishes. Perhaps chemical analysis will be able to determine whether or not the dishes ever contained beef. Finally, statistics must also be made good use of, even in the research of birds in Roman graves.

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FIRST REPORT ON BIRD REMAINS FROM BULDIR ISLAND, ALEUTIAN ISLANDS, ALASKA

CHRISTINE LEFEVRE[1] & DOUGLAS SIEGEL-CAUSEY[2]

(1) URA 1415 du C.N.R.S., Muséum national d'Histoire naturelle. Laboratoire d'Anatomie comparée, 55 rue Buffon.
75005 Paris. France.

(2) Museum of Natural History and
Department of Systematics and Ecology, University of Kansas. Lawrence, KS 66045-2454, U.S.A.

ABSTRACT: The bird remains of two test pits excavated on the Buldir Island midden are studied. The species identified are mostly marine, the Alcidae being the most numerous. The incoherencies between the zooarchaeological spectrum and the present avifauna are discussed, by taking into account such parameters as the accessibility of the colonies and the body-weight of the different species.

KEYWORDS: BIRDS, ALEUTIAN ISLANDS, ARCHAEOZOOLOGY, PALEOBIOGEOGRAPHY

RESUMEN: Se estudian los restos de aves de dos muestras excavadas en el yacimiento de Buldir Island. Las especies identificadas son principalmente marinas, y los Alcidae son los más numerosos. Las incoherencias apreciadas entre el espectro arqueozoológico y la distribución actual se valoran, considerando parámetros antropológicos tales como la accesibilidad a las colonias así como el peso de las diferentes especies implicadas.

PALABRAS CLAVE: AVES, ISLAS ALEUTIANAS, ARQUEOZOOLOGIA, PALEOBIOGEOGRAFIA

INTRODUCTION

The Aleutian Islands provide a rich example to document human adaptations to cold maritime environments, but most of the zooarchaeological studies concerned the Eastern Aleutians (Yesner, 1977). A research program, focused on the Western Aleutians, started in 1990, including zooarchaeological and paleobiogeographical studies, which should allow reconstruction of Aleuts' exploitation patterns of animal resources and to document the former biodiversity of the islands.

The Aleutian Islands are a mountainous chain of volcanic origin, extended along a rim of some 1.800 km, like a link between Asia and America. They are lying between the 51st and 55th parallels, and delimit the separation between the North Pacific Ocean and the Bering Sea. The islands are divided in five groups, including 14 large islands and 55 smaller ones, as well as innumerable rocks and islets. From East to West, they are know as the Fox Islands, the Islands of the Four Mountains, the Andreanof Islands, the Rat Islands and the Near Islands (Figure 1).

The climate is characterized by constant rain, wind of high velocity, and dense fog, but with moderate and fairly uniform temperatures. The winter average is 0°C, the summer average is 10°C, and the islands are ice-free and opened to navigation during the whole year. The waters surrounding the Aleutians are among the richest in the world, with 16 species of whales, sea lions and seals, sea otters, and huge numbers of seabirds.

The islands were settled from East to West, as now agreed by most authors (Black, 1983). The oldest human occupations are documented in the eastern islands since the VIth millennium. The

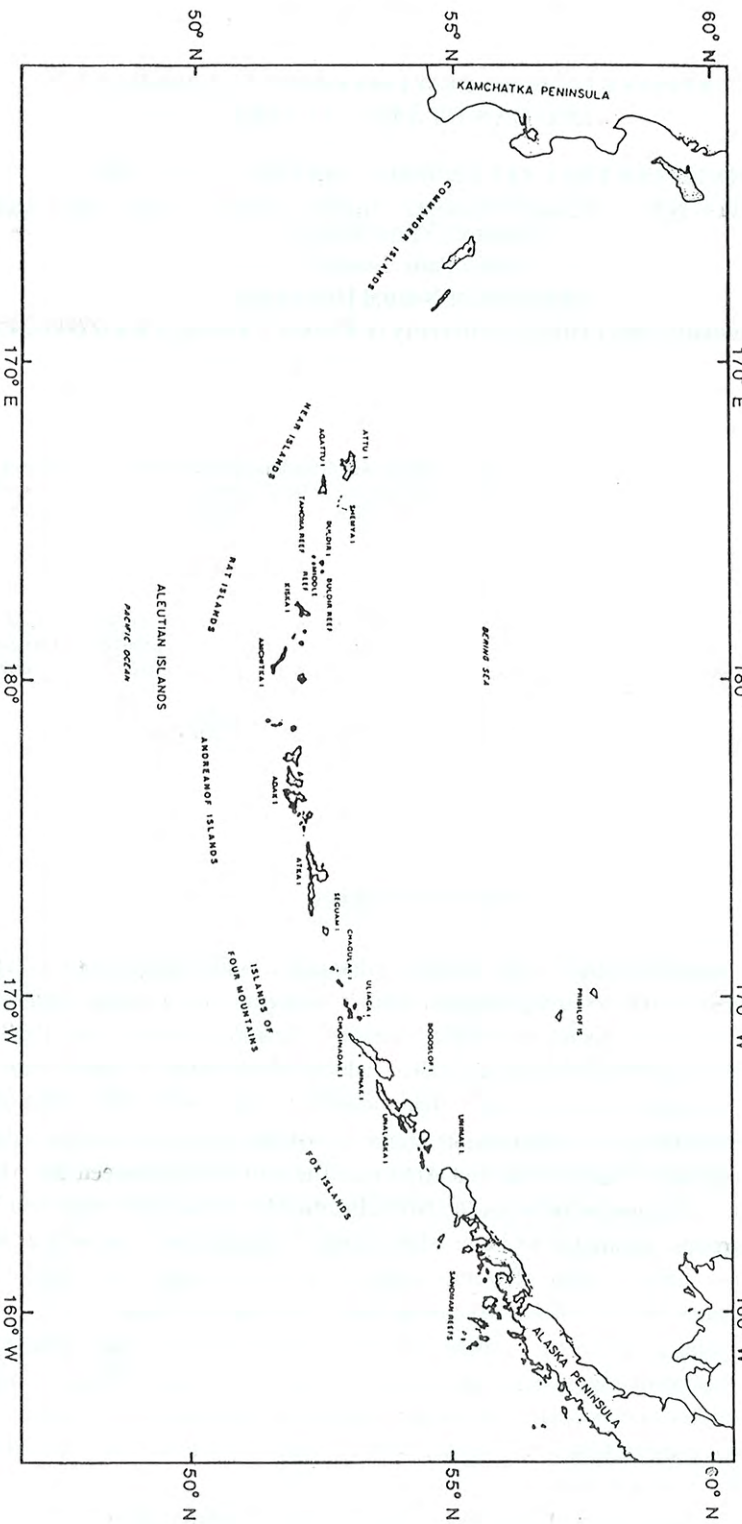


FIGURE 1 - The Aleutian Islands, Alaska. From Byrd and Day, 1986.

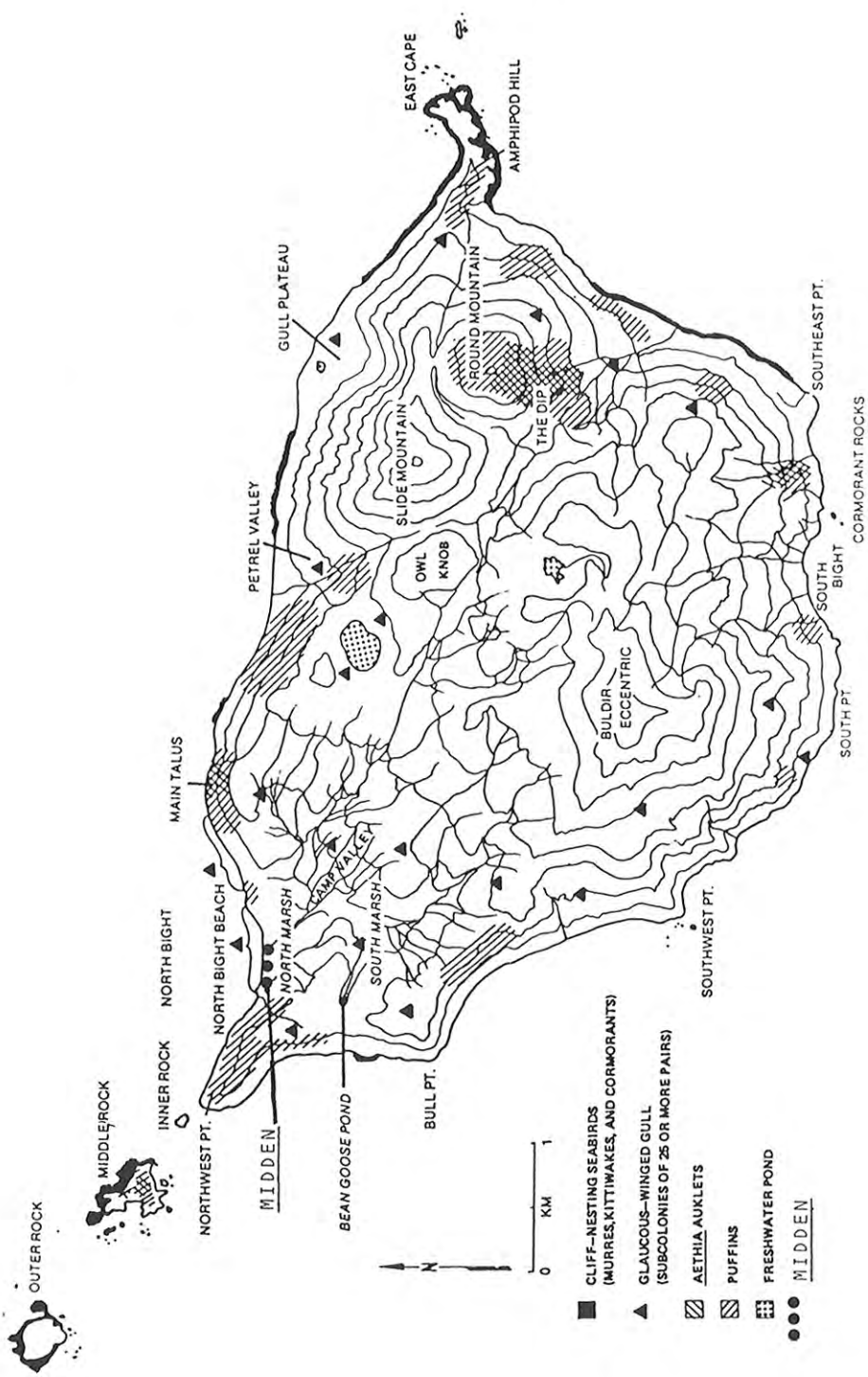


FIGURE 2 - Buldir Island, Alaska, showing place names, concentration of nesting seabirds and the midden. From Byrd and Day, 1986.

central part of the chain was occupied around 3.000 BC, and no dates previous to the first millennium are known for the western islands (Dumond, 1987). Aleuts are of Eskimoid origin, and they share many cultural features with the Eskimos. They were highly dependent on the sea, where they hunted marine mamals from their *baidarka*, a kayak-like skin-covered light craft.

Buldir has a peculiar location among the chain, because it is the most isolated island of the Aleutians. It is the westernmost island of the Rat Islands group, lying about 110 km both from Shemya Island to the west and Kiska Island to the east, "providing the only landfall in a 220 km-wide pass" (Byrd & Day, 1986: 109). The island is approximately 6,4 km long and 3,2 km wide (Sekora, 1973), and its characteristics "include boulder-strewn beaches, frequently backed by steep sea cliffs (over 50% of the 20 km-long coastline), steep mountains, coastal talus slopes, and one alluvial valley near sea level" (Byrd & Day, 1986: 109). Buldir was sighted for the first time on the 28th of October, during the second Bering expedition, in 1741.

MATERIAL AND METHODS

The Buldir Island midden

The midden was discovered in 1962 (Jones, 1963), on North Bight Beach, along the only flat meadow of the island, known as Camp Valley (Figure 2). During a survey in 1972, the site was not relocated, and was "considered to have been possibly destroyed during the intervening period" (Sekora, 1973: 115). In 1989, the Bureau of Indian Affairs (BIA) surveyed several islands in the Western Aleutians, and relocated the site on North Bight Beach. "Exposed cultural debris" was observed covering almost 400 m.

We conducted a prospection during the summer of 1991 (Siegel-Causey et al., 1991). By that time, the east-west section of the midden was exposed on 180 m along the beach. The width of the midden was estimated between 25 and 30 m, limited on its eastern and southern borders by a stream. The distance from the beach exposure to the high tide limit measured 23 m at point 0 and 29 m at point 143.

The vegetation covering the midden (beach rye *Elymus arenarius*, cow parsnip *Heracleum lanatum*, wild celery *Angelica lucida*, and Aleutian fern *Athyrium felixfemina*) was very high when we started to work, at the end of July, preventing any observation of surface features or any test pits elsewhere than along the beach exposure. For this reason, we decided to sketch nine profiles along this exposure, excavating two test pits (Siegel-Causey et al., 1991).

The first pit, located at Point 0, measured 1 x 1 m. Under the vegetal cover, 80 cm of sterile sand were observed above the archaeological sediment, which was excavated following 6 artificial levels of 10 cm. No natural distinctions between the layers were detected. The filling was mainly made of a black and wet soil, water saturated throughout most of the pit, allowing a very good artifactual preservation. Numerous bones were associated with few artifacts, such as lithic points, griddle stones, awls and worked wood fragments, and lenses of dense vegetation mat or sea urchins were observed. The study of the mammal remains indicated the presence of at least 17 individuals of sea lions (*Eumetopias jubatus*). The study of the fish bones is in progress. Two radiocarbon datings on wood indicate an age comprised between the XV and XVI centuries.

The second test pit, located at Point 143, had a 1 m length and a 10 cm width. Cultural layers started just under the vegetal cover. Seven layers were observed as a succession of different fillings of various depth. The density of bone remains was variable, and very few mammal bones were seen. Two radiocarbon datings on wood provide ages of 530 +/- 60 BP (Beta-54255) for layer 3 and 1160 50 BP (Beta-54256) for layer 7.

All the bones from both pits were collected. The sediment was screened with 1/4 and 1/16 inch mesh. The bones are kept at the Kansas University Museum of Natural History. Comparative skeletal specimens used are those from the KUMNH collection. We tried to identify all the elements, except those from level 5 of Pit 2. Due to a lack of time, only the coracoïdes, humeri, femora, tibiotarsi and tarsometatarsi were identified in Pit 2, the remaining bones entering the accounts of the unidentified fraction.

RESULTS

Some 6.000 bird bones were collected in the Buldir Island midden, almost 75% of them coming from Pit 2 (Table 1, Table 2). Keeping in mind that this pit was excavated on 10 cm width only, such a number gives an idea of the bone density of some of the levels in this pit. The percentage of unidentified remains amounts to 22,7% in Pit 1, and to 54,3% in Pit 2. This higher proportion is due to the fact that the identification was restricted to five osseous elements only (see above).

If we combine the numbers of species identified in both pits, we have a total of 23. Except for the Canada goose and a passeriform, they are all marine species. All but two are presently breeding on the island (Table 3). The first exception is *Larus hyperboreus*, the glaucous gull, a spring migrant. The second exception is *Brachyramphus sp.*, the marbled or Kittlitz's murrelet. The first one, *B. marmoratus*, is not known to breed beyond Unalaska Island (Murie, 1959). The second one, *B. brevirostris*, was "not rare at Amchitka and Adak" in 1879 (Murie, 1959: 188), and a pair was collected on Attu Island in June 1937 (Op. cit.). Both of them are not recorded in the last census of the avifauna of the island (Byrd & Day, 1986).

In both cases, the most abundant group are the Alcidae. In Pit 1, the most numerous is *Aethia pygmea*, the whiskered auklet, with 28% of the minimum numbers of individuals (Table 1, Figure 3). In Pit 2, *Aethia cristatella*, the crested auklet, is the most abundant, with 25% of the minimum number of individuals, followed by *Ptychoramphus aleuticus*, Cassin's auklet, with 20% of the MNI (Table 2, Figure 4).

DISCUSSION

It was not possible to link the test pits to either particular sequences or structures. Pit 1 can be considered as one single layer, due to the fact that no natural differences were observed in the stratigraphy. The study of the mammal remains confirmed the impression we had during the digging: we were able to assemble bones from levels 2 and 4 (1 case), 2 and 6 (1 case), 3 and 5 (1 case) and from 5 and 6 (3 cases). On the other hand, the 7 levels observed in Pit 2 correspond to different moments in the story of the midden, but that is all we can say. For these reasons, the results of this study are limited. They can be considered from two points of view.

BULDIR 91 - PIT 1														
Levels	1		2		3		4		5		6		TOTAL	TOTAL
	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI
Diomedea albatrus					1	1					1	1	**2**	**2**
Fulmarus glacialis											3	1	**3**	**1**
Oceanodroma leucorhoa			1	1	2	2	9	2	11	2	36	6	**59**	**13**
Phalacrocorax sp.	1	1	2	1	6	1	2	1	3	1			**14**	**5**
Branta canadensis			1	1	2	1	1	1	3	1	11	3	**18**	**7**
Larus sp.							1	1					**1**	**1**
Larus glaucescens			2	2					2	2			**4**	**4**
Larus hyperboreus	1	1	11	2	16	2	9	1	19	3			**56**	**9**
Rissa tridactyla	1	1	8	1	23	2	21	4	39	6	18	2	**110**	**16**
Rissa brevirostris					8	2					1	1	**9**	**3**
Uria sp.					3	1					3	1	**6**	**2**
Uria aalge							2	1					**2**	**1**
Uria lomvia	1	1					5	2					**6**	**3**
Cephus colomba			5	1					5	3	3	1	**13**	**5**
Synthliboramphus antiquus			48	8	21	4	59	9	56	7	66	7	**250**	**35**
Ptychoramphus aleuticus	1	1			24	6							**25**	**7**
Cyclorrhynchus psittacula					5	1	15	7	20	3	17	4	**57**	**15**
Aethia pusilla	4	1	4	3			1	1			3	2	**12**	**7**
Aethia cristatella	2	1	11	5	14	4			15	5	6	3	**48**	**18**
Aethia pygmaea			13	3	60	11	42	11	151	22	199	18	**465**	**65**
Cerorhinca monocerata									2	1	9	2	**11**	**3**
Fratercula cirrhata									1	7	2	1	**3**	**8**
Fratercula corniculata			1	1			5	1					**6**	**2**
Unidentified	0		30		41		27		96		154		**348**	
TOTAL	**11**	**7**	**137**	**29**	**196**	**38**	**199**	**42**	**423**	**63**	**532**	**53**	**1528**	**232**

TABLE 1 - Buldir 91 - Pit 1. Number of identified specimens (NISP) and minimum number of individuals (MNI) for levels 1 to 6.

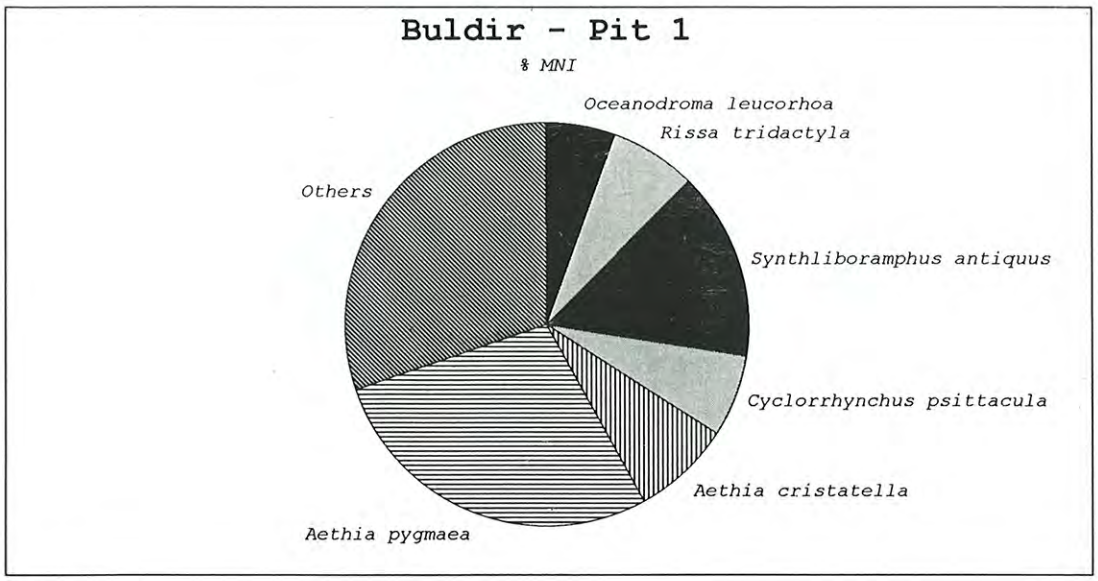


FIGURE 3 - Buldir 1991, Pit 1. Representation of the Minimum Number of Individuals (MNI) for the main species.

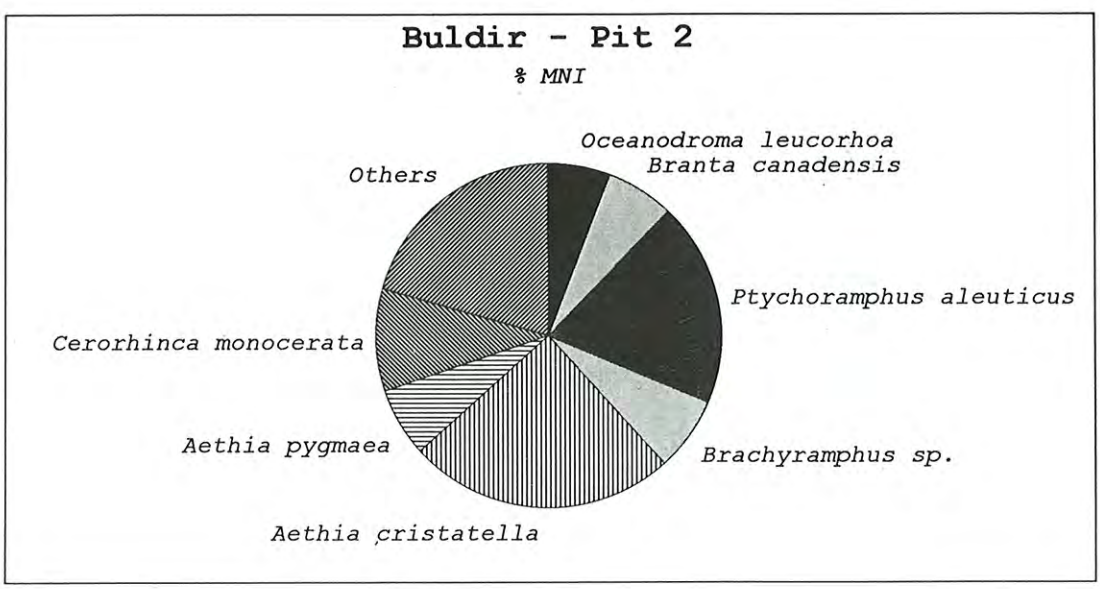


FIGURE 4 - Buldir 1991, Pit 2. Representation of the Minimum Number of Individuals (MNI) for the main species.

BULDIR 91 - PIT 2																
Levels	1		2		3		4		5		6		7		TOTAL	TOTAL
	NISP	MNI	NISP	MNI	NISP	MNI	NISP	MNI	NISP*	MNI	NISP	MNI	NISP	MNI	NISP	MNI
Diomedea albatrus					1	1							3	1	**4**	**2**
Oceanodroma leucorhoa									85	19	1	1			**86**	**20**
Phalacrocorax sp.					1	1									**1**	**1**
Branta canadensis					4	2			51	21					**55**	**23**
Larus hyperboreus			3	1					11	5					**14**	**6**
Uria lomvia	2	1			2	1									**4**	**2**
Synthliboramphus antiquus	6	1	12	5			3	1			17	3	20	4	**58**	**14**
Ptychoramphus aleuticus	2	1	17	2	6	2	4	1	410	54	14	3	37	4	**490**	**67**
Brachyramphus sp.					201	24									**201**	**24**
Cyclorrhynchus psittacula					2	1					1	1			**3**	**2**
Aethia pusilla			2	1	7	2	3	1			2	1	12	2	**26**	**7**
Aethia cristatella	11	2	14	4	304	30	11	3	291	42	18	3	13	3	**662**	**87**
Aethia pygmaea									114	22					**114**	**22**
Cerorhinca monocerata	1	1	7	2	14	6			147	21	3	1	8	3	**180**	**34**
Fratercula sp.											2	1			**2**	**1**
Fratercula cirrhata			2	1	20	4	23	2	44	8			1	1	**90**	**16**
Fratercula corniculata			8	2	24	3	1	1	43	10					**76**	**16**
Melospiza melodia									18	5					**18**	**5**
Unidentified	21		46		329		58		1888**		43		90		**2475**	**0**
TOTAL	**43**	**6**	**111**	**18**	**915**	**77**	**103**	**9**	**3102**	**207**	**101**	**14**	**184**	**18**	**4559**	**349**
* cor, hum, fem, tib, tar only					** other bones and unidentified											

TABLE 2 - Buldir 91 - Pit 2. Number of identified specimens (NISP) and minimum number of individuals (MNI) for levels 1 to 7. For level 5, identified specimens are coracoïdes, humeri, femora, tibiotarsi and tarsometatarsi only.

From the paleobiogeographic point of view, the list of species ideally provides data on both their presence and relative abundance. It can help in spotting particular changes which occured in the composition and distribution of the avifauna of the island. The case of Buldir is interesting because we know that no mammals such as rats or foxes were introduced, which means that "Buldir is a relatively pristine remnant of the Aleutian ecosystem" (Byrd & Day 1986: 116).

From the anthropological point of view, the list of identified species informs on the hunting preferences of the Aleuts, and documents their food habits, as well as the use of birds for clothing.

Paleobiogeography

Comparison of the zooarchaeological results with the present avifauna composition evidences incoherence in the list of identified species. Nowadays, the breeding avifauna of Buldir includes 32 species (Table 3, Figure 5), most of them (65%) belonging to a seabird family. In terms of breeding pairs (i.e. 99,9% of the individuals), the number from the two species of storm-petrels (*O. furcata* and *O. leucorhoa*) is so huge (1.500.000) that it completely hides the remaining species. This is why we present the percentages of breeding pairs both with and without the storm-petrels. Without the petrels one can see the importance of the Alcidae in the avifauna : 12 species are breeding on the island, representing 88% of the numbers of remaining pairs (i.e., after eliminating the petrel population). Among them, the most abundant ones are *Aethia pusilla*, the least auklet. After the Alcidae, come the Laridae in particular the kittiwakes (*Rissa tridactyla*).

A few remarks can be made on this discordant abundances between present and subfossil samples. Some species quite numerous today are poorly represented in the bone remains, and other species, absent or quite rare today, are common in the sub-fossil assemblages. Here are several cases:

- the kittiwake (*Rissa tridactyla*), presently well represented on the island, is absent in all the levels of Pit 2;

- the least auklet (*A. pusilla*), presently the most abundant of the Alcidae with 49% of the number of breeders, is poorly represented in the archaeological remains, with 3% of the MNI in Pit 1, and 2% in Pit 2

- the whiskered auklet (*A. pygmaea*), the most numerous species in Pit 1 with 28% of the MNI, is presently common but not abundant (1.250 pairs, 0,87%);

- the crested auklet (*A. cristatella*), the most numerous species in Pit 2 with 25% of the MNI, is presently common but not abundant (1.250 pairs, 0,87%);

- Cassin's auklet (*Ptychoramphus aleuticus*), the second most abundant species in Pit 2 with 25% of the MNI, is now represented by only 200 pairs, 0,14%;

- the rhinoceros auklet (*Cerorhinca monocerata*), 10% of the MNI in Pit 2, is now represented by only 12 breeding pairs;

- *Brachyramphus sp.*, 6,9% of the MNI in Pit 2, does not appear in the present avifauna of the island.

Does this mean that the abundance of the species has increased or decreased during the last thousand years, or is it only a matter of human choice, in relation with the different purposes involved in bird hunting ? To try to answer such a question, we must examine what could have been those purposes from the anthropological point of view.

Buldir Island Present Abundance of Birds
Census Byrd & Day, 1986

	N Pairs	0%	0%
Oceanodroma furcata	650 000	39,56	Oceanodroma not include
Oceanodroma leucorhoa	850 000	51,73	
Fulmarus glacialis	115 *	0,01	0,08
Phalacrocorax pelagicus	100	0,01	0,07
Phalacrocorax urile	140	0,01	0,10
Branta canadensis	170	0,01	0,12
Anas crecca	5	0,00	0,00
Somateria mollissima	13 **	0,00	0,01
Haliaetus leucocephalus	1	0,00	0,00
Falco peregrinus	5	0,00	0,00
Stercorarius parasiticus	50	0,00	0,03
Larus glaucescens	2 500	0,15	1,75
Rissa tridactyla	10 800	0,66	7,55
Rissa brevirostris	2 200	0,13	1,54
Uria aalge	1 100	0,07	0,77
Uria lomvia	12 300	0,75	8,60
Cepphus colomba	125 **	0,01	0,09
Synthliboramphus antiquus	4 500 **	0,27	3,15
Ptychoramphus aleuticus	200	0,01	0,14
Cyclorrhynchus psittacula	5 000 **	0,30	3,50
Aethia pusilla	70 000	4,26	48,93
Aethia cristatella	1 250 **	0,08	0,87
Aethia pygmea	14 000	0,85	9,79
Cerorhinca monocerata	12 **	0,00	0,01
Fratercula cirrhata	9 000 **	0,55	6,29
Fratercula corniculata	9 000 **	0,55	6,29
Nyctea scandiaca	1	0,00	0,00
Troglodytes troglodytes	60 **	0,00	0,04
Melospiza melodia	150 **	0,01	0,10
Calcarius lapponicus	150 **	0,01	0,10
Plectrophenax nivalis	23 **	0,00	0,02
Leucosticte arctoa	87 **	0,01	0,06
TOTAL	**1 643 057**	**100**	**100**

*=data from 1976
**=means of the estimations

TABLE 3 - Present abundance of the Buldir Island avifauna. Census from Byrd and Day, 1986.

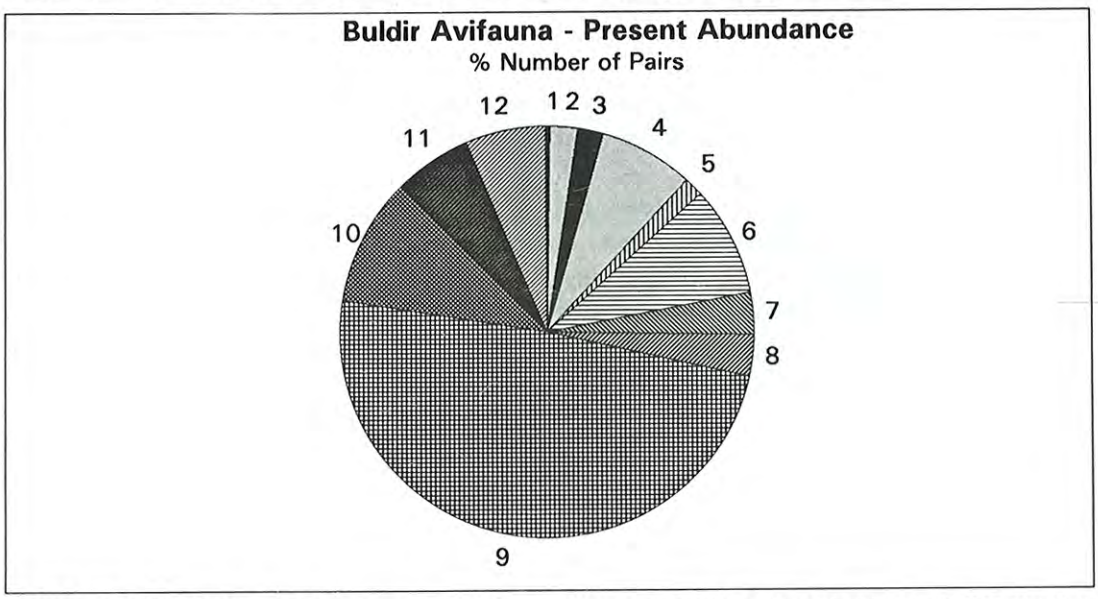


FIGURE 5 - Buldir Avifauna (not including *Oceanodroma sp.*). Representation of the present abundance, with the percentage of number of pairs. 1 = Passeriformes. 2 = Other species. *3 = Larus glaucescens. 4 = Rissa tridactyla.* 5 = *Rissa brevirostris.* 6 = *Uria lomvia.* 7 = *Synthliboramphus antiquus.* 8 = *Cyclorrhynchus psittacula.* 9 = *Aethia pusilla.* 10 = *Aethia pygmaea.* 11 = *Fratercula cirrhata.* 12 = *Fratercula corniculata.*

Anthropology

The Aleuts hunted birds for two main goals: food and clothing. The last one is well documented by the recent ethnographical sources (Fitzhugh & Crowell, 1988; Varjola et al., 1990): the Aleuts wore beautiful parkas made from skins of puffins, cormorants, guillemots or murres. We do not know how old is such a cultural practice. In case the bird remains could help in answering such a question, those coming from test pits not linked to any understandable structures are useless.

A minimum of three parameters must be considered in examining the use of birds as food: the size and weight of the species, the accessibility of the colonies and the hunting equipment.

Ethnographical sources, once again, can help to answer the last point (Collins et al., 1945; Laughlin, 1980). Nets and snares made of baleen and sinew were used to catch birds like puffins and auklets, without too many difficulties. Bolas could have been used to catch birds in flight. A light spear with a single barbed point at the end and a cluster of three other points projecting at an angle from near the center of the shaft was also used and cast by means of a throwing board. This might have been the equipment used to catch cliff nesting birds, otherwise inaccessible to a man.

The second point we must consider is the accessibility of the colonies to the hunters. Auklets (*Aethia sp.*, *Ptychoramphus aleuticus*, *Cyclorrhynchus psittacula*), murrelets (*Brachyramphus sp.*) and puffins (*Fratercula sp.*) are quite easy to approach: they breed in burrows and rock crevices on the boulders down the talus slopes, and such places are numerous on Buldir Island (Figure 2). Murres (*Uria sp.*) and kittiwakes (*Rissa sp.*) are more difficult to reach, nesting on steep cliffs hardly attainable. This differential accessibility to the colonies must be taken into account in order to explain the success of the first point regarding the diet of the Aleuts.

The last parameter, the size and weight of the species, was perhaps the most important. Here are examples of weight (in gramms) of the Alcidae (Bédart, 1969):

Uria. aalge	930,8	*Aethia pusilla*	86,3
Uria lomvia	975,5	*Aethia cristatella*	284,5
Cepphus columba	483,8	*Aethia pygmaea*	118,0
Synthliboramphus antiquus	233,5	*Cerorhinca monocerata*	571,0
Ptychoramphus aleuticus	172,6	*Fratercula cirrhata*	838,2
Brachyramphus sp.	236,0	*F. corniculata*	647,3
Cyclorrhynchus psittacula	317,6		

Figures 6 and 7 display the species weights in decreasing order, and indicate the percentage of minimum number of individual compared with the present abundance of breeding pairs. We will analyse such representations keeping in mind the parameter of accessibilty that we have discussed above.

- The murres (*Uria sp.*) and the puffins (*Fratercula sp.*) offer the highest body-weight ratio (almost a kilo). Both are fairly abundant today, but the murres are more difficult to reach than are the puffins. This can explain why the last ones are better represented in the archaeological samples than are the first ones.

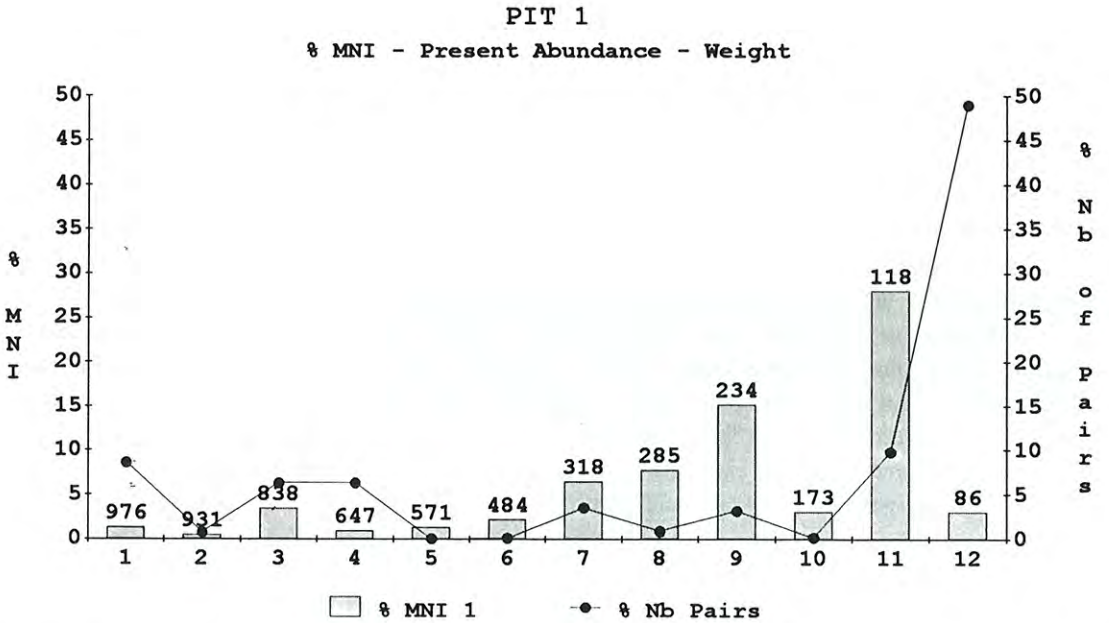


FIGURE 6 - Buldir 1991, Pit 1. Minimum number of individuals of Alcidae, presented in decreasing order of weight (indicated by the numbers on top of the bars), compared with the present abundance. 1 = *Uria lomvia*. 2 = *Uria aalge*. 3 = *Fratercula cirrhata*. 4 = *Fratercula corniculata*. 5 = *Cerorhinca monocerata*. 6 = *Cepphus columba*. 7 = *Cyclorrhynchus psittacula*. 8 = *Aethia cristatella*. 9 = *Synthliboramphus antiquus*. 10 = *Ptychoramphus aleuticus*. 11 = *Aethia pygmaea*. 12 = *Aethia pusilla*.

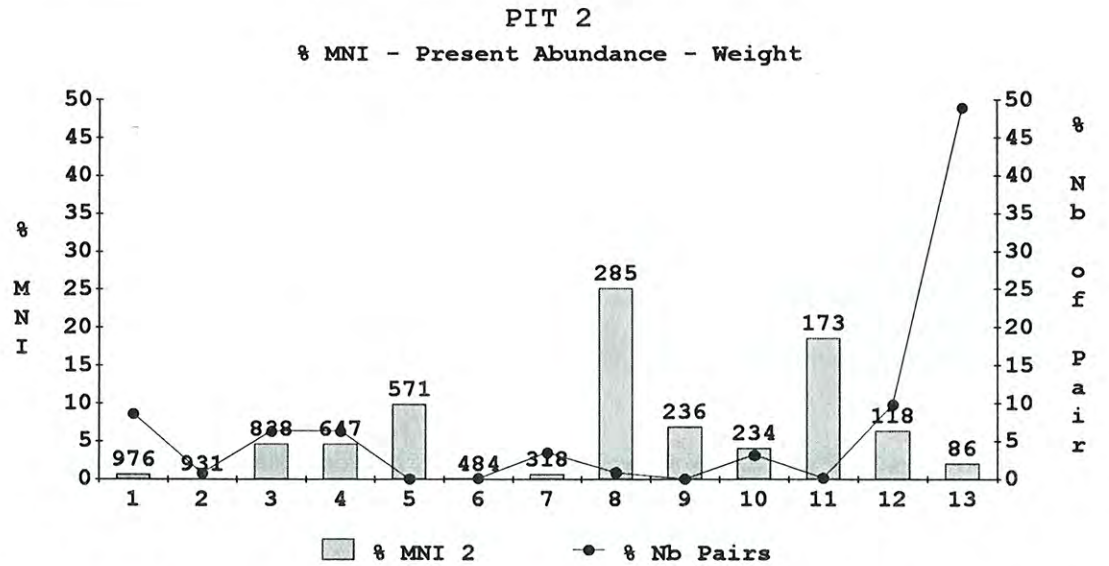


FIGURE 7 - Buldir 1991, Pit 2. Minimum number of individuals of Alcidae, presented in decreasing order of weight (indicated by the numbers on top of the bars), compared with the present abundance. 1 = *Uria lomvia*. 2 = *Uria aalge*. 3 = *Fratercula cirrhata*. 4 = *Fratercula corniculata*. 5 = *Cerorhinca monocerata*. 6 = *Cepphus columba*. 7 = *Cyclorrhynchus psittacula*. 8 = *Aethia cristatella*. 9 = *Brachyramphus sp.* 10 = *Synthliboramphus antiquus*. 11 = *Ptychoramphus aleuticus*. 12 = *Aethia pygmaea*. 13 = *Aethia pusilla*.

- *Cerorhinca monocerata* and *Cepphus columba* also have economically interesting body-weights (around a pound), but none are abundant today (12 and 125 breeding pairs recorded respectively). The first one is quite well represented in Pit 2. Can we suggest that the species was more abundant a thousand years ago?

- For the auklets, with a body-weight around 300 grams, the situation is not clear. We detect one common feature in both two pits: *Aethia pusilla*, the most abundant species among the Alcidae today, is poorly represented in the archaeological remains. It is also the species having the lightest body-weight, therefore constituting a less interesting prey item. Heavier species, such as *A. cristatella*, *Synthliboramphus antiquus*, or *Ptychoramphus aleuticus*, are better represented in the archaeological fauna than expected, due to their lower present-day abundance. Can we conclude that they used to be more numerous on the island, or is it only a hunting bias (accessibility of the colonies + decent body-weight = profitable prey) ?

CONCLUSION

The program on the western Aleutians is only beginning, and these results are very preliminar. Several questions have still to be answered, but this study already sheds new light on a few points. Concerning changes in the avifauna during past centuries, we must note the presence of *Brachyramphus sp.* prior to the XVth century. We have also noticed differences between archaeological and present day abundances for the Alcidae, but it is hard to interpret them in a straightforward way. The wide spectrum of marine species represented in the midden indicates the importance of bird exploitation, but these results will be more interesting when compared with the bone remains, from mammals and fish, whose study is still in progress.

ACKNOWLEDGEMENTS

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BIRDS FROM FOUR COASTAL SITES IN THE NETHERLANDS

WIETSKE PRUMMEL
Biologisch-Archaeologisch Instituut
Poststraat 6
NL-9712 ER Groningen

ABSTRACT: Bird remains from four coastal sites in the Netherlands, dating from the first century AD until the 17th century, are discussed. Several breeding species of Roman times lost their habitat afterwards. Duck decoys, plover nets and standing nets for scolopacine birds or their predecessors were in use at least since the early middle ages.

KEYWORDS: THE NETHERLANDS, BIRD REMAINS, ROMAN PERIOD, EARLY MIDDLE AGES, 17th CENTURY, DUCK DECOYS, PLOVER NETS, STANDING NETS

RESUMEN: El trabajo valora las avifaunas recuperadas en cuatro yacimientos costeros holandeses que abarcan un lapso temporal entre el siglo I y el XVII. Varias especies que nidificaban en el país en época romana han dejado de hacerlo. Se constatan, cuando menos desde principios de la Edad Media, la existencia de cimbeles, redes para chorlitos y redes fijas de captura de aves.

PALABRAS CLAVE: PAISES BAJOS, RESTOS DE AVES, ROMANO, ALTA EDAD MEDIA, SIGLO XVII, CIMBEL, RED DE CHORLITO, RED FIJA

INTRODUCTION AND MATERIAL: THE SITES

This paper discusses bird remains from four sites along the west and north coast of the Netherlands, the biotopes of the birds and the fowling methods possibly used. The four sites are Velsen 1, Wijnaldum, Oosterbeintum and Harlingen (Figure 1). Velsen 1 was a Roman castellum on the west coast of the Netherlands that existed from about AD 15 to about AD 30. The site, which was excavated in the 1970s and 1980s, had been situated in the freshwater environment of the River Oer-IJ, a former branch of the River Rhine. Open water, sandbanks, clay deposits, back swamps, lagoons, peat-bogs, coastal barriers and dunes had been present in the surroundings of the site, while the mouth of the River Oer-IJ had been 20 km away. The coastal barriers had protected the site against the sea. No sieving was done during the excavation, but the bones were recovered with great care.

Wijnaldum and Oosterbeintum were situated on salt marshes among tidal flats in the North of the Netherlands (Figure 1). Higher parts of these salt marshes have been inhabited since the Iron Age. The sites, which are called *terpen* or *wierden*, were heightened with sods to protect them against flooding. The high salt marsh offered good opportunities for animal husbandry, especially for grazing cattle and sheep. From the 11th century onwards the area became protected by dikes.

The North of the Netherlands was not occupied by the Romans. However, there were many contacts with the Roman Empire, as is evident from the many Roman objects found in the *terpen*. The habitation of Wijnaldum started in the 2nd century AD and lasted until late medieval times. The excavation started in 1991 and is still in progress. The results given in Table 1 are preliminary. Water-sieving with meshes of 4 and 1.5 mm has been done. Oosterbeintum was an early medieval

mixed cemetery of inhumations and cremations, in which animals (one horse and six dogs) have been buried as well as people (Prummel, in press). The cemetery was in use from about AD 450 until about AD 750. Samples of soil from cremations have been water-sieved with 1.5 mm mesh. The cemetery has been excavated in 1988 and 1989. The publication is in progress.

Harlingen was a sea port on the Wadden sea (Figure 1). The material studied comes from a 17th-century cesspit of a well-to-do family.

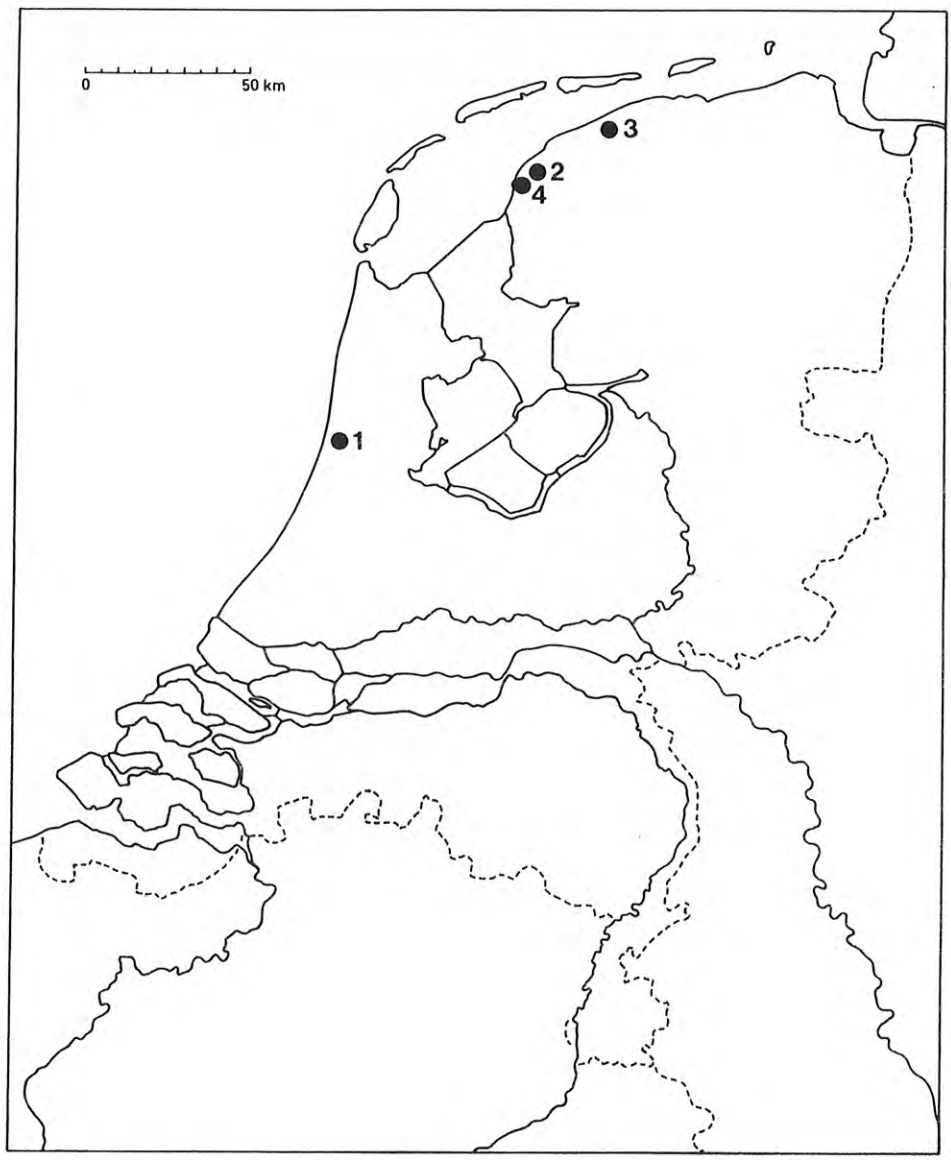


FIGURE 1 - Map of the Netherlands with 1. Velsen 1, 2. Wijnaldum, 3. Oosterbeintum and 4. Harlingen.

SITE	1	2	3	4
DOMESTIC BIRDS				
Gallus gallus domesticus	+	+	+	+
Pavo cristatus	+	-	-	-
Anser anser	-	(+)	(+)	(+)
Columba livia	-	-	-	+
WILD BIRDS				
Gavia stellata	+	-	+	-
Ardea cinerea	+	-	-	-
Platalea leucorodia	+	-	-	-
Cygnus bewickii	-	+	+	-
Cygnus olor/cygnus	+	+	-	-
Anser anser	+	+	-	(+)
Anser fabalis	+	-	-	-
Anser albifrons	+	+	-	-
Branta bernicla	+	-	-	-
Branta leucopsis	+	-	-	-
Tadorna tadorna	+	-	-	-
Anas platyrhynchos	+	+	+	+
Anas strepera	-	+	-	-
Anas penelope	+	+	-	+
Anas crecca	+	-	+	+
Anas acuta	(+)	+	-	+
Anas clypeata	-	+	-	+
Aythya fuligula	+	-	-	-
Aythya marila	+	-	-	-
Aythya sp.	-	-	+	-
Bucephala clangula	+	-	-	-
Mergus merganser	+	-	-	-
Haliaeetus albicilla	+	+	-	-
Lyrurus tetrix	+	-	-	-
Perdix perdix	+	-	-	-
Grus grus	+	-	-	-
Pluvialis apricaria	+	+	+	+
Calidris alpina	-	+	+	-
Calidris minutus/temminckii	-	(+)	+	-
Calidris canutus	-	+	-	-
Tringa totanus	-	+	+	-
Philomachus pugnax	+	+	-	-
Numenius arquata	+	-	+	-
Limosa sp.	-	+	-	-
Scolopax rusticola	+	-	-	-
Gallinago gallinago	+	-	-	-
Larus argentatus	+	-	-	-
Larus cf. marinus	+	-	-	-
Columbus palumbus	+	-	-	-
Turdus pilaris	+	-	-	-
Turdus philomelos	+	-	-	-
Fringillidae	+	-	-	-
Pica pica	+	-	-	-
Corvus corax	+	-	-	-
Corvus cf. frugilegus	+	-	-	-
Corvus corone	+	-	-	-

TABLE 1 - Birds from coastal sites in the Netherlands: 1 - the Roman castellum Velsen 1 (AD 15-30) (Prummel, 1987); 2 - Wijnaldum (2th - 10 century) (Prummel, 1991); 3 - early medieval cemetery Oosterbeintum (AD 450-750) (Prummel, 1991); 4 - Harlingen, 17th-century cesspit (Prummel, 1992). + species or group present, (+) species or group presumably present, - species or group absent.

RESULTS: THE BIRDS

Velsen 1

The most important bird species at Velsen 1 was the domestic fowl: 80% of the bird remains were chicken bones. The Romans introduced the domestic fowl into the Netherlands (Prummel, 1987; Lauwerier, 1988). Peacock (*Pavo cristatus*) was represented by a single bone (Prummel, 1987). Domestic goose has not been demonstrated in Velsen 1.

A wide variety of wild birds was represented at the castellum (Table 1: 1; Prummel, 1987). Ducks, in the first place mallard (*Anas platyrhynchos*), geese and swans, in the first place greylag goose (*Anser anser*), and crane (*Grus grus*) (Figure 2) were the most important wildfowl species caught by the soldiers. Black grouse (*Tetrao tetrix*), wood pigeon (*Columba palumbus*) and partridge (*Perdix perdix*) were caught in small numbers. The soldiers caught several species of wader (Charadriidae and Scolopacidae), each of which is represented by one or more bones: golden plover (*Pluvialis apricaria*), ruff (*Philomachus pugnax*), curlew (*Numenius arquata*), woodcock (*Scolopax rusticola*) and snipe (*Gallinago gallinago*). The white-tailed eagle (*Haliaeetus albicilla*) was hunted for its flight feathers. The other wild birds were represented by just a few bones. Among them the Corvidae and the Turdidae were of some importance (Table 1: 1).

Wijnaldum and Oosterbeintum

The only domestic bird in these sites was the domestic fowl, which was represented in small numbers (Table 1: 2-3). Obviously domestic fowl was still rare in the North of the Netherlands in the first centuries AD. This is in accordance with the situation at the *terp* Feddersen Wierde in the North of Lower Saxony (Germany), dating from the 1st century BC until the 5th century AD, where not a single bone of domestic fowl has been found (Reichstein, 1991).

The most important wild birds in Wijnaldum and Oosterbeintum were ducks and waders, Charadriidae and Scolopacidae. Among the duck remains, those of species of the genus *Anas* are the most numerous (Figure 3). The diving ducks, of the genera *Aythya*, *Mergus*, etc. are less well represented. The Charadriidae are represented by the golden plover (*Pluvialis apricaria*). Several scolopacine birds were found in considerable numbers in Wijnaldum and/or Oosterbeintum, including redshank (*Tringa totanus*), ruff (*Philomachus pugnax*), black-tailed and/or bar-tailed godwit (*Limosa limosa/lapponica*), dunlin (*Calidris alpina*) and little and/or Temminck's stint (*Calidris minuta/Temminckii*). The dunlin and stint remains of Oosterbeintum were found in cremations. The bones themselves were calcined (Figure 4). The birds obviously played a role in the funerary rituals of the site (Prummel & Knol, 1991). The white-tailed eagle (*Haliaetus albicilla*) has been identified in Wijnaldum, the red-throated diver (*Gavia stellata*) in Oosterbeintum. Bewick's swan (*Cygnus bewickii*) was found at both sites (Table 1: 2-3) (Prummel, 1991).

Harlingen

In the cesspit of a well-to-do 17th-century family remains of domestic fowl, wild or domestic goose, domestic pigeon, several species of *Anas* ducks and golden plover have been found (Table 1: 4). It is interesting to remark that with this family domestic fowl obviously was not very popular, since in their cesspit the number of bones of domestic fowl was smaller than the total number of remains of the wild birds (Prummel, 1992).

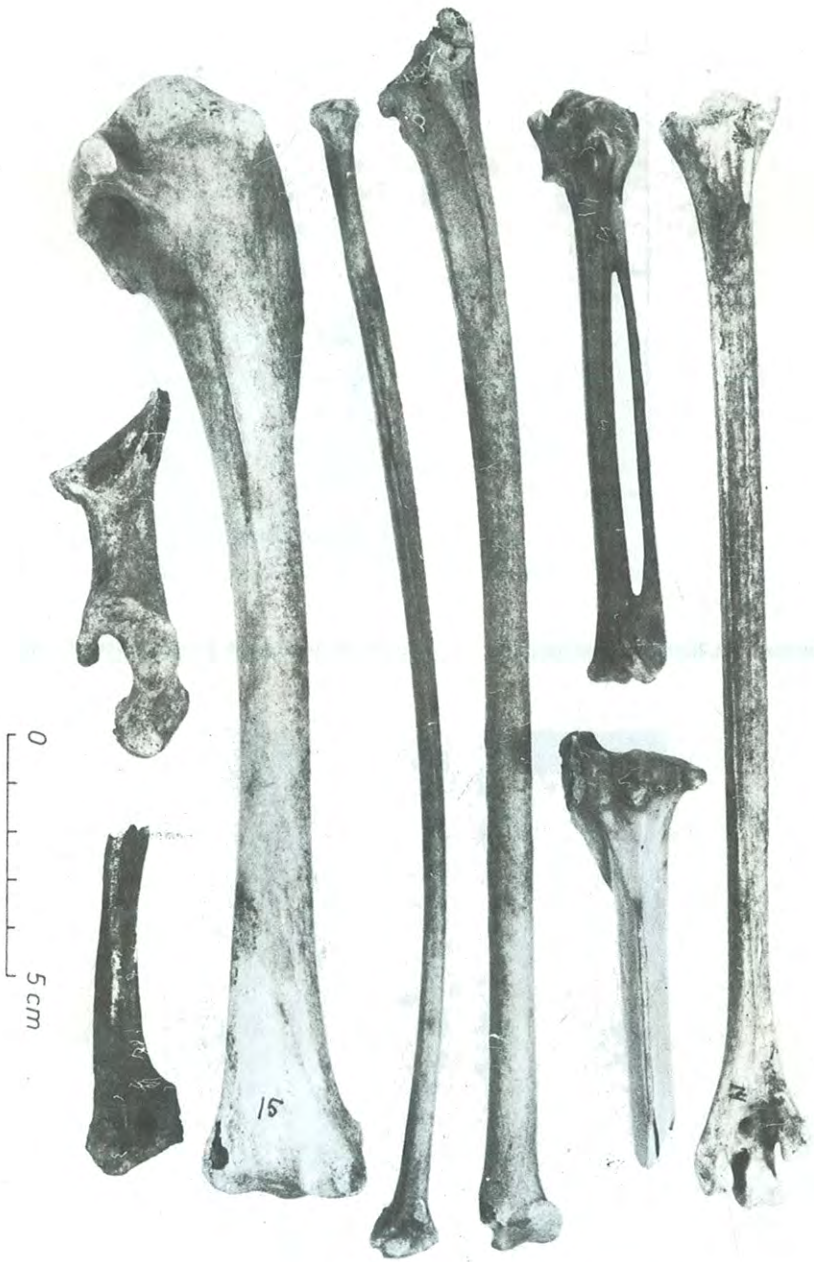


FIGURE 2 - Velsen 1, AD 15-30. Several bones of crane, *Grus grus* (photograph R.J. Kosters, Groningen). Scale 1:1.6.

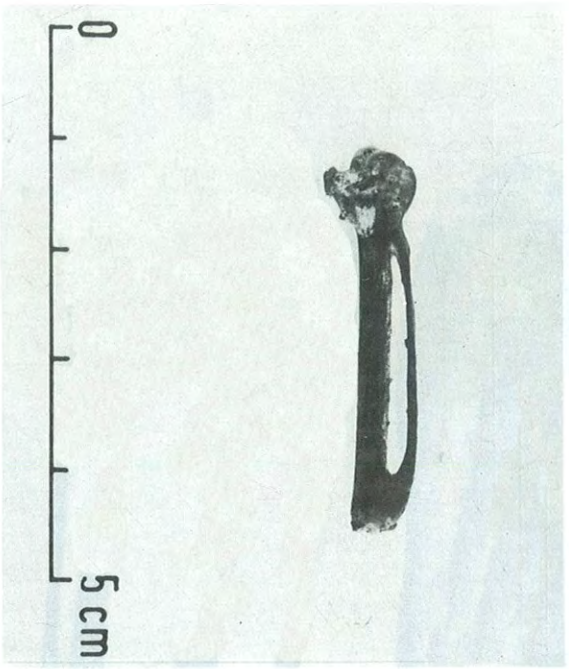


FIGURE 3 - Oosterbeintum. Right carpometacarpus of teal, *Anas crecca* (photograph R.J. van Ewyck, Groningen). Scale 2:1.

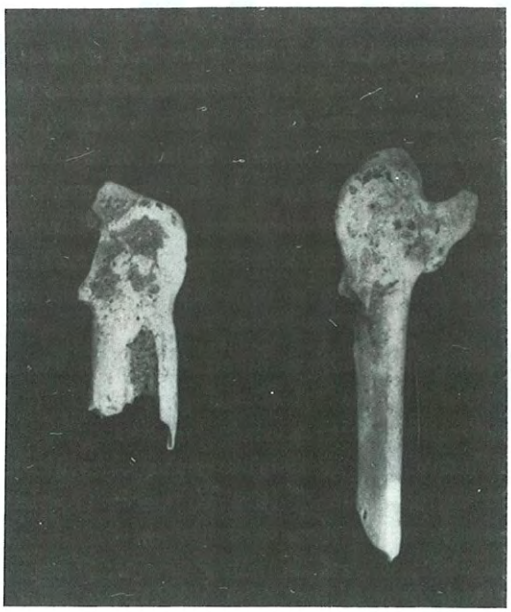


FIGURE 4 - Oosterbeintum. Calcined left and right carpometacarpus of little or Temminck's stint (*Calidris minuta/temminckii*) from a cremation urn (photograph R.J. van Ewyck, Groningen). Scale 5:1.

DISCUSSION

Velsen 1

Greylag goose, crane and black grouse will have been breeding birds of the peat-bogs and moorlands in the surroundings of the site in Roman times. Greylag goose and crane are at the present time passage migrants or winter visitors, while the black grouse is altogether absent from the area. In late medieval times these wet areas were reclaimed, destroying the habitats of these species. The white-tailed eagle was a breeding species along the coast of the Netherlands. The wood pigeon and the Turdidae will have been caught in the dunes. The long and varied list of species (Table 1: 1) reflects the variation in landscape.

Wijnaldum, Oosterbeintum and Harlingen

Ducks and waders will have occurred in large densities along the Wadden Sea coast, on the tidal flats and on the salt marsh. Therefore it is not surprising that they are the most numerous wild bird species in Wijnaldum, Oosterbeintum and Harlingen. The area offered no breeding habitat for greylag goose, crane and black grouse. What makes these results interesting is that ducks and waders are nowadays caught in the area with fowling methods which, as historical evidence shows, have been in existence for at least several centuries.

Anas ducks are caught with duck decoys, which have been in use at least since the 14th century (Kear, 1990). A duck decoy, from the Dutch word *kooi* (cage), is a rectangular pond surrounded by forest. In a large area around the decoy noisy activities are prohibited. On the pond tame ducks swim around, which attract the migrating ducks that pass through in late summer and autumn. Four or more gradually narrowing ditches run from the corners of the pond, ending in traps. Along the ditches screens of reed are placed to hide the fowler. A small white-orange coloured dog (a special breed) lures the wild ducks to the end of the ditch, where they are caught in the trap. Only ducks of the genus *Anas* can be caught in these decoys. Several wading species may unintentionally be caught using duck decoys. A total of 2000 to 6500 ducks could be caught in a decoy yearly (Lebret, 1952; 1979). Several decoys are still in existence in the Netherlands for fowling and others for ringing. The silence area is important for wildlife in general.

The *Anas* ducks consumed in the 17th century house in Harlingen were definitely caught in decoys along the Frisian coasts or on the Wadden Sea islands in the North of the Netherlands. Maybe the same constructions or more simple predecessors were used to catch ducks in Wijnaldum and Oosterbeintum.

Golden plover was caught on a large scale in the North of the Netherlands at least since the 16th century (Eenshuistra, 1973). The fowler uses a single 20-m-long net, that initially lies flat on the ground. Decoy golden plovers and lapwings, apparently searching for food, are placed before and behind the net. A living golden plover is placed on a little seesaw. With a flute the fowler attracts the plovers from the air. When the plovers land the fowler pulls the net up and lets it fall across them. Some birds are caught, others escape (a video of this fowling method has been shown at the conference). In the last three centuries many golden plovers were exported to England and France (Eenshuistra, 1973). This fowling method is still in use for ringing birds (Jukema, 1991).

Other waders such as lapwing (*Vanellus vanellus*), grey plover (*Pluvialis squatarola*), snipe (*Gallinago gallinago*), curlew (*Numenius arquata*), godwit (*Limosa* sp.), several shanks

(Tringa-species), dunlin (*Calidris alpina*), knot (*Calidris canutus*) and ruff (*Philomachus pugnax*) are caught using this fowling method as well. Several of these bird species have been identified in Wijnaldum and Oosterbeintum. They may have been caught together with golden plovers. In historical times the golden plovers were considered as the most palatable and valuable catch of this fowling method. This will explain why only the golden plover is represented in the 17th-century Harlingen cesspit of a well-to-do family. The golden plovers from Harlingen were definitely caught in this way. The same or more primitive types of nets will have been used on the high salt marsh in Roman and early medieval times to catch the golden plovers and other waders.

Longitudinal, fixed, standing nets of 15-20 m length and ca 1.7 m height, placed above the tidal flat, were used along the Frisian coast in the last few centuries to catch dunlin (*Calidris alpina*), Temminck's and little stint (*Calidris temminckii* and *minuta*). Birds that land to forage on the tidal flats get entangled in these nets. Apart from dunlin and stints, curlew, lapwing, grey plover, gulls and even ducks and geese could be caught with these standing nets. Since 1912 the method is prohibited in the Netherlands (Eenshuistra, 1948). The scolopacine birds found in Wijnaldum and Oosterbeintum may have been caught in this way.

CONCLUSION

The wild bird remains found at four sites along the west and north coast of the Netherlands from the 1st to the 17th century represent mainly bird species that will have been rather abundant and that will have been considered palatable. Greylag goose, crane, black grouse and white-tailed eagle will have been breeding birds along the coast in Roman times. The bird remains demonstrate that fowling methods, such as duck decoys, plover nets and standing nets, that were used in this area in the last few centuries either were used already in Roman or early medieval times, or had more simple predecessors in this area.

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THE ROLE OF BIRDS IN THE ECONOMY OF MEDIEVAL AND POST-MEDIEVAL FLANDERS: A DIVERSITY OF INTERPRETATION PROBLEMS

ANTON ERVYNCK
Institute for the Archaeological Heritage
of the Flemish Community.
Doornveld 1 Box 30, B-1731 Zellik. Belgium.

ABSTRACT: This paper evaluates the role of birds in the meat supply of medieval and post-medieval Flanders, Belgium. Apparently, bird remains are rather scarce in the archaeozoological record from Flemish sites. Are birds then only of minor economical importance or is the scarcity of their remains the result of a biased sample? Some factors that could theoretically be responsible for an underrepresentation of bird bones in archaeological contexts and archaeozoological inventories are outlined. Two case studies suggest that these factors have only minor influence and that bird bones are indeed not frequent in the sites. In terms of human consumption the breeding of birds was perhaps not very significant but birds could still be economically important because they were expensive and because one was interested in their secondary products (eggs).

KEYWORDS:FLANDERS, BELGIUM, MEDIEVAL, POST-MEDIEVAL, ARCHAEOZOOLOGY, ECONOMY, AVES

RESUMEN: El trabajo evalúa el papel de las aves como aporte cárnico en el Flandes medieval y post-medieval. Los restos de aves son, aparentemente, infrecuentes en el registro arqueológico de yacimientos flamencos. ¿Es real o artificial esta escasez?. El trabajo comenta una serie de agentes teóricos como potenciales responsables de esta infrarrepresentación. Dos ejemplos prácticos, sin embargo, demuestran que tal escasez es auténtica. Quizás en términos de consumo humano la cría de aves de corral no fué importante aunque la importancia económica de éstas pudo haberlo sido en función de dos factores: el alto precio de los animales y el interés por la producción de huevos.

PALABRAS CLAVE: FLANDES, BELGICA, MEDIOEVO, POST-MEDIEVAL, ARQUEOZOOLOGIA, ECONOMIA, AVES

INTRODUCTION

The role of birds in the economy of a medieval society will have been mostly limited to the field of food supply. Indeed, bird bones are present amongst the consumption refuse in excavations in medieval and post-medieval sites in Flanders, Belgium. However, one of the characteristics of the faunal collections from these sites is that bird bones are rather scarce. Thus, do birds play only an unimportant role in the food supply? Or, if they really formed an important part of the menu, why then are their remains never found frequently? It is our aim to evaluate the scarcity of the bird remains and to show that many factors hamper a sound interpretation of the importance of birds in our medieval and post-medieval economies.

Present-day Flanders, the Dutch-speaking part of Belgium, covers parts of many medieval political entities. These include not only the former county of Flanders or dukedom of Brabant, but also their many feudal precursors. However, when we describe phenomena as Flemish, this means that they occurred in the area of modern Flanders. The ideas proposed in this paper are based upon the study of bone collections from many sites, published by different authors. A reference list to these archaeozoological studies can be found in Ervynck (1992a) for urban sites, Ervynck (1992b) for castles and Ervynck et al. (in press) for abbeys. Where data from a specific site are mentioned, the reference to the original publication will be given.

Bird remains in Flemish medieval and post-medieval sites consist mainly of the bones of three domestic species: chicken (*Gallus gallus* f. domestica), goose (*Anser anser* f. domestica) and duck (*Anas platyrhynchos* f. domestica). These species were certainly the main meat suppliers within the avian livestock. Other domestic species are rarely found. The remains of hunted species only form a minor part of the bird bone finds. Without doubt, the consumption of more special, highly esteemed domestic species, such as peacock (*Pavo cristatus* f. domestica), and of hunted species will have been important in terms of social status but in terms of biomass intake this phenomenon can be neglected.

THE SCARCITY OF THE BIRD BONE RECORD

Is it possible that the number of bird bones in archaeological sites is not a good reflection of the number of birds eaten? Several factors have to be taken into account.

Fragmentation before deposition

In general, since bird bones are more fragile than mammalian skeletal elements, fragmentation will be more pronounced in the first group. Moreover, birds and mammals are differently processed for consumption and this affects the fragmentation of the remains. For instance, large mammal bones will be removed from a piece of meat while bird bones can be chopped into pieces while dividing the carcass. The destructive effect of long-time boiling will affect bird bones more severely than mammal bones. Because a bird is often eaten with the bones still in the carcass, these can be fragmented ('crunched') by the process of consumption itself.

Depositional factors

The way in which bird bones are deposited on a site can differ widely from that in which large mammal bones are discarded. Part of the large mammal bones are already removed from the carcass at the slaughter place while the rest of them is mostly chopped away from the meat in the kitchen. In contrast, most of the skeleton from a chicken ends up at the table. Within the group of consumption remains, avian and mammalian bones thus belong to different taphonomical categories (*sensu* Gautier, 1987). Within a human dwelling place slaughter offal, kitchen debris and leftovers from the table are mostly not deposited in the same way nor in the same place. Partial excavation of a site can, hazardously, miss one of these contexts and produce a distorted view of the local bird consumption. More important is that different deposition can lead to different chances of preservation. Table leftovers can be thrown away on a compost heap while slaughter offal is deposited in a deep pit. The chances of preservation are clearly higher for the second way of deposition.

Moreover, table leftovers frequently became part of a recycling process when they were given to the dogs or the pigs. These animals do not easily destroy complete cattle metapodials but they can deal with the carcass of a chicken. In that way, it is possible that a considerable part of the bird bones that were ever present on a site never became part of the soil archives.

Preservation

Differences in the deposition of bones affect their chances of preservation. As has been said, bird bones are always more fragile than large mammal bones and when a collection of bones does not quickly become part of the soil, the fragile ones are most likely to be destroyed by trampling or weather conditions. Even when bones do become part of the soil, preservation conditions are not very favorable in the whole of Flanders. Part of the area is characterised by the presence of sandy soils wherein bones, if located above the ground water level or present in alternating humidity conditions, are hardly preserved. It is possible that under unfavorable conditions fragile bird bones will disappear more easily than large compact mammal bones. This is especially true when dealing with juvenile specimens.

Primary *versus* secondary refuse

Primary refuse consists of material that is deposited on (or close to) the place where it was produced while secondary refuse consists of material that has been transported (Schiffer, 1976). This transport can be responsible for an underrepresentation of smaller finds in an archaeozoological collection. When on a site a primary deposit of consumption refuse is cleaned up and transported to a dump at some distance, a selection can take place. Often, only the more conspicuous elements of the primary deposit will be transported. Of course, transport itself can also destroy the more fragile bones.

Sampling methodology

Lack of sieving or even adequate hand sampling in the traditional Flemish archaeology is often quoted as an explanation for the scarcity of bird remains in our archaeozoological record. Recently, however, on sites wherefrom the faunal remains are studied by the Institute for the Archaeological Heritage of the Flemish Community, sampling methods have largely improved and suitable contexts are completely sieved on a 0.5 mm mesh. Even when faunal material is collected by hand, more attention is paid to the recovery of the more fragile, smaller bones. Considering that extensive sieve sampling is not always possible during many rescue excavations Flemish archaeologists have to perform, this change in attitude is sometimes as important as the shift towards sieve sampling. However, one gets the impression that the improved sampling methodology does not alter significantly the frequency of bird bones in our archaeozoological collections. A comparison between sieved and non-sieved samples subscribes this (see the case studies).

Determination problems

Bird remains pose more identification problems than mammal bones. Some avian skeletal elements, such as the phalanges, the vertebra and certainly the ribs, are generally not identifiable to species while this determination can be performed for large mammal remains. Secondly, there are more closely related species of birds than there are of mammals in the average fauna we encounter in our excavations. A considerable amount of bird bones will remain unidentified because they come from a series of families which are rich in species, such as the passerines or the wader birds. If archaeozoologists have not definitely settled the criteria for discrimination between the bones of

sheep and goat, how could they then distinguish the bones from carrion crow (*Corvus corone*) and hooded crow (*Corvus cornix*) or from the greenshank (*Tringa nebularia*) and the spotted redshank (*Tringa erythropus*)?. Finally, poor preservation conditions and fragmentation will affect the identification of bird bones more severely than will be the case with large mammals. As a result, a larger part of the bird bones end up in the category '*indeterminata*'. This will affect the counts of the finds and will lead to an underestimation of the role birds played in the food supply of a certain site. However, this disadvantage can partly be avoided when all bird bones (identified or not) are compared to all mammal bones. In that way, it is recommended to subdivide the *indeterminata* in an archaeozoological inventory into the major animal groups (mammals, birds, fish, etc.).

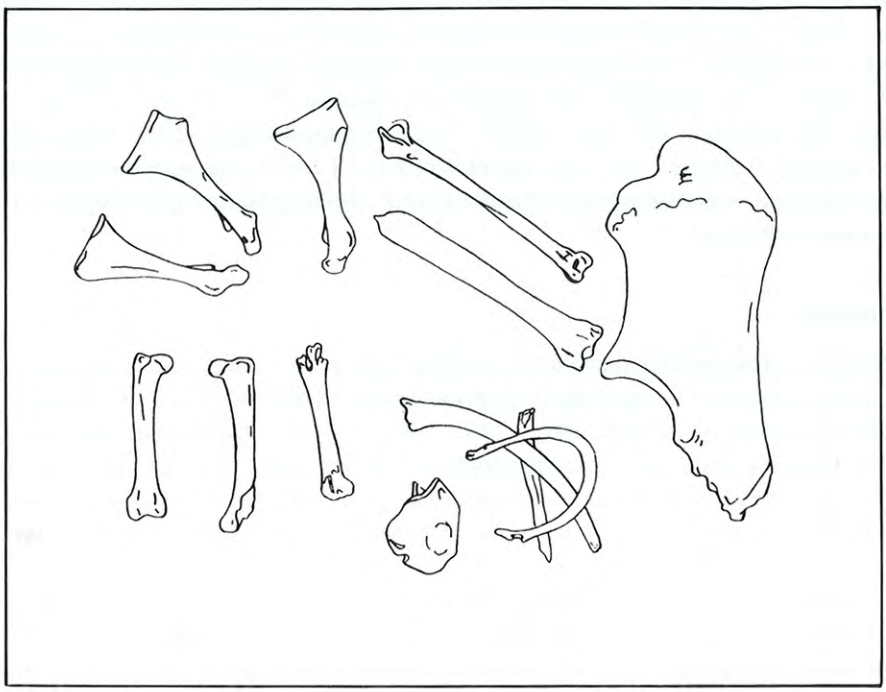
Consumed or not?

In order to assess the role of birds in the meat supply, one must be sure that the remains come from consumed animals. When near complete skeletons of magpie (*Pica pica*) or jay (*Garrulus glandarius*) are found amongst kitchen offal, do they represent consumption refuse or killed but non-eaten birds? From the cookery books we know that songbirds were prepared in the medieval kitchen but does this mean that all little birds we encounter in archaeological contexts represent consumption refuse? On the other hand, prestigious birds, as heron (*Ardea cinerea*) or peacock, were sometimes prepared for luxurious banquets, presented in their own plumage but not eaten. However, a misinterpretation of these curiosities will not severely affect the evaluation of the role of birds in the meat supply of our sites. These 'special' birds are rarely found.

Counting

How can the amount of avian bones that are found in an archaeological context be compared statistically with the amount of large mammal bones? A simple comparison of the raw find numbers simply cannot be sufficient. Firstly, the skeleton of mammals contains a different number of bones than that of birds. Secondly, we have seen that more avian skeletal elements become part of the '*indeterminata*' than is the case with mammalian bones. Moreover, deposition and preservation conditions might have eliminated a major part of the more brittle bird bones. Instead of counting real find numbers, evaluating the minimum numbers of individuals (MNI) could help to overcome some of these problems. However, this way of counting will always pose problems (Gautier, 1984). In particular when comparing the MNI of birds and mammals, the calculations can go wrong. From large mammals only certain body parts normally arrive at the kitchen while birds often arrive complete. By definition, a calculation and comparison of the MNI's is then useless.

A theoretical example illustrates further counting problems (Figure 1A). Assume that we are dealing with a small bone collection from an archaeological context, consisting of 12 bones of mallard (*Anas platyrhynchos*) and one skeletal element of cattle (*Bos primigenius* f. taurus). When trying to make an inventory of this collection, different counting techniques can be applied. A simple fragment count suggests a dominance of mallard remains (Figure 1B). A calculation of the MNI subscribes this statement. However, the MNI differs slightly depending on the way the estimation has been made. The MNI can be solely based upon the most frequent skeletal element but can also take into account the assumed presence of left-right pairs and be based upon the most frequent bone from one body side. Moreover, the presence of real pairs (bones from left and right body side with matching dimensions) can be investigated and, finally, bones from distinct age classes can be counted separately.



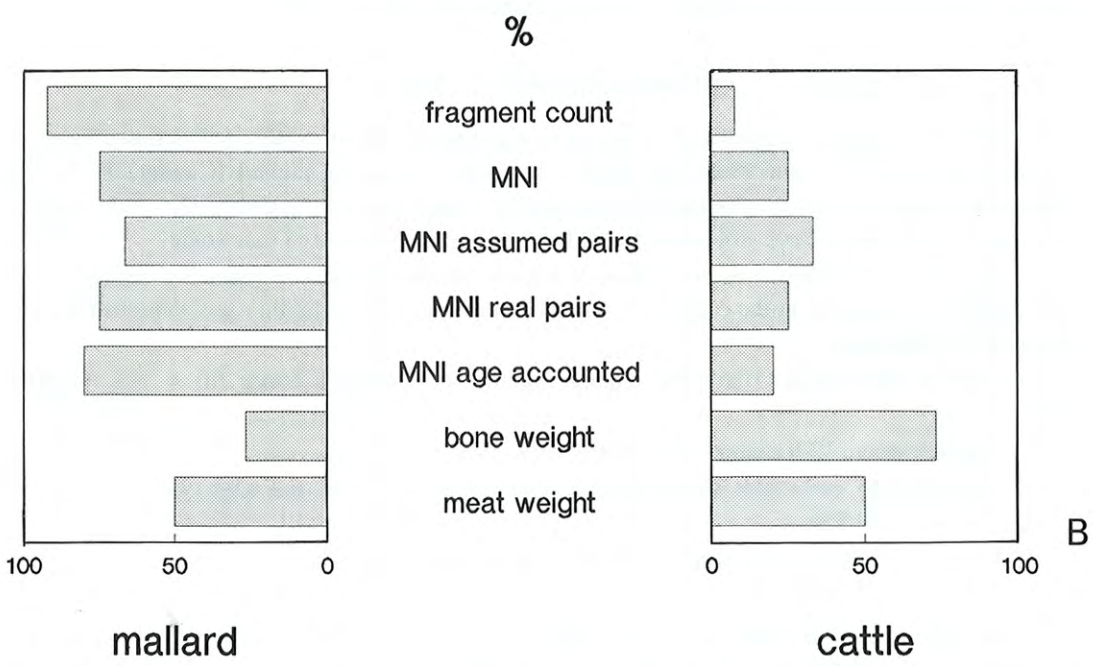


FIGURE 1 - A: An imaginary bone collection, consisting of twelve bones of mallard and one cattle bone. B: Different ways of evaluating the role of both species in the meat supply.

Alltogether the different ways of calculating the MNI point to a dominance of mallard remains in the collection (Figure 1B). If bone weight, often seen as a better way of evaluating the meat supply of each species, is considered, cattle becomes the more important animal in the collection (Figure 1B). In reality, however, the collection investigated was made up in such a way that the bones from mallard and cattle represent the same weight of consumed meat (Figure 1B). Clearly, the counting techniques applied do not give a good presentation of this. Of course, this simple example, based on a very small collection, seems somewhat ridiculous but it stresses underlying errors that are no longer evident in large collections.

Meat production

When bone find numbers have to be translated into meat weight, further problems arise. For example, a capon weighs a lot more than a normal rooster or a hen but these sterilized males are not recognizable in the bone collections (West, 1982, 1985). The bones from domestic goose and duck, found in our medieval sites, represent a homogeneous population that does not differ significantly in osteological characteristics from the wild living species. Despite that, it remains uncertain whether domestic and wild living species attained the same weight, since domestic birds could be easily fattened.

In conclusion, a lot of factors will hamper the evaluation of birds in the meat supply of former sites. A lot of them will provoke an underestimation of the frequency of birds in former consumption patterns. However, this still does not allow us to conclude that birds played more than a minor role in the medieval and post-medieval food-supply. Despite the effect of the factors, the scarcity of bird remains can still reflect a real situation. Two case studies will illustrate this.

CASE STUDY 1: MEDIEVAL AND POST-MEDIEVAL GENT

Gent (Ghent) was certainly one of the most important towns in medieval Flanders (Figure 2). It is also the Flemish town wherefrom bone collections were first studied (Gautier, 1977) and wherefrom, until now, most archaeozoological data for urban sites were gathered (Ervynck, 1992a). For these reasons, the archaeozoological record from Gent is used here as a case study.

All sites investigated thus far indicate a relative scarcity of bird remains. Six samples from consumption refuse layers in the centre of town, all dating back to the Middle Ages, demonstrate this. The sites considered are:

-Gouvernementstraat, 10th-12th century, number of identified bones (n) = 142 (Gautier, 1979);

-Kammerstraat, 12th century, n = 76 (Ervynck, 1990);

-Vrijdagmarkt, early 12th-13th century, n = 71; 1275-1325 A.D., n = 426; 1325-1375 A.D., n = 1085 (Lentacker, 1984);

-Belfortstraat, 13th century, n = 1190 (Van der Plaetsen, et al. 1986).

All bone collections from these excavations have been collected by hand, except for the last site where sieved samples (0.5 mm mesh) were added to the hand-collected collection. The identifiable bones from these urban sites have been divided in three groups: birds, small animals (smaller than sheep) and large animals. It is clear (Figure 3) that the relative frequencies of birds vary

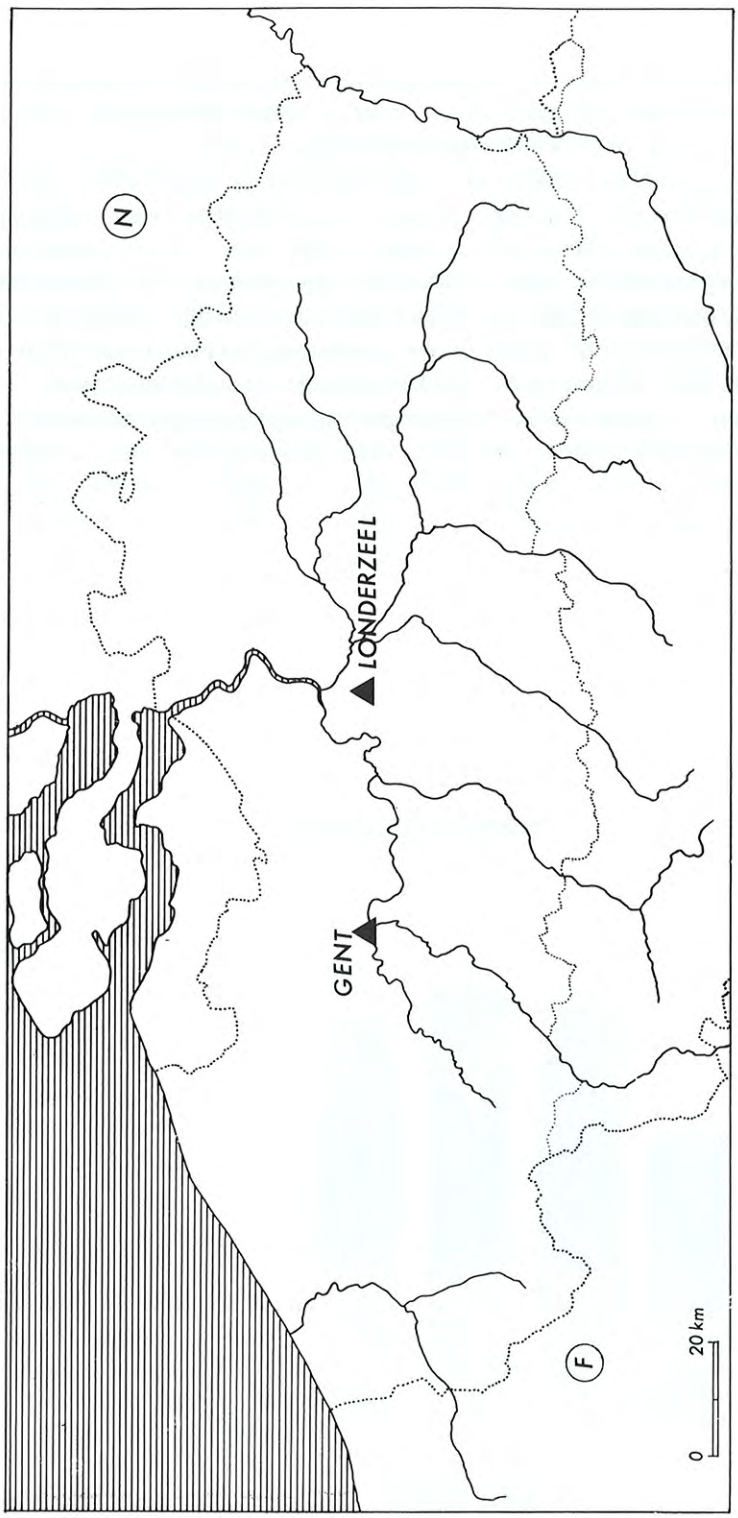


FIGURE 2 - Map of Flanders, Belgium, locating the sites mentioned in the text.

considerably between the sites but, in general, tend to remain low. Sampling procedures may not have anything to do with this since the last context (which was partially sieved) only shows an increase of the frequency of the bones from small animals, i.e. fish.

Since rough sampling methodology is apparently not the cause for the scarcity of bird remains in Gent, an explanation must be sought elsewhere, e.g. in the preservation conditions on the sites or the possibility that we are dealing with secondary refuse. However, this suggestion seems unlikely because sieving shows that fish bones are present in large quantities. On the other hand, depositional factors can be responsible for the lack of bird bones. Is it possible that in the medieval midtown refuse layers, undoubtedly the result of the continuous dumping of all kinds of garbage and household refuse, table leftovers such as chicken carcasses are underrepresented?

The analysis of faunal remains from cesspits can shed light upon this problem. Normally table leftovers were deposited in those structures, which functioned not only as container for human excrements but also for all kinds of household refuse. In Flemish towns the construction of cesspits with bricks starts in the 15th century. Three examples from Gent are used in this study:

-a cesspit from 'Den Bonten Mantele', last filled in the 18th century, n = 74 (Gautier, 1977);

-a cesspit in the 'Oudburg', filling dated back to the 17th-18th century, n = 130 (Van der Plaetsen, 1989);

-a cesspit in the 'Schepenhuisstraat', filling dated back to 1650-1750 A.D. (Stoops, 1992).

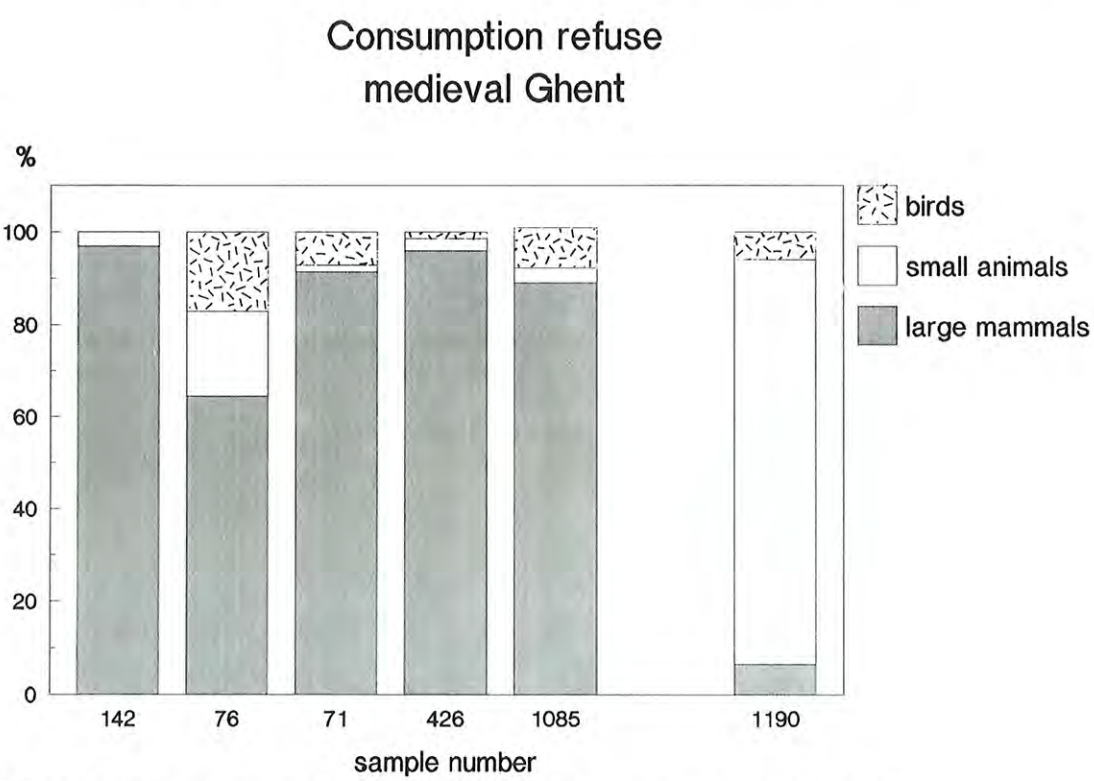


FIGURE 3 - Relative abundance of animal groups in six consumption refuse layers from medieval Gent.

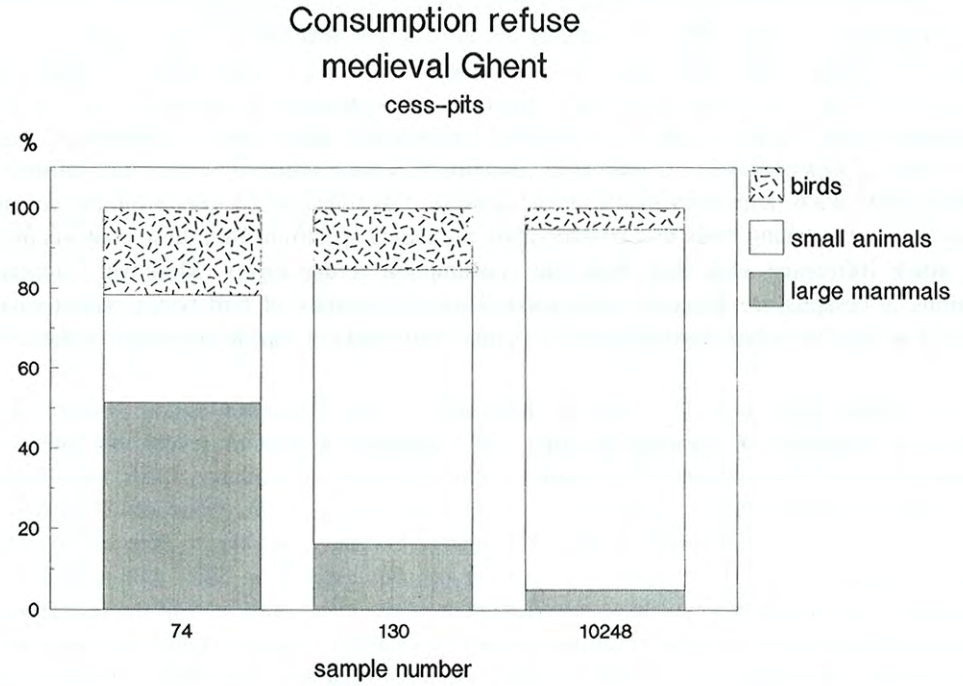


FIGURE 4 - Relative abundance of animal groups in three post-medieval cesspits from Gent.

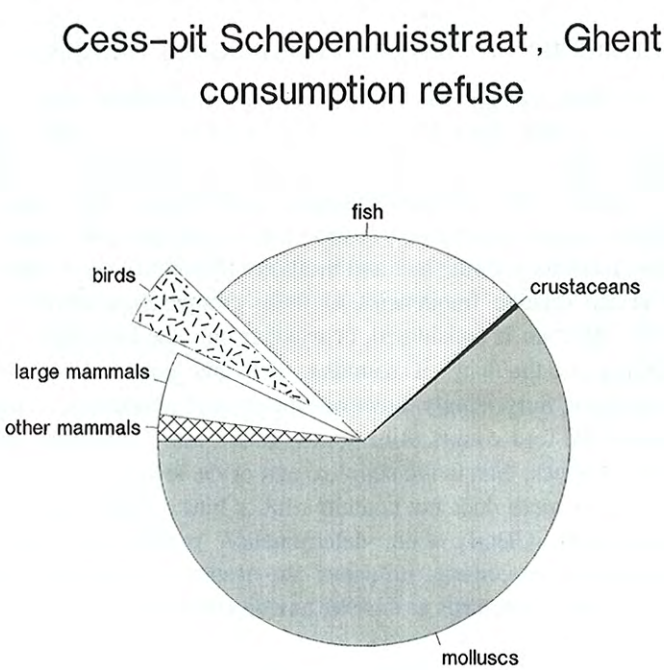


FIGURE 5 - Detailed frequency chart of the animal groups present in the post-medieval filling of a cesspit in the 'Schepenhuisstraat', Gent.

The first context was hand-collected without special attention for animal bones. On the second site, the material was also collected manually but special care was taken for the sampling of faunal remains. The filling of the third cesspit was completely sieved on a 0.5 mm mesh. When the relative frequencies of bird bones in these three structures are compared in the same way as for the consumption refuse layers, it can be shown that bird remains, again, are not abundant (Figure 4). Better sampling procedures do not tend to increase the bird bone frequency while small animals such as fish become really numerous in the sieved context. The filling of cesspits normally consists of primary refuse but taking birds into consideration the faunal spectrum from these contexts does not show much difference with that from the consumption refuse layers. Moreover, preservation conditions in cesspits are generally very good. Thus, the scarcity of bird bones cannot easily be explained by any factor previously described. Perhaps birds did not appear frequently on the citizen's table.

A detailed analysis of the filling of the cesspit in the 'Schepenhuisstraat' (Figure 5) again points to the problems of counting the finds. The numbers of remains reveal that amongst the consumption refuse most of the faunal samples come from fish and molluscs. Birds, large mammals (cattle, sheep, pig) and smaller mammals only form a minor part of the collection. Does this mean that these groups were unimportant in the food supply? Certainly, one has to take into account the biomass, represented by the numbers of each group, but even then birds will not gain much importance. Large mammals will have supplied most of the meat consumed in the household who owned this cesspit. Moreover, the possibility cannot be excluded that part of the meat arrived in the kitchen of the 'Schepenhuisstraat' without bone, something that was more likely to occur with the meat of large mammals than of birds. We can, again, only conclude that birds played a minor role in the food supply of this site.

CASE STUDY 2: THE MEDIEVAL CASTLE AT LONDERZEEL (BRABANT)

In the castle of Londerzeel (province of Brabant) a consumption refuse layer, dating back to the 14th century, was excavated (Dewilde et al., in press). From this context faunal material was gathered, both manually and by sieving. The bird remains are dominated by domestic species, i.e. chicken. In order to analyze the effect of sampling methodology and manner of counting, an inventory of the faunal remains is presented in four ways. Each time the faunal material has been divided in four groups: mammals, birds, fish and mollusks (Figure 6). As a result, major differences are to be observed in the relative frequencies of these groups, depending on whether the hand collected or the sieved collection is considered, or whether only the identified or all bones are taken into account. Depending on the way of counting, fish and mammal remains are numerically unimportant or very frequent. Surprisingly, however, the relative abundance of bird remains does not alter very much between the four counts. Bird bones are not more numerous in the most complete count, based on all sieved bones, than in the simple count of the identified hand collected finds. Note that the category of *indeterminata* does not contain a lot of bird remains; most of the unidentifiable finds come from mammals. Clearly then, determination possibilities, preservation condition, fragmentation and sampling procedures influence the results but do not suggest a significant underestimation of the frequency of birds in this site having taken place.

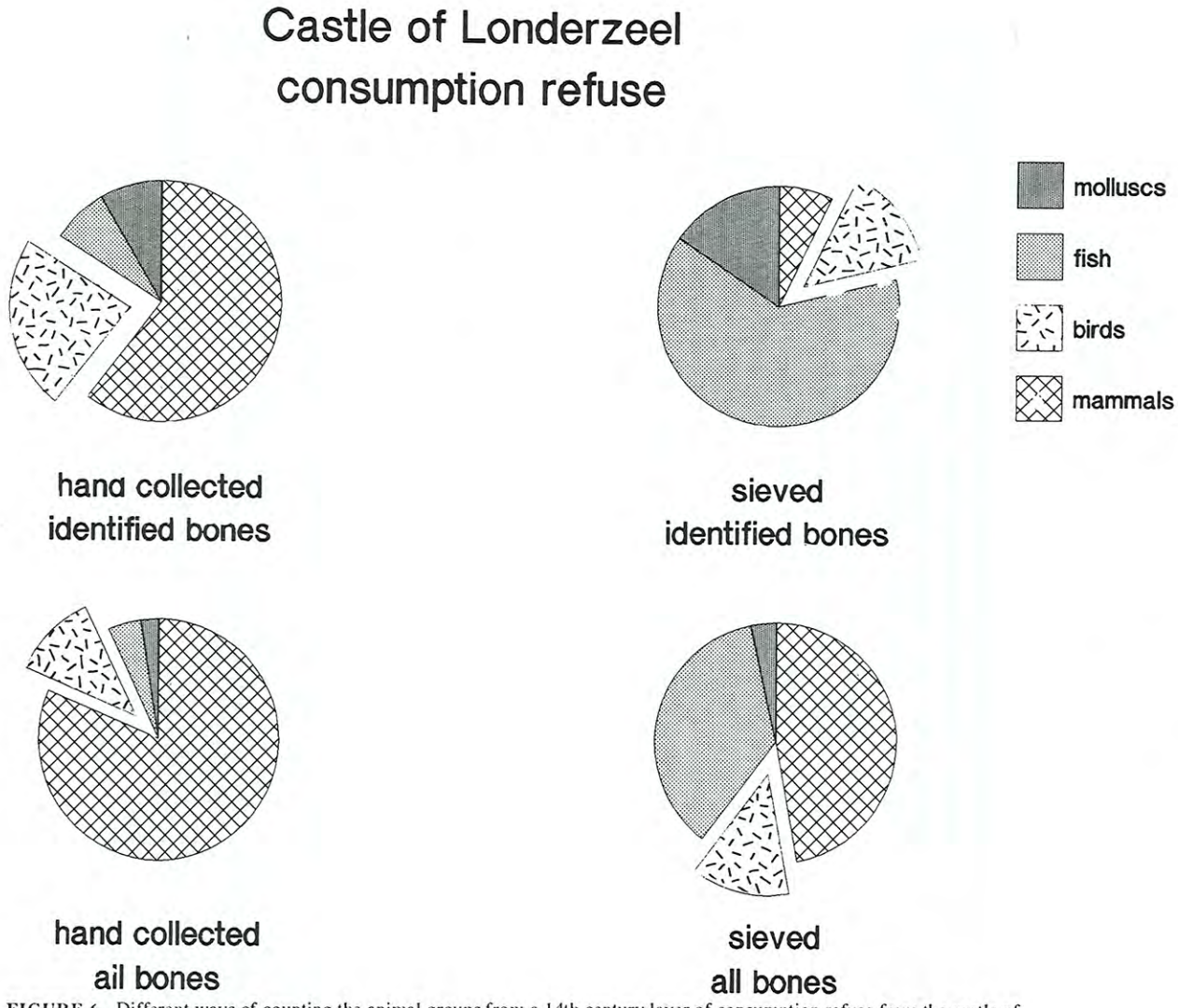


FIGURE 6 - Different ways of counting the animal groups from a 14th century layer of consumption refuse from the castle of Londerzeel.

A REAPPRAISAL OF BIRD REMAINS

Both case studies suggest that bird remains are really not very frequent in our sites and that their scarcity is not clearly linked to the theoretical factors described above. Are birds thus really unimportant for the economy of medieval and post-medieval Flanders? Maybe find counts or meat weight do not tell the whole story! Two suggestions reappraise the role of birds in the economy of medieval and post-medieval Flanders.

It could be that birds were not frequently eaten but that they were expensive and thus economically important. It is known from historical sources that sometimes peasants had to pay their rent *in natura* by annually offering the landowner a fixed amount of caponized fowl. Generally these animals were considered to be very valuable (Lindemans, 1952). It is also known that in Flanders, until World War I, chicken was considered by common families to be sunday food.

Finally, it is likely that chickens and geese were not primarily bred for their meat but were kept for their secondary products, namely eggs. An archaeozoological evaluation of this aspect will pose severe difficulties, e.g. because the laying frequencies of the medieval races are not known. Moreover, egg shells are seldomly preserved in sufficient quantity, they will often have been recycled, a.o. by the birds themselves, and, even when they are present in an archaeological context, how should they be quantified? When archaeozoologists already have troubles with the calculation of the MNI (minimum number of individuals), how could they possibly estimate the MNE (minimum number of eggs)?

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EXPLOITATION OF BIRDS DURING THE NATUFIAN AND EARLY NEOLITHIC OF THE SOUTHERN LEVANT

EITAN TCHERNOV
Department of Evolution, Systematics and Ecology
The Hebrew University of Jerusalem
Jerusalem 91904, Israel

ABSTRACT: There is a punctuational increase in the species diversity of bird remains from the Kebaran (early Epipaleolithic) to the Natufian (late Epipaleolithic) in the southern Levant. The intensive and extensive exploitation of very large spectrum of species continued to the PPNA (Pre-Pottery Neolithic A) and the PPNB (Pre-Pottery Neolithic B), excluding levels where early domestication was found. Reliance on such a large variety of bird species demanded an elaborated hunting experience and usage of versatile techniques, which seem to traditionally continue from the early Natufian to the PPNB. In some cases evidences for clear preferences for specific body parts (used also for tools and ornamentations) for each group of birds could be shown. It is only through the earliest long-term occupation of Natufian and PPN southern Levantine sites, that profound ecological changes have taken place. Consequently a significant increase in the exploitation of a large spectral array of animal species, grains, plants and birds was the main response for overusage of the area and draining the food resources. The drastic increase in the spectra of animal species exploited is due to the exclusive and extensive exploitation of the limited resources around the site by killing off the game and spending ever more time and energy to maintain constant intake of food which drained the resources to a critical level. The growing scarcity of large game forced people not only to broaden the spectrum of hunted animals, but also to concentrate on retrieving greater diversity of minor resources (mostly birds), as well as trying to manipulate wild populations (gazelles). The traditional resource animal species (mainly large game) became progresively insufficient under these conditions. Sedentary people were forced to rely on much less energetically (amount of meat per catch) rewarding animals, and many small species became highly represented in Natufian and PPN sites, of which the shift into highly specialized bird hunting seemed to be of great importance. The evolution of commensalism that suddenly appeared under the special conditions of sedentism, and the punctuational speciation of commensal animals like *Passer domesticus*, is discussed.

KEYWORDS: "BROAD SPECTRUM", COMMENSALISM, NATUFIAN, PPNA, PPNB, SEDENTISM

RESUMEN: El trabajo demuestra la existencia de un aumento en la diversidad específica de restos de aves en el Levante meridional desde el Kebariense (epipaleolítico temprano) hasta el Natufiense (epipaleolítico tardío). La explotación intensiva y extensiva de un muy amplio espectro de especies se prolonga hasta el neolítico precerámico (NPCA) y el neolítico precerámico B (NPCB), a excepción de niveles en donde se constata una domesticación temprana. La dependencia de una tan extensa variedad de especies aviares requiere tanto una elaborada experiencia cinegética como un uso de técnicas versátiles, que parece haberse prolongado desde el natufiense inicial hasta el NPCB. Ocasionalmente se ha podido comprobar la preferencia por determinadas partes corporales (asimismo usadas como ornamentos y herramientas) en diferentes grupos de aves. A partir de las primeras ocupaciones prolongadas en yacimientos levantinos meridionales (natufienses y NPC) comienzan a producirse profundos cambios ecológicos. El aumento significativo en la explotación de una amplia gama de especies animales (incluidas aves) y vegetales (incluyendo granos) parece ser por tanto una respuesta consecuente con la suprautilización del terreno y la merma en los recursos alimentarios que ésta acarrea. El aumento acusado del espectro de especies animales explotadas se debe a la exclusiva explotación extensiva de los limitados recursos al ir acabando con la caza tradicional y dedicar progresivamente más tiempo y energía para mantener una ingestión constante de alimento que sobrexplota los recursos hasta niveles cada vez más críticos. La escasez creciente de caza mayor no sólo forzó la ampliación del espectro cinegético sino también a concentrarse en la captura de recursos de menor importancia (fundamentalmente aves) y a la manipulación de poblaciones silvestres (gacelas). Los recursos animales tradicionales (caza mayor) se hicieron progresivamente más insuficientes dentro de esta dinámica. Las gentes sedentarias tuvieron que depender de animales progresivamente menos rentables (en términos de biomasa/captura) y muchas especies de pequeño tamaño se recuperan con altas frecuencias en yacimientos natufienses y del PPN. En este marco resulta particularmente relevante el surgimiento de una caza especializada de aves. El trabajo concluye con una breve discusión sobre la evolución del comensalismo que surge súbitamente en el marco del sedentarismo y con la especiación de especies comensales tales como el gorrión común, *Passer domesticus*.

PALABRAS CLAVE: "AMPLIO ESPECTRO", COMENSALISMO, NATUFIENSE, SEDENTARISMO, NEOLITICO PRECERAMICO A, NEOLITICO PRECERAMICO B

INTRODUCTION

After hundreds of millennia of Pleistocene hominid evolution, in a certain geographical region small groups of hunters and gatherers, with ephemeral occupation of land and high residential mobility, suddenly gave rise to larger, functionally interdependent groups, hierarchically organized along economic and social lines. This event came to full realization during the later part of the Epi-Palaeolithic of the southern Levant (Tchernov, 1991, in press). The sedentary settlements and agricultural communities of the southern Levant developed from the Epi-Paleolithic hunter-gatherer's way of life (Hovers, 1989; Hovers et al., 1988). Social and economic changes from the foraging mode of subsistence are clearly visible with the appearance of the Natufian entity, when sedentism, intensive harvesting of wild cereals and some storage took place (Bar-Yosef, 1981, 1983; Henry, 1983, 1989).

The transition from a situation in which the entire population within a given area was spontaneously organized from bands of hunter-gatherers to another one with relative large societies of sedentary foragers, is probably one of the best examples of an abrupt increase in the socio-economy of man. Belfer-Cohen (1991) argued that the shift to sedentism in the Levantine sequence took place within a short time span which explains why archeologists have great difficulties in identifying the transition phase between the Geometric Kebaran complex and the Early Natufian. Hence sedentism seems to be a very late phenomenon in human evolution. Bar-Yosef and Belfer-Cohen (1989) agree that the irreversible transformation of several families, extended families, or even small bands into higher social organization acquired new properties, such as division of labor, formation of task groups or intergroup identification.

According to Valla (1987, 1988) $C^{(14)}$ dates show that the most ancient period of the Natufian would be dated from ca 12,500 B.P. up to ca 11,000 B.P.; the recent phase would last up to about 10,500 B.P., followed by the final phase up to about 10,200 B.P. The Natufian entity emerged within a relatively limited area; from the Euphrates in the north (Moore, 1989) to the Negev highlands in the south and the Jordanian plateau in the east (Bar-Yosef & Belfer-Cohen, 1989; Henry, 1985, 1989). Most of the "Early" and "Middle" Natufian sites were found within the Mediterranean and Irano-Turanian phytogeographic regimes, and its core area was concentrated along the pistacia-oak belt (Figure 1). It seems that the Natufian area was increasing in time when they dispersed into marginal and, eventually, into desert areas (Henry, 1985, 1989; Betts, 1989; Garrard et al., 1988). Yet these peripheral sites were much smaller in size (Bar-Yosef & Belfer-Cohen, 1989), and were probably inhabited by populations with higher mobility patterns.

While nomadism, or mobility, was the rule in human behavior throughout the major part of history, vagility among other mammals seems to be an uncommon behavioral pattern. It is hence surprising that man, who became in later prehistoric time such a dominant factor in most ecosystems, at a certain time and a certain place shows such a punctuational shift from a mainly nomadic way of life with ephemeral occupation of habitats, to sedentism some 12.000 years ago. In order for large carnivores to detect large prey more efficiently, they have to cover large foraging areas, and therefore became more mobile animals. The only way to decrease mobility, or to reduce the foraging area, and to establish a more sedentary behavioral pattern, is to shift to predation of smaller animals, or to become less specialized or more omnivorous (Harestad & Bunnell, 1979; Shipman & Walter, 1989). Much the same is true for herbivorous mammals; the larger they are, the more mobile they are. By analogy, during the shift of the Natufians to sedentism, we may expect them to change their

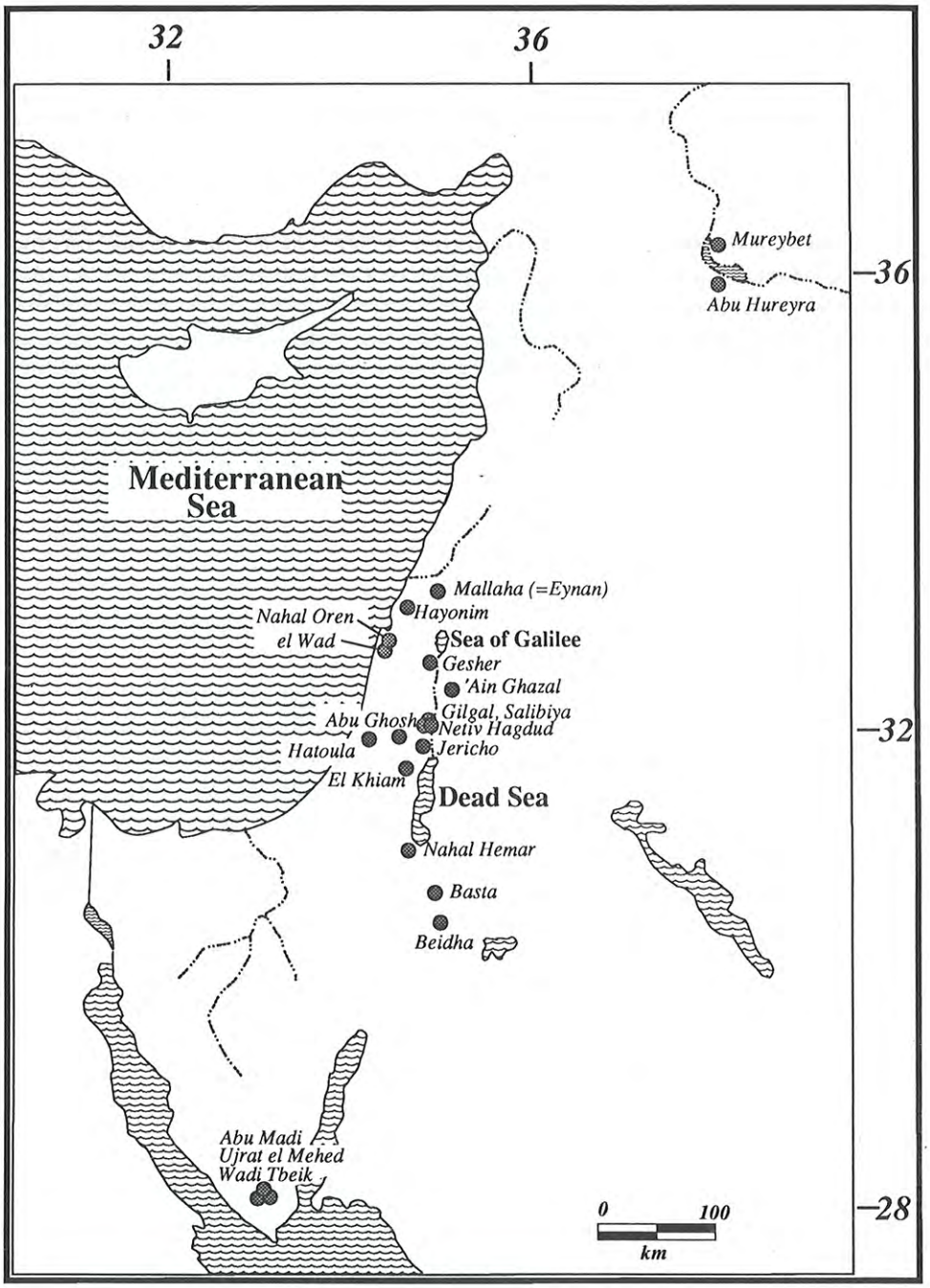


FIGURE 1 -A map of the southern Levant showing the main Natufian, Pre-Pottery Neolithic A and Pre-Pottery Neolithic B sites within the Mediterranean, Irano-Turanian and Arabian regimes, where essentially sedentism took place and the earliest villages are known.

exploitation behavior by including a broader spectrum of food resources, to become more vegetarian, or, in general, gain more omnivorous habits. Indeed, shifting into the sedentism strategy caused changes in the feeding behavior of man. This conforms to the "ecological rule" which states that whenever an organism will shift into a lower stage in the ecological pyramid, or from a stage of a primary consumer to a secondary consumer, it will loose energy, or use less rewarding food. Indeed, the transformation of human populations into a less mobile life cycle, brought them into a lower trophic level.

A prolonged occupation of a site will cause an enormous drain on the adyacent areas, which ultimately will turn into a barren land. High exploitation of the resources, killing off the game, and spending more time just to maintain constant level of food intake within the limited area available for the people, will utterly alter the natural habitats around the sites. A centripetal ecological gradient will be created by the intensive anthropogenic activities around the site (Tchernov, 1991). It is expected that the belt closest to the occupational site will be constantly and extensively used by the inhabitants. Ecologically it will be completely devoid of plants and animals. The peripheral belts around the core of the site will show a gradual relaxation in the exploitation of the resources, but the width of these ecological belts will fluctuate due to the seasonal changes brought about in the carrying capacity of the area. Habitats will gradually turn to be more natural in the outer belts, so that hunting can be practised only at a certain distance from the site. It is important to emphasize that the constant degradation of biological resources from and around early human settlements created a unique and isolated mini-ecosystem that was virtually devoid of most plants and animals, but opened new niches and opportunities for preadapted colonizers.

In order to overcome the overexploited region deficiencies, more satisfactory technologies for food gathering, meat retrieval and efficient storage, should have been adopted if people kept on living in the same place. Under these circumstances, especially when the area around the site has no sufficient or constant supply of food to support the local inhabitants, there will be a pressure to develop symbiotic relationships with nomadic people. Indeed, connections with remote populations are evidenced particularly from the conchiological record of all Natufian sites (Mienis, 1987; Bar-Yosef, in press), showing that trading with remote regions was highly developed during this period, and that obligate socio-economic mutualism had been already established between nomadic and sedentary populations.

The Avian Component in the "Broad Spectrum"

Diet of the Natufian and Early Neolithic Populations

During the Neolithic, the strategic solution in order to survive in a degradating and progressively-exhausted habitat was to rely more strongly on animal husbandry and farming. But during the early Natufian economical solutions should have been sorted out in other directions, and the ultimate ones followed the behavioral patterns of other vagile animals that shift into low mobility, as has been mentioned in the introduction, by adopting a wider ecological niche (=broader spectrum exploitation of the local resources, Flannery, 1972). In an analogous way to other large mammals with restricted mobility, the ultimate outcome of human sedentism triggered larger scale and much more intimate biological interactions with coexisting (=sympatric and syntopic) species.

A significant increase in the species diversity of terrestrial molluscs (Tchernov, 1991), birds and reptiles was recorded in the Natufian. The great majority of the species which were used for food, were either small sized animals, not at all used before the Natufian, among which many species of birds (in particular passeriformes) various species of lizards and snakes, fishes and land snails constituted a significant portion (Figure 2). All these non-rewarding small animals abruptly became very abundant and an integrative part of the food resources for the Natufian and early Neolithic villagers.

At the same time the earliest 'villagers' continued to practice intensive and specialized hunting of specific species of small and large game. Hence, the early sedentary populations were not only shifting into a broader dietary spectrum, and relying on a greater proportion of smaller ("lower ranked") animal species, but, contrary to earlier periods, they gradually focused their hunting efforts on specific species. The specialization toward hunting certain small species like *Lepus*, Phasianidae (mainly *Alectoris* and *Coturnix*) and Waterfowl in extremely high proportions and throughout the year, is well recorded in all Natufian and PPNA sites, and throughout their sequence. One of the main hunting targets among birds is the chukar partridge (*Alectoris chukar*). Its tarsometatarsi, especially their distal parts, for example, were regularly and intensively used as a raw material for manufacturing beads (Pichon, 1984, 1987, 1989). Other specializations were aimed towards waterfowl and birds of prey. Among the small mammals *Lepus* became the most popular prey. But *Gazella gazella* which always significantly outnumbers all other ungulates is still the main food resource of the Natufian people. The Natufians exerted also a highly sophisticated male selection culling on the local populations. The representation of males in the Natufian sites fluctuate between 60-80%, depending on the site and date (Horwitz et al., 1991).

SEDENTISM AND COMMENSALISM

One of the most interesting phenomena that followed the long term occupation of the Natufian sites is the abrupt appearance of commensals around human habitations (Tchernov, 1984, in press). When new habitats were created by the Natufians within and around the primeval villages, they attracted special colonizers, basically omnivorous and catholic vertebrates (mice, rats, wolves, sparrows, etc.), which found themselves co-existing broadly in and around the anthropogenic sites, the result of which was, on an evolutionary scale during a relatively short period, the development of indirect commensal relationships by the newly created subspecies or species.

These species are able to use human habitats and consequently might reduce to a minimum their gene exchanges with surrounding populations. Indeed, one of the most interesting phenomena that followed the long term occupation of the Natufian sites is the abrupt appearance of commensals around human habitations (Tchernov, 1984, in press). Once a more constant availability of food and/or shelter was provided, it could have attracted fostered (commensal) populations of certain species which would consequently gain an advantage over non-commensal ('wild') populations. Such one-sided symbiosis may increase the survivorship rate, especially of juveniles, of the active commensal partner due to a series of causes, among them:

1. Presence of kitchen middens within and around the sites could have been used as a permanent supply of food.

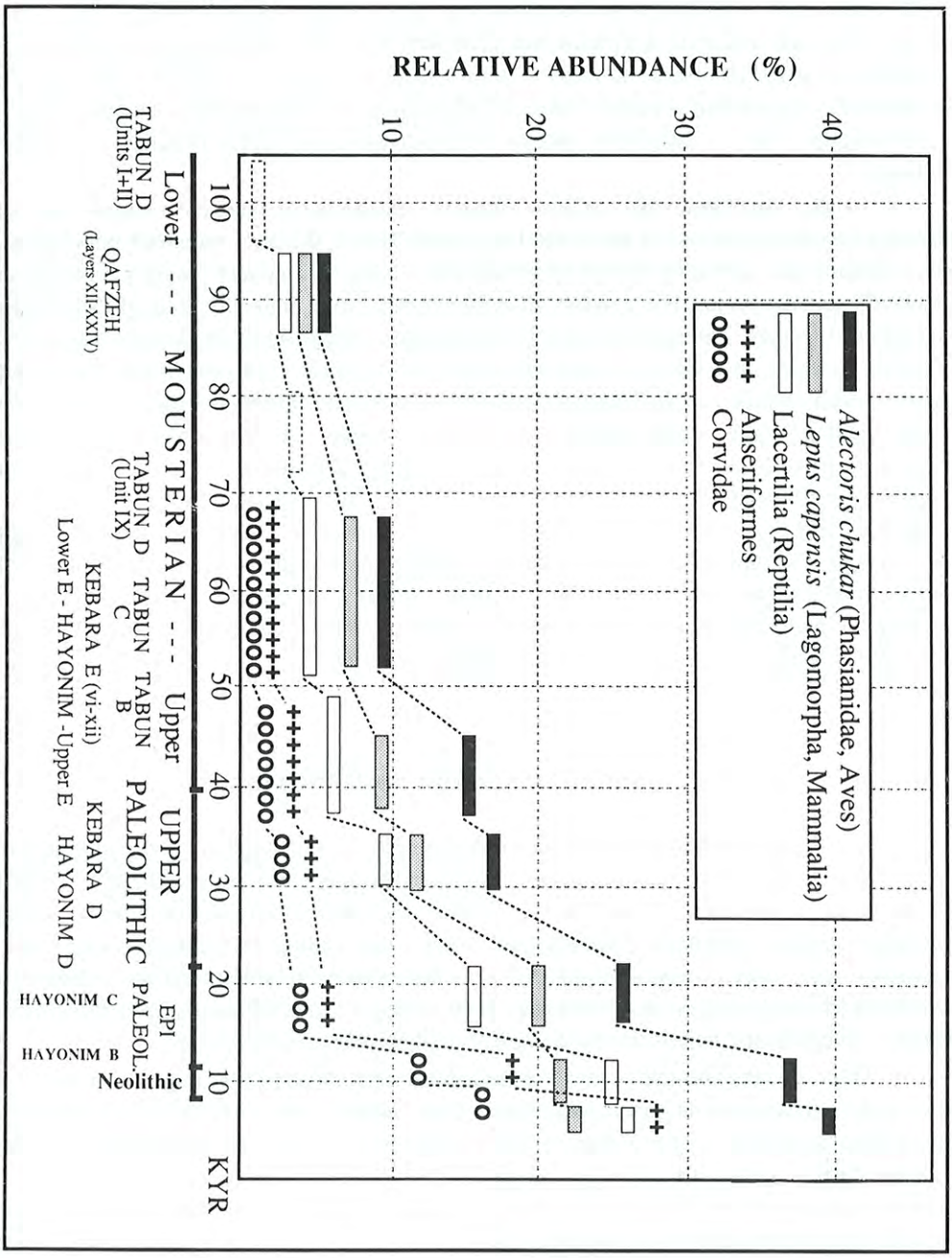


FIGURE 2 - The main changes in the subsistence strategy and feeding behavior of the Natufian sedentary people. The growing scarcity of large game forced people not only to broaden the spectrum of hunted animals, but to concentrate on a greater diversity of minor resources. Relative frequencies of *Lepus capensis* (MNI based on Pm1; given in %) in relation to all rodents (MNI of M1). An abrupt increase in the frequency of this species took place during the Epipaleolithic. The relative abundance of Lacertilia (lizards) and snakes, as compared to all rodent taxa. The MNI was based on lower jaw counts. Relative frequencies of *Alectoris chukar*, Anseriformes and Corvidae (given in %) in relation to all birds (based on MNI of humeri).

2. A relatively predator-free habitat; in particular an increase in the availability of protected dens and resting sites.

3. The proximity of intensive human activities may largely deter most of the other coexisting species. As a consequence, low species diversity in the close vicinity of the sites will decrease inter-specific competition, at the cost of increasing intra-specific competition, and hence high selection, genetic drift and consequently the amount of biological changes.

The most abundant commensals in the Middle East are *Mus domesticus, Rattus rattus, Rattus norvegicus* (late colonization), and *Acomys cahirinus* (restricted to semi-arid and arid regions) which belong to the Muridae, Rodentia; *Passer domesticus* (Ploceidae, Passeriformes), and *Columba livia* (Columbiformes). Carnivores like the jackal (*Canis aureus*) and the fox (*Vulpes vulpes*) may show accidental to more permanent associations with man in rural regions (a stage intermediate to plesiobiosis and early commensalism). The domestication of the dog, which could have been the consequence of an earlier commensal relationship between wolves and man, later played an important role in human behaviour which remains to this day.

Passer domesticus is not known prior to the Natufian, and much like *Mus domesticus*, could have been punctuationally speciated (Tchernov, 1962) from an ancestral form which I called *P. predomesticus*, and found to be closely related to the African sparrow *P. iagoensis* (Markus, 1964) (Figure 3).

The frequency distribution of skeletal elements of the house sparrow does not show whether this species was used in any way by the Natufians, in spite of its great abundance within and around their sites (at least at Hayonim cave) (Figure 4).

EXPLOITATION OF BIRDS IN THE PPNA

The onset of the early Neolithic may be placed in the southern Levant around 10,300-10,200 B.P. (based on dated wood, mainly *Tamarix*). The reading of C^{14} in phase BI and II in Muryebet was around 10,600-10,500 B.P. Hence, there is no evidence for synchroneity for the onset of the Neolithic between the northern and southern Levant (Bar-Yosef, 1989). The Neolithic succession was determined and coined by Kenyon (1957) based on her excavations at Jericho, as Pre-Pottery Neolithic A, Pre-Pottery Neolithic B (PPNA, PPNB) and Pottery Neolithic (PN). The emergence of the large Early Neolithic communities (Cauvin, 1987; Bar-Yosef, 1989) was already associated with either cultivated or intensively collected wild barley. Exploitation of vegetal resources seems to have greatly increased (various legumes, oats, acorns, pistachio nuts and figs (Kislev et al., 1986), while the exploitation of animal resources seems to continue along with the Natufian tradition; specialized hunting of a large array of vertebrates, among which many small species of mammals, birds and reptiles are represented.

In many ways the PPNA may be accepted as a prolongation of the Natufian period. The economic basis was a mixture of cultivation of emmer, barley and legumes. Fruits and wild seeds were collected including nuts and acorns. Plant remains indicate the practice of cultivation of wild barley and the systematic gathering of seeds and fruits in the region up to about 10 km around each site. Specialized hunting and trapping of a large spectrum of animals, but in particular water birds, as well as selective hunting of gazelles and some fishing in a few sites, provided the meat component in

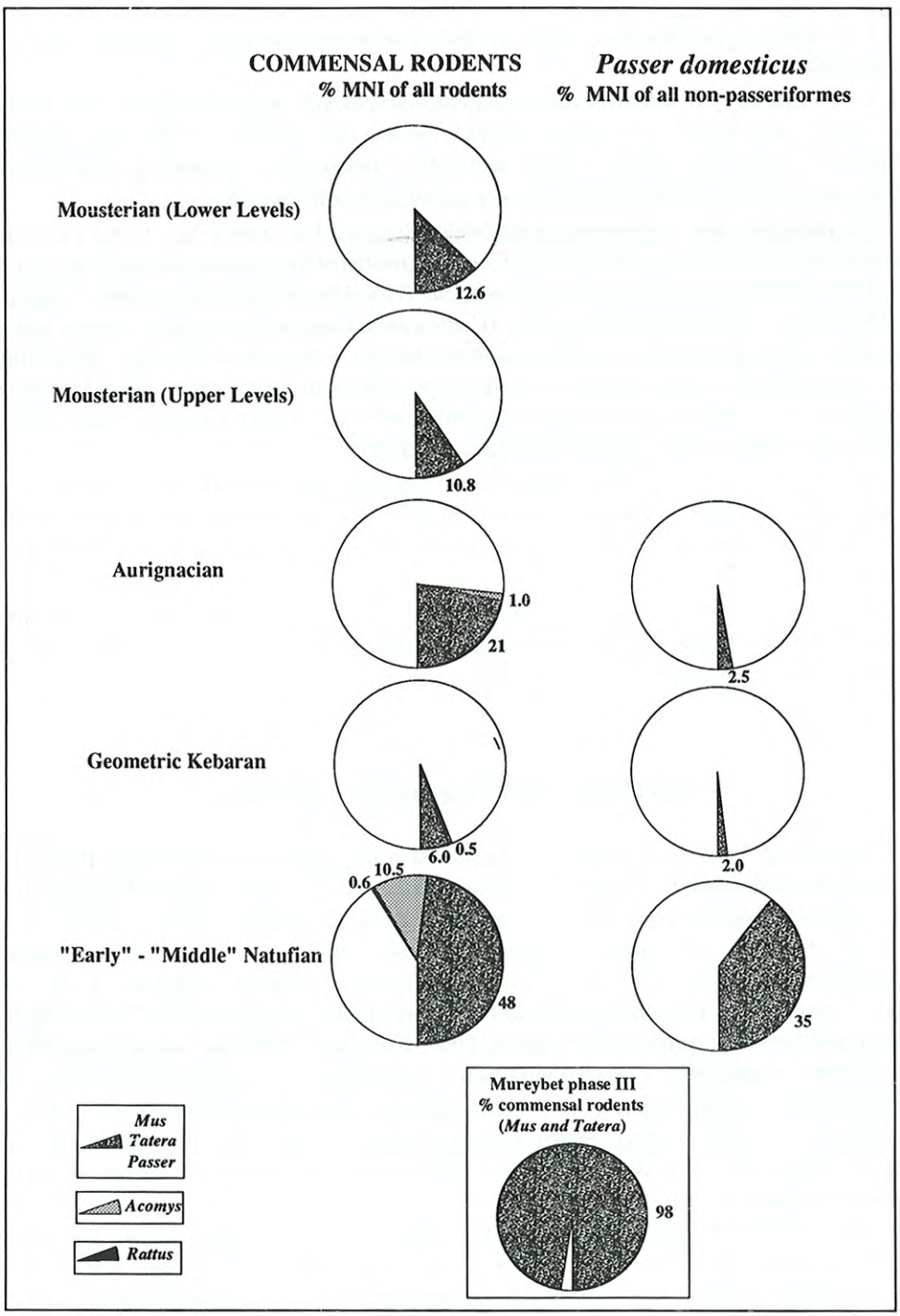


FIGURE 3 - Relative frequencies of commensal rodents (*Mus, Rattus* and *Acomys*, Muridae) and *Passer domesticus* (Ploceidae) from the Middle Paleolithic to the Natufian period.

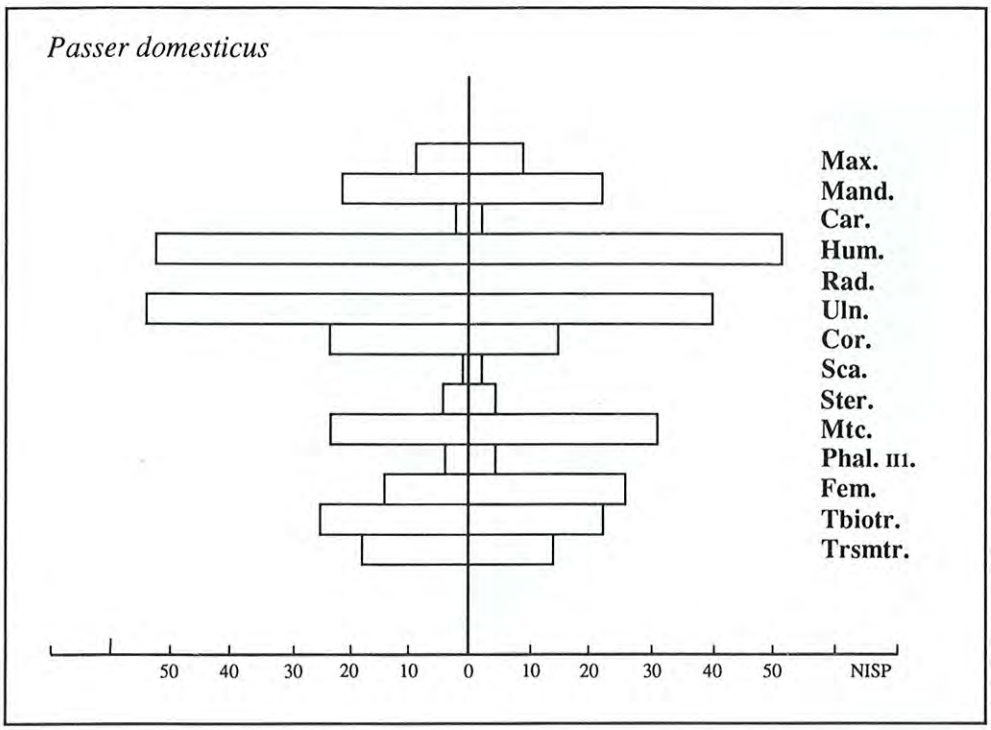


FIGURE 4 - A comparison of the relative representation of the skeletal parts of *Passer domesticus* from the Natufian layers of Hayonim cave. Modified after Pichon (1984).

the diet. In this respect, this strategy seems to be a direct continuation of the Natufian tradition. Gazelles were still the main game animal in the Mediterranean belt.

PPNA sites are not very common in the southern Levant, and much less information is available on the archaeozoology of this interim period between the Natufian early sedentism and the beginning of domestication in the PPNB period.

The mound of Netiv Hagdud lies (Figure 1) at about -190/-200 m below sea level at the outlet of Wadi Kakar, 14 km north to Jericho (Bar-Yosef et al., 1991). The site of Netiv Hagdud in the Jordan Valley was recently analyzed in some detail, and may cast more light on the exploitation of animals and birds during this period.

Increase in the exploitation of a large spectral array of animal species, grains and plants, could have been only the consequence of overuse of an area and draining the food resources for a long period of time (Tchernov, in press). The traditional sources of animal species hunted for meat under these conditions, became insufficient so that sedentary human populations were enforced to rely on much less energetically (amount of meat per catch) rewarding animals, and many small species became newly and highly represented in all Natufian layers (Figure 5). But it is not only the almost revolutionary broadening of the exploited animal species what is intriguing, but the specialization toward hunting certain small species (like Lepus and Alectoris) in extremely high proportions and

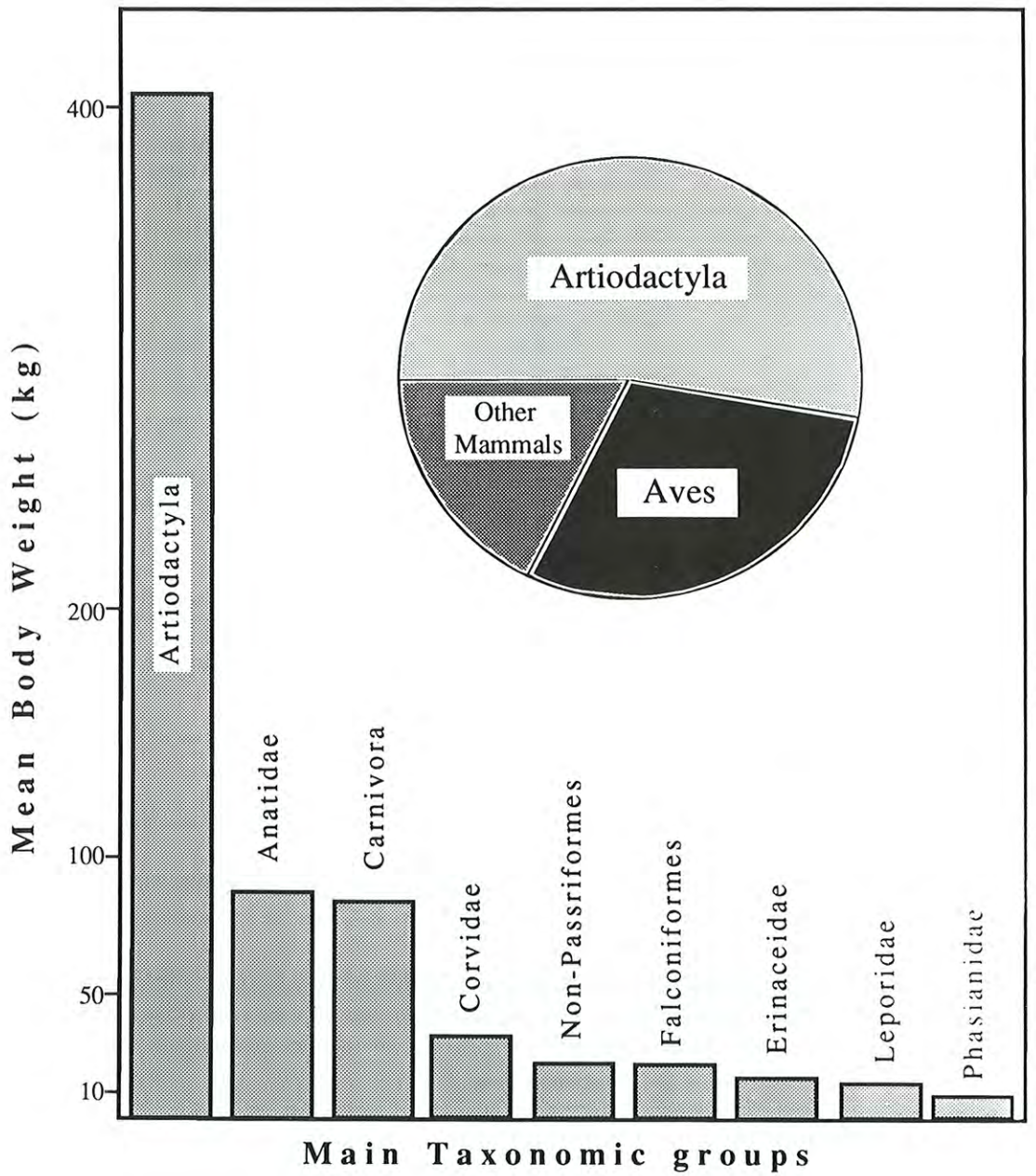


FIGURE 5 - The gross proportion of the mean body weight (given in Kg) of the main taxonomic groups that were exploited by the PPNA people in the site of Netiv Hagdud.

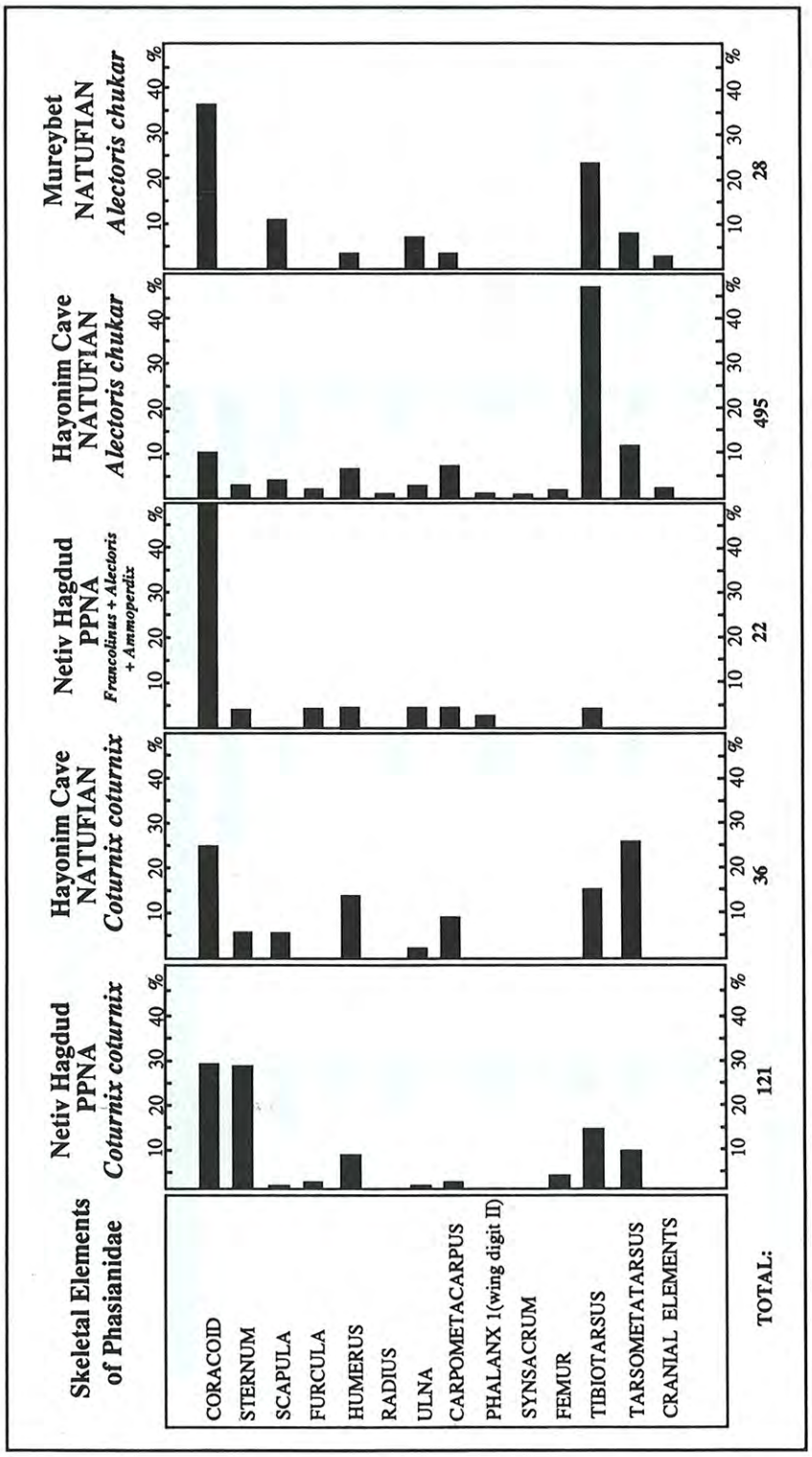


FIGURE 6 - A comparison of the relative representation of the skeletal parts of several species of Phasianidae in PPNA and Natufian sites. There is a clear preference for the coracoid (as well as all the "triosseum" complex in Netiv Hagdud), probably indicating a special exploitation of the pectoral muscles. The tibiotarsus and the tarsometatarsus appear also in abundance in most of the sites. The distal part of the tarsometatarsus of *Alectoris chukar* was intensively used during the Natufian period for manufacturing beads (Pichon, 1984).

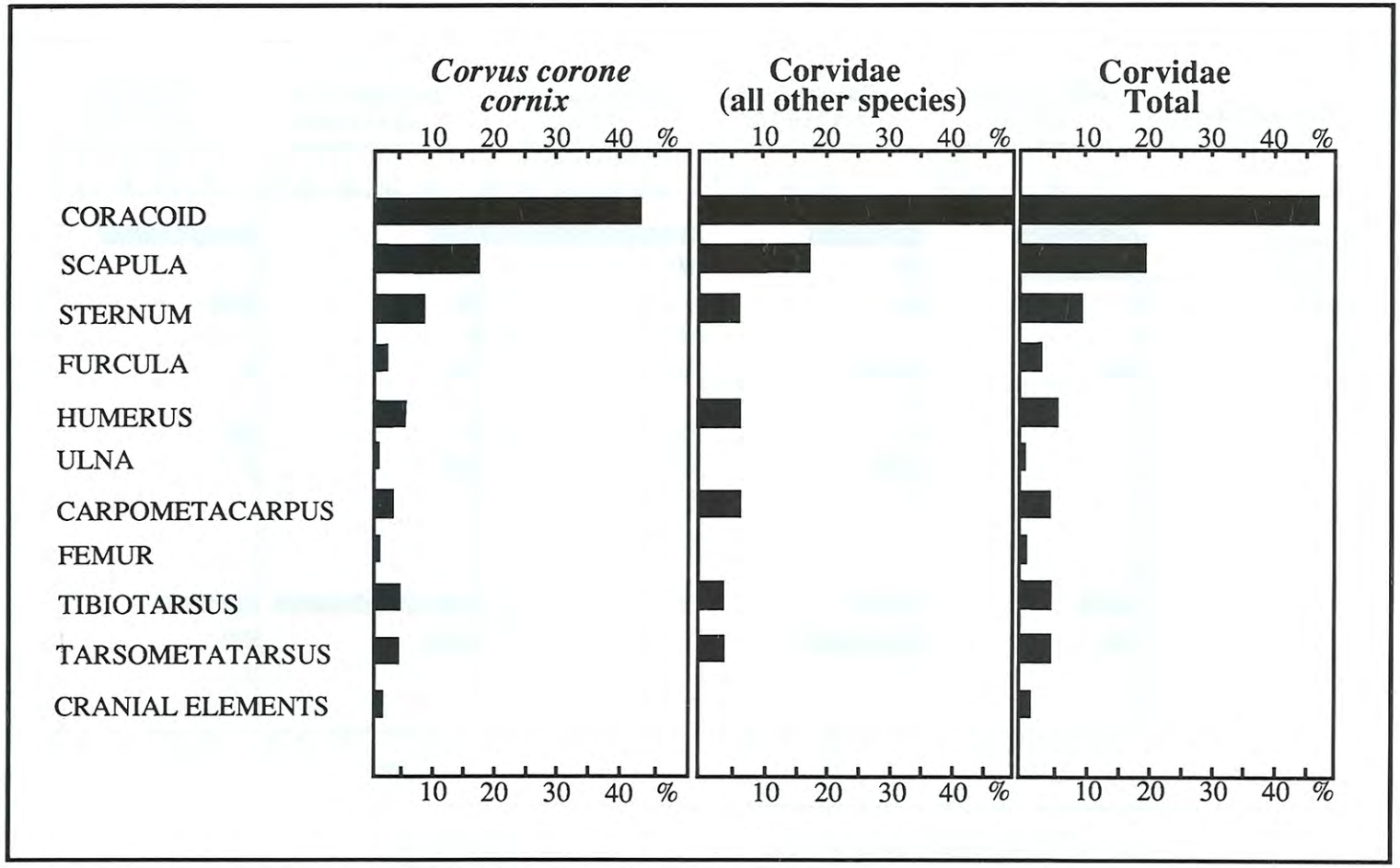


FIGURE 7 - A relative representation of the skeletal parts of Corvidae, mainly *Corvus corone* from the PPNA of Netiv Hagdud. There is a conspicuous preference for the "triosseum" complex, or the pectoral muscles of this group which was heavily exploited by the community of Netiv Hagdud.

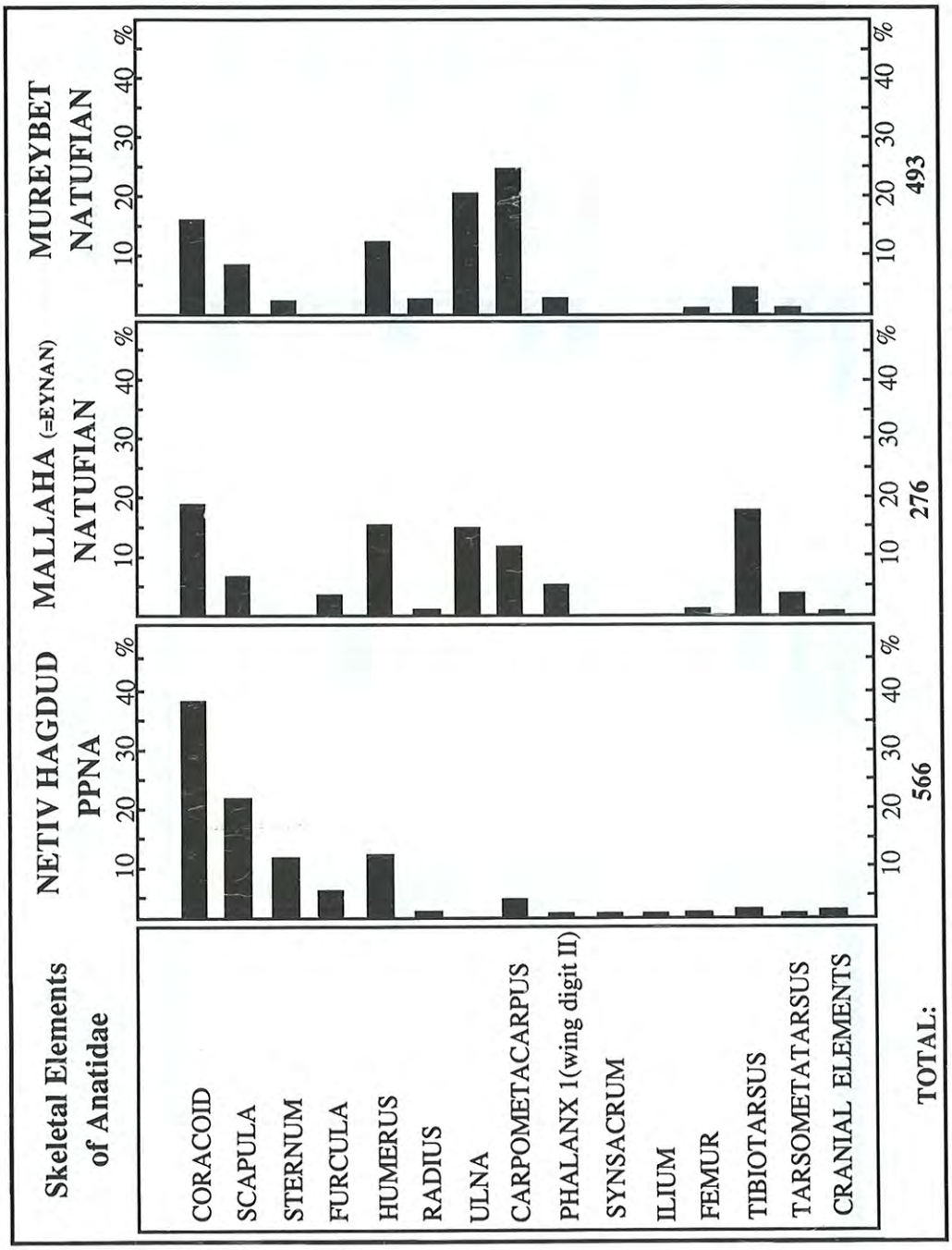


FIGURE 8 - A comparison of the relative representation of the skeletal parts of ducks (Anatidae) in the PPNA of Netiv Hagdud and two Natufian sites. There is a general preference for the "triosseum" complex in both periods. There is, however, higher selection for the wing and foot portions during the Natufian.

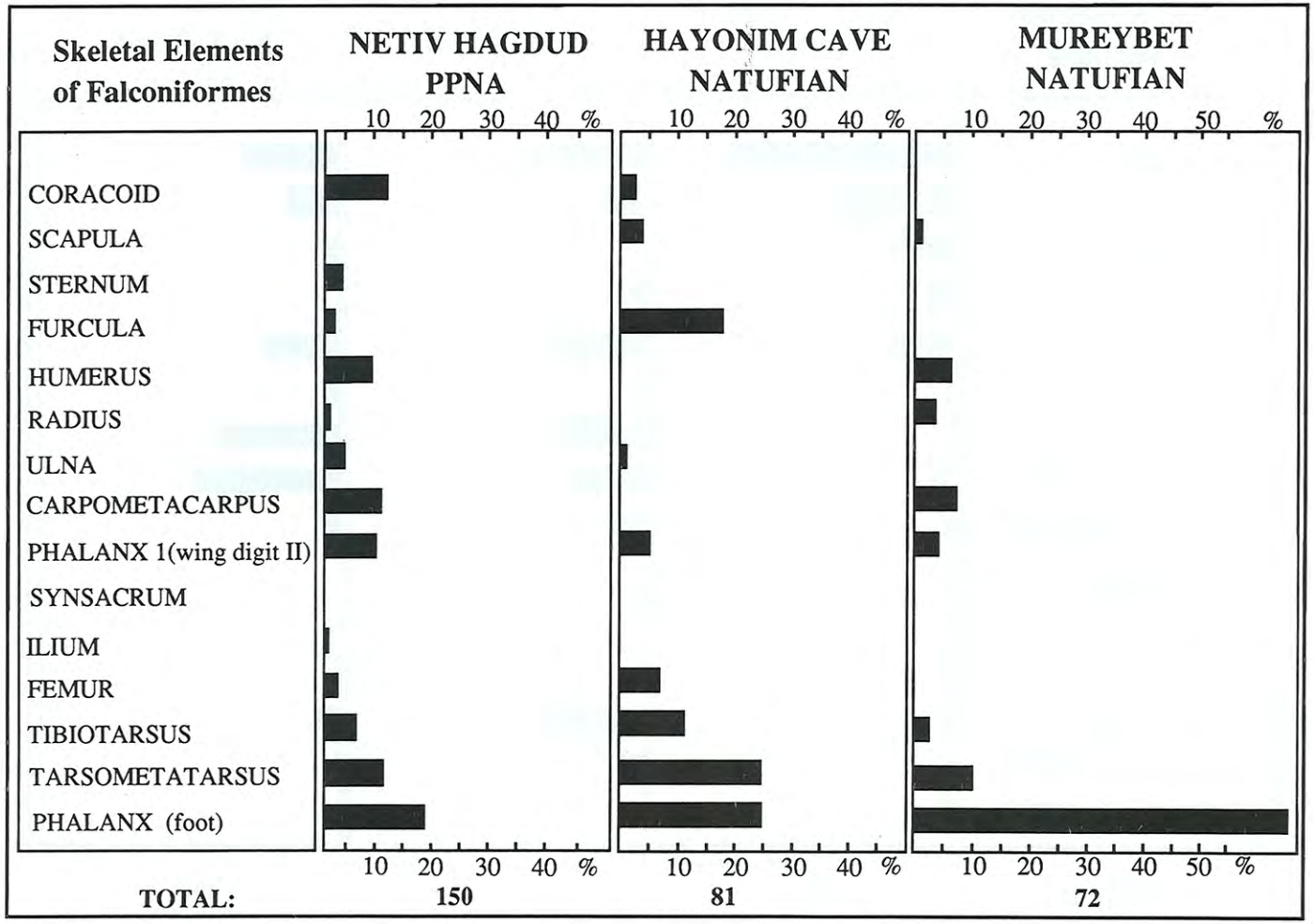


FIGURE 9 - A comparison of the relative representation of the skeletal parts of several species of falconiform birds in PPNA and Natufian sites. During these periods there is a clear preference for collecting foot phalanxes, as well as tarsometatarsi and tibiotarsi. As for other skeletal elements there is no consistent pattern among the sites.

Skeletal Elements	*C. coturnix*		*Francolinus+Alectoris +Ammoperdix*		*Alectoris chukar*		*C.coturnix*		*Alectoris chukar*	
SITES	Netiv Hagdud[a] PPNA				Hayonim Cave[b] Natufian				Mureybet[b] Natufian	
Skeletal Elements	n	%	n	%	n	%	n	%	n	%
Cranial elements	-	-	-	-	11	2.2	-	-	1	3.6
Coracoid	35	28.9	12	55.2	51	10.3	9	25.0	10	35.6
Sternum	34	28.1	1	4.6	15	3.0	2	5.6	-	-
Scapula	1	0.8	-	-	22	4.4	2	5.6	3	10.7
Furcula	2	1.7	1	4.6	13	2.6	-	-	-	-
Humerus	11	9.1	1	4.6	34	6.9	5	13.8	1	3.6
Ulna	1	0.8	1	4.6	12	2.4	1	2.8	2	7.2
Radius	-	-	-	-	3	0.6	-	-	-	-
Carpometacarpus	1	1.7	1	4.6	36	7.3	3	8.4	1	3.6
Wing phalanx II	-	-	-	-	8	1.6	-	-	-	-
Pelvical elements	-	-	-	-	5	1.0	-	-	-	-
Femur	5	4.1	-	-	9	1.8	-	-	-	-
Tibiotarsus	18	14.9	1	4.6	214	43.3	5	13.9	8	28.5
Tarsometatarsus	12	9.9	4	17.2	62	12.6	9	25.0	2	7.2
Total	**121**	**100**	**22**	**100**	**495**	**100**	**36**	**100**	**28**	**100**

TABLE 1 - Number of skeletal elements and their percentage representation in the Phasianidae in natufian and PPNA sites.
(a) Tchernov, unpublished data; (b) Pichon (1984, 1987).

Skeletal Elements	*Corvus corone cornix*	*Corvus monedula*	*Corvus ruficollis*	*Corvus rhipidurus*	*Pica pica*	Corvidae Total
Coracoid	144 (44.31%)	10 (43.48%)	2 (100%)	-	4 (100%)	160 (45.07%)
Scapula	60 (18.46%)	5 (21.74%)	-	-	-	65 (18.31%)
Sternum	32 (9.85%)	1 (4.34%)	-	1 (100%)	-	34 (9.58%)
Furcula	11 (3.38%)	-	-	-	-	11 (3.10%)
Humerus	19 (5.84%)	2 (8.69%)	-	-	-	21 (5.91%)
Ulna	3 (0.92%)	-	-	-	-	3 (0.84%)
Carpometacarpus	14 (4.31%)	2 (8.69%)	-	-	-	16 (4.54%)
Phalanx 1, wing digit III	1 (0.31%)	-	-	-	-	1 (0.28%)
Ilium	1 (0.31%)	-	-	-	-	1 (0.28%)
Femur	4 (1.23%)	-	-	-	-	4 (1.13%)
Tibiotarsus	12 (3.69%)	1 (4.34%)	-	-	-	13 (3.66%)
Tarsometatarsus	18 (5.54%)	1 (4.34%)	-	-	-	19 (5.35%)
Upper Jaw	1 (0.31%)	-	-	-	-	1 (0.28%)
Lower Jaw	3 (0.92%)	1 (4.34%)	-	-	-	4 (1.13%)
Quadratum	2 (0.62%)	-	-	-	-	2 (0.56%)
Total	325	23	2	1	4	**Grand Total: 355**
M.N.I.	**72** (=144/2 corac.)	**5** (=10/2 corac.)	**1** (=2/1 corac.)	**1**	**2** (=4/2 corac.)	**80** (=160/2 corac.)
Total Weight Estimation (kg)*	72x395= **28.440**	5x240= **1.200**	**0.675**	**0.440**	2x175= **0.350**	**Total: 31.105**

TABLE 2 - Number of skeletal elements and their percentage representation in the family Corvidae and the minimum number of individuals (MNI). Assumig that each hunted individual reflects a complete carcass consumed in the site, the meat weight estimations also represented. Weights of the Corvidae were recorded by the author. (*) The weight of: *Corvus corone cornix*: 330-460 g (x=395), *Corvus monedula*: 190-290 g (x=240), *Corvus ruficollis*: 500-850 g (x=675), *Corvus rhipidurus*: 330-550 g (x=440), *Pica pica*: 150-200 g (x=175).

Anatidae	Netiv Hagdud[a] PPNA		Mallaha (Eynan)[b] Natufian		Mureybet[b] Natufian	
Skeletal Elements	n	%	n	%	n	%
Coracoid	219	38.7	53	19.2	78	15.9
Scapula	129	22.8	24	8.7	42	8.5
Sternum	64	11.3	-	-	10	2.0
Furcula	39	6.9	8	2.9	-	-
Humerus	67	11.8	43	15.6	73	14.9
Radius	4	0.7	4	1.5	14	2.8
Ulna	-	-	41	14.9	98	19.9
Carpometacarpus	20	3.5	28	10.2	123	24.9
Wing phalanx II	1	0.2	14	5.1	15	3.0
Synsacrum	1	0.2	-	-	-	-
Femur	4	0.7	3	1.1	5	1.0
Tibiotarsus	6	1.1	43	15.6	27	5.5
Tarsometatarsus	1	0.2	13	4.8	8	1.6
Cranial elements	10	1.7	2	0.7	-	-
Total	**566**	**100**	**276**	**100**	**493**	**100**

TABLE 3 - Number of skeletal elements and their percentage representation in the family Anatidae in natufian and PPNA sites. (a) Tchernov, unpublished data. Based on the following species: *Anas platyrynchos, Anas querquedula, Anser albifrons*; (b) After Pichon (1984, 1987). Based on the following species: *Anas platyrhynchos, Anas querquedula, Anas clypeata, Anas crecca, Marmaronetta angustirostris; Aythya spp, Tadorna tadorna, Bucephala clangula.*

SITES	Netiv Hagdud[a] PPNA		Hayonim[b] Natufian		Mureybet[b] Natufian	
Skeletal Elements of Falconiformes	n	%	n	%	n	%
Coracoid	19	12.7	2	2.5	-	-
Scapula	-	-	3	3.7	1	1.4
Sternum	6	4.0	-	-	-	-
Furcula	3	2.0	14	17.3	-	-
Humerus	13	8.7	-	-	4	5.6
Radius	1	0.7	-	-	2	2.8
Ulna	7	4.7	1	1.2	-	-
Carpometacarpus	17	11.3	5	6.2	5	6.9
Wing phalanx II	16	10.7	1	1.2	3	4.2
Synsacrum	1	0.7	-	-	-	-
Femur	7	4.7	6	7.4	-	-
Tibiotarsus	13	8.7	9	11.1	2	2.8
Tarsometatarsus	18	12.0	20	24.7	8	11.1
Foot phalanges	29	19.1	20	24.7	47	65.2
Cranial elements	-	-	-	-	-	-
Total	**150**	**100**	**81**	**100**	**72**	**100**

TABLE 4 - Number of skeletal elements and their percentage representation in the Falconiformes in natufian and PPNA sites. (a) Based on the following species: *Milvus migrans, Buteo spp., Pernis apivorus, Aquila spp., Falco spp., Accipiter spp.*, and undetermined Falconiformes. Tchernov, unpublished data; (b) Based on the following species: *Buteo spp, Aquila spp., Falco spp.*, Pichon (1984, 1987).

throughout the year (Pichon, 1989). The abrupt increase in the amount of Phasianidae (*Alectoris chukar*) and waterfowl (mainly Anatidae) is clearly shown in Figure 2. The body part frequencies of partridges indicate that very often, and in contrast with the ducks, they did bring the whole body (not the skull though) to the site, but from most of the species they selected only the legs that included femora, tibiotarsi, tarsometatarsi and many phalanges that could have been used, especially the sharp claws, as tools. Figures 6 to 9 and Tables 1 to 4 show the different preferences for body parts obtained from each one of the avian groups. The impression gained is that raptors were used for different purposes and not only as a food resource. For example, the tarsometatarsi of *Alectoris chukar* (Table 1; Figure 6), especially their distal parts, were regularly and intensively used as raw material for manufacturing beads (see details in Pichon, 1984, 1987, 1989).

But when dealing with some other common groups of birds the purpose of use becomes still clearer. All groups of birds of great importance in terms of biomass (Anatidae, Phasianidae and Corvidae but not Falconiformes) (Tables 1 to 4; Figures 6 to 9) show a clear preference for the "triosseum" complex; scapula, coracoid and sternum, on which the "breast" muscles, pectoralis major and pectoralis minor, are attached. Obviously the purpose of carrying this special part of the body was for specific exploitation of these massive and clean muscles, yet very lean. Some other less common non-passeriform groups of birds show a much higher frequency of the pectoral girdle.

For the Falconiformes a completely different selective attitude is exemplified by the relative frequency of their skeletal elements (Table 4; Figure 9). In this group legs (tarsometatarsi but in particular the phalanges) were more frequently selected and transported to the home base, while coracoids and sterni of all the raptors are largely absent, except for *Milvus migrans* and the unidentified falconiforms, the majority of which may anyhow belong to *Milvus migrans*. It is hence reasonable to assume that, in contrast with all other raptors, kites were also used as a food resource in a similar procedure as ducks by tearing the pectoral muscles out of the carcass. In general foot elements are much more abundant than elements from the pectoral girdle and the forelimbs. Obviously the local inhabitants handled most of the falconiformes differently. The body parts frequencies indicate that very often, and in contrast with the ducks, they did bring the whole body (not the skull though) to the site area, but of most species they selected only the legs, mainly the phalanges, from which the sharp claws could have been used as tools.

Although there is a plethora of avian material, mainly from the Natufian period (Hayonim Terrace, Hayonim cave (Layer B), Eynan (=Mallaha) and Hatoula) which still awaits a thorough research from different paleobiological and zooarchaeological perspectives, some concluding results from the Natufian and early Neolithic (PPNA, PPNB) avifaunas can be already made in the southern Levant. The systematic list which is given in Tables 5 a,b,c, summarizes the updated information of all the birds from this region during this period. This list can therefore be used as a basic reference for further ornithoarchaeological studies in the region and this publication is a unique opportunity to make the summarized data available for the first time to a larger audience of faunal analysts and archaeologists in general.

HAYONIM CAVE[a]	MALLAHA[a]	MUREYBET[a]	NETIV HAGDUD[b]	GILGAL[c]	JERICHO[d]	JERICHO[d]	*'AIN GHAZAL*[e]
N A T U F I A N			P	P N	A	P P	N B
Podicipitiformes	**Podicipitiformes**	**Podicipitiformes**	**Podicipitiformes**	**Podicipitiformes**	**Podicipitiformes**	**Podicipitiformes**	**Podicipitiformes**
-	*Podiceps cristatus*	-	-	-	-	-	-
-	*Podiceps nigricollis*	*Podiceps nigricollis*	-	-	-	-	-
-	*Tachybaptus ruficollis*	-	-	-	-	-	-
-	-	-	**Pelecaniformes**	**Pelecaniformes**	**Pelecaniformes**	**Pelecaniformes**	**Pelecaniformes**
-	*Palacrocorax carbo*	-	-	-	-	-	-
-	*Phalacrocorax pygmaeus*	-	-	-	-	-	-
-	-	-	-	-	-	-	-
Ralliformes	**Ralliformes**	**Ralliformes**	**Ralliformes**	**Ralliformes**	**Ralliformes**	**Ralliformes**	**Ralliformes**
Rallus aquaticus	*Rallus aquaticus*	-	-	-	-	-	-
Crex crex	-	-	-	-	-	-	-
P. porzana	-	*P. porzana*	-	-	-	-	-
Fulica atra	*Fulica atra*	-	*Fulica atra*	-	-	-	-
Gallinula chloropus	*Gallinula chloropus*	-	-	-	-	-	-
-	*P. porphyrio*	-	-	-	-	-	-
Charadriiformes	**Charadriiformes**	**Charadriiformes**	**Charadriiformes**	**Charadriiformes**	**Charadriiformes**	**Charadriiformes**	**Charadriiformes**
V. vanellus	-	-	-	-	-	-	-
-	-	-	*Hoplpopterus spinosus*	*Hoplpopterus spinosus*	-	-	-
-	-	*Philomachus pugnax*	-	-	-	-	-
-	-	*Tringa stagnatilis*	-	-	-	-	-
-	*Tringa nebularia*	*Tringa nebularia*	-	-	-	-	-
-	-	-	-	-	-	-	-
-	*Scolopax rusticola*	-	-	-	-	-	-
-	-	-	-	-	*Numenius arquata*	-	-
Gruiformes	**Gruiformes**	**Gruiformes**	**Gruiformes**	**Gruiformes**	**Gruiformes**	**Gruiformes**	**Gruiformes**
-	-	-	-	-	-	*G. grus*	-
-	-	-	-	-	*Anthropoides virgo*	-	-
T. tetrax	-	*T. tetrax*	-	-	-	-	-
Otis tarda	*Otis tarda*	-	*Otis tarda*	-	-	-	cf. *Otis tarda*
Chlamydotis undulata	-	-	-	-	*Chlamydotis undulata*	*Chlamydotis undulata*	cf. *Chlamydotis undulata*
-	-	-	-	-	-	-	-
Ciconiiformes	**Ciconiiformes**	**Ciconiiformes**	**Ciconiiformes**	**Ciconiiformes**	**Ciconiiformes**	**Ciconiiformes**	**Ciconiiformes**
-	-	-	*Leptoptilus crumeniformes*	-	-	-	-
-	*Ardea cinerea*	*Ardea cinerea*	-	-	-	-	-
-	-	*Egretta alba*	-	-	-	-	-
-	*Egretta garzetta*	*Egretta garzetta*	-	-	-	-	-
-	-	-	-	-	*Ciconia niger*	-	-
-	*Ciconia ciconia*	-	*Ciconia ciconia*	-	-	-	-
-	-	-	-	-	*Columba oenas*	-	-
Columbiformes	**Columbiformes**	**Columbiformes**	**Columbiformes**	**Columbiformes**	**Columbiformes**	**Columbiformes**	**Columbiformes**
Columba livia	*Columba livia*	*Columba livia*	*Columba livia*	*Columba livia*	-	-	*Columba livia*
Columba palumbus	-	-	-	-	-	-	-
Streptopelia spp.	-	*Streptopelia* sp.	*Streptopelia decaocto*	*Streptopelia* sp.	-	-	-
Pterocles alchata	-	-	-	-	-	-	-

TABLE 5a -A comparison of the avifaunal assemblages in several natufian, PPNA and PPNB sites in the southern Levant. (a) Pichon (1984, 1987); (b) Tchernov, unpublished data; (c) Noy et al., 1980; (d) G.S. Cowles & J. Blandermar, personal communication; (e) Köhler-Rollefson (1988, 1989).

HAYONIM CAVE[a]	MALLAHA[a]	MUREYBET[a]	NETIV HAGDUD[b]	GILGAL[c]	JERICHO[d]	JERICHO[d]	*'AIN GHAZAL*[e]
N A T U F I A N			P	P N	A	P P	N B
Anseriformes	Anseriformes	Anseriformes		Anseriformes	Anseriformes	Anseriformes	Anseriformes
T. tadorna	*T. tadorna*	*T. tadorna*	*T. tadorna*	*T. tadorna*	-	-	-
-	*Casarca ferruginea*	-	-	-	-	-	-
A. anser	*A. anser*	*A. anser*	-	-	-	*A. anser*	-
-	*Anser erythropus*	-	-	-	-	-	-
Anser albifrons	-	-	*Anser albifrons*	*Anser albifrons*	-	-	-
-	*Anas penelope*	*Anas penelope*	-	-	-	-	cf. *Anas* sp.
Anas crecca	*Anas crecca*	*Anas crecca*	-	-	*Anas crecca*	*Anas crecca*	-
-	*Anas querquedula*	*Anas querquedula*	*Anas querquedula*	*Anas sp.*	-	-	-
Anas platyrhinchos	*Anas platyrhinchos*	*Anas platyrhinchos*	*Anas platyrhinchos*	*Anas platyrhinchos*	*Anas platyrhinchos*	*Anas platyrhinchos*	-
-	*Anas acuta*	*Anas acuta*	-	-	-	-	-
-	*Anas clypeata*	*Anas clypeata*	-	-	-	-	-
-	*Marmaronetta angustirostis*	*Marmaronetta angustirostis*	-	-	-	-	-
-	-	*Netta rufina*	-	-	-	-	-
-	*Aythya ferina*	*Aythya ferina*	-	-	-	-	cf. *Aythya* sp.
Aythya nyroca	*Aythya nyroca*	*Aythya nyroca*	-	-	-	-	-
Aythya fuligula	*Aythya fuligula*	*Aythya fuligula*	-	-	-	-	-
-	*Aythya marila*	*Aythya marila*	-	-	-	-	-
-	*Melanitta fusca*	-	-	-	-	-	-
-	*Bucephala clangula*	*Bucephala clangula*	-	-	-	-	-
-	*Mergus albellus*	*Mergus albellus*	-	-	-	-	-
-	-	*Mergus serrator*	-	-	-	-	-
-	*Mergus merganser*	-	-	-	-	-	-
-	*Oxyura leucocephala*	-	-	-	-	-	-
-	*Cygnus* sp.	-	-	-	*C. cygnus*	-	-
Falconiformes	Falconiformes	Falconiformes	Falconiformes	Falconiformes	Falconiformes	Falconiformes	Falconiformes
Pandion haliaëtus	*Pandion haliaëtus*	*Pandion haliaëtus*	-	-	-	-	-
-	-	-	*Pernis apivorus*	-	-	-	-
-	-	-	-	-	*M. milvus*	-	-
-	-	*Milvus migrans*	*Milvus migrans*	-	*Milvus migrans*	*Milvus migrans*	-
Neophron percnopterus	-	-	-	-	-	-	*Neophron percnopterus*
Gyps fulvus	-	-	-	-	-	-	-
Aegypius monachus	-	-	-	-	-	-	-
-	-	*Circus macrourus*	*Circus* sp.	-	-	-	*Circus* sp.
-	-	*Circus pygargus*	-	-	-	-	-
-	-	*Circus aeruginosus*	-	-	-	-	-
Accipiter nisus	-	*Accipiter nisus*	*Accipiter* sp.	-	*Accipiter nisus*	-	*Accipiter* small sp.
Accipiter gentilis	-	*Accipiter gentilis*	-	-	*Accipiter gentilis*	*Accipiter gentilis*	*Accipiter gentilis*
B. buteo	*B. buteo*	*B. buteo*	*B. buteo*	*B.cf. buteo*	-	-	*B. buteo*
Buteo rufinus	*Buteo rufinus*	*Buteo rufinus*	*Buteo rufinus*	-	-	-	-
-	-	-	-	-	-	-	*Aquila* cf. *rapax*
Aquila pomarina	-	-	*Aquila pomarina*	-	-	-	-
-	-	*Aquila clanga*	*Aquila* sp.	-	*Aquila clanga*	*Aquila* sp.	-
Aquila chrysaëtos	-	*Aquila chrysaëtos*	-	-	*Aquila chrysaëtos*	-	*Aquila chrysaëtos*
Falco naumanni	-	*Falco naumanni*	*Falco* spp.	-	-	-	-
Falco tinnunculus	-	*Falco tinnunculus*	-	-	-	-	-
Falco subbuteo	-	*Falco subbuteo*	-	-	-	-	-

TABLE 5b - A comparison of the avifaunal assemblages in several natufian, PPNA and PPNB sites in the southern Levant. (a) Pichon (1984, 1987); (b) Tchernov, unpublished data; (c) Noy et al., 1980; (d) G.S. Cowles & J. Blandermar, personal communication; (e) Köhler-Rollefson (1988, 1989).

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N A T U F I A N			P P N A			P P	N B
Galliformes	Galliformes	Galliformes	Galliformes	Galliformes	Galliformes	Galliformes	Galliformes
-	-	*P. perdix*	-	*T. tadorna*	-	-	-
Alectoris chukar	*Alectoris chukar*	*Alectoris chukar*	*Alectoris chukar*	*Alectoris chukar*	*Alectoris chukar**	*Alectoris chukar**	*Alectoris chukar*
-	-	*F. francolinus*	*F. francolinus*	-	-	-	-
-	-	-	*Ammoperdix hay*	-	-	-	-
C. coturnix	*C. coturnix*	-	*C. coturnix*	-	*C. coturnix*	-	*C. coturnix*
Phasianus colchicus	-	-	-	-	-	-	-
Strigiformes	Strigiformes	Strigiformes	Strigiformes	Strigiformes	Strigiformes	Strigiformes	Strigiformes
Tyto alba	-	-	-	-	-	*Anas crecca*	-
-	*B. bubo*	-	-	-	-	-	-
Asio otus	-	*Asio otis*	-	-	-	-	cf. *Asio* sp.
Otus scops	-	*Asio flammeus*	-	-	-	-	-
Athene noctua	-	*Athene noctua*	*Athene noctua*	-	-	-	-
Strix aluco	-	-	-	-	-	-	-
Apodiformes	Apodiformes	Apodiformes	Apodiformes	Apodiformes	Apodiformes	Apodiformes	Apodiformes
Apus affinis	-	-	-	-	-	-	-
Coraciiformes	Coraciiformes	Coraciiformes	Coraciiformes	Coraciiformes	Coraciiformes	Coraciiformes	Coraciiformes
Alcedo atthis	-	-	-	-	-	-	-
Merops apiaster	-	-	-	-	-	-	-
Coracias garrulus	-	*Coracias garrulus*	-	-	-	-	-
Upupa epops	-	-	-	-	-	-	-
Passeriformes	Passeriformes	Passeriformes	Passeriformes	Passeriformes	Passeriformes	Passeriformes	Passeriformes
Melanocorypha calandra	-	-	*Melanocorypha calandra*	-	-	-	-
Galerida cristata	-	-	*Galerida cristata*	-	-	-	-
Alauda arvensis	-	-	-	-	-	-	-
Hirundo 2 spp.	-	-	-	-	-	-	-
-	-	-	*Pycnonotus xanthopygos*	-	-	-	-
Motacilla 2 spp.	-	-	-	-	-	-	-
-	-	-	*Lanius excubitor*	-	-	-	-
Lanius spp.	-	-	-	-	-	-	-
T. troglodytes	-	-	-	-	-	-	-
Nectarinia osaea	-	-	-	-	-	-	-
Saxicola torquata	-	-	-	-	-	-	-
Oenanthe 2 spp.	-	*Oenanthe hispanica*	-	-	-	-	-
Monticola solitarius	-	-	-	-	-	-	-
Phoenicurus ochruros	-	-	-	-	-	-	-
Erithacus rubecula	-	-	-	-	-	-	-
Luscinia 2 spp.	-	-	-	-	-	-	-
Turdus 3 spp.	-	-	*Turdus merula*	-	-	-	-
Prinia gracilis	-	-	-	-	-	-	-
Sylvia 3 spp.	-	-	-	-	-	-	-
Phylloscopus sibilatrix	-	-	-	-	-	-	-
Regulus regulus	-	-	-	-	-	-	-
Muscicapa striata	-	-	-	-	-	-	-
Remiz pendulinus	-	-	-	-	-	-	-
Parus major	-	-	-	-	-	-	-
Emberiza 2 spp.	-	-	-	-	-	-	-
Fringilla coelebs	-	-	cf. *Fringilla* sp.	-	-	-	-
-	-	-	*C. coccothraustes*	-	-	-	-
Serinus sp.	-	-	*Serinus sp.*	-	-	-	-
Carduelis 3 spp.	-	-	-	-	-	-	-
Loxia curvirostra	-	-	-	-	-	-	-
Passer domesticus	-	-	*Passer domesticus*	-	-	-	-
Passer hispaniolensis	-	-	-	-	-	-	-
P. petronia	-	-	-	-	-	-	-
-	-	-	*Onychognathus tristrami*	-	-	-	-
Sturnus vulgaris	-	-	*Sturnus vulgaris*	-	-	-	-
O. oriolus	-	-	-	-	-	-	-
Garrulus glandarius	*Garrulus glandarius*	*Garrulus glandarius*	-	-	-	-	-
P. pica	-	-	*P. pica*	-	-	-	-
Corvus monedula	*Corvus monedula*		*Corvus monedula*	-	*Corvus monedula*	-	-
-	-	-	*Corvus rufficollis*	-	-	*Corvus rufficollis**	*Corvus rufficollis***
-	-	-	*Corvus rhipidurus*	-	-	-	-
-	-	-	-	-	*Corvus frugilegus*	*Corvus frugilegus*	-
Corvus corone	*Corvus corone*	*Corvus corone*	*Corvus corone*	*Corvus corone*	-	-	*Corvus corone*

TABLE 5c - A comparison of the avifaunal assemblages in several natufian, PPNA and PPNB sites in the southern Levant. (a) Pichon (1984, 1987); (b) Tchernov, unpublished data; (c) Noy et al., 1980; (d) G.S. Cowles & J. Blandermar, personal communication; (e) Köhler-Rollefson (1988, 1989). (*) Cowles & Blandermar (personal communication) mentioned *Alectoris barbara* from this site; however, this species never existed in the southern Levant, and was never sympatric with *A. chukar*. The only species that existed in this region throughout the Middle and Upper Pleistocene of the Levant is *Alectoris chukar*.

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ARCHEO-ORNITHOLOGY AND THE SYNANTHROPISATION OF BIRDS: A CASE STUDY FOR BULGARIA

ZLATOVAR BOEV
National Museum of Natural History
Sofia 1000, blv. Tsar Osvoboditel 1, Bulgaria.

ABSTRACT: This work represents an attempt to analyze the synanthropisation process in Bulgarian avifaunas from the perspective of an ornithoarchaeological study which includes a review of 23 archaeological settlements with 555 bones from 64 wild species. From the analysis we believe that the first synanthropic/synurbanist birds in Bulgaria start appearing during the Bronce Age-Iron Age times and that this group of anthropic birds is a rather important component of the avian taxocenosis (close to 50% of the taxa retrieved). There is a correspondence between the degree of synanthropisation and the age of the earliest finds of a species in archaeological sites. The group of the most poorly synanthropised birds (seasonal synanthropes) is not only the one with the oldest finds but also the most abundant one in the assemblages, as also happens today in ornithocenosis.

KEYWORDS: BULGARIA, BIRDS, ARCHAEOZOOLOGY, SYNANTHROPISM, SYNURBANISM.

RESUMEN: Este estudio es un intento de analizar el proceso de sinantropización de la avifauna búlgara desde la perspectiva de un análisis ornitoarqueológico que incluye un repaso a 23 yacimientos arqueológicos con 555 restos de 64 especies de aves silvestres. El análisis indica que el proceso de sinantropización aviar en Bulgaria comienza entre las edades del Bronce y del Hierro y que el grupo de aves antrópicas representa un importante componente de la taxocenosis aviar, próximo al 50%. Existe una correspondencia entre el grado de sinantropización y la fecha de los primeros hallazgos de una especie en yacimientos arqueológicos. Así, el grupo menos sinantropizado, el de los sinantrópicos estacionales, es el de primera aparición en el registro pero también, como ocurre en la actualidad, el más abundantemente representado en las muestras.

PALABRAS CLAVE: BULGARIA, AVES, ARQUEOZOOLOGIA, SINANTROPISMO, SINURBANISMO.

INTRODUCTION

An increased human presence in natural habitats has led to an ever greater impoverishment of the wild fauna today. It has also been the main cause of synanthropisation and synurbanisation of more and more animal species. Birds, being among the fastest to adapt, have appeared in settlements and colonized them since prehistoric times. We support the hypothesis made by Iankov (1983 a, b) and Donchev & Iankov (1989) who consider synanthropisation as real causal contact of wild birds with human constructions. Synurbanisation represents the highest level of synanthropisation and the best criterion for it is the nesting of birds in towns and villages. Obviously, for each species and under the specific conditions of each settlement, a unique synanthropic situation has arisen. Hence, the rates and the ways of introduction of wild birds into towns and villages varies specifically. Synanthropisation rates not only depend on feeding and nesting conditions, or the presence (more often the absence) of refuges and enemies, but also are strongly determined by number of clutches during the year. It is not by chance that the house sparrow (*Passer domesticus*, L.) and the collared dove (*Streptopelia decaocto*, Friv.) are extreme synurbanists in present day Bulgarian towns and villages: they produce up to four clutches per year. The feral pigeon (*Columba livia var. domestica*) is also an extreme synurbanist, though with no fixed periods in its breeding cycle.

Where and when should we investigate the beginning of the process of synanthropisation and synurbanisation in birds?. Archaeozoological data can provide answers to this intriguing question. Though the coexistence of birds with humans dates back to paleolithic times, it is only after the

appearance of permanent settlements, during the so-called "Neolithic revolution", 5.000-6.000 years ago, that this coexistence takes a new dimension. An arbitrary criterion would be the beginning of plough-land-farming and the use of draughtpower associated with it. According to Todorova (1972), the incidence of the process could be drawn back to 6.000-7.000 years ago.

Kovachevo, on the Struma River, SW Bulgaria, is the oldest Neolithic settlement in the country. It has been dated 9.000 years B.P.Settlements such as these, have had by no means the design of bulky and massive buildings, and the capacity of altering the landscape was probably limited.

MATERIAL AND METHODS

In this paper we will discuss only avian analysis from the Bronze and Iron Ages, up until medieval times (i.e. a period ranging over 4.000 years)[1] (Table 1).

A total of 546 Eneolithic settlements were known in Bulgaria in 1977, concentrated in two main areas, the Ludogorije Region (NE Bulgaria) and the Upper Thracian Plain (SE Bulgaria) (Todorova, 1979). Though only 63 of these sites have been studied, the scarce animal remains, together with other information, tentatively indicate that during the 5th millenium B.C., large areas of almost all plain and valley regions of the country had already been influenced by a permanent human presence and agricultural activity to a considerable extent. The bird faunas from these sites are still waiting for analysis.

On the other hand, we have a total of 4594 bone remains of birds collected from archaeological excavations of 23 towns in Bulgaria covering the period from the Bronze Age to the Late Middle Ages (Figure 1). Of these, a total of 555 remains come from 64 species of wild birds, the remaining finds belonging both to domestic birds (fowl, geese, duck, pigeon, turkey and peacock) and unidentifiable bone fragments (bone splinters). The bone remains of *Anser anser* (L.), *Anas platyrhynchos* L. and *Columba livia* L. have been excluded from the wild species samples because of their unreliable differentiation from the bones of domesticated forms of these species.

All remains have been identified with the help of the osteological collection at the Zoological Department of the National Museum of Natural History in Sofia. We divide the species listed by Donchev & Iankov (1989) in the following five categories: AI-Seasonal synathropes; AII-Passive synanthropes; BI-Initial synurbanists; BII-Advanced synurbanists, and BIII-Extreme synurbanists. The taxonomical nomenclature follows Howard & Moore (1980). The chronology of settlements is shown on Table 1.

(1) - The sites of Bagachyna (n° 1 in Table 1) has been included in our study. despite unprecise dating, since some of the finds have been assigned to the 1st milenium B.C.

No	Settlement	Age
1	Bagachina	4000 - 1000 B.C.
2	Urdoviza	3000 - 2000 B.C.
3	Sozopol	3000 - 1000 B.C.
4	Kabyle	1st millenium B.C. - 6th century A.D.
5	Malak Preslavets	5th - 1st century B.C.
6	Yassa-Tepe	1st millenium B.C.
7	Arbanas	1st - 3rd century A.D.
8	Durankulak	?1st - 4th century A.D.
9	Ratiaria	2nd - 4th century A.D.
10	Nicopolis-ad-Istrum	2nd - 6th century A.D.
11	Armira	3rd century A.D.
12	Abritus	3rd - 4th century A.D.
13	Kostinbrod	First half of 4th century A.D.
14	Karanovo	6th to 14th century A.D.
15	Garvan	6th to 11th century A.D.
16	Karnobat	6th - 9th century A.D.
17	Baba Vida	8th - 17th century A.D.
18	Veliki Preslav	9th - 10th century A.D.
19	Krivnya	9th - 10th century A.D.
20	Pliska	10th century A.D.
21	Hissarluka	9th - 12th century A.D.
22	Dyadovo	11th - 12th century A.D.
23	Voden	10th - 14th century A.D.

TABLE 1 - Dates of the settlements

RESULTS AND DISCUSSION

A. Species composition

The 64 species of wild birds retrieved in Bulgarian sites represent almost one sixth of the recent avifauna of the country (i.e. 18'13%), where, according to Simeonov & Michev (1991) a total of 353 species live at present. We consider these numbers to be a low estimate since, according to our information, the Bulgarian avifauna by the end of march 1992 included no less that 367 species[2]. The 23 archaeological sites included in this paper, on the other hand, represent 1'1% of the aproximately 2.000 sites known in the country in 1988.

(2) - The subfossil species belong to 13 orders of birds: Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Anseriformes, Falconiformes, Galliformes, Gruiformes, Caprimulgiformes, Strigiformes, Charadriiformes, Columbiformes and Passeriformes.

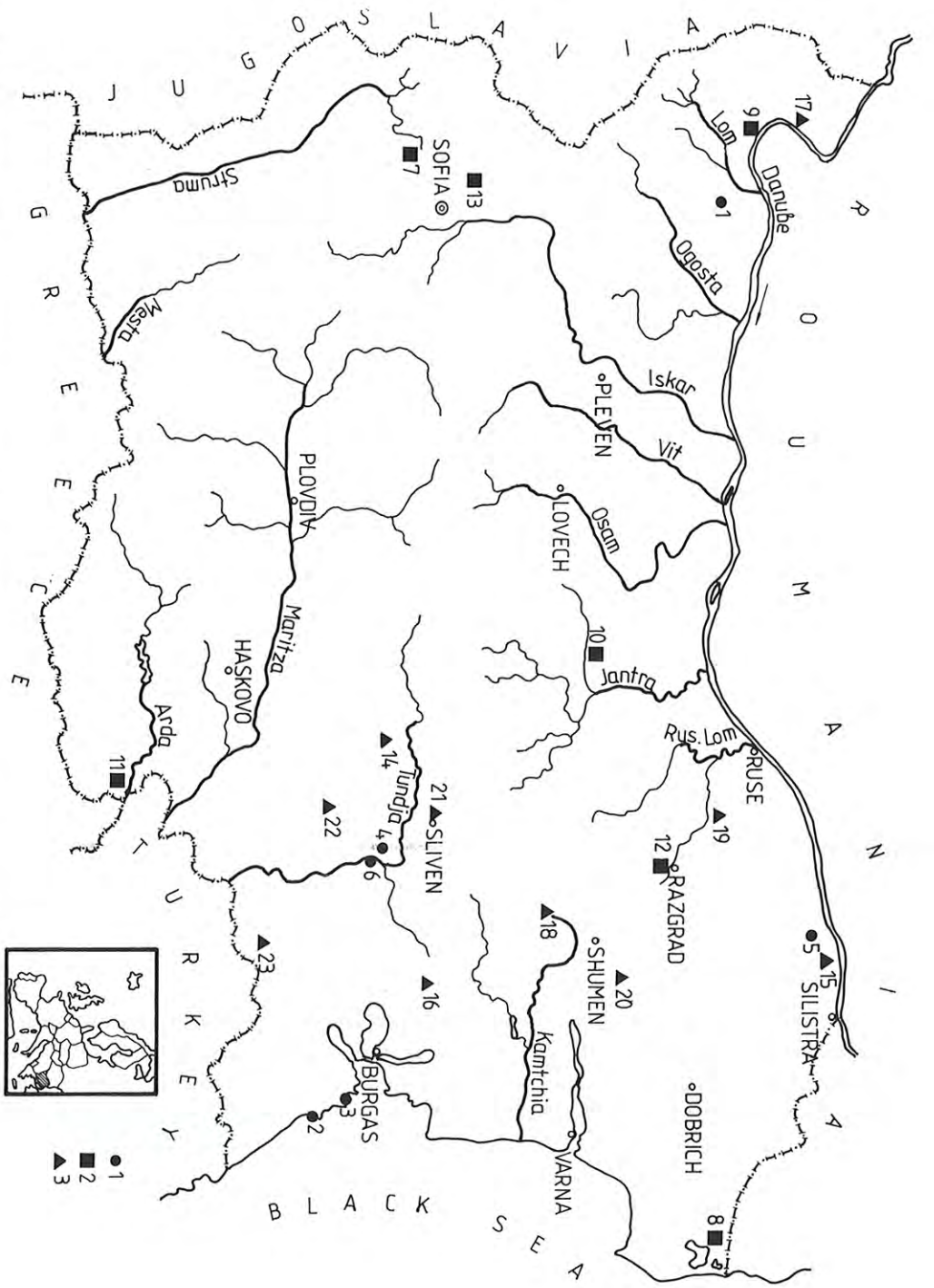


FIGURE 1 - Location of the ancient settlements studied in Bulgaria: 1. 4.000 years to 1st century B.C.; 2. 1st century A.D. to 4th century A.D.; 3. 5th to 14th century A.D.

B. Game birds versus synanthropic/synurbanistic birds

When no complementary information on the importance of a particular species in the life of the inhabitants of the ancient city is available (i.e. traces of processing; cutmarks, burning, etc...), the archaeornithologist is unable to determine wether the bird was intentionally brought to the site or represents an accidental occurrence.

Of considerable interest to the specialists in synanthropisation are these so-called "accidental" bird remains in ancient settlements. This fact should be always stressed since "birds of undetermined importance to man" ussually include a variety of synanthropic and synurbanistic species, attracted both today as well as in the past by the advantages of "settled" habitats: abundance of food throughout the year, abundance of refuges, restricted number of predators, suitable nesting sites, etc... In this way, the abundant finds of *Corvus corax* L. from the Middle Ages sites of Skeldergate and Walmgate in England, have been explained by Allison (1984) as trophic concentrations around the "dung-hills" of towns, where food of their interest would have been abundant. In this way, a settlement could have become a daily feeding ground for the species. *Corvus corax* is a seasonal synanthrope in the contemporary habitats in Bulgaria. Though breeding out of the range of anthropogenetic landscapes, isolated specimens or small flocks regulary visit villages and towns during certain periods (Donchev & Iankov, 1989). The remains of the raven have been found in two Medieval settlements in Bulgaria -Karanovo and Pliska (one of the medieval capitals of Bulgaria) (Table 2).

The situation of two other corvid species, *Pyrrhocorax graculus* L. and *Nucifraga caryocatactes* (L.), is similar to that of *C. corax*. At present they both inhabit high mountain areas in Bulgaria, and both species were established in the Roman town of Nicopolis-ad-Istum (Boev, 1991a). Today they are regular visitors of valleys and towns during the winter period. The raven, alpine chough and nutcracker belong to the first group of seasonal synanthropes according to the classification listed above. The trophic link of some carrion-feeders to archaeological settlements very often stands as the only explanation for the presence of their remains in the samples. The Griffon vulture (*Gyps fulvus* Habl.) is the most abundant subfossil Falconiform, having been retrieved at 4 sites (ancient towns), while the Lammergeier (*Gypaetus barbatus* L.) was recorded at two settlements. It is interesting that the wing bones of the two specimens found in Pliska (10th century A.D.) bore marks of sharp edge cuts, indicating that they have been processed for some reason (Boev, in press, a, b).

C. AI - Seasonal synanthropes

Seasonal synanthropes breed only out of range of the synanthropic (i.e., urban) landscapes, though visiting towns and villages during certain periods of the year mostly because of trophic and microclimatic reasons. This group is the most numerous one both in recent bulgarian avifaunas from towns and villages, as well as in bird remains from archaeological settlements. A total of 12 species belonging to 6 orders (21'06% of the seasonal synanthropes of recent bulgarian bird fauna), have been retrieved in subfossil samples. Among these species *Buteo buteo* (L.) and *Accipiter gentilis* (L.), have been both retrieved in 3 sites. Other species in this group include *Phalacrocorax carbo* (L.), *Ardea cinerea* L., *Carduelis cannabina* (L.) and *Caprimulgus europaeus* L. (Table 2). The presence of 3 Anseriform birds (Anas querquedula L., Aythya ferina (L.) and Cygnus olor (Gm.)) can be

No	Species	No settlement/no of bone finds
1	Columba palumbus	10/4
2	Columba oenas	10/3
3	Streptopelia turtur	10/7, 4/11, 22/1, 21/1
4	Pyrhocorax graculus	10/2
5	Corvus monedula	10/7
6	Corvus frugilegus	10/4, 5/2
7	Corvus corone	10/1, 6/1, 18/3
8	Corvus corax	20/1, 14/3
9	Pica pica	10/2, 23/1
10	Sturnus vulgaris	10/1
11	Carduelis cf. cannabina	10/1
12	Passer domesticus	10/2
13	Phasianus colchicus	10/16, 20/1, 8/1, 18/8, 9/3, 23/2, 16/1, 15/1, 19/5, 20/2, 21/17, 4/8
14	Perdix perdix	10/81, 7/4, 8/4, 18/2, 11/1
15	Coturnix coturnix	10/20
16	Alectoris graeca	10/3, 21/1
17	Fringilla coelebs	10/2
18	Buteo buteo	10/1, 4/1, 21/2
19	Accipiter nisus	10/1, 18/1
20	Accipiter gentilis	21/4, 5/1, 10/2
21	Garrulus glandarius	10/1
22	Gyps fulvus	4/1, 18/1, 9/1
23	Gypaetus barbatus	10/1, 20/3
24	Aquila cf. heliaca	8/1
25	Aquila pomarina	14/1
26	Hieraetus fasciatus	18/2, 21/1
27	Falco cherrug	4/1
28	Ciconia ciconia	4/3, 11/1
29	Cygnus olor	10/1, 2/28, 8/3, 19/1
30	Anas crecca	10/4, 2/1
31	Anas querquedula	10/1, 3/2, 4/1
32	Anas strepera	4/1
33	Anas penelope	18/1
34	Anser fabalis	10/2, 18/2
35	Anser albifrons	10/2, 2/2, 19/1
36	Anser erythropus	18/1, 2/1
37	Tadorna tadorna	10/1, 2/1, 18/1
38	Aythya ferina	10/1, 2/4
39	Aythya nyroca	3/2, 2/3
40	Caprimulgus europaeus	10/1
41	Cygnus cygnus	2/4
42	Pelecanus onocrotalus	2/3, 13/1, 19/1
43	Phalacrocorax carbo	3/2, 2/12, 10/1
44	Phalacrocorax aristotelis	2/2
45	Gavia stellata	2/1
46	Gavia immer	2/1
47	Gavia arctica	3/1
48	Podiceps cristatus	2/5, 10/1, 3/2
49	Podiceps griseigena	2/2
50	Podiceps nigricollis	2/2
51	Athene noctua	10/1
52	Strix aluco	10/1, 18/1
53	Bubo bubo	7/1
54	Otis tetrax	10/1, 5/1
55	Otis tarda	10/2, 4/2, 6/6, 21/4, 16/1
56	Fulica atra	2/2, 3/119, 8/1
57	Grus grus	2/1, 8/1, 4/1, 17/1, 6/1
58	Crex crex	4/1
59	Nicifraga caryocatactes	10/1
60	Ardea cinerea	3/1, 17/1
61	Circaetus gallicus	18/2, 12/1
62	Aquila chrysaetos	5/1
63	Tetrao urogallus	17/2, 21/1
64	Tringa nebularia	5/1

TABLE 2 - Distribution of wild birds in ancient bulgarian sites.

explained by their importante as gamebirds in the past. As a whole, waterfowl is the most abundant group in ancient towns and villages, and includes 15 species from Bulgarian archaeological sites (Boev, 1991b). The three corvid species (*C. corax, P. graculus* and *N. caryocatactes*) are also seasonal synanthropes.

D. AII - Passive Synanthropes

A total of 9 species (19,57% of recent passive synanthropes in Bulgaria) belong to this group. Passive synanthropes breed in natural habitats, though some pairs might occasionally nest within the settlements in habitats analogous to natural ones. *Columba palumbus* L., *Streptopelia turtur* (L.), *Phasianus colchicus* L., *Perdix perdix* (L.), *Coturnix coturnix* (L.), *Accipiter nisus* (L.), *Strix aluco* L., *Fulica atra* L. and *Crex crex* (L.) were established among passive synanthropes in the ancient settlements in Bulgaria. With the exception of *A. nisus* and *S. aluco*, the remaining species belong to the gamebird group. Their abundant bone remains in towns and villages in the past indicate that their appearance there most probably relates to their gamebird status. The Sparrowhawk and the Tawny owl may have invaded the settlements as wild synanthropes. The group as a whole probably invaded these urban habitats some 1.700-3.000 years ago (Table 3).

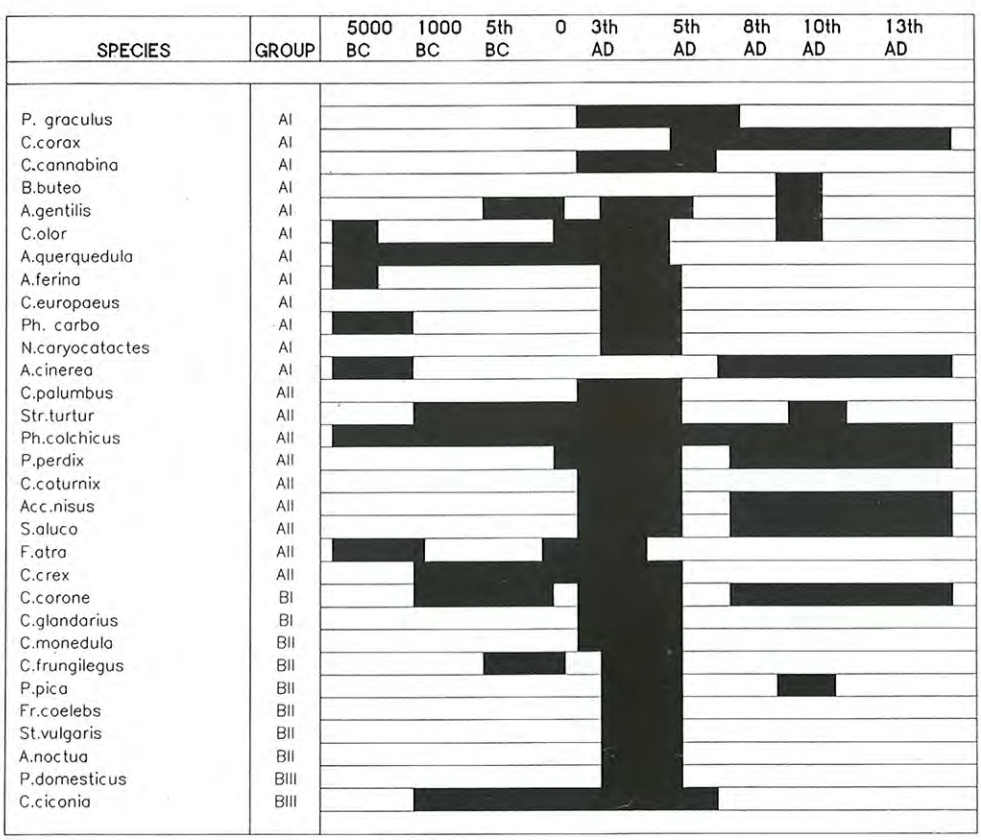


TABLE 3 - Temporal distribution of synantropic/synurbanistic birds in Bulgaria.

E. BI - Initial Synurbanists

This is the most poorly represented group of the whole bird assemblage. It includes only two species (*Corvus corone* L. and *Garrulus glandarius* (L.)) and comprises 7'69% of the recent initial synurbanists (a group which, at present, includes 26 bulgarian species). The ecological requirements of these birds are such that even though most of the populations nest outside urban habitats, certain individuals, occasionally up to a quarter of the populations, invade villages, towns and cities including their most urbanized sections. According to data from Bulgaria (Table 3) initial synurbanists began to make use of settlements as nesting grounds 2.000-3.000 years ago.

F. BII - Advanced Synurbanists

This group includes species which, by systematically breeding around settled areas, establish separate populations from the wild (i.e., non-urban) ones (Donchev & Iankov, 1989). This group includes 18 species from the recent Bulgarian avifauna. Only six of them (33'33% of the recent advanced synurbanists) have been recognized in the archaeozoological samples: *Corvus monedula* L., *Corvus frugilegus* L., *Pica pica* L., *Fringilla coelebs* L., *Sturnus vulgaris* L., and *Athene noctua* (Scop.). All of them have been detected in the large Roman town of Nicopolis-ad-Istum (2nd-4th century A.D.), the capital of the Roman province of Moesia Inferior (Boev, 1991a). The magpie has also been found at the Medieval settlement of Voden (Table 2; Boev, in press, b), while the rook appears in the Roman settlement of Malak Preslavets as well. Because of the absence of specimens from this group of advanced synurbanists in the remaining 20 sites, we can rather confidently postulate that the first advanced bulgarian synurbanists appeared during the initial centuries A.D. (i.e., 1.800-2.000 years ago).

G. BIII - Extreme Synurbanists

Extreme synurbanists are species whose populations breed mainly, if not exclusively, in settled areas, including highly urbanized ones. Only 8 bird species have reached this stage of synurbanisation in Bulgaria at present. Two of them (25% of the present day taxa within the group) have been identified in the archaeozoological samples: *Passer domesticus* L. and *Ciconia ciconia* L.. The House sparrow has been only recorded at Nicopolis-ad-Istrum, while the White stork was found at 2 sites -the large Hellenic and Roman town of Kabyle and in Armira (Table 2, 3).

The bones from Kabyle are not precisely dated, so we can loosely adscribe them to the 1st millenium B.C.

CONCLUSIONS

Though the recent Bulgarian avifauna exhibits a rather marked anthropogenetic influence (155 species = 41'9% of the countrys's bird fauna are synanthropic/synurbanistic species), the results from our analysis demostrate that this character is by no means a feature of recent or even sub-recent times, since no less than 31 species from archaeological sites (48'8% of the 64 identified) might have also been synanthropic/synurbanistic. The higher percentage of these birds in the past is an artifact partly due to the fact that we assign to this category all specimens of species such as the Coot, Mute swan, Woodpigeon, Pheasant and Grey partridge which in the past might have not been part of this

anthropogenous sector. In spite of that, we can not exclude them from the group of synanthropic/synurbanistic species. Compared to the recent composition of Bulgarian avifauna, the "subfossil synanthropes/synurbanists" comprise 8'75%. As a whole, archeo-ornithological material confirms the grouping of recent synanthropic/synurbanistic birds in this part of the european subcontinent. The group of the most poorly synanthropised birds (seasonal synanthropes) is the most numerous one. This is logical for its representatives tend to be present in the oldest settlements, as has been confirmed by our research. As each of the groups represents a stage in an increasing synanthropisation sequence, the earliest finds of a species tend to be younger in time the more anthropic a taxon is and viceversa.

The amount of material studied thus far is not sufficient either to guarantee a complete picture of the invasions of wild birds into ancient towns and villages in the Bulgarian lands, nor to outline the development of an "urban avifauna". In spite of that, it provides us with an approximate idea about the bird species composition sharing human settlements over the past 4.000 years in the country.

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BIRDS AND THE SCAVENGER NICHE

T.P. O'CONNOR
Dept. of Archaeological Sciences, University of Bradford,
Bradford BD7 1DP, U.K.

ABSTRACT: The development of towns and cities has created a potential scavenger niche for opportunists, and several species of birds have adapted to exploit this source of food. Evidence from northwest Europe shows a relatively small group of urban scavengers to have been successful, principally predators and carrion feeders, and including species which have been most markedly reduced in range during the last few centuries.

KEYWORDS: URBAN, SCAVENGER, ACCIPITRIDAE, CORVIDAE

RESUMEN: La aparición de pueblos y ciudades ha creado un nicho carroñero potencial para oportunistas al que una serie de especies de aves, interesadas en la explotación de esta fuente de alimento, se han adaptado. La información obtenida en Europa noroccidental evidencia el éxito de un pequeño grupo de carroñeros urbanos, especialmente depredadores y necrófagos, donde se incluyen especies cuyas áreas de distribución se han visto marcadamente reducidas durante los últimos siglos.

PALABRAS CLAVE: URBANO, CARROÑERO, ACCIPITRIDAE, CORVIDAE

One of the more distinctive and archaeologically significant environmental impacts which humans have had is the creation of sets of new habitats, most typically by the development of substantial nucleated settlements such as towns or industrial sites. To the biota of the surrounding region, a town presents both challenges and opportunities. It may disrupt spatial feeding behaviour, or result in some degree of pollution of watercourses or land. The subsistence activities of the human population may modify the regional environment by turning grassland over to arable, or by clearing woodland. More positively, a town represents a source of food and shelter to an opportunistic species, and one in which competition may be reduced by the exclusion of less adaptable taxa. The gradual adaptation to modern towns of a wide range of plants and animals has been described by contemporary ecologists (Gilbert, 1991; Bornkamm et al., 1982), and some attempts have been made to look at the ecology of ancient towns in a similar way (Hall & Kenward, 1990). Birds are diverse in their behaviour and their autecology, and this class includes taxa which are highly adaptable in terms of food sources, requirements of living and breeding space, and tolerance of disturbance. A number of taxa have adapted well to living in modern towns, either by direct exploitation of the human population, as with the pigeon *Columba livia*, or by exploiting the effects which the urban environment has on a food resource, as with the use by swifts *Apus* spp of concentrations of insects borne on thermals over towns. Some of the most successful urban birds are scavengers: broad-spectrum omnivores which subsist on the detritus of human settlements, or on detritivores of a lower trophic level. This commensal relationship is as old as nucleated settlement. Tchernov (1984) has documented the association of humans with house sparrow *Passer domesticus* as early as the Natufian period, and *P. domesticus* has become one of the most successful Old World commensal birds.

In ecological terms, the scavenger niche is an interesting and complicated one. If the food source being exploited is human refuse, then population growth in the scavengers is

donor-controlled. The limits to growth are imposed by the rate of donation of refuse by the human population. The scavenger population can theoretically increase up to the carrying capacity of the food source, but any decline in the population (and thus a reduction in 'predation') will have no effect on the availability of 'prey'. To put this into real terms, if the *Columba livia* population which scavenges the Old Town at Dubrovnik exceeds the carrying capacity of the town's refuse, then the death or emigration of half of the pigeons will not necessarily result in the 'survival' of more refuse and thus a rise in carrying capacity. Equally, the 'population' of refuse may vary dramatically in its abundance irrespective of the size of the scavenger population. The familiar linking of predator and prey populations which can be seen in most carnivores and phytophages does not apply to scavengers. It is interesting to reflect that donor-control is otherwise seen in populations such as detritivores in leaf-litter habitats: one of the few similarities between *Columba livia* and Isopoda (wood lice). A characteristic of species assemblages which are donor-controlled is that they are expected to be relatively stable, and this stability is expected to be either independent of, or to increase with, increased diversity and food web complexity. Thus donor controlled systems contrast quite markedly with predator-prey systems where the Lotka-Volterra dynamics apply (Begon et al., 1990, 361-2). For populations of vertebrate scavengers, therefore, we should not be surprised to find consistency through time and quite diverse associations, rather than predominance by one taxon.

It is proposed to examine the role of birds as urban scavengers in northern Europe by attempting to determine which taxa are likely to have made successful scavengers, and then by comparing this list of candidates with the archaeological record. The feeding and hunting behaviour of different species will have rendered them more or less likely to be able to adapt to the opportunities which a town presents. First, broad spectrum omnivores ought to be favoured. Urban refuse might, in some circumstances, provide a predictable source of a particular food item, but the very nature of a donor-controlled supply means that it inhibits that co-evolution of predator and prey which favours specialised predation. Those groups of birds which feed on live fish or littoral invertebrates might therefore be ruled out, thus excluding virtually all of the Charadriiformes. Unspecialised seed-eaters might succeed, as any town will have its weeds, but taxa specialised to a particular group of food plants would not. Insect-feeders could be well suited to urban scavenging, apart from those such as the spotted flycatcher *Muscicapa striata* which rely on a particular hunting strategy which towns would be unlikely to facilitate. On the whole, it is the facultative carnivores and carrion-feeders which are likely to have been most successful, exploiting the animal-waste elements in refuse, and the invertebrate scavengers which would be attracted to it.

In order to consider the most likely candidates as urban scavengers in the past, we have to make the assumption that the present patterns of feeding behaviour observed in different bird taxa are a good indicator of past behaviour. Here there is an obvious circular argument, for few bird populations within Europe can be regarded as unaffected by human activity, and thus any modern data will represent the behaviour of bird populations which are to a greater or lesser degree accommodating human influence. However, it may be an acceptable and useful assumption that modern behaviour shows the adaptation and aptitudes of a particular family or species, and therefore gives some grounds for analogy with past populations.

To proceed through the European avifauna more or less systematically, one of the first families which deserves consideration is the Anatidae. This has obviously been an important group in terms of prey and domesticates, and some urban sites have yielded impressively long lists of duck and goose species, notably Dorestad (Prummel, 1983) and London (Bramwell, 1975). There is an

issue concerning specific identification within the Anatidae, but this is not the place to discuss it. Only one anatid seems a likely urban scavenger, and then only at waterside sites, and that is the mallard *Anas platyrhynchos*. This species is a very broad spectrum feeder, and succeeds very well in a number of modern towns. Its conspecificity with the domestic duck perhaps indicates a degree of preadaption to synanthropic behaviour, and therefore we should maybe allow that the *Anas platyrhynchos* bones identified at riverine urban sites derive from several different populations: truly wild individuals taken by hunting, fully domestic ducks reared under close control, and a resident urban duck population which subsisted by scavenging and maybe interbred to some degree with both the wild and domesticated populations. Acceptance of this model would require an end to the practice of identifying some specimens as 'mallard' and some as 'domestic duck', there being no such simple division. In any case, this discrimination is usually made on the questionable premise that 'large = domestic', a division which might appear to be valid on the grounds of size variation in modern ducks, but which would not bear close scrutiny on zoological grounds.

A similar question of domesticated status arises with respect to the rock dove *Columba livia*, and its familiar descendant the street pigeon. *C. livia* is commonly reported from medieval urban sites around Europe, and was listed at eleven of Parker's (1988) 86 Roman sites. Occasionally, the identification is explicit, as in medieval Beverley (Scott, 1992), or in the recognition of both *C. livia* and stock dove *C. oenas* in medieval London (B. West in litt.). Often, however, one is confronted by the depressing attribution 'dove - *Columba* sp.', leaving open the question of whether the author actually means *C. livia/C. oenas*, or really meant to include the possibility of the readily-identified *C. palumbus*. One might even wonder whether the *Streptopelia* species have been properly considered and explicitly excluded. Bubien-Walaszewska (1979, 247) records *C. livia* f. *domestica* from six early medieval sites in Poland, an attribution to domestic status which presumably depends on context, as there are no attributions to *C. livia*. The archaeology of the street pigeon is thus a hopeless tangle of uncertain attributions and sweeping assumptions. The ecology of *C. livia* would seem not to be inconsistent with a relatively early adoption of the scavenging role within the contemporary range of the wild form, though taxonomic uncertainties make it difficult to decide what this former range might have been. Archaeological specimens firmly attributed to *C. livia* could conceivably be truly wild birds, closely-managed domestic birds, feral individuals from a formerly domestic population, or synanthropic individuals from a formerly wild population, and it seems unlikely that the matter will ever be satisfactorily resolved.

Moving on, the diurnal raptors offer several obvious candidates as urban scavengers. The osprey *Pandion haliaeetus* can probably be excluded, as its specialist feeding behaviour render it unlikely to adapt to scavenging. Osprey was recorded from post-medieval deposits at Exeter, England (Maltby, 1979), but this must be seen as a trophy or chance occurrence. The Accipitridae include several species which are currently common scavengers, notably the kites *Milvus* spp. The red kite *M. milvus* is a broad sceptrum feeder, taking live prey up to the size of a rabbit *Oryctolagus cuniculus* and also feeding on carrion (Peterson et al., 1974, 70-71). Although rare in Europe today, 'kites' (presumably this species) are historically recorded as scavengers in towns. The substantial literature pertaining to kites in London even records a period when their role in tidying up was rewarded by legal protection (Gurney, 1921), an ironic contrast with the reason for the present-day protection of this species. Bones attributed to *M. milvus* have been recorded from many towns in Europe, amongst them medieval Leicester (Thawley, 1981), medieval Beverley (Scott, 1991, 1992), Late Saxon Portchester (Grant, 1976), Saxon and medieval York (O'Connor, 1989, 1991), early

medieval Menzlin, where *M. migrans* was also recorded (Benecke, 1988), and from four of the 86 Roman sites in Britain listed in Parker's survey (Parker, 1988). One other notable record is from the late prehistoric hill-fort at Danebury (Grant, 1976). Absences are always rather contentious, as absence of evidence is not evidence of absence, but the lack of records of *Milvus* spp. in Bubien-Walaszewska's survey of 32 early medieval sites in Poland, taken with the frequent occurrence of *M. milvus* on sites in Britain, suggests that *M. milvus* may have been well adapted to urban scavenging but was limited on biogeographical grounds to towns in the more western parts of Europe. If further data bear this out, then the record from Menzlin becomes particularly noteworthy.

The buzzard *Buteo buteo* is also commonly recorded from urban sites, and is, like the kites, a generalist feeder on live prey and carrion. Parker noted *B. buteo* at nine sites out of 86 in his Roman survey. Though this list obviously included rural sites as well, urban occurrences included those in Cirencester, Brancaster, and Staines. The species has also been recorded from early medieval London (B. West in litt.), post-medieval Coventry (Bramwell, 1982), medieval Leicester (Thawley, 1981), Mecklenburg (Muller, 1984), medieval Oslo (Lie, 1988), Saxon and medieval York (O'Connor, 1989, 1991), medieval Menzlin (Benecke, 1988), medieval Exeter (Maltby, 1979), and at three early medieval Polish sites (Bubien-Walaszewska, 1979). *Buteo buteo*, then, would seem to have been as successful as a scavenger as *Milvus milvus*, and perhaps with a more general European distribution.

One accipitrid which has attracted some attention in the archaeological context is the white-tailed eagle *Haliaeetus albicilla*. Reichstein (1974) reviewed the occurrence of this species at sites in Central Europe, drawing attention to what he argued was a markedly disparate occurrence of skeletal elements. Bones of the wing, particularly ulna, radius, and carpo-metacarpus, appeared in the archaeological record more frequently than other elements, leading the authors to suggest that eagles' wings were traded extensively as a source of feathers, probably to fletch arrows. The implication of this interpretation is that the archaeological distribution of *H. albicilla* does not represent the former range of the species. Given that the numerous occurrences which Reichstein notes from Denmark and throughout Germany lie outside the modern range (eastern and south-eastern Europe, western coastal Norway, western Iceland), their interpretation of what is, admittedly, an odd distribution of skeletal elements, has credibility. However, not all of the numerous occurrences of the species beyond those sites surveyed by Reichstein consist principally of wing bones. From York, for example, the present author has recorded pedal phalanges, and elements of the legs and pectoral girdle. Roman deposits in Leicester recently yielded a skull of *H. albicilla*, with evidence that the skull had been cut away from the neck (Ian Baxter, pers comm.), and Parker's (1988) six records from Roman Britain include two urban occurrences from Droitwich and London. Parker does not include Roman records from an urban context at Binchester and from the fort at Segontium (both unpublished records, this author), and the species also occurred in 1st century AD deposits at Velsen (Prummel, 1987). These Roman records are important. The 'feather hypothesis' is unlikely to hold for early medieval central Europe and for Roman western Europe: that would be something of a cross-cultural coincidence, and the documentary evidence which underpins the hypothesis for the medieval period is absent for the Roman period. In Roman western Europe, therefore, *H. albicilla* appears to have occupied a range appreciably wider than that occupied today: if in Roman Europe, why not into the medieval period as well? Though it is accepted that for at least some of the sites in Reichstein's survey, their interpretation may well explain the disparity in frequency of elements, the data clearly indicate that *H. albicilla* was far more widespread in Europe in the past. The species takes live prey and carrion, and has been recorded as nesting in trees and on the ground, as well as on the cliffs and rocks with

which it is more usually associated today. In ecological terms, therefore, *H. albicilla* is just as suited to the role of urban scavenger as any other accipitrid. Amongst the medieval sites which have yielded specimens are Mecklenburg (Müller, 1984), Oslo (Lie, 1988), Menzlin (Benecke, 1988), and York (O'Connor, 1989, 1991).

Moving on from the diurnal raptors, the next group which deserves consideration is the Passeriformes, and in particular the Corvidae. This family includes some of the most resourceful and adaptable of European birds, as well as specialists such as the choughs *Pyrrhocorax* spp. and the nutcracker *Nucifraga caryocatactes*. Diverse behaviour notwithstanding, the family shows little somatic adaptation to a particular feeding habit, and most species take a wide range of prey and detritus. In those respects, the corvids make excellent scavengers. The number of urban sites in Europe which have yielded remains of corvids is too great to list them all at length, and there are, in any case, some problems with secure attribution to *Corvus corone* or *C. frugilegus* where sufficient reference material is not available. Jackdaw *C. monedula* and raven *C. corax* are perhaps the most frequently encountered, with *C. corax* noted at 39 of Parker's 86 sites, a frequency exceeded only by *Anas platyrhynchos* and *Gallus gallus*. Amongst medieval towns in Europe, *C. corax* seems to have been virtually ubiquitous, though the present author's records show one interesting absence. In York, *C. corax* is frequent at all periods up to the end of the medieval period, yet the species is absent from substantial assemblages recorded from 8th to 15th century AD deposits barely 40km away in Beverley (Scott, 1991, 1992). This difference cannot be explained in terms of preservation of bird bones, recovery methods, or identification bias, and a sufficiently large quantity of bird bones from Beverley has been identified to indicate that *C. corax* was, if not actually absent, certainly appreciably less common in medieval Beverley than in nearby York. There is no obvious explanation: D. Bramwell (in litt.) has suggested an absence of tree cover for roosting and breeding in the Beverley area, though documentary records would tend to contradict this.

As *C. corax* appears to have been such a successful scavenger throughout the medieval period, it seems valid to ask why it is not still a common sight around northern European towns, and when the decline in numbers set in. There are two major problems with using direct evidence of presence or absence of any species as evidence of a changing range in relatively recent times. The first is the philosophical problem that one can never be confident of having recovered the latest specimen. The gap between the original live population and the recovered archaeological assemblage is so great that the latest known archaeological specimen can only confirm that a species was present as late as that date, not that it was not present later than that date. The second problem is more basic. The post-medieval deposits in a town are often immediately below the modern surface, and are thus those most vulnerable to destruction by modern building work, and to destruction by brisk removal by archaeologists in search of early medieval or Roman structures. Even in towns with a relatively respectable history of archaeological investigation, the 16th to 19th centuries AD may be very poorly represented. One can only observe that *C. corax* occurs in Britain in 16th century contexts at Coventry (Noddle, 1982), and is absent from the 18th and early 19th century deposits investigated to date in York (author's records). Historical records show that *C. corax* was a common urban bird in Britain into the 17th century, and the association with the Tower of London is, quite literally, legendary (Gurney, 1921). Somewhere within the last two centuries, then, *C. corax* has left the urban avifauna, at least in Britain. It is difficult to see this as a consequence of a major change in urban ecology at this time. If *C. corax* was closely associated with the medieval urban habitat of small, crowded timber buildings and copious surface accumulations of refuse, then a speedy disappearance

during the 14th and 15th centuries might have been expected. However, if more systematic disposal of refuse in post-medieval towns left some scavengers surviving in less than optimal conditions, then some may have been vulnerable to competition from new species. In this context, the comparative scarcity of bones of gulls *Larus* spp. in medieval towns in western Europe, even in coastal areas, deserves mention, given that some, notably *L. ridibundus*, are common urban scavengers today.

Two other species amongst the Passeriformes deserve mention. The house sparrow *Passer domesticus* has been mentioned above as an avian synanthrope of great antiquity and conspicuous success, and the starling *Sturnus vulgaris* is similarly active as a scavenger in towns in some parts of Europe. With these species there is a problem of archaeological visibility, however, as their bones are small, and probably infrequently recovered when present. In some earlier work, too, little effort may have been made to identify bones of the smaller Passeriformes even when they were recovered. There is the possibility of confusion of *P. domesticus* with some of the larger finches Fringillidae with which its biogeographical range overlaps. Accordingly, one can only note that both species have commonly been reported from Roman and medieval urban sites where deposits have been sieved to ensure recovery of small bones, though this amounts to too few records to use as the basis of any meaningful discussion.

In some ways, any attempt to look at the ecology of birds in Roman and medieval towns through the archaeological record is premature and rather depressing. Although this paper has deliberately not set out to be a complete synthesis of all available records, it is clear from a scrutiny of the British, German, Dutch and Scandinavian literature that we are in the position of having a very few points of light in a still very cloudy picture. The prediction from ecological first principles that it would be generalist obligate or facultative carnivores which would be best suited to adoption of this niche is to some degree borne out by the regular occurrence of *Milvus milvus, Buteo buteo, Haliaeetus albicilla, Corvus monedula* and *C. corax*, probably with *Passer domesticus* and *Sturnus vulgaris*, given appropriate recovery. To this list would have to be added *Columba livia*, and maybe a case can also be made for *Anas platyrhynchos* in towns with a riverine location. That is a not inconsiderable number of taxa, and the possible westerly distribution of *M. milvus* reminds us that not every town will have had populations of all or most of these species. Donor control of the food supply to scavengers means that population densities can potentially be higher than in 'wild' populations, a point again particularly relevant to *M. milvus*. In vertebrate animals, it is not unusual for a synanthropic, or even explicitly urban, habit to be adopted as a means of maintaining populations towards the limits of the biogeographical range, or as a means of extending that range. Maybe the development of towns and the range of opportunities which they offered presented some taxa whose habitats were under pressure in the countryside with a means of maintaining populations in return for a modification of behaviour. Adaptive tolerance by raptors of human disturbance has recently been described for the Berlin area (Fiuczynski, in Bornkamm et al., 1982, 342-3). Given the archaeological and documentary evidence that *Milvus milvus* was still common around towns in Britain into the late medieval period (Edlin, 1952, 74), it would be fascinating to be able to assess its abundance in rural areas at the same time. Was the species generally widespread, or had its range already begun to fragment to the limited rural refugia in which it is found today, plus an opportunistic and, at least briefly, successful urban population? Regrettably, the data currently available do not permit such an analysis.

Human beings have in common with virtually all other organisms that they modify their environment to some degree, and thus have direct and indirect effects on the other organisms around

them. In building towns, people created new suites of habitats, in which versatile organisms could develop new niches. The role of urban scavenger was one such niche, and it is evident that a number of birds adopted this niche with success. When considering bird bone assemblages from urban sites, or from any nucleated human settlement, therefore, we must move away from naive categorisation into 'wild' and 'domestic' species, and allow that some of the species represented in the refuse of human settlement were at least as much the exploiters as the exploited.

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THE BIRDS AND THE BEES

JAAP SCHELVIS
Biological-Archaeological Institute
Poststraat 6, 9712 ER Groningen. The Netherlands

ABSTRACT: In this essay attention is drawn to the ecological information which is provided by the remains of invertebrate animals found in an archaeological context. To illustrate this I present three examples in which the study of invertebrates can help to detect or identify the remains of birds, bird nests or bird droppings.

KEYWORDS: INVERTEBRATES, BIRDS, ARCHAEOZOOLOGY, PARASITES

RESUMEN: Este artículo trata de la información ecológica que se puede obtener de los restos de invertebrados hallados en un contexto arqueológico. Para ilustrarlo presentamos tres ejemplos en los cuales el estudio de invertebratos puede ser útil para evidenciar y, en su caso, identificar taxonómicamente no sólo los restos de pájaros sino también sus nidos y excrementos.

PALABRAS CLAVE: INVERTEBRADOS, PAJAROS, ARQUEOZOOLOGIA, PARASITOS

There exists a remarkable discrepancy in the animal kingdom between the number of species within each phylum and the number of archaeozoologists working on those groups (Figure 1). Our own taxonomic position as representatives of the vertebrate subphylum of the Chordata, together with the usual anthropocentric attitude of most scientists, are among the most logical explanations for this phenomenon. Obviously, some groups are also more difficult to use in archaeozoological interpretations because their remains have not been retrieved (yet) during excavations. However, I feel that the vast amount of ecological information that is to be derived from the invertebrates is still widely underestimated. Apart from the well established mollusc research, the interest in other groups such as beetles and other arthropods seems to be marginal at best. Recent research, on mites (Acari) by Schelvis (1992a), however, has shown that other groups of invertebrates may yield fascinating results when studied in detail.

As an example of the ways in which invertebrates can help to support traditional archaeozoological studies I will present three different methods of detecting the presence of avian remains on the basis of invertebrates.

1. Identification of nidicolous faunas characteristic of bird nests.

A specific relationship between birds and invertebrates is developed by the so called nidicolous invertebrate fauna, which consists of mite and insect species of specific occurrence in the nests of birds (and mammals). Bird nests are hardly ever recognised during archaeological excavations. The study of nidicolous invertebrates may thus help to detect and, in some cases, even identify, bird nests.

In the summer of 1990 an investigation took place on the 13th century building-history of the 'Calmershuis' in the town centre of Groningen in the North of the Netherlands. During this research

a large number of holes were detected in the 1.0-1.2 m-thick brick walls. These holes, the so called 'kortelingsgaten', were made during the construction of the wall in order to support the scaffolding on which the bricklayers were standing. The holes were closed from the inside of the wall but remained mostly open from the outside thereby producing ideal nesting places for birds. It is therefore not surprising that in several of these holes the remains of bird nests were found. Which birds were occupying these nests? One of the holes contained a substantial amount of nesting material as well as several egg-shell fragments and a nearly complete skeleton of a Swift (*Apus apus*) (Zeiler & Lommert, 1992). Whether this was indeed the nest of a Swift originally is doubtfull since the amount of nesting material seems far too big. However, Swifts are known to evict House Sparrows (*Passer domesticus*), Starlings (*Sturnus vulgaris*) etc. and use their nest-sites (Cramp, 1985). To solve this problem, it is obvious that we will need to study more than just the bones. An attempt will be made to identify the pieces of egg-shell (Siddell, this volume). Furthermore, the remains of the invertebrates found in the nesting material will be studied. Among the dipterous larvae, various beetles (Carabidae, Staphylinidae and Curculionidae), wood-lice, spiders and predatory mites found in this deposit could well be representatives of a nidicolous fauna characteristic of one of the above mentioned bird species.

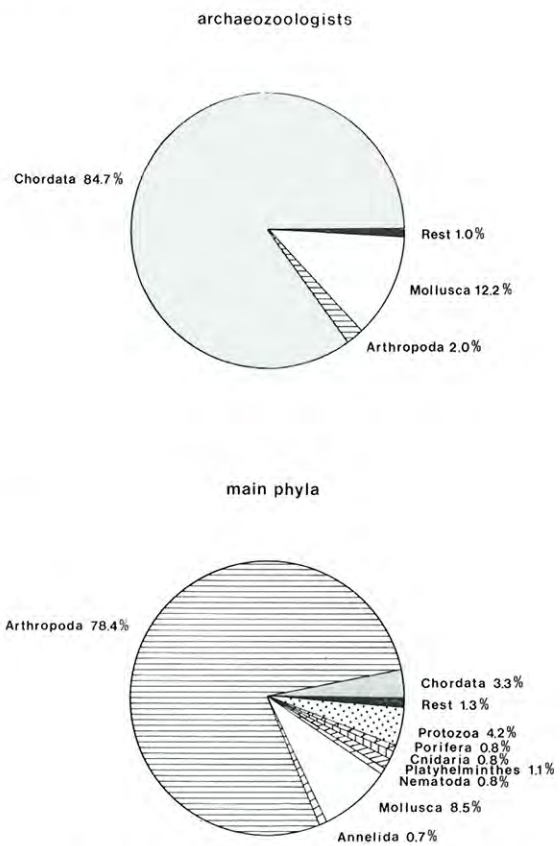


FIGURE 1 - The animal kingdom; top; Distribution of the relative number of archaeozoologists working on the phyla shown (based on information provided by the 1992-ICAZ-newsletter) and bottom; the relative number of species to be found in the main phyla (Barnes, 1980).

2.Identification of remains of specific avian ectoparasites.

Vertebrates invariably posess a number of more or less specific ectoparasites. Especially among the *Mallophaga*, the chewing lice occuring on birds, the degree of specificity is astonishing. Indeed, according to Kellogg's law, the taxonomic relationship between bird families can be judged by the degree of similarity of their lice faunas.

During the 1990 excavation of the Wolters-Noordhoff-complex in Groningen, a number of remarkably well preserved feathers were found in a 13th century dung deposit (Figure 2).

The feathers belonged to either a Rook (*Corvus frugilegus*) or a Crow (*Corvus corone*). Meticulous investigation of the feathers revealed the presence of the remains of a featherlouse (*Mallophaga*) and of feathermites (*Analgesidae*). Unfortunately, the state of conservation of the lice remains did not allow an identification to species level. If this had been possible, the identification could have provided an answer to the question on whether these feathers came from a Rook or from a Crow (Zeiler & Schelvis, 1991).



FIGURE 2 - Two of the 13th century tail feathers of a Rook or a Crow which were found to contain the remains of ectoparasites (left) and a detail of one of the feathers (right).

3.Establishing the presence of specific invertebrate inhabitants of avian excrements.

Mesostigmatic predatory mites (*Gamasida*) characteristically occur in habitats rich in decaying organic matter. One of these habitats is formed by the excrements of (domestic) animals. It has been shown (Schelvis, 1992a) that most of these coprophylous mites occur predominantly in the dung or droppings of one particular domestic animal species. By identifying the remains of these predatory mites, it is possible to detect the presence and to identify the accumulating agent(s) of archaeological dung deposits including poultry droppings.

A sample of 1 kg was taken in 1982 during an excavation in the town centre of Leeuwarden, also located in the North of the Netherlands. The occupation level was dated to the 12th century A.D. (De Langen, 1992). On top of the 153 remains of oribatid mites, which were used for an environmental reconstruction, this sample yielded six species of predatory mites. According to Schelvis (1992b) half of these species (*Androlaelaps casalis, Uroobovella pyriformis* and *Trichouropoda orbicularis*) can be considered dung-indicating species (Figure 3). Finally, two individuals of the poultry-indicating species *Trichouropoda ovalis* were found. Therefore, the conclusion is that this medieval sample did include poultry droppings.

The results of the identification of dung deposits can be combined with those from traditional archaeozoological studies. By combined analysis of both the bone remains and series of dung samples found in a settlement, it will be possible to distinguish between animal species which were actually reared at the site from those whose remains ended up there either through trade or hunting.

The overall conclusion of this paper therefore, is that the study of invertebrate remains can provide useful ecological information on the presence and/or identity of birds, bird nests and bird droppings.



FIGURE 3 - The 12th century remains of a male *Trichouropoda orbicularis*, a dung indicating predatory mite species (length: 750 mm).

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Archaeofauna 2 (1993): 169-174

UNA FAUNA MEDIEVAL INUSUAL: LAS AVES DE CAVA BAJA (PROV. MADRID, ESPAÑA)

FRANCISCO HERNANDEZ CARRASQUILLA
Laboratorio de Arqueozoología. Depto Biología.
Universidad Autónoma de Madrid
28049 Madrid. España.

RESUMEN: En este trabajo analizamos los restos de aves recuperados en la excavación de un silo utilizado como basurero durante la Edad Media en Madrid. Atendiendo a los materiales arqueológicos se ha datado el silo a principios del siglo XII. Podemos destacar del conjunto la presencia de Grulla Damisela (*Anthropoides virgo*); especie extinguida hoy en dia en Europa Occidental. La asociación faunística parece indicar la presencia de zonas húmedas dentro de un ecosistema estepario. El número increiblemente bajo de aves domésticas, entre otras razones, parece señalar que los agentes acumuladores de estos restos de alimentación serían personas de alto rango social, probablemente cetreros aristócratas.

PALABRAS CLAVES: EDAD MEDIA, *Anthropoides virgo*, CETRERIA, MADRID

ABSTRACT: The paper report on a series of bird remains recovered from the excavation of a pit-hole used as a refuse dump during the Middle Ages in Madrid. According to the archaeological remains we have dated the site in the begining of the 12th century. Most remarkable has been the detection of the Demoiselle Crane (*Anthropoides virgo*), a species at present extinguished from Western Europe. The faunal association indicates a marhsland biotope within a steppe ecosystem. The incredibly low number of domestic birds in such a recent site speaks in favour of a dietary regime for people of high rank, probably aristocratic falconers.

KEYWORDS: MIDDLE AGES, *Anthropoides virgo*, FALCONRY, MADRID

INTRODUCCION

La excavación de urgencia efectuada en la Calle de Cava Baja de la ciudad de Madrid ha sacado a la luz varias estructuras, principalmente silos, que aparentemente actuaron como receptáculos de desechos (orgánicos e inorgánicos) durante la Edad Media.

El presente trabajo está restringuido al estudio del material recuperado en el silo 3056, por ser la estructura con mayor número de restos de aves. Según el tipo de cerámica recuperada en el silo, se puede situar su utilización a principios del siglo XII. La cerámica es típicamente musulmana aunque la población de esa época podría ser de transición musulmana-cristiana (Area, com. per.). El estudio de la avifauna ha mostrado una asociación faunística que difiere sustancialmente de lo que suele ser habitual en otros yacimientos medievales estudiados por nosotros.

METODOLOGIA

La metodología utilizada es la usual en este tipo de estudios; para una descripción detallada nos remitimos a Hernández (1992b).

La identificación del material se ha llevado a cabo utilizando la colección osteológica del LAZ-UAM. El NMI (Número Mínimo de Individuos) se ha estimado siguiendo las directrices

propuestas por Clason (1972) y Payne (1972). La osteometría esta basada en Von den Driesch (1976); las medidas de los restos no están incluidas en el trabajo, las personas interesadas pueden solicitarlas directamente al autor.

RESULTADOS Y DISCUSION

La Tabla 1 recoge la relación de especies recuperadas en el yacimiento.

La asociación faunística descrita presenta singularidades que la hacen potencialmente interesante, no sólo para arqueozoólogos o arqueólogos, sino también para ornitólogos clásicos.

Desde un punto de vista estrictamente zoológico podemos destacar la presencia de varias especies actualmente extinguidas en España, bien como reproductoras (Grulla Común, Tarro Canelo) o bien en sentido estricto (Grulla Damisela). Entre todos los taxones identificados comentaremos los más interesantes, a nuestro modo de ver, por sus implicaciones biogeográficas así como de cara a su conservación o posible reintroducción. En este último punto nos gustaría hacer constar el interés que puede tener en un proyecto de reintroducción de especies la información aportada por el registro arqueozoológico ya sea sobre áreas de distribución pasadas, posibles causas del declive, etc....

Sin duda, la especie más destacable del conjunto es la Grulla Damisela (*Anthropoides virgo*). La falta de información precisa sobre el estatus de este ave en Iberia ha propiciado que haya adquirido cierto halo de misterio entre los ornitólogos españoles. Se supone que en el pasado reciente pudo criar en algunos puntos del sur de España, como Doñana o la Laguna de La Janda (Irby, 1875, 1895) aunque su cría nunca llegó a ser demostrada (Valverde, 1960). Hasta el siglo XIX era un migrante regular en el sur de España (Valverde, Op. cit.).

	ESPECIES	NR	NMI
ESPATULA	*Platalea leucorodia*	5	1
TARRO CANELO	*Tadorna ferruginea*	3	1
ZARAPITO REAL	*Numenius arquata*	14	2
ZARAPITO TRINADOR	*Numenius phaeopus*	9	3
SISON	*Tetrax tetrax*	40	4
AVUTARDA	*Otis tarda*	18	2
GRULLA COMUN	*Grus grus*	1	1
GRULLA DAMISELA	*Anthropoides virgo*	12	1
GALLINA	*Gallus gallus*	1	1
PERDIZ COMUN	*Alectoris rufa*	10	2
SIN IDENTIFICAR		16	
TOTAL		129	18

TABLA 1 - Relación de especies recuperadas en el silo 3056 de Cava Baja.

El registro fósil de la Grulla Damisela, si bien escaso, puede ser un punto de partida para intentar reconstruir la historia de esta especie en el Paleártico Occidental. En la Figura 1 están representados los yacimientos cuaternarios donde ha sido citada; de igual manera, la figura incluye el área de cría actual. Durante el Pleistoceno, cuando gran parte de Europa era una estepa, parece probable que la Grulla Damisela estuviese distribuida de manera más o menos continua por todo el Paleártico (Tyrberg, 1991). El avance de los bosques durante el inicio del Holoceno debió circunscribir la corología de esta especie a áreas esteparias relictas; parece razonable suponer que España debió ser uno de los paises europeos con mayor número de ejemplares debido a la extensión de sus estepas naturales. De hecho, la ausencia de restos óseos de esta especie en yacimientos holocénicos centroeuropeos, pese al gran número estudiado, parece indicar que Iberia debió ser el último refugio de la Grulla Damisela en Europa Occidental, donde se extinguió en los últimos 100 años.

Como conclusión, la Grulla Damisela debió estar ampliamente distribuida por el Paleártico durante el Würm. Los cambios climático-ecológicos que acompañaron el paso del Pleistoceno al Holoceno redujeron drásticamente su hábitat de cría; esta pérdida de hábitat a lo largo del Holoceno unida a la persecución humana explicarían, la rarefacción de la especie primero y, en segundo lugar, su extinción en Europa Occidental. La Figura 2 muestra alguno de los restos recuperados de esta especie en el yacimiento de Cava Baja.

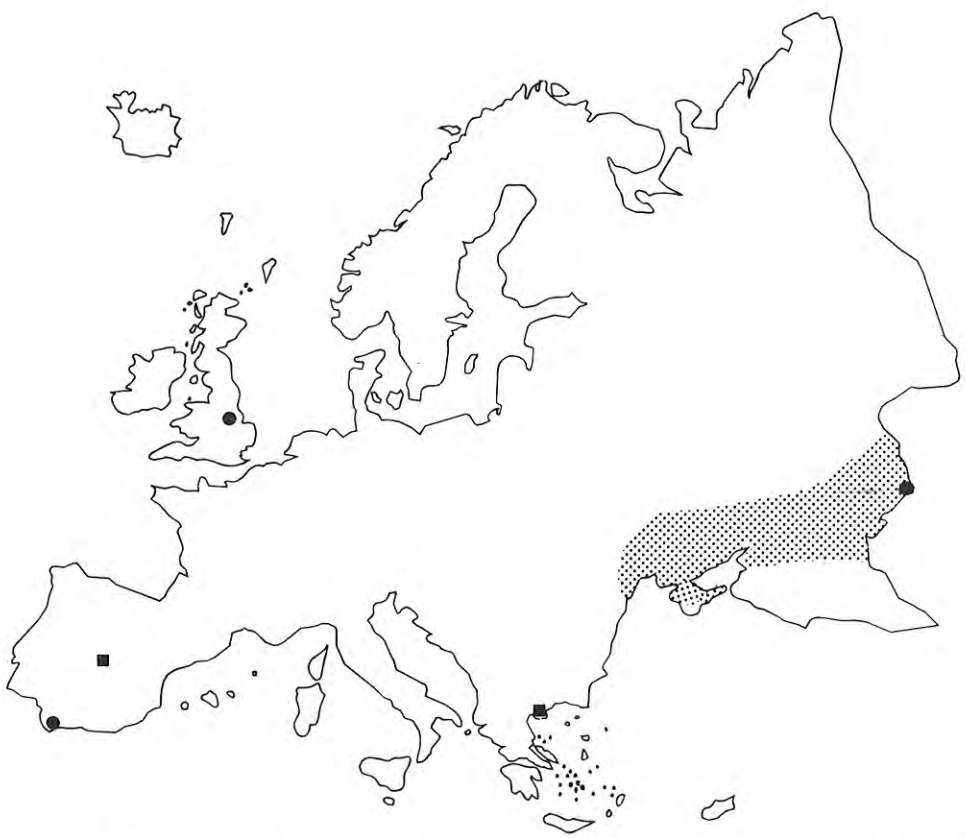


FIGURA 1 - Area de cría actual de la Grulla Damisela (*A. virgo*) (zona punteada) y yacimientos europeos donde ha sido citada. Puntos: Pleistoceno; Cuadrados: Holoceno. (Fuentes: Cowles (1981), Eastham (1968), Burchak-Abramovich (1975), Janossy (1992), presente estudio).

Entre el resto de especies destacaremos brevemente las siguientes:

La Espátula (*Platalea leucorodia*) cría hoy en día en varias puntos muy localizados del S.O. peninsular aunque durante los pasos migratorios es posible observarla en buena parte del territorio ibérico (Galarza, 1986). Es más que probable que esta especie criara antaño en puntos apropiados de todas las regiones españolas. El comentario anterior puede aplicarse igualmente a la Grulla Común (*Grus grus*); extinguida recientemente como ave nativa (Bernis, 1966) pero aún abundante como invernante (Alonso & Alonso, 1990) y que atendiendo a sus hallazgos fósiles, debió tener una distribución amplia por la Península Ibérica.

El Tarro Canelo (Tadorna ferruginea) mantiene hoy en dia una pequeña población de aves invernantes en el S.O. de España (SEO, 1985). A pesar de que no se ha podido demostrar su cría en épocas recientes, antiguamente debió criar en el Centro y Sur peninsular (Bernis, 1966); este comentario se vería apoyado por su presencia en varios yacimientos arqueológicos peninsulares (Figura 3).

En conjunto, el tipo de hábitat que indican las especies silvestres recuperadas en Cava Baja parece apuntar a una zona húmeda dentro de un ecosistema estepario.

Desde un punto de vista cultural, esta asociación faunística sorprende por el número increiblemente bajo de aves domésticas frente a la gran variedad de aves silvestres, máxime si consideramos la cronología del yacimiento. La Gallina tiende a dominar las muestras arqueornitológicas desde el mismo momento en que se generaliza su presencia en Iberia durante el Hierro II (Hernández, 1992a). Este predominio de la especie en yacimientos arqueológicos es tanto más notorio cuanto más moderno es el asentamiento.

Si calculamos la importancia relativa de los restos de Gallina en otros yacimientos medievales estudiados obtenemos valores que oscilan entre un 40-80% del total de restos identificados de aves (datos propios inéditos). En Cava Baja, sin embargo, este valor es inferior al 1%. Esta diferencia tan notable entre yacimientos cronológicamente semejantes y con un número de restos comparable, ha de estar necesariamente relacionada con la condición y el estilo de vida de las personas que podemos considerar como agentes acumuladores de esta tafocenosis.

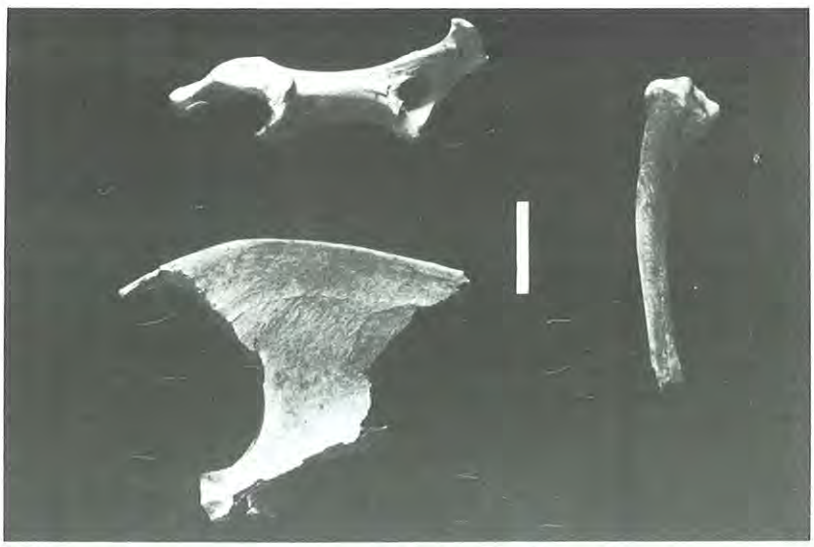


FIGURA 2 - Restos de Grulla Damisela recuperados en Cava Baja. Cintura pectoral. (escala: 1 cm).

Pensamos que estas aves podrían haber sido cazadas por personas de alto rango socioeconómico con aves de cetrería. Las observaciones que nos han movido a emitir esta hipótesis son las siguientes: no hay prácticamente aves domésticas en el yacimiento; las aves han sido consumidas; el hábitat deforestado indicado por la asociación faunística es el más idóneo para la práctica de la cetrería, y ,por último, el tamaño de las aves (mediano-grande) es el seleccionado por los cetreros por ser el más productivo. El interés por la cetrería entre la nobleza medieval está perfectamente documentado históricamente (Zapata, 1565; Velázquez del Tovar, S. XV; Valles, 1556).

CONCLUSIONES

El predominio absoluto de aves silvestres frente a las domésticas hace que este yacimiento sea inusual para la Edad Media.

Se ha detectado al presencia de una especie completamente extinguida de la avifauna ibérica: la Grulla Damisela. Las razones de su extinción deben buscarse en la pérdida de hábitat de cría sumado a la persecución humana. El declive de la especie en Europa Occidental debió comenzar en los inicios del Holoceno. España debió ser el último refugio relicto de la especie en Europa Occidental. La desaparición de la Grulla Damisela en Occidente se remonta a los últimos 100 años.

Varias especies recuperadas se han extinguido recientemente como reproductoras y/o han disminuido notablemente sus áreas de distribución en la Península.

La evidencia de que el material proviene de restos de comida unido al bajo número de aves domésticas, entre otras razones, podría hacer pensar que nos encontramos ante restos de alimentación de un sector social de alto rango, probablemente aristócratas versados en técnicas de cetrería.



FIGURA 3 - Zona de invernada actual del Tarro Canelo en España (área punteada) y yacimientos cuaternarios donde está citado (Fuentes: Sánchez (1990), presente estudio, Eastham (1986), datos propios inéditos).

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TWO EXAMPLES SHOWING CONTRADICTORY RESULTS BY USING SKELETOCHRONOLOGY IN BIRDS

MARTA LAPEÑA[1], DANIEL PATON[1], FRANCISCO HERNANDEZ[1], FLORENTINO DE LOPE[2] & ANGELES JUARRANZ[*1]

(1) Laboratorio de Arqueozoología Depto. de Biología.
Universidad Autónoma de Madrid. 28049 Madrid. Spain.
(2) Depto. de Zoología. Universidad de Extremadura.
16071 Badajoz. Spain.
(*) Address for correspondence: Dr. A. Juarranz

ABSTRACT: Bone sections from two different bird species of known age (*Delichon urbica* and *Alectoris rufa*) have been analyzed by skeletochronology. Growth lines appeared in long as well as in flat bones, though only those observed in the ascendent branch of the lower mandible from *Delichon urbica* seemed to be related with the age of the animal. In the case of *Alectoris rufa* the number of lines present in bone sections did not always correspond with the age of the animal. These results cast doubts on the inferential value of incremental lines in bird bones for archaeozoological and wildlife management purposes.

KEYWORDS: SKELETOCHRONOLOGY, BIRDS, LINES OF ARRESTED GROWTH, MANDIBLE

RESUMEN: Utilizando la técnica de esqueletocronología, se han estudiado diferentes secciones óseas de dos especies de aves (*Delichon urbica* y *Alectoris rufa*) cuyas edades se conocían. Las líneas de crecimiento se observaron tanto en huesos largos como planos; sin embargo, únicamente las vistas a nivel de la rama ascendente de la mandíbula inferior de *Delichon urbica*, parecen estar relacionadas con la edad del animal. En el caso de *Alectoris rufa*, el número de líneas presentes en las secciones, no siempre correspondía con la edad del ejemplar. Los resultados generan dudas sobre la posibilidad de utilizar las líneas de incremento en aves y su aplicación en Arqueozoología y dinámica de poblaciones.

PALABRAS CLAVE: ESQUELETOCRONOLOGIA, AVES, LINEAS DE CRECIMIENTO, MANDIBULA

INTRODUCTION

Many methods have been developed for age estimation in vertebrates, including the increase in body dimensions or weight with time, fusion of epiphysis or the increase in dry weight of the eye lens (Lamotte & Bourliere, 1975). However, most of them are inaccurate and prone to errors (Halliday & Verrel, 1988). Skeletochronology seems to be a valuable technique that allows one to establish the age of most vertebrate groups with a high degree of accuracy (Klevezal & Kleinenberg, 1969; Halliday & Verrel, 1988; Castanet & Baez, 1991). The method is based on the presence of growth marks, lines of arrested growth (LAG), that can be identified on histological sections of certain bones. In birds, however, not much work using skeletochronology has been done (Koubert & Hrabe, 1984; Klevezal et al., 1972; Van Soet & Van Utrecht, 1971; Nelson & Boorkhout, 1980).

In this paper, a series of flat and long bones from two different samples of know age of the species *Delichon urbica* (House Martin) and *Alectoris rufa* (Red-Legged Partridge) have been analyzed in order to establish those most suitable for skeletochronological purposes.

MATERIAL AND METHODS

Ten *Delichon urbica* (House Martin) from Extremadura (South -West Spain), and fifteen *Alectoris rufa* (Red-legged partridge) from a farm (Center of Spain), have been used. All animals were of known age. Specimens were macerated in tap water at 370° C until total putrefaction took place. Several types of long (Tibiotasus, Tarsometatarsus and Phalanges) and flat (Mandibula and Sternum) bones were selected. The bones were cleaned from surrounding tissue and decalcified in aqueous solutions of either 3% nitric acid (NA, Panreac) or 5% ethylenediamine tetracetic acid (EDTA, Probus) and then washed in a constant flow of water for at least one hour. The central area of the diaphysis from long bones and specific areas (Figure 1) from the flat bones were selected, frozen in CO_2 and cross-sectioned in 10-20 m thick with a freezing microtome. Staining was performed using aqueous solutions of either Ehrlich's hematoxylin (EH, Merck) for 40-60 min or $5x10^{-4}$ M toluidine blue (TB, Merck), methylene blue (MB, Sigma) or acridine orange (AO, Allied chemical) for 10-15 min. Sections were afterwards washed for three succesive times in distilled water, mounted in glycerol gelatin (Merck) and protected with a cover slip.

The age of each animal was established by counting, under the microscope, the number of lines of arrested growth (LAG) present in the bone sections, considering the outer margin of the section as a LAG (Smirina, 1972).

RESULTS

It was difficult to observe lines at the diaphysis level of long bones, whereas these could be distinguished in most of the flat bones from both species. Since the number of lines in the sections from samples of the same individual was variable, it was difficult to estimate the age of the animal from the sections of all bones examined, except for the mandible. In the case of this bone we have found that some sections from *Delichon urbica* showed lines that seemed to correlate well with the animal's known age.

In order to select that portion of the mandible in which age-related lines were best seen, the bone was cut in several pieces (Figure 1) before sectioning it with the microtome. Cross-sections at level B of the ascendent branch of mandible turned out to be the best zone to observe reliable lines in both species.

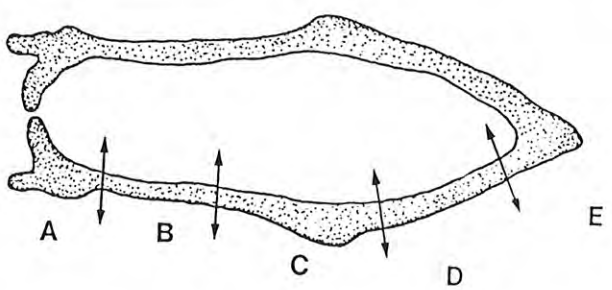


FIGURE 1 - Anatomical scheme of the mandible of *Delichon urbica*. The one belonging to *Alectoris rufa* is not represented. The mandibles were cut off at the levels indicated before being cross-sectioned.

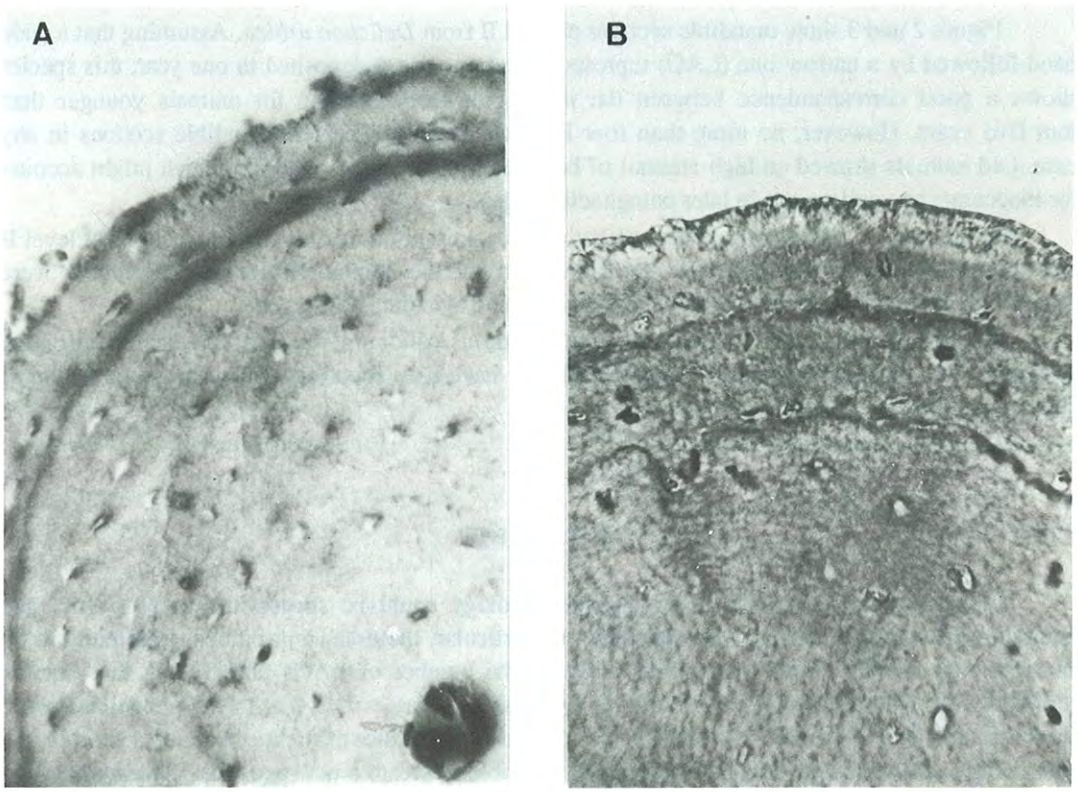


FIGURE 2 - Transverse sections at the ascendent branch of lower mandible (level B) of *Delichon urbica*. Sections were stained with Ehrlich's hematoxylin. A: one LAG is present on the section, since the animal was less than 2 years old. B: specimen with two LAGs. (x 40).

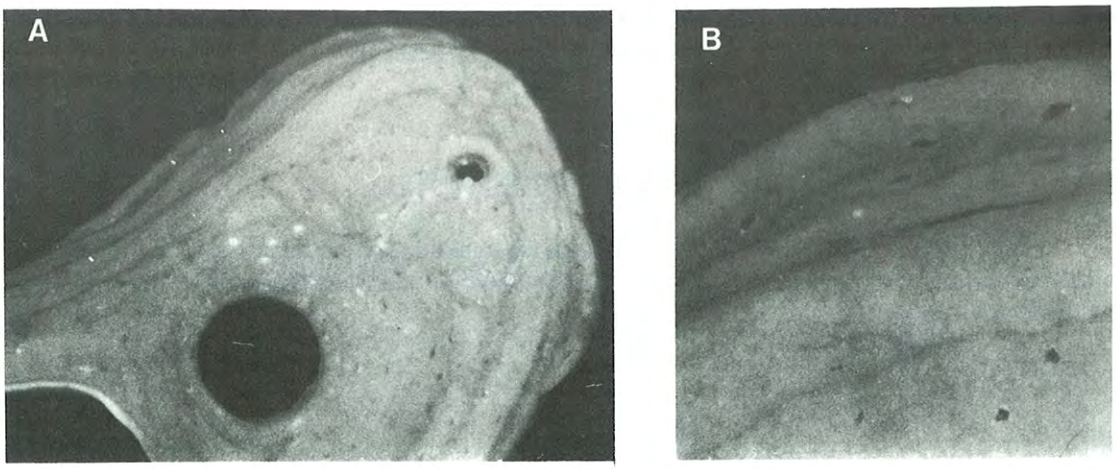


FIGURE 3 - Cross-sectioned mandible of a five years old specimen of *Delichon urbica* stained with 0.5 m acridine orange. Only three LAGs are clearly visible on the section, however, considerable bone remodelling is observed when compared with younger animals. A: (x 16); B: (x 40).

Figure 2 and 3 show mandible sections at level B from *Delichon urbica*. Assuming that a wide band followed by a narrow one (LAG) represents the bone tissue deposited in one year, this species shows a good correspondence between the number of lines and age for animals younger than four-five years. However, no more than four lines were observed in the mandible sections in any case. Old animals showed an high amount of bone resorption and remodelling which might account for inaccurate age assigments in later ontogenetic stages.

In the case of *Alectoris rufa* the number of lines present on the mandibular sections at level B did not correspond, in general, with the known age of the animal. Moreover, differences were observed in the number of lines in animals with the same age (data not shown).

Finally, no differences between either the various cationic dyes (EH, TB, and OA) or the decalcification procedures followed (NA and EDTA) have been found regarding the visualization of lines in the different samples studied.

DISCUSSION

It is tempting to consider that skeletochronology could be successfully applied for age estimation in *Delichon urbica*. Mandible, and, in particular, the ascendent branch, was found to be the best bone to this purpose. In young animals, the number of LAGs observed in the sections correlates well with age and it was possible to establish age-classes 1, 2, 3 and 4. When animals were older than four-five years, the number of lines counted were smaller than expected, and a strong bone remodelling was observed. It was, nevertheless, possible to create a new age-class corresponding to animals older than four years. Taking into account both factors, number of LAGs and bone remodelling, mandible analysis by skeletochronology could be a useful tool for age estimation of *Delichon urbica* and other bird species (Koubek & Hrabe, 1984; Nelson & Boohout, 1980; Van Soert & Van Utrech, 1971). On the other hand, no lines related with age have been observed on bones of *Alectoris rufa*, so that the method is perhaps not suitable for this species though the question still remains open as to wether this lack of positive correlation in the partridge relates to the hormonal imbalance which caged (i.e., farm) animals might eventually develop.

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ESTUDIO OSTEOLOGICO COMPARADO DE DOS SUBESPECIES DE *CORVUS CORAX* (AVES: PASSERIFORMES)

ELIZABETH C. HERNANDEZ[1], MERCEDES MARTIN[2] y JUAN CARLOS RANDO[3]
(1) Museo de Ciencias Naturales. Aptdo. Correos 853.
38080 Santa Cruz de Tenerife (Islas Canarias).
(2) Museo Arqueológico de Tenerife. Aptdo. Correos 853.
38080 Santa Cruz de Tenerife (Islas Canarias).
(3) Departamento de Biología Animal (U.D.I. Zoología).
Facultad de Biología. Universidad de La Laguna.
38206 La Laguna (Tenerife, Canarias).

RESUMEN: Se ha realizado el estudio biométrico de 21 esqueletos de la subespecie *Corvus corax tingitanus*, pertenecientes a diversas islas del Archipiélago Canario, y se ha procedido a su comparación con los resultados obtenidos de 15 esqueletos de *Corvus corax corax* (Mallorca, Islas Baleares). Estos resultados están referidos a 7 medidas craneales y 8 postcraneales, de las que se deducen diferencias significativas entre ambas subespecies a nivel de tamaño, apreciándose una disminución de talla para *C.c. tingitanus* que no se produce de manera proporcional en todo el esqueleto.

PALABRAS CLAVE: OSTEOLOGIA, PASSERIFORMES, CORVUS, CANARIAS, BALEARES

ABSTRACT: We have carried out a biometric study of 21 skeletons of *Corvus corax tingitanus* from the Canary Islands and have compared them with 15 skeletons of *Corvus corax corax* from Majorca (Balearic Islands). These results are referred to seven cranial and eight postcranial lengths. There are some differences among the dimensions of the canary island subspecies; *Corvus corax tingitanus* being smaller than *Corvus corax corax*. The degree of reduction of the various lenghts is variable and not proportional in different body regions of the birds.

KEYWORDS: OSTEOLOGY, PASSERIFORMES, CORVUS, CANARY ISLANDS, BALEARIC ISLANDS

INTRODUCCION

La especie *Corvus corax* (Cuervo) ha sido poco estudiada en España, existiendo tan sólo algunos trabajos concretos (Nogales, 1990; López del Pozo, 1991).

Esta especie comprende diversas subespecies entre las que se encuentran *Corvus corax corax*, *Corvus corax tingitanus* y *Corvus corax hispanus* según algunos investigadores, mientras que otros opinan que es difícil realizar la clasificación de este grupo debido a su amplia distribución mundial y a que muchas de sus subespecies se basan en caracteres biométricos, como parece verificarse en las que son objeto del presente trabajo.

C. c. tingitanus, presente en las Islas Canarias, posee los huesos del pico y de las extremidades más pequeños que *C. c. corax* de la Península Ibérica y Archipiélago Balear. Para Baleares ha sido citada la subespecie *C. c. hispanus*, que según Hartert & Kleinschmidt (1901) se caracteriza por tener una talla intermedia entre las otras dos subespecies mencionadas. Dorst (1947), entre otros, no considera como subespecie a *Corvus corax hispanus* como tal, aunque si confirma los datos que se tenían hasta el momento de *C. c. tingitanus*, que posee una talla menor que *C. c. corax*.

Este trabajo, cuyo objetivo ha sido poner de manifiesto las diferencias existentes a nivel biométrico entre los Cuervos de los archipiélagos mencionados, complementa el estudio a nivel osteológico que actualmente estamos realizando de *Corvus corax tingitanus*, cuyos restos están apareciendo en yacimientos arqueológicos y paleontológicos de Canarias.

La presencia de Cuervos en Canarias ha sido documentada por los cronistas en los primeros tiempos posteriores a la llegada de los europeos a estas islas. Abreu Galindo (1632) en su historia de la conquista cita a esta ave en varias ocasiones, e incluso comenta que los bimbaches, antiguos pobladores de la isla de El Hierro, cerraban con muros de piedra las cuevas donde enterraban a sus muertos para que estos pájaros no devorasen sus cadáveres; en esta isla, hasta no hace muchos años, los pollos de los cuervos eran comidos por sus habitantes (Lorenzo Perera, 1992). En Tenerife no está comprobado arqueológicamente que los Guanches cazaran estas aves, si bien es probable que les pudieran servir como alimento (Tejera Gaspar, 1990).

MATERIAL Y METODOS

Se ha realizado la biometría de 21 esqueletos actuales de *Corvus corax tingitanus* y 15 de *Corvus corax corax*, siguiendo el método utilizado por Moreno (1985) con algunas modificaciones (Figuras 1 y 2). Estos especímenes están depositados en el Departamento de Biología Animal (U.D.I. Zoología) de la Universidad de La Laguna (Tenerife) y en el Institut d'estudis avançats de les illes Balears (Palma de Mallorca).

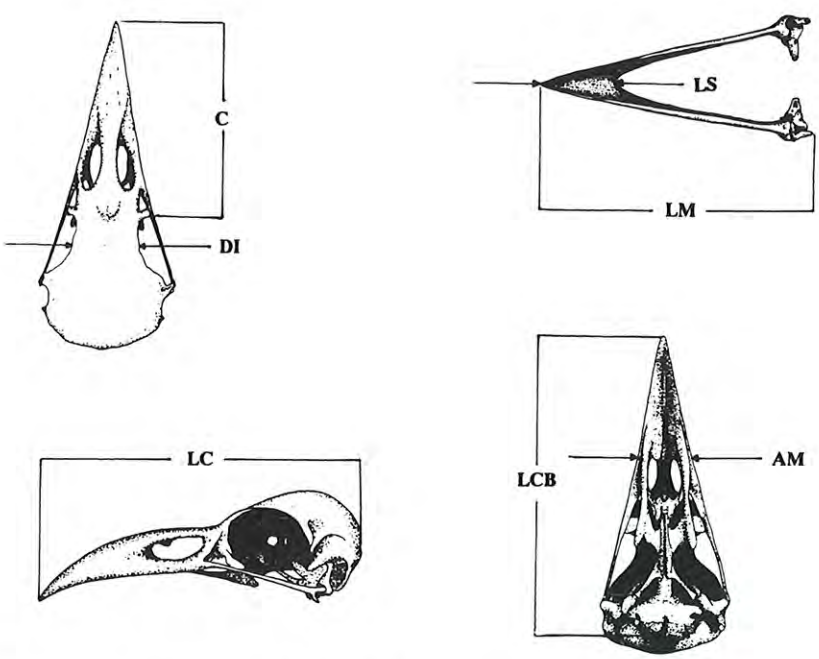


FIGURA 1 - Medidas craneales tomadas en los cuervos de Canarias y Baleares: **C**: culmen, **DI**: distancia interorbitaria, **LC**: longitud craneal, **LCB**: longitud condilobasal, **AM**: anchura maxilar, **LM**: longitud mandibular y **LS**: longitud sínfisis.

Una vez efectuadas las medidas se ha procedido al tratamiento estadístico de los datos, considerando el número de especímenes, media, rango y el error de la media (Tabla I). Para reflejar las diferencias osteológicas de las dos subespecies, se ha utilizado la longitud relativa de unos huesos con respecto a los otros expresada en porcentaje (McMinn et al., 1990; Walker et al., 1990) (Figuras 3 y 4).

Posteriormente, se aplicó el Test de la "U" de Mann-Whitney (Sokal & Rohlf, 1986; Fowler & Cohen, 1990), con una P=0.05, para comprobar la existencia de diferencias significativas entre ambas subespecies, rechazándose la hipótesis nula cuando el valor más pequeño de "U" es menor que el valor crítico (Tabla II).

Finalmente se han comparado los resultados con los obtenidos por Moreno (1986) en *Corvus corax* de la Península Ibérica, pareciendo existir una disminución de talla entre los Cuervos de las tres poblaciones.

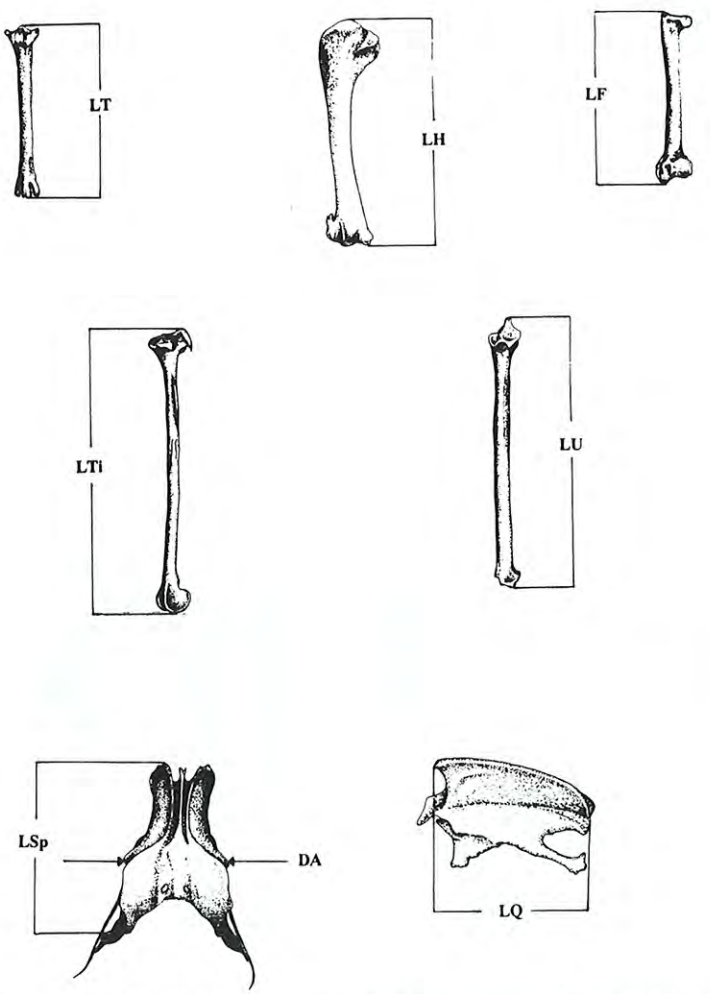


FIGURA 2 - Medidas postcraneales efectuadas en especímenes de *Corvus corax* de Canarias y Baleares: **LH**: longitud humeral, **LU**: longitud ulnar, **LF**: longitud femoral, **LTI**: longitud tibiotarso, **LT**: longitud tarso-metatarso, **LSp**: longitud sinsacro, **LQ**: longitud quilla y **DA**: distancia antitrocantérea.

MEDIDAS CRANEALES

	C	DI	LC	LCB	AM	LM	LS
Canarias							
n	20	20	20	20	20	19	19
$\bar{x}$	64.79	19.08	105.49	99.08	24.31	89.64	22.14
interv.	56.77-71.54	16.79-22.04	97.28-114.85	91.31-109.02	21.75-26.20	81.70-99.97	20.20-25.73
error	64.79 ± 3.18	19.08 ± 1.15	105.49 ± 3.66	99.08 ± 3.84	24.31 ± 1.08	89.64 ± 3.92	22.14 ± 1.34
($\bar{x} \pm \sigma_n$)							
Baleares							
n	13	13	13	13	13	13	13
x	69.13	22.99	112.36	104.55	26.91	95.23	22.16
interv.	63'32-72.49	19.39-25.88	105.97-117.13	98.23-108.88	25.62-28.35	89.44-99.28	20.33-23.01
error	69.13 ± 2.82	22.99 ± 1.81	112.36 ± 3.12	104.55 ± 3.09	26.91 ± 0.87	95.23 ± 2.70	22.16 ± 0.74
($x \pm \sigma_n$)							

MEDIDAS POSTCRANEALES

	LH	LU	LF	LTi	LT	LSp	DA	LQ
Canarias								
n	14	14	14	14	10	13	14	13
$\bar{x}$	81.76	98.65	62.88	105.60	65.77	68.21	40.42	62.73
interv.	75.63-88.12	90.85-106.28	57.48-69.49	96.34-115.16	60.76-70.29	62.36-74.58	38.24-43.89	57.97-66.58
error	81.76 ± 2.86	98.65 ± 3.66	62.88 ± 2.75	105.60 ± 4.34	65.77 ± 3.01	68.21 ± 2.83	40.42 ± 1.66	62.73 ± 2.31
($\bar{x} \pm \sigma_n$)								
Baleares								
n	8	9	8	8	6	8	9	8
$\bar{x}$	89.87	109.64	67.60	114.03	70.74	73.03	42.55	69.09
interv.	84.62-96.88	101.34-116.38	62.47-72.18	105.33-122.24	65.65-74.79	66.76-77.68	39.57-45.82	62.91-73.84
error	89.87 ± 3.89	109.64 ± 4.36	67.60 ± 2.82	114.03 ± 5.83	70.74 ± 2.97	73.03 ± 3.77	42.55 ± 1.85	69.09 ± 3.79
($\bar{x} \pm \sigma_n$)								

TABLA I - Resultados de las medidas efectuadas en los esqueletos craneales de C. c. tingitanus y *C. c. corax*, donde C: culmen, DI: distancia interorbitaria, LC: longitud craneal, LCB: longitud condilobasal, AM: anchura maxilar, LM: longitud mandibular, LS: longitud sinfisis, LH: longitud humeral, LU: longitud ulnar, LF: longitud femoral, LTi: longitud del tibiotarso, LT: longitud tarso-metatarso, LSp: longitud sinsacro, LQ: longitud quilla y AD: distincia antitrocanterea.

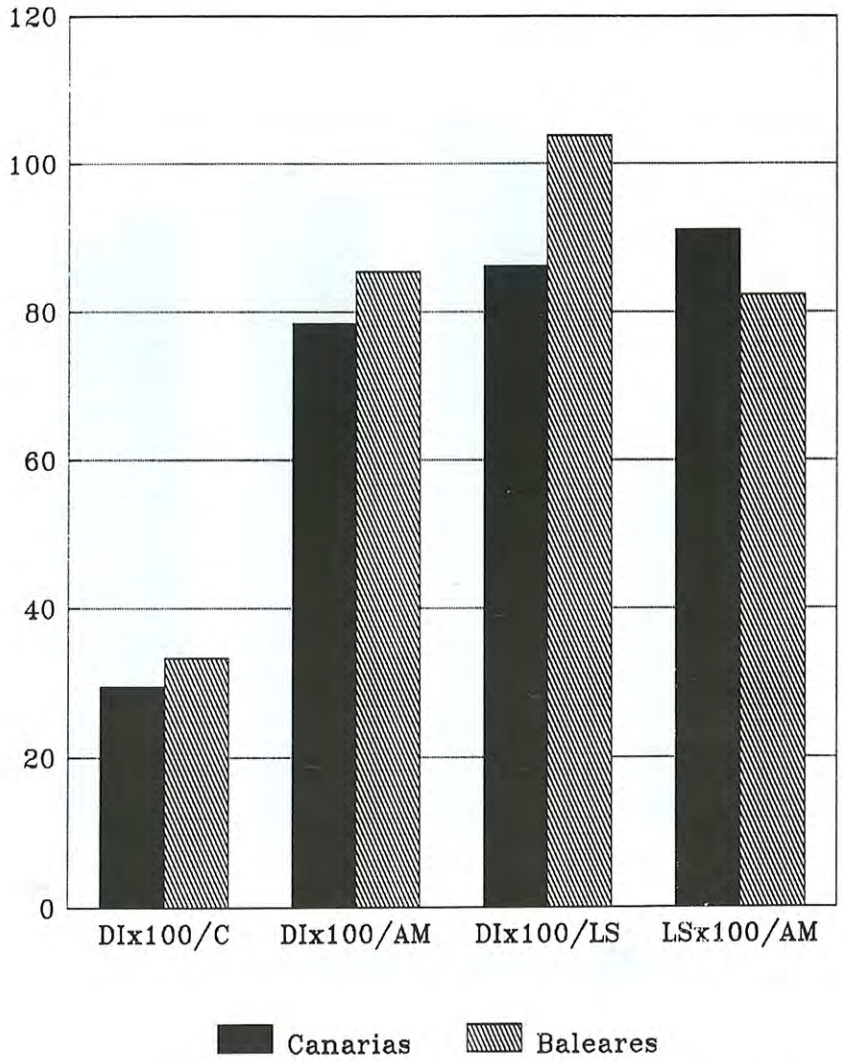


FIGURA 3 - Medidas craneales de *Corvus corax* expresadas como porcentaje de otras medidas craneales, donde la distancia interorbitaria expresada como un porcentaje de la longitud de la sínfisis (DIx100/LS) presenta la mayor diferencia entre las dos subespecies de ambos archipiélagos.

DISCUSION Y RESULTADOS

Los datos biométricos están referidos a siete medidas craneales: culmen (C), distancia interorbitaria (DI), longitud craneal (LC), longitud condilobasal (LCB), anchura maxilar (AM), longitud mandibular (LM) y longitud de la sinfisis (LS). Los resultados en seis de ellas fueron menores para los cuervos canarios, y tan sólo la longitud de la sinfisis (LS) presentó un valor similar (Canarias: 22.14 mm, Baleares: 22.16 mm) para las dos subespecies analizadas (Tabla I). Estos datos se vieron reflejados al realizar el test de la "U" de Mann-Whitney en el que las medidas craneales presentaban diferencias significativas entre ambas subespecies, con la excepción de LS (Tabla II).

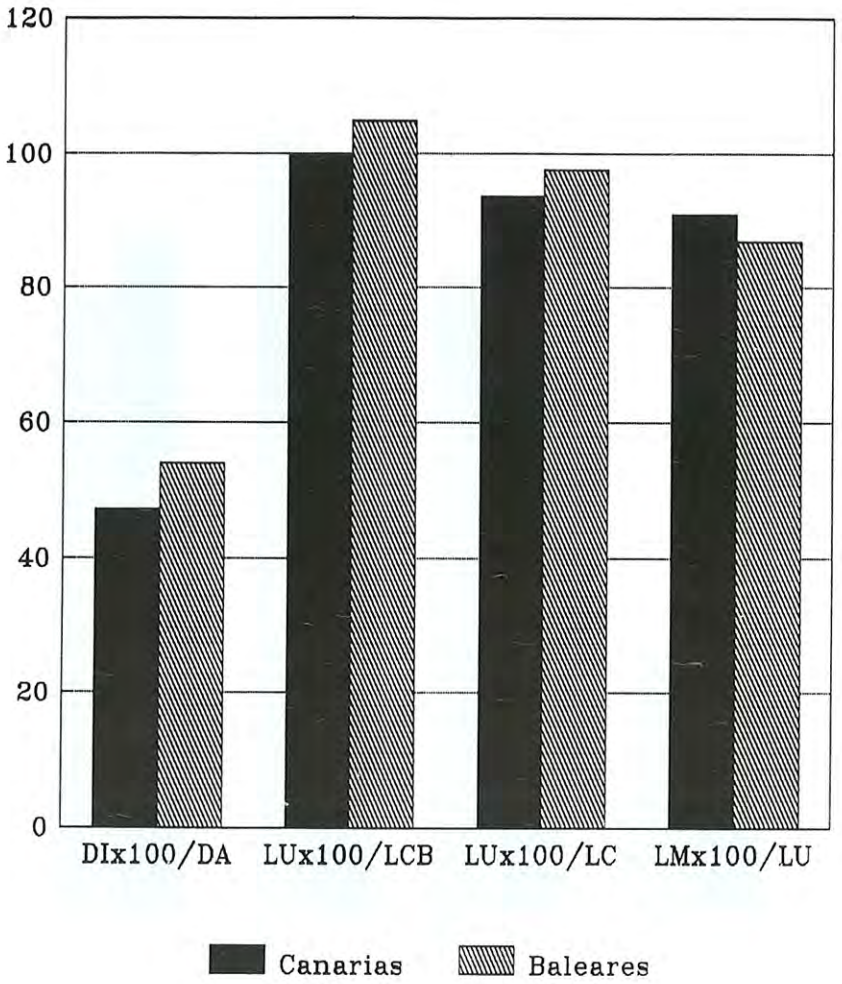


FIGURA 4 - Medidas craneales de *Corvus corax* expresadas como porcentajes de medidas postcraneales, donde la distancia interorbitaria expresada como un porcentaje de la distancia antitrocantérea (DIx100/DA) presenta la mayor diferencia entre las subespecies de Canarias y Baleares.

En las medidas postcraneales los valores fueron menores en los cuervos de Canarias para las ocho medidas consideradas (longitud humeral, long. ulnar, long. femoral, long. del tibiotarso, long. del tarso-metatarso, long. del sinsacro, distancia antitrocantérea y long. de la quilla) (Tabla I), y al realizar el test anteriormente citado se apreció que todas ellas presentaban diferencias significativas entre ambas subespecies (Tabla II).

Al representar los rangos y las medias de forma lineal para dos medidas (distancia interorbitaria y longitud ulnar), que hemos tomado como ejemplo y que presentaban diferencias significativas, se observa que existe cierto solapamiento en los rangos de la muestra (Figura 5), donde los mayores especímenes de Canarias presentan dimensiones similares a los menores ejemplares de Baleares; sin embargo es necesario señalar que en estos casos la media de una subespecie se encuentra fuera del rango de la otra y viceversa.

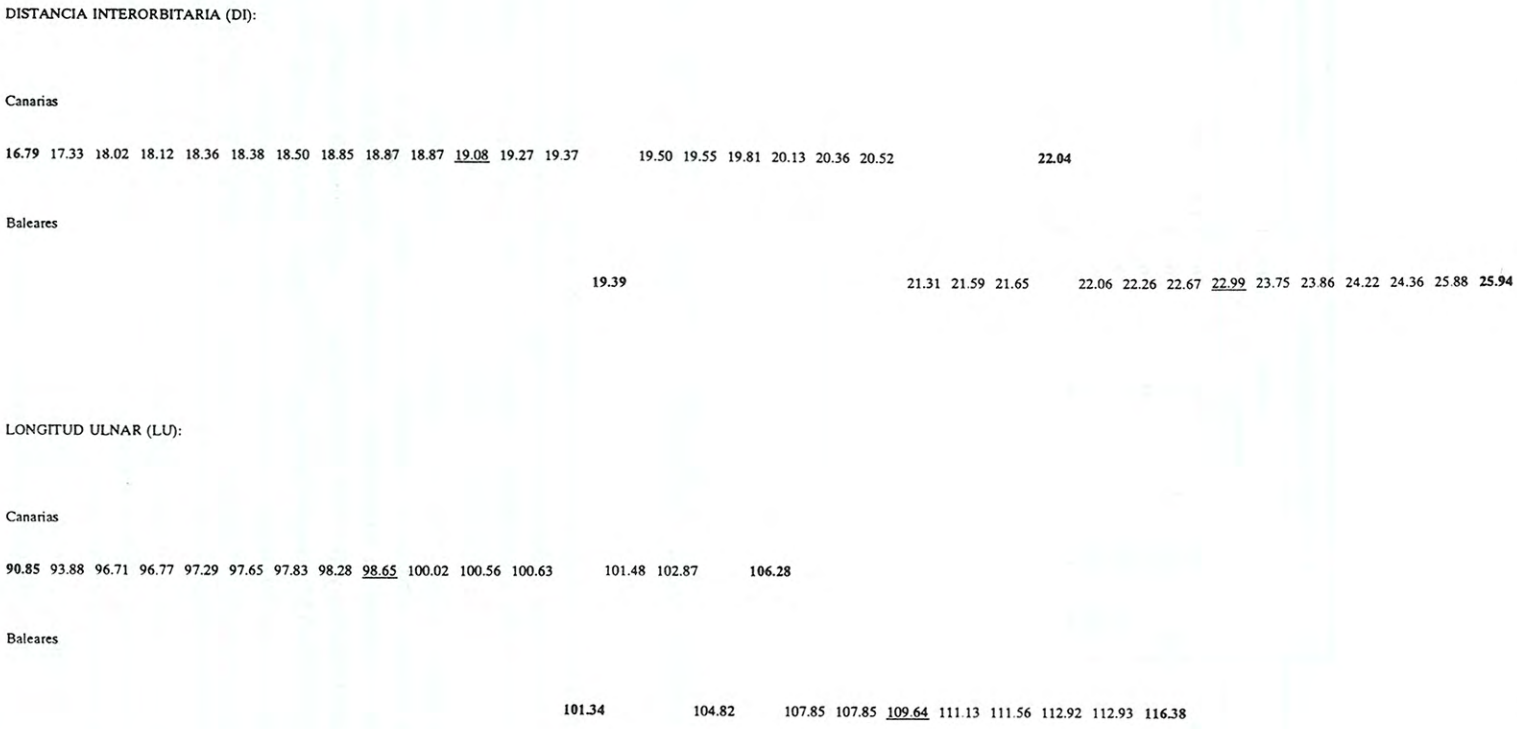


FIGURA 5 - Valores de dos medidas (distancia interorbitaria y longitud ulnar) de las subespecies de *Corvus corax* de Canarias y Baleares. En la gráfica aparecen destacadas las cifras correspondientes a los rangos y las medias.

	Con diferencia significativa					Sin diferencia significativa				
		n_1	n_2	valor menor de "U"	valor crítico		n_1	n_2	valor menor de "U"	valor crítico
Medidas craneales	C	20	13	38	76	LS	19	13	106	72
	DI	20	13	10	76					
	LC	20	13	20	76					
	LCB	20	13	32.5	76					
	AM	20	13	7	76					
	LM	19	13	28	72					
Medidas postcraneales	LH	14	8	4	26					
	LU	14	9	4	31					
	LTi	14	8	13	26					
	LQ	13	8	9.5	24					
	LF	14	8	16	26					
	LT	10	6	8	11					
	LSp	13	8	17.5	24					
	DA	14	9	25	31					

TABLA II - Resultados del test de la "U" de Mann-Whitney realizado con las medidas craneales y postcraneales de los Cuervos procedentes de Canarias y Baleares. Para la aplicación de este método se ha seguido a FOWLER & COHEN (1990).

Para comprobar si la disminución de tamaño era similar en todos los huesos hallamos la relación existente entre ellos, expresando en porcentaje las medidas de unos con respecto a otros. En primer lugar se realizó entre las medidas craneales de las dos muestras, observándose las mayores diferencias en (Figura 3): la distancia interorbitaria expresada como un porcentaje del culmen (DIx100/C), que resultó ser del 29.44% en Canarias y 33.25% en Baleares; la distancia interorbitaria con respecto a la anchura maxilar (DIx100/AM), cuyos valores fueron de 78.48% en Canarias y 85.43% en Baleares; la distancia interorbitaria con respecto a la longitud de la sínfisis (DIx100/LS), siendo 86.17% para Canarias y 103.74% para Baleares; y, la longitud de la sínfisis con respecto a la anchura maxilar (LSx100/AM), obteniéndose un 91.07% para Canarias y un 82.34% en Baleares. De todo ello se deduce que la variación de tamaño no ha sido proporcional en los huesos del cráneo. Destaca el hecho de que la mayor diferencia se produce en DIx100/LS, al no presentar LS diferencias significativas en ambas subespecies, la mayor variación se produciría en la distancia interorbitaria.

Aplicando esta misma metodología para las medidas postcraneales no se observaron diferencias apreciables entre ambas subespecies, lo que implica que la disminución de tamaño ha ocurrido de forma similar en ambos casos.

Finalmente se aplicó el mismo método entre medidas craneales y postcraneales (Figura 4), presentándose las mayores diferencias para ambas subespecies en el caso de DIx100/DA (47.20% para Canarias y 54.03% para Baleares).

CONCLUSIONES

1°.- Los resultados obtenidos en seis de las medidas craneales efectuadas en *C. c. tingitanus* y *C. c. corax* indican que existen diferencias significativas entre ambas subespecies. Estas medidas son la longitud del culmen, distancia interorbitaria, longitud craneal, longitud condilobasal, anchura maxilar y longitud mandibular.

2°.- Estas diferencias significativas entre las dos subespecies se pueden observar, asimismo, en todas las medidas postcraneales realizadas: longitud humeral, long. ulnar, long. femoral, long. del tibiotarso, long. del tarso-metatarso, long. del sinsacro, distancia antitrocantérea y long. de la quilla.

3°.- Los huesos craneales presentan variaciones en las proporciones al considerar cada uno de ellos con respecto a los demás, siendo los valores de estas variaciones mayores al considerar la distancia interorbitaria (DI).

4°.- La subespecie de Canarias se caracteriza por tener menor tamaño a nivel osteológico que la perteneciente a Baleares. Esta disminución se produce de manera proporcional en el esqueleto postcraneal, pero no ocurre lo mismo en el caso del cráneo.

5°.- Parece existir una clina geográfica con respecto al tamaño de los cuervos presentes en la Península Ibérica, Baleares y Canarias. Esta variación, consistente en un aumento de la talla con la latitud, no ha podido ser confirmada debido al bajo número de ejemplares procedentes de la Península Ibérica que hemos considerado, si bien los datos bibliográficos parecen corroborar esta hipótesis.

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BIRD BONE TAPHONOMY FROM THE INSIDE OUT: THE EVIDENCE OF GULL PREDATION ON THE MANX SHEARWATER *Puffinus puffinus*

DALE SERJEANTSON[1], BRIAN IRVING[2] & SHEILA HAMILTON-DYER[3]
(1) Faunal Remains Unit, Department of Archaeology,
University of Southampton
(2) University College London Institute of Archaeology,
Department of Human Environment
(3) Centre for Human Ecology and Palaeoeconomy,
Department of Archaeology University of Southampton

ABSTRACT: During a visit to the island of Skomer, South Wales, UK, in July 1992, we saw many dead manx shearwaters, assumed killed by great black-backed gulls *Larus marinus*, with distinct pattern of damage to the carcass. In this paper we describe and illustrate the traces of damage seen on the bones and the sequence of disarticulation of the carcass. The gulls make a distinctive gash in the sternum, and some less distinctive breaks in some other bones. The first part of the carcass to become disarticulated is the head, which has often been turned inside out by the gull. This is followed by the legs, which become detached from the body separately. The two wings and pectoral girdle remain in articulation longest, after all the flesh has been removed.
Past work on bird bone taphonomy has used the evidence of surface preservation of the bones and the ratios of the main anatomical elements. Though the Skomer birds provide some support for the hypothesis of Ericson that birds from natural deposits will be represented mainly by their wing bones, this may be an oversimplification. The anatomical distribution of two small archaeological groups is considered, from the Udal North, Hebrides, Scotland, and from Launceston Castle, Cornwall, England. The context of both suggests an anthropogenic origin, but anatomical distributions are very different.
Measurements of the humerus, ulna and tarsometatarsus are given in Appendix 1. The tarsometatarsus length is compared with an earlier sample from the same island.

KEYWORDS:MANX SHEARWATER *Puffinus puffinus*, GULL PREDATION, BIRD BONE, TAPHONOMY, ARCHAEOLOGICAL FINDS, MEASUREMENTS

RESUMEN: Durante una visita a la isla de Skomer, en el Gales meridional (Reino Unido), durante julio de 1992, detectamos la presencia de numerosos cadáveres de pardela pichoneta, presumiblemente muertas por la acción del gavión (*Larus marinus*), con un peculiar patrón de daños, apreciable en las carcasas. En este trabajo describimos e ilustramos las señales de ataque en los huesos así como la secuencia de desarticulación del cuerpo. Las gaviotas realizan un corte peculiar en el esternón y otra serie de fracturas menos características en otra serie de huesos. La primera porción del cuerpo en desarticularse es la cabeza, a quien, con frecuencia, la gaviota vuelve del revés. A continuación vienen las patas posteriores que se separan del tronco de forma independiente. La cintura pectoral y ambas alas son las zonas que durante más tiempo permanecen en conexión anatómica, después de haberse eliminado la carne.
Los trabajos de tafonomía aviar han hecho uso preferente, hasta la fecha, de la conservación de restos en superficie y de las relaciones entre los principales elementos anatómicos. Aunque los ejemplares de Skomer apoyan en cierta medida la hipótesis de Ericson de que las aves en depósitos naturales se encuentran principalmente representadas por huesos alares, tal aseveración no deja de ser en exceso simplista. Así, en dos pequeñas muestras ornitoarqueológicas, de aparente origen antrópico, procedentes de Udal North (islas Hébridas, Escocia) constatamos dos muy diferentes patrones de representatividad esquelética. Las medidas de los húmeros, ulnas y tarsometatarsos aparecen recopiladas en el Apéndice 1. La longitud del tarsometatarso se compara con una muestra más antigua de la misma isla.

PALABRAS CLAVE: PARDELA PICHONETA *Puffinus puffinus*, DEPREDACION GAVIOTAS, TAFONOMIA, HUESOS, AVES, MUESTRAS ARQUEOLOGICAS, MEDIDAS

INTRODUCTION

During a visit to the island of Skomer, South Wales, in July 1992, we saw the many dead manx shearwaters. We collected a sample for study, and in this paper describe the traces of damage

left on the bones, and the sequence of disarticulation of the carcass. Such observations can contribute to understanding the taphonomy of the bones of manx shearwaters and other birds found on archaeological sites, and the question of whether or not the bones are anthropogenic in origin.

In the second part of the paper previous work on bird bone taphonomy is reviewed, and the anatomical distribution of two small groups of shearwater bones is discussed.

THE SHEARWATER COLONY ON SKOMER

Skomer is one kilometre from the Dyfed peninsula, off the south west tip of Wales (Figure 1). It has the second largest breeding colony of manx shearwaters in the world, after the island of Rhum in the Hebrides, Western Scotland. Along with its sister island, Skokholm, one kilometre to the south-east, it has been the study site for much of what is known about the species' population biology (Lockley, 1942; Brooke, 1990). These studies also considered predation and mortality. There are approximately 100,000 breeding pairs on Skomer. Adult birds return during March, with the first eggs being laid during May. By late June the young are hatched, with fledging taking place during August and September. The parent birds return at night for nest building, incubation and feeding the chicks, and leave the island before dawn. They lay the eggs in burrows in the light sandy soils. This is thought to keep the temperature constant and to hide the eggs and chicks from predators. The island is no longer farmed (Evans, 1990) and has no mammalian predators. The breeding populations on islands which have been colonised by ground predators, mainly rats, are much reduced or have disappeared.

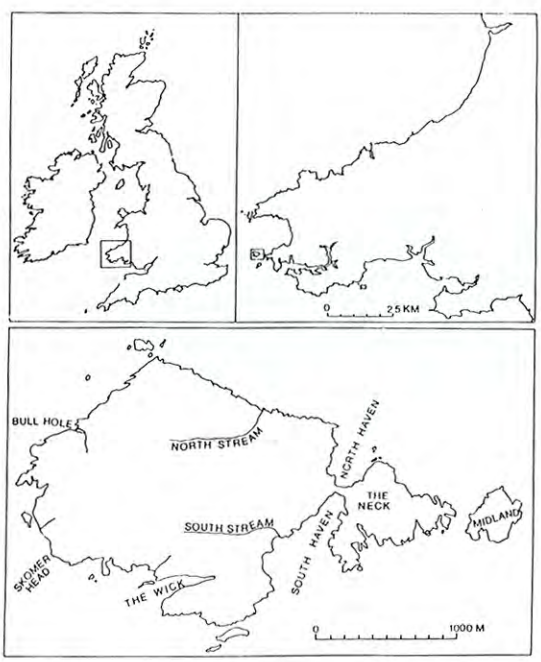


FIGURE 1 - Location of Skomer island.

THE SAMPLE

Human movement on the island, a National Nature Reserve, is restricted, but dozens of part carcasses and a few which were almost complete were seen lying on the ground in the inmediate vicinity of the path round the island which visitors follow. The carcasses were concentrated into discreet areas which seemed to have little or no bearing on the distribution of burrows. We collected from all round the island except the Neck. A total of 33 complete and part carcasses was collected. Carcasses in a range of different stages of disarticulation were selected. They were cleaned for study at the Faunal Remains Unit, Department of Archaeology, Southampton. The remains were raised to boiling point in water, and when the temperature had dropped to 37°C a proteolytic enzyme, Neutrase, was added; they were then left for between three days and three weeks. The bones were then gently brushed and rinsed clean.

THE PREDATOR

It seemed likely that only one predator was involved, but the restrictions on movement precluded any search for predator nest sites. During his research on the breeding shearwaters of Skokholm, Lockley each morning found corpses of birds slain by great black-backed gulls, which he identified from the tell-tale inverted skin. Subsequently, the coincidence of nest sites of the great black-backed gull and dead shearwaters was reported by Corkhill (1973). The birds collected by us also had the inverted skin with the head inside out (Figure 2), and were found in discrete groups, so we are confident that the predator of this sample is the great black-backed gull. The damage to the sternum, described below, also fits this conclusion. There is another possible cause of mortality of the shearwaters on Skomer: the disease Puffinosis, but this was ruled out as the cause of death of these birds as it is suffered mainly by the chicks when they emerge from the burrows in September.

DAMAGE TO THE BONES

The clearest traces are on the sternum. All but one of the 20 collected have some damage, which takes the form of pecking away part of one side of the bone (Figure 3B). At its least, seen on only three bones, the damage consists of a hole in the sternal keel. Those with most severe damage (four) have lost most of the bone other than the proximal end with the coracoidal groove. The peck marks are the most obvious and most characteristic trace of gull damage: some marks and the gouges removed from the bone match the shape of a gull's bill, and suggest that the method of attack was a stab or peck in the breast. That this is indeed the method by which the great black-backed gulls attack and kill the shearwaters is confirmed by the observations of Corkhill.

Other bones which are sometimes damaged are the furcula, scapula, coracoid and tibiotarsus. Eight out of 18 of the furculae are damaged or broken, either cracked on one side (Figure 3A), or completely broken. Of the 35 scapulae, 11 are cracked or broken, and of the 36 coracoids, 28 have the sternal border broken off. The long cnemial crest on the tibiotarsus is also frequently damaged; over half are either cracked or broken through. Just one skull collected is damaged: it is severely crushed on the left and right parietal, as is the mandible from the same bird. No damage is visible on any of the wing bones collected, or on other leg bones.

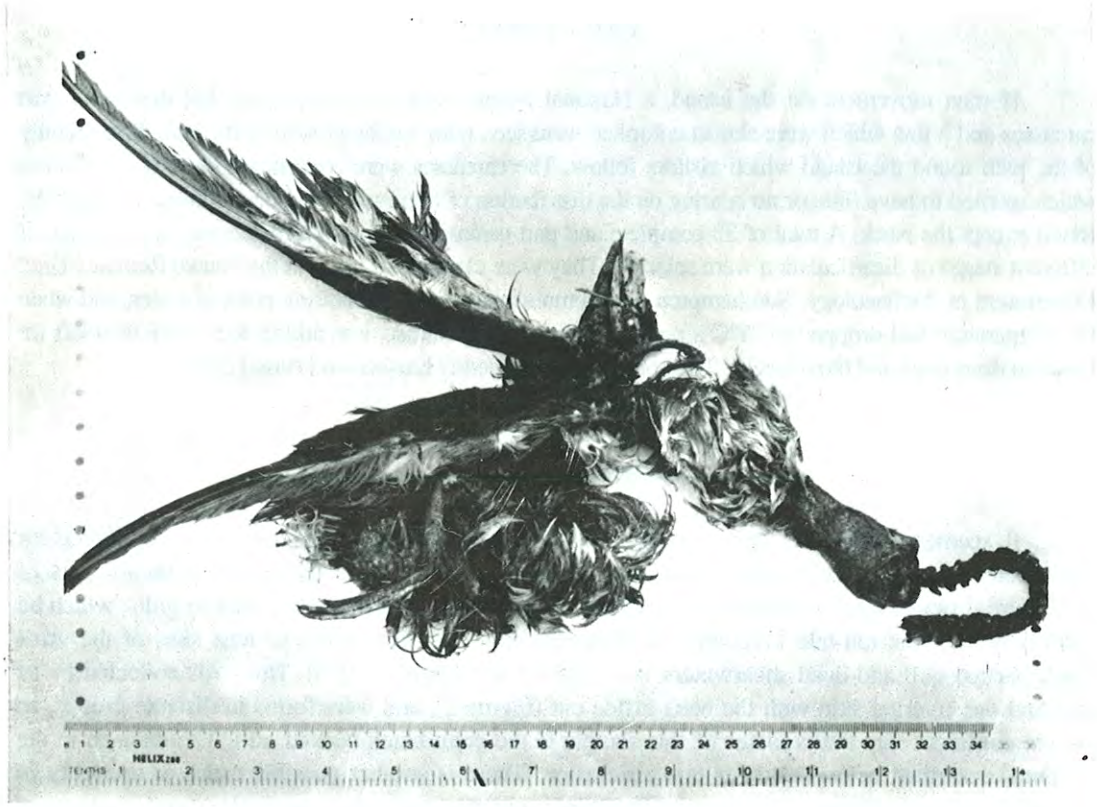


FIGURE 2 - Carcass of manx shearwater killed by a great black-backed gull. The skull is inside out in the skin, the muscle has been eaten, but most of the skeleton survives, held together by skin and ligaments.

The evidence of the bones confirms that the birds were killed by gulls. There is a single carcass which leaves room for doubt, as it has no visible damage on the sternum, furcula, or scapulae, but the sternal border of the coracoid is snapped off.

The further feature of damage inflicted by the gulls which does not affect the bones themselves: they turn the carcass inside out, leaving the head back to front inside the skin, having severed the vertebral column (Figure 2).

SEQUENCE OF DISARTICULATION

The sequence of disarticulation and the relative rate of disarticulation was established by analysis of the bone most often found in articulation in our sample. The first part of the skeleton to disappear is the rib cage; only one of the carcasses found has an almost complete rib cage. The cervical vertebrae then separate and disperse. Skin and ligaments retain the legs attached to the rest of the skeleton for a time. Next each leg from the femur down separates from the rest of the carcass.

We found no examples where these remained in articulation with the synsacrum and with each other, but separate from the rest of the skeleton. The head then separates from the trunk.

The stage during which the carcasses survive as a pair of wings still joined by the sternum, furcula, scapula and coracoid (Figure 4) is a very long lasting one, to judge from the numbers of carcasses seen in this condition, and from descriptions by other workers on Skomer. It is clear that the ligaments of the wing are stronger and resist decay for longer than the others.

DISCUSSION

The damage to the sternum and furcula are characteristic of slaughter by a gull, and the traces are sufficiently distinctive that it would be safe to infer that bones recovered from ancient sites with similar damage were casualties of bird predation, rather than human predation. A long gash in the sternum may distinguish it from the damage caused by a raptor, with a shorter bill. The damage to the scapula, coracoid and tibiotarsus is much less distinctive. Humans or bird predators can damage the parts of the pectoral girdle when disarticulating these bones, or the tibiotarsus if it is roughly pulled or broken apart from the femur, and such traces are quite common on bones from human food remains from early settlements. The sternal border of the coracoid in particular is very commonly damaged. The sternum is unfortunately only rarely recovered in anything like an intact form from excavated sediments.

Turning the skin inside out and leaving the head back to front could in theory be recognised in a fossil or sub-fossil bird, if recording of bones *in situ* is carried out in sufficient detail to show this. On many sites disturbance or compaction of the sediments would distort the association.

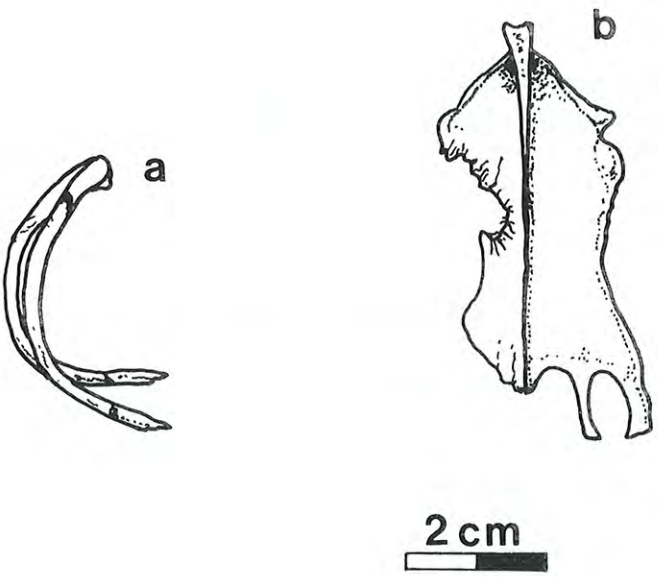


FIGURE 3 - Furcula (a) and sternum (b) of manx shearwater showing damage caused by great black-backed gull.

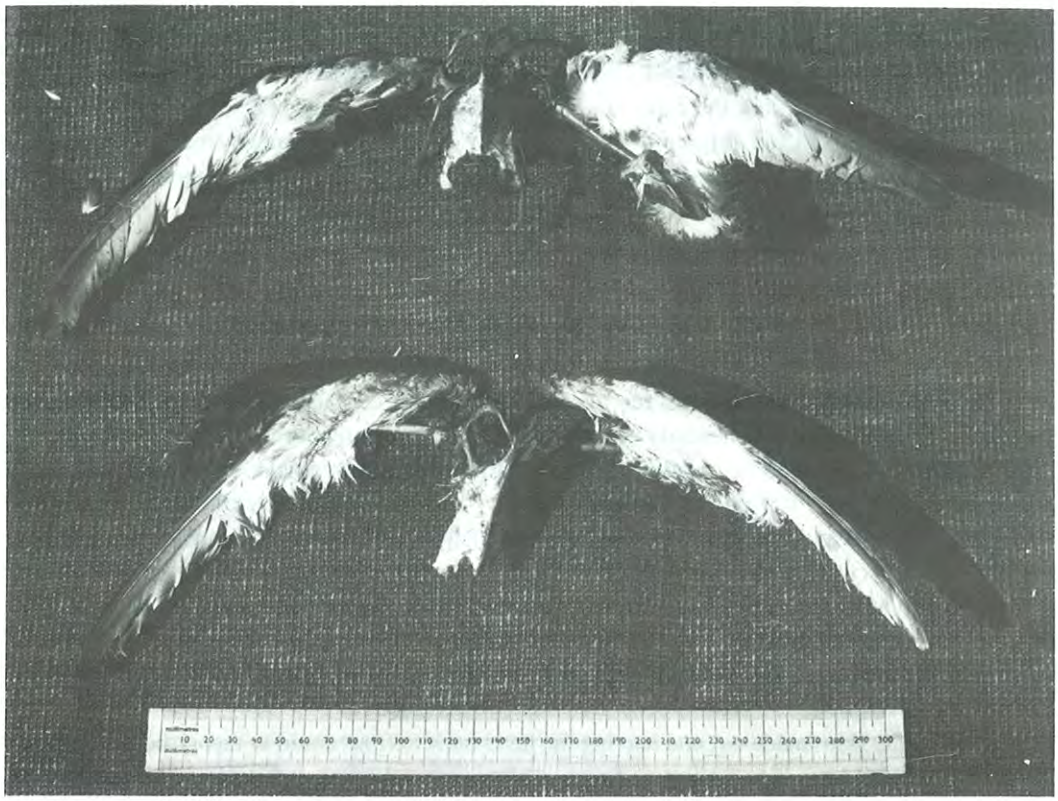


FIGURE 4 - Two part skeletons of manx shearwater comprising the pectoral girdle and wings. Most were found in this condition.

A complete articulated pectoral girdle is not a typical condition in which to find bones of birds eaten by man. Though both humans and gulls will consume the muscle on the sternum, humans are more likely to disarticulate the bones of the pectoral girdle, if only because cooking makes it easier to separate the bones when eating the bird.

BIRD BONE TAPHONOMY

There have been two different approaches to interpreting the taphonomic history of bird bone finds, which have had the aim of identifying whether the predator was humans or other birds. Surface texture is one area of study: bones from bird pellets have a less eroded surface texture than those which derive from human meals (Andrews, 1990; Armour-Chelu, 1988). A second method of analysis has been to examine differences in the numbers of skeletal elements found (Mourer-Chauviré, 1983; Bramwell et al., 1987; Ericson, 1987; Livingston, 1989). These studies have identified contrasts between different assemblages, but proposed conflicting interpretations.

The anatomical elements found in a fissure interpreted as the former eyrie of a golden eagle (Bramwell et al., 1987) included few wing and leg bones, and the most common anatomical elements were the coracoid, scapula and sternum. The interpretation favoured was that the limb bones were eaten: "Complete digestion of these smaller (sic) bones is perhaps more likely". These results do not fit well with the finds from Skomer, and it seems that we should not expect fully consistent results when the circumstances of the find and the predator are so different.

A useful method of analysis has been to contrast the ratio of wing and leg bones (Ericson, 1987; Livingston, 1989). Ericson, counting the humerus, ulna and carpometacarpus to represent the wing, and the femur, tibiotarsus and tarsometatarsus to represent the leg, found that wing bones predominated in natural accumulations. The Skomer shearwaters support this conclusion and suggest that the reason for the disproportion is that the wing bones remain in articulation longer than the leg bones in a carcass not subjected to butchery and cooking.

However, studies of birds from three Nevada sites in the USA suggest that the picture is more complicated. Using the same six bones, Livingston found that the ratio of wing bones of small duck *Anas* sp. was similarly high (81% and 74%) in two assemblages, one anthropogenic and the other derived from owl pellets. Further, when survival in different families and different species from human settlement debris was analysed, ratios varied widely. These suggest instead that density of bone elements was the underlying property which most governs bone survival, a case well accepted in mammal bone taphonomy (Brain, 1976). There is great scope for experimental work, and for analyses of more human midden accumulations on different species.

ARCHAEOLOGICAL FINDS

The anatomical distribution of two small groups of shearwater bones from archaeological sites is now discussed in the light of the Skomer finds and previous work.

Most finds of manx shearwaters have been made on settlements round the west and north coast of Scotland (see eg review in Serjeantson, 1988). At most sites numbers of bones are small, but the manx shearwater is the second most common bird, after the gannet *Sula bassana*, at Buckquoy (Bramwell, 1977), on Mainland Island of the Orkney archipelago, and at Udal North (Serjeantson ND, Serjeantson, 1988), on North Uist, Hebrides, Scotland. More surprising are finds from inland sites: there is a single bone from sixteenth century deposits at Baynards Castle, London (Bramwell, 1975), a collection which is otherwise mainly ducks and waders, and 10 from AD C13TH and C14th deposits at Launceston Castle, Cornwall, England (Albarella & Davis, in prep.).

At both sites the circumstances and context of the finds are such that we can be confident that the birds were collected for food. Capture of manx shearwaters and other seabirds is well documented around the English and particularly the Scottish coasts and islands from the time of the earliest written records. They were collected both for local consumption and for trade. They were captured and exported from their breeding colonies on the Isle of Man (from where the birds derive their name), the Faroe Islands, the Hebrides (Baldwin, 1974), Orkney, Shetland (Fenton, 1978, 510), and the Scilly Isles (Brooke, 1990). In early times when rents and dues were paid in agricultural produce, they formed part of the rents of the Hebridean islands of Mingulay, Barra and Rhum (Elwes, 1869), and part of the feudal dues of the Scilly islanders of south west England.

The context of the finds also suggests strongly that the bones are from birds which were consumed. At the Udal the bones were found with food remains among the debris from a settlement, some 400 m from the shore. Even more than the Udal, the context of the Launceston finds effectively rules out any origin other than human, as the castle is on the mainland 20 Km from the nearest coast. One tibiotarsus is from an inmature bird: the bone is as long as the adult bones and the distal end is ossified, but the proximal end is unfused and porous in texture. In the nineteenth century, fledgling chicks were selected for capture in August and September, by which time they have reached adult size, and are "so very fat that you would take it to be wholly fat" (quoted by Fenton, 1978, 511). It is especially unlikely that a bird at this stage of development could have been found near the castle naturally. Here too the bones are with others which are clearly food remains.

At the Udal, if the same six elements analysed by Ericson and Livingston are counted, 78% of the bones are from the wing and 22% from the leg (Table 1). Radii, and coracoids were also found. The tarsometatarsus from phase VII-IX was found with three foot phalanges. All the sediments were sieved. The most obvious interpretation of the imbalance is that wing bones are larger and more robust than the leg bones.

The Launceston sample is much more selected, consisting as it does of 10 bones, all of which are tibiotarsi, six complete, and four broken mid-shaft. The lack of other parts of the skeleton here is difficult to explain. Differential survival cannot account for the survival of the tibiotarsus over the humerus and ulna, both relatively long and robust, so the explanation must lie elsewhere. Equally, partial recovery due to the failure to sieve the deposits in bulk cannot explain the absence of wing bones, though could account for the lack of femora, a relatively small bone in the procellariformes. The presence of leg rather than wing bones could be taken to confirm Ericson's conclusion that these are more common in humanly generated deposits, the likely explanation here being that wings were removed before the birds were packed for storage and transport.

	Udal V-VI	Udal VII-IX	Udal IXc-X	Udal XI-XIII	Udal total	%	Launceston C13th/C14th	%
HUMERUS		4	3	2	9			
ULNA		5		2	7			
CARPOMETACARPUS		1	1		2			
subtotal wing					18	78.3		
FEMUR	1				1			
TIBIOTARSUS	1			2	3		10	
TARSOMETATARSUS		1			1			
subtotal leg					5	21.7		100
wing+leg					23		10	
CORACOID		2			2			
RADIUS		4		1	5			
total	2	17	4	7	30		10	

V-VI AD C14TH -C15TH; VII-IX C1160-1300; IXc-X c800-1160; XI-XIII c300-800

TABLE 1 - Anatomical distribution of bones of manx shearwater *Puffinus puffinus* from Medieval deposits at the Udal, Outer Hebrides, Scotland and Launceston Castle, Cornwall, England.

The tibiotarsi from Launceston bones were also examined for damage. Part or all of the cnemial crest is broken off in each specimen where the proximal end survives. As discussed above, this part of the bone is so fragile that it is liable to break under any pressure, and, if not broken before deposition, is only too likely to fracture under pressure from compaction of the sediments in which it is buried. The midshaft breaks could well have been made by humans, though they show no very clear chops or cuts at the break points.

CONCLUSION

The study of the Skomer birds has helped to illuminate some of the processes of damage to birds killed by agents other than man. In our present state of understanding of bird bone taphonomy, anatomical distribution alone cannot provide an answer to whether bones were accumulated by humans or other animals, but may have a part to play. At the Udal and Launceston, the context of the finds was the most important evidence for their origin. Nevertheless, just as with mammals, analysis of the anatomical elements and of damage to the bones both have important parts to play in identifying the origin of the bones.

ACKNOWLEDGEMENTS

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Appendix 1. MEASUREMENTS

With notable exceptions, there have been few metrical studies of disarticulated bones from modern bird populations, and we are of the opinion that publication of such measurements is useful to researchers engaged in the identification and analysis of bird bones from archaeological sites.

Measurements were taken of the humerus (Table 2), ulna (Table 3), and tarsometatarsus (Table 4). On the ulna the measurement points (Figure 5) are Bp (cf Driesch, 1976, p118, Figure 56b) and GL (56e); on the tarsometatarsus they are GL, Bp, SC and Bd (62b); and on the humerus, GL, Dip, SC and Bd (54c). It can be assumed that all specimens are adult or first year birds; none of the bones show the porosity or unfused condition which would be present at that time of year on the bones of the chicks.

Tarsometatarsus length can be compared with a sample measured by Brooke (1990, 20):

	MEAN LENGTH	S.E.	N
Brooke	45,9	0,17	50
This sample	43,4	0,33	28

The mean length varies by 2.5 mm. This may be accounted for by differences in age class or sex, but it is also possible that the result of the Brooke sample is greater because the bones were still in articulation and unskinned when measured, as his illustration (Figure 2.1) of how the measurements were taken shows. The standard error (S.E.) is greater in this sample no doubt because the sample is smaller.

spec no		GL	Bp	SC	Did
1	R	71.9	6.8	3.3	7.4
1	L	72.2	6.7	3.4	7.4
2	R	72.7	6.6	3.3	7.4
2	L	72.7	6.6	3.3	7.4
3	R	72.3	6.9	3.5	7.5
3	L	72.4	6.8	3.4	7.5
4	R	67.9	6.5	3.2	7.0
5	R	73.8	6.8	3.3	7.6
5	L	73.7	6.7	3.4	7.5
6	R	70.6	6.6	3.3	7.3
6	L	70.9	6.6	3.3	7.2
7	R	72.0	6.5	3.2	7.5
7	L	72.2	6.3	3.2	7.4
8	R	73.5	6.7	3.4	7.4
8	L	73.4	6.6	3.5	7.4
9	R	75.9	7.0	3.4	7.8
9	L	75.9	7.0	3.3	7.8
10	R	71.0	6.7	3.2	7.3
10	L	70.9	6.7	3.2	7.4
11	R	72.4	6.7	3.4	7.4
11	L	72.3	6.7	3.4	7.5
12	R	71.4	6.9	3.3	7.3
12	L	71.6	6.8	3.3	7.4
13	R	71.5	6.7	3.3	7.4
13	L	72.6	6.7	3.3	7.4
14	R	74.7	6.6	3.1	7.5
14	L	74.4	6.6	3.2	7.4
15	R	72.2	6.7	3.3	7.1
15	L	72.4	6.6	3.3	7.2
16	R	71.0	6.3	3.2	7.1
16	L	71.1	6.3	3.2	7.1
17	R	68.7	6.3	3.1	6.9
17	L	68.9	6.3	3.2	6.9
18	R	72.1	6.5	3.1	7.2
18	L	72.1	6.4	3.1	7.4
19	R	72.1	6.7	3.2	7.5
19	L	71.9	6.7	3.2	7.5
20	R	74.0	6.7	3.4	7.3
20	L	73.9	6.7	3.3	7.4
21	R	72.6	6.7	3.3	7.3
22	R	75.4	6.8	3.2	7.4
22	L	75.3	6.7	3.3	7.3
23	R	71.7	6.8	3.3	7.5

TABLE 2 - Measurements of the ulna.

spec no		GL	Bp	SC	Bd
1	R	44.1	5.9	1.7	5.1
1	L	43.8	5.9	1.7	5.2
2	R	44.3	5.7	1.5	4.8
2	L	44.2	5.7	1.6	5.0
3	R	44.1	5.8	1.6	5.3
3	L	44.0	5.7	1.8	5.2
4	R	39.0	5.2	1.2	4.5
4	L	39.1	5.1	1.2	4.6
5	R	44.8	5.2	1.3	4.8
5	L	44.6	5.1	1.3	4.7
6	R	42.6	5.3	1.4	4.6
7	R	42.7	5.3	1.3	4.8
7	L	42.9	5.2	1.7	4.9
9	R	46.1	5.8	1.3	5.3
9	L	45.8	5.8	1.4	5.3
10	R	41.7	5.3	1.4	4.7
10	L	41.2	5.2	1.5	4.8
13	L	43.0	5.3	1.3	4.6
17	R	42.4	4.9	1.3	4.7
17	L	42.2	4.8	1.3	4.7
26	R	41.8	5.3	1.5	4.8
27	L	44.4	5.7	1.7	4.8
28	R	44.5	5.4	1.3	5.1
29	L	46.1	5.6	1.2	4.7
30	L	44.2	5.4	1.3	4.8
31	L	43.9	5.3	1.3	4.7
32	R	44.7	5.4	1.3	4.8

TABLE 3 - Measurements of the tarsometatarsus.

spec no		GL	Dip	SC	Bd
1	R	79.9	19.0	5.4	10.9
1	L	80.2	19.1	5.5	10.9
2	R	78.3	19.9	5.6	11.2
2	L	78.4	19.8	5.5	11.1
3	R	80.4	19.8	5.9	11.6
3	L	80.5	19.9	5.8	11.5
4	R	75.2	18.2	5.2	10.3
5	R	80.1	19.9	5.7	11.1
5	L	80.2	20.1	5.7	11.0
6	R	77.9	20.3	5.9	11.1
6	L	78.0	20.2	5.9	11.0
7	R	78.2	19.2	5.4	10.8
7	L	78.4	19.2	5.4	10.6
8	R	80.2	19.2	5.3	10.9
8	L	80.3	19.2	5.3	11.0
9	R	83.8	20.9	5.8	11.4
9	L	84.2	21.0	5.9	11.0
10	R	76.4	19.8	5.3	10.9
10	L	76.6	19.7	5.3	10.9
11	R	81.1	19.5	5.6	11.0
11	L	81.3	19.4	5.6	11.0
12	R	78.7	20.6	5.9	11.2
12	L	78.9	19.9	5.9	11.0
13	R	78.2	19.9	5.5	11.1
13	L	78.6	19.5	5.7	10.7
14	R	80.2	19.9	5.4	10.9
14	L	80.3	19.8	5.4	10.8
15	R	77.8	19.0	5.9	10.7
15	L	77.9	19.1	5.9	10.7
16	R	77.1	19.3	5.2	10.4
16	L	77.4	19.5	5.2	10.5
17	R	74.6	18.7	5.2	10.1
17	L	74.8	18.9	5.2	10.0
18	R	79.7	19.7	5.4	10.8
18	L	79.8	19.8	5.4	10.8
19	R	79.0	20.3	5.6	11.0
19	L	79.1	20.4	5.6	11.0
20	R	80.4	20.0	5.8	11.0
20	L	80.4	20.1	5.8	11.0
21	R	78.1	19.2	5.6	10.7
22	R	82.0	19.9	5.8	11.1
22	L	82.3	19.9	5.9	10.9
25	L	80.6	18.9	5.3	10.2

TABLE 4 - Measurements of the humerus.

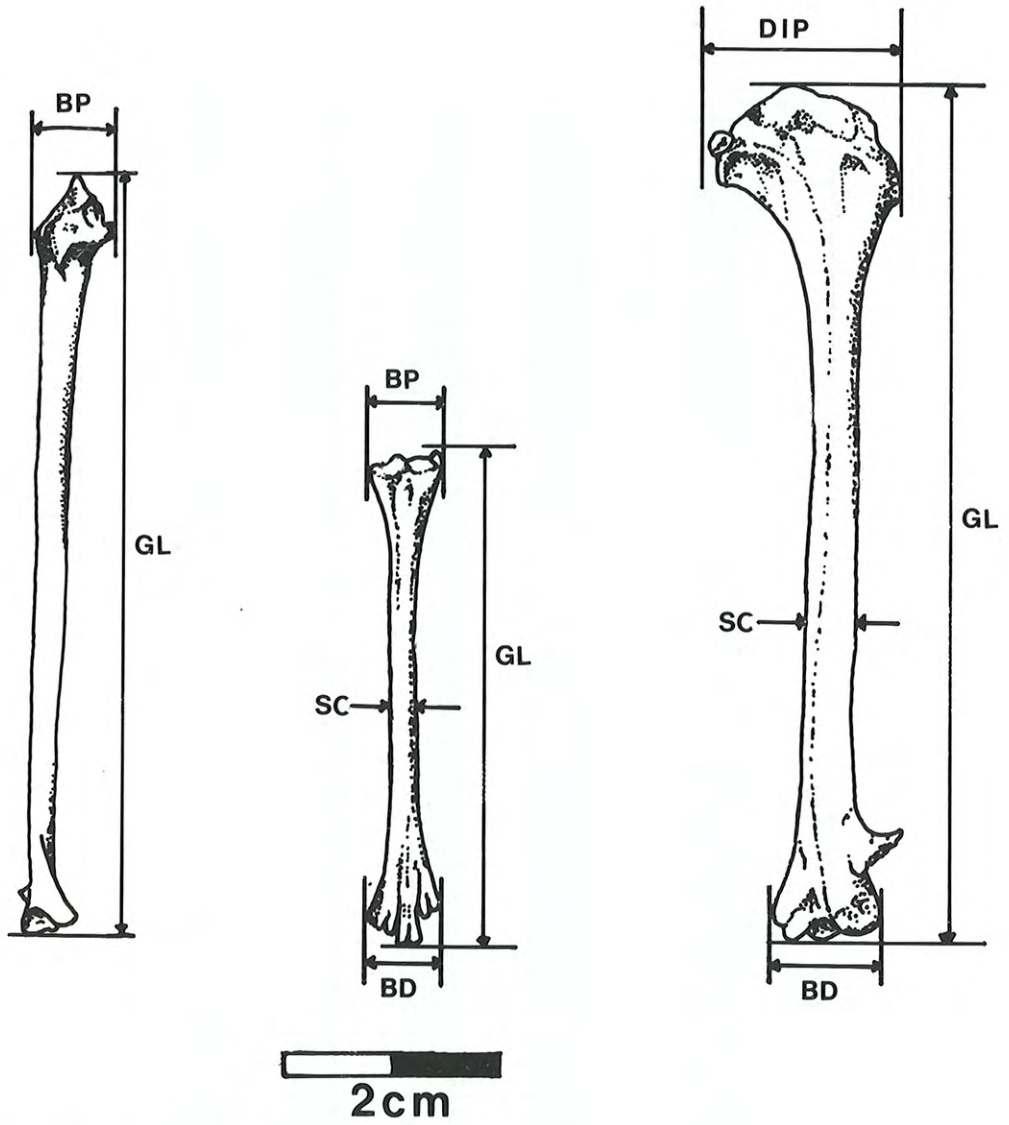


FIGURE 5 - Measurements points on the ulna, tasometatarsus and humerus.

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DOMESTIC GEESE FROM MEDIEVAL DUBLIN

RACHEL HUTTON MACDONALD[1], KEVIN C. MACDONALD[1]
& KATHLEEN RYAN[2]

(1) Clare Hall, Herschel Road, Cambridge, CB3 9AL. United Kingdom
(2) MASCA, The University Museum of Archaeology and Anthropology,
Philadelphia. PA 19104-6324. USA

ABSTRACT: Archaeological excavations at the city of Dublin in Ireland, have yielded a substantial assemblage of bird bone dating to the 13th century A.D. This is composed predominantly of domestic fowls, and in particular of domestic geese, which were probably introduced to Ireland by the invading Anglo-Normans. This collection provides a unique opportunity to examine the metric characteristics of the Medieval domestic geese of Ireland. It also allows us to examine the nature of a substantial avian assemblage created by human exploitation, which may be of value to taphonomic studies.

KEYWORDS:IRELAND, DOMESTIC GEESE, ANGLO-NORMANS, TAPHONOMY, BODY PART DISTRIBUTION, BUTCHERY

RESUMEN: Las excavaciones arqueológicas en la ciudad irlandesa de Dublín han proporcionado una apreciable muestra de restos aviares procedentes del siglo XIII. Este conjunto está compuesto principalmente por aves de corral, especialmente gansos domésticos, que seguramente fueron introducidos en la isla por los invasores anglo-normandos. La colección proporciona una oportunidad única para examinar las características biométricas de los gansos domésticos irlandeses del Medioevo. Al mismo tiempo, nos permite examinar la naturaleza de una gran comunidad aviar creada por la actividad económica humana y extraer conclusiones de valor potencial en estudios tafonómicos.

PALABRAS CLAVE: IRLANDA, GANSO DOMESTICO, ANGLO-NORMANDOS, TAFONOMIA, DISTRIBUCION PORCIONES CORPORALES, DESPIEZE

INTRODUCTION

According to accounts in the *Annals of Ulster, Annals of Clonmacnoise* and *Chronicum Scotorum*, a *longphort* or sea-fortress was established by the Scandinavians (Vikings) at Dublin in AD 841. From the 850s to the 870s strong native Irish resistance and attractions of other areas encouraged the Scandinavians to turn their attentions towards England, Iceland, and France until they eventually abandoned Dublin in AD 902. However, there is, as yet, no archaeological evidence for this *longphort* or its location.

The Scandinavians returned to Dublin 12 to 15 years later and fortifications were built around a new settlement. This was the site named by the Irish as *Dun Dubhlinne* (fort of the black pool) which was described as one of the seven wonders of Ireland as late as the 1160s. The town of well laid out streets, which included habitations, craft industries, and waterfront, flourished under Scandinavian control from the early 10th to the later 12th centuries. By the beginning of the 12th century, "the direction of Ireland's foreign trade had shifted away from the old northern trade routes frequented by the Vikings in the 10th and 11th centuries and was increasingly concentrated on the seas between south-west England and northern and western France" (Wallace, 1981a).

In 1170 Dublin was captured by the Anglo-Normans, whose influence had been growing in the region for several decades. This takeover led to a growth in Civil and Ecclesiastical Institutions.

The port was expanded, a bridge built over the River Liffey and wetland was reclaimed as the waterfront grew. It was also during this period that domestic Geese were introduced into Dublin.

ARCHAEOLOGY

Archaeological investigation of Medieval Dublin began in 1961, during the reconstruction of Dublin Castle, when excavation revealed stratified Viking and Anglo-Norman (10th-13th century) occupational deposits[1]. The next year Dublin Corporation, beginning planned redevelopment in the city, made available for excavation an area on High Street (see Figure 1, after Wallace, 1981a) and adjacent areas including the site of Wood Quay. These areas were excavated during the 1960s and 70s as redevelopment proceeded[2]. The waterlogged deposits ensured that there was remarkable preservation of organics, including bones, plant remains, leather and wood (see Plate I).

From these excavations it became evident that the expansion of Dublin's waterfronts from 1.210-1.300 AD has left information on land reclamation and consequently large amounts of Medieval refuse, forming vast faunal and artifactual collections for the archaeologist of today. Bone materials included well preserved food remains, bone tools and objects of personal adornment. Bird bones were recovered from all levels of the excavation but were present in greatest numbers from the 13th century contexts. Bird remains from the 11th century Viking levels were analysed by Tanya O'Sullivan (1990) as a part of her MA thesis at University College Dublin.

This paper focuses on the Domestic Geese from the excavations at Wood Quay which yielded over 6.000 identifiable bird bones dating to the 13th Century. Of these, ca. 35% are attributable to domestic Geese, 35% to domestic Chicken and 30% to wild taxa including game birds, raptors and waders.

DOMESTIC GEESE AND THEIR ORIGIN

The European Domestic Goose is thought to have been derived from the wild Greylag Goose *Anser anser*. The goose was originally domesticated in southeastern Europe (Zeuner, 1963), and may have become more widespread during Classical times. It first appears in Britain during the Roman period, but only in very small quantities. During the Anglo-Saxon period, domestic geese remains become increasingly more numerous, and this has led Bramwell (1980) to suggest that the Saxons were responsible for an increase in goose rearing in England at this time. A similar phenomenon can be seen in the avian remains recovered from Dublin, with only a small assemblage of bird bone being recovered from the Viking levels (O'Sullivan, 1990); these included a number of geese bones, all identified as being of wild, rather than domestic, species. However, in deposits post dating the Anglo-Norman Invasion, substantial quantities of bird bone were recovered, in which domestic fowls predominate. Thus, it would seem probable that the Anglo Normans were responsible for the introduction of goose rearing in Dublin. Elsewhere in Ireland, Finbar McCormick (1991) has noted

(1) - Excavations at Dublin Castle were undertaken by the Office of Public Works under the direction of Mr. O'Heochaidhe (1960-61); A. Lynch and C. Manning (1984-86); L. Swan (1992).
(2) - Excavation of High Street and adjacent areas, including Wood Quay, were undertaken by the National Museum of Ireland under the direction of A. B. O Riordáin (1962-76) and P. F. Wallace (1974-81).

that the Gaelic Irish appear to have had a low esteem for domestic fowls in comparison to their Anglo-Norman contemporaries; only 8% of the bird bones from the 13th century Gaelic (i.e. Native Irish) settlement of Lough Gur are those of domestic species. In contrast, the food remains of the Anglo-Norman settlers are dominated by domestic birds, with chickens and domestic geese comprising 70% of the bird bones at Wood Quay and 64-74% of the birds bones identified by Jope (1954) from the motte and bailey of Clough Castle, Co. Down.

DIFFERENTIATION OF DOMESTIC GEESE FROM THEIR WILD COUNTERPARTS

The differentiation of domestic geese from their wild counterparts remains one of the most contentious issues in avian archaeozoology. Although the differentiation of domestic from wild geese is not the principal theme of this paper, it is perhaps worthwhile to summarise the present state of our knowledge on the subject and to demonstrate how we attempted to do so.

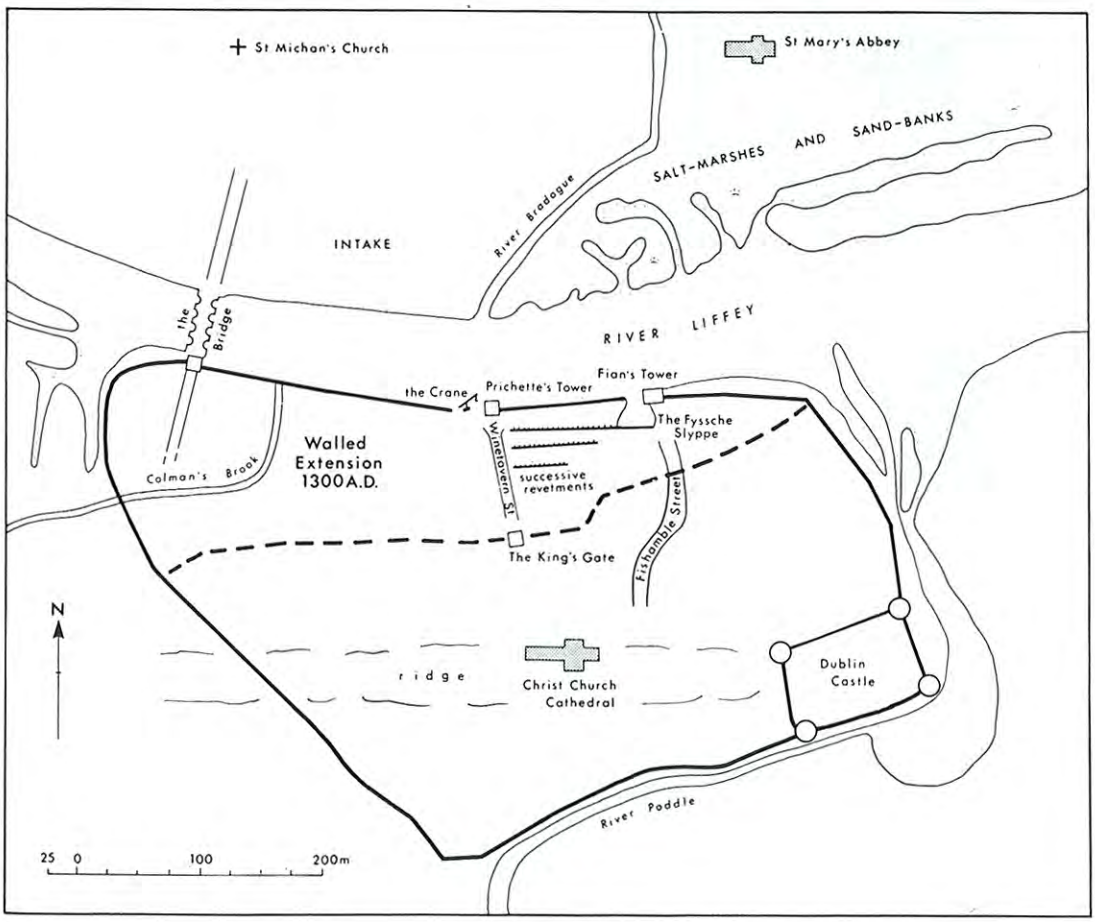


FIGURE 1 - Map of Walled Dublin A.D. 1.300; Wood Quay is located between Winetavern Street and Fishamble Street. (*From G. F. Mitchell, Archaeology and Environment in Early Dublín*, 1987).

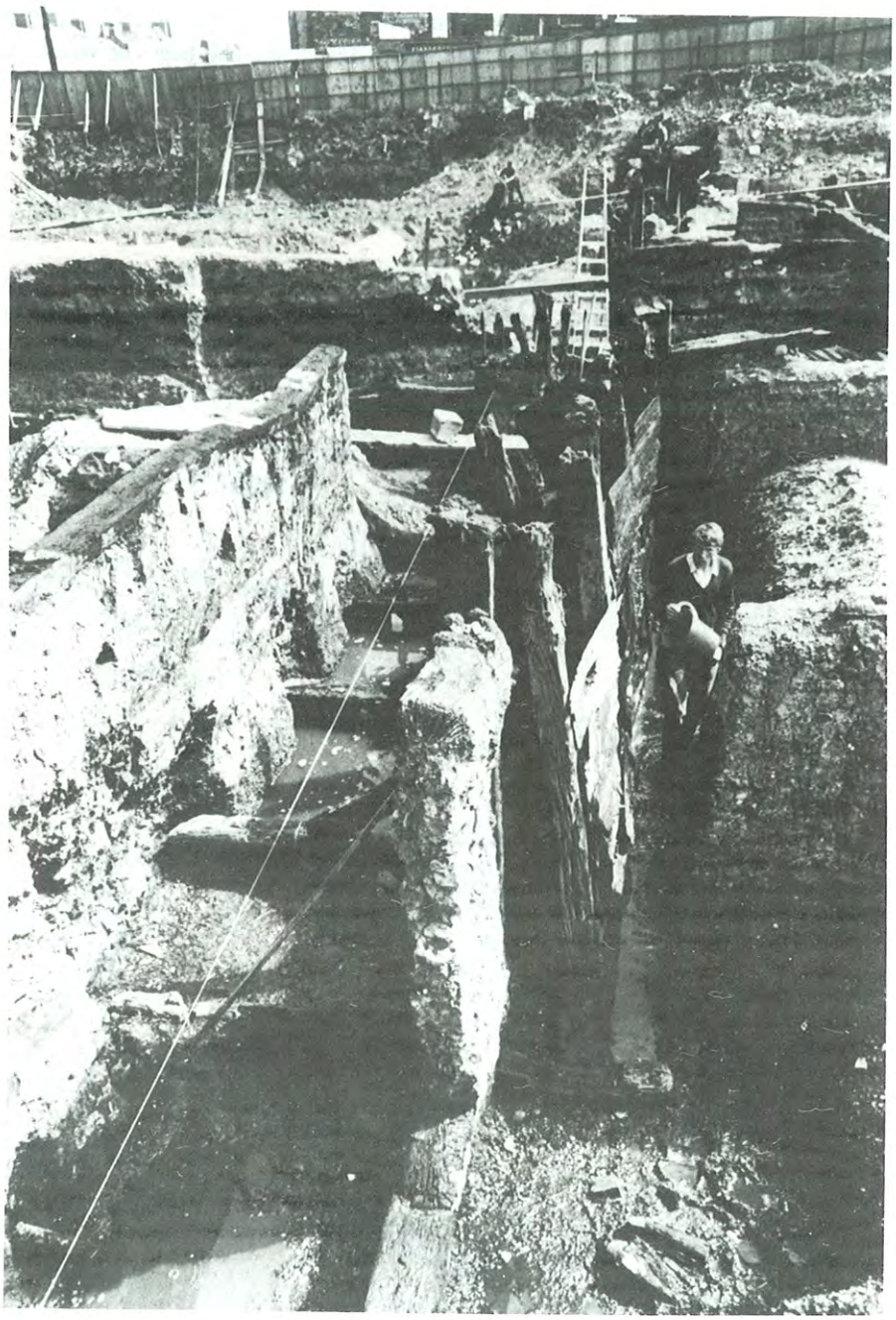


PLATE I - Excavations in progress, exposing the 13th century revetment at Wood Quay.

A number of different wild goose species may be found in the countryside surrounding Dublin. These include the supposed wild progenitor of the domestic form, *Anser anser* (the greylag goose), along with the migratory *Anser albifrons* (the white fronted goose), *Branta bernicla* (the brent goose) and possibly also *Branta leucopsis* (the barnacle goose). In 1967, Bacher described two osteological traits which could reliably distinguish *Anser* from *Branta*. The first of these was found on the furcula, which was pneumatised in the case of *Anser*, and unpneumatised in the case of *Branta*. The second criteria was based on the morphology of the *spina sterni externa* of the sternum which was flattened in the case of *Branta*. All of the bones identified as domestic from Wood Quay were *Anser* on the basis of the criteria outlined above. It should be noted, however, that Allison (1985) has found some variation in the morphology of the *spina sterni externa* within species, casting some doubt on the validity of this morphological trait as a means of differentiation.

Size was perhaps the most important factor taken into consideration, since the wild species, most notably those of *Branta* are considerably smaller and slighter in build, with only slight variation in size as compared to domestic breeds. While there is considerable overlap of size between species in some skeletal elements, Bramwell (1977) noted that the tarsometatarsus was the most reliable bone on which to differentiate domestic from wild geese. He believed that this was due to the (assumed) greater weight of the domestic bird which led to an increase in robusticity of the bone reflected in the thickness of the shaft and increased distal breadth; this may have been exacerbated by the greater dependence on the lower limbs as a result of flightlessness. Bramwell's conclusion has been supported by work done in Germany to show increasing size in the lower limb as a result of domestication (Reichstein & Pieper, 1986, and see below). Metrical data from tarsometatarsi identified from the Wood Quay assemblage can be seen plotted against that of a limited sample of modern comparative specimens in Figure 2. This clearly shows a tendency for the Wood Quay material to be much larger than either of the *Branta* species and slightly larger than *Anser albifrons*, falling well within the range indicated for *Anser anser*.

Conversely, there is an increasing body of evidence that as lower limb bones become larger and more robust as a result of domestication, the bones of the wing decrease in size. This is probably due to the decreased use of the wings as a result of clipping and increasing flightlessness. Reichstein & Pieper (1986) illustrated this phenomenon by plotting regression lines for the greatest lengths of the principal wing bones of modern domestic and wild geese. They were then able to argue that a medieval goose population recovered during excavations at Haithabu in Germany in the 1960's was indeed domesticated since they correlated well with the regression line plotted for the modern domestic species. They were also able to do this with the lower limb bones to show an increase in robusticity. Greatest length measurements (GL) taken for the humerus from the Wood Quay assemblage along with their regression line have been plotted against the regression line for wild species given by Reichstein and Pieper, and the results can be seen in Figure 3. This clearly shows a reduction in size of the humerus, and argues in favour of the assemblage being domesticated.

Domestication and subsequent flightlessness has also resulted in the reduction of musculature, with muscle attachments becoming considerably less distinct in the domestic birds. This may be seen on the ulna for example, with the reduction of the feather attachments (*Papillae remigales caudales*) from definite to indistinct bony eminences. Thus any particularly small, slender bones which also had strongly defined musculature were put aside as probable wild geese.

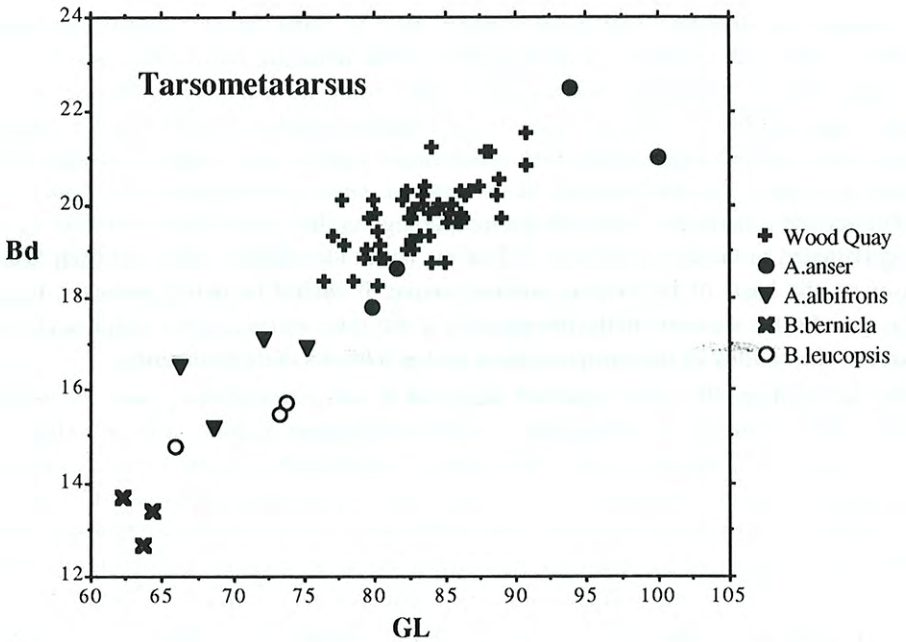


FIGURE 2 - Length and breadth (after Driesch, 1976) of the tarsometatarsus of different known geese species, along with those from Wood Quay.

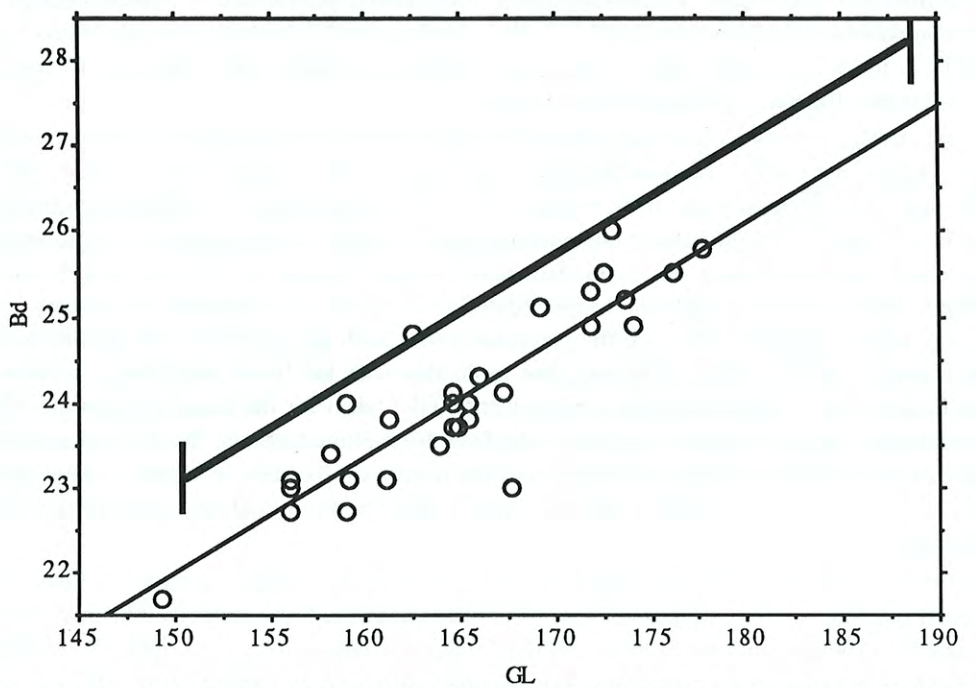


FIGURE 3 - The greatest lengths of the humeri from Wood Quay plotted with the regression line obtained for wild geese species (the heavier line) by Reichstein & Pieper (1986).

Lepiksaar (1969), noted the presence of a flattened facet on the anterior surface of the caput femoris (femur), in domestic geese, possibly as a direct result of flightlessness. This proved to be a problematic means of differentiation in this assemblage since the femur was rather poorly represented (see below) and when recovered was often damaged proximally making assessment impossible. A re-examination of the material revealed some flattening on the anterior surface of the caput femoris on the remains identified as domestic, but this was highly variable in its degree.

Only a very small fraction of the total geese remains from Wood Quay were identified as being probably those of the wild species (approximately 3%). A similarly small percentage of wild (versus domestic) geese bones has been recorded elsewhere in Britain during this period, for example at several sites in York (Allison, 1985). Geese rearing was particularly popular throughout Britain at this time in towns in low lying or marshy environments, such as at Lincoln, Kings Lynn, Oxford and Leicester (Astill & Grant, 1988), with geese being more important in towns than in rural areas. Geese had the advantage over chickens in that they could be driven rather than transported to market, and calorifically, they would have been more significant. Their very obvious presence in towns is documented historically in Winchester, where geese are banned from the main streets by a city ordinance dating to AD 1380 (Keene, 1985). Thus although there are considerable difficulties inherent in the differentiation of domestic and wild geese species, it may be possible to attempt to differentiate them using a variety of characteristics as opposed to a single diagnostic one. The presence of a very large goose population in the faunal material recovered from a large urban site is also more likely to be of a variety of goose bred locally and available all year round. In the Medieval period we also have good textual evidence for the keeping of domestic geese throughout Britain and Ireland, which supports our supposition that the majority of the geese consumed in Dublin at this time were domesticated.

RESULTS OF ANALYSIS

A total NISP of 2.108 bone fragments were recorded as probable domestic geese from the assemblage. Each bone was given three zones (proximal, shaft and distal, or three arbitrary zones in the case of the sternum, pelvis, etc...), and the presence or absence of these portions was recorded, to allow for the accurate calculation of MNI and MNE. The bones represented a minimum of 159 individual geese, and a minimum of 1845 individual bones. The vast majority of the bone was from mature birds (94'8%), which may be suggestive of geese being economically important in terms of egg production, as well as a significant source of meat. The presence of laying females in the assemblage was indicated by a single broken femur, with medullary bone clearly deposited in the marrow cavity. Other intact long bones may have had similar deposits, not so readily evident.

One of our primary interests in the assemblage, given its size, was to describe the nature of the deposit which is known to have been exploited exclusively by man (although there may be some modification by dogs (and/or pigs)). It was hoped that this could shed some light on older avian assemblages where the primary accumulator of the bone was unknown. Following the formula of Mourer-Chauviré (1983), the principal limb bones (coracoid, humerus, radius, ulna, carpometacarpus, femur, tibiotarsus, and tarsometatarsus) were summed and then expressed as a percentage of this total, see Figure 4. Clearly, the humerus, radius and tibiotarsus are the most

numerous in the assemblage, followed by the ulna, carpometacarpus, and tarsometatarsus. The femur and the coracoid are only poorly represented. This correlates only partially with the model put forward by Mourer-Chauviré (1983) for an assemblage of bone accumulated primarily by humans (e.g. humerus and femur numerous in anthropogenic assemblages, with carpometacarpus and tarsometatarsus numerous in raptorial assemblages). The body part distribution of the Wood Quay assemblage of course also reflects the impact of carnivore scavenging.

Body part distribution expressed as a percentage of the expected number of bones based on MNI, can be seen in Figure 5. Clearly, as already observed, the humerus, radius and tibiotarsus dominate the assemblage. Overall the limb bones are much better represented than are the bones of the axial skeleton. This may be due in part to preservational bias in favour of the more robust long bones, as opposed to the more fragile pelvis and sternum. Another contributory factor may be the use of primary butchering of the birds away from the site, with the removal of the heads, and perhaps the meatless wing tips (the carpal phalanx, and other phalanges). This would seem to indicate that the deposit consists largely of domestic refuse. The splitting of the bird longitudinally may also constitute a form of primary butchery, or dressing of the bird for sale, and can be seen clearly in the form of chop marks on the pelvis (see Plate II) and the furcula, as well as on the sternum. Similarly, by plotting the percentage of total chop and cut marks by bone (see Figure 6), the axial bones favour chopping and the limb bones cutting presumably to facilitate dismemberment of the carcass into smaller familiar portions such as the leg and the wings. Fine cut marks were noted primarily on the distal humerus (see Plate III) proximal and distal radius and ulna, consistent with the dismemberment of the wing. Similarly, on the lower limb, cuts were noted on the proximal and distal femur, distal tibiotarsus (see Plate III), and the proximal tibiotarsus. A large number of cut marks were also noted on the coracoid, furcula and scapula, probably the result of the removal of the breast meat.

Some of the bone showed clear evidence of carnivore gnawing, although this was not dominant (on approximately 9% of the assemblage). By plotting the percentage of gnawed bone per element (see Figure 7) it can be seen that the humerus is clearly the most commonly gnawed element (N.B. the calculation eliminates the sample size bias per element). This is an unusual feature since you would not expect dogs (or pigs) to be so selective (although underrepresented elements may have been totally destroyed). All other elements show only minimal evidence for gnawing, although of these, the limb bones are more commonly gnawed, no doubt as a result of the marrow they contain. The extent of the damage sustained by the bone due to gnawing varies from simple puncture marks (see Plate IV), to varying degrees of bone destruction (see Plate V). Clearly the shredding of the bone as seen in Plate V, is likely to be due to either dogs or pigs. However the puncture marks seen in Plate IV, most notably on the humerus, may be of human origin.

Charring was also noted on the surface of the bone, although this was very uncommon, occuring on only 2'3% of the material. The sample of charred bone is thus too small to be very meaningful, but some tentative conclusions may be drawn from the results as plotted in terms of skeletal element distribution (Figure 8). Charring was most frequently observed on the scapula. Other axial elements also show a moderate degree of charring, such as the furcula and the coracoid, although some limb bones, notably the ulna, humerus and carpometacarpus were also affected. These almost certainly relate to portions of bones exposed during roasting.

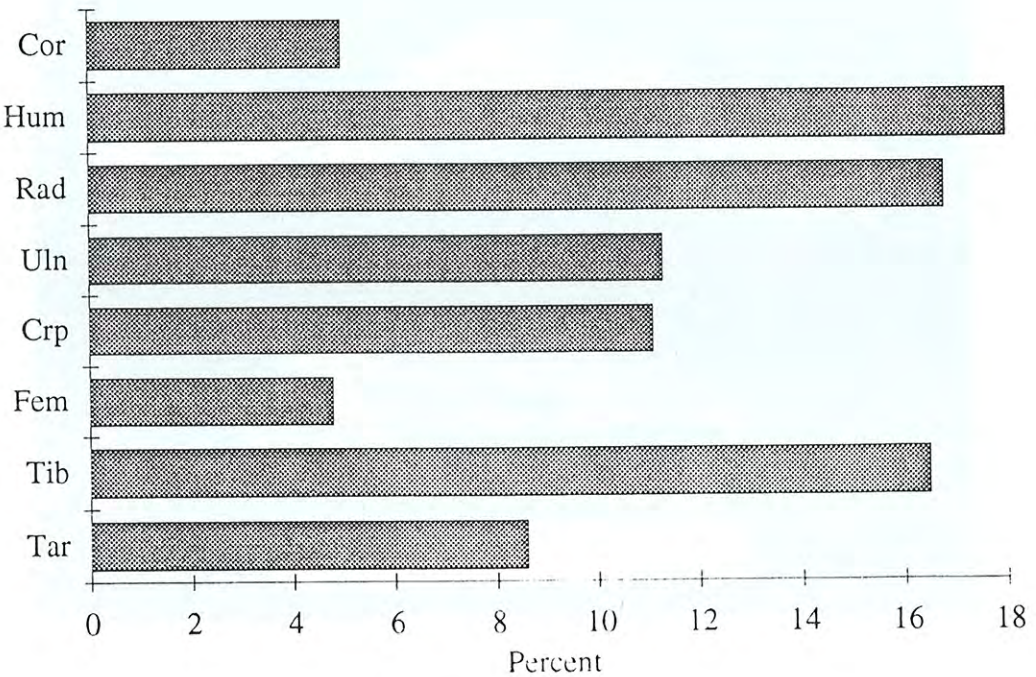


FIGURE 4 - Body part frequency after Mourer-Chauviré (1983).

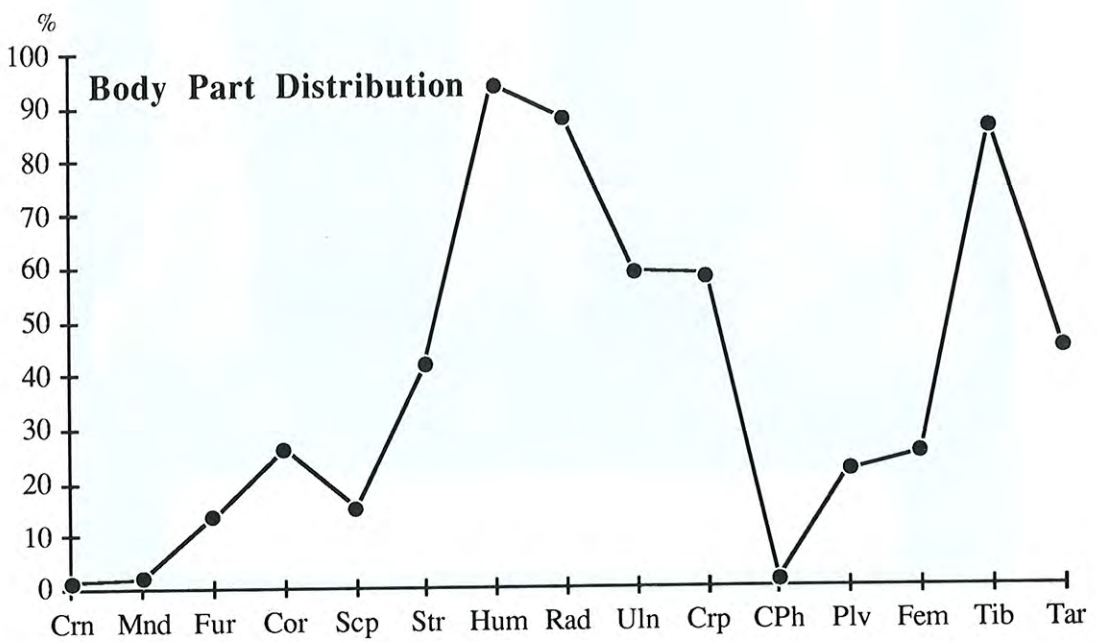


FIGURE 5 - Skeletal element distribution expressed as a percentage of MNI.

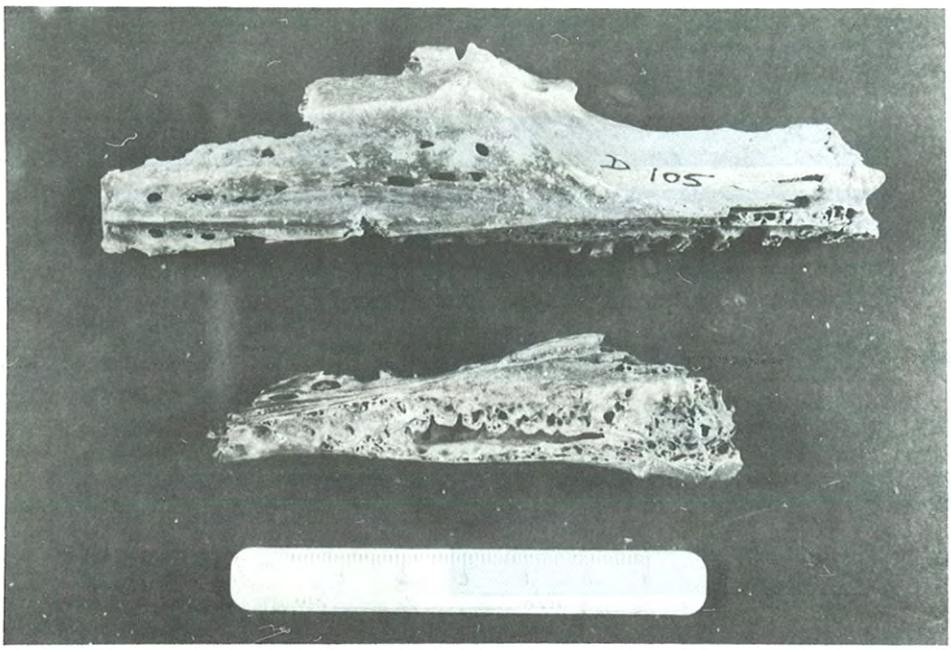


PLATE II - Longitudinal chopping of the carcass as seen on the pelvis.



PLATE III - Cut marks commonly found on the distal humerus and distal tibiotarsus.



PLATE IV - Puncturing of bone by teeth, possibly human (?) as seen on the humerus, proximally and distally.

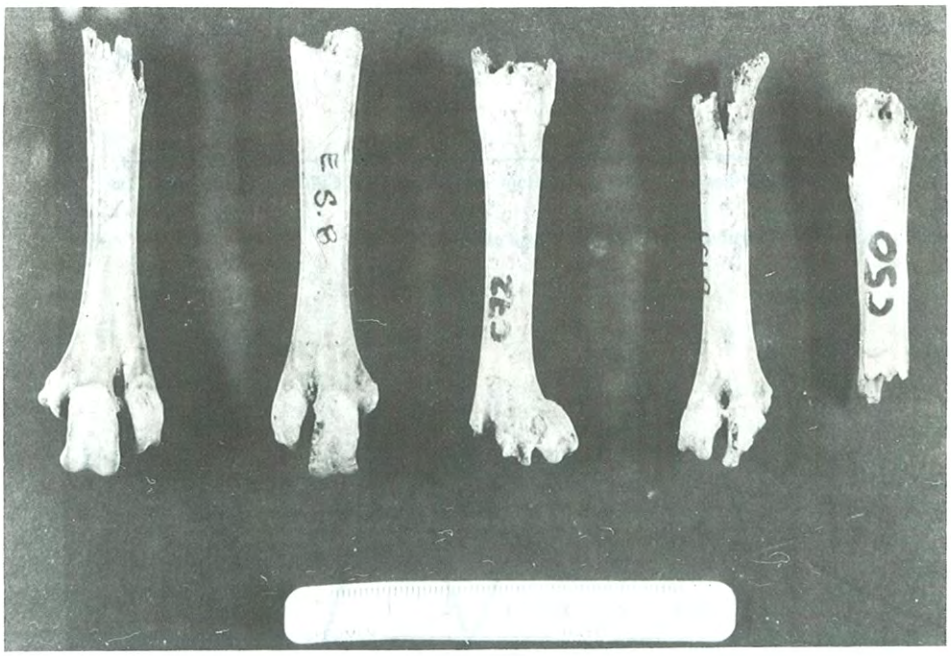


PLATE V - Sequence of carnivore gnawing from minor to major destruction of the tarsometatarsus.

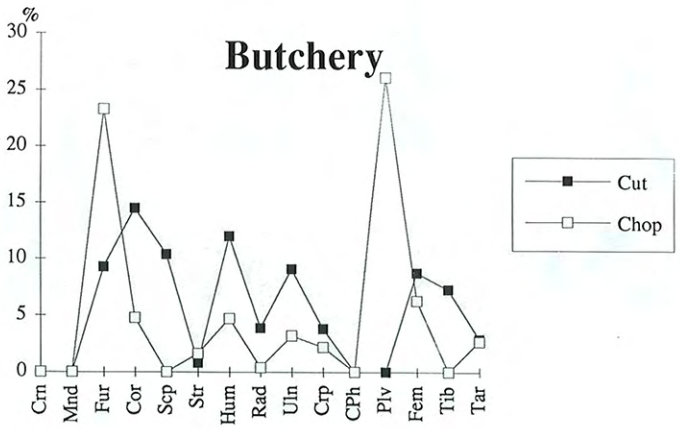


FIGURE 6 - Proportion of cut versus chop marks by skeletal element.

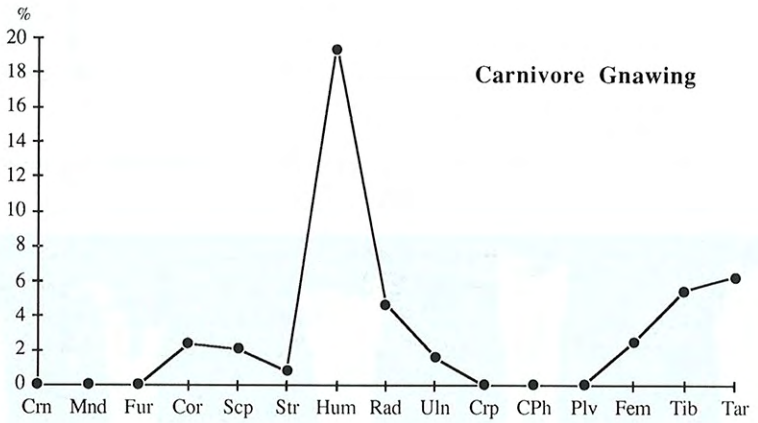


FIGURE 7 - Proportion of carnivore gnawing by skeletal element.

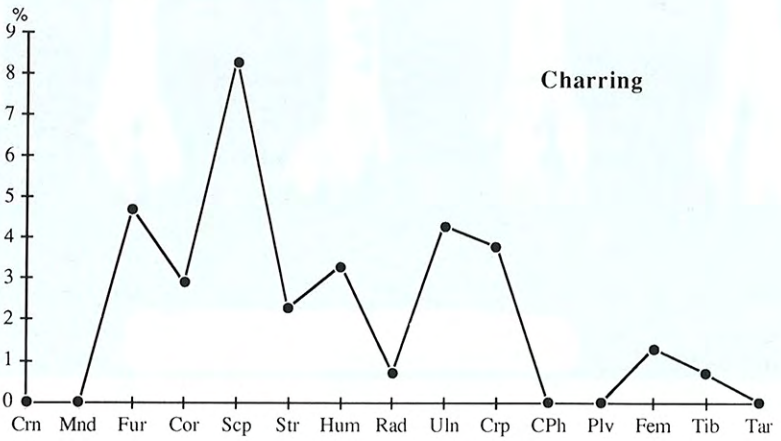


FIGURE 8 - Proportion of charred material by skeletal element.

The occupants of Medieval Dublin would seem to have enjoyed goose meat, and the large quantity of bone would suggest that this was a food source available to most of the population, and not just the higher classes. The material recovered is suggestive of some primary butchering of the birds prior to their consumption and perhaps sale. There is also a strong indication that the birds were sold or cooked in halves (chopped down the middle), if not as individual limbs, and breasts, portions.

COMPARISON WITH OTHER DOMESTIC GEESE POPULATIONS

By comparing the goose measurements obtained from the Wood Quay assemblage with others in Britain and Europe of a similar date, it can be seen that there is considerable similarity. The greatest lengths for the tarsometatarsi of populations from Medieval Dublin, York (Allison, 1985) and Haithabu (Reichstein & Pieper, 1986) are given in Table 1. Regarded chronologically, it appears that there was a diminution in size over time in domesticates during the medieval period (e.g. from 10th century Anglo Scandinavian York (Allison, 1985) to the 13th c. samples) which may have only been corrected until modern times.

CONTEXT	N	RANGE	MEAN
Domestic -- Medieval York, England	12	78.5 -- 89.2	83.6
Domestic -- Medieval Wood Quay, Ireland	69	77.1 -- 90.8	83.9
Wild -- Modern, Germany	32	76 -- 105	84.8
Domestic -- Medieval Haithabu, Germany	37	78 -- 97	86.1
Domestic -- Anglo/Scan. York, England	13	80.9 -- 91.7	87.4
Domestic -- Modern, England	17	82 -- 104	93
Domestic -- Modern, Germany	28	90 -- 107	99

TABLE 1 - Greastest length of the tarsometatarsi of some medieval and modern goose populations.

CONCLUSIONS

The problem of differentiating wild from domestic species of geese may be at least partially overcome by using a combination of metrical and morphological criteria. This situation will improve no doubt as increasing metrical data becomes available. However, it is unlikely that it will ever be possible to separate wild from domestic forms with complete certainty.

Following their introduction by the Anglo Normans, domestic geese were almost certainly of considerable importance to the economy of Medieval Dublin, and were probably available to the majority of the population as a source of food, both as meat and as eggs. The geese were probably reared locally, and are likely to have been a common sight in the streets of Dublin during this period.

ACKNOWLEDGEMENTS

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LAS RAPACES NOCTURNAS COMO ACUMULADORES POTENCIALES DE RESTOS FAUNISTICOS EN YACIMIENTOS ARQUEOLOGICOS: LOS MICROMAMIFEROS DE PEÑALOSA

MANUEL ANGEL CEREIJO PECHARROMAN
Laboratorio de Arqueozoología. Depto. Biología.
Universidad Autónoma de Madrid
28049 Madrid. España.

RESUMEN: Con el fin de inferir el origen de una muestra de micromamíferos procedente del yacimiento del Bronce de Peñalosa (Jaén), se ha desarrollado un análisis tafonómico. La hipótesis de partida que presupone el origen del acúmulo como consecuencia de la acción depredadora de una rapaz nocturna (*Tyto alba*) se verá reforzada a través de una serie de criterios independientes habituales en análisis faunísticos.

PALABRAS CLAVE: TAFONOMIA, MICROMAMIFEROS, LECHUZA (*Tyto alba*), EDAD DEL BRONCE, IBERIA

ABSTRACT: In order to explore the origin of a discrete micromammalian assemblage found in the Bronce-age site of Peñalosa (prov. Jaén) a taphonomic analysis has been carried out. The hypothesis which assumes the sample to be the result of a single accumulating agent, namely the barn owl (*Tyto alba*), is reinforced through a series of independent criteria which constitute routines of any conventional faunal analysis.

KEYWORDS: TAPHONOMY, MICROMAMMALS, BARN OWL (*Tyto alba*), BRONCE AGE, IBERIA

INTRODUCCION

El estudio de los micromamíferos presentes en yacimientos arqueológicos humanos resulta menos frecuente que el de otro tipo de faunas debido especialmente al escaso uso de técnicas de excavación adecuadas para la recuperación de restos óseos de pequeño tamaño. Sin embargo, la aportación de este grupo puede llegar a convertirse en una importante herramienta para la interpretación de distintos aspectos del asentamiento. En este trabajo se pretende aprovechar características inherentes al grupo faunístico, resultado de su importancia como presas habituales en las dietas de vertebrados, para inferir la presencia de aves sinantrópicas.

Planteamos como un primer ensayo sobre las posibilidades de la identificación indirecta la hipótesis de la intervención de una rapaz nocturna (lechuza) como agente acumulador selectivo de estos restos. Las razones por las que se selecciona esta especie como punto de partida, obedecen a criterios de parsimonia. En primer lugar, la lechuza (*Tyto alba*) es, en la actualidad, la rapaz nocturna más común de la Península Ibérica, y aparece en prácticamente todos los periodos del registro arqueológico peninsular (Hernandez, com. verb.). Por otra parte, los restos recuperados en el yacimiento pertenecen a la musaraña común (*Crocidura russula*), que resulta ser una especie particularmente abundante en la dieta de la lechuza.

MATERIAL Y METODOS

El material objeto de este estudio procede del yacimiento de Peñalosa, localizado en Sierra Morena próximo a la localidad de Baños de la Encina (Jaén). La estructura general del yacimiento se corresponde con un gran poblado en loma provisto de potentes sistemas de fortificación.

Los restos analizados (260 huesos de insectívoros) fueron recuperados en el corte 9 del nivel estratigráfico BE I datado en la Edad del Bronce.

Hemos utilizado técnicas tafonómicas habituales en los estudios arqueozoológicos (desglose anatómico, cuantificación de alteraciones de los restos, etc.), asociadas a una metodología comparativa basada en la información aportada por distintos estudios sobre la dieta de las rapaces nocturnas, y sobre las alteraciones ocasionados por procesos digestivos de rapaces nocturnas en restos de micromamíferos.

La determinación de edades relativas de los restos de musarañas se obtuvo a partir de los criterios de Gómez y Sans-Coma (1976).

RESULTADOS

En la Tabla 1 se representa el desglose anatómico de la muestra, que pertenece en su totalidad a *Crocidura russula* (musaraña común). Los 260 restos están constituidos básicamente por elementos craneales (41%) y apendiculares (49%), recuperándose tan solo 25 piezas axiales (9%). El número mínimo de individuos obtenido fué de 35 (mandíbulas).

La lechuza como acumulador potencial de restos de musaraña (*Crocidura russula*)

El Gráfico de la Figura 1 representa la composición específica del contenido de varias muestras de egagrópilas de rapaces nocturnas recogidas en diversos puntos de la Península Ibérica (López Gordo et al., 1976; Delibes et al., 1983; Felipe, 1986). La musaraña común resulta especialmente abundante en las muestras de lechuza (*Tyto alba*). En el caso de La Maresma, llega incluso a alcanzar el 62% del total del número de restos, y se manifiesta como la especie más habitual en su dieta. Estos datos son valoraciones globales, ya que en determinadas épocas del año la musaraña en la Sierra de Gredos puede llegar a constituir el 70% de las presas de la lechuza (Felipe, Op. cit.).

La dieta de otras especies como el mochuelo (*Athene noctua*) o el buho chico (*Asio otus*), compuesta mayoritariamente por roedores (ratones y topillos), muestra una representación porcentual de musarañas considerablemente inferior a la de la lechuza, cuya presencia incluso podríamos calificar de ocasional.

Señales de Digestión

Como aproximación al estudio del origen de este acúmulo, se buscaron señales provocadas por la posible digestión de algún depredador habitual de la especie. Se utilizó como muestra control para poder realizar este test comparativo, un conjunto de restos de musarañas procedentes de

egagrópilas de lechuza (*Tyto alba*) de la Sierra de Gredos (Avila) (Felipe, 1986), y los datos sobre rapaces nocturnas recopilados por Andrews (1990).

En la muestra procedente del yacimiento únicamente se encontraron señales de digestión en 2 porciones proximales y 2 distales de fémures, y en las proximales de 3 tibias (2,7% de la muestra). En las de egagrópilas de lechuza de la Sierra de Gredos se encontraron señales en 2 porciones proximales y 1 distal de fémur, 4 distales y 1 proximal de tibia, y 1 distal de radio (en total 4,5%), sobre un total de 200 restos de musaraña extraídos aleatoriamente de una muestra de 983 egagrópilas de lechuza.

Los resultados en ambos casos resultan similares, tanto en lo referente a la porción anatómica afectada, como en la forma y la frecuencia en la que se manifiestan estas señales.

ELEMENTOS ANATOMICOS	NR	%NR
NEUROCRANEO		
VISCEROCRANEO	39	15,0
MANDIBULA	69	26,5
DIENTE		
ATLAS		
AXIS	1	0,4
V.CERVICAL	2	0,8
V. TORACICA	9	3,5
V.LUMBAR	10	3,8
SACRO	1	0,4
V.CAUDAL	2	0,8
COSTILLAS		
ESCAPULA		
HUMERO	29	11,2
RADIO	4	1,5
ULNA	12	4,6
CARPAL		
METACARPO		
PELVIS	18	6,9
FEMUR	30	11,5
TIBIA	34	13,1
FIBULA		
ASTRAGALO		
CALCANEO		
TARSAL		
METATARSO		
FALANGES		
NR TOTAL	260	100

TABLA 1 -Desglose anatómico de la muestra de restos de musaraña común (*Crocidura russula*) recuperada en el yacimiento de Peñalosa.

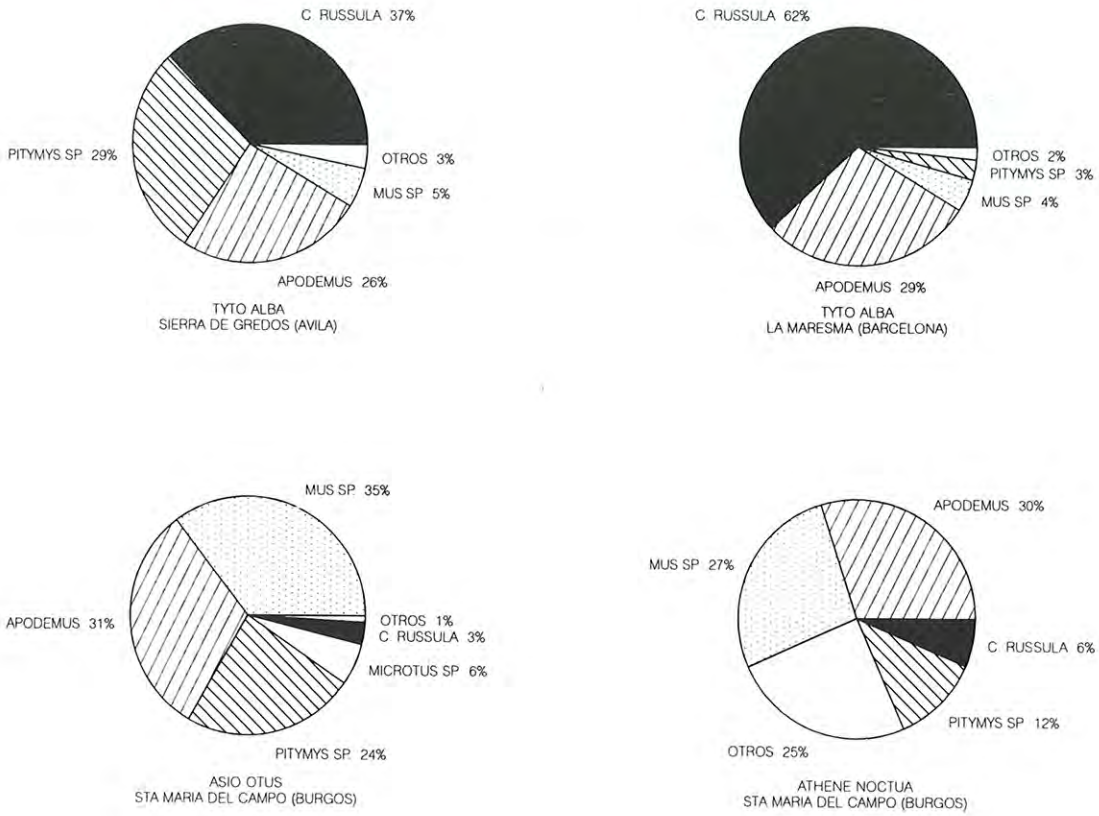


FIGURA 1 -Representación porcentual de la composición de micromamíferos en las dietas de varias especies de rapaces nocturnas en la Península Ibérica obtenidas a partir del estudio de egagrópilas.

Utilizamos algunos de los parámetros propuestos (Andrews, 1990) para diferenciar la intensidad de los procesos digestivos de distintas rapaces nocturnas, a través de restos recuperados en egagrópilas. En la Figura 2 se representa el porcentaje de cabezas de fémur con signos de digestión respecto del total de porciones proximales de la muestra. El índice correspondiente a los restos de Peñalosa (12%), se encuentra entre el de la lechuza común y campestre, y el del buho chico (11% y 14%, respectivamente). Los valores de los restos de cárabo y, especialmente, de mochuelo se distancian sensiblemente de los de la muestra (26% y 66%), indicando un mayor grado de alteración por procesos digestivos. Estos resultados coinciden con los comentarios de Mayhew (1977) sobre la preservación diferencial de los restos óseos procedentes de egagrópilas de rapaces, en los que se destaca a la lechuza como la especie que menos altera los restos procedentes de la digestión.

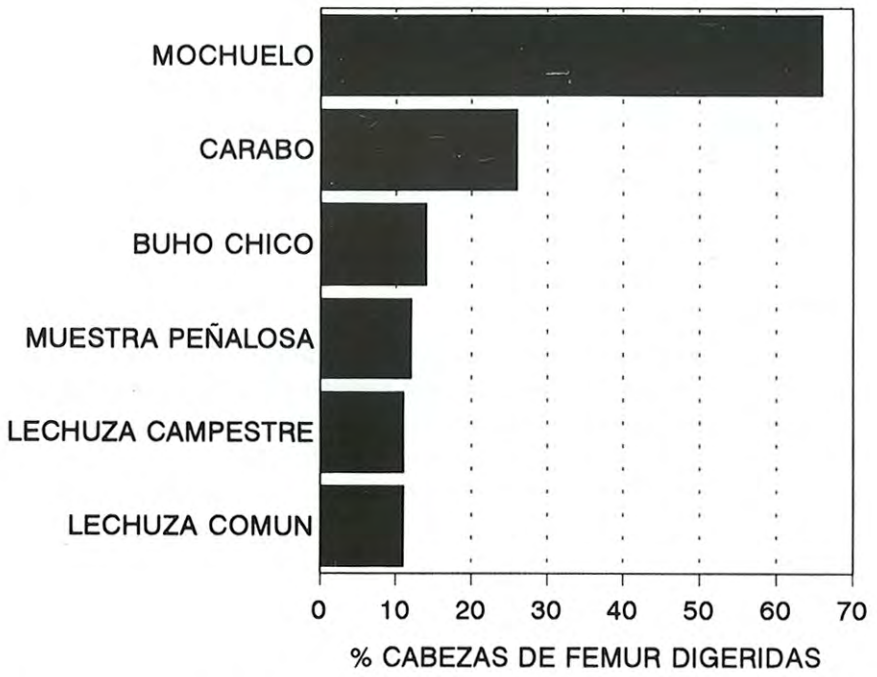


FIGURA 2 - Representación porcentual del número de cabezas de fémur con señales de digestión procedentes de egagrópilas de varias rapaces nocturnas y de la muestra de Peñalosa.

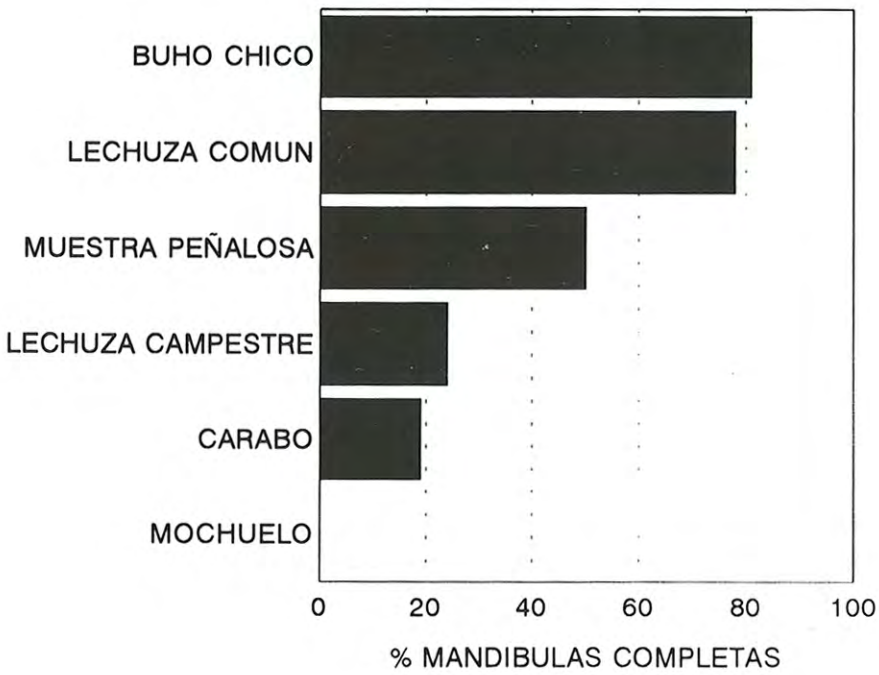


FIGURA 3 - Representación porcentual del número de mandíbulas completas procedentes de egagrópilas de varias rapaces nocturnas y de la muestra de Peñalosa.

En el histograma de la Figura 3, se representa un segundo parámetro utilizado por Andrews (Op. cit.) basado en la fracturación de las mandíbulas. En esta ocasión, la muestra de Peñalosa (50% de mandibulas completas) se encuentra entre los valores de la lechuza común y campestre (78% y 24%, respectivamente). Las egagrópilas del buho chico manifestaron un mayor porcentaje de mandíbulas completas (81%), mientras que en las egagrópilas de mochuelo no aparece ninguna completa.

Desglose anatómico

El siguiente análisis pretende comparar de nuevo la muestra de Peñalosa con otras muestras control, y se utilizan igualmente datos aportados por Andrews (1990) sobre la distribución anatómica de restos recuperados en egagrópilas de lechuza en distintas áreas de Europa. A fín de enriquecer los aspectos comparativos del análisis, se recurrió a la información procedente de restos de micromamíferos recuperados en el yacimiento peninsular de Atapuerca (Burgos) (Fernández-Jalvo & Andrews, 1992). De esta última muestra únicamente se han extraído los resultados correspondientes a los niveles donde se diagnosticaron rapaces nocturnas como acumuladores potenciales de los restos de micromamíferos.

El Gráfico de la Figura 4 se ha elaborado mediante el cómputo de las abundancias relativas encontradas en cada uno de los elementos esqueléticos sobre las esperadas para un determinado NMI. Las distribuciones esqueléticas tienen un patrón general similar, en el que se acusa especialmente la pérdida de elementos como las vértebras, escápulas, o radios frente a la pervivencia de mandíbulas, fémures o tibias. No obstante, varían los perfiles en el grado de pérdida de restos, más acusado en las muestras procedentes de yacimientos (sometidas a una mayor presión tafonómica) que en la muestra de egagrópilas. Dentro del conjunto de muestras de egagrópilas no se aprecia un comportamiento diferencial que permita asignar pautas específicas que caractericen a cada uno de los depredadores potenciales.

En el segundo Gráfico (Figura 5) se contrastan 2 parámetros utilizados por Andrews (Op. cit.) extraídos a partir de índices que enfrentan distintas proporciones de elementos anatómicos. El primer índice refleja la proporción de restos craneales respecto a los postcraneales de acuerdo con la siguiente fórmula:

Indice A = (fémur + húmero) / (mandíbula + maxila)

El segundo índice se refiere únicamente a los restos postcraneales y se estima de acuerdo con la fórmula:

Indice B = (tibia + radio) / (fémur + húmero)

Dentro del espacio acotado por estos dos índices reflejado en la Figura 5 los restos de Peñalosa se sitúan próximos a los valores de los extremos de ambos ejes, en la zona en donde se supone una menor alteración en las proporciones de restos, y próximos a los valores alcanzados por la lechuza y el cárabo.

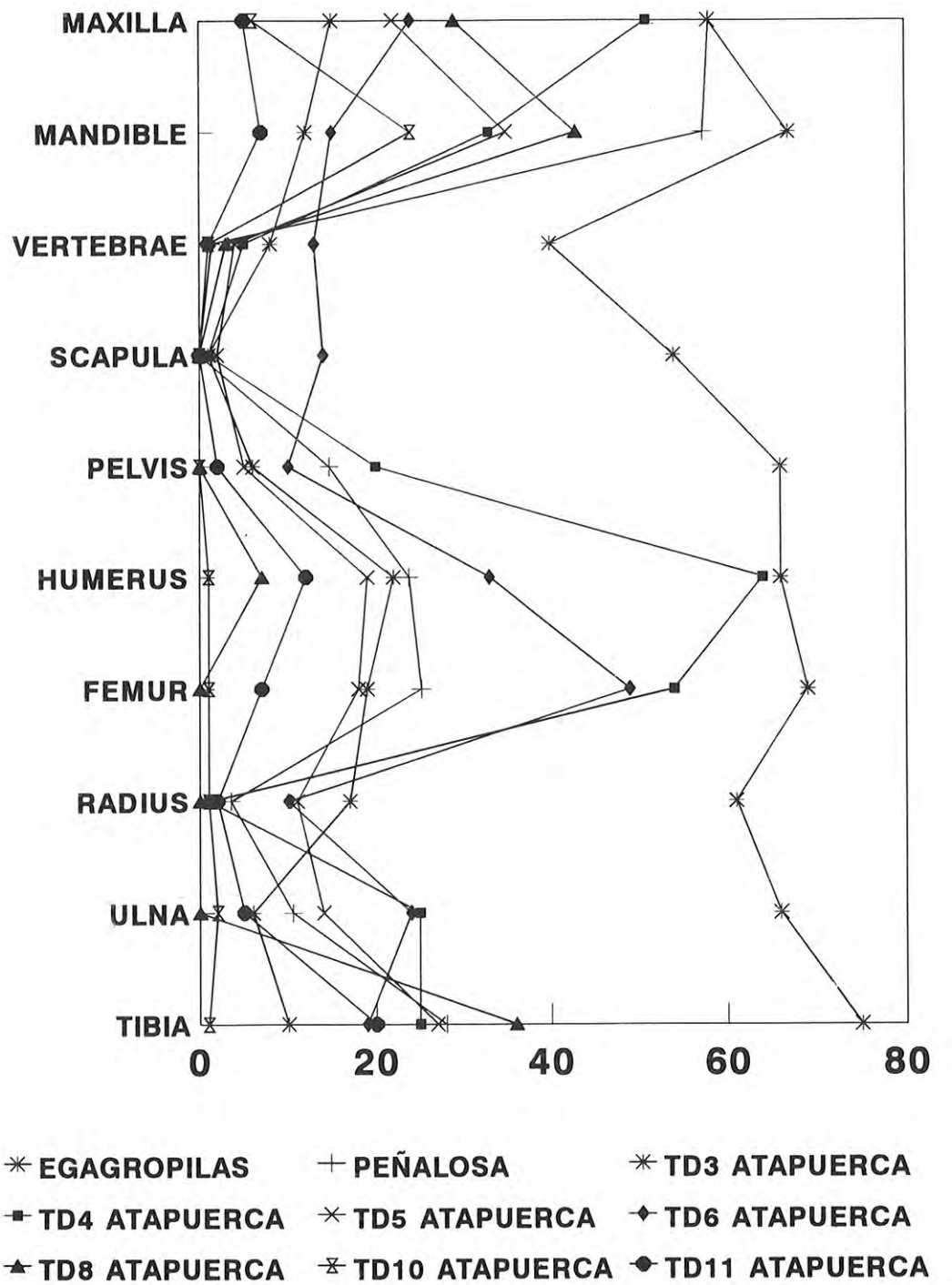


FIGURA 4 - Abundancias relativas de cada uno de los elementos esqueléticos para un NMI de distintas muestras de micromamíferos recuperados en yacimientos y en egagrópilas de lechuza.

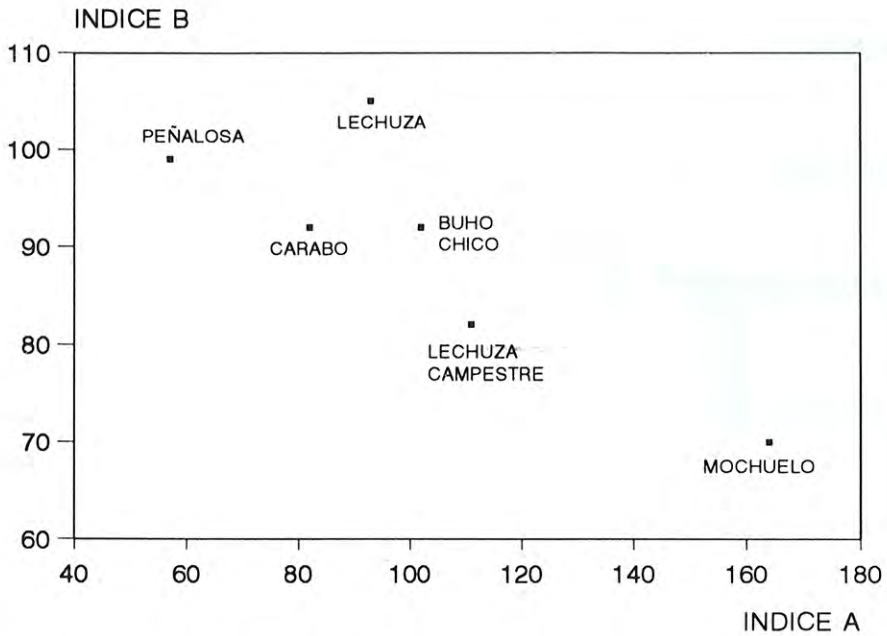


FIGURA 5 - Representación de los índices de Andrews (1990) (ver texto) aplicados a distintas especies de rapaces nocturnas.

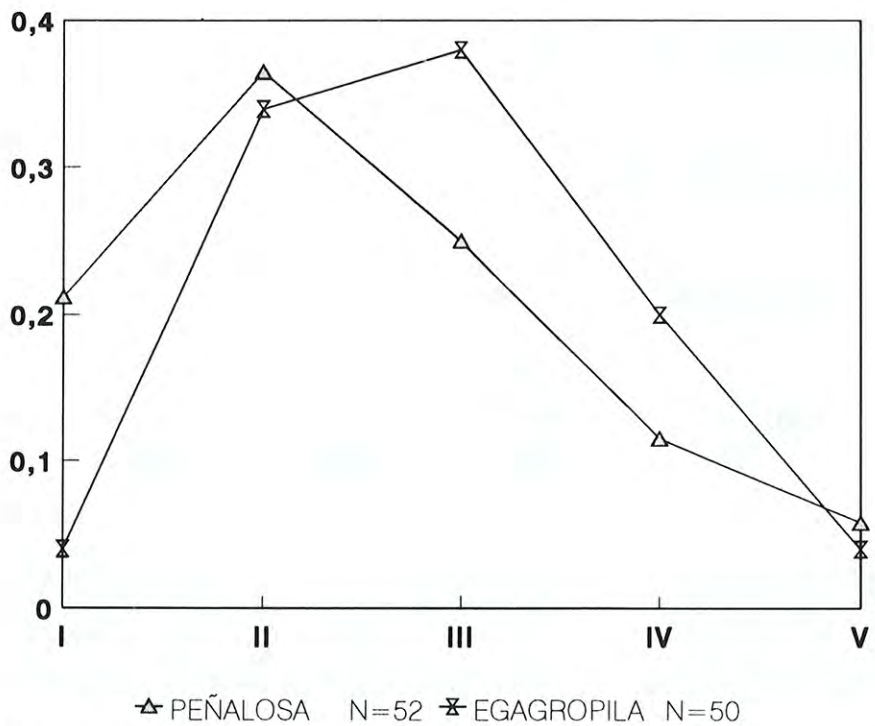


FIGURA 6 - Representación porcentual de las cohortes de edad basadas en el desgaste dentario de los restos de musaraña procedentes de Peñalosa, y de egagrópilas de lechuza de la Sierra de Gredos.

Estructura poblacional

En este último apartado se comparan las estructuras poblacionales de las tafocenosis correspondientes a los ejemplares de *Crocidura russula* procedentes de egagrópilas de lechuza en la Sierra de Gredos, y de los restos recuperados en el yacimiento de Peñalosa.

En la Figura 6 se puede apreciar como el perfil correspondiente a la estructura poblacional de los ejemplares recuperados en la muestra de Peñalosa resulta similar al de la población de egagrópilas de lechuza. Se produce cierta analogía entre estas dos muestras evidenciada por la equivalencia en las reducidas proporciones de individuos jóvenes y seniles (clase I y V, respectivamente), y en la fracción más numerosa de subadultos y adultos (clases II a IV).

DISCUSION Y CONCLUSIONES

La aparente coincidencia entre la hipótesis de partida y los resultados obtenidos en cada uno de los apartados puede encaminarnos a exponer la confianza en dicha hipótesis que presuponía a la lechuza como causante del acúmulo de estos restos de musaraña. Sin embargo, se deben tener en cuenta ciertas consideraciones sobre los datos obtenidos en estos análisis:

1. A partir de los resultados sobre la potencialidad de las rapaces nocturnas como acumuladores de restos de musaraña descritos en el primer apartado, no es posible extrapolar con certeza la composición monoespecífica de la muestra de Peñalosa a la dieta de ninguna de las especies consideradas. Ni siquiera en el caso de la lechuza en la que se recogen los mayores porcentajes de musaraña. Bien es cierto que hay que tener en cuenta que los datos recopilados corresponden a valoraciones medias de las dietas de rapaces nocturnas, y, en algunos casos, estas especies pueden llegar a registrar porcentajes superiores en la captura de musarañas. En nuestro laboratorio hemos comprobado la existencia de varias egagrópilas de lechuza, recogidas en la Sierra de Gredos, con una composición monoespecífica de musarañas.

2. Los resultados obtenidos a través de las señales de digestión y del desglose anatómico muestran una gran variabilidad en las posibles interpretaciones del grado de digestión en función del parámetro utilizado. Si bien en la mayor parte de los análisis aparece la lechuza como la especie que causa una menor alteración sobre los restos de sus presas y el mochuelo como caso contrario, aparecen diferencias significativas entre el resto de especies que se encuentran en un lugar intermedio con respecto a estos factores de alteración de los restos.

3. En el último apartado se contrastan los resultados sobre la estructura poblacional de los restos de Peñalosa únicamente con la hipótesis de partida. La semejanza en los resultados de estas 2 muestras puede interpretarse como resultado de la coincidencia en el método de extracción utilizado sobre las poblaciones naturales origen de estos restos. Ambas muestras podrían haber sido causadas por una actuación selectiva de la lechuza de acuerdo con los patrones etológicos de caza de esta especie. No obstante, cabe igualmente postular la posibilidad de una coincidencia en la distribución poblacional de estos dos conjuntos de restos motivada por un fenómeno de convergencia tafonómica (Morales & Roselló, en prensa), o incluso que esta misma distribución se corresponda con la de los

restos procedentes de otras especies sobre las cuales no disponemos de información, o al menos de información en suficiente cantidad.

4. En cada uno de los análisis realizados la interpretación de los resultados puede verse seriamente sesgada por la inevitable tendencia a utilizar fáciles paralelismos entre la muestra utilizada y la especie de la que se tiene una mayor información, en este caso, la lechuza.

5. Se debe insistir sobre la posibilidad de encontrarnos ante un fenómeno de convergencia tafonómica (Morales & Roselló, Op. cit.) causante de la coincidencia en los resultados de las muestras procedentes del yacimiento de Peñalosa y de egagrópilas, especialmente de lechuza. No han sido contrastadas hipótesis que traten el acúmulo como resultado de la presencia de una micromorfología particular del terreno que pudiera actuar a modo de trampa para estos ejemplares, o incluso como consecuencia de una intrusión natural de esta especie en el nivel arqueológico (no hay que olvidar los hábitos semifosores de la musaraña).

Esta dificultad en la asignación del origen de acúmulos de micromamíferos es advertida por Mayhew (1977), quien previene además sobre las situaciones en las que el yacimiento se encuentra abierto (no en una cueva). En estos casos (como es el de la muestra de Peñalosa) los restos se ven sometidos a la acción de muchos otros agentes tafonómicos que actuan conjuntamente, y que resultan difícilmente diferenciables en el análisis posterior.

Como resumen de todos estos puntos se podría concluir que el grado de incertidumbre que subyace en cada uno de los análisis efectuados no permite asignar con fiabilidad el origen de esta muestra a un depredador concreto. Sin embargo, dicho grado de incertidumbre se reduce paulatinamente cuando se interpretan conjuntamente los resultados proporcionados por distintas técnicas de análisis que examinan diferentes aspectos del mismo material. Tanto las pautas de las señales de digestión sobre los restos óseos, como los índices anatómicos utilizados para caracterizar las muestras, o las estructuras poblacionales de las tafocenosis (inferidas a partir de las cohortes basadas en el desgaste dentario), resultan aparentemente similares entre los restos de musaraña de Peñalosa y los restos de esta misma especie procedentes de egagrópilas de lechuza. En los análisis comparados con otras rapaces nocturnas esta coincidencia no se produce en todos los casos.

Tal "coincidencia múltiple" nos inclina a pensar en una similitud en el origen y en la secuencia de procesos tafonómicos sufridos por los restos procedentes de egagrópilas de lechuza común y los recuperados en Peñalosa, sin olvidar las objecciones comentadas.

Resulta necesario ampliar este primer análisis sobre las posibilidades de inferencia en los restos de micromamíferos, mediante el incremento en el número de situaciones o hipótesis de partida posibles y, en consecuencia, aumentando la secuencia comparativa de los análisis, con el fín de alcanzar resultados más concluyentes.

La aportación más relevante de este estudio no sólo es la posibilidad de postular la presencia de la lechuza común en este nivel particular del yacimiento , sino el poder confirmar la aplicabilidad de ciertos métodos tafonómicos analíticos para su utilización en la identificación indirecta de restos arqueofaunísticos.

AGRADECIMIENTOS

Arturo Morales revisó criticamente el manuscrito y aportó puntos de vista que resultaron útiles en la definitiva configuración del trabajo.

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CATALOGO PROVISIONAL DE LOS YACIMIENTOS CON AVES DEL CUATERNARIO DE LA PENINSULA IBERICA

FRANCISCO HERNANDEZ CARRASQUILLA
Laboratorio de Arqueozoología. Depto. Biología.
Universidad Autónoma de Madrid
28049 Madrid. España

RESUMEN: En este catálogo se recogen los yacimientos cuaternarios estudiados en la Península Ibérica hasta 1992 que contienen algún taxón identificado de Aves. El número de localidades asciende a 160, habiéndose detectado sesgos, tanto geográficos como temporales, en la distribución de los yacimientos.

PALABRAS CLAVE: AVES, CUATERNARIO, PENINSULA IBERICA, CATALOGO

SUMMARY: This catalogue includes those Quaternary sites from the Iberian Peninsula where avian remains have been identified. A total of 160 sites have been recorded. Both geographical and temporal biases have been detected in the distribution of these sites.

KEY WORDS: BIRDS, QUATERNARY, IBERIAN PENINSULA, CATALOGUE

INTRODUCCION

Este trabajo contiene una sinopsis de aquellos yacimientos cuaternarios de la Península Ibérica donde se ha identificado algún taxón de Aves. No se ha incluido en el compendio ninguna localidad insular; las personas interesadas pueden consultar las recientes revisiones de Alcover et al. (1981) y Alcover et al. (1992) para las Islas Baleares; Alcover (1992) para las Islas Canarias y Pieper (1985) para Madeira y Porto Santo.

Esperamos que esta contribución estimule la revisión de yacimientos antiguos, y que potencie el interés por el estudio de nuevos materiales.

PRECEDENTES HISTORICOS

En la segunda década de este siglo se publica el primer catálogo de yacimientos de la Península Ibérica en el que explícitamente se dedica un apartado a las aves (Harlé, 1912). Anteriormente a esta publicación, Milne-Edwards (1881) cita en parte de su obra algún yacimiento peninsular. Lambrecht (1933) en su clásico volumen de Paleornitología comenta de pasada varios yacimientos ibéricos. En la década de los 60, Villalta (1964) publica el primer catálogo referido exclusivamente a las aves del Cuaternario peninsular. Desde ese compendio hasta el presente se han publicado listas parciales (Aguirre, 1989), otras referidas a regiones concretas (Elorza, 1990), a momentos cronológicos determinados (Hernández & Morales, en prensa) o incluidas en tesis doctorales sobre otros temas (Altuna, 1972; Morales, 1976; De Miguel, 1987, entre otros).

MATERIAL Y METODOS

Hemos considerado yacimientos publicados hasta diciembre de 1992, asi como materiales inéditos. Siguiendo a Castaños (1992) hemos incluido el Villafranquiense dentro del Pleistoceno Inferior.

El catálogo se encuentra dividido en 5 grupos cronológicos (Plio-Pleistoceno, Pleistoceno Inferior, Medio, Superior y Holoceno); dentro de cada uno, los yacimientos están ordenados geográficamente, de Norte a Sur y de Oeste a Este.

Cada entrada contiene los siguientes campos:

Número identificativo. Nombre del yacimiento
Localidad, Provincia
Datación relativa (cultural, biozona..); datación absoluta (Radioisótopos)
Bibliografía
Lista de fauna

Los números de referencia se correponden con los mapas. Los yacimientos que presentan niveles en varios periodos se encuentran marcados con un asterisco (*) después del nombre, sin variar su número identificativo en los distintos periodos.

Los taxones están ordenados dentro de cada yacimiento de acuerdo con la lista patrón de Voous (1977); siguiendo a De Juana (1991) hemos considerado especies válidas a *Puffinus yelkouan*, *Aquila adalberti*, y *Larus cachinnans*.

No hemos cuestionado ni revisado la correcta adscripción taxonómica del material listado, aunque obviamente un buen número de yacimientos se verían claramente beneficiados con su re-estudio; fundamentalmente estamos pensando en los materiales estudiados antes de los años 70.

Somos conscientes de que podemos haber pasado por alto algún yacimiento; por ello estaríamos muy agradecidos el que se nos llamase la atención sobre posibles errores en los yacimientos incluidos así como sobre aquellos que no hemos llegado a citar.

DISTRIBUCION GEOGRAFICA Y TEMPORAL DE LOS YACIMIENTOS

La Figura 1 muestra la densidad (número) de yacimientos con aves en España (territorio peninsular). El sesgo observado en la distribución y densidad de yacimientos por provincias, no se encuentra relacionado, a nuestro modo de ver, con una mayor o menor riqueza del patrimonio arqueológico, sino simplemente con la actuación, presente o pasada, de personal cualificado en osteología de aves.

Temporalmente no todas las épocas están igualmente prospectadas (Figura 2).

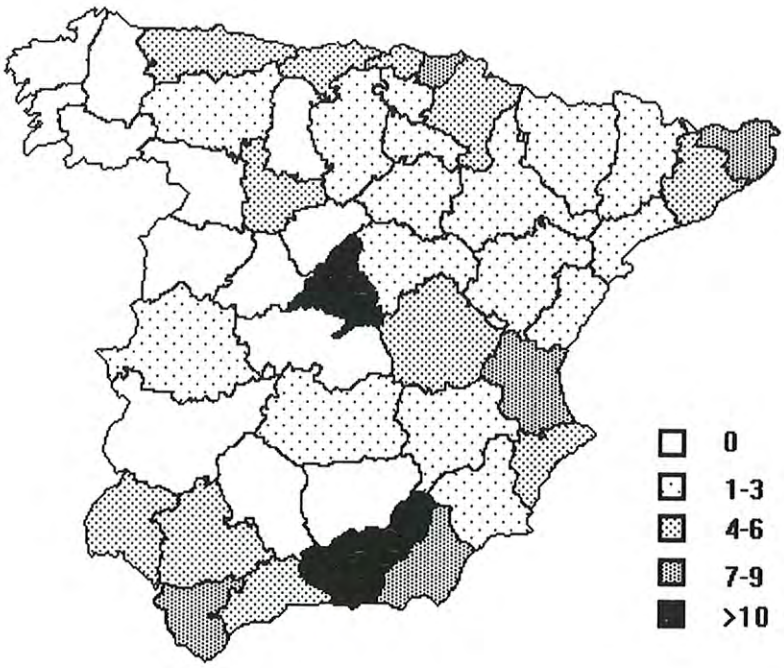


FIGURA 1 - Número de yacimientos por provincia.

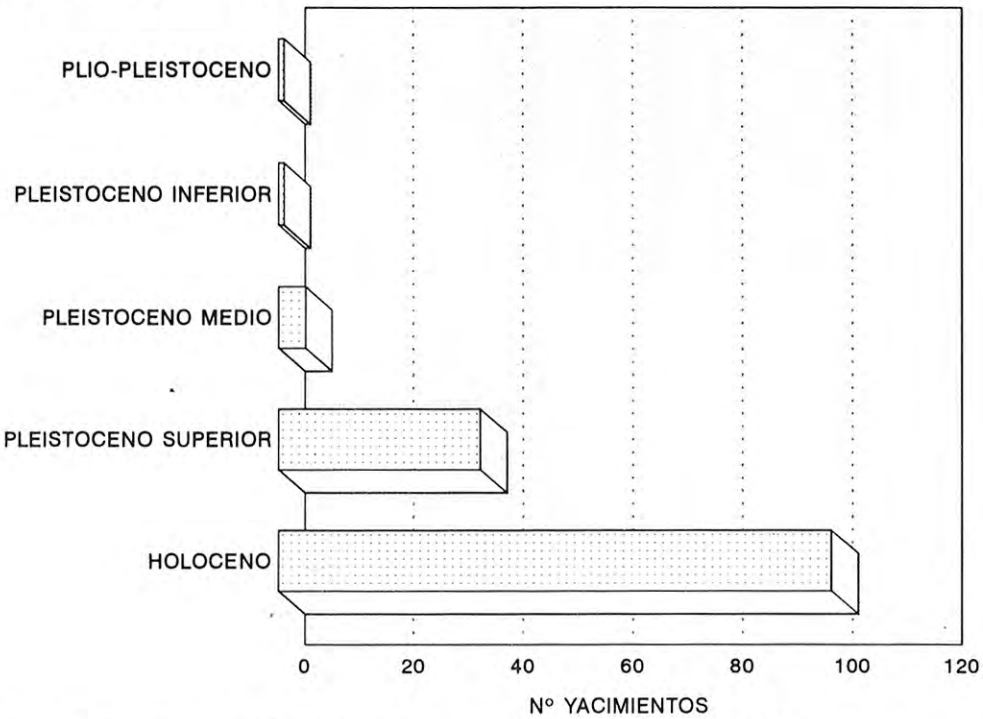


FIGURA 2 - Distribucción temporal de yacimientos con aves en el Cuaternario de la Península Ibérica.

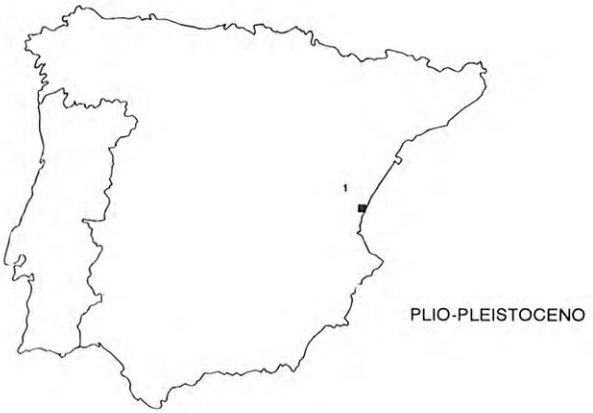


FIGURA 3 - Distribución geográfica de los yacimientos Plio-Pleistocénicos.

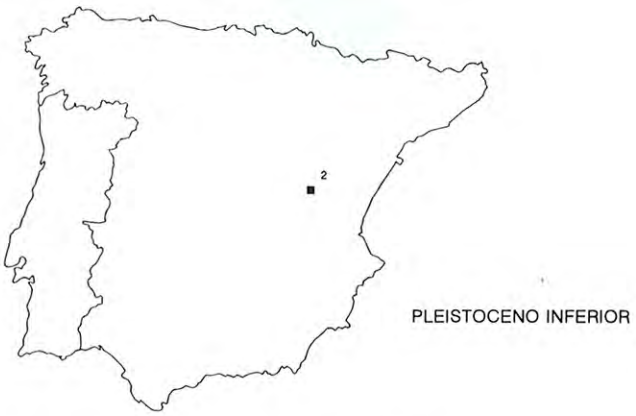


FIGURA 4 - Distribución geográfica de los yacimientos del Pleistoceno Inferior.

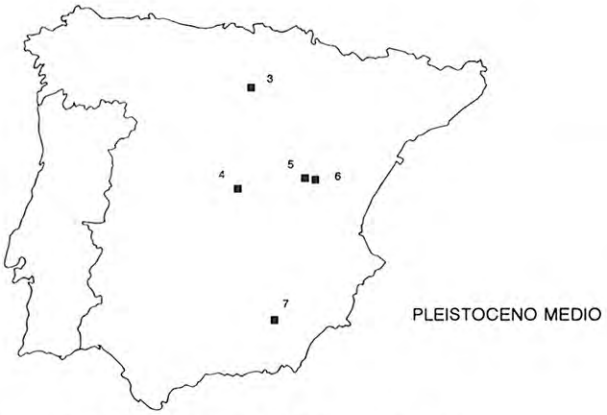


FIGURA 5 - Distribución geográfica de los yacimientos del Pleistoceno Medio.

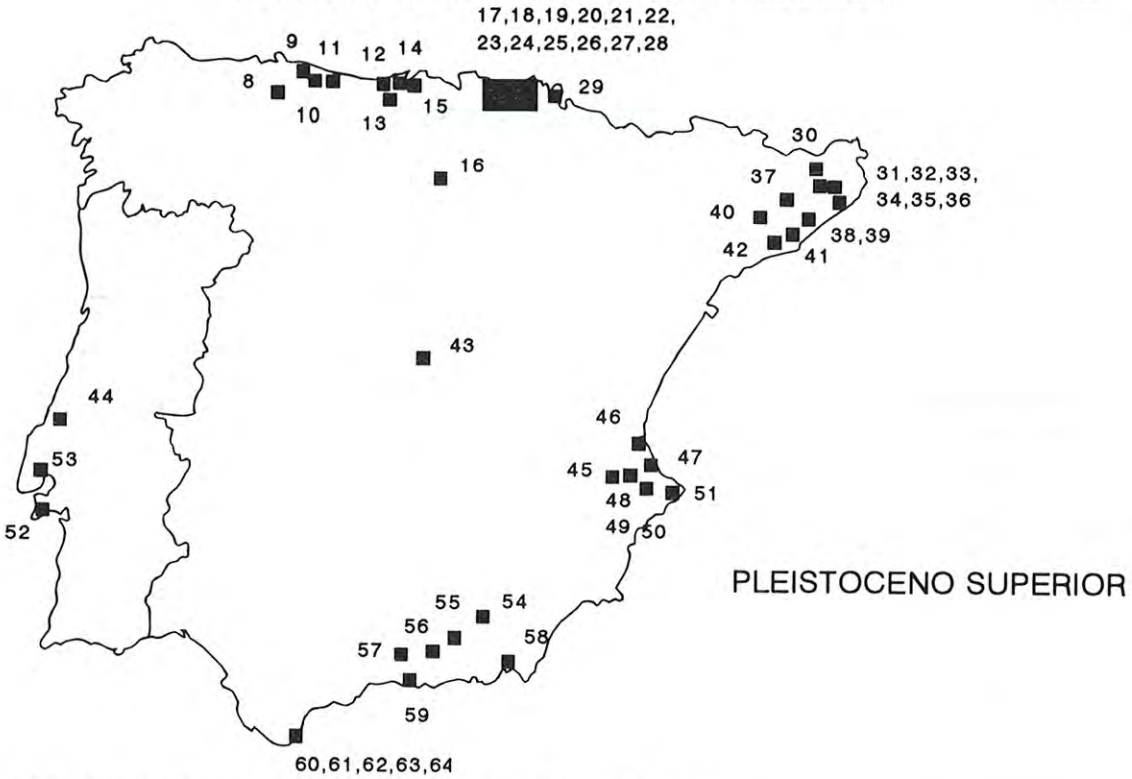


FIGURA 6 - Distribución geográfica de los yacimientos del Pleistoceno Superior.

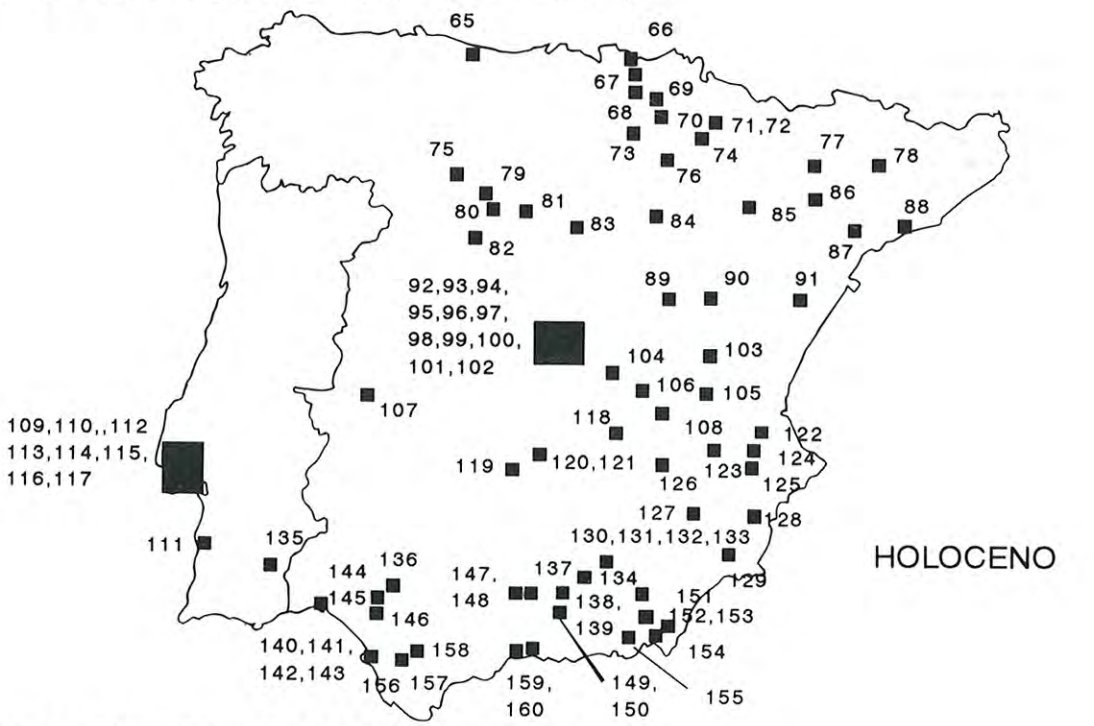


FIGURA 7 - Distribución geográfica de los yacimientos Holocénicos.

LISTA DE YACIMIENTOS

PLIO-PLEISTOCENO

La Figura 3 muestra la localización del yacimiento.

1. CASABLANCA I

Almenara, Castellón de la Plana

NM 17; 1,6 M.A.

Mourer-Chauviré & Sánchez (1988)

Tyto balearica

PLEISTOCENO INFERIOR

En la Figura 4 se encuentra la localización del yacimiento.

2. PUEBLA DE VALVERDE

Puebla de Valverde, Teruel

Villafranquiense Medio

Gautier & Heintz (1974)

Aquila cf chrysaetos
Grus cf grus
Corvus cf corax

PLEISTOCENO MEDIO

La Figura 5 muestra la localización de los yacimientos citados en este periodo cronológico.

3. ATAPUERCA

Atapuerca, Burgos

Achelense, Cromeriense-Eemiense

Sánchez (1987)

Falco tinnunculus
Perdix paleoperdix
Coturnix coturnix
Otis tarda
Pluvialis apricaria
Calidris alpina
Tringa totanus
Limosa limosa
Gallinago gallinago
Gallinago/ Lymnocryptes
Scolopacidae sp 1
Scolopacidae sp 2
Sterna albifrons
Columba livia/oenas
Galerida cristata
Lullula arborea
Alauda arvensis
cf Saxicola rubetra
cf Turdus merula
Turdus viscivorus
Turdus cf pilaris/viscivorus
Fringilla coelebs
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp
Corvus monedula
Corvus antecorax

4. TORRALBA

Torralba del Moral, Soria

Achelense, Cromeriense superior/Elsteriense

Sánchez (1990)

Tadorna ferruginea
Mergus serrator
Anatidae indet.
Porphyrio porphyrio

5. AMBRONA

Ambrona, Soria

Achelense, Cromeriense superior/Elsteriense

Sánchez (1990)

Anser anser
Tadorna ferruginea
Fulica cf atra

4 ó 5. TORRALBA O AMBRONA

Torralba, Ambrona, Soria

Achelense, Cromeriense superior/Elsteriense

Sánchez (1990)

Anas strepera
Vanellus vanellus

6. ARIDOS-1

Arganda del Rey, Madrid

Achelense Medio, Mindel-Riss

Mourer-Chauviré (1980)

Anas platyrhynchos
Anas crecca
Anas clypeata
Accipiter nisus
Alectoris graeca-rufa
Perdix paleoperdix
Porzana porzana
Columba oenas
Columba palumbus
Strix aluco
Upupa epops
Picus viridis
Dendrocopos major submajor
Galerida cristata
Hirundo rustica
Turdus pilaris
Turdus iliacus
Parus cristatus
Coccothraustes coccothraustes
Corvus monedula

7. HUESCAR-1

Huescar, Granada

Base del Pleistoceno Medio

Sánchez (1989)

cf Tachybaptus ruficollis
Anas crecca/querquedula
Anas platyrhynchos
Anas clypeata
Anas strepera
Anas sp
Netta rufina
Aythya ferina
Aythya nyroca
Aythya fuligula
Aythya sp
Perdix perdix
Crex crex
Bubo bubo

PLEISTOCENO SUPERIOR

La Figura 6 muestra la localización de los yacimientos.

8. CUEVA DEL CONDE

Oviedo, Asturias

Musteriense

Altuna (1977)

Pyrrhocorax graculus

9. LA CUEVONA

Ribadesella, Asturias

Magdaleniense

Sánchez (1986)

Gyps fulvus
Bubo bubo

10. CUETO DE LA MINA

Posada, Asturias

Paleolítico superior

Hernández (Inédito)

Aquila cf chrysaetos
Anseriformes indet.
Uria aalge
Asio cf flammeus

11. CUEVA DE LA RIERA (*)

Posada, Llanes, Asturias

Magdaleniense superior (C^{14} 10.890 +/- 430 BP) a Aziliense

Eastham (1986)

MAGDALENIENSE SUPERIOR (Nivel 24)

Anser fabalis/brachyrhynchus
Anas platyrhynchos
Anas acuta
Anas querquedula
Lagopus mutus
Parus major
Garrulus glandarius

ESTERIL (Nivel 25)

Anas acuta

MAGDALENIENSE SUPERIOR/AZILIENSE (Nivel 26)

Phalacrocorax carbo
Anser fabalis/brachyrhynchus
Anas platyrhynchos
Anas acuta
Anas crecca
Anas querquedula
Somateria mollisima
Strix aluco
Turdus merula
Turdus philomelos
Turdus viscivorus

12. CUEVA DE ALTAMIRA

Santillana del Mar, Cantabria

Solutrense

Straus(?), T. Tyrberg com. pers.

Gyps fulvus/Aegypius monachus
Aquila sp?

13. CUEVA DEL CASTILLO

Puente Viesgo, Cantabria

Achelense hasta Magdaleniense

Newton en Cabrera (1984)

ACHELENSE (Nivel 24)

Corvus monedula

MUSTERIENSE (Nivel 20 y 22)

Aegypius monachus?
Falco tinnunculus
Corvus monedula
Pyrrhocorax sp
Coccothraustes coccothraustes

AURIÑACIENSE DELTA (Nivel 18)

Anas platyrhynchos
Aquila sp
Falco tinnunculus
Perdix perdix
Lagopus mutus
Scolopax rusticola
Larus canus
Corvus corax
Corvus monedula
Corvus sp
Pica pica

AURIÑACIENSE GAMMA (Nivel 16)

Anas crecca
Anas sp
Anas penelope
Anas clypeata
Melanitta fusca
Melanitta nigra
Mergus serrator
Falco tinnunculus
Aquila sp
Aegypius monachus
Lagopus mutus
Perdix perdix
Tetrastes bonasia
Fulica criustes
Fringilla montifringilla
Plectrophenax nivalis
Miliaria calandra

AURIÑACIENSE BETA (Nivel 14)

Anas platyrhynchos
Branta bernicla?
Aquila sp
Columba livia
Corvus monedula
Corvus corax
Pyrrhocorax sp

AURIÑACIENSE ALFA-BETA (Nivel 13)

Anas crecca
Anas sp
Falco tinnunculus
Lagopus mutus
Asio flammeus
Corvus corax
Corvus sp
Garrulus glandarius
Pyrrhocorax?

AURIÑACIENSE ALFA (Nivel 12)

Anas platyrhynchos
Falco tinnunculus
Lagopus mutus
Tetrastes bonasia
Corvus monedula

14. CUEVA DE HORNOS DE LA PEÑA

Torrelavega, Cantabria

Magdaleniense/Solutrense/Auriñaciense/Musteriense

Harlé (1912)

Lagopus mutus
Perdix perdix
Corvus monedula
Pyrrhocorax graculus

Auriñaciense/Solutrense

Newton en Quirós (1982)

AURIÑACO-SOLUTRENSE

Aquila sp
Gypaetus barbatus
Lagopus sp
Tetrastes bonasia
Corvus monedula
Pyrrhocorax sp

AURIÑACIENSE

Aquila sp
Tetrastes bonasia

15. CUEVA DE EL PENDO (*)

Camargo, Cantabria

Gravetiense, Magdaleniense y Azilíense

Fuentes (1980)

GRAVETIENSE

Gyps fulvus

MAGDALENIENSE

Aquila sp
Athene noctua
Turdus philomelos
Garrulus glandarius
Corvus corone

16. CUEVA DE VALDEGOBA

Huérmeles, Burgos

Paleolítico Medio

Diez *et al* (1988-89)

Anas sp1
Anas sp2
Aegypius monachus
Falco tinnunculus
Alectoris sp
Coturnix coturnix
Columba sp
Athene noctua
Turdus sp
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Passeriformes indet.

17. CUEVA DE SANTIMAMIÑE (*)

Basondo, Cortézubi, Vizcaya

Auriñaciense hasta Romano

Gaillard en Elorza (1990)

AZILIENSE, MAGDALENIENSE VI y V, SOLUTRENSE, AURIÑACIENSE

Anser anser
Anas platyrhynchos
Aythya ferina
Accipiter nisus?
Aquila chrysaetos
Falco subbuteo
Falco tinnunculus
Alectoris rufa
Alectoris graeca
Alectoris barbara
Perdix perdix
Gallinula chloropus
Columba livia
Columba oenas
Tyto alba
Alauda arvensis
Turdus merula
Prunella collaris
Corvus corax
Corvus corone cornix
Pica pica
Nucifraga caryocatactes
Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

TARDIGLACIAL

Anser anser
Anas platyrhynchos
Milvus milvus
Buteo buteo
Aquila chrysaetos
Falco peregrinus
Alectoris rufa
Perdix perdix
Porzana porzana
Gallinula chloropus
Vanellus vanellus
Columba oenas
Columba palumbus
Tyto alba
Turdus philomelos
Turdus iliacus
Turdus torquatus
Turdus merula
Corvus corax
Pica pica
Nucifraga caryocatactes
Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Anas strepera
Anas crecca/querquedula
Anas platyrhynchos
Anseriformes indet.
Aquila sp
Falco tinnunculus
Falco spp
Accipitridae indet.
Tetrao urogallus
Tetrao tetrix
Lagopus lagopus
Lagopus mutus
Lagopus spp
Perdix perdix
Galliformes indet.
Pluvialis spp
Vanellus vanellus
Calidris maritima
Numenius phaeopus
Numenius spp
Scolopax rusticola
Chlidonias niger
Alle alle
Charadriiformes indet.
Columba livia/oenas
Bubo bubo
Bubo/Nyctea
Asio flammeus
Passeriformes indet.

18. CUEVA DE LUMENTXA (*)

Lequeitio, Vizcaya

Aziliense-Magdaleniense

Gaillard en Elorza (1990)

Lagopus mutus
Bubo bubo
Turdus philomelos
Pyrrhocorax pyrrhocorax

19. CUEVA DE LAMINAK II

Berriatua, Vizcaya

Tardiglacial

Hernández (inédito)

Mergus albellus
Mergus serrator
Aythya ferina
Aythya fuligula
Aythya spp
Anser anser/fabalis
Tadorna tadorna

20. CUEVA DE ARENAZA (*)

San Pedro de Galdames, Vizcaya

Tardiglacial, Aziliense

Eastham en Elorza (1990)

TARDIGLACIAL

Anas platyrhynchos
Gypaetus barbatus?
Buteo buteo
Columba livia
Columba palumbus
Tyto alba
Corvus monedula/Pyrrhocorax graculus

21. CUEVA DE ERMITTIA (*)

Deva, Guipúzcoa

Solutrense hasta Neo-Eneolítico

Elorza (en prensa)

SOLUTRENSE

Aythya fuligula
Aquila chrysaetos
Lagopus lagopus
Lagopus sp
Nyctea scandiaca
Asio flammeus
Hirundo rustica
Turdus merula
Turdus philomelos
Turdus sp
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp

MAGDALENIENSE

Aquila chrysaetos
Lagopus sp
Turdus viscivorus?
Turdus sp
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp

22. CUEVA DE EKAIN (*)

Deva, Gulpúzcoa

Aurliñaciense hasta Aziliense

Eastham (1984)

AURIÑACO-PERIGORDIENSE (Nivel IX-X)

Garrulus glandarius
Pyrrhocorax graculus

Nivel VIII

Hirundo rustica
Ptyonoprogne rupestris
Anthus spinoletta
Turdus merula

MAGDALENIENSE INFERIOR (Nivel VIIa-f)

Anas platyrhynchos
Falco tinnunculus
Hirundo rustica
Anthus spinoletta
Oenanthe oenanthe
Turdus philomelos
Parus major
Pyrrhocorax graculus
Garrulus glandarius
Passer domesticus
Carduelis chloris
Miliaria calandra
Emberiza citrinella
Emberiza sp

MAGDALENIENSE VIa/b

Pyrrhocorax graculus

23. CUEVA DE AMALDA (*)

Cestona, Guipuzcoa

Musteriense hasta Romano

Eastham (1989)

MUSTERIENSE (Nivel VII)

Anas platyrhynchos
Aquila chrysaetos
Galerida cristata
Turdus philomelos
Turdus viscivorus
Corvus corone
Pyrrhocorax pyrrhocorax
Miliaria calandra
Emberiza citrinella

PERIGORDIENSE (Nivel VI)

Anas platyrhynchos
Accipiter gentilis
Falco peregrinus
Falco tinnunculus
Perdix perdix
Asio otus
Asio flammeus
Bubo bubo
Turdus merula
Turdus viscivorus
Corvus corax
Pyrrhocorax pyrrhocorax
Garrulus glandarius
Miliaria calandra

PERIGORDIENSE o PROTOMAGDALENIENSE (Nivel V)

Anas platyrhynchos
Falco peregrinus
Falco tinnunculus
Columba livia
Pica pica
Pyrrhocorax pyrrhocorax
Miliaria calandra

SOLUTRENSE (Nivel IV)

Anas platyrhynchos
Columba livia
Strix aluco
Galerida cristata
Oenanthe oenanthe
Turdus merula
Pica pica
Corvus corax
Pyrrhocorax pyrrhocorax
Miliaria calandra

24. CUEVA DE ERRALLA

Cestona, Guipúzcoa

Magdalenlense, C^{14} 16.720, 16.200, 15.470 BP

Eastham (1985)

ESTERIL

Falco subbuteo
Falco tinnunculus
Pluvialis apricaria
Columba livia
Motacilla alba
Pyrrhocorax graculus
Emberiza cirlus

MAGDALENIENSE INFERIOR (Dryas I)

Anas platyrhynchos
Aquila/Buteo
Accipiter gentilis
Falco subbuteo
Falco naumanni
Lagopus mutus
Alectoris rufa
Perdix perdix
Coturnix coturnix
Tringa totanus
Chlidonias niger
Columba livia
Nyctea scandiaca
Asio otus
Strix aluco
Jynx torquilla
Lullula arborea
Alauda arvensis
Hirundo rustica
Oenanthe oenanthe
Turdus merula
Turdus iliacus
Turdus philomelos
Turdus viscivorus
Acrocephalus scirpaceus
Lanius minor/excubitor
Pyrrhocorax graculus
Garrulus glandarius
Sturnus vulgaris
Passer domesticus
Carduelis carduelis
Carduelis chloris
Emberiza cirlus
Emberiza citrinella
Miliaria calandra

ESTERIL (Pre- Bölling)

Lagopus mutus
Columba livia
Lullula arborea
Alauda arvensis
Lanius minor/excubitor
Pyrrhocorax graculus
Emberiza citrinella

MAGDALENIENSE FINAL (Alleröd)

Falco tinnunculus
Turdus philomelos
Pyrrhocorax graculus
Sturnus vulgaris
Carduelis chloris
Emberiza citrinella
Miliaria calandra

25. CUEVA DE TORRE

Oyarzun, Guipúzcoa

Magdalenlense

Barandiarán (1971)

Sula bassana

26. CUEVA DE LEZETXIKI

Mondragón, Gulpúzcoa

Musteriense (Würm I-II)

Eastham en Elorza (1990)

Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

Buteo rufinus
Falco peregrinus
Lagopus mutus
Vanellus vanellus
Columba oenas
Columba palumbus
Turdus viscivorus
Corvus corax
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Sturnus vulgaris

27. CUEVA DE URTIAGA (*)

Itziar, Deva, Gulpúzcoa

Würm III hasta Neo-Eneolítico

Eastham en Elorza (1990)

WÜRM III

Neophron percnopterus
Accipiter gentilis
Buteo rufinus
Aquila chrysaetos
Falco peregrinus
Falco rusticolus
Corvus monedula
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

ESTERIL (17.050 +/- 140 BP)

Buteo rufinus
Aquila chrysaetos
Falco peregrinus
Falco rusticolus
Lagopus mutus
Perdix perdix
Otis tarda
Columba livia
Corvus corax
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

MAGDALENIENSE VI Y V

Anser anser
Anser fabalis
Branta leucopsis
Tadorna tadorna
Anas penelope
Anas clypeata
Mergus serrator

28. CUEVA DE AITZBITARTE IV (*)

Renteria, Gulpúzcoa

Auriñaciense hasta Aziliense

Eastham en Elorza (1990)

AURIÑACIENSE

Elanus caeruleus
Falco tinnunculus
Lagopus mutus
Columba livia/oenas
Streptotelia turtur
Alauda arvensis
Pyrrhocorax graculus

SOLUTRENSE

Tadorna tadorna
Anas querquedula
Mergus merganser
Elanus caeruleus
Falco subbuteo
Falco tinnunculus
Lagopus lagopus
Lagopus mutus
Perdix perdix
Tringa totanus
Scolopax rusticola
Columba livia/oenas
Strix aluco
Alauda arvensis
Turdus viscivorus
Corvus corax
Pica pica
Garrulus glandarius
Pyrrhocorax graculus
Pyrrhocorax pyrrhocorax
Sturnus vulgaris
Emberiza citrinella
Emberiza melanocephala

MAGDALENIENSE

Anas platyrhynchos
Gypaetus barbatus
Falco tinnunculus
Lagopus mutus
Perdix perdix
Columba livia/oenas
Strix aluco
Lullula arborea
Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Sturnus vulgaris
Emberiza citrinella
Emberiza melanocephala
Miliaria calandra

MAGDALENIENSE FINAL

Podiceps sp
Elanus caeruleus
Falco tinnunculus
Lagopus mutus
Perdix perdix
Columba livia/oenas
Turdus viscivorus
Corvus corax
Corvus monedula
Pyrrhocorax pyrrhocorax
Garrulus glandarius
Emberiza citrinella
Miliaria calandra

29. CUEVA DE BERROBERRIA

Alkerdi, Urdax, Navarra

Solutrense

Villalta (1964)

Aquila sp
Lagopus mutus
Pyrrhocorax graculus

30. CUEVA S'ESPASA DE LA ALTA GARROXTA

S'Espasa, Gerona

Primeras fases del Würm

Estévez (1975-76)

Falco sp
Columba oenas
Columba livia
Columba palumbus
Strix aluco
Nyctea scandiaca
Corvus corax
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Fringilla coelebs

31. GRUTA DE SERINYA

Serinya, Gerona

Paleolítico Superior

Milne Edwards en Villalta (1964) y Villalta (1964)

Circus sp
Coturnix coturnix
Alectoris graeca
Otis tetrax
Otis tarda
Chlamydotis undulata
Columba livia
Corvus corax
Pyrrhocorax graculus

32. BORA GRAN D'EN CARRERAS

Serinya, Gerona

Magdaleniense Superior, 11.700 BP

Vilette (1983)

Perdix perdix
Columba oenas
Pyrrhocorax graculus

33. RECLAU VIVER

Serinya, Gerona

Solutrense

Villalta (1964)

Gyps fulvus
Alectoris barbara
Corvus corax
Pyrrhocorax pyrrhocorax

34. CUEVA DE L'ARBREDA (*)

Serinya, Gerona

Auriñaciense hasta Epipaleolítico

Vilette (1983)

AURIÑACIENSE (Arb. 23-28)

Podiceps auritus/nigricollis
Branta bernicla
Anas platyrhynchos
Anas crecca
Anas querquedula
cf Falco subbuteo
Alectoris graeca
Perdix perdix
Coturnix coturnix
Charadrius morinellus
cf Limosa limosa
Columba oenas
Columba palumbus
Asio flammeus
Athene noctua
cf Galerida cristata
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus corax

GRAVETIENSE (Arb. 18-22)

Anatidae indet.
Aythya nyroca
Alectoris graeca
Perdix perdix
cf Limosa limosa
Columba oenas
Athene noctua
Turdus torquatus
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus corax

TRANSICION (Arb. 17)

Falco tinnunculus
Perdix perdix
Columba oenas
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

SOLUTRENSE (Arb. 13-16)

Anas platyrhynchos
cf Falco subbuteo
Falco naumanni
Falco tinnunculus
Alectoris graeca
Perdix perdix
Columba oenas
Turdus torquatus
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

35. CUEVA DE L'ARBREDA II

Serinya, Gerona

Paleolítico Superior

Vilette (1983)

Falco tinnunculus
Alectoris graeca
Coturnix coturnix
Asio flammeus
Turdus torquatus
cf Turdus merula
Pinicola enucleator
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

36. EL ROC DE LA MELCA

25 Km N.O. de Gerona, Gerona

Gravetiense, 20.900 BP

Vilette (1983)

Perdix perdix
Coturnix coturnix
Corvus monedula

37. CINGLE VERMELL

Vilanova de Sau, Barcelona

11.620 +/- 140 BP

Vilette (1983)

Anser cf anser
Anatidae indet.
Falco tinnunculus
Alectoris barbara
Perdix perdix
Coturnix coturnix
Columba livia
Apus apus
Apus melba
Melanocorypha calandra

Monticola saxatilis
Turdus torquatus
Turdus iliacus
Turdus viscivorus
Pyrrhocorax pyrrhocorax
Corvus monedula

38. CUEVA DEL TOLL

Moya, Barcelona

Paleolítico Superior?

Villalta (1964)

Lagopus mutus
Alectoris barbara
Alectoris graeca
Perdix perdix
Strix aluco
Locustella luscinoides?
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

39. CUEVA DE LAS TUXUNERAS

Moya, Barcelona

Paleolítico Superior?

Villalta (1964)

PyrrhobKraH pyrrhocorax
Pyrrhoc'rax graculus

40. ABRIC ROMANI

Capellades, Barcelona

Musteriense

Villalta (1964)

Anas platyrhynchos
Aquila sp
Alectoris barbara
Pyrrhocorax graculus

41. BRECHAS DE LA CANTERA DE L'ALTISSEN

Castelldefels, Barcelona

Pleistoceno Superior

Villalta (1964)

Aquila chrysaetos
Columba livia
Columba oenas
Strix aluco
Athene noctua
Carduelis flammea
Fringilla coelebs

42. AVENC DEL GEGANT

Sitges, Barcelona

Pleistoceno Superior

Villalta (1964)

Aquila chrysaetos
Turdus merula

43. PINILLA DEL VALLE

Pinilla del Valle, Madrid

Riss-Würm

Alférez et al. (1982)

cf Anas sp
Passeriforme indt

44. GRUTA DE FURNINHA

Leiria, Portugal

Pleistoceno Superior

Harlé (1912)

Calonectrix diomedea
Phalacrocorax aristotelis aristotelis
Cygnus ¿olor?
Tadorna tadorna
Anas crecca
Melanitta nigra
Alectoris rufa
Perdix perdix?
Columba livia
Bubo bubo
Asio flammeus
Turdus pilaris
Turdus philomelos
Corvus ¿corone?
Corvus ¿monedula?
Pica ¿pica?
Pyrrhocorax pyrrhocorax

45. MALLAETES

Barig, Valencia

Auriñaciense, C^{14} 30.570 +/- 560 BP

Eastham en Davidson (1989)

Anas platyrhynchos
Alectoris rufa
Columba livia
Athene noctua
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

46. CUEVA DEL VOLCAN DEL FARO

Cullera, Valencia

Paleolítico Superior, 15.000-21.000 BP

Eastham en Davidson (1989)

Anas platyrhynchos
Anas querquedula
Netta rufina
Anas crecca
Anas acuta
Falco tinnunculus
Falco rusticolus
Alectoris rufa
Coturnix coturnix
Uria aalge
Columba livia
Apus apus
Picus viridis
Galerida theklae
Turdus viscivorus
Turdus merula
Corvus corax
Pyrrhocorax graculus
Pyrrhocorax pyrrhocorax
Sturnus cf unicolor
Passer sp
Emberiza sp

47. PARPALLO

Gandia, Valencia

Paleolítico Superior

Eastham en Davidson (1989)

Anas platyrhynchos
Columba livia

48. COVA NEGRA DE BELLUS

Játiva, Valencia

Würm I, II, Musteriense

Eastham (1988) Y (1989)

WÜRM I (MUSTERIENSE)

Anas platyrhynchos
Accipitridae indt
Phasianidae indt
Coturnix coturnix
Strigiformes indt
Apus melba
Turdus spp
Pyrrhocorax sp

WÜRM I/II (MUSTERIENSE)

Anseriformes indt
Phasianidae indt
Columba livia
Apus melba
Pyrrhocorax sp

WÜRM II (MUSTERIENSE)

Phalacrocorax aristotelis
Scolopax rusticola
Gallinago sp
Columba livia

Tyto alba
Strix cf intermedia
Bubo bubo cf davidii
Apus melba
Turdus spp
Lanius sp
Corvus sp

WÜRM I, II Y I/II

Accipiter sp
Aegolius funereus
Apus apus
Melanocorypha calandra
Monticola solitarius
Garrulus glandarius
Pica pica
Corvus corax

49. COVA NEGRA DE BELLUS

Játiva, Valencia

Pleistoceno Superior

Villalta (1964)

Upupa epops
Apus sp
Pyrrhocorax graculus

50. EL SALT

Alcoy, Alicante

Musteriense

Eastham (1988)

Anas platyrhynchos
Phasianidae indt
Columba sp
Pyrrhocorax sp

51. COVA DES CENDRES

Teulada, Alicante

Magdaleniense Superior

Badal et al. (1991)

ESTRATO I

Coturnix coturnix
Calidris ferruginea
Columba livia/oenas
Pyrrhocorax sp

ESTRATO II

Anatidae indt
Accipitridae indt
Falco tinnunculus
Falco columbarius
Haematopus ostralegus
Columba livia/oenas
Strigidae indt
Lullula arborea
Turdus sp
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp

ESTRATO III (C^{14} 12.650 +/- 80 BP)

Anatidae indt
Accipitridae indt
Aquila chrysaetos
Accipiter nisus
Alectoris sp
Coturnix coturnix
Charadriidae indt
Columba livia/oenas
Bubo bubo
Apus apus
Turdus sp
Turdus viscivorus
Turdus merula
Fringillidae indt
Pica pica
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp
Corvus monedula
Corvus corone

52. CUEVA DE FIGUEIRA BRAVA

Portinho da Arrabida, Portugal

Musteriense, C^{14} 30.930 +/- 700 BP

Mourer-Chauviré & Antunes (1991)

Gavia stellata
Puffinus holei
Sula bassana
Melanitta nigra
Clangula hyemalis

Alca torda
Pinguinus impennis

53. GRUTA DE DAS FONTAINHAS

Lisboa, Portugal

Pleistoceno Superior

Harlé (1912)

Alectoris rufa
Vanellus vanellus
Corvus monedula?
Pyrrhocorax ¿graculus?

54. CUEVA DE LA CAMPAÑA DEL PINAR

Granada

Pleistoceno Superior

Koby & Spahni (1956)

Turdus viscivorus
Turdus merula
Pyrrhocorax graculus

55. LAS YEDRAS

Granada

Würm I

Ruiz (1978)

Aquila chrysaetos
Corvus sp

56. CUEVA DE ZAFARRAYA

Alcaucín, Málaga

Musteriense

Eastham (1989)

Accipitridae indt
Falco tinnunculus
Alectoris rufa
Apus melba
Hirundo rustica
Monticola solitarius
Pyrrhocorax sp

57. EL PADUL

Padul, Granada

Pleistoceno Final

Fuentes & Meljide (1970)

Anas platyrhynchos

58. CUEVA DE AMBROSIO

Almeria

Solutrense

Sánchez (1988)

Falco naumanni
Alectoris rufa
Columba livia
Athene noctua
Hirundo rustica
Prunella collaris
cf Turdus pilaris/merula
Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Petronia petronia
Acanthis cannabina

59. CUEVA DE NERJA (*)

Nerja, Málaga

Paleolítico Superior hasta PostCalcolítico

Eastham (1986) y Boessneck & Driesch (1980)

MAGDALENIENSE (Eastham)

Puffinus griseus
Sula bassana
Anser sp

Anas platyrhynchos
Anas crecca
Aythya nyroca
Circaetus gallicus
Falco tinnunculus
Alectoris rufa
Larus fuscus
Uria aalge
Pinguinus impennis
Columba livia
Monticola solitarius
Lanius excubitor
Corvus corone
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Coccothraustes coccothraustes

PALEOLITICO SUPERIOR (NT 79, Boessneck & Driesch)

Gavia stellata?
Puffinus yelkouan
Puffinus gravis
Calonectrix diomedea
Sula bassana
Anser albifrons?
Tadorna tadorna
Anas platyrhynchos
Melanitta nigra
Milvus milvus
Accipiter gentilis
Buteo buteo
Gypaetus barbatus
Fulica atra
Larus cachinnas/fuscus
Larus marinus
Alca torda
Uria aalge
Pinguinus impennis
Columba livia
Corvus corax
Corvus corone
Pyrrhocorax pyrrhocorax
Sturnus sp

EPIPALEOLITICO/PALEOLITICO SUPERIOR (NM 79, Boessneck & Driesch)

Calonectrix diomedea
Puffinus gravis
Sula bassana
Tadorna tadorna
Larus canus/Rissa tridacytla
Alca torda
Columba livia
Bubo bubo

60. CUEVAS

Gibraltar, Cádiz

Paleolítico Superior

Duckworth en Cortés et al. (1980)

Gavia sp
Sula bassana
Phalacrocorax carbo
Aquila/Haliaetus
Gyps fulvus
Falco tinnunculus
Francolinus francolinus
Fratercula arctica
Fratercula/Puffinus
Columba livia
Turdus merula
Turdus viscivorus
Turdus sp
Pica pica
Corvus corone
Corvus corax
Corvus/Pyrrhocorax

61. CUEVA DEL BISTEC

Gibraltar, Cádiz

Paleolítico Superior

Duckworth en Cortés et al. (1980)

Falco tinnunculus
Larus/Stercorarius
Uria aalge

62. CUEVA GENISTA 4A

Gibraltar, Cádiz

Paleolítico Superior

Duckworth (1911) en Cortés et al. (1980)

Gavia sp
Phasianus colchicus?
Fratercula arctica
Columba livia

63. CUEVA DE LA TORRE DEL DIABLO

Gibraltar, Cádiz

Musteriense, C^{14} > 30.000 BP

Breuil (1922) y Garrod et al. (1928) en Cortés et al. (1980)

Calonectrix diomedea
Puffinus yelkouan
Phalacrocorax carbo?
Phalacrocorax aristotelis
Branta leucopsis
Melanitta fusca?
Mergus serrator
Haliaetus albicilla
Gyps fulvus
Aegypius monachus
Hieraetus pennatus
Hieraetus fasciatus
Falco naumanni?
Falco tinnunculus
Falco columbarius
Falco subbuteo
Falco eleonorae
Falco peregrinus
Alectoris rufa
Alectoris barbara?
Vanellus vanellus
Larus fuscus
Sterna sandvicensis?
Uria aalge
Pinguinus impennis
Columba livia
Columba oenas
Strix aluco
Apus melba
Picus viridis
Hirundo rustica
Turdus merula
Turdus viscivorus
Turdus sp
Pyrrhocorax graculus?
Pyrrhocorax pyrrhocorax
Sturnus vulgaris
Fringilla coelebs

64. CUEVA DE GORHAM (*)

Gibraltar, Cádiz

Musteriense hasta Púnico

Eastham (1968)

WÜRM I (Niveles K-U)

Gavia stellata
Phalacrocorax aristotelis
Ardea ¿purpurea?
Tadorna ferruginea
Anas platyrhynchos
Netta rufina
Aythya nyroca
Aythya fuligula
Clangula hyemalis
Melanitta fusca
Milvus milvus
Gyps fulvus
Hieraetus fasciatus
Falco tinnunculus
Alectoris rufa
Anthropoides virgo?
Fulica atra
Haematopus ostralegus
Larus ridibundus
Larus fuscus
Pinguinus impennis
Alle alle
Columba livia
Nyctea scandiaca
Strix ¿uralensis?
Hirundo rustica
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus monedula
Corvus corone
Corvus corax

PRIMER INTERESTADIAL (Nivel J)

Pyrrhocorax pyrrhocorax
Corvus corax

WÜRM II (C^{14} > 48.000 BP; Niveles F-H)

Phalacrocorax aristotelis
Ciconia ciconia
Clangula hyemalis
Milvus milvus
Haliaetus albicilla
Gyps fulvus
Hieraetus fasciatus
Falco peregrinus
Alectoris rufa
Alectoris graeca
Fulica atra
Columba livia
Turdus viscivorus
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus corone
Corvus corax
Sturnus sp

SEGUNDO INTERESTADIAL (Nivel E)

Milvus milvus
Gyps fulvus
Alectoris rufa
Fratercula arctica
Columba livia
Turdus viscivorus
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Emberiza sp

WÜRM III (29.000 BP; Niveles B-D)

Puffinus yelkouan
Phalacrocorax aristotelis
Milvus milvus
Haliaetus albicilla
Gyps fulvus
Falco tinnunculus
Falco peregrinus
Alectoris rufa
Charadrius sp
Himantopus himantopus?
Larus fuscus
Larus cachinnans
Fratercula arctica
Columba livia
Bubo bubo
Hirundo rustica
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus monedula
Corvus corone
Sturnus sp
Fringilla coelebs

HOLOCENO

La Figura 7 muestra la localización de los yacimientos.

11. CUEVA DE LA RIERA (*)

Posada, LLanes, Asturias

Azilíense, Magdaleniense

Eastham (1986)

AZILIENSE (Nivel 25, C^{14} : 10.630 +/- 120 BP)

Anser fabalis/brachyrynchos
Anas platyrhhynchos
Anas querquedula
Aquila chrysaetos
Falco tinnunculus
Perdix perdix
Turdus philomelos
Garrulus glandarius
Miliaria calandra

65. CUEVA DE MAZACULOS II

La Franca, Asturias

Asturiense, 7.340 a. C.

Hernández (inédito)

Buteo buteo
Turdus sp

15. CUEVA DE EL PENDO (*)

Camargo, Santander

Gravetiense hasta Azilíense

Fuentes (1980)

AZILIENSE (Nivel I)

Falco sp
Perdix perdix

17. CUEVA DE SANTIMAMIÑE (*)

Basondo, Cortézubi, Vizcaya

Auriñaciense hasta Romano

Gaillard en Elorza (1990)

ROMANO, HIERRO, BRONCE, ENEOLITICO, NEOLITICO

Anser anser
Falco peregrinus
Gallus sp
Tyto alba
Turdus philomelos

Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

18. CUEVA DE LUMENTXA (*)

Lequeitio, Vizcaya

Magdaleniense hasta postNeolítico

Gaillard en Elorza (1990)

NEOLITICO-POSTNEOLITICO

Podiceps sp
Anser anser
Melanitta nigra
Gallus sp
Numenius phaeopus

20. CUEVA DE ARENAZA (*)

San Jose de Galdames, Vizcaya

Tardiglacial, Aziliense

Eastham en Elorza (1990)

AZILIENSE

Buteo buteo
Tyto alba

21. CUEVA DE ERMITTIA (*)

Deva, Gulpúzcoa
Solutrense hasta Neo-Eneolítico
Elorza (en prensa)

AZILIENSE

Lagopus mutus
Rissa tridactyla/Larus canus
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Pyrrhocorax sp

ENEO-NEOLITICO

Aquila chrysaetos
Perdix perdix
Turdus merula
Turdus philomelos
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

22. CUEVA DE EKAIN (*)

Deva, Gulpúzcoa

Auriñaciense hasta Aziliense

Eastham (1984)

AZILIENSE (Nivel II, C^{14}: 9.540 +/- 210 BP; Nivel IV, C^{14}: 9.460 +/- 185 BP)

Tadorna tadorna?
Anas platyrhynchos
Anas penelope
Anas querquedula
Lagopus mutus
Alauda arvensis
Lullula arborea
Turdus merula
Sylvia atricapilla?
Garrulus glandarius
Pyrrhocorax graculus
Sturnus vulgaris

66. HERRIKO BARRA

Zarauz, Gulpúzcoa

Neolítico temprano, C^{14} 5810 +/- 170 BP

Elorza & Sánchez (en prensa)

Fulmarus glacialis
Puffinus puffinus
Grus grus
Rissa tridactyla
Pinguinus impennis
Alca torda
Uria aalge
Fratercula arctica

23. CUEVA DE AMALDA (*)

Cestona, Guipúzcoa

Musteriense a Romano

Eastham (1989)

CALCOLITICO (Nivel III)

Columba livia
Oenanthe oenanthe
Monticola solitarius
Turdus merula
Phylloscopus collybita
Garrulus glandarius
Pyrrhocorax pyrrhocorax
Fringilla coelebs

ROMANO (Nivel II, S. IV d. C.)

Lullula arborea
Monticola solitarius
Turdus merula
Turdus philomelos
Pyrrhocorax pyrrhocorax
Pyrrula pyrrula

ROMANO FINAL (Nivel I)

Columba palumbus
Monticola solitarius
Turdus philomelos
Pyrrhocorax pyrrhocorax
Fringilla coelebs
Coccothraustes coccothraustes

27. CUEVA DE URTIAGA (*)

Itzlar, Deva, Guipúzcoa

Würm IIIb a Neo-Eneolítico

Eastham en Elorza (1990)

AZILIENSE

Anser fabalis
Anas platyrhynchos
Anas clypeata
Aythya ferina
Tetrao tetrix
Alle alle
Columba livia/oenas
Calandrella cinerea?
Corvus monedula
Pyrrhocorax graculus
Pyrrhocorax pyrrhocorax
Garrulus glandarius
Sturnus vulgaris
Emberiza sp

NEO-ENEOLITICO

Branta leucopsis
Gypaetus barbatus
Tetrao tetrix
Fratercula arctica
Sturnus vulgaris

28. CUEVA DE AITZBITARTE IV (*)

Renteria, Guipúzcoa

Aurliñaciense hasta Aziliense

Eastham en Elorza (1990)

AZILIENSE

Anas platyrhynchos
Lagopus mutus
Alectoris rufa
Perdix perdix
Scolopax rusticola
Hirundo rustica
Turdus viscivorus
Corvus corax
Corvus corone/Garrulus glandarius
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

67. URTAO II

Oñate, Guipúzcoa

Calcolítico, C^{14} 4.490 +/- 170 BP, 4.610 +/- 120 BP

Elorza (1989)

Falco tinnunculus
Lagopus sp
Alectoris rufa
Perdix perdix
Coturnix coturnix
Calidris sp
Columba livia/oenas
Strix aluco
Hirundo rustica
Turdus viscivorus
Turdus philomelos

Turdus iliacus
Turdus merula
Garrulus glandarius
Pyrrhocorax graculus
Pyrrhocorax pyrrhocorax
Corvus corax
Sturnus vulgaris
cf Carduelis chloris
Coccothraustres coccothraustres
Emberiza sp

68. CASTILLO DE AITZORROTZ

Escoriaza, Guipúzcoa

Medieval (S. XII - XIV d. C.)

Mariezkurrena & Altuna (1981)

Aquila chrysaetos
Gallus gallus

69. JENTILEN - LAIHOA

Urdiain, Navarra

Medieval (S. XIII d. C.)

Altuna (1974)

Falco tinnunculus
Tyto alba
Gallus gallus

70. MURU - ASTRAIN

Sansol, Pamplona

Hierro II

Castaños (1988)

Gallus gallus

71. EL PUYO

Urraul Bajo, Navarra

Medieval

Castaños (1988)

Gallus gallus
Corvus corone

72. APARDUES

Urraul Bajo, Navarra

Medieval

Castaños (1988)

Gallus gallus

73. CERRO DE SANTA ANA

Entrena, Logroño

Hierro II

De Miguel & Morales (1983)

Gallus gallus

74. LA RADA

Rada, Navarra

Medieval (S. XII - XV d. C.)

Castaños (Inédito)

Aquila sp
Gallus gallus

75. SACAOJOS

La Bañeza, León

Hierro I

Driesch & Boessneck (1980)

Ciconia ciconia
Anas platyrhynchos
Anas crecca/querquedula
Columba livia/oenas
Corvus corone

76. LA HOYA

La Hoya, Alava

Celtibérico (450 - 350 a. C.)

Altuna & Mariezkurrena (1983)

Gallus gallus

77. CUEVA DEL MORO

Olvena, Huesca

Neolítico

Castaños (1991)

Aquila adalberti
Falco tinnunculus
Alectoris rufa
Columba sp
Pica pica
Pyrrhocorax graculus
Corvus monedula/corone

78. CUEVA DE EL PARCO

Alós de Balaguer, Lérida

Epipaleolítico

Hernández (inédito)

Alectoris rufa
Perdix perdix
Athene noctua
Columba livia
Turdus sp
Turdus viscivorus
cf Turdus iliacus
Pica pica
Pyrrhocorax graculus
Fringilla sp
Miliaria calandra
cf Miliaria calandra

34. CUEVA DE L' ARBREDA (*)

Serinya, Gerona

Musteriense a Epipaleolítico

Villette (1983)

EPIPALEOLITICO

Anas platyrhynchos
Anas penelope
Perdix perdix
Columba palumbus
cf Turdus merula
Pyrrhocorax graculus

79. FUENTEUNGRILLO

Villalba de los Alcores, Valladolid

Medieval (S. XII - XV d. C.)

Hernández (inédito)

Anser anser
Anas platyrhynchos
Alectoris rufa
Gallus gallus
Tetrax tetrax
Columba livia
Sturnus sp

80. EL SOTO DE MEDINILLA

Valladolid

Hierro I y II

Hernández (inédito)

HIERRO I

Haliaetus albicilla
Alectoris rufa
Otis tarda
Pica pica
Corvus corone
Passer domesticus/hispaniolensis

HIERRO II

Alectoris rufa
Gallus gallus

81. MELGAR DE ABAJO

Melgar de Abajo, Valladolid

Hierro I

Hernández (inédito)

Alectoris rufa

82. LA MOTA

Medina del Campo, Valladolid

Hierro

Hernández (Inédito)

Ardea cinerea
Alectoris rufa
Anthropoides virgo

83. TIERMES II

Montejo de Tiermes, Soria

S. I - III d. C.

Hernández (Inédito)

Aquila cf adalberti
Alectoris rufa
Gallus gallus
Pica pica

84. BILBILIS

Calatayud, Zaragoza

Romano (S. I a. C. - III d. C.)

Castaños (Inédito)

Alectoris rufa
Gallus gallus

85. LOS CASTELLAZOS

Medina de Aragón, Zaragoza

S. III a. C.

Hernández (Inédito)

Aquila chrysaetos
Alectoris rufa
Gallus gallus
Pyrrhocorax pyrrhocorax

86. ZAFRANALES

Fraga, Huesca

Bronce y Medieval (musulmán S.XII d. C.)

Castaños (1988)

BRONCE

Alectoris rufa

MEDIEVAL

Gallus gallus

87. SANT-GREGORI

Falset, Tarragona

Epipaleolítico

Hernández (Inédito)

Corvus corax

88. ALORDA PARK

Calafell, Tarragona

Ibérico, Hierro II

Hernández (1992)

Accipiter nisus
Alca torda
Gallus gallus
Apus apus
Pica pica

89. RECOPOLIS

Riba de Saelices, Guadalajara

Medieval (musulmán)

Morales et al. (inédito)

Gallus gallus

90. El POBLADO DE SAN ESTEBAN

El Poyo del Cid, Teruel

Romano (S. I d. C.)

Castaños (1981)

Alectoris rufa
Gallus gallus
Columba livia
Turdus philomelos
cf Ficedula hypoleuca
Parus cristatus/ater
Lanius senator
Pyrrhocorax pyrrhocorax

91. COVA FOSCA

Ares del Mestre, Castellón de la Plana

Neolítico cerámico (nivel 2 : 7.710 BP

nivel 1 : 7.190 BP, nivel removido)

Vilette (1983)

NIVEL 2

Falco tinnunculus
Alectoris barbara
Alectoris sp
Columba sp
Turdus cf pilaris
Turdus torquatus
Turdus iliacus
Turdus viscivorus
Corvus monedula

NIVEL 1

Gypaetus barbatus
Columba sp
Turdus torquatus
Turdus merula
Turdus iliacus
Turdus viscivorus
Garrulus glandarius
Emberiza calandra

NIVEL REMOVIDO

Alectoris barbara
Alectoris sp
Coturnix coturnix
Columba sp
Athene noctua
cf Monticola saxatilis
Turdus cf pilaris
Turdus torquatus
Turdus viscivorus

92. CALATALIFA

Villaviciosa de Odón, Madrid

Medieval (S. XI d. C.)

Hernández (inédito)

Anser anser
Alectoris rufa
Gallus gallus
Tetrax tetrax
Columba livia
Corvus monedula

93. CERRO REDONDO

Fuente el Saz, Madrid

S. III - II a. C.

Hernández (inédito)

Aquila sp
Tetrax tetrax
Corvus corax

94. TORRE DEL ANDADOR

Albarracín, Teruel

Medieval (S. XIII - XIV d. C.)

Aguilar (inédito) y Hernández (inédito)

Anser anser
Anas platyrhynchos
Gypaetus barbatus
Falco tinnunculus
Alectoris rufa
Gallus gallus
Columba livia
Apus apus
Corvus corax

95. SAN ANTONIO

Vallecas, Madrid

S. VIII - VI a. C.

Hernández (Inédito)

Otis tarda

96. LA TORRECILLA DE IVAN CRISPIN

Getafe, Madrid

Romano

Hernández (Inédito)

Anser anser
Anas platyrhynchos
Alectoris rufa
Phasianus colchicus
Gallus gallus
Tetrax tetrax
Otis tarda
Burhinus oedicnemus
Columba livia/oenas
Columba palumbus
Streptopelia turtur
Athene noctua

97. ANGOSTA DE LOS MANCEBOS

Madrid

Medieval (S. XI d. C.)

Hernández (en prensa)

Alectoris rufa
Gallus gallus
Otis tarda
Pterocles orientalis
Columba livia/oenas
Galerida sp
Turdus sp
Pica pica
Sturnus sp

98. SAN ISIDRO

Madrid

Medieval, musulmán (S. XI d. C.), cristiano (S. XII - XIII d. C.)

Hernández (Inédito)

MUSULMAN

Anser anser
Gallus gallus

CRISTIANO

Anser anser
Anas platyrhynchos
Alectoris rufa
Gallus gallus
Gallinula chloropus
Columba livia/oenas
Sturnus sp

99. CAVA BAJA (SILO 3056)

Madrid

Medieval (S. XII d. C.)

Hernández (en prensa)

Platalea leucorodia
Tadorna ferruginea
Alectoris rufa
Gallus gallus
Grus grus
Anthropoides virgo
Tetrax tetrax
Otis tarda
Numenius arquata
Numenius phaeopus

100. PLAZA DEL ROLLO

Madrid

Medieval

Hernández (Inédito)

Gallus gallus

101. EL BURGALES

Alcalá de Henares, Madrid

Romano, Visigodo

Hernández (inédito)

NIVEL ROMANO

Pelecanus crispus
Alectoris rufa
Gallus gallus

NIVEL ROMANO/VISIGODO

Alectoris rufa
Gallus gallus

NIVEL SUPERFICIAL

Pelecanus crispus
Alectoris rufa
Gallus gallus
Columba livia/oenas

NIVEL REMOVIDO

Alectoris rufa
Gallus gallus

102. VILLAREJO DE SALVANES

Villarejo de Salvanés, Madrid

Medieval cristiano (S. XIII - XV d. C.)

Hernández (inédito)

Ciconia ciconia
Anas sp
Alectoris rufa
Gallus gallus
Sturnus sp

103. CUEVA DE PEDRO FERNANDEZ

Estremera, Madrid

Calcolítico (Bronce medio)

Corral (1985) en De Miguel (1987)

Alectoris rufa

104. PICO DE LA MUELA

Valera de Abajo, Cuenca

S. XIV - XV d. C.

De Miguel y Morales (1985)

Gallus gallus

105. REILLO

Reillo, Cuenca

Hierro I y II

Hernández (inédito)

HIERRO I

Alectoris rufa

HIERRO II

Gallus gallus

106. FUENTE DE LA MOTA

Barchín del Hoyo, Cuenca

Hierro (C^{14} 210, 300, 310 a. C.)

Morales (1981) y De Miguel y Morales (inédito)

Alectoris rufa
Gallus gallus
Passeriforme indet.

107. BOTIJAS

Cáceres

S. IV - I a. C.

Morales (1976)

Otis tarda

108. CUEVA DEL CUCO

Quintanar del Rey, Cuenca

Bronce Medio

Corral (1986) en De Miguel (1987)

Alectoris rufa

109. CABEÇO DA AMOREIRA

Muge, Portugal

Mesolítico, C^{14} 7.030 +/- 350 BP; 6.050 +/- 300 BP

Lentacker (1990-91)

Podiceps ruficollis/nigricollis
Botaurus stellaris
Anser anser
Tadorna tadorna
Anas platyrhynchos
Anas platyrhynchos/strepera
Anas crecca
Anas crecca/querquedula
Anas penelope
Anas penelope/Aythya fuligula
Anatidae sp
Buteo buteo
Falco columbarius/naumanni
Falco naumanni
Falconiformes indet.
Alectoris rufa
Otis tarda
Vanellus vanellus
Scolopax rusticola
Scolopax rusticola/Gallinago gallinago
Numenius arquata
Larus cachinnans
Charadiiformes indet.
Columba palumbus
Tyto alba
Asio otus/Strix aluco
Strix aluco
Turdus philomelos
Corvus corone
Passeriformes indet.

110. CABEÇO DA ARRUDA

Muge, Portugal

Mesolítico, C^{14} 6.430 +/- 300 BP; 5.150 +/- 300 BP

Lentacker (1990-91)

Anser anser
Anser fabalis
Anas platyrhynchos
Anas crecca/querquedula
Anas clypeata/Aythya ferina
Anatidae indet.
Accipiter nisus
Buteo buteo
Falconiformes indet.
Alectoris rufa
Grus grus
Scolopax rusticola
Columba palumbus
Columba livia
Corvus corone
Passeriformes indet.

111. MEDO TOJEIRA

Samouquelra, Portugal

Mesolítico, C^{14} 7.200 BP - 5.800 BP

Lentacker (1990-91)

Puffinus gravis/diomedea
Charadriiformes indet.

112. BARROSINHA

Setubal, Portugal

Neolítico, C^{14} 4730 +/- 50 BP

Lentacker (1990-91)

Sula bassana
Procellariiformes indet.
Charadriiformes indet.

113. RAMALHA

Ramalha, Portugal

Neolítico

Lentacker (1990-91)

Tadorna tadorna

114. ROTURA

San Luis, Setubal, Portugal

Calcolítico

Lentacker (1990-91)

Sula bassana
Alectoris rufa
Columba livia
Passeriformes indet.

115. LECEIA

Leceia, Portugal

Calcolítico

Lentacker (1990-91)

NIVEL C2 (2300 - 2100 BP)

Alectoris rufa
Falconiformes indet.
Laridae indet.

116. PENEDO DE LEXIM

Mafra, Portugal

Neolítico/Eneolítico

Driesch & Ritcher (1976)

Alectoris rufa

117. CASTRO DO ZAMBUJAL

Zambujal, Portugal

Campaniforme - Cobre final

Driesch & Boessneck (1976)

CAMPANIFORME

Sula bassana
Phalacrocorax carbo
Cygnus olor
Gyps fulvus
Aegypius monachus
Gypaetus barbatus
Aquila chrysaetos
Alectoris rufa
Tetrax tetrax
Otis tarda
Calidris alpina
Columba livia
Columba palumbus
Tyto alba
Athene noctua
Hirundo rustica
Corvus monedula
Corvus frugilegus?
Corvus corone
Corvus corax

COBRE FINAL/CAMPANIFORME

Sula bassana
Ciconia ciconia
Buteo buteo
Falco sp
Alectoris rufa
Coturnix coturnix
Scolopax rusticola
Tringa nebularia
Columba livia
Columba palumbus
Pica pica
Pyrrhocorax pyrrhocorax
Corvus monedula
Corvus frugilegus?
Corvus corone
Corvus corax

COBRE FINAL

Sula bassana
Phalacrocorax aristotelis
Buteo buteo
Alectoris rufa
Otis tarda
Scolopax rusticola
Pyrrhocorax pyrrhocorax

118. MORRA DE QUINTANAR

Munera, Albacete

Bronce

Hernández (inédito)

Milvus migrans
Alectoris rufa
Otis tarda
Athene noctua
Picus viridis

Corvus corone
Corvus corax
Corvus corone/corax

119. CALATRAVA LA VIEJA

Carrión de Calatrava, Ciudad Real

S. XIII d. C.

Aguilar (1990) y Hernández (Inédito)

Ciconia ciconia
Anas platyrhynchos
Aegypius monachus
Alectoris rufa
Gallus gallus
Coturnix coturnix
Fulica atra
Grus grus
Tetrax tetrax
Otis tarda
Burhinus oecdinemus
Columba livia/oenas
Melanocorypha calandra
Hirundo rustica
Phyrrhocorax phyrrhocorax
Corvus monedula
Sturnus sp
Miliaria calandra

120. AZUER

Daimiel, Ciudad Real

Bronce, 1.500-1.300 a. C.

Driesch & Boessneck (1980)

Anser albifrons
Anas platyrhynchos
Buteo buteo?
Falco peregrinus
Alectoris rufa
Grus grus
Otis tarda
Tetrax tetrax
Strix aluco
Athene noctua
Tyto alba
Pica pica

121. LOS PALACIOS

Daimiel, Ciudad Real

Bronce, 1.500-1.200 a. C. y Hierro

Driesch & Boessneck (1980)

BRONCE

Otis tarda

HIERRO

Gallus gallus

122. COVA DEL BARRANC FONDO

Játiva, Valencia

Neolítico Antiguo

Aparicio (1975) en De Miguel (1987)

Ardea cinerea
Aquila chrysaetos?
Alectoris rufa
Columba livia
Corvus corone
Pyrrhocorax pyrrhocorax

123. EL AMAREJO

Bonete, Albacete

Finales S. III, principios del S. II a. C.

Aguilar (1992)

Gallus gallus

124. CUEVA DE LA SARSA

Bocairente, Valencia

Neolítico, 5.000 a. C.

Boessneck & Driesch (1980)

Falco tinnunculus
Alectoris rufa
Columba livia
Streptotelia turtur
Strix aluco
Caprimulgus europaeus
Hirundinidae indet.
Turdus viscivorus
Corvus corax
Pyrrhocorax pyrrhocorax
Sturnus sp

125. EL ACEQUION

Albacete

Bronce

Hernández (inédito)

Anas sp
Falco tinnunculus
Grus grus
Otis tarda
Columba livia/oenas
Athene noctua
Corvus corax
Corvus corone

126. CABEZO REDONDO

Villena, Alicante

Bronce, C^{14} 2.000-1.000 a. C.

Driesch & Boessneck (1969)

Podiceps ruficollis
Ardea cinerea
Platalea leucorodia
Phoenicopterus ruber
Anser albifrons
Tadorna tadorna
Anas platyrhynchos
Anas querquedula
Aquila sp
Milvus milvus
Alectoris rufa
Coturnix coturnix
Grus grus
Otis tarda
Fulica atra
Limosa limosa
Columba livia
Columba palumbus
Athene noctua
Asio flammeus
Corvus corax
Corvus corone

127. BEGASTRI

Cehegín, Murcia

Visigodo

Hernández (inédito)

Gyps fulvus
Accipiter gentilis
Gallus gallus
Alectoris rufa

128. LOS SALADARES

Orihuela, Alicante

Hierro, 500-350 a. C.

Driesch (1973)

Fulica spp

129. LA BASTIDA DE TOTANA

Murcia

Bronce (Argar)

Hernández (inédito)

Aquila chrysaetos
Alectoris rufa

130. CASTELLON ALTO

Galera, Granada

Bronce, 1.800-1.500 a. C.

Milz (1986)

Ciconia ciconia
Anas crecca
Aquila adalberti

Aquila chrysaetos
Accipiter nisus
Alectoris rufa
Columba livia
Columba palumbus
Athene noctua
Pyrrhocorax pyrrhocorax
Corvus monedula

131. LOMA DE LA BALUNCA

Castellejar, Granada

Bronce

Milz (1986)

Anas platyrhynchos
Alectoris rufa
Pyrrhocorax pyrrhocorax

132. CERRO DEL REAL

Galera, Granada

Bronce (postArgar)

Boessneck (1969)

Gyps fulvus
Gallus gallus

133. CERRO DE LA VIRGEN

Galera, Granada

Cobre hasta Edad Media

Driesch (1972)

NIVEL I COBRE (antes 2.000 a. C.)

Anser fabalis/anser
Anas platyrhynchos
Aythya nyroca
Alectoris rufa
Columba livia
Columba palumbus
Bubo bubo
Pica pica
Pyrrhocorax pyrrhocorax

TRANSICION

Alectoris rufa
Otis tarda
Columba livia
Columba palumbus
Pyrrhocorax pyrrhocorax
Corvus corax

NIVEL II (2.000-1.600 a. C.)

Anser fabalis/anser
Anas platyrhynchos
Aythya nyroca
Gypaetus barbatus
Aquila sp
Falco naumanni
Alectoris rufa
Otis tarda
Columba livia
Columba palumbus
Corvus corone
Corvus corax

TRANSICION (II/III)

Columba palumbus

TRANSICION (III/IV)

Corvus monedula

EDAD MEDIA (714 d. C.)

Gallus gallus
Alectoris rufa

134. TERRERA DEL RELOJ

Dehesas de Guadix, Granada

Bronce

Milz (1986)

Ciconia ciconia
Anas crecca
Aquila adalberti
Alectoris rufa
Otis tarda
Columba livia
Columba palumbus
Athene noctua
Pyrrhocorax pyrrhocorax
Corvus monedula

135. MERTOLA

Mértola, Portugal

Edad Media (Musulmán)

Hernández (inédito)

Gallus gallus
Alectoris rufa
Columba livia/oenas

136. MUNIGUA

Mulva, Sevilla

Romano

Boessneck & Driesch (1980)

Gallus gallus
Alectoris rufa
Columba livia
Columba palumbus
Tyto alba

137. CUEVA HORA

Darro, Granada

Epipaleolítico

Fuentes & Meijide (1975)

Alectoris rufa
Coturnix coturnix
Vanellus vanellus
Columba livia
Columba palumbus
Turdus merula
Turdus philomelos
Corvus corax
Corvus monedula
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus

138. CUESTA DEL NEGRO

Purullena, Granada

Bronce

Lauk (1976)

Neophron percnopterus
Alectoris rufa
Tetrax tetrax
Pyrrhocorax pyrrhocorax

139. CUESTA DEL NEGRO (Tumbas)

Purullena, Granada

Bronce

Driesch (1976)

Aquila chrysaetos
Alectoris rufa
Columba palumbus

140. LA TIÑOSA

Huelva

Siglo IV a. C.

Morales (1978)

Grus grus

141. PUERTO 10

Huelva

Hierro I (Tartésico)

Hernández (inédito)

Gavia stellata
Puffinus sp
Aythya ferina
Anas strepera
Anas platyrhynchos
Anas aff platyrhynchos
Alectoris rufa
Fulica atra

142. PUERTO 6

Huelva

Hierro I (725/700-650 a. C.)

Aguilar & Hernández (1989)

Aegypius monachus

143. CABEZO DE SAN PEDRO

Huelva

Hierro I (tartésico)

Driesch (1973)

Anas platyrhynchos
Alectoris rufa
Gallus gallus
Grus grus

144. CERRO DE LAS CABEZAS

Valencina de la Concepción, Sevilla

Cobre, C^{14} 2.100 a. C.

Driesch (1982)

Sula bassana
Pelecanus sp
Ciconia ciconia
Cygnus ¿olor?
Anser anser/fabalis
Anser albifrons
Anas platyrhynchos
Netta rufina
Aegypius monachus
Gyps fulvus
Aquila chrysaetos
Haliaetus albicilla
Alectoris rufa
Gallus gallus
Grus grus
Columba palumbus

145. CERRO MACARENO

Sevilla

Cobre

Amberger (1985)

Aegypius monachus
Corvus corone

146. LA CARTUJA (CELDA DEL PRIOR)

Sevilla

Siglo XV-XVI d. C.

Hernández (1990)

Anas platyrhynchos
Alectoris rufa
Gallus gallus
Columba livia
Corvus monedula
Sturnus spp

147. LOS CASTILLEJOS DE MONTEFRIO

Peñas de los Gitanos, Granada

Neolítico a Cobre Final

Ziegler (1990)

NEOLITICO MEDIO-FINAL

Columba palumbus

NEOLITICO FINAL

Milvus milvus
Aquila adalberti
Columba palumbus
Columba livia/oenas

NEOLITICO SUPERIOR / COBRE FINAL

Columba palumbus

COBRE SUPERIOR

Columba palumbus

COBRE PLENO-FINAL

Corvus monedula

148. CERRO DE LOS CASTELLONES

Laborcillas, Granada

Cobre

Driesch & Kokabi (1977)

Otis tarda

149. CERRO DE LA ENCINA

Monachil, Granada

Cobre

Friesch (1987)

Hieraetus pennatus?
Alectoris rufa
Otis tarda
Columba livia

150. CERRO DE LA ENCINA

Monachil, Granada

Bronce

Lauk (1976)

Ciconia ciconia
Aegypius monachus
Falco tinnunculus
Alectoris rufa
Grus grus
Otis tarda
Larus cachinnans
Bubo bubo
Pica pica
Corvus corone
Pyrrhocorax pyrrhocorax

151. TERRERA VENTURA

Tabernas, Almería

Eneolítico a Campaniforme

Driesch & Morales (1977)

NEOENEOLITICO (2.700 a. C.)

Accipiter nisus

ENEOLITICO-PRECAMPANIFORME (2.700-2.400 a. C.)

Sula bassana
Accipiter nisus
Alectoris rufa
Columba livia

ENEOLITICO-CAMPANIFORME (2.400-2.000 a. C.)

Accipiter nisus
Alectoris rufa
Turdus philomelos

152. EL TARAJAL

Campo de Níjar, Almería

Bronce Antiguo

Morales (1976)

Alectoris rufa
Otis tarda
Columba livia/oenas

153. FUENTE ALAMO

Los Campos, Almería

Bronce, Romano, Edad Media

Driesch et al. (1985)

BRONCE

Accipiter nisus
Aquila chrysaetos
Aquila adalberti
Aegypius monachus
Alectoris rufa
Columba livia
Columba palumbus
Pica pica

ROMANO

Alectoris rufa
Gallus gallus

EDAD MEDIA (MUSULMAN)

Alectoris rufa

154. EL BARRANQUETE

Almería

Bronce Antiguo, C^{14} : 2.350 a. C.; 2.330 a. C. Driesch (1975)

Anas crecca
Alectoris rufa
Columba livia
Columba palumbus
Corvus corax

155. LOS MILLARES

Santa Fé de Mondújar, Almería

Cobre

Peters & Driesch (1990)

Struthio camelus
Sula bassana
Anser albifrons
Anas platyrhynchos
Aquila adalberti
Aquila chrysaetos
Tetrao urogallus
Alectoris rufa
Columba livia
Columba palumbus
Pyrrhocorax pyrrhocorax
Passeriformes indet.

156. CASTILLO DE DOÑA BLANCA

Puerto de Santa María, Cádiz

Hierro I hasta Edad Media

Jonsson & Hernández (Inédito)

MITAD DEL S. VIII a. C.

Struthio camelus
Anas platyrhynchos
Alectoris rufa
Gallus gallus
Numenius arquata
Larus canus/genei
Streptotelia turtur
Turdus cf iliacus

FIN S. VIII a. C. Y PRINCIPIO DEL S. VII a. C.

Anas platyrhynchos
Tadorna tadorna
Aquila adalberti
Gallus gallus
Gallinula chloropus
Larus fuscus/cachinnans

S. VII a. C.

Netta rufina
Milvus milvus

FIN S. VII a. C. E INICIOS DEL S. VI a. C.

Anas platyrhynchos

PRIMERA MITAD DEL S. VI a. C.

Phalacrocorax carbo
Alectoris rufa

FINALES DEL S. V a. C. E INICIOS DEL S. IV a. C.

Aquila adalberti
Gallus gallus

PRIMERA MITAD DEL S. IV a. C.

Anas platyrhynchos/acuta
Aquila adalberti
Alectoris rufa
Gallus gallus
Tetrax tetrax

MITAD DEL S. III a. C.

Platalea leucorodia
Aquila adalberti
Gallus gallus

REVUELTO (s. VIII-IV a. C.)

Anser anser/fabalis

EDAD MEDIA

Platalea leucorodia
Anser anser/fabalis
Gallus gallus
Stercorarius pomarinus

157. CUEVA DEL PARRALEJO

San José del Valle, Cádiz

Neolítico, Calcolítico, Edad Media

Boessneck & Driesch (1980)

NEOLITICO

Anas platyrhynchos
Alectoris rufa
Otis tarda
Columba palumbus

CALCOLITICO

Columba livia

EDAD MEDIA

Gallus gallus

SIN DATACION

Aegypius monachus
Aquila chrysaetos

158. CUEVA DE LA DEHESILLA

Algar, Cádiz

Calcolítico; S. XVII-XVIII d. C.

Boessneck & Driesch (1980)

CALCOLITICO

Accipiter gentilis

S. XVII-XVIII d. C.

Neophron percnopterus

159. CERRO DE LA TORTUGA

Teatinos, Málaga

Fenicio

Uerpmann & Uerpmann (1983)

Gallus gallus
Alectoris rufa

160. TOSCANOS

Torre del Mar, Málaga

Fenicio (S. VIII-VII a. C.) y Fenicio-Romano

Boessneck (1973)

FENICIO (S. VIII a. C.)

Alectoris rufa
Gallus gallus
Columba palumbus

FENICIO (S. VII a. C.)

Phalacrocorax carbo
Milvus migrans
Hieraetus fasciatus
Alectoris rufa
Gallus gallus
Larus marinus
Larus cachinnans
Alca torda
Streptotelia turtur

FENICIO-ROMANO

Alectoris rufa
Gallus gallus
Fulica atra
Larus cachinnans

59. CUEVA DE NERJA (*)

Nerja, Málaga

Epipaleolítico hasta PostCalcolítico

Boessneck & Driesch (1980) y Eastham (1985)

EPIPALEOLITICO (Eastham)

Puffinus griseus
Sula bassana
Anas plathrhynchos
Accipiter/Aquila
Falco subbuteo
Alectoris rufa
Coturnix coturnix
Larus ridibundus
Uria aalge
Columba livia
Hirundo rustica
Luscinia megarhynchos
Monticola solitarius
Turdus merula
Pyrrhocorax pyrrhocorax

EPIPALEOLITICO (NT79, Boessneck & Driesch)

Calonectrix diomedea
Sula bassana
Tadorna tadorna
Aythya ferina?
Melanitta nigra
Aquila adalberti
Alectoris rufa
Grus grus
Fulica atra
Larus cachinnans/fuscus
Larus marinus
Pinguinus impennis
Columba livia
Pyrrhocorax pyrrhocorax
Sturnus sp

TRANSICION (NT79, Boessneck & Driesch)

Calonectrix diomedea
Sula bassana
Pinguinus impennis
Columba livia

NEOLITICO (Eastham)

Anas crecca
Falco tinnunculus
Alectoris rufa
Coturnix coturnix
Uria aalge
Monticola solitarius
Oenanthe leucura
Corvus corone

NEOLITICO PLENO Y ANTIGUO (NM 79, Boessneck & Driesch)

Aquila chrysaetos
Larus marinus

NEOLITICO ANTIGUO (NT79, Boessneck & Driesch)

Calonectrix diomedea
Sula bassana
Columba livia

NEOLITICO RECIENTE-PLENO (NT79, Boessneck & Driesch)

Calonectrix diomedea
Sula bassana
Columba livia
Bubo bubo

CALCOLITICO (NT79, Boessneck & Driesch)

Columba livia

POSTCALCOLITICO (NT 79, Boessneck & Driesch)

Alectoris rufa
Columba livia
Tyto alba
Athene noctua

64. CUEVA DE GORHAM (*)

Gibraltar, Cádiz

Musteriense hasta Púnico

Eastham (1968)

NIVEL SUPERIOR, POSTGLACIAL, PUNICO (Nivel A)

Phalacrocorax aristotelis
Aythya fuligula
Milvus milvus
Gyps fulvus
Falco peregrinus
Fulica atra
Fratercula arctica
Columba livia
Pyrrhocorax pyrrhocorax
Pyrrhocorax graculus
Corvus corax
Sturnus sp
Emberiza sp

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