Archaeofauna 6 (1997): 97 - 113

Hunting, fowling and stock-breeding in the Dutch Neolithic

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(Received *20 March 1997*; accepted *16 June 1997*)

ABSTRACT: This article deals with the faunal remains from three Dutch Neolithic sites (Swifterbant, Hazendonk and Kolhorn). In order to obtain a more complete picture of the economy in the Dutch Neolithic, the results of these investigations were compared with the zoological, botanical, ecological and archaeological data from fourteen other Neolithic sites in the same area. In addition to the faunal spectra, the nature of the sites and the type of economy in relation to the environmental conditions are discussed.

KEYWORDS: FAUNAL REMAINS, NEOLITHIC, THE NETHERLANDS, SEASONS OF HABITATION, ENVIRONMENT, ECONOMY

RESUMEN: Este trabajo sintetiza los análisis de fauna llevados a cabo en los yacimientos neolíticos holandeses de Swifterbant, Hazendonk y Kolhorn. A fin de evidenciar una panorámica lo más completa posible de la economía del neolítico holandés, los resultados faunísticos de estos yacimientos se confrontan con los zoológicos, botánicos, ecológicos y arqueológicos de otros catorce yacimientos neolíticos de la misma zona. Además de los espectros de fauna, se valora aquí las características de los diferentes asentamientos y los tipos de economía en ellos detectados en función de los condicionantes ambientales.

PALABRAS CLAVE: RESTOS DE FAUNA, NEOLÍTICO, HOLANDA, ESTACIONALIDAD, AMBIENTE, ECONOMÍA

INTRODUCTION

This article deals with the faunal remains from Neolithic settlements in the Holocene sedimentation area of the western and central Netherlands. The aim of the study was to answer questions concerning the development of stock-keeping and hunting in an exceptional environment, the functional variability of settlements, and the possible seasonality of their occupation. In this way it was hoped to obtain a better understanding of the function of the settlements within their societies, their adaptation to the environment over a period stretching from c. 4350 to c. 2000 cal B.C. and the transition from an economy of hunting and gathering to one of husbandry and crop cultivation.

The faunal material from three sites was studied: Swifterbant, Hazendonk and Kolhorn (Figure 1). The remains from the first site, came from the place known as «S3», which was situated on a low-lying levee alongside a creek. A large single unit was excavated, representing more than half of the actual settlement (van der Waals, 1977). Most of the material came from the settlement itself, and was rather fragmented. A small number of well preserved bones were found during the excavation of a small section of the creek next to the site.

Contrary to that of Swifterbant, the bone material from Hazendonk comes from dump areas on the margins of the settlement, along the slopes of the river dune on which the settlement was located. The remains would mainly have been thrown directly from the dune by the inhabitants. After its abandonment, the top of the dune was disturbed by bioturbation. Most of the bone material came from the third phase of habitation, the Hazendonk-3 phase (Middle Neolithic A) and from the fifth and the sixth phase, the Vlaardingen-1b and Vlaardingen-2b phases (Middle Neolithic B and Late Neolithic A, respectively). A smaller number of

bones came from the earliest phases, Hazendonk-1 and -2 (Middle Neolithic A), while hardly any bone material from the fourth phase (Vlaardingen-1a) was recovered. The site of Kolhorn (Late Neolithic A) can be divided into two subsites: the northern and the southern site. So far it is not known whether these sites were contemporaneous or not, nor whether there are any other differences between the two.

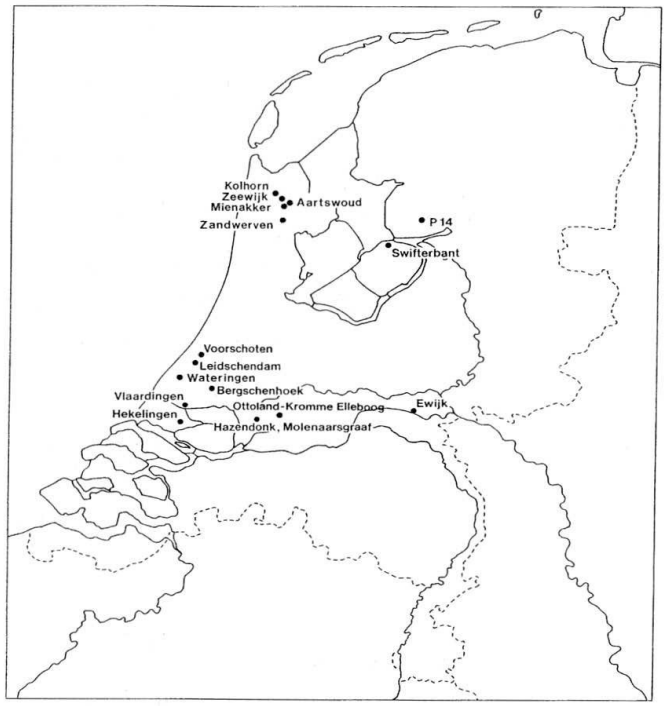

FIGURE 1

The location of Bergschenhoek, Swifterbant, Hazendonk, Hekelingen, Vlaardingen, P14, Voorschoten, Leidschendam, Wateringen, Ewijk, Molenaarsgraaf, Ottoland-Kromme Elleboog, Zandwerven, Aartswoud, Zeewijk and Kolhorn (reconstruction after Louwe Kooijmans 1974). Drawing by H.R. Roelink and M.A. Weijns.

Because of the enormous amount of material, samples were studied from only parts of the various sectors that were excavated. In addition, the bone material from two series of samples from a well (situated in the southern site) was studied.

In order to obtain a more complete picture of the economy in the Dutch Neolithic, the results of these investigations were compared with the zoological, botanical, ecological and archaeological data from fourteen other Neolithic sites in the same area (Figure 1; Table 8).

LANDSCAPE AND VEGETATION AROUND SWIFTERBANT, HAZENDONK AND KOLHORN

Both Swifterbant and Hazendonk were located in the freshwater marshland of the Holocene delta of the rivers Rhine and Meuse, while Kolhorn was situated in the saline and brackish area on the coast.

The Swifterbant site, S3, was situated on a low-lying levee alongside a creek. During the period of habitation (c. 4100-4000 B.C.; calibrated) the area was dissected by a system of creeks. Behind the levees, which corresponded in height and width to the depth and width of the creeks, there were extensive backswamps. The backswamps were bordered by dunes, formed at the end of the last Ice Age by the accumulation of wind-blown sand. These dunes were permanently dry, while the levees could become inundated during high-water periods (van der Waals, 1988). The natural vegetation on the levees consisted of a deciduous forest of hazel, ash, wild apple, hawthorn, elm, alder and some oak. In the backswamps an open marshland vegetation and willow carr were found. In those places where alder was felled it will have been possible for a damp grassland vegetation to develop. In open spaces around the settlement, plants able to withstand being trodden on such as plantain and common knotgrass, would occur, species belonging to so-called anthropogenic vegetations.

The forest on the river dunes consisted mainly of larger trees: oak, ash, lime and some hazel, with alder predominating at the foot of the dunes (Casparie *et al.*, 1977; van Zeist & Palfenier, 1981).

In the course of time the conditions in the area became gradually wetter as a result of the rising sea level; eventually the system became totally submerged (Deckers *et al.*, 1980).

During the period when the Swifterbant site was occupied, habitation started on the river dune of Hazendonk. Louwe Kooijmans (1987) mentions seven phases of Neolithic habitation between 4350 and 2200 cal B.C. These phases alternate with periods in which the dune was deserted, as is indicated by a recovery of the disturbed vegetation.

Like Swifterbant, the Hazendonk site was situated in a freshwater area. Van der Woude (1983) gives a detailed reconstruction of the landscape around the Hazendonk dune. This shows a sequence of different types of environment. During the first phase of habitation (Hazendonk-1), the

landscape consisted of alderwoods and gradually expanding lakes. The highest parts of the stream ridges bore elm and hazel. These species also occurred on the river dunes, such as the Hazendonk itself, together with oak forest. Along the shores of the lakes there was a vegetation of reeds and other marshland plants. The total area of habitable terrain was very small, although the Hazendonk was not the only dry place in the area: west of the Hazendonk a second river dune was situated, where finds of charcoal are linked to the Hazendonk-1 occupation.

Around the period of the Hazendonk-3 habitation, the lakes reached their maximum extent. Consequently, part of the alderwoods had disappeared. On the river dunes the oak forest was maintained. According to van der Woude (1983) there must have been clearings, cut by the Hazendonk-3 people. During the next period, Vlaardingen-1b, the water level decreased, which in many places caused an expansion of the alderwoods. Although by this time the landscape must have been very much like that during the Hazendonk-1 and -2 periods, a considerable part of the oak forest on the river dunes seems to have been cut down by the inhabitants of the Hazendonk, and also the alder carr seems to have been more open than before, especially around the slopes of the dune.

By the time of the Vlaardingen-2b phase the lakes expanded again, creating a scenery dominated by large stretches of open water and wooded natural levees. By this time only very small parts of the river dunes still emerged above their wet surroundings, and only 0.4 ha of the Hazendonk remained, which had been 1.2 ha in the Hazendonk-1 phase. According to the reconstructions made by van der Woude (1983), the total area of alder carr was considerably smaller than in the Hazendonk-3 period, although in both periods the landscape was characterized by large stretches of open water.

At Kolhorn, two sites, only c. 15 m apart, were located in a tidal-flat area on a sand ridge alongside a small creek. The sand ridge was situated in the upper reaches of a creek system, which had begun to silt up (Banga & van Dijk, 1979). Although in archaeological terms the sites may have been contemporary or overlapping, their exact chronological relationship is by no means certain. The reconstruction of the landscape and the vegetation is mainly based on the study of the well, which was situated in the southern part of the settlement. Van der Waals (1989 a, b) says that at the time of habitation the creek was no longer carrying salt water, but the lagoon nearby and possibly also the main stream still were. The landscape was open and treeless, and was covered by grasses and weeds of freshwater or brackish habitats. Hakbijl *et al.* (1989), who studied the plant and insect remains from the well, say that *Phragmites* and *Atriplex* were the dominant species. Remains of specific salt-marsh plants have not been found, and also the number of Hystrichosphaeridae (marine Dinoflagellatae forming cysts which are transported by the wind and are common in pollen spectra from the coastal area) is very low. This leads the authors to the conclusion that the influence of the sea must have been minimal. The results of the geochemical investigation carried out by Zuurdeeg *et al.* (1989) indicate that when the settlement was established, the area was no longer flooded by saline water. According to these authors, a general desalinization was in progress, which was accompanied by the growth of peat. However, at the time of the digging of the well, general desalinization was not far advanced; it was most pronounced on the levee itself, where a freshwater lens about two metres deep and 30 metres wide had formed. It is possible that the chloride content of the water in the well fluctuated according to seasonal changes in the groundwater level.

The study of the remains of oribatid mites from the well (Schelvis, 1989) leads to a somewhat different conclusion. It suggests a gradual salinization of the environment of the well during its use and points to a notable influence of the sea.

THE FAUNAL SPECTRA IN RELATION TO THE ENVIRONMENT

One of the most striking aspects of the faunal spectra of Swifterbant and Hazendonk (Tables 1-5) is the high frequency of remains of fur bearing animals, mainly otter (*Lutra lutra*) and beaver (*Castor fiber*). Pig and wild boar (*Sus domesticus/S. scrofa*) are, nevertheless, the most numerous species in Swifterbant.

The faunal spectrum of Hazendonk fluctuates remarkably during the course of time. Not only does the ratio of domestic mammals - mainly cattle (*Bos taurus*) - to game species become smaller in the successive phases of habitation, also the proportions of the individual game species (such as red deer) vary considerably.

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	49	1.3	160	0.7
Sheep/goat (*Ovis/Capra*)	9	0.2	97	0.4
Cattle (*Bos taurus*)	321	8.2	7453	30.5
Pig (*Sus domesticus*)	34	0.9	475	1.9
Total domestic mammals	**413**	**10.6**	**8185**	**33.5**
Pig/wild boar (*Sus domesticus/S. scrofa*)	2062	52.7	9399	38.5
Cattle/aurochs (*Bos taurus/B. primigenius*)	1	-	37	-
Large cervid/bovid (Cervidae/Bovidae)	21	0.6	48	0.2
Small cervid/ovicaprid (Cervidae/Ovicapridae)	2	-	3	-
Total wild/domestic mammals	**2086**	**53.3**	**9487**	**38.8**
Horse (*Equus ferus caballus*)	2	-	104	0.4
Aurochs (*Bos primigenius*)	2	-	107	0.4
Wild boar (*Sus scrofa*)	45	1.2	1491	6.1
Red deer (*Cervus elaphus*)	118	3.0	1192	4.9
Elk (*Alces alces*)	21	0.6	499	2.0
Cervidae sp.	21	0.6	134	0.5
Cat (*Felis* cf. *silvestris*)	1	-	1	-
Fox (*Vulpes vulpes*)	1	-	-	-
Polecat (*Mustela putorius*)	2	-	1	-
Otter (*Lutra lutra*)	511	13.1	867	3.5
Small carnivore (Carnivora sp.)	6	0.1	-	-
Brown bear (*Ursus arctos*)	6	0.1	31	0.1
Common seal (*Phoca vitulina*)	1	-	1	-
Beaver (*Castor fiber*)	491	12.6	2189	9.0
Root vole (*Microtus oeconomus*)	1	-	-	-
Small rodent (Rodentia sp.)	2	-	-	-
Total wild mammals	**1230**	**31.5**	**6580**	**26.9**
Total identified mammals	**3729**	**95.4**	**24252**	**99.2**
Mammal, indet.	2149		7064	
Mallard (*Anas platyrhynchos*)	50	1.3	65	0.4
Anas sp.	3	0.1	1	-
Pochard (*Aythya ferina*)	1	-	1	-
Tufted duck (*Aythya fuligula*)	1	-	1	-
Shelduck (*Tadorna tadorna*)	1	-	1	-
Duck (Anatidae)	112	2.8	63	0.3
Goose (*Anser/Branta* sp.)	4	0.1	4	-
Mute swan (*Cygnus olor*)	1	-	9	-
Mute/Whooper swan (*Cygnus olor/C. cygnus*)	4	0.1	10	-
Carrion crow (*Corvus corone*)	1	-	1	-
White-tailed eagle (*Haliaetus albicilla*)	6	0.2	27	0.1
Cormorant (*Phalacrocorax carbo*)	2	-	8	-
Total identified birds	**181**	**4.6**	**191**	**0.8**
Bird, indet.	98		7	

TABLE 1

The faunal remains from Swifterbant, S3 (hand-collected material; artefacts not included); NR = number of remains; BW = bone weight (in g; percentages < 0.1 are not indicated).

SPECIES	NR	%	BW	%
Sheep/goat (*Ovis/Capra*)	1	0.6	2	0.2
Cattle (*Bos taurus*)	25	14.2	762	63.0
Total domestic mammals	**26**	**14.8**	**764**	**63.2**
Pig/wild boar (*Sus domesticus/S. scrofa*)	17	9.7	54	4.5
Total wild/domestic mammals	**17**	**9.7**	**54**	**4.5**
Red deer (*Cervus elaphus*)	10	5.7	96	7.9
Cervidae sp.	2	1.1	2	0.2
Otter (*Lutra lutra*)	51	29.0	82	6.8
Small carnivore (Carnivora sp.)	1	0.6	-	-
Beaver (*Castor fiber*)	60	34.1	206	17.0
Total wild mammals	**124**	**70.5**	**386**	**31.9**
Total identified mammals	**167**	**95.0**	**1204**	**99.6**
Mammal, indet.	176		393	
Mallard (*Anas platyrhynchos*)	3	1.6	2	0.2
Duck (Anatidae)	6	3.4	3	0.2
Total identified birds	**9**	**5.0**	**5**	**0.4**
Bird, indet.	3		1	

TABLE 2

The faunal remains from Hazendonk, phase Hazendonk-1 & -2.
(BW in g; percentages < 0.1 are not indicated).

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	10	2.0	50	1.7
Sheep (*Ovis aries*)	1	0.2	1	-
Sheep/goat (*Ovis/Capra*)	3	0.6	7	0.2
Cattle (*Bos taurus*)	21	4.3	463	16.0
Pig (*Sus domesticus*)	2	0.4	14	0.5
Total domestic mammals	**37**	**7.5**	**535**	**18.4**
Pig/wild boar (*Sus domesticus/S. scrofa*)	52	10.5	369	12.7
Large cervid/bovid (Cervidae/Bovidae)	7	1.4	106	3.7
Total wild/domestic mammals	**59**	**11.9**	**475**	**16.4**
Wild boar (*Sus scrofa*)	8	1.6	90	3.1
Red deer (*Cervus elaphus*)	71	14.4	723	25.0
Roe deer (*Capreolus capreolus*	4	0.8	11	0.4
Cervidae sp.	7	1.4	7	0.2
Polecat (*Mustela putorius*)	1	0.2	-	-
Otter (*Lutra lutra*)	43	8.7	72	2.5
Small carnivore (Carnivora)	1	0.2	-	-
Beaver (*Castor fiber*)	259	52.3	938	32.4
Total wild mammals	**394**	**79.6**	**1841**	**63.6**
Total identified mammals	**490**	**99.0**	**2851**	**98.4**
Mammal, indet.	1015		1131	
Mute swan (*Cygnus olor*)	1	0.2	9	0.3
Mute/Whooper swan (*Cygnus olor/C. cygnus*)	4	0.8	38	1.3
Total identified birds	**5**	**1.0**	**47**	**1.6**
Bird, indet.	7		3	

TABLE 3

The faunal remains from Hazendonk, phase Hazendonk-3. (BW in g; percentages < 0.1 are not indicated).

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	8	1.5	29	0.5
Sheep/goat (*Ovis/Capra*)	7	1.3	27	0.5
Cattle (*Bos taurus*)	6	1.1	286	4.7
Pig (*Sus domesticus*)	3	0.6	47	0.8
Total domestic mammals	**24**	**4.5**	**389**	**6.5**
Pig/wild boar (*Sus domesticus/S. scrofa*)	71	13.3	430	7.1
Large cervid/bovid (Cervidae/Bovidae)	12	2.2	117	2.0
Small cervid/ovicaprid (Cervidae/Ovicapridae)	6	1.1	6	0.1
Total wild/domestic mammals	**89**	**16.6**	**553**	**9.2**
Wild boar (*Sus scrofa*)	3	0.6	61	1.0
Red deer (*Cervus elaphus*)	154	29.0	4133	68.2
Roe deer (*Capreolus capreolus*)	56	10.5	215	3.5
Elk (*Alces alces*)	1	0.2	146	2.4
Cervidae sp.	13	2.4	73	1.2
Cat (*Felis* cf. *silvestris*)	1	0.2	1	-
Fox (*Vulpes vulpes*)	3	0.6	11	0.2
Pine marten (*Martes martes*)	4	0.8	3	-
Martes sp.	1	0.2	-	-
Otter (*Lutra lutra*)	57	10.7	96	1.6
Small carnivore (Carnivora sp.)	4	0.8	3	-
Badger (*Meles meles*)	1	0.2	8	0.1
Brown bear (*Ursus arctos*)	3	0.6	60	1.0
Beaver (*Castor fiber*)	110	20.7	292	4.8
Total wild mammals	**411**	**77.4**	**5102**	**84.1**
Total identified mammals	**524**	**98.6**	**6044**	**99.7**
Mammal, indet.	867		1813	
Mallard (*Anas platyrhynchos*)	2	0.4	2	-
Duck (Anatidae)	1	0.2	-	-
Mute/Whooper swan (*Cygnus olor/C. cygnus*)	1	0.2	13	0.2
Eagle owl (*Bubo bubo*)	2	0.4	6	0.1
Carrion crow (*Corvus corone*)	1	0.2	-	-
Total identified birds	**7**	**1.4**	**21**	**0.3**
Bird, indet.	9		5	

TABLE 4

The faunal remains from Hazendonk, phase Vlaardingen-1b.
(BW in g; percentages < 0.1 are not indicated).

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	49	6.6	329	8.6
Cattle (*Bos taurus*)	24	3.2	455	11.9
Total domestic mammals	**73**	**9.8**	**784**	**20.5**
Pig/wild boar (*Sus domesticus/S. scrofa*)	72	9.7	400	10.5
Large cervid/bovid (Cervidae/Bovidae)	6	0.8	8	0.2
Small cervid/ovicaprid (Cervidae/Ovicapridae)	7	1.0	14	0.4
Total wild/domestic mammals	**85**	**11.5**	**422**	**11.1**
Wild boar (*Sus scrofa*)	10	1.4	229	6.0
Red deer (*Cervus elaphus*)	8	1.1	188	4.9
Roe deer (*Capreolus capreolus*)	215	29.1	691	18.1
Cervidae sp.	4	0.5	4	0.1
Cat (*Felis* cf. *silvestris*)	4	0.5	6	0.2
Polecat (*Mustela putorius*)	2	0.3	1	-
Martidae sp.	1	0.1	-	-
Otter (*Lutra lutra*)	57	7.7	85	2.2
Small carnivore (Carnivora sp.)	3	0.4	2	0.1
Badger (*Meles meles*)	1	0.1	2	0.1
Beaver (*Castor fiber*)	227	30.7	1330	34.8
Total wild mammals	**532**	**71.9**	**2538**	**66.5**
Total identified mammals	**690**	**93.2**	**3744**	**98.1**
Mammal, indet.	1907		1552	
Mallard (*Anas platyrhynchos*)	10	1.4	8	0.2
Anas sp.	4	0.5	1	-
Duck (Anatidae)	6	0.8	-	-
Greylag goose (*Anser anser*)	11	1.5	28	0.8
Anser sp.	11	1.5	25	0.7
Goose (*Anser/Branta* sp.)	4	0.5	5	0.1
Mute/Whooper swan (*Cygnus olor/C. cygnus*)	3	0.4	3	0.1
Eagle (*Aquila/Haliaetus* sp.)	1	0.1	3	0.1
Total identified birds	**50**	**6.8**	**73**	**1.9**
Bird, indet.	42		10	

TABLE 5

The faunal remains from Hazendonk, phase Vlaardingen-2b.
(BW in g; percentages < 0.1 are not indicated).

As for Kolhorn, one of the most striking differences compared to Swifterbant and Hazendonk is the far greater role of birds in the faunal spectrum, both in terms of numbers of remains and in number of species (Tables 6 and 7). Other notable features are the high frequency of remains of small rodents, as well as the small number of bones of fur bearings animals.

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	68	3.6	424.5	5.6
Sheep/goat (*Ovis/Capra*)	9	0.5	79.3	1.1
Cattle (*Bos taurus*)	143	7.6	5120.9	67.9
Pig (*Sus domesticus*)	2	0.1	44.1	0.6
Total domestic mammals	**222**	**11.8**	**5668.8**	**75.2**
Dog/fox (*Canis familiaris/Vulpes vulpes*)	6	0.3	0.5	-
Pig/wild boar (*Sus domesticus/S. scrofa*)	42	2.2	201.3	2.7
Small cervid/ovicaprid (Cervidae/Ovicapridae)	2	0.1	0.1	-
Total wild/domestic mammals	**50**	**2.6**	**201.9**	**2.7**
Red deer (*Cervus elaphus*)	5	0.3	67.0	0.9
Aurochs (*Bos primigenius*)	1	-	820.0	10.9
Beaver (*Castor fiber*)	1	-	7.0	0.1
Polecat (*Mustela putorius*)	9	0.5	2.7	-
Stoat (*Mustela erminea*)	1	-	0.2	-
Otter (*Lutra lutra*)	1	-	3.0	-
Fox (*Vulpes vulpes*)	1	-	1.0	-
Grey seal (*Halichoerus grypus*)	1	-	6.0	0.1
Common porpoise (*Phocoena phocoena*)	9	0.5	82.0	1.1
Whale (Cetacea)	45	2.4	356.2	4.7
Ground vole (*Arvicola terrestris*)	1	-	-	-
Root vole (*Microtus oeconomus*)	17	0.9	1.3	-
Microtus sp.	108	5.7	5.4	0.1
Rodentia	10	0.5	-	-
Total wild mammals	**210**	**10.8**	**1351.8**	**17.9**
Total identified mammals	**482**	**25.2**	**7222.5**	**95.8**
Mammal, indet.	4123	-	1763.9	-
Teal (*Anas crecca*)	7	0.4	1.9	-
Garganey (*Anas querquedula*)	4	0.2	0.9	-
Teal/garganey (*Anas crecca/A. querquedula*)	368	19.4	31.2	0.4
Mallard (*Anas platyrhynchos*)	97	5.1	62.7	0.8
Wigeon (*Anas penelope*)	1	-	0.4	-
Shoveler (*Anas clypeata*)	1	-	0.1	-
Anas sp.	308	16.3	56.9	0.8
Aythya sp.	1	-	0.2	-
Duck (Anatidae)	546	28.8	127.8	1.7
Greylag goose (*Anser anser*)	1	-	2.0	-
Brent goose (*Branta bernicla*)	10	0.5	7.1	0.1
Branta sp.	2	0.1	0.3	-
Swan (*Cygnus* sp.)	2	0.1	14.7	0.2
Black-throated diver (*Gavia arctica*)	1	-	1.3	-
Black-/Red-throated diver (*Gavia arctica/G. stellata*)	1	-	0.4	-
Great crested grebe (*Podiceps cristatus*)	1	-	0.4	-
Gannet (*Sula bassana*)	1	-	2.2	-
Eagle (*Aquila/Haliaetus* sp.)	3	0.2	1.5	-
Marsh harrier (*Circus aeruginosus*)	1	-	0.1	-
Harrier (*Circus* sp.)	1	-	0.1	-
Bird of prey	1	-	0.1	-
Greater flamingo (*Phoenicopterus ruber*)	1	-	2.1	-
Golden/Greyplover (*Pluvialis apricarius/P. squatarola*)	1	-	0.1	-
Dunlin (*Calidris alpina*)	31	1.6	2.3	-
Knot (*Calidris canutus*)	8	0.4	1.2	-
Ruff (*Philomachus pugnax*)	10	0.5	1.4	-
Blue-headed wagtail (*Motacilla flava*)	1	-	-	-
Carrion crow (*Corvus corone*)	1	-	0.1	-
Total birds, identified	**1411**	**73.6**	**319.5**	**4.0**
Birds, indet.	8410		650.6	
Frog (*Rana* sp.)	1	-	-	-

TABLE 6

The faunal remains from Kolhorn (north), sectors 1-4. (BW in g; percentages < 0.1 are not indicated).

SPECIES	NR	%	BW	%
Dog (*Canis familiaris*)	48	4.1	341.7	11.3
Sheep/goat (*Ovis/Capra*)	1	0.1	0.4	-
Cattle (*Bos taurus*)	57	4.9	2161.1	71.3
Total domestic mammals	**106**	**9.1**	**2503.2**	**82.6**
Dog/fox (*Canis familiaris/Vulpes vulpes*)	2	0.2	0.2	-
Pig/wild boar (*Sus domesticus/S. scrofa*)	16	1.4	71.0	2.3
Large cervid/bovid (Cervidae/Bovidae)	16	1.4	126.2	4.2
Small cervid/ovicaprid (Cervidae/Ovicapridae)	1	0.1	0.2	-
Total wild/domestic mammals	**35**	**3.1**	**197.6**	**6.5**
Roe deer (*Capreolus capreolus*)	4	0.3	16.7	0.6
Cervidae	1	0.1	0.3	-
Beaver (*Castor fiber*)	2	0.2	12.8	0.4
Otter (*Lutra lutra*)	2	0.2	1.0	-
Polecat (*Mustela putorius*)	1	0.1	0.2	-
Martidae	1	0.1	0.2	-
Cat (*Felis* cf. *silvestris*)	1	0.1	0.1	-
Whale (Cetacea)	1	0.1	55.0	1.8
Root vole (*Microtus oeconomus*)	9	0.8	0.6	-
Microtus sp.	21	1.8	1.2	-
Rodentia	2	0.2	-	-
Total wild mammals	**45**	**4.0**	**88.1**	**2.8**
Total identified mammals	**186**	**16.2**	**2788.9**	**91.9**
Mammal, indet.	4419	-	1608.5	-
Teal (*Anas crecca*)	25	2.1	5.2	0.2
Garganey (*Anas querquedula*)	2	0.2	0.2	-
Teal/garganey (*Anas crecca/A. querquedula*)	198	17.0	25.9	0.9
Mallard (*Anas platyrhynchos*)	95	8.1	45.3	1.5
Gadwall (*Anas strepera*)	1	0.1	0.8	-
Shoveler (*Anas clypeata*)	2	0.2	0.3	-
Anas sp.	249	21.4	46.8	1.6
Red-crested pochard (*Netta rufina*)	1	0.1	0.2	-
Duck (Anatidae)	393	33.7	108.3	3.6
Greylag goose (*Anser anser*)	1	0.1	1.3	-
Brent goose (*Branta bernicla*)	1	0.1	0.7	-
Black-/Red-throated diver (*Gavia arctica/G. stellata*)	1	0.1	2.3	0.1
Eagle (*Aquila/Haliaetus* sp.)	1	0.1	0.7	-
Harrier (*Circus* sp.)	1	0.1	0.6	-
Quail (*Coturnix coturnix*)	2	0.2	0.2	-
Golden/Greyplover (*Pluvialis apricarius/P. squatarola*)	2	0.2	0.3	-
Dunlin (*Calidris alpina*)	1	0.1	0.1	-
Herring gull (*Larus argentatus*)	3	0.3	0.6	-
Total birds, identified	**979**	**84.2**	**239.8**	**7.9**
Birds, indet.	4983	-	386.6	-

TABLE 7

The faunal remains from Kolhorn (south), sectors 13-18. (BW in g; percentages < 0.1 are not indicated).

The fish remains, both in Swifterbant and Hazendonk, comprised mainly freshwater species, while in Kolhorn only marine species were present (Clason & Brinkhuizen 1978; Brinkhuizen, 1979). Moreover, large numbers of mussel shells were found at Kolhorn (Niclewicz-Hokse, 1990).

With the exception of red deer (*Cervus elaphus*), aurochs (*Bos primigenius*), horse (*Equus ferus caballus*), elk (*Alces alces*) and sheep/goat (*Ovis/Capra*), the wet, wooded landscape in Swifterbant must have been very suitable for the species represented in the bone material.

The fluctuations in the frequencies of some of the species found at Hazendonk seem to be related to the changes in the landscape. The relatively low frequency of pig/wild boar in all phases, compared to Swifterbant, is remarkable, since at both sites the conditions seem to have been favourable for this species.

The environment at Kolhorn seems to have been suitable for sheep/goat and otter. Nevertheless, only a small number of remains of these species were found here. For the birds, rodents and some of the other mammals found in Kolhorn, the conditions must have been very favourable. Their remains point to an open, wet and treeless environment with a maritime influence. This roughly corresponds with the results of the study of mite remains from the well (Schelvis, 1989).

THE ROLE OF THE SPECIES IN THE SUBSISTENCE: AGE DISTRIBUTION AND EXPLOITATION PATTERNS

It appears that at Swifterbant game species and domestic mammals played a more or less equal role in the meat supply. Pig, wild boar, cattle and beaver are the most important species in this respect. Other mammals and birds seem to have played only a minor role in the meat diet of the inhabitants of S3.

The role of the various species in the subsistence of the Hazendonk people varies considerably through time. In the earliest phases, Hazendonk-1 and -2, cattle seems to have been the most important species with regard to the meat supply. During the Vlaardingen-1b phase, red deer seems to have gained predominance. Beaver is an important species in all phases. The role of roe deer (*Capreolus capreolus*) becomes more important from the Hazendonk-3 phase onwards, while pig and wild boar seem to have made a smaller but fairly constant contribution to the meat supply in all phases. As at Swifterbant, birds seem to have played only a minor role in this respect. On the whole, the role of domestic mammals in the meat supply decreases in the course of time, while that of the game species becomes more important.

As for Kolhorn, cattle appear to have been by far the most important species for the meat supply. Pig and sheep, as well as wild mammals, seem to have played only a modest role. Birds probably were far more important for the meat supply here than at Swifterbant and Hazendonk.

Both at Swifterbant and at Hazendonk beavers and otters were hunted for their fur and their meat. The same probably applies to the Kolhorn animals, although no cutmarks or burning traces were found on the remains. The method of skinning otters at Swifterbant and Hazendonk, and polecat (*Mustela putorius*) at Kolhorn (Figure 2), seems to have been the same as that described by Trolle-Lassen (1987) for the Mesolithic otters and polecats of Tybrind Vig.

The age structures of the hunted populations of fur animals at Swifterbant and Hazendonk indicate selective hunting of animals older than one year. The same seems to have been the case with the polecats at Kolhorn.

POSSIBLE SEASONS OF HABITATION

Although the faunal material from Swifterbant, Hazendonk and Kolhorn provides indications of the seasons in which the sites were occupied, the data do not answer the question of whether we are dealing with seasonal or year-round occupation; evidence of human activities in a specific season does not exclude occupation during the rest of the year.

In general, the presence of remains of domestic mammals at all three sites makes it clear that people were present over a longer period. Although it is evident that especially at Hazendonk the hunting of fur animals was an important activity or even, at least in some periods, one of the main activities, the site cannot be characterized as a camp that was used only for this purpose. In the earliest phases of habitation cattle breeding seems to have been an

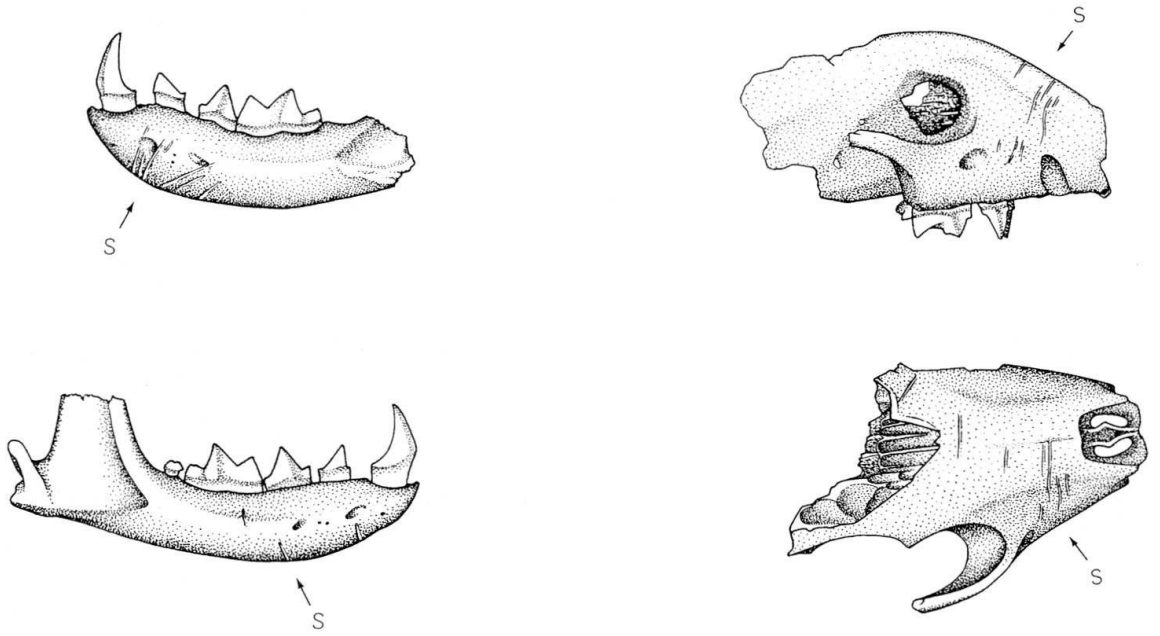

FIGURE 2
Kolhorn: cut marks on mandible and cranium of polecat. Drawings by M.A. Weijns.

even more important subsistence activity than hunting. Although in the course of time its role became less important, people continued to engage in cattle breeding. Moreover, not only fur animals were hunted on a large scale, but also other game species, as the large numbers of red deer remains in the Vlaardingen-1b period indicate. In all phases fishing too seems to have been an important activity of the Hazendonk people.

At Swifterbant, it seems that the slaughtering of pigs took place mainly between spring and early autumn. The data on cattle with respect to the time of slaughtering, and the presence of sturgeon (*Acipenser sturio*) and thin-lipped grey mullet (*Liza ramada*) point to the same period. A small number of pig bones indicate slaughtering in autumn and winter, and the remains of swans point to human activities in the same seasons. Of the beaver remains, one indicates killing in mid-winter. The age distribution based on the mandibles of beaver seems to point to their being caught on a year-round basis, but this is not certain. As for the otter, the few data available indicate catches between July and January.

In the case of Hazendonk the amount of data on age distribution of pig, cattle, beaver, red deer and roe deer is limited. Consequently, they do not provide a clear image of the nature of the habitation, nor do they allow any conclusions about probable changes through time. In any case it can be concluded that in all phases the site must have been occupied between spring and late autumn or early winter. One roe deer from the Vlaardingen-2b phase probably was killed in mid-winter. As at Swifterbant, the presence of swan bones (Hazendonk-3, Vlaardingen-1b & -2b) indicates human presence between late autumn and early spring, while remains of sturgeon point to a period between spring and (early) autumn.

At Kolhorn indications of seasonality are mainly provided by the bird remains. Three species point to catches in spring to late summer or early autumn, as do the remains of thin-lipped grey mullet. Three other bird species indicate fowling between (late) autumn and early spring, while mussels must have been harvested in the same period. The presence of sturgeon at Kolhorn cannot be used as evidence of seasonality, owing to the site's location on the coast. In at least one case cattle was slaughtered in spring or summer.

The fact that all three sites show indications of human presence year-round, may lead to two different conclusions. Either people lived there throughout the year, or only between spring and autumn,

bringing their livestock with them from a base camp and returning in winter only for hunting and fowling.

If one assumes that Swifterbant, Hazendonk and Kolhorn were occupied throughout the year, then the inhabitants could have practised different activities in different seasons. For instance, beavers could have been caught especially between late autumn and early spring, although at Swifterbant and Hazendonk the data on age distribution suggest a pattern of year- round catching. The fact that at Swifterbant the age data of the domestic mammals suggest that slaughtering took place also between late autumn and early spring seems to support the theory of permanent occupation. Yet this theory is doubtful, because the conditions for winter occupation in Swifterbant must have been unfavourable. The levee must have been quite wet. This is evident from the sections, showing thick layers of reed and willow wood that must have served to insulate the damp soil and to raise the ground level. The wood remains are well preserved, which also points to wet conditions. Furthermore, there are indications that part of the site was washed away during the period of its habitation.

In general, one of the clearest indications of year-round occupation of a settlement is the presence of posts and postholes reflecting heavy structures, as well as distinct house plans. At Swifterbant the absence of sturdy dwellings argues against permanent occupation. However, it is clear from the small cemetery on the neighbouring site S2, which contained the burials of eight adults (four men and four women) and one child, that we are dealing with complete households. The fact that the hearths on the levee were rebuilt several times at the same spot indicates that the site was used on a regular basis over a prolonged period.

All in all, it seems most probable that the site of Swifterbant S3 was occupied from spring to autumn, and that the inhabitants visited it in winter only for hunting and fowling. Another possible scenario is that during some years conditions were more favourable, so that there was an alternation between seasonal and year-round occupation. This too could explain the data pointing to winter activities.

In view of the natural conditions, it is easier to imagine a permanent occupation of Hazendonk than of Swifterbant. Hazendonk was a permanently dry place in a wet landscape, unlike the levee of S3. This does not automatically mean that Hazendonk was permanently occupied. The absence of house structures of any kind argues against permanent occupation, although any traces could have been lost through bioturbation of the top of the dune. Moreover, recent excavations (Zeiler, unpublished) revealed the existence of more river dunes in the vicinity of Hazendonk than was previously thought. The material found on these river dunes indicates occupation. This could mean that people moved from one river dune to another, which in turn could explain the fact that Hazendonk was abandoned and recolonized several times.

At Kolhorn no clear house plans were found either, which makes permanent occupation doubtful. Nonetheless, there are indications of activities in the period between late autumn and early spring. Here too, the most probable explanation is that people were present between spring and autumn, bringing their livestock with them from their base camp and returning in winter only for fowling and harvesting mussels.

COMPARISON WITH OTHER NEOLITHIC SITES: THE ECONOMY IN RELATION TO THE ENVIRONMENT

In terms of environment, three different groups can be distinguished among the Neolithic sites in the central and western Netherlands. Eight sites were located in the freshwater marshland of the Holocene delta of the Rhine and Meuse.

Bergschenhoek, Swifterbant, Hazendonk, Vlaardingen, Hekelingen I and III, P14, Ewijk, Molenaarsgraaf and Ottoland-Kromme Elleboog were situated in the Holocene delta of the rivers Rhine and Meuse. All these sites were located in the central and western Netherlands, except for Ewijk, which was in the east of the country.

The other sites were all situated in the coastal region. Voorschoten, Leidschendam and Wateringen 4 lay in the Older Dunes in the western part of the Netherlands, while Kolhorn, Zandwerven, Zeewijk, Aartswoud and Mienakker were situated in the saline and brackish environments of the northwest.

There seems to be a correlation between, on the one hand, the surface area of the sites and the natural conditions in the vicinity of the sites and, on the other, the type of economy. As for the settlements

located in the freshwater marshes it seems that, if conditions were too wet and there was little available space, *i.e.* if there was no scope for crop cultivation, then people relied on both husbandry and hunting for their meat supply (Table 8). The cereal pollen, chaff and grains found at these sites most probably came from imported, unthreshed ears. If, on the other hand, enough space was available and conditions were dry enough to allow crop cultivation, then hunting was almost completely abandoned, and people came to rely almost exclusively on husbandry for their meat supply. This change in subsistence is not only linked with chronological and cultural changes, but also with environmental conditions, as is shown most clearly by the case of Ewijk.

SITE	Period	% NR D	% BW D	% NR G	% BW G
Swifterbant, S3 small, narrow levee; 35x20 m	MNA	36.0	44.0	64.0	56.0
Hazendonk river dune; 250x50-100x40 m					
Hazendonk-1&-2	MNA	21.0	67.0	79.0	33.0
Hazendonk-3	MNA	10.5	24.0	89.5	76.0
Vlaardingen-1b	MNB	12.0	10.0	88.0	90.0
Vlaardingen-2b	LNA	17.0	27.0	83.0	73.0
Vlaardingen small, narrow levee	MNB	30.0		70.0	
Hekelingen I small, narrow levee	MNB	42.0		58.0	
Hekelingen III small, narrow levee	MNB				
phase 1 (sites A1 & M1)		53.0	51.0	47.0	49.0
phase 2 (site B2)		38.0	36.0	61.5	64.0
phase 3 (sites E3 & K3)		37.0	35.0	63.0	65.0
P14 sand ridge; 1400x300 m					
phase 1	ENB/MNA	39.5		60.5	
phase 3	LNA/LNB	51.5		48.5	
Ewijk large, wide levee	MNB	96.0	92.5	4.0	7.5
Molenaarsgraaf stream ridge	LNB	93.5		6.5	
Ottoland-Kromme Elleboog stream ridge	LNB	99.5		0.5	
Voorschoten sand ridge	MNB	86.5		13.5	
Leidschendam sand ridge	MNB	88.0		12.0	
Wateringen 4 dune	MNA	61.0	82.0	39.0	18.0
Zandwerven sand ridge	MNB	98.0		2.0	
Aartswoud sand ridge	LNA	87.5	89.5	12.5	10.5
Zeewijk sand ridge	LNA	88.0	96.0	12.0	4.0
Mienakker sand ridge	LNA	88.5		11.5	
Kolhorn sand ridge	LNA				
northern site		73.0	81.0	27.0	19.0
southern site		80.5	93.5	19.5	6.5

TABLE 8

Topography, period and frequencies of domestic (D) and wild mammals (G) from seventeen Dutch Neolithic sites. **ENB** – Early Neolithic B = 4900 - 4100 cal B.C.; **MNA** = Middle Neolithic A = 4100 - 3400 cal B.C.; **MNB** = Middle Neolithic B = 3400 - 2900 cal B.C.; **LNA** = Late Neolithic A = 2900 - 2450 cal B.C.; **LNB** = Late Neolithic B = 2450 - 2000 cal B.C.

The data strongly suggest that if conditions were favourable both for the keeping of domestic stock and for crop cultivation -i.e. if enough pasture and arable land were available- the people of the Vlaardingen culture switched to an economy based almost completely on husbandry and agriculture, even if other groups continued to rely to a great extent on hunting. This implies that they did possess knowledge of crop cultivation, but were able to put this knowledge into practice only if the environmental conditions enabled them to do so. This change in subsistence must be explained not only from the environmental point of view, but also as an active choice the people made to exploit certain ecological niches within their broad-spectrum subsistence.

The coastal settlements (in the Older Dunes as well as in the saline and brackish regions) seem to form a kind of intermediate group in this respect. This applies to the sites of the Hazendonk-3 culture such as Wateringen 4, as well as to those of the Vlaardingen culture - Voorschoten, Leidschendam and Zandwerven - and the Single Grave Culture, such as Kolhorn. In most cases evidence of local crop cultivation was found, but for their meat supply the inhabitants still relied both on stock keeping and hunting, fowling, fishing and harvesting molluscs. In the Older Dunes, game species such as red deer were important meat sources. Although fowling also played a role (especially in Wateringen 4), it was by no means as important here as it was in the saline and brackish regions in the northwestern part of the country. Here wild mammals only played a minor role in the economy; for their meat supply people depended mainly on cattle breeding, together with fowling, fishing and harvesting of molluscs.

As for the domestic stock, cattle was by far the most important in all sites. Sheep and/or goat played only a minor role. In nearly all of the sites these species are represented only in (very) small numbers, and sometimes they are not found at all, such as at Wateringen 4. Even at Aartswoud and Ewijk, the sites with the highest numbers of remains of sheep/goat, the proportion in the total bone weight is low: c. 3% at Aartswoud and at most 12% at Ewijk. The fact that sheep/goat do occur in small numbers in the small sites in the freshwater marhes is not surprising, but it is striking that the same is the case in the saline and brackish areas, where natural conditions seem to have been more favourable. Prummel (1979) mentions that the numbers of sheep/goat are small also in the Bronze Age settlements in the northwestern part of the Netherlands (Andijk, Hoogkarspel and Zwaagdijk). Probably by then the environment was more brackish than saline, allowing the occurrence of liver-fluke. It is only from the Early Middle Ages onwards that sheep seem to have been kept in large numbers in this part of the country; goats were probably almost absent. This could be due to a salinization of the environment, but also to the greater role of wool production in the Middle Ages.

The question remains as to whether the inhabitants of the small and narrow levees and small river dunes in the marshes and those who inhabited the dry areas belonged to the same group, *i.e.* whether some of the occupants of the dry areas moved into the marshes for certain seasons and certain activities, bringing their livestock and grain with them. Another possibility is that the inhabitants of the small sites in the swamps constituted a separate community with a slightly different way of life from the inhabitants of the dry areas, with whom they however did maintain contacts. The archaeological evidence (similarities in material culture) seems to favour the first possibility. Despite these similarities, it is evident that even during the Hazendonk-3 period there was a broad variation in terms of subsistence. This could mean that the economic diversity known from the Vlaardingen period may already have existed in the Hazendonk-3 period, and that the relatively well-known Vlaardingen settlement system may be similar to the settlement system of the Hazendonk-3 period (Raemaekers *et al.* in press).

If we assume that the inhabitants of the small levees and river dunes in the freshwater marshes did not constitute a community separate from that of the dry areas, and that the sites in the marshland were indeed only occupied from spring to early autumn, one important question remains: where did the «marsh people» stay during the winter?

The same question can be asked with regard to the inhabitants of the sites in the saline and brackish area identified as seasonal settlements, such as Kolhorn and Mienakker. These questions must remain unanswered.

The transition from the Mesolithic hunter-gatherer economy to the production-based subsistence economy of the Neolithic did not take place at the same time in all parts of the Netherlands. Even at Late Neolithic sites, such as Kolhorn, Zeewijk and P14, hunting, fowling and fishing still

played a prominent role in people's subsistence. It is not until the Middle Bronze Age (c. 1650 cal B.C.) that the importance of hunting, fowling and gathering in the economy clearly becomes subordinate. In the freshwater tidal area and in the marshy area of the central delta no small hunting or fishing camps are known from the Middle Bronze Age onwards. However, it is theoretically possible that even after the Middle Bronze Age there still were sites in the Netherlands where hunting played a role. This was indeed the case in Britain: the faunal spectrum from the Iron Age site of the Upper Delphs, Haddenham, U.K. (1st millennium B.C.) (Evans & Serjeantson, 1988) indicates that hunting still played a significant role, and that stock-raising was combined with exploitation of the wetlands in the vicinity of the site.

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