EXPLOITATION OF FUR ANIMALS IN NEOLITHIC SWIFTERBANT AND HAZENDONK (CENTRAL AND WESTERN NETHERLANDS)

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ABSTRACT: Remains of fur animals make up a considerable part of the bone material of Swifterbant and Hazendonk, two Neolithic sites in the Central and western Netherlands. In this article an attempt is made to give a reconstruction of the way in which the species were exploited. In this connection the age and sex distribution of the hunted populations are discussed, as well as the analysis of the skinning and butchering traces.

KEYWORDS: Fur animals, Neolithic, the Netherlands, exploitation, age, sex, skinning, butchering.

1. INTRODUCTION

The Swifterbant site was situated on a low-lying levee alongside a creek. During the period of habitation (c. 3300-3200 BC) the Swifterbant area was dissected by a system of creeks, developed around 4000 BC. Behind the levees extensive backswamps were present. Along the borders of the creek system there were river dunes (figs 1-2). These dunes were permanently dry, while the levees could be inundated during times of high water levels. The vegetation on the levees consisted of a deciduous forest of hazel, ash, elm, wild apple, hawthorn, alder and some oak. In the backswamps an open marshland vegetation and willow carr were present. On the river dunes there will have been a forest of mainly 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: about 3000 BC the system became totally submerged (Deckers et al., 1980).

In the same period that the Swifterbant site was occupied, habitation started on the river dune of Hazendonk. Louwe Kooijmans (1980) mentions nine phases of Neolithic habitation between 3400 and 1700 BC. The phases are separated from each other by periods in which the dune was not occupied, as is indicated by a complete recovering of the disturbed vegetation. The main part of the bone material comes from the so-called Hazendonk-3 phase (c. 3000 BC: 4870±55-4735±35 BP) and the Vlaardingen-1b and Vlaardingen-2b phases (2500-2400 BC: 4535±40-4050±120 BP and 2100-1900 BC: 4010±35-3965±35 BP, respectively). A smaller number of bones comes from the earliest phases, Hazendonk-1 and -2 (5265±60-4875±40 BP and 5090±40-4800±40 BP, respectively), while hardly any bone material from the Vlaardingen-1a and -2a phases was collected.

Just like Swifterbant, Hazendonk was situated in a freshwater area (fig. 1). Van der Woude (1983) gives a detailed reconstruction of the landscape around Hazendonk for the period between c. 7400 BP until c. 3000 BP, which shows a sequence of different types of landscape (fig. 3).

Around 5300 BP, during the earliest phase of habitation (Hazendonk-1), the landscape consisted of alder swamp forest and gradually expanding lakes. On the highest parts of the stream ridges elm and hazel were growing. These species also occurred on the river dunes such as Hazendonk, together with an oak forest. Along the shores of the lakes a vegetation of reed and other marshland plants was present.

Around 4800 BP (the period of the Hazendonk-3 habitation) the lakes had reached their maximal extent. Consequently part of the swamp forest had disappeared. On the river dunes the oak forest was maintained.

During the next period, (4600-4100 BP: the period of the Vlaardingen-1b habitation) the water depth decreased, which in many places caused an expansion of the alder swamp forest. By this time a considerable part of the oak forest on the river dunes seems to have been cut by inhabitants of Hazendonk.

About 4000 BP (Vlaardingen-2b) the lakes expanded again, giving way to a scenery mainly characterized by large stretches of open water and wooded natural levees. By this time only very small parts of the river dunes were still emerging above the surrounding wet area.

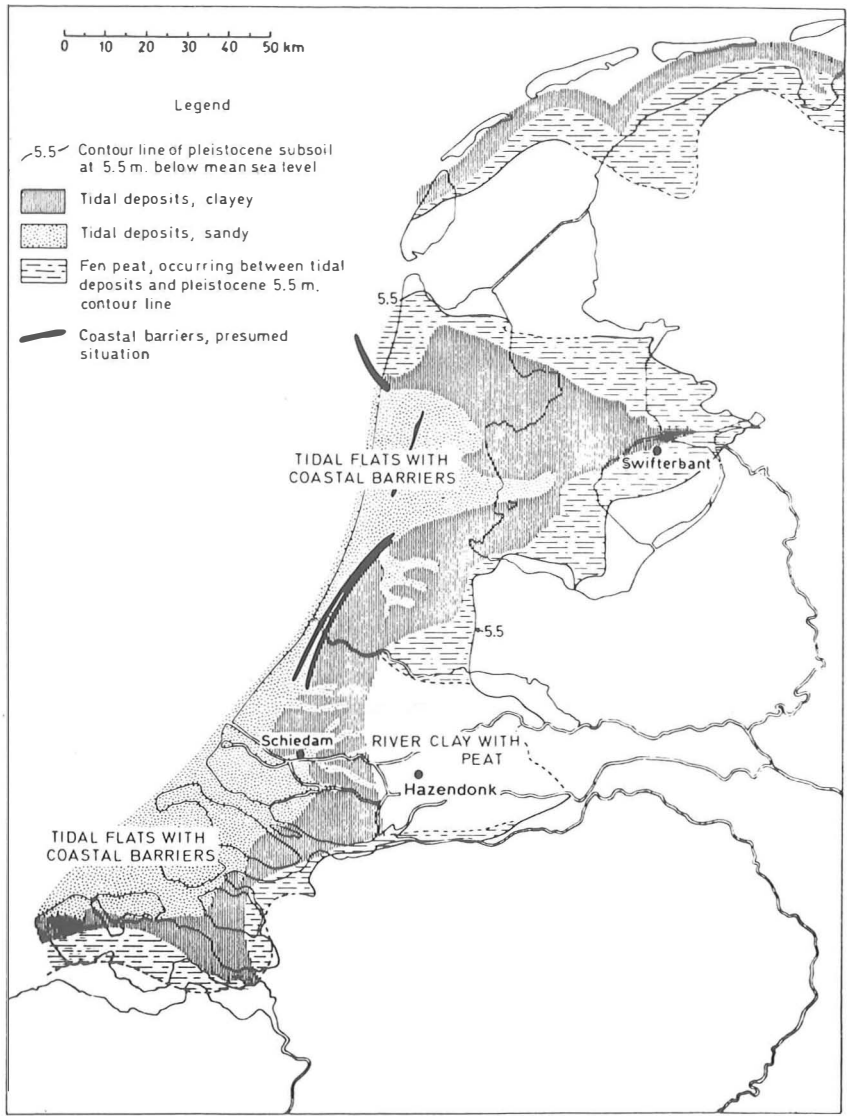


Fig. 1. The location of Swifterbant and Hazendonk with respect to the coastal region in the 4th millennium BC (simplified reconstruction after Pons et al., 1963). Drawing H.R. Roelink.

2. AGE DISTRIBUTION, SEX RATIO AND EXPLOITATION PATTERN OF THE FUR ANIMALS HUNTED IN SWIFTERBANT AND HAZENDONK

2.1. Material and methods

Both in Swifterbant and Hazendonk a considerable part of the bone material consists of remains of fur animals, mainly beaver (*Castor fiber* L.) and otter (*Lutra lutra* L.). In Swifterbant these two species make up 27% of the total number of bone fragments (15% for beaver; 12% for otter), i.e. 12.5% of the total bone weight (9% for beaver; 3.5% for otter).

Apart from these species some bones were found of polecat (*Putorius putorius*) and brown bear (*Ursus arctos* L.), as well as one fragment of cat (*Felis catus* L./*F. silvestris* Schreber), one of common seal (*Phoca vitulina* L.) and one of fox (*Vulpes vulpes* L.). In Hazendonk the proportion of otter is fairly constant throughout the various phases: between 8 and 10.5% of the total number of remains (1.5-2.5% of the total bone weight). Only in the earliest phases (Hazendonk-1 and -2) is otter represented in larger numbers: 28.5% of the total number of remains (c. 7% of the total weight). The part of beaver varies between 20.5 and 51.5% of the total number of bones (i.e. 5-36% of the total weight).

Fox, cat, badger (*Meles meles* L.), polecat, pine marten (*Martes martes* L.), *Martes* sp. and brown bear are represented in the Hazendonk material by a few bones.

As for the age analysis of the otter I used the data

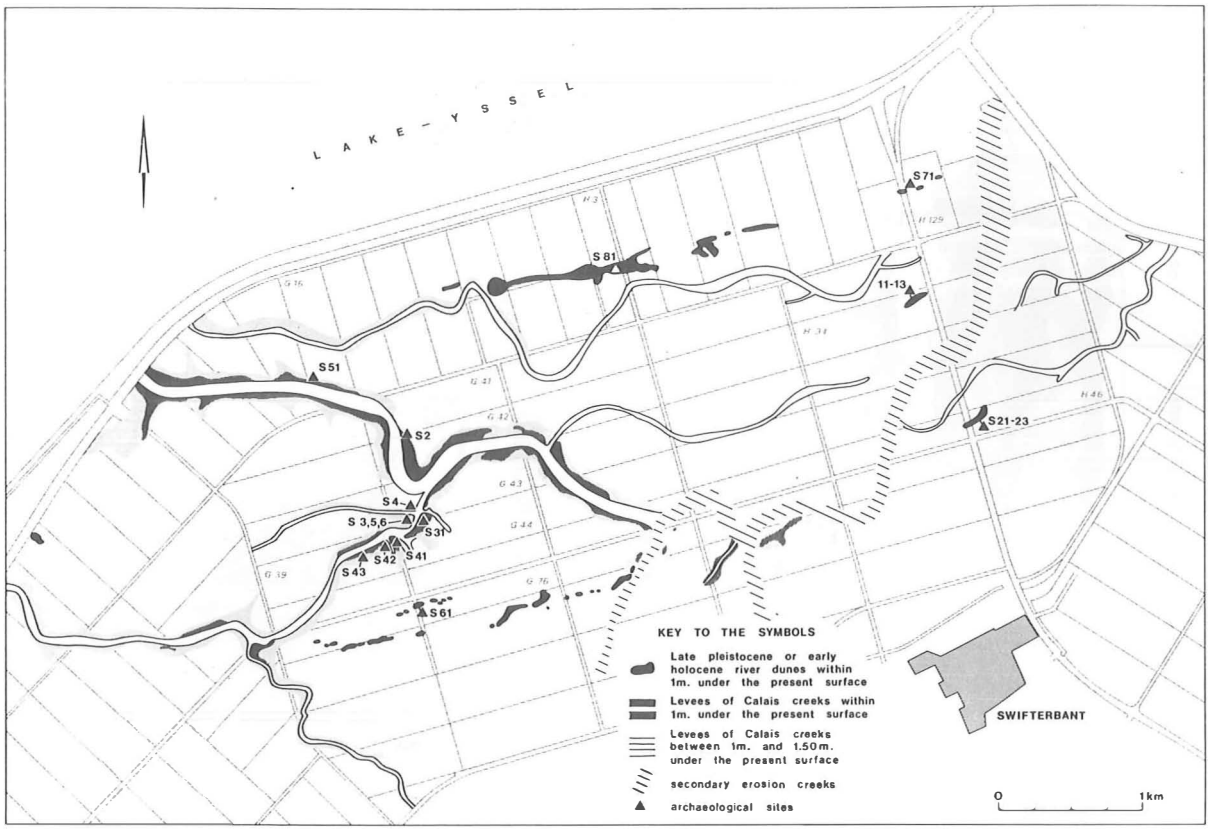


Fig. 2. The location of Mesolithic sites (on river dunes) and Neolithic sites (on levees) in the area NW of Swifterbant (from Deckers et al., 1980). Drawing G. Delger and J. Klein.

I collected from recent material in the Museum of Natural History in Århus, Denmark (Zeiler, 1988). As for the other species (beaver, pine, marten, polecat and fox) only data from literature were used to establish the ages. The same was done with respect to the analysis of the sex ratio.

A number of bones shows cut marks. For the analysis of the different cut marks I used the classification given by Trolle-Lassen (1987) for the fur animals of the Danish Mesolithic site Tybrind Vig, i.e. otter, polecat, pine marten and wild cat. On the basis of experimental work on these species she divided the cut marks into three groups, according to the action that caused them, i.e. skinning, dismemberment and filleting of the animal. With regard to the other species present in Swifterbant and Hazendonk (beaver, fox, brown bear and badger) I used the same classification, although no experimental data were available. A problem arising here is that the pattern of cut marks varies to some extent with the different bone and muscle anatomy of the different species (pers. comm. T. Trolle-Lassen). Therefore I only indicated the probable cause of cut marks on the bones of these species.

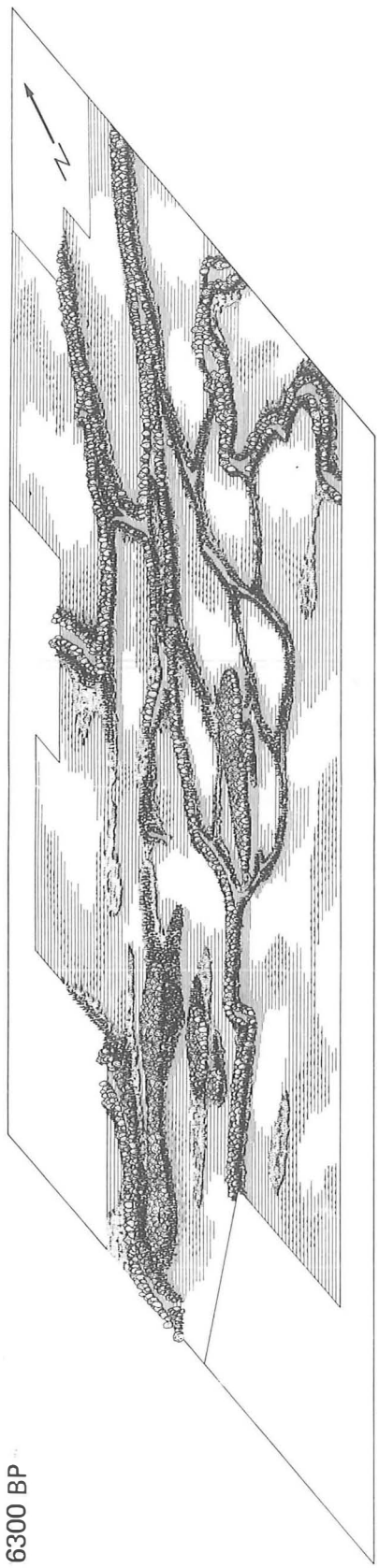
2.2. Otter

2.2.1. *Age distribution*

Swifterbant

The age analysis of the Swifterbant otters based on the degree of fusion in the postcranial bones (table 1) shows that only one animal of less than one year old was killed. Nearly 90% of the otters were killed after their second year of life. The data derived from the analysis of tooth wear (table 2) seem to correspond to this: none of the 45 lower and upper jaws were from animals younger than one year. Five of them were aged between one and four years, two come from otters older than two years, and eight were aged younger than four years.

In the otter population (consisting of 91 specimens) studied by Stubbe (1969) 41.8% consists of animals younger than one year; 32.9% was two years old, while only 25.3% of the otters became older than two years. So the age structure of the Swifterbant otters indicates a selective hunting of animals older than two years. This corresponds to the data given by Trolle-Lassen (1987) for the Mesolithic otters from Tybrind Vig (Denmark), none of which were younger than one year.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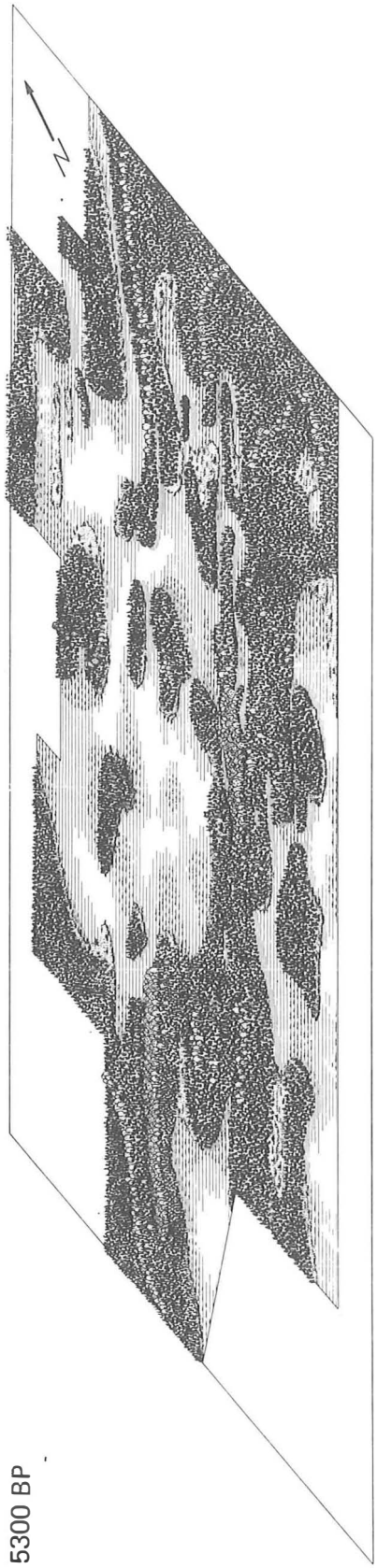
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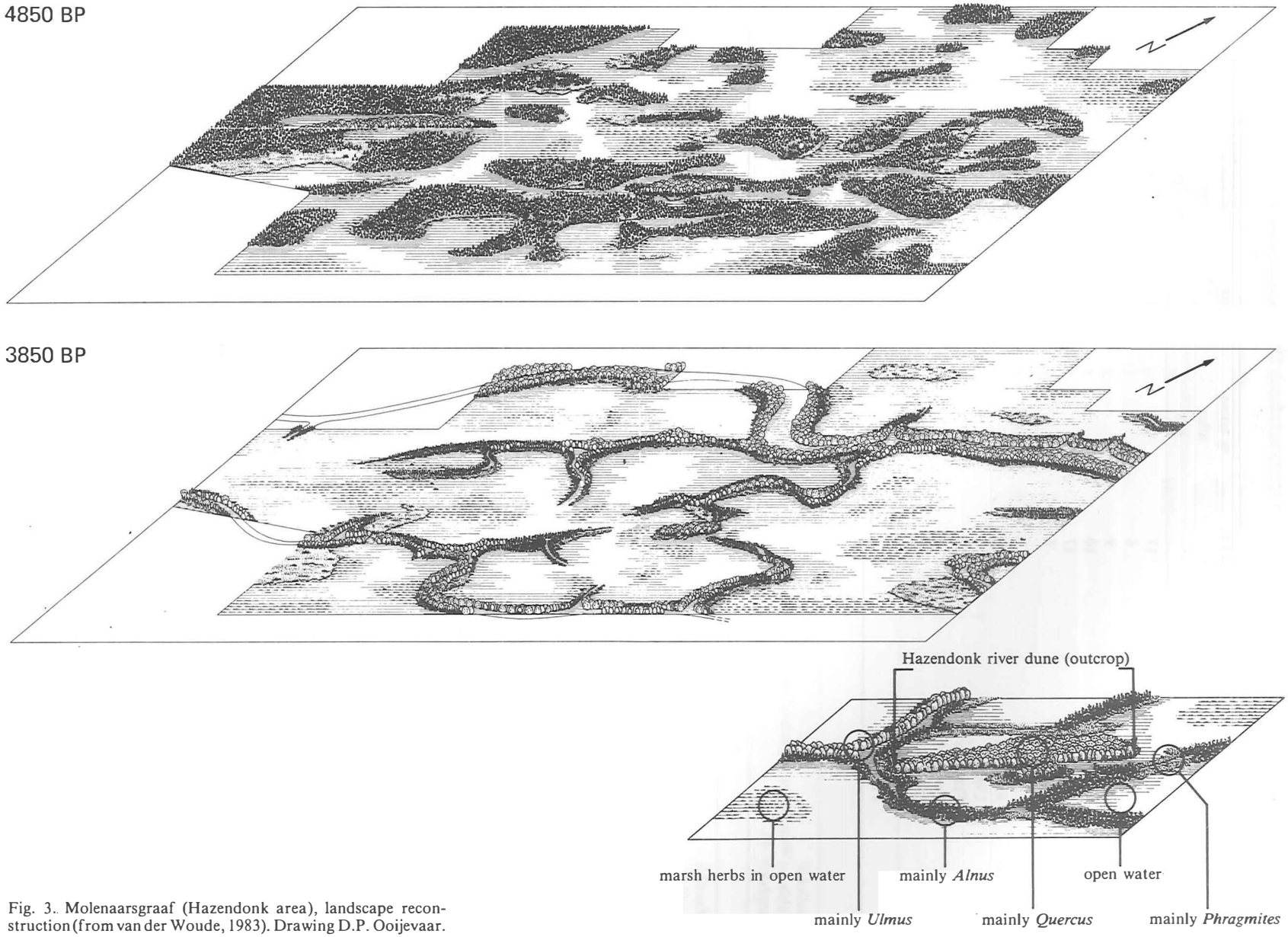


Fig. 3. Molenaarsgraaf (Hazendonk area), landscape reconstruction (from van der Woude, 1983). Drawing D.P. Ooijevaar.

Table 1. Age structure of otters killed in Swifterbant. UF = epiphysis unfused; FU = epiphysis fused; p = proximal; d = distal; an = anterior; po = posterior.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
1	Humerus d	17	97.0	1	3.0	
(n=67)	Radius p	6				
	Ulna p	9		1		
	Metac. d	10				
	Metat. d	17				
	Calcan. p	6				
2	Humerus p	3	89.6		10.4	7.4
(n=48)	Radius d	3				
	Ulna d	3				
	Femur p	20		3		
	Femur d	4		1		
	Tibia p	7				
	Tibia d	1		1		
	Fibula d	2				

Table 2. Wear stages on teeth of otters killed in Swifterbant. Number of specimens with no dentin visible (*) or dentin visible (+). Total number = 45.

	C	P2	P3	P4	M1	Estimated age(years)
Mandible						
n=12	-	-	-	-	+	>1
n=9	-	-	-	+	+	>1
n=1	+	+	+	-	+	>1
n=1	-	-	+	-	+	>1
n=1	-	+	+	+	+	>1
n=3	-	-	-	+	-	>1
n=1	+	-	-	+	+	>1
n=1	-	*	-	-	+	>1
n=1	-	-	-	+	*	1-4
n=1	-	-	+	*	*	1-4
n=1	-	-	+	*	+	1-4
n=1	-	-	*	*	+	1-4
n=1	-	-	-	*	+	1-4
n=2	-	-	-	-	*	<4
n=1	-	-	-	*	-	<4
n=3	-	-	-	*	*	<4
Maxilla						
n=1	-	+	+	-	-	>1
n=1	+	-	-	-	+	>2
n=1	-	-	-	+	+	>2
n=2	-	-	-	*	*	<4

Hazendonk

Among the otters from Hazendonk no individuals younger than one year were found (tables 3-5). The analysis of the fusion in the postcranial bones showed that the age structure of the hunted population in the youngest phases of habitation (Vlaardingen-1b & -2b) was almost the same as in Swifterbant: more than 90% of the otters were older than two years. In the older phases (Hazendonk-1, -2 & -3) a greater proportion than in Swifterbant (21%) seems to be caught at an age between one and two years. Still 79.3% of the otters was older than two years. Of the total number of otters (i.e. from all periods of habitation) 85% consists of individuals older than two years. The data derived from the wear analysis on the teeth seem to confirm this

Table 3. Age structure of otters killed at Hazendonk, phase Hazendonk-1, -2 and -3.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
1	Scapula d	2	100.0		0.0	
(n=16)	Humerus d	6				
	Radius p	1				
	Ulna p	2				
	Metac. d	1				
	Metap. d	1				
	Calcan. p	3				
2	Humerus p	4	79.3		20.7	20.7
(n=48)	Ulna d	1				
	Femur p	5		1		
	Femur d	2		3		
	Tibia p	2		1		
	Tibia d	9		1		

Table 4. Age structure of otters killed at Hazendonk, phases Vlaardingen-1b & -2b.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
1	Humerus d	3	100.0		0.0	
(n=10)	Ulna p	2				
	Metac. d	1				
	Metat. d	2				
	Metap. d	1				
	Calcan. p	6				
2	Humerus p	3	90.9		9.1	9.1
(n=11)	Radius d	2				
	Ulna d	1				
	Femur p	3		1		
	Femur d	1				
	Tibia p	1				

Table 5. Age structure of otters killed at Hazendonk, all phases.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
1	Scapula d	2	100.0		0.0	
(n=26)	Humerus d	9				
	Radius p	1				
	Ulna p	4				
	Metac. d	2				
	Metat. d	2				
	Metap. d	2				
	Calcan. p	4				
2	Humerus p	7	85.0		15.0	15.0
(n=40)	Radius d	2				
	Ulna d	2				
	Femur p	8		2		
	Femur d	2		3		
	Tibia p	3		1		
	Tibia d	9		1		

Table 6. Wear stages on teeth of otters killed at Hazendonk (all phases). Number of specimens with no dentin visible (*) or dentin visible (+). Total number = 25.

	C	P2	P3	P4	M1	Estimated age(years)
Mandible						
n=3	-	-	-	-	+	>1
n=6	-	-	-	+	+	>1
n=1	-	+	+	-	+	>1
n=1	+	-	-	-	-	>1
n=1	-	-	-	+	-	>1
n=1	-	-	+	+	*	1-4
n=1	*	-	*	*	-	<3
n=4	-	-	-	*	*	<4
n=1	-	-	-	*	-	<4
n=1	-	-	-	-	*	<4
n=1	-	-	*	-	-	<4
Maxilla						
n=1	-	-	+	+	+	>2
n=1	-	-	-	+	+	>2
n=1	-	-	-	+	*	1-6
n=1	-	-	-	-	*	<6

(table 6). So the age distribution of the Hazendonk otters indicates a similar selective hunting as in Swifterbant.

2.2.2. *Sex ratio*

Swifterbant

As for the sex ratio it seems that in Swifterbant males and females are equally represented. Comparison of the measurements with those taken of two recent specimens of the B.A.I. reference collection and with the data mentioned by Degerbøl (1933) gives a number of 28 bones of female otters and 28 of males. Moreover two penis bones were found. Consequently the sex ratio is about 1:1. The MNI (minimal number of individuals, based upon the measurements of the most numerous skeletal element, i.e. the mandible) was nine. According to the measurements five of these belonged to females and four to males.

The data mentioned by Jensen (1964) and Stubbe (1969) indicate a sex ratio of 1:1 in recent European otter populations. Hamilton & Eadie (1964) mention a difference in sex ratio of trapped Canadian otters depending on the season. For the otters trapped from late October through February the sex ratio was equal, while for those caught in March and April the ratio was 151 males: 100 females. According to them the late autumn and midwinter catch presents a true picture of the sex ratio in the population. The higher number of males trapped in spring could be due to a difference in activity of the sexes in the whelping and mating season.

Of the otters studied by Jensen (1964), more than 80% were caught in the period between October and February. Forty of these were females, against 37 males. The sex ratio was quite different among the otters caught between March and September: 13 males against 5 females. In the five specimens killed in March and April the ratio was 4:1. This seems to confirm the observations of Hamilton and Eadie.

This the 1:1 sex ratio in the Swifterbant material could be an indication that if otters were caught between spring and early autumn, then hunting was not limited to this period.

Hazendonk

The sex ratio of the Hazendonk otters differs considerably from that in Swifterbant. Among the material from the Hazendonk phases 16 bones of females (according to the measurements) and one of a male (a penis bone) were found. The MNI of females (based upon the measurements of the most numerous skeletal element, i.e. the humerus) was four. The measurements indicated that all of these were from females.

In the material from the Vlaardingen layers the ratio was 10:3, with a MNI of three (based upon the measurements of the most numerous skeletal element, i.e. the mandible). According to the measurements two of these came from females and one from a male. Both sexes of the otter look alike, although on average the total length and body weight of males exceed those of females (Jensen, 1964). From this one can conclude that it is not so easy (if not impossible) to distinguish between males and females in the open field. This means that the use of active hunting techniques and traps in which animal is killed is more or less aselective as regards sex. The data mentioned above concerning

shot and trapped otters in Denmark and Canada seem to confirm this: over a whole year the sex ratio with the killed otters is approximately 1:1. While there is a preponderance of males in spring/summer, in none of the months does the number of females considerably exceed the number of males. In view of this it seems unlikely that the strong preponderance of females in the Hazendonk material is due to hunting of otters in a specific season.

Neither is there any reason to suppose a difference in body size between the female otters in Swifterbant and Hazendonk, which could cause an artificial shifting in the sex ratio. The measurements give no indication of this.

The difference in sex ratio between the Swifterbant and Hazendonk otters can possibly be explained by the way the sites were excavated and the parts that were excavated. In Swifterbant a large single unit was excavated, representing more than half of the actual settlement on the levee (van der Waals, 1977). The bone material was extremely fragmented and seems to have become spread over the site in the course of time. In Hazendonk, on the contrary, the excavation was done through a series of pits all along the slope of the dune. The top of the dune was already eroded by the time the excavation took place. This means that only the material that was thrown out of the settlement could be collected, while in Swifterbant the material came from the actual settlement. In Hazendonk in some pits only material from one period was found, while in others more than one period was represented. This way of excavating in relativily small, separate surface units (compared to Swifterbant) gives a greater possibili-

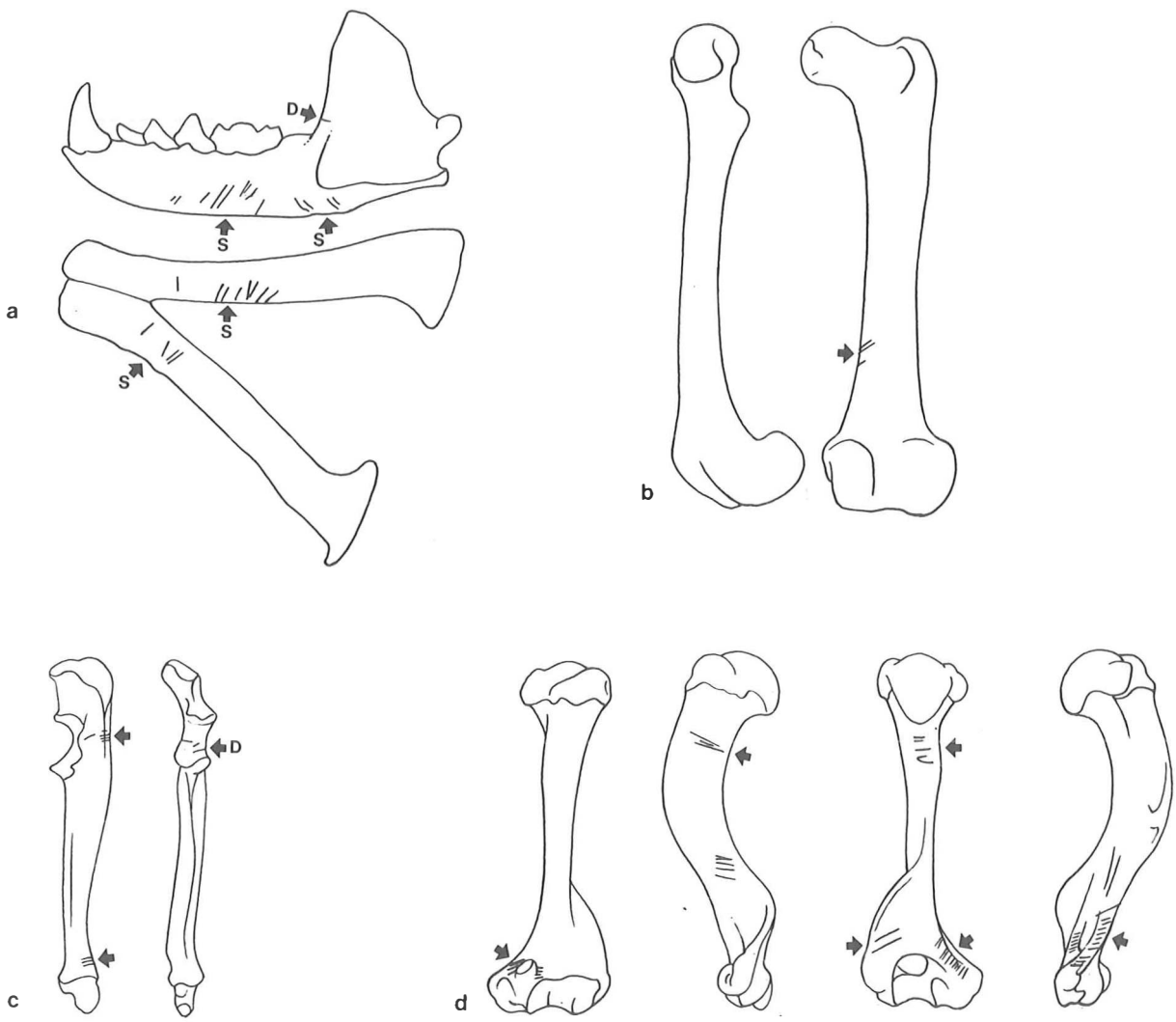


Fig. 4. Swifterbant: cut marks on mandible (a), femur (b) ulna (c) and humerus (d), of otter. S = skinning; F = filleting; D = dismemberment. Drawings H.R. Roelink (c, d) and E. Morville and H.R. Roelink (a, b). Scale 2:3.

ty of finding the bones belonging to the same individual in the sample, thus predisposing a distortion of the real sex ratio. Possibly also the smaller number of measurable otter bones In Hazendonk compared to Swifterbant (40 to 68) causes a false image of the sex ratio.

2.2.3. *Exploitation pattern: cut marks and burning traces*

Swifterbant

Cut marks were found in the Swifterbant material on the mandible, ulna, humerus and femur (fig. 4). Those on the basal and lateral side of the mandible show the places where the skin was cut loose. They correspond more or less to the cut marks described by Trolle-Lassen for the otters of Tybrind Vig. On the basis of experimental work on otters she was able to reconstruct the method of flaying by analysing the cut marks on the mandible, cranium, pelvis, phalanges I and metapodials. According to her, the skin was cut loose around the rostrum (shown by cut marks on the mandible and cranium), along the ventral midline of the pelvis and tranversally along phalanges and metapodials, leaving the skin of the paws, together with the phalanges II and III, connected with the fur of the trunk. This is corroborated by the underrepresentation of the phalanges II and absence of the phalanges III.

Although the cut marks on the Swifterbant mandibles indicate a similar method of flaying, it must be remarked that a good comparison cannot be made in every aspect. The preservation of both the skulls and the pelvis fragments in the Swifterbant material was very poor. The same applied for most of the metapodials and phalanges. However, the underrepresentation of the second and absence of the third phalanges among the otter remains seems a strong indication that the animals were skinned in the same way as in Tybrind Vig.

Just like the Tybrind Vig otters, those in Swifterbant were hunted both for their fur and meat. Cut marks on the proximal part of the ulna (inside the joint) show the place where the limbs were disarticulated. Also these correspond to the cut marks on the Tybrind Vig material, indicating a similar method of dismemberment. The cut mark on the lower part of the ramus could be due to dismemberment, but this is not certain, since this type was missing on the experimental material of Trolle-Lassen as well as on the Tybrind Vig material. Also the cut marks above the joint and around the medial foramen of the humerus are of the same type as in Tybrind Vig, which indicates that they come from filleting. Those on the proximal part of the humerus also seem to have been caused by filleting.

Burning (in several degrees, from partial charring to complete calcination) occurred on almost every type of skeletal element, notably on 14.4% of the total number of otter remains. This too indicates that the meat of the otters was eaten.

Hazendonk

As for the Hazendonk material, only on a small number of bones could cut marks be found (fig. 5). Those on the lateral side of the mandible seem to indicate, together with the underrepresentation of the phalanges II and absence of the phalanges III, a similar method of flaying as in Swifterbant and Tybrind Vig.

The cut marks on the humerus seem to have been caused by filleting. As with the Swifterbant otters, traces of burning were present on almost every type of skeletal element. In the material from the Hazendonk phases this was the case with 21.8% of the total number of otter bones. The percentage in the Vlaardingen-1b/-2b material was almost the same (17.2%). Thus it can be concluded that also at the Hazendonk otters were hunted both for their fur and meat.

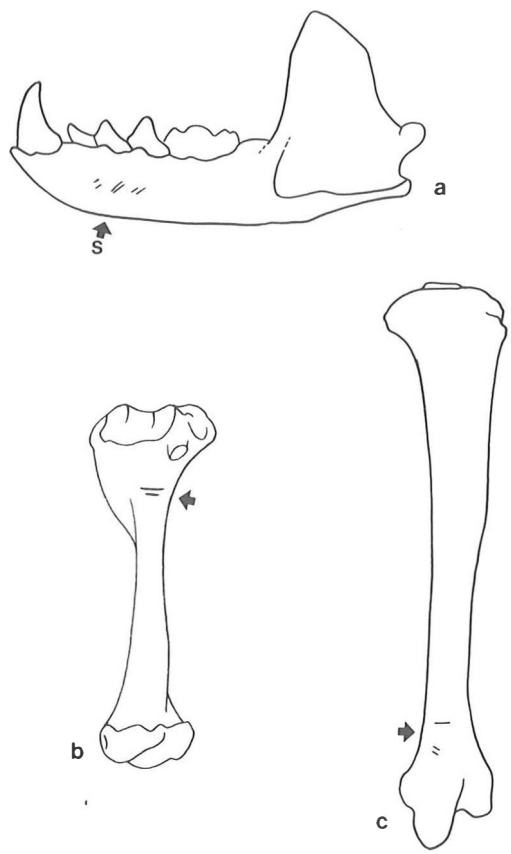


Fig. 5. Hazendonk: cut marks on mandible (a), humerus (b) and tibia (c) of otter. Drawings H.R. Roelink (b) and E. Morville and H.R. Roelink (a, c). Scale 2:3.

Table 7. Age structure of beavers killed in Swifterbant. UF = epiphysis unfused; FU = epiphysis fused; p = proximal; d = distal; an = anterior; po = posterior

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
2	Scapula d	5	100.0		0.0	
(n=39)	Humerus p	1				
	Humerus d	8				
	Radius p	1				
	Ulna p	6				
	Metac. d	1				
	Femur p	12				
	Tibia d	3				
	Phal.I an d	1				
	Phal.II po d	2				
	Phal.II an/po d	1				

2.3. Beaver

2.3.1. *Age distribution*

Swifterbant

Just as in the case of otter, hardly any remains of individuals younger than one year were found among the beavers. According to the age criteria given by Iregren & Stenflo (1982) for the epiphyseal fusion in the postcranial bones, all the 39 remains from Swifterbant were from beavers older than (at least) two years (table 7).

Applying the data given by Piechocki (1973, in: Niethammer & Krapp, 1977) for the epiphyseal fusion in the femur, 12 of these would have been older than seven years. It must be remarked that according to Piechocki fusion in the femur occurs at a considerably later age than is mentioned by Iregren and Stenflo. In the first case the epiphyses do not fuse until the age of seven, while in the latter fusion starts in the third year of life.

To establish the ages of beavers on the basis of 24 mandibles the method mentioned by Novak (1976) was used. This method is based upon the time of shedding of the lower milk premolar and the degree of closure of the roots of the permanent mandibular teeth. According to Novak the lower milk premolar is shed when the animal is about ten months old. Just as in the case mentioned before the data given by Piechocki indicate a later age. According to him the milk premolar is shed only after two years. Novak's observations on this subject are supported by the data mentioned by Lavrov (in: Ognev, 1963). The majority (79%) of the mandibles come from beavers older than 1½ years, which corresponds more or less to the data on the postcranial bones. One individual must have been about eight months old; one was killed at an age of c. one year, and two must have been between 1 and 1½ years old (Zeiler, in press).

Hazendonk

The age structure of the hunted beaver population in Hazendonk is almost the same as in Swifterbant. Analysis of the fusion patterns in the postcranial bones showed that 66 out of 68 specimens from the Hazendonk phases came from beavers older than two years. Six of these must have been older than seven years, according to the criteria of Piechocki. One individual was aged older than one year, and another must have been younger that two years.

As for the Vlaardingen-phase material, all 51 specimens came from beavers older than two years (with four individuals older than seven years; tables 8 and 9).

Among the 22 mandibles (coming from all phases of habitation) one was aged one year, and two between 1 and 1½ years. More than 95% came from beavers older than two years.

2.3.2. *Sex ratio*

Just as in the case of the otter, distinction between the sexes is very difficult. In his article on sex determination in the European beaver, Zaniewski (1965: p. 297) mentions that "The topography of the urogenital organs in the beaver, which are hidden in the cloacal chamber, and the absence of distinct secondary sex characters in live beavers make it difficult to determine sex in these animals". The only exception are females that are lactating or about to give birth: under such conditions the four pectoral mammae are prominent (Osborn, 1955).

Bailey and Hendee (in: Zaniewski, 1965) mention that Eskimos claim to be able to distinguish between male and female beavers from the way they hold their heads while swimming. According to them, males swim with the head raised further above the surface of the water than the females, which keep the head almost completely submerged while swimming.

Table 8. Age structure of beavers killed at Hazendonk, phase Hazendonk-1, -2 and -3. UF = epiphysis unfused; FU = epiphysis fused; p = proximal; d = distal; an = anterior; po = posterior.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
1	Radius p	1	100.0		0.0	
2	Scapula d	8	98.5		1.5	
(n=68)	Humerus p	1				
	Humerus d	8		1		
	Radius p	5				
	Ulna p	6				
	Metac. d	2				
	Femur p	6				
	Tibia d	12				
	Fibula d	1				
	Metat. d	8				
	Metap. d	3				
	Phal.I an d	1				
	Phal.II po d	2				
	Phal.I an/po d	3				

Table 9. Age structure of beavers killed at Hazendonk, phase Vlaardingen-1b and -2b. UF = epiphysis unfused; FU = epiphysis fused; p = proximal; d = distal; an = anterior; po = posterior.

Age (years)	Bone/epiph.	n FU	% killed after age	n UF	% killed before age	% killed between two ages
2	Humerus p	1	100.0		0.0	
(n=51)	Humerus d	9				
	Radius p	2				
	Ulna p	4				
	Metac. d	3				
	Femur p	4				
	Tibia d	7				
	Fibula d	3				
	Metat. d	6				
	Metap. d	2				
	Phal.I an d	1				
	Phal.II po d	3				
	Phal.I an/po d	3				
	Phal.II an/po d	3				

As until now no literature on sexing beavers from the measurements of the skeletal elements is known to me, it was not possible to make an analysis of the sex ratio of the hunted beaver populations in Swifterbant and Hazendonk.

2.3.3. *Exploitation pattern: cut marks and burning traces*

Swifterbant

Cut marks were found in the Swifterbant material on the mandible, clavicula, humerus, pelvis, femur and phalanx I (figs 6-7). The cut marks on the rostral and basal parts of the mandible resemble those described by Trolle-Lassen for the Tybrind Vig otters, thus indicating a similar method of flaying. This seems to be confirmed by the cut marks on the first phalanx, and the underrepresentation of the phalanx II and III (four of both against 14 phalanges I).

Cut marks right above the distal epiphysis of the humerus could have been caused by filleting. The same probably applies for those on the distal part of the humerus.

The small cut marks around the base of the articular process of the mandible could indicate that after skinning the mandible was cut loose from the cranium.

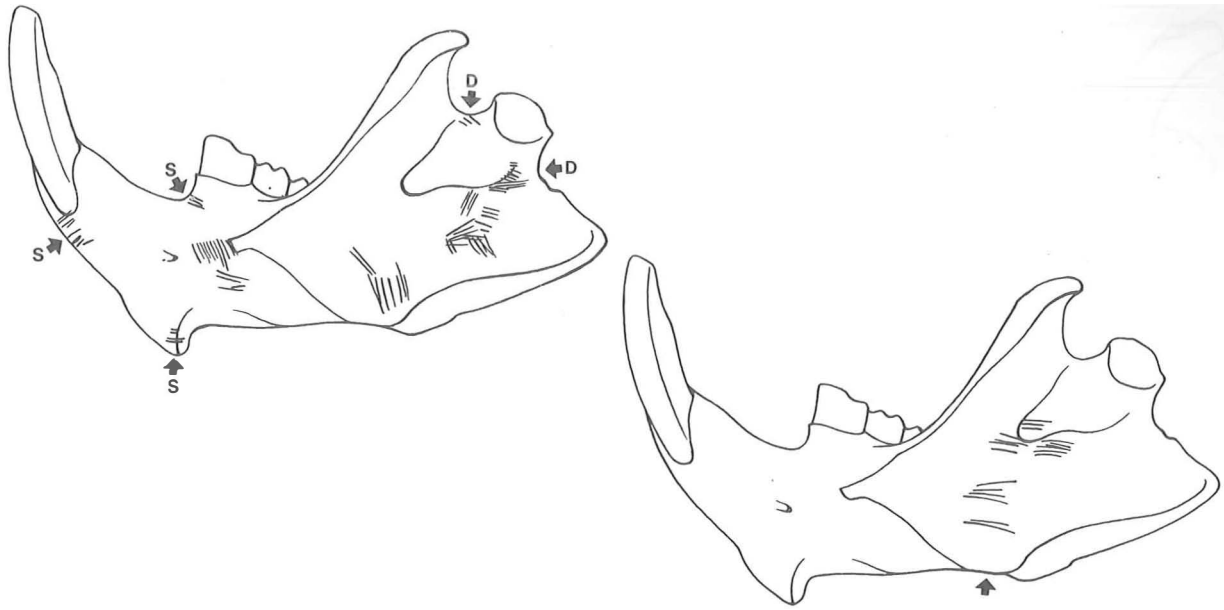


Fig. 6. Swifterbant and Hazendonk: cut marks on mandible of beaver. Drawing H.R. Roelink. Scale 2:3.

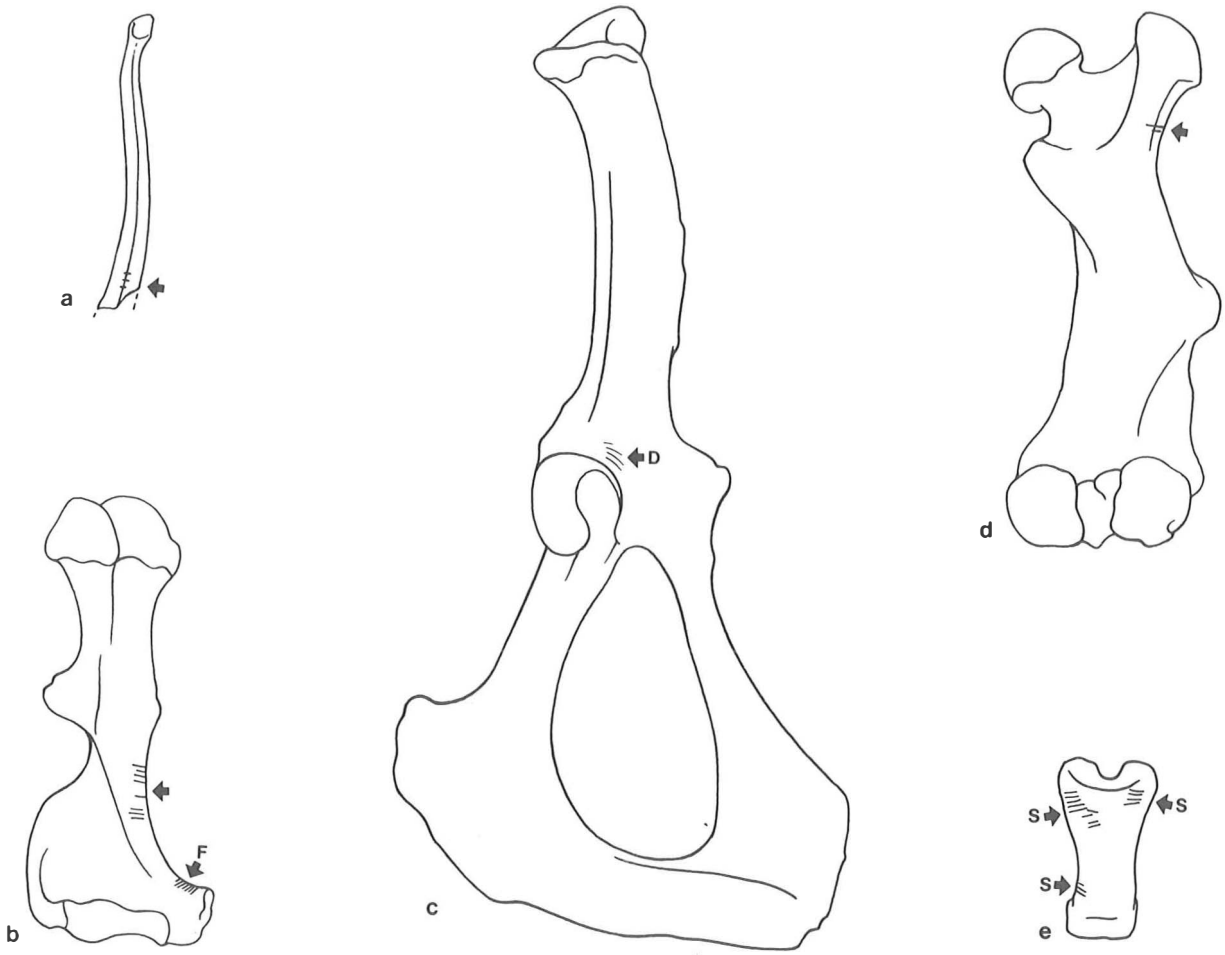
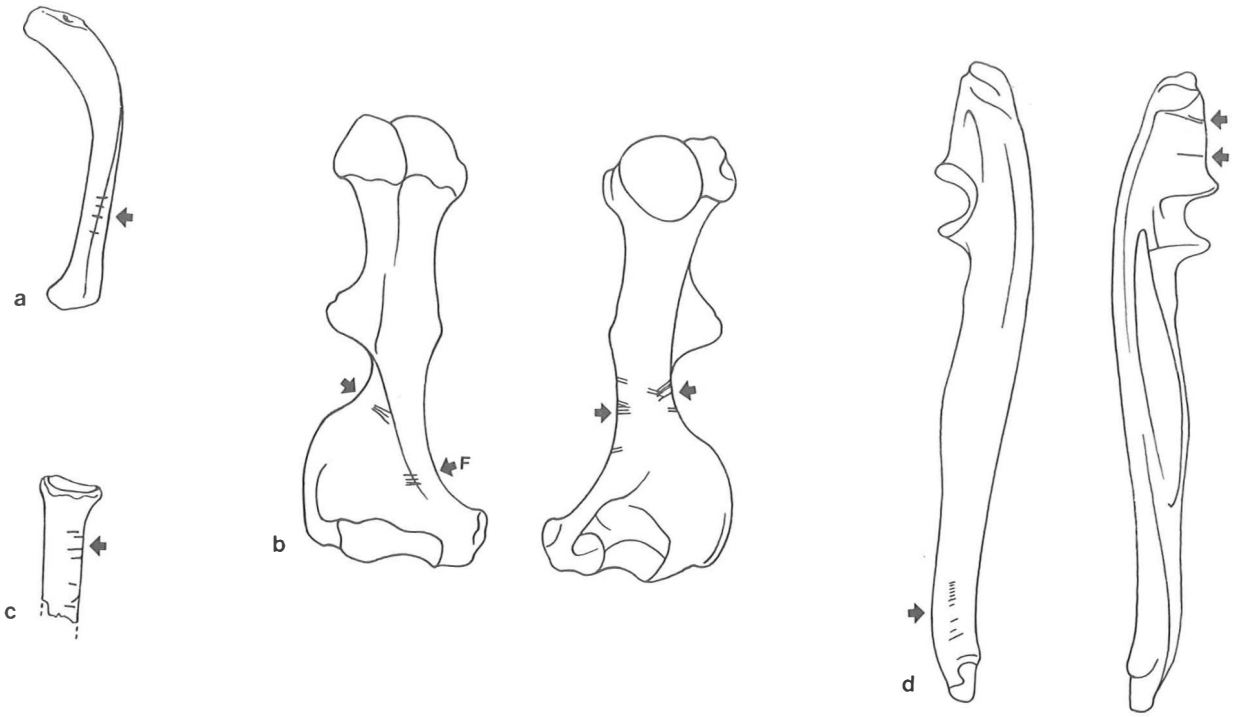
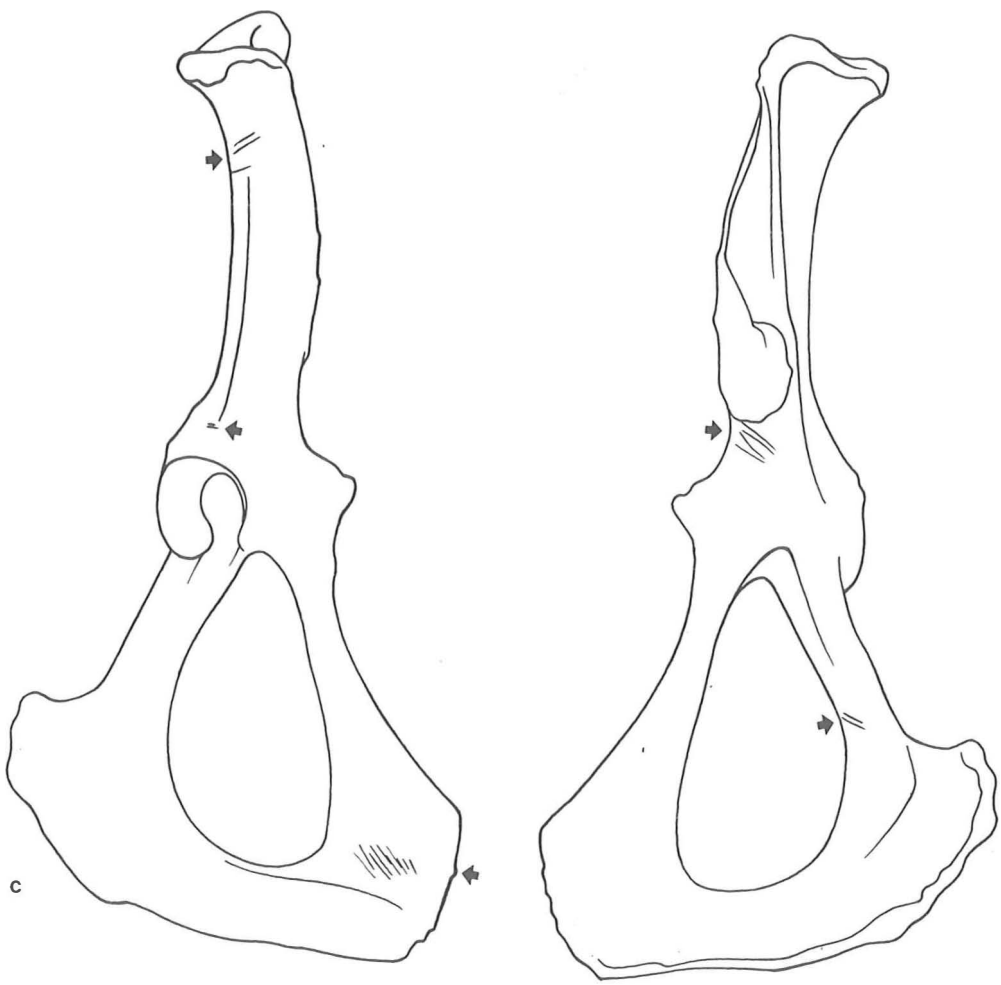


Fig. 7. Swifterbant: cut marks on clavicula (a), humerus (b), pelvis (c), femur (d) and phalanx I (e) of beaver. Drawings H.R. Roelink. Scale 2:3.


a
b
F
c
d


c

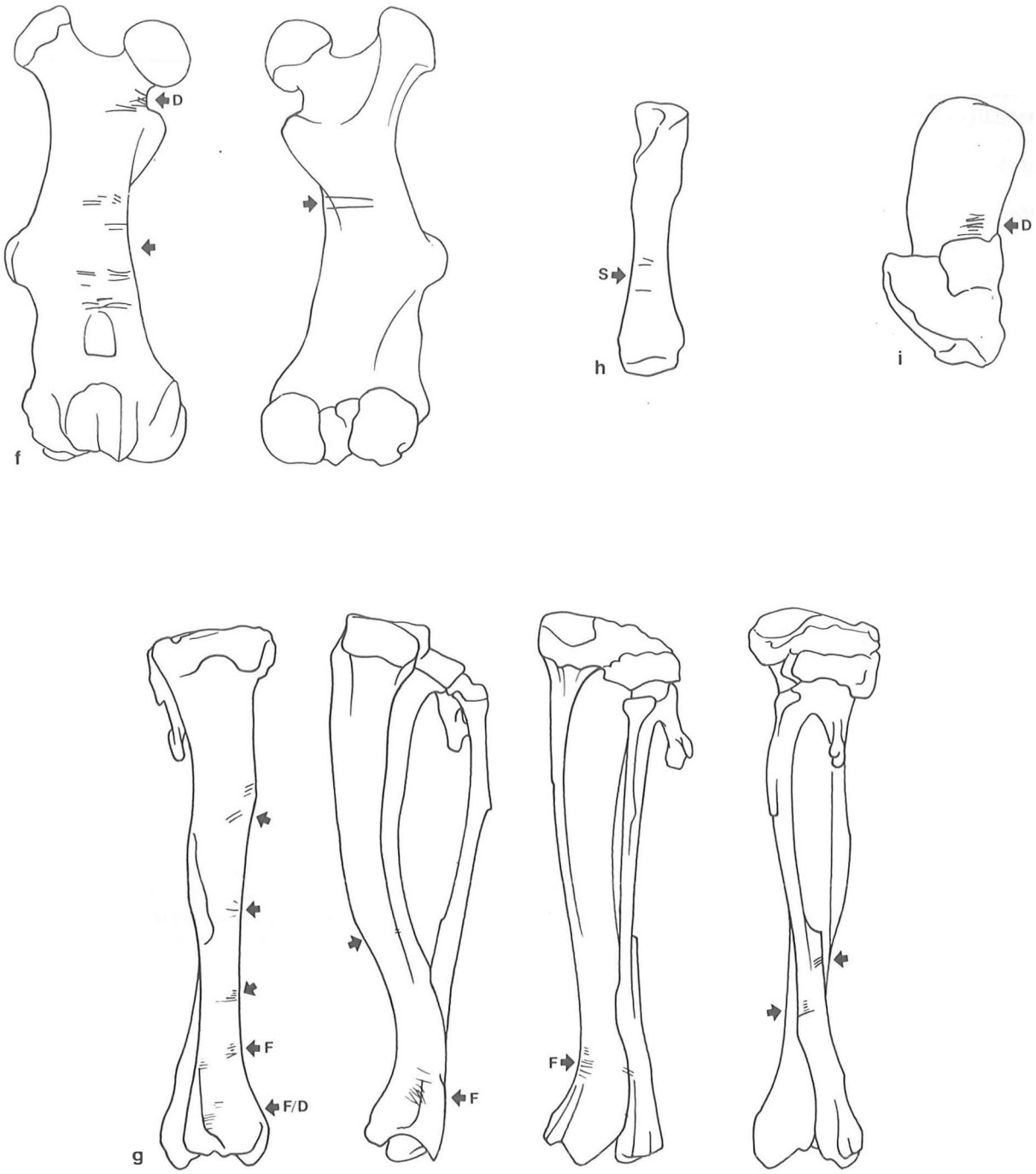


Fig. 8. Hazendonk: cut marks on clavicula (a), humerus (b), radius (c), ulna (d), pelvis (e), femur (f), tibia (g), metatarsal (h) and calcaneus (i). Drawings H.R. Roelink. Scale 2:3.

Also the cut marks on the pelvis, at the cranial side of the acetabulum, are probably the result of dismemberment.

As in the case of otter, burning traces (from partially charred to completely calcined) occurred on every kind of skeletal element, notably on 14.9% of the total number of beaver remains.

Hazendonk

As for the Hazendonk material, cut marks were found on the mandible, clavicula, humerus, radius, ulna, pelvis, femur, tibia, metatarsal and calcaneus (figs 6 and 8). Those on the mandible are less numerous than in Swifterbant, but they seem to be of the same types: short cut marks just beneath the articular process, indicating the place where the mandible was cut loose from the cranium, and on the basal part and right at the beginning of the cheektooth row that most probably come from skinning.

Apart from this skinning of the beavers is apparent from the cut marks on the metatarsus. The latter resemble those described by Trolle-Lassen for the Tybrind Vig otters, suggesting that the Hazendonk beavers were skinned in such a way that the bones of the phalanges II and III remained attached to the fur on the trunk. This seems to be confirmed by the ratio between the different phalanges in the Vlaardingen material: 15 phalanges I, five phalanges II and one phalanx III. The number of phalanges in the material from the Hazendonk phases was too small to draw reliable conclusions. Also the cut marks on the postcranial bones are more or less the same as in the Swifterbant material (fig. 8).

The cut marks on the distal part of the humerus (above the joint) probably come from filleting of the beavers. The cut marks on the distal part of the tibia could also come from filleting; those above the joint could have been caused by dismemberment, although in that case it seems likely that they would be placed more distally (pers. comm. T. Trolle-Lassen).

The cut marks right beneath the caput femoris probably indicate the place where the femur was cut loose from the pelvis. The same possibly applies for the small cut marks at the cranial side of the acetabulum. Also those on the calcaneus could have been caused by dismemberment of the limbs.

Burning traces occurred more frequently in the material from the Hazendonk phases than in the Vlaardingen-1b/2b material: on 23.9% and 9.4%, respectively, of the total number of beaver remains.

In conclusion it can be said that in Swifterbant as well as in Hazendonk beavers were hunted both for their fur and meat. The method of skinning seems to have been the same as that described by Trolle-Lassen for the Mesolithic otters of Tybrind Vig.

3.4. Pine marten/*Martes* sp.

Remains from martens were only present in the material of the Vlaardingen period of Hazendonk. Four bones of pine marten were found (all coming from the same excavation unit): a right mandible, two distal parts of a right scapula and a pelvis fragment. In the mandible only the P4 and M1 were still present, on which no wear could be seen. This means that, according to Habermehl (1985), this individual must have been younger than 21 months. Cut marks on the basal side indicate the place where the fur was cut loose (fig. 9: a). In both scapula fragments the distal parts were fused. Fusion of this part takes place very early, so the individuals could have been only seven months old or perhaps younger (pers. comm. T. Trolle-Lassen). The bone structure of the pelvis fragment indicates that this most probably belonged to an adult individual.

Two remains were identified as *Martes* sp.: a distal fragment of a metapodial (with the epiphysis fused) and a distal epiphysis of a humerus.

3.5. Polecat

In Swifterbant two mandible fragments of polecat were found. In one of these dentin was visible on the P4 and M1. The other specimen had only part of the M1 left, on which no wear could be seen. Habermehl (1985) mentions that in polecats all the permanent teeth are present at c. 16 weeks; tooth wear starts at an age of c. eight months. This means that the first mandible came from a polecat older than eight months, while the second belonged to an individual at least 16 weeks old.

Three remains of polecat were found in Hazendonk. A right mandible from the Hazendonk-3 period showed exposed dentin on the P4 and M1. In a second mandible fragment, from the Vlaardingen-2b period, only the M1 was left. Also here the dentin was visible, which indicates that both animals must at least have been older than eight months. Cut marks on the basal parts of both mandibles show that the polecats were skinned (fig. 9: b).

Apart from these remains a left calcaneus of polecat was found. The proximal epiphysis was fused, indicating that this bone too came from an adult individual.

3.6. Fox

The fox is represented in Swifterbant by one phalanx II, apparently from an adult individual. Three remains of the species were found among the Vlaardingen material of Hazendonk: a left and a right humerus, probably coming from the same (adult) animal, and the distal half of a left tibia. The latter must have belonged to a young fox, since the epiphysis had not yet fused. According to the data

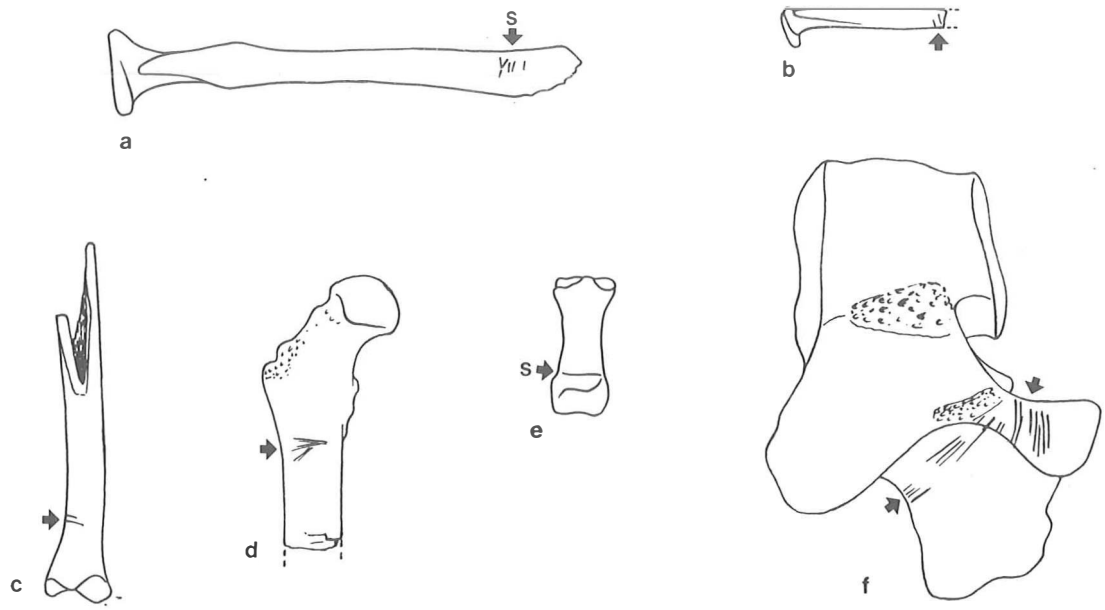


Fig. 9. Hazendonk: cut marks on mandible of pine marten (a), polecat (b), tibia of fox (c), femur of badger (d), lumbar vertebra (e) and phalanx II of brown bear (f). Drawings H.R. Roelink (b, c, d, e) and E. Morville and H.R. Roelink (a). Scale 2:3.

of Habermehl (1985) this animal must have been younger than about eight months. The outer tip of the diaphysis of the proximal side was charred. Just above the distal end two short cut marks are visible, which could be an indication that the animal was filleted (fig. 9: c).

3.7. Badger

The badger was only found in the Vlaardingen material in Hazendonk. A right patella came from the Vlaardingen-2b period. The size and bone structure indicate that it belonged to an adult animal. Among the material from the Vlaardingen-1b period the proximal half of a right femur was found, belonging to an adult individual (i.e. with a fused epiphysis). The bone had been sawn in two, and had several cut marks on it, probably caused by filleting (fig. 9: d). Gnawing marks show that the waste material was given to the dogs.

3.8. Brown bear

Both in Swifterbant and in Hazendonk remains of brown bear were present. As for Swifterbant, six remains were found, representing at least one adult individual: a phalanx I, two phalanges II and three fragments of metacarpals. In one of the metacarpals, the spongiosum was charred.

Three remains of brown bear were found in the Vlaardingen-1b material of Hazendonk: a phalanx II, a right patella and a lumbar vertebra. The latter two bones came from the same pit, and therefore could have belonged to the same individual. Although the phalanx came from a pit on the other side of Hazendonk, it does not necessarily come from another individual.

Cut marks on the dorso-caudal, dorsal and dorso-cranial sides of the vertebra show that it was cut loose from the precedent and the next vertebra (fig. 9: e). This strongly suggests that the meat of the bear was eaten. On the distal part of the phalanx, just above the epiphysis, a cut mark can be seen, probably showing the place where the hide was cut loose.

3.9. Cat

A mandible fragment of a cat was found in the bone material from Swifterbant. As no measurements could be taken, it is not clear if it belonged to a wild or a domesticated cat. The same applies for a (completely charred) mandible fragment, a lower canine, a maxilla fragment and a heavily worn upper P4 from Hazendonk. The latter three fragments came from the same pit, and therefore could have belonged to the same individual. The proximal breadth of a femur was 22 mm, a measurement that lies exactly in the overlap range between wild and domesticated cat (Kratochvíl, 1976). All cat bones from the Hazendonk came from the Vlaardingen-1b and -2b periods.

3.10. Common seal

The only bone of common seal was found in the material of Swifterbant. It was the distal half of a phalanx I (anterior), almost completely calcined. It is possible that the animal was caught in the immediate vicinity of the site. IJsseling & Scheygrond (1949) mention that seals regularly swim up rivers in open connection with the sea. The Swifterbant animal could thus have reached the area by way of the creek system, which had a connection with the sea (Ente, 1976).

4. CONCLUSIONS

Beaver and otter, the most important species among the fur animals in Swifterbant and Hazendonk, were hunted both for their fur and meat. With regard to the otter this is demonstrated clearly by the different types of cut marks, which strongly resemble those described by Trolle-Lassen (1987) for the Mesolithic otters of Tybrind Vig (Denmark). Thus it is reasonable to suppose a similar method of skinning, dismemberment and filleting of the killed animals in Neolithic Swifterbant and Hazendonk as in Mesolithic Tybrind Vig. Although the cut marks on the bones of beaver could not be compared with experimental data, they seem to reflect more or less the same human exploitation pattern. Also the traces of burning on the bones show that the meat of these species was eaten at both sites.

On the remains of pine marten and polecat only cut marks caused by skinning could be seen. Thus it is not clear if the meat of these species was eaten too. The remains of fox and badger showed cut marks, probably caused by filleting and traces of burning, indicating that in any case the meat of these species was eaten. The same applies for the common seal and the cat, as well as for the brown bear in Swifterbant, in view of the traces of burning on their remains. As for the brown bear in Hazendonk, the cut marks seem to indicate both skinning and filleting.

The age structures of the hunted populations of fur animals at both sites make it clear that hardly any young animals were killed. Only in a single case an individual younger than one year was found. This implies a selective hunting by the inhabitants of Swifterbant and Hazendonk of animals older than one year.

The 1:1 sex ratio in recent otter populations is reflected in the Swifterbant material. The very different sex ratio in the Hazendonk material is probably merely a consequence of the difference in the way the two sites were excavated and/or of the smaller number of measurable otter bones in the Hazendonk material compared to Swifterbant.

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6. SUMMARY

Remains of fur animals, mainly beaver (*Castor fiber* L.) and otter (*Lutra lutra* L.) make up a considerable part of the bone material of Swifterbant and the Hazendonk, two Neolithic sites in the Central and western Netherlands, respectively (fig. 1). Other species of fur animals – pine marten (*Martes martes* L.), polecat (*Putorius putorius* L.), fox (*Vulpes vulpes* L.), brown bear (*Ursus arctos* L.), cat (*Felis catus* L./*F. silvestris* Schreber), badger (*Meles meles* L.) and common seal (*Phoca vitulina* L.) – are represented by small numbers of remains. In this article an attempt is made to give a reconstruction of the way in which these species were exploited. In this connection the age and sex distribution of the hunted populations are discussed, as well as the analysis of the butchering traces.

The age structures of the hunted populations of fur animals at both sites make it clear that hardly any animals younger than one year were killed. This implies a selective hunting by the inhabitants of Swifterbant and Hazendonk of animals older than one year. The 1:1 sex ratio in recent otter populations is reflected in the Swifterbant otters. The sex ratio in the Hazendonk is very different. This is probably merely a consequence of the difference in the way the two sites were excavated and/or the smaller number of measurable otter bones in the Hazendonk material compared to Swifterbant.

Cut marks and traces of burning on the bones indicate that beaver and otter were killed both for their fur and their meat. The small numbers of remains of the other species give no clear indications in this respect, although it seems that at least in a single case the meat of brown bear, badger, fox, cat and common seal was eaten.

7. REFERENCES

CASPARIE, W.A., B. MOOK-KAMPS, R.M. PALFENIER-VEGTER, P.C. STRUIJK & W. VAN ZEIST, 1977. The paleobotany of Swifterbant (= Swifterbant contribution 7). *Helinium* 17, pp. 28-55.

DECKERS, P.H., J.P. DE ROEVER & J.D. VAN DER WAALS, 1980. Jagers, boeren en vissers in een prehistorisch getijdengebied bij Swifterbant. *ZWO-jaarboek*, pp. 111-145.

DEGERBØL, M., 1933. Danmarks pattedyr i fortiden i sammenligning med recente former I. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening* 96, pp. 357-641.

ENTE, P.J., 1976. The geology of the northern part of Flevoland in relation to the human occupation in Atlantic times (= Swifterbant contribution 2). *Helinium* 16, pp. 15-35.

HABERMEHL, K.-H., 1985. *Altersbestimming bei Wild- und Pelztieren*. 2. Auflage. Hamburg/Berlin.

HAMILTON, W.J. & W.R. EADIE, 1964. Reproduction in the otter, *Lutra canadensis*. *Journal of Mammalogy* 45, pp. 242-252.

IREGREN, E. & G. STENFLO, 1982. An osteological and statistical attempt to interpret seasonal occupation of dwelling sites. *Pact* 7, pp. 225-234.

JENSEN, A., 1964. Odderen i Danmark. *Danske vildtundersøgelser* 3, pp. 1-48.

KRATOCHVÍL, Z., 1976. *Das postkranialskelett der Wild- und Hauskatze (Felis silvestris und F. lybica/F. catus)*. Prague.

LOUWE KOOIJMANS, L.P., 1980. Archaeology and coastal change in the Netherlands. In: F.H. Thompson (ed.), *Archaeology and coastal change* (= Occasional Paper of the Society of Antiquaries of London new series I). London, pp. 106-133.

NIETHAMMER, J. & F. KRAPP, 1978. *Handbuch der Säugetiere Europas. I: Nagetiere*. Wiesbaden.

NOVAK, M., 1976. *The beaver in Ontario*. Ontario.

OGNEV, S.I., 1963. *Mammals of the USSR and adjacent countries. 5: Rodents*. Jerusalem.

OSBORN, D.J., 1955. Techniques of sexing beaver, *Castor canadensis*. *Journal of Mammalogy* 36, pp. 141-142.

PONS, L.J., S. JELGERSMA, A.J. WIGGERS & J.D. DE JONG, 1963. Evolution of the Netherlands coastal area during the Holocene. *Verhandelingen van het Kon. Ned. Geologisch-Mijnbouwkundig Genootschap* (Geol. serie) 21-22, pp. 197-208.

STUBBE, M., 1969. Zur Biologie und zum Schutz des Fischotters *Lutra lutra* (L.). *Arch. Naturschutz u. Landschaftforsch.* 9, pp. 315-324.

TROLLE-LASSEN, T., 1987. Human exploitation of fur animals in Mesolithic Denmark: a case study. *Archaeozoologia* 1(2), pp. 85-102.

WAALS, J.D. VAN DER, 1977. Excavations at the natural levee sites S2, S3/S5 and S4 (= Swifterbant contribution 10). *Helinium* 19, pp. 7-12.

WOUDE, J.D. VAN DER, 1983. Holocene paleoenvironmental evolution of a perimarine fluviatile area. *Analecta praehistorica Leidensia* 16, pp. 1-124.

IJSSELING, M.A. & A. SCHEYGROND, 1949. *De zoogdieren van Nederland*. Zutphen.

ZANIEWSKI, L., 1965. Sex determination in the European beaver, *Castor fiber* Tliinaeus, 1758. *Acta Theriologica* 10, pp. 297-301.

ZEILER, J.T., 1988. Age determination based on epiphyseal fusion in postcranial bones and tooth wear in otters (*Lutra lutra*). *Journal of Archaeological Science* 15, pp. 555-561.

ZEILER, J.T., in press. Seasonal or permanent occupation of a Neolithic site near Swifterbant (Central Netherlands). A reconsideration. *Archaeozoologia*.

ZEIST, W. VAN & R.M. PALFENIER-VEGTER, 1981. Seeds and fruits from the Swifterbant S3 site. *Paleohistoria* 23, pp. 105-168.