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Fishing from the Stone Age Settlement Norsminde

by INGE BØDKER ENGHOFF

INTRODUCTION

The Norsminde settlement was situated on the north coast of the Norsminde inlet, near the mouth of the inlet into Kattegat, about 20 km south of Århus, Denmark.

During the Atlantic period the inlet was considerably larger than today: it was about 10 km long, and the largest width was 2.7 - 3 km. The mouth was originally about 500 m across but gradually decreased in width; today the mouth is 40-50 m. The water depth was also greater than today. The stream channel running along the north coast had a maximum depth of 9 m, and Kysing Fjord (which is now reclaimed) was a large shallow-water area (fig 1). The settlement was placed at a small spring, but there were no major watercourses or lakes in the neighbourhood.

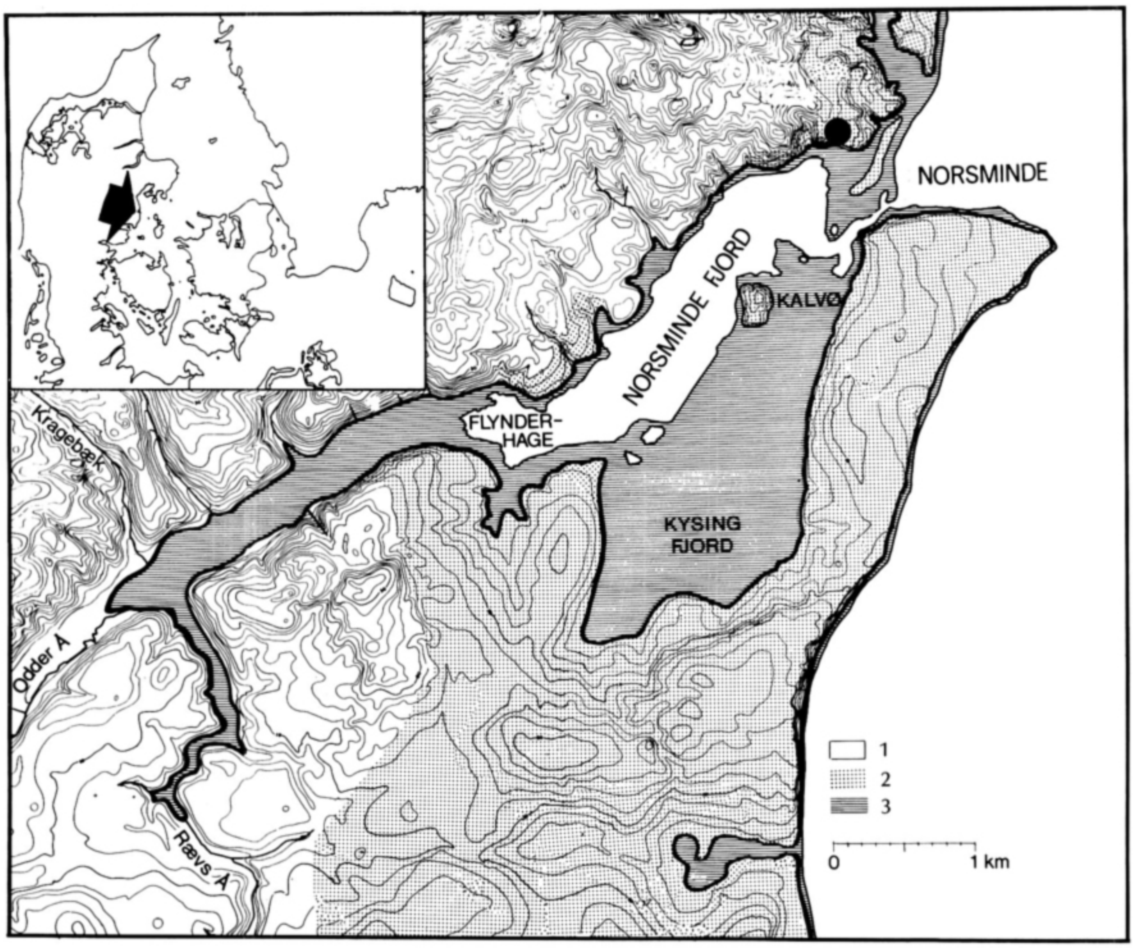

Fig. 1: Map showing the situation of the shell midden at Norsminde (black dot). – 1: clay, 2: sand, 3: ancient seafloor.

MATERIAL

The Norsminde shell midden is about 30 m long (east-west) and about 12 m wide (north-south) at the widest place (eastern part). The maximum depth of the deposits is 1.5 m (in the eastern part); the western deposits are 40-60 cm deep. The shell midden has been excavated since 1972 under supervision of S.H. Andersen, Institute of Prehistoric Archaeology, University of Århus (see Andersen 1991, this volume). The deposits include three layers: In the bottom there is a shell midden from the Ertebølle culture phase, directly overlaid by a midden from the early Neolithic Funnel Beaker Culture. The uppermost blackish layer contains artifacts from various Neolithic periods. Horizontally the shell midden appears to be divided into three parts, in accordance with the local topography. A fireplace was found in the bottom of each part.

C_{14}-datings of the Ertebølle layer from all over the midden cover the interval ca. 3500-3100 B.C. (conventional C_{14}-years). This indicates a comparatively short period of inhabitation within the late Ertebølle culture phase. The early Neolithic layer has been dated to 3000-2500 B.C. (conventional C_{14}-years), most datings lying within the interval 2900-2800 B.C. The Neolithic period of inhabitation thus also appears to have been quite short.

The shell midden was systematically excavated and may in fact be rated as totally excavated. The soil was not sieved in the field, but fish bones and other objects were collected as they were observed during the excavation. This means that many fish bones have been overlooked. However, bulk samples were sieved in the laboratory, in part through a 0.5 mm mesh screen (e.g., samples from the "fish layers" mentioned below), and numerous fish bones were recovered in this way. Equal numbers of randomly selected bulk samples were sieved from Mesolithic and Neolithic layers, respectively.

The distribution of fish bones in the midden was uneven: Some bones were scattered throughout, some occurred in large concentrations ("fish layers").

The state of preservation of the fish bones is highly variable. Many of them are badly preserved, probably due to heavy percolation of rain and ground water. Other fish bones, however, are well preserved.

Part of the southern area of the midden has been removed by the sea (presumably after 3000 B.C.; water-worn flint in the upper, blackish layers indicate inundation of the settlement, probably during the sub-boreal transgression). However, archaeological studies, including numerous profiles, show that the preserved part of the Ertebølle layer has not been secondarily disturbed. Also, the main part of the early Neolithic layer seems undisturbed by the sea.

The fish bone material is kept in the Zoological Museum, University of Copenhagen.

	No. of bones	%
Flounder (*Platichthys flesus*)	190*	2.13
Turbot/Brill (*Psetta maxima/ Scophthalmus rhombus*)	10	0.11
Plaice/Flounder/Dab (*Pleuronectes platessa/Platichthys flesus/ Limanda limanda*)	4599	51.55
Flatfish (Heterosomata) unspecified	271	3.03
Flatfish (Heterosomata) total	5070	56.83
Cod (*Gadus morhua*)	194	2.17
Saithe (*Pollachius virens*)	2	0.02
Gadids (Gadidae) unspecified	2418	27.10
Gadids (Gadidae) total	2614	29.30
Eel (*Anguilla anguilla*)	770	8.63
Herring (*Clupea harengus*)	272	3.05
Mackerel (*Scomber scombrus*)	43	0.48
Grey Gurnard (*Eutrigla gurnardus*)	43	0.48
Greater Weaver (*Trachinus draco*)	32	0.36
Bullhead (*Acanthocuttus scorpius*)	32	0.36
Salmon/Trout (*Salmo* sp.)	23	0.26
Eelpout (*Zoarces viviparus*)	13	0.15
Dragonet (*Callionymus lyra*)	3	0.03
Three-spined Stickleback (*Gasterosteus aculeatus*)	2	0.02
Sand-eel (*Hyperoplus/Ammodytes* sp.)	1	0.01
Gobiid (Gobiidae)	1	0.01
Pipefish (Syngnathidae sp.)	1	0.01
Spurdog (*Squalus acanthias*)	1	0.01
Total	8921	99.99

* Plus 237 dermal denticles.

Table 1. The species of fish in the Norsminde material, numbers of bones from each species (or higher category), and percentual occurrences.

SPECIES OF FISH AND THEIR RELATIVE FREQUENCIES IN THE MATERIAL

The fish bones were identified by comparison with recent, identified skeletons.

The entire fish bone material from Norsminde was analyzed with the exception of a few samples from layers

	Platichthys	*Psetta/Scophthalmus*	*Pleuronectes/Platichthys/Limanda*	Heterosomata unspecified	*Gadus*	*Pollachius*	Gadidae unspecified	Anguilla	*Clupea*	*Scomber*	*Eutrigla*	*Trachinus*	*Acanthocottus*	*Salmo*	*Zoarces*	*Callionymus*	*Gasterosteus*	*Hyperoplus/Ammodytes*	Gobiidae	Syngnathidae	*Squalus*
HEAD BONES																					
Para sphenoideum			3	1	28		1				1										
Vomer			46		14		1	6													
Mesethmoideum							3														
Frontale	1							1													
Exoccipitale			1	3																	
Basioccipitale			92				25	8			1		1								
Prooticum									3												
Opisthoticum			5																		
Pteroticum	54																				
Otolithi				58			164														
Neurocranium unspecified	122										8										
Praemaxillare			37		24		9			1											
Maxillare			47		16		7	4													
Dentale			18		13	1	3	10													
Articulare			16	1			25	1													
Quadratum			53	4			28	2													
Palatinum			13	15			8														
Pterygoidea		1	63				9														
Praeoperculare			5													1					
Interoperculare							2														
Operculare			4	2			4						1								
Symplecticum							2														
Hyomandibulare			30	4			8	3													
Hypohyale			2																		
Keratohyale			22	2			2	7													
Epihyale			15	1			2	5													
Urohyale	13		37					1													
Branchialia			82				6														
SHOULDER GIRDLE																					
Posttemporale							22														
Supracleithrale			48	3			17														
Cleithrum			40	4			2	5													
Postcleithrale			50																		
PELVIC GIRDLE																					
Basipterygium			8														2				
VERTEBRAE		9	3756	173	99	1	2068	717	269	42	33	32	30	23	13	2		1	1	1	1
OTHERS																					
Os anale			106																		
Dermal denticles	237																				
Total	190 +237	10	4599	271	194	2	2418	770	272	43	43	32	32	23	13	3	2	1	1	1	1

Table 2. Specification of the identified fish bones, in total 8921 (excluding 237 dermal denticles of *Platichthys*).

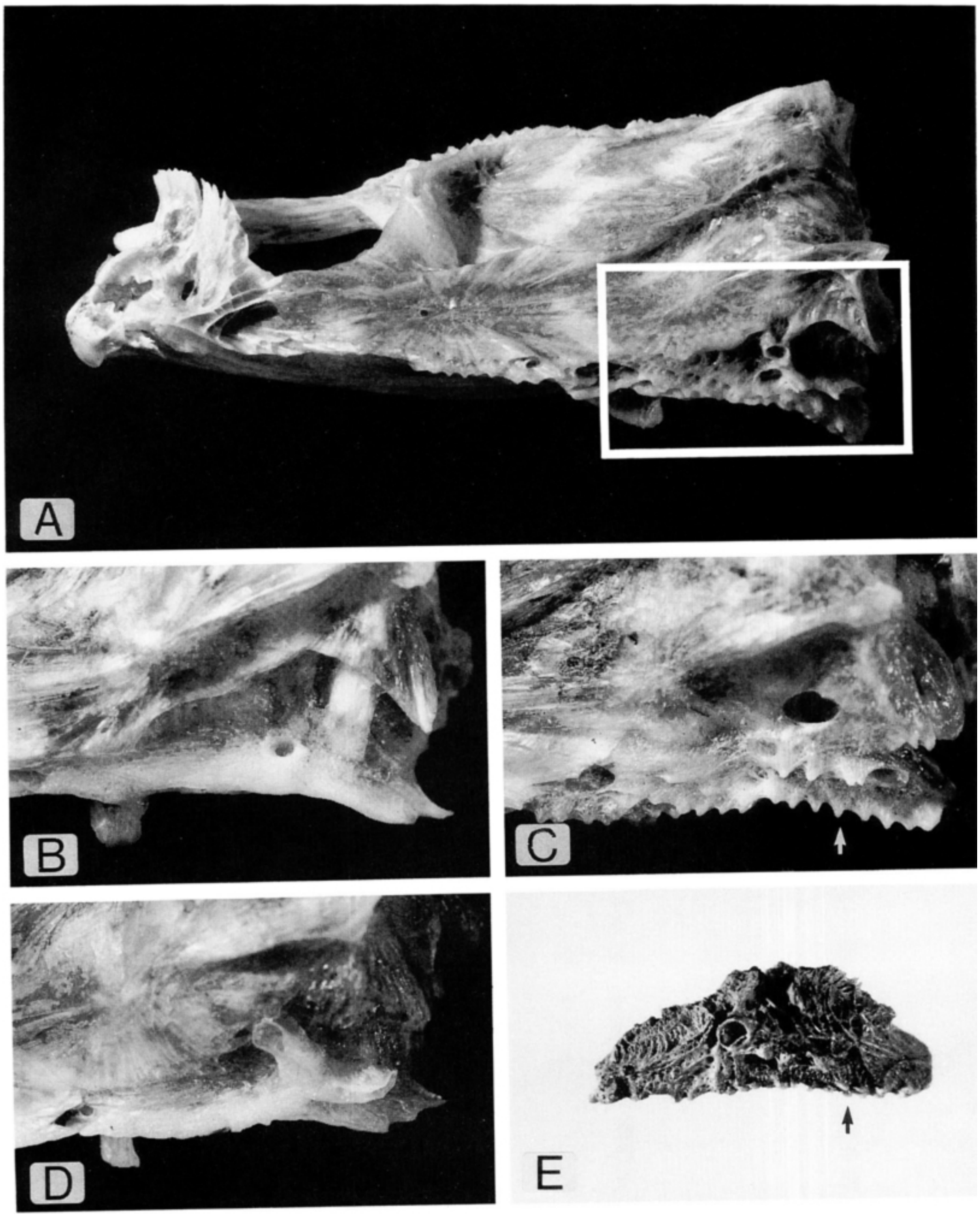

Fig. 2: Identification of subfossil *Platichthys*. – A: Neurocranium of recent *Platichthys* with position of pteroticum indicated. B-D: Pteroticum of recent *Pleuronectes* (B), *Platichthys* (C), and *Limanda* (D). E: Pteroticum (length 13.1 mm) of subfossil *Platichthys*. The arrows in C and E show the nodose-serrated margin.

with a high concentration of fish bones, from which representative sub-samples were extracted and analyzed.

Table 1 shows the species of fish found, the number of bones from each species, and the percentage occurrence of each species. The percentages are based on 8921 identified bones. The list includes 18 species of fish, in the following referred to by their Latin generic names.

The flatfish (including *Platichthys* and *Psetta/Scophthalmus*), completely dominate the material and constitute 57% of the bones. They are followed by gadids (including *Gadus* and *Pollachius*) with 29%, *Anguilla* (9%), and *Clupea* (3%). The remaining species: *Scomber*, *Eutrigla*, *Trachinus, Acanthocottus, Salmo, Zoarces, Callionymus, Gasterosteus, Hyperoplus/Ammodytes,* Gobiidae, Syngnathidae, and *Squalus,* amount to 2%.

It should be added here that the percentages must not be taken too literally. The fish species have different numbers of bones and different chances of preservation in the soil (Enghoff 1987 and references therein).

All species which are abundant in the material, are represented by bones from all body regions (Table 2).

All species on the list are marine. They include species demanding high salinity, e.g., *Pollachius, Eutrigla,* and *Callionymus,* as well as species frequenting brackish water, e.g., *Platichthys* and *Zoarces.*

All species on the list are common in Danish waters today.

Callionymus, Hyperoplus/Ammodytes, and Syngnathidae are new to the Danish subfossil fauna.

NOTES TO THE IDENTIFICATIONS

Flatfish bones are difficult, and in many cases even impossible to identify to species. The flatfish bones in the present material can be divided into two groups, viz., the *Psetta/Scophthalmus* group and the *Pleuronectes/Platichthys/ Limanda* group. Within the former group, to which only 10 bones were referred, further identification was impossible.

The latter group included no less than 4789 bones, of which 190 could be identified as *Platichthys,* whereas *Pleuronectes* and *Limanda* could not be detected. In connection with an analysis of fish bones from the Iron Age settlement Sejlflod, I was able to demonstrate (unpublished report) that the head bone urohyale may be used for distinguishing these three species. The Norsminde material included 50 flatfish urohyales of which 13 could be identified as *Platichthys* – the others were too fragmented for further identification. In connection with the present analysis I further found that several bones (chiefly the pteroticum) in the neurocranium of *Platichthys* have a characteristic nodose-serrated lateral margin which is absent in *Pleuronectes* and *Limanda* (Fig. 2). The Norsminde material contained 176 of these neurocranium bones, all with the *Platichthys* structure - corresponding bones from *Pleuronectes* and *Limanda* were not recognized. In addition the material contained 237 dermal denticles diagnostic of *Platichthys* (Enghoff 1987).

With this background I believe that the *Pleuronectes/Platichthys/Limanda* group in Norsminde is predominantly represented by *Platichthys.* Concerning the problems of flatfish bone identification, see further Heinrich (1987) and Lepiksaar & Heinrich (1977).

The identification of gadid bones was based on 7 species-specific bones: praemaxillare, maxillare, dentale, vomer, parasphenoideum, first vertebra, and second vertebra. An attempt was made to identify these bones to species; remaining gadid bones were then considered to derive, with corresponding frequencies, from the same species. Apart from 2 bones from *Pollachius,* all identified gadid bones derived from *Gadus.* The gadid material thus consists almost exclusively of *Gadus.*

DISTRIBUTION OF FISH BONES IN THE SHELL MIDDEN

The most striking aspect of bone distribution is that all bones except one were found in Mesolithic layers. This phenomenon was observed in the field during the excavation, and the field observations were supported by the results of sieving in the laboratory. Froom (1979) also noticed this in her column sample from Norsminde, which was sieved through 2 and 1 mm mesh screens. In order to check the absence of fish bones from Neolithic layers personally I sieved several samples of these layers and examined the retained material meticulously with a stereo microscope, without finding more than the single, abovementioned bone (a gadid vertebra). All other Neolithic samples lacked fish remains.

The majority of fish bones (90%) derive from a smaller, welldelimited area in the middle part of the midden (squares 31/24, 31-32/25, 31-32/26, and 31-32/28). This area was correspondingly denoted as the "fish layer" during excavation. A fireplace is situated 1-2 m west of the fish layer. The other parts of the midden are mainly represented by scattered finds of fish bones. The 4 most frequent species: *Platichthys, Gadus, Anguilla* and *Clupea,* occur all over the excavated area (to the extent that fish bones are present at all). However, *Platichthys* dominates in the above-mentioned "fish layer", whereas *Gadus* appears to dominate in other areas. (Of 854 fish bones found outside the "fish layer" 783 are from gadids.) The rarer species of fish (in total: 2% of the bones) were found only in the "fish layer" (except for 4 bones).

As to the vertical distribution of fish bones in the Mesolithic layers, regular column samples which might have elucidated this aspect were not available. In order to get

Sample no.	level	layer	No. of fish bones							
			Heterosomata	Gadidae	*Anguilla*	*Clupea*	*Scomber*	*Trachinus*	*Salmo*	*Zoarces*
BHSF	272	?	1	6	1	2				
VTA	278–80	E	1	14						
BHSD	283–86	?	2	12		3		1		
XFM	296	?	19	9		3	1		1	1
WTY	304	E	10	7	2					
ZRC	309	E	10							
ZXD	311	E	3	1						
ZXQ	313	E	14	1						
ZRA	314	E	2	1						
AAAF	314	E	13	4	1		1			
ABTB	329	?		11						

Table 3. Vertical distribution of fish bones from square 31/28. Level difference: 57 cm. E = Ertebølle layer.

an impression of the vertical distribution the squares 31/28 and 32/28 were examined more closely. These squares contained numerous fish bones from many different levels. Samples from square 31/28 span a vertical difference of 57 cm. All samples are Mesolithic and indicate uniform fishing throughout the period represented (Table 3). The same is true of the samples from square 32/28 (Table 4). No C_{14}-datings are available from these two squares. But a series of C_{14}-datings from an area close by (within a few meters) indicates ages from 3450±95 B.C. to 3370±65 B.C. (conventional C_{14}-years) and are thus largely contemporaneous.

SIZE OF THE FISH

The *Pleuronectes/Platichthys/Limanda* group (henceforward referred to as *Platichthys*, cf. above) and *Gadus* were represented by so many bones that construction of size-frequency diagrams was warranted. The lengths of subfossil *Platichthys* and *Gadus* were estimated by means of regression formulae based on large recent materials.

Flounder - *Platichthys flesus*

Among Platichthys bones suitable for measuring the first vertebra was most abundant in the Norsminde material. Therefore, corresponding values of diameter of first vertebra and total length were measured on 27 recent *Platichthys*. The relation between these values is given by the regression equation:

$$TL = 69.7268 \times W^{0.9068}$$

(the correlation coefficient $r = 0.9525$, $n = 27$), where: TL = total length of fish in mm, and W = largest width of posterior face of first vertebra in mm.

(The correlation between TL and W is identical in *Platichthys* and *Pleuronectes*, whereas *Limanda* has a slightly lower value of W at correponding TL.)

Sample no.	level	layer	No. of fish bones								
			Heterosomata	Gadidae	*Anguilla*	*Clupea*	*Scomber*	*Eutrigla*	*Salmo*	*Zoarces*	*Callionymus*
VKM	272	E		9		1					
VSZ	282	E	8	24		2		1	2	1	
VLW	289	E	4	9	1						
VZY	290	E	23	5	3						
WXX	292	E	303	53	8	1		1			
WTZ	296	E	201	33	1	3	1		2		3
ZUU	299	E	1								
ZRH	300	E	15	5			1				
AACF	302	E	2	5							
ABEZ	304	E	12	4							
ZRD-G	305	E	33	7	1					6	
ZUN	310	E	1								

Table 4. Vertical distribution of fish bones from square 32/28. Level difference: 38 cm. E = Ertebølle layer.

Measurements of the first vertebra of subfossil *Platichthys* (n = 85) were substituted in the equation. The resulting size-frequency diagram is shown in Fig. 3. The diagram shows that the *Platichthys* from Norsminde were between 15 and 37 cm long, the majority (71 out of 85) between 22 and 30 cm.

Cod - *Gadus morhua*
The lengths of subfossil *Gadus* were estimated in the same way as with *Platichthys*. I chose to measure the diamater of the second vertebra which is abundant in the material.

The regression equation is:

$$TL = 86.1390 \text{ X } W^{0.8162}$$

(the correlation coefficient r = 0.9972, n = 55), where: TL = total length of fish in mm, and W = largest width of posterior face of second vertebra in mm.

The resulting size-frequency diagram is shown in Fig. 4. The length of the Norsminde *Gadus* varies from 16 to 38 cm.

Other species
The length of the subfossil *Anguilla* was estimated by means of regression equations based on measurements of cleithrum, keratohyale, dentale, and first vertebra (see Enghoff, 1987). The Norsminde material contained only 19 measurable bones of these kinds, so a size-frequency diagram was not made. The length of Norsminde *Anguilla* varies from 32 to 93 cm; most specimens lie in the lower range.

Regarding the remaining species from Norsminde they are generally small fish - either small species (e.g., *Gasterosteus* and *Hyperoplus/Ammodytes*) or small individuals of species which may grow large (e.g. *Salmo*). Here, *Scomber* is an exception, being represented by individuals of a good size.

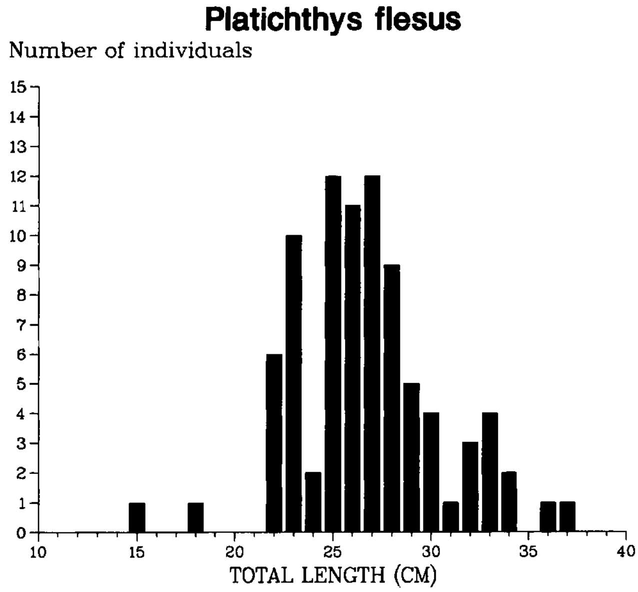

Fig. 3: Size-frequency diagram of flounder *(Platichthys flesus)* from Norsminde. Total length estimated on the basis of measurements of first vertebra. N = 85.

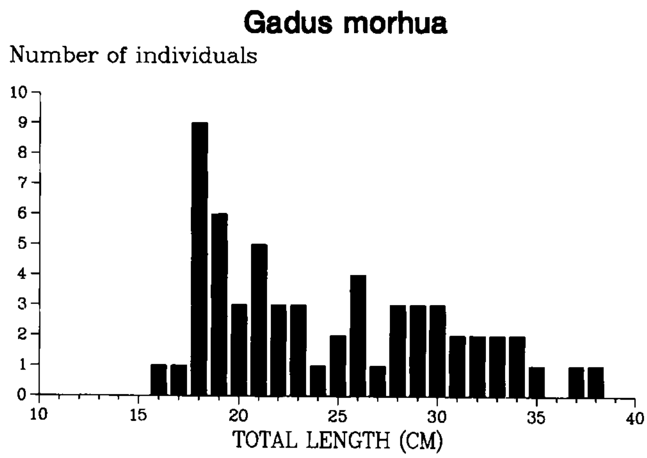

Fig. 4: Size-frequency diagram of cod *(Gadus morhua)* from Norsminde. Total length estimated on the basis of measurements of second vertebra. N = 59.

FISH BONES ASSOCIATED WITH LARGE COCKLE AND OYSTER SHELLS

Many large shells of cockle (*Cerastoderma edule*) and oyster (*Ostrea edulis*) in the Norsminde shell midden contained a firmly cemented mass of sediment, fish bones etc. In order to find out whether each shell contained a random medley of bones, or bones referable to one individual fish I examined 14 of the largest shells from the "fish layer": 12 from square 32/25 and 2 from square 31/25.

Seven of the shells contained bones which appeared to belong together. One contained a bone from the ear region (pteroticum) plus an otolith. The others contained 2-10 vertebrae of the same size and from the same region of the vertebral column. The species of fish were *Platichthys* (7 shells), *Gadus* (1 shell), and *Anguilla* (1 shell) (2 shells each contained 2 associations of bones). The remaining shells contained randomly mixed bones from several species of fish.

DISCUSSION

The Norsminde settlement was located on the shore of a marine inlet near its mouth into the Kattegat. Off the settlement there was a natural oyster bed. Since the lowest salinity tolerated by the oyster (*Ostrea edulis*) is 23‰ (Younge 1960), the salinity in this end of the inlet must have been above this level.

No major watercourses or lakes were present in the vicinity of the settlement. Accordingly, the list of fish species includes only marine species. Not a single bone of a freshwater fish has been found. Further, a C_{13}-analysis of a human skull fragment found in the Ertebølle layer of the shell midden indicated that the diet of this person was strongly dominated by sea-food.

The dominating species of fish in the shell midden is *Platichthys* (57% of the bones derive from flatfishes, cf. above). Since flatfish bones dominate the Norsminde material in spite of their high fat contents (and consequently poor chances of preservation), the importance of flatfishes must have been great. This is not surprising: *Platichthys* prefers to assemble in lagoons and inlet mouths during the summer, and the shallow Kysing Fjord must have been ideal for *Platichthys* fry. The *Platichthys* bones from Norsminde derive from fairly large individuals. Today *Platichthys* rarely grows longer than 30 cm [c. 1 kg], maximal length is 50 cm. The deep water close to the north coast of the inlet may have housed large *Platichthys*.

The second most frequent species in the Norsminde material is *Gadus* (29% of the bones). Unlike *Platichthys*, the Norsminde *Gadus* are small, even smaller than *Gadus* from the Vedbæk settlement (Enghoff 1983). *Gadus* of such small size occur close to the beach.

Several of the species on the list are common in brackish water, e.g., *Platichthys*, but also *Acanthocottus*, *Zoarces*, gobiids, *Gasterosteus*, and *Anguilla*. But taken as a whole, the species list does not indicate brackish water - the truly marine element is too large: e.g., *Pollachius*, *Eutrigla*, *Trachinus*, and *Callionymus*. In accordance with this, the inlet cannot have been all brackish, as mentioned above. However, it cannot be excluded that the Mesolithic inhabitants of the settlement have conducted fishing from the nearby coast of Kattegat proper.

A most intriguing aspect of the Norsminde fishbone material is the almost complete absense of bones from the Neolithic layers, compared with the abundance of them in the Mesolithic layers.

The consistent absence of fish bones from Neolithic layers appears strange. It is true that the Neolithic layers lie closer to the surface, where conditions of preservation are poorest, but on the other hand, bones from other vertebrates have been preserved, albeit poorly. It is hard to imagine that the Neolithic people, who did collect cockles (*Cerastoderma*) and hunt seals (*Phoca*), did not exploit the fish, which could be caught without much trouble, for instance by means of fish traps. It is generally thought that the transition from the Mesolithic to the Neolithic period was accompanied by profound environmental changes. It is true that the oyster declined strongly at that time. But even if there were changes in temperature and salinity, and even if the mouth of the inlet became narrower, there must have been fish available, although perhaps other species or other relative frequencies. Today *Platichthys* and *Anguilla* are among the commonest species of fish in Danish estuaries, e.g., Norsminde (=Kysing) Fjord (Muus 1967: 174). An over-exploitation of fish resources during the Mesolithic period is unthinkable - the available fishing tools cannot have been efficient enough for this.

Negative evidence is always difficult to explain. The possibility that the Neolithic people left their fish bones outside the shell midden always remains. But then why not the mammal bones?

Within the Mesolithic part of the shell midden the fishing appears to have been uniform: The 4 commonest species, *Platichthys*, *Gadus*, *Anguilla*, and *Clupea*, are represented in all parts of the midden where fish bones have been recovered at all. This is not surprising, since the Mesolithic part represents a comparatively short period of sedimentation within the late Ertebølle culture phase: about 400 years (see above). Furthermore, 90% of the bones derive from a discrete area, a few meters square in the central part of the shell midden, where C_{14}-datings are largely concordant, see above. The analysis of the contents of large bivalve shells, several of which contained associated bones, also indicates rapid sedimentation within this area.

However, the horizontal distribution of fish bones is not entirely uniform. In the above-mentioned delimited area in the central part, where fish bones were most plentiful, *Platichthys* bones predominate. In other parts of the excavated area where fishbones have been found (scattered finds, mostly of a few bones each), *Gadus* bones are actually in the majority. In agreement with this, Froom (1979) stated that the fish bones she examined from the eastern part of the midden were all from *Gadus*. P. Rowley-Conwy (pers. comm.) also studied fish bones from the eastern part of the midden and found almost exclusively *Gadus*. Since the various parts of the shell midden are regarded as largely contemporaneous (S.H. Andersen, pers. comm.) the difference regarding the dominating species of fish cannot be interpreted as reflecting different fisheries during different periods. Rather, the difference results from taphonomic factors: according to experience, gadid bones have high probabilities of preservation in the soil, compared to most other fish bones. Thus, gadid bones may have been preserved in those parts of the Norsminde shell midden, where fish bones are relatively scarce, and from where bones of other fishes may have disappeared. The conditions of preservation in the Norsminde midden are generally bad, but in the small area in the central part of the midden, conditions of preservation appear to have been good. Many fish bones have been preserved here (90% of the material), and in addition to the many flatfish bones, this area alone contained bones of several other species having a low resistance, such as *Scomber*, *Salmo*, and *Squalus*. Of course it cannot be entirely excluded that the high concentration of fish bones in the small area has nothing to do with taphonomy, and that it represents a period of particularly intense fishing. In any case, the Norsminde fish bone material as a whole is strongly dominated by *Platichthys*.

During the Mesolithic period, fishing appears to have taken place during the summer half of the year. The presence of the seasonal fish *Scomber* indicates this. Most of the other species caught, in the relevant sizes, e.g., small *Gadus*, would also be most easy to catch during the summer season, when they frequent coastal waters. This interpretation of the fishing agrees with results of growth ring analyses of *Gadus* otoliths from Norsminde (Froom 1979).

Neither fishhooks nor other definite fishing tools have been found in the Norsminde midden. Some bone points found may, however, have been used for fish spears (S.H. Andersen, pers. comm.).

The fish on the species list, combined with their small size, indicate fishing close to land. Such fishing would have been conducted most easily and with minimum performance by means of fish traps which are known from the Mesolithic period (Becker & Troels-Smith 1941), perhaps supplemented with weirs. Trap fishing is also indicated by the varied and uncritical selection of species caught. However, the relatively large size of the *Platichthys* is puzzling in this respect. Small flatfishes are almost absent altogether, although they must have been numerous in shallow water. *Platichthys* may be speared, but this method is less efficient than trapping.

A large number of settlements are situated at Norsminde Fjord, including several which have been contemporaneous with the Norsminde settlement: Frederiks Odde, Store Nor, Flynderhage, Norslund Syd, Smedensborg, and Kalvø (Andersen 1976). From none of these do we have analyzed fish bone material of any importance, so it is not possible to say whether the fishing pattern shown by the Norsminde material is of general validity for the area during the period in question.

In comparison with contemporaneous settlements from where analyses of large fish bone materials are available, Norsminde is distinguished by the dominance of *Platichthys* bones. This is explained in terms of the topographic situation of the settlement. It is also noteworthy that not a single bone from a freshwater fish has been found - in this respect Norsminde resembles the Tybrind Vig settlement (Trolle-Lassen 1984). The classial settlement at Ertebølle on the contrary, is dominated by freshwater fishes, in spite of its marine situation. This apparent paradox has been interpreted as a specialization in fishing for *Anguilla* (Enghoff 1987). The fish bone material from the shell midden at Bjørnsholm, dominated by *Anguilla* bones, can be interpreted in the same way (Enghoff unpublished). The fish bones recovered from the settlements at Vedbæk include a large proportion of *Gadus* bones (Aaris-Sørensen 1980), but subsequent studies have shown that flatfishes have also played an important role here (Enghoff unpublished).

In summary, fish bones from Danish Ertebølle settlements differ widely with regard to species composition and frequencies. This may be primarily due to differences in availability of the various fish species in the local fishing waters. However, part of the divergencies may be attributable to local specializations in the exploitation of particular phenomena in the habits of the fishes, e.g., the autumnal migrations of *Anguilla*.

Information on the Norsminde shell midden and its excavation has been extracted from Andersen (1991, this volume) unless otherwise stated.

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Inge Bødker Enghoff, Zoological Museum, University of Copenhagen, Universitetsparken 15, DK-2100 Copenhagen Ø.

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