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Fishing in the Baltic Region from the 5th century BC to the 16th century AD: Evidence from Fish Bones

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ABSTRACT: Archaeological fish bone assemblages from the Baltic region of Europe are reviewed for the period from the 5th century BC to the 16th century AD. The evidence from the fish bones is used to illuminate fishing, fish consumption and fish trade. At almost all sites, the selection of fish species in the assemblages indicates a very strong influence from the local fish fauna. The species of fish and the size of the individuals indicate that a variety of fishing methods have been employed throughout the period studied, including nets, hooks and weirs. In some countries, a chronological development in fishing, for example, a tendency towards more sea-going fishing, is reflected in the fish bone assemblages.

KEYWORDS: FISH, FISH BONE ASSEMBLAGES, BALTIC, IRON AGE, VIKING AGE, MIDDLE AGES, PREHISTORIC FISHING, PROTOHISTORIC FISHING, FISHING IN HISTORICAL TIMES

RESUMEN: En este trabajo se lleva a cabo una revisión pormenorizada de las muestras ictioarqueológicas de la región del Báltico en el periodo comprendido entre el siglo V a.C. y el siglo XVI d.C. Los acúmulos de peces nos sirven para arrojar luz sobre las técnicas pesqueras así como el consumo y comercio de pescado. En casi todos los asentamientos la selección de especies en las muestras indica una muy fuerte influencia de las faunas locales de peces en el espectro ictiofaunístico. Las especies de peces y el tamaño de los individuos indican que a lo largo de todo el periodo estudiado fueron utilizadas una serie de artes de pesca que incluyen redes, anzuelos y trampas. En algunos países las muestras ictioarqueológicas reflejan una serie de tendencias diacrónicas en las estrategias pesqueras como, por ejemplo, una tendencia hacia desarrollar pesquerías en zonas progresivamente más alejadas de las costas.

PALABRAS CLAVE: PECES, ASOCIACIONES ICTIOARQUEOLÓGICAS, BÁLTICO, EDAD DEL HIERRO, EDAD VIKINGA, EDAD MEDIA, PESCA PREHISTÓRICA, PESCA PROTOHISTÓRICA, PESCA EN ÉPOCAS HISTÓRICAS

INTRODUCTION

Fish bones are often preserved in remains from former cultures as a more or less direct result of fishing. Fish bones recovered during archaeological excavations provide evidence of catch, consumption and trade of fish in former times. The species of fish represented in the remains, the sizes of the individual fish, and other aspects of the fish bone evidence can indicate the kind of water in which they were caught (lake, river, coast or open sea), the season during which the fishing took place and which methods were used.

In the present paper evidence from fish bones is used to elucidate fishing, fish consumption and fish trade in the Baltic region of Europe during the period from the 5th century BC (beginning of the Iron Age in Denmark) to the mid-16th century AD (end of the Middle Ages). The southern North Sea region will be dealt with in a similar way in a

forthcoming paper (Enghoff, submitted) which covers the period from the 1st to the 16th century AD. The North Sea paper will also include a general discussion of the fish trade which applies to both regions.

Significant developments in Baltic fishing equipment and techniques took place during the period covered, including the development of seagoing ships which made fishing on the open sea and long-distance trade possible. This is clearly reflected in the fish bone evidence which in this review is allowed to "speak for itself": written sources have not been taken into account although they are available for the latter part of the period.

MATERIAL AND METHODS

The Baltic region has, for the purposes of this review, been defined as comprising the following countries: Denmark (except the North Sea coast of Jylland), southern Norway, Sweden, Finland, Estonia, Latvia, Lithuania, westernmost Russia, Poland (except the southernmost parts) and Germany (except the North Sea coast and the southernmost parts).

The review is based mainly on published studies by the author and many others, and a number of unpublished reports have kindly been put at my disposal by various colleagues. Furthermore, original analyses of material from five Danish sites (Smedegård, Gl. Lejre, Birkely, Selsø-Vestby and Sebbersund) are included.

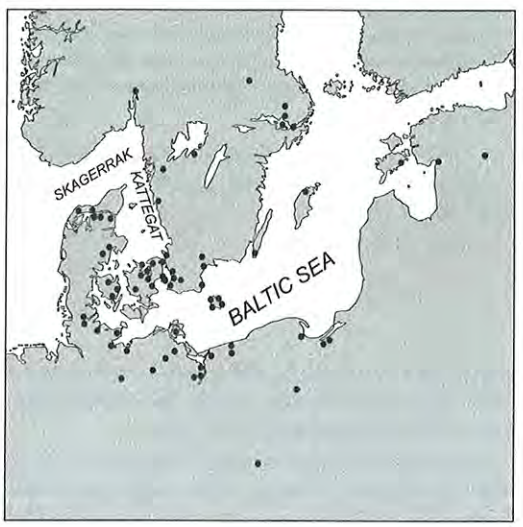

FIGURE 1
Map of the Baltic region of Europe, showing the location of the reviewed sites. See also the more detailed maps for each country (Figures 2, 6, 9-11).

The locations of the reviewed sites are shown in Figure 1. Records from Denmark, Norway, Sweden, Estonia, Poland and Germany are given in Tables 2-7. No information was available from Russia, Lithuania, Latvia and Finland. The entries in Tables 2-7 are numbers of fish bones for each species where such numbers were available. Where absolute numbers were not given, or frequency was indicated as a percentage or by a letter code, entries in the tables are given as presence/absence. This method of presentation was chosen for the sake of uniformity, at the expense of loss of information in some cases. Scales, dermal denticles etc. have not been included in the bone counts, instead their presence is recorded in footnotes to Tables 2-7. In the tables, as well as in the sections on individual sites from each country, sites are arranged chronologically, according to the age of their oldest phase. The fish species are divided into marine, migratory and freshwater species in Tables 2-7. Within each of these ecological groupings the species are listed systematically (i.e. by taxonomic group).

Table 1 summarizes the occurrence of fish species in the fish bone assemblages analyzed here, with English and Latin names according to Whitehead *et al.* (1984-1986) for marine species and, as far as possible, Blanc *et al.* (1971) for freshwater ones; when these were not applicable, Wheeler (1978) was used. Since the English names of fish species may be unfamiliar to many readers, the species are arranged alphabetically in Table 1.

The fish bone evidence included in the review is obviously of very variable quality, having been influenced by several taphonomic factors. These include, for example, the different conditions for preservation of bones prevailing at the sites, the different susceptibility to decay of bones from different species, the influence of various treatments (for instance cooking) on the chances of survival (Nicholson, 1992a, 1992b, 1993) and the different excavation techniques used through time. With regard to the last factor, small fish bones will only be recovered in any quantity if sieving of the sediment through a fine mesh is employed (Payne, 1972; Enghoff, 1993). It is very important to keep this in mind when evidence from different sites is compared and general conclusions are drawn. It is, however, often possible to evaluate smaller, less

	DK	N	S	EST	PL	D
Alpine bullhead, *Cottus poecilopus*	.	.	.	.	.	.
Asp, *Aspius aspius*	.	.	+	.	+	+
Atlantic bluefin tuna, *Thunnus thynnus*	+	+	.	.	.	.
Atlantic horsemackerel, *Trachurus trachurus*	.	.	.	.	.	+
Atlantic mackerel, *Scomber scombrus*	+	+	+	.	.	+
Ballan wrasse, *Labrus bergylta*	.	+	.	.	.	.
Barbel, *Barbus barbus*	.	.	.	.	+	.
Black goby, *Gobius niger*	+	.	.	.	.	.
Brill, *Scophthalmus rhombeus*	.	.	.	.	.	.
Bullhead, *Cottus gobio*	.	.	.	.	.	.
Bullrout, *Myoxocephalus scorpius*	+	.	+	.	.	+
Burbot, *Lota lota*	+	.	+	+	+	+
Cartilaginous fishes, Chondrichthyes	+	+	+	.	.	+
Chub, *Leuciscus cephalus*	.	.	.	.	+	+
Clupeids, Clupeidae	+	.	+	+	+	+
Cod, *Gadus morhua*	+	+	+	+	+	+
Common bream, *Abramis brama*	+	.	+	+	+	+
Common carp, *Cyprinus carpio*	.	.	.	.	+	+
Common sole, *Solea vulgaris*	+	.	.	.	.	.
Crucian carp, *Carassius carassius*	+	.	+	.	+	+
Cyprinids, Cyprinidae	+	+	+	+	+	+
Dab, *Limanda limanda*	.	.	.	.	.	+
Dace *Leuciscus leuciscus*	.	.	.	+	+	+
Eel, *Anguilla anguilla*	+	+	+	+	+	+
Eelpout, *Zoarces viviparus*	+	.	+	.	.	+
Flatfish, Heterosomata	+	+	+	+	+	+
Flounder, *Platichthys flesus*	+	.	+	+	.	+
Gadids, Gadidae	+	+	+	+	+	+
Garfish, *Belone belone*	+	+	+	.	.	+
Gobiids, Gobiidae	+	.	.	.	.	.
Golden Redfish, *Sebastes marinus*	.	+	.	.	.	.
Goldsinny Wrasse, *Ctenolabrus rupestris*	+	.	.	.	.	.
Greater Weaver, *Trachinus draco*	+	.	.	.	.	.
Haddock, *Melanogrammus aeglefinus*	+	+	+	.	.	+
Hake, *Merluccius merluccius*	+	.	+	.	.	+
Halibut, *Hippoglossus hippoglossus*	.	.	+	.	.	+
Herring, *Clupea harengus*	+	+	+	+	+	+
Ling, *Molva molva*	+	+	+	.	.	+
Norway pout, *Trisopterus esmarki*	.	+	.	.	.	.
Orfe, *Leuciscus idus*	.	.	+	+	+	+
Perch, *Perca fluviatilis*	+	+	+	+	+	+
Percids, Percidae	+	+	+	+	+	+
Pike, *Esox lucius*	+	+	+	+	+	+
Pikeperch, *Stizostedion lucioperca*	.	.	+	+	+	+
Plaice, *Pleuronectes platessa*	+	.	+	.	.	+
Pollack, *Pollachius pollachius*	.	.	.	.	.	.
Poor-cod, *Trisopterus minutus*	.	+	.	.	.	.
Porbeagle, *Lamna nasus*	+	.	.	.	.	+
Ray, *Raja* sp.	+	+	+	.	.	+
Roach, *Rutilus rutilus*	+	+	+	+	+	+
Rudd, *Scardinius erythrophthalmus*	+	.	+	.	+	+
Ruffe, *Gymnocephalus cernua*	.	.	.	.	+	+
Sailray, *Raja lintea*	.	.	.	.	.	+
Saithe, *Pollachius virens*	+	+	+	.	.	+
Salmon, *Salmo salar*	.	+	+	.	+	+
Salmonids, Salmonidae	+	+	+	+	+	+
Shad, *Alosa* sp.	.	.	.	.	+	+
Sharks, Pleurotremata	+	+	+	.	.	+
Skate, *Raja batis*	.	.	+	.	.	.
Smallspotted catshark, *Scyliorhinus canicula*	.	+	.	.	.	.
Smelt, *Osmerus eperlanus*	.	.	.	.	+	.
Smoothhound, *Mustelus* sp.	+	.	.	.	.	+
Spurdog, *Squalus acanthias*	+	+	+	.	.	.
Starry skate, *Raja radiata*	.	.	.	.	.	+
Sturgeon, *Acipenser sturio*	+	.	+	+	+	+
Swordfish, *Xiphias gladius*	.	.	.	.	.	+

Tench, *Tinca tinca*	+	.	+	+	+	+
Thornback Ray, *Raja clavata*	+	.	+	.	.	+
Three-spined Stickleback, *Gasterosteus aculeatus*	+	.	.	.	.	+
Topeshark, *Galeorhinus galeus*	+	.	.	.	.	.
Torsk, *Brosme brosme*	.	+	.	.	.	.
Trout, *Salmo trutta*	+	.	+	.	+	+
Turbot, *Psetta maxima*	+	.	+	.	.	+
Twaite shad, *Alosa fallax*	.	.	.	.	+	.
Wels, *Siluris glanis*	.	.	+	+	+	+
White bream, *Blicca bjoerkna*	.	.	.	.	+	.
Whitefish, *Coregonus* sp.	+	.	+	+	+	+
Whiting, *Merlangius merlangus*	+	+	+	.	.	.
Wrasses, Labridae	+	+	.	.	.	.
Zährte, *Vimba vimba*	.	.	.	+	+	+
Ziege, *Pelecus cultratus*	.	.	.	.	+	.
Zope, *Abramis ballerus*	.	.	+	.	+	+

TABLE 1

List of the fish taxa (species and a few genera and higher categories) of fish mentioned in the text, and indication of the countries from which they have been recorded in Iron Age to Medieval fish bone assemblages.

The list is arranged alphabetically according to the English names, with corresponding Latin names added. The nomenclature follows Whitehead *et al.* (1984-1986) for marine species and, as far as possible, Blanc *et al.* (1971) for freshwater ones; when these were not applicable, Wheeler (1978) was used.

D = Germany, DK = Denmark, EST = Estonia, N = southern Norway, PL = Poland, S = Sweden.

Species which are not indicated as occuring is any of the countries are included because they occur in the national lists as unconfirmed possibilities (e.g., brill which has been recorded only as "turbot/brill").

meticulously excavated samples against the background of large, sieved ones. In order to obtain as complete a coverage as possible, small, non-sieved materials have therefore been included in the present review.

Denmark is treated in somewhat more detail than the other countries, owing to the author's personal experience with several of the sites. The Danish evidence has been divided according to cultural periods: Iron Age, Viking Age and Middle Ages, in addition to being assigned to a particular century or centuries. For the sake of comparability, evidence from other countries is as a rule only referred to by century, since the cultural periods may be differently defined and delimited.

Some of the papers dealing with fish bones refer to finds of fishing equipment. This information has been taken into account but a systematic search for literature on this subject has not been made, just as written sources dealing with fish trade etc. have not been consulted.

DENMARK, INDIVIDUAL SITES

The review is based partly on already published evidence and partly on material from a number of hitherto unpublished sites which have in part been analyzed by the author within the framework of the present project. These are Smedegård, Gl. Lejre, Birkely, Selsø-Vestby and Sebbersund. Three sites from the island of Bornholm are reported on the basis of unpublished studies by Henrik Høier.

The site numbers refer to Figure 2 (see Table 2 for detailed species lists).

FIGURE 2

Map of Denmark, showing the location of the reviewed sites. Site numbers refer to the section "Denmark, individual sites". The three sites marked with A (Nørre Fjand), B (Ribe) and C (Trøjborg) are treated in detail elsewhere (Enghoff, submitted).

Sejlflod (1)

An Iron Age village on the Limfjord (Nielsen & Rasmussen, 1986). The fish bones mostly derive from chalk layers in house floors dating from 500 BC to AD 1050 (Pre-Roman, Roman and Germanic Iron Age as well as Viking Age). The fish bones were recovered by sieving through a 2 mm mesh and are generally well preserved (Enghoff, 1992, unpublished report c).

The fish bone samples appear to be quite uniform throughout this long period of time and are dominated by flatfish, especially flounder (68% of the bones). Dog coprolites found at Sejlflod also contained many remains (bones and dermal denticles) of flounder (Figure 3). Garfish (20%), which is a seasonal species occurring in Danish waters only from spring to autumn, is an indicator of summer fishing. Greater weaver (10%) has also played an important role, and whitefish is present as well. The fishing from Sejlflod may very well have taken place in the Limfjord which, at the beginning of the Iron Age, had several openings to the North Sea (Petersen, 1987) and was more saline than today. Even today all the species on the Sejlflod list, perhaps with the exception of whitefish, can be caught in the easternmost Limfjord.

FIGURE 3

Top. Dog coprolites found at Sejlfold, $2^{1/2}$ × natural size. Bottom. Bones and dermal denticles from flounder, found by dissolution of the coprolites, 3 × natural size.

Mellemholm (2)

Another Iron Age village on the Limfjord. The fish bones derive from a rubbish pit, dated on the basis of ceramics to about 400 BC (Pre-Roman Iron Age). The fish bones were recovered by sieving through a 2 mm mesh (Rosenlund, unpublished report a) and are strongly dominated by plaice/flounder/dab; in addition there are a few bones of garfish and eel.

Smedegård (3)

A Pre-Roman to Roman Iron Age village (300 BC - AD 100) located between the Skagerrak and the Limfjord. The conditions for preservation of organic material at the site are good. The fish bones were recovered by flotation and wet sieving through a 4 mm mesh and have been identified by Enghoff (present work). The animal bones other than fish bones from Smedegård are currently subject of a Ph.D. study by T. Nord Andreasen.

The catch at Smedegård was quite varied, being dominated by garfish (30%), plaice/flounder/dab (26%), especially flounder, and eel (21%) (Figure 4). A very special feature of Smedegård is the presence of topeshark and smoothhound (8%), plus a single bone from spurdog. Also noteworthy is a characteristic scute from sturgeon. Whitefish is represented as well, as at Sejlflod. Today, whitefish does not occur north of the Limfjord but is common in the Limfjord itself where the inhabitants at Smedegård may have caught it. Summer fishing is documented by the presence of garfish. All in all, there are indications of fishing both in the North Sea (especially the sharks) and in the Limfjord, and perhaps even fishing in fresh water for pike, roach and perch, although these species may also have been caught in the brackish parts of the Limfjord.

Lundeborg (4)

A trading centre on the island of Fyn. Occupation was probably limited to short periods of the year (Thomsen, 1994). The settlement dates from

Site	Sejlflod	Mellemholm	Smedegård	Lundeborg	Sorte Muld	Gl. Lejre	Aggersborg	Birkely	Selsø-Vestby				Sebbersund	Århus Sønderve	
Site nº.	1.	2.	3.	4.	5.	6.	7.	8.	9.				10.	11.	
Age (centuries)	6 BC-11 AD	5 BC	4 BC-2 AD	3-4 AD	6-7 AD	7-11 AD	8-10 AD	8-11 AD	8-9 AD	9-10 AD	10-11 AD	12-13 AD	10 AD	10-12 AD	10-14 AD 1
Recovery technique	s	s	s	s	s	s	h	s	s	s	s	[6]	s	h	h
MARINE SPECIES															
Porbeagle	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smoothhound	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Topeshark	.	.	16	.	.	.	.	.	.	.	.	.	.	.	.
Spurdog	.	.	2	.	.	.	.	.	.	.	.	.	.	1	+
Thornback ray	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Cartilaginous fishes, unspecified	.	.	10	.	.	.	.	.	.	.	.	.	.	.	.
Herring	.	.	.	.	13332	965	.	32	616	8	362	>>9770	+	.	.
Garpike	398[1]	a few	125	1	.	56	224	.	30	3	2	.	+	2	+
Hake	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Gadids, total	2	.	15	59	495	343	86	559	1138	6	146	.	.	904	?
Cod	1	.	11	59	495	44	81	164	30	1	20	.	.	856	+
Haddock	.	.	1	.	.	12	5	1	.	.	8	.	.	46	+
Whiting	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saithe	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.
Pollack/Saithe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ling	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gadids, unspecified	1	.	3	.	.	287	.	394	1057	5	118	.	.	.	.
Goldsinny wrasse	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Greater weaver	184	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Atlantic mackerel	.	.	.	.	2	1	.	.	1	.	.	.	.	.	.
Atlantic bluefin tuna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eelpout	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Black goby	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gobiids, unspecified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bullrout	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Three-spined stickleback	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Site	Sejlflod	Mellemholm	Smedegård	Lundeborg	Sorte Muld	Gl. Lejre	Aggersborg	Birkely	Selsø-Vestby				Sebbersund	Århus Sønderve	
									8-9 AD	9-10 AD	10-11 AD	12-13 AD	10 AD	10-12 AD	10-14 AD 1
Flatfishes, total	1319	.	151	15	3	67	172	27	1693	232	323	.	?	20	?
Turbot	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Turbot/Brill	.	.	8	.	.	.	.	.	.	.	.	.	.	.	.
Plaice	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Flounder	17	.	7	.	.	1	.	.	18	1	2	.	+	.	.
Plaice/Flounder/Dab	1301	ca. 500	134	15[3]	3	66	172	27	1675	231	321	.	98%	20	+
Common sole	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flatfishes, unspecified	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
MIGRATORY SPECIES															
Sturgeon	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.
Trout	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trout/Salmon	7	.	.	1[4]	79[5]	24	.	.	.	.	1	.	.	.	.
Whitefish	1[2]	.	22	.	.	.	.	.	.	.	.	.	+	.	.
Salmonids, unspecified	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Eel	20	1	123	.	22	8	.	22	1	1	1	.	+	.	.
FRESHWATER SPECIES															
Pike	.	.	2	.	.	11	.	14	.	.	.	.	.	1	.
Cyprinids, total	.	.	43	.	.	40	.	388	1	.	21	.	.	3	?
Crucian carp	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Tench	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.
Roach	.	.	9	.	.	2	.	1	.	.	.	.	.	.	.
Rudd	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Common bream	.	.	.	.	.	4	.	25	.	.	.	.	1	+	3
Cyprinids, unspecified	.	.	34	.	.	34	.	362	.	.	21	.	.	.	.
Burbot	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Perch	.	.	6	.	.	21	.	64	5	1	4	.	.	.	+
Total	1931	ca. 500	518	76	13935	1537	482	1106	3485	251	860	>>9770	ca. 1500	932	?

[1] excluding 11 scales.
[2] excluding 62 scales.
[3] orig. ref.: flatfish unspecified.
[4] orig. ref.: Salmon.
[5] orig. ref.: Salmon.
[6] untreated sediment samples.
[7] original publication: flatfish unspecified.
[8] original publication: Salmon.
[9] original publication: Salmon.
[10] excluding 2 scales.
[11] excluding 3 dermal denticles.
[12] excluding 104 dermal denticles.
[13] excluding 74 scales.
[14] excluding 137 scales.
[15] 2 scales only.
[16] 1 scale only.
[17] excluding 232 scales.
[18] excluding 2450 scales.
[19] original reference: Salmon.

TA

Numbers of identified fishbones from Danish sites. Recc

Møllebjerg	Kobbegaard	Munkerup	Pedersborg Voldsted	Svendborg Matr. 482	Svendborg Matr. 449a	Næsholm	Køge	Holbæk	Tårnby Torv			Odense Sortebrøde	Dragør	Øm Kloster
12. 11 AD s	13. 11 AD s	14. 11 AD s	15. 12 AD s	16. 12-15 AD ?	12-15 AD ?	17. 13-14 AD h	18. 13-14 AD h	19. 13-15 AD h+s	20. 13-14 AD s	14-15 AD s	16 AD s	21 13-16 AD s	22 14-15 AD h+s	23 15-16 AD h
.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
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2988	1305	2984	1	12	.	.	80	743	375	1164	.	57	+	.
.	.	.	.	27	.	1	.	203	.	.	.	3	.	2
.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
147	533	686	327	162	?	77	10	1496	9	219	7	450	?	7
147	533	686	327	129	+	29	10	880	1	55	7	201	+	3
.	.	.	.	15	+	48	.	134	.	1	.	248	+	4
.	.	.	.	.	.	.	.	7	.	.	.	.	.	.
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.	.	.	.	2	.	.	.	4	.	.	.	1	.	.
.	.	.	.	16	+	.	.	468[10]	8	163	.	.	.	.
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.	87	.	.	7	.	.	2	16	.	.	.	1	.	.
.	.	.	.	.	.	.	.	3	.	.	.	.	.	.

Møllebjerg	Kobbegaard	Munkerup	Pedersborg Voldsted	Svendborg Matr. 482	Svendborg Matr. 449a	Næsholm	Køge	Holbæk	Tårnby Torv 13-14 AD	14-15 AD	16 AD	Odense Sortebrøde	Dragør	Øm Kloster
.	.	6	1	448	?	.	.	1120	1	26	.	124	?	1
.	.	.	.	1	.	.	.	5[11]	.	2	.	.	.	.
.	.	.	.	.	.	.	.	2	.	.	.	.	.	.
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.	.	6	1	447[7]	+	.	.	1011	.	22	.	124	+	1
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.	11	25	.	1[8]	+[9]	.	.	1	.	.	.	.	.	1[19]
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4	1	4	.	2	.	.	.	183	4	237	.	69	+	7
.	.	.	21	10	.	.	.	9[13]	.	.	.	17	.	32
.	.	.	14	2	?	3	.	18	1	1	.	14	.	59
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	14	.	.	3	.	.	.	.	.	7	.	.
.	.	.	.	.	.	.	.	2	.	.	.	1	.	9
.	.	.	.	.	.	.	.	1	.	.	.	1	.	2
.	.	.	.	.	.	.	.	4	.	.	.	1	.	36
.	.	.	.	2	+	.	.	11[14]	1	1	.	4	.	12
.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	.	.	22	1	.	[15]	[16]	10[17]	.	3	.	181[18]	.	83
3160	1940	3705	389	673	?	82	92	3843	391	1654	8	925	?	198

; 2

technique: h = hand-collected, s = sieved, ? = unknown.

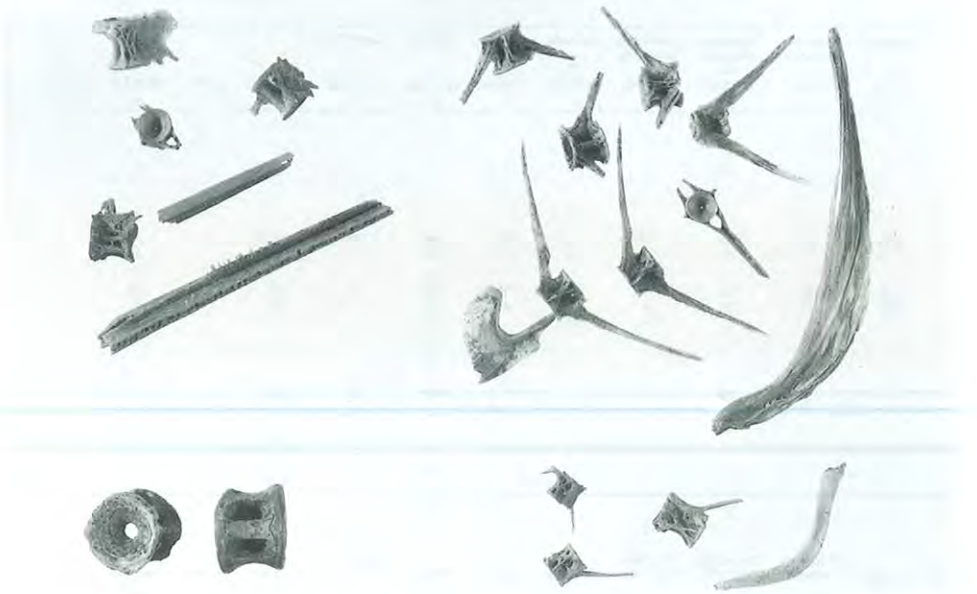

FIGURE 4

A selection of fish bone from Smedegård. The most important species in the Smedegård material are garfish (upper left: vertebrae and two jaw bones), plaice/flounder/dab (upper right: vertebrae, os anale, urohyale of flounder) and eel (lower right: vertebrae, cleithrum). A characteristic trait of the Smedegård material is the relative large percentage of cartilaginous fishes (lower left: topeshark vertebrae, note drilled hole in center), $1^{1/2}\times$ natural size).

the beginning of the 2nd to the end of the 7th century AD, but the main occupation period is dated to the 3rd and 4th centuries, i.e., late Roman Iron Age. The fish bones were recovered by wet sieving (mesh size unknown) (Hatting, 1989, 1994).

The fish bone material from Lundeborg differs from that discussed so far by being composed exclusively of marine species: cod dominates, and garfish shows that the site was used during the summer half of the year. However, the modest size of the material (76 bones) precludes detailed speculations.

Sorte Muld (5)

A chieftain's seat and cult site on the island of Bornholm, dating from the Germanic Iron Age (6th-7th centuries AD). The fish bones were recovered by wet sieving through a 3 mm (in a few cases 4 mm) mesh (Watt, 1991).

The fish bone material from Sorte Muld is very strongly dominated by herring (13332 bones). The only other well-represented species is cod, but 79 bones of salmon/trout is also a large number for this species. There are two of the easily decomposed bones of mackerel, indicating summer fishing. The recovery of such a large number of the small bones of herring is due to the meticulous sieving technique employed (Hatting, 1989).

Gl. Lejre: Mysselhøjgård (6)

A chieftain's farm close to Roskilde, dated to the 7th-11th centuries AD. The fish bones were recovered by dry sieving through 4 mm mesh (Enghoff, unpublished report b and present work).

The material includes many bones of herring, 63% of the identified bones. Cod and haddock were important too, comprising up to 22% of the assemblage. The presence of garfish, and a single bone of mackerel, indicate summer fishing. A notable number of salmon/trout bones and a single bone of thornback ray deserve special mention, as these species were then regarded as luxury food reserved for the upper class (Zbierski, 1976). The

herring bones seem not to be the result of a particular processing technique since bones from all body regions are represented.

Aggersborg (7)

A Viking Age village located at an important point of passage across the Limfjord, dated to AD 700-980 (Roesdahl, 1986).

The fish bone material was hand-collected (Hatting & Rosenlund, unpublished report; Rosenlund, 1976). The inhabitants seem to have eaten mostly garfish since about half of the bones belong to this species. Plaice/flounder/dab and gadids were also important.

Birkely (8)

The grubenhaus settlement Birkely was located on a major lake, Arresø, in Sjælland close to Kattegat. It is dated to the 8th-11th centuries AD. The fish bone material was recovered by dry sieving through a 4 mm mesh and mostly derives from inside the houses (Enghoff, unpublished report a).

Consistent with the site's geographical location, rather more than half of the fish bones derive from marine fish, just less than half come from freshwater fish and the remainder come from migratory species. The list consists of species commonly eaten. Gadids and cyprinids (especially common bream), in particular, were important.

Selsø-Vestby (9)

The settlement Selsø-Vestby lay on Roskilde Fjord (Sørensen & Ulriksen, 1995). The Viking Age settlement was abandoned during the 11th century AD and was succeeded, early in the 12th century AD, by a Middle Age village. The fish bone evidence covers the 8th-13th centuries AD but can be subdivided into three Viking Age phases: 8th-9th, 9th-10th, and 10th-11th centuries plus a Medieval (13th century) phase. The fish bones from the Viking Age phases were recovered by wet sieving through a 4 mm mesh of sediment samples from inside the grubenhauser. The Medieval material consists of sediment samples with a high concentration of herring bones.

During all three Viking Age phases there are three important groups of fish species, i.e. plaice/flounder/dab (mostly, perhaps even exclusively, flounder), gadids and herring. There is also a smaller but constant presence of garfish. The relative fre-

FIGURE 5

Untreated sediment sample from early Medieval layers at Selsø-Vestby. The sediment consists almost exclusively of bones of herring.

FIGURE 6

Herring bones from Selsø-Vestby. All the bones belong to the hyoid arch, the gill arches, and the shoulder girdle, $1^{1/2} \times$ natural size.

quencies of these important groups vary through time. Herring bones thus constitute 42% of the bones from the 10th-11th centuries, against 18% in the 8th-9th centuries, suggesting an increasing importance of herring. The cod from the 10th-11th centuries seem to be larger (the majority 0.55-0.60 m long, a few up to 1.04 m) than those from the 8th-9th centuries (the majority 0.40-0.45 m). There are no signs of the processing cod for stockfish.

The early Medieval material consists exclusively of huge amounts of herring bones (Figure 5). On the basis of the biased representation of bone elements this material is interpreted as the remains of an industry where herring were salted after removal of the gills. All bones in the sample (Figure 6) belong to the region just behind the head (hyoid arch, gill arches, shoulder girdle; see Enghoff (1996) for further details). The entire Selsø-Vestby material may tentatively be interpreted as reflecting increasingly important herring fishery, culminating in a surplus which formed the basis of a herring industry.

Sebbersund (10)

A Viking Age trading place on the Limfjord. More than 150 grubenhauser have been recognized, as well as a market place and a craftmen's area. Sebbersund has been dated to about AD 700-1000. The fish bones were recovered by sieving sediment from a 10th century grubenhaus through a 3 x 4 mm mesh (P. Birkedahl, pers. comm.).

A preliminary analysis of the fish bones (Enghoff herein) shows a strong dominance of plaice/flounder/dab, esp. flounder (98% of 1500 fish bones). Eel, garfish and herring have played minor roles. As is typical of material from the Limfjord area, whitefish is also present.

Århus Søndervold (11)

A Viking Age settlement located on a coastal hillock facing the sea (Kattegat). The settlement evolved into a Medieval town (Hellmuth Andersen *et al.*, 1971). The well-preserved bone material can be divided into two phases: 10th-12th centuries AD (Viking Age) and 13th-14th centuries AD (Middle Age), plus mixed material from both periods (Møhl 1971; Rosenlund, 1976).

Fishing for cod seems to have been of overwhelming significance during both phases, although Møhl (1971) interpreted the cod fishing during the Viking Age phase as more intensive. Apart from cod, haddock and ling were also exploited; the latter is a deep-water species.

Møllebjerg (12), Kobbegaard (13), and Munkerup (14)

Three Viking Age to early Medieval farm sites on the island of Bornholm in the Baltic Sea, dated to the 11th century AD.

The fish bones were retrieved by sieving through a 3 mm mesh. They were studied by Henrik Høier (pers. comm.). At all three sites the assemblages are strongly dominated by herring, with 0.20-0.40 m long cod in a clear second place. The relatively large number of bones of trout/salmon is noteworthy. There are no bones of freshwater fish whatsoever.

Pedersborg Voldsted (15)

Early Medieval castle mounds with fish bone material dated to ca. AD 1100 (Rosenlund 1976).

Cod dominates the material, although quite a number of freshwater fish (pike, tench, perch) were eaten as well. The absence of cranial bones from cod was interpreted by Møhl (unpublished correspondence) as showing that decapitated, dried and salted cod were imported. As there were no moats at Pedersborg, Møhl interpreted the freshwater fish as having been caught in nearby fishing waters. The find of sturgeon, which is not common in Danish material, is of note.

Svendborg (16)

Medieval port on the island of Fyn (Jansen, 1988) where fish bones have been identified from excavations in "Land register lot numbers 449a and 482" (Aaris-Sørensen, 1976; Hatting 1979, 1988). The material has been dated to the 12th-15th centuries AD.

So far, only a preliminary species list for fish remains is available (Hatting, 1988) according to which plaice/flounder/dab in particular, but also cod and haddock were important. Herring is also present, but in smaller quantities.

Næsholm (17)

The castle Næsholm was functional from about AD 1240 to about 1340 (La Cour, 1961). The fish bones mainly derive from the castle ground itself, but there are some from the moat too (Møhl, 1961). The bones were hand-collected and are therefore not numerous.

Most of the fish bones are from haddock and cod, but even herring and garfish are represented. Freshwater fishing is indicated by tench and perch.

Køge: Vestergade 24 (18)

Fish bones from the Medieval town of Køge. The fish bones were hand-collected from midden layers at a house and are dated to about AD 1250-1350 (Hatting & Pedersen, 1982).

In spite of the collection method, herring bones dominate, followed by cod.

Holbæk: Ahlgade 15-17 (19)

A Medieval town on Holbæk Fjord. The fish bones are dated to the 13th early 15th centuries AD. The bones were partly hand-collected, partly extracted by sieving through a 1.5 mm mesh (Enghoff, 1995, 1997).

The fish bone material is very varied, 23 species having been identified. Gadids seem to have been most important (39%) and are represented by cod, haddock, whiting, ling and saithe. Cod is represented both by quite small individuals (four fifths of them measured 0.30-0.60 m in length) and both by very large specimens (1.00-1.30 m). Even the other gadids are represented by large individuals: the saithe are much longer than 1 m, and one of the ling measured around 1.30 m. A few cod and haddock bones show cutmarks indicating decapitation, but there are no indications that remnants of stockfish are involved. This is because bones from all body regions are present, and all sizes of cod are represented in the material. Flatfish were important too, in particular flounder. They are followed by herring which constitute 19% of the bones. Sieving was employed on only part of the excavated area. This is where the many herring bones were found, suggesting that the herring may have been even more important than indicated by the results obtained. The fish bone material from Holbæk has been interpreted as representing varied local fishing for local consumption. There are no indications of changes through the study period, nor are there indications of import or export of fish (Enghoff, 1995).

Tårnby Torv (20)

Farm complexes from Medieval Tårnby village on the island of Amager in the Øresund (Svart Kristiansen *et al.*, 1994). Fish bones were recovered in the field by wet sieving through a 3 mm mesh, and separation into 0.5 mm, 1 mm and 2 mm fractions. The samples can be linked to different houses and to various periods of time from, AD 1250 to 1900, but only samples from the 16th century and earlier are considered here.

Most of the fish bones are from the 14th-15th centuries, and out of these, 70% are from herring (which had not been processed, cf. Selsø-Vestby). The only additional species of some importance are eel and gadids, including quite small, 0.30-0.65 m long cod. The presence of mackerel indicates fishing during the summer half of the year. Freshwater fish seem to have played an insignificant role (Enghoff, 1994 b).

Odense Sortebrødrekloster (21)

A Medieval monastery. The fish bones derive from the kitchen area and are dated to about AD 1400-1540 (Rosenlund, 1976, unpublished report b). Sieving has been employed but mesh size is unknown.

Haddock and cod seem to have been the most utilized species. Plaice/flounder/dab, eel and herring also constituted ordinary monastery food, along with a number of freshwater species.

Dragør, Stakhaven (22)

A Medieval fishing village on the island of Amager, with a peak in activity each year during the "herring season". The fish bones almost exclusively derive from the period ca. AD 1342-1425 and were hand-collected with the exception of a single soil sample which was sieved (Liebgott, 1979; Rosenlund, 1976).

A comparison with Tårnby, the other fishing village on Amager which has been studied, is hampered by the different sampling techniques. It is, nevertheless, obvious that largely the same fish were exploited, although more species are represented in the Tårnby material (probably due to the sieving). The single sieved sample from Stakhaven contained herring, and this species probably played a greater role than indicated by the total number of fish bones recovered from this site.

Øm Kloster (23)

A Cistercian monastery at Øm in Jylland. The find has been dated to the 15th-16th centuries AD and consists of hand-collected bones. An inventory list of the monastery for the year 1554 is available (Rosenlund, 1984).

The fish bone material includes a number of freshwater species, as well as salmon/trout, eel, garfish, gadids and plaice/flounder/dab. The surviving inventory list may be used as a kind of key to the evidence. According to the list in 1554 the monastery imported six barrels of eels, as well as 80,000 dried gadids and 15,000 flatfish. The inventory list also mentions fishponds for live storage of freshwater fish. Rosenlund (1984) emphasized that the list of species represented by recovered bones provides more detailed information about the species composition and that there is no disagreement between this and the inventory list. However, a remarkably large taphonomic loss has been demonstrated.

DENMARK, OVERVIEW

The material from Danish sites covers the period from the 5th century BC to the 16th century AD, corresponding to the Iron Age (500 BC - AD 800), the Viking Age (AD 800-1050) and the Middle Ages (AD 1050-ca.1550). Three sites (Nørre Fjand, Ribe and Trøjborg), situated on the Danish North Sea coast, are treated in detail elsewhere (Enghoff, submitted) but will also be included in the present overview.

Iron Age fishing in Denmark

It seems to be a common feature of the settlements in the Limfjord Region (i.e., Sejlflod, Mellemholm and Smedegård) that flounder was the most commonly caught fish. In addition, many garfish were taken, and whitefish is present at two of the sites. The fish bone assemblages from these Limfjord sites are very similar, leading to the conclusion that the main fishing from the sites took place in the Limfjord itself. At the same time there are some differences reflecting the location of each settlement on the Limfjord. For instance, quite a number of greater weaver were taken at Sejlflod; this species is particularly abundant in this part of Denmark. The weavers may have been caught in the eastern mouth of the Limfjord, or there may have been supplementary fishing in the Kattegat. The many sharks at Smedegård were probably caught in the Skagerrak. Today, most of the shark species known from Denmark are distributed in a belt just extending around the northern tip of the country. The same shark species, including the southern species smoothhound, were also found on Mesolithic sites in the same part of Denmark (Enghoff, 1994a).

During the Mesolithic, the Limfjord Region was characterized by another particular type of fishing, with eel being the main target species (Enghoff, 1987, 1993, 1994a). It is tempting to interpret the shift from eel to flounder as a result of a change in fishing technique. During the Mesolithic, fishing was apparently conducted mainly by means of stationary fish traps, for example, basket traps with weirs. Finds of net sinkers from the Iron Age (for example at Nørre Fjand) indicate that fishing with nets had become usual then, which would explain the observed change in the fish bone evidence.

The fish bone assemblages from Nørre Fjand and Lundeborg, where iron fish-hooks have been found, are too small to allow significant conclusions to be drawn. It does, however, seem that fishing here was different from that on the Limfjord. The Nørre Fjand material consists only of freshwater fish, and Lundeborg is dominated by cod.

At Sorte Muld on the island of Bornholm the situation is again entirely different. The large amount of material clearly shows fishing for herring, herring and more herring - more than 13,000 herring bones have been recovered, and also a number of salmon/trout bones. Herring and salmon are characteristic of fishing on Bornholm today. The dominance of herring fishing fits neatly with the idea that net fishing became common in the Iron Age. It is notable that, in spite of very meticulous sieving at several Danish Mesolithic sites, these have yielded at most only a few herring bones. It is not until the Iron Age that large catches of herring are indicated. Nets seem to be necessary in order to catch this species in any quantity.

Bones of the seasonal species, garfish and/or mackerel, are present at all the Iron Age sites, with the exception of Nørre Fjand where bone numbers were small. This indicates that fishing generally took place during the summer half of the year.

To summarize, fishing prior to the Viking Age did not concern new species relative to those caught during the Mesolithic (Enghoff, 1994a). The size of the fish also seems not to have changed (here a reservation must be made since size estimations are not available from the previously published Iron Age sites). The differences vis-a-vis the Mesolithic evidence concern the relative frequency of the species. The general impression is still that of local fishing strongly dominated by species

which were common in local fishing waters, but during the Iron Age, net fishing seems to have been the most important technique. There are no indications of fish trade or processing.

Viking Age fishing in Denmark

The pronounced dominance of flounder and garfish which characterizes the Iron Age settlements in the Limfjord region continues throughout the Viking Age (Aggersborg, Sebbersund, Sejlflod). The presence of whitefish at Limfjord sites also continues. Nowadays, whitefish occur commonly in the Limfjord and these fish also migrate into watercourses flowing into the North Sea south of the Limfjord.

Fishing from the trading centre of Ribe, further south in Jylland, is also dominated by flounder. This is consistent with the fact that flounder was a characteristic target species for fishing in the Wadden Sea during later periods. The cod from Ribe seem to have been slightly larger (ca. 0.37-0.60 m long) than cod caught during the Stone Age (cf. Enghoff, 1994a). Haddock is another species caught from Ribe which is rare in earlier finds. The rare find of thinlip grey mullet at Ribe can be interpreted, against the background of prehistoric finds, as resulting from fishing from Ribe. Even whitefish are present at the site (cf. above).

Fishing from Århus Søndervold mostly produced cod, but also some haddock.

At the Viking Age settlements on Roskilde Fjord on the island of Sjælland, herring enters the scene. There are not many herring at Birkely, but at Gl. Lejre, herring constitutes 63% of the fish bones. At Selsø Vestby the frequency of herring increases through the Viking Age, starting at 18% and increasing to 42%.

The three Viking Age to early Medieval sites on the island of Bornholm: Møllebjerg, Kobbegaard and Munkerup, show the same pattern as that seen at the island's Iron Age site (Sorte Muld): very strong dominance of herring and occurrence of salmon/trout.

To summarize, fishing during the Viking Age seems still to have been a local activity, the nature of the catch being strongly influenced by the fish fauna in the surrounding waters. Flounder and garfish were still characteristic and dominant in the Limfjord region, and herring was frequent in eastern Denmark. For the first time in Danish history, haddock was common at several sites. There is also a tendency for the cod to be larger than in samples from the Stone Age: Ribe 0.37-1.13 m (mostly 0.45-0.70 m), Selsø-Vestby 8th-9th centuries 0.34-1.04 m (mostly 0.35-0.50 m), Selsø-Vestby 10th-11th centuries 0.33-1.04 m (mostly 0.50-0.65 m, i.e. larger than in 8th-9th centuries). The cod from the Bornholm sites are, however, smaller (0.20-0.40 m). Fishing with nets must still be regarded as having been commonplace. The cod and haddock remains could be interpreted as indicating hook fishing with long lines. Finds of fishing equipment from the Viking Age include hooks (Århus Søndervold, Aggersborg), leister prongs (Århus Søndervold, Sebbersund, Aggersborg) and net sinkers (Ribe).

No major differences are evident between material from settlements, trading places and the chieftain's farm. Attention should, however, be drawn to the single bone of thornback ray from Gl. Lejre. Neither is there any indication of the export or import of fish, nor of fish brought along by strangers as travelling provisions. There is no evidence for large-scale processing of fish.

Medieval fishing in Denmark

The Middle Ages offer fish bone assemblages from monasteries as well as castles and towns. Due to the surviving inventory list, we know for certain that dried gadids and flatfish were imported to the monastery Øm Kloster, along with barrels of eels. At another monastery, Odense Sortebrødrekloster, gadids were also very important, with haddock taking first place. Two new gadid species make an appearance, viz., ling and hake; both deep water species. Flatfish and eels were also eaten, and freshwater fish were common at both monasteries.

The three castles, Næsholm, Pedersborg and Trøjborg, show the same pattern: Gadids, especially haddock, were important, in addition to flatfish and various freshwater fish.

The towns are represented by Svendborg, from where there are mostly flatfish, although with an important element of cod and haddock. At Holbæk, another town site, gadids are most numerous and are represented by cod, haddock, whiting, ling and saithe; flatfish and herring were also important. Herring appears again, this time in abundance, at Tårnby (70% of the bones) and Dragør, two fishing villages on the Øresund. Øresund was famous during the Middle Ages for an astonishing abundance of herring during a couple of months each year, when the fat autumn herring migrated through the

sound. Bones of Atlantic bluefin tuna found both at Tårnby and Dragør also deserve to be mentioned. Tuna is nowadays a rare species in Denmark, but Øresund was, until a few decades ago, known for its seasonal occurrence of this fish. Herring dominates further at the nearby village of Køge, but the greatest manifestation of herring bones is seen at Selsø-Vestby, where there is clear and unique evidence indicating a proper herring industry.

To summarize, cod and especially haddock became conspicuously frequent in the Middle Ages. Haddock became common for the first time at Viking Age sites, but was much more frequent at Medieval ones. Flatfish and herring were other frequent fishes. It must, however, be emphasized that the large occurrences of herring are still predominantly concentrated in eastern Denmark.

New species entered the list, viz., ling (Århus Søndervold, Svendborg, Holbæk, Odense Sortebrødrekloster) and hake (Århus Søndervold, Odense Sortebrødre Kloster), indicating fishing

FIGURE 7

Map of Sweden and Norway, showing the location of the reviewed sites. Site numbers refer to the sections "Sweden, individual sites" (dots) and "Norway, individual sites" (square).

Site	Oslo, Kanslergt. 10			Oslo, Mindets Tomt			Oslo Oslogt. 4	Oslo Søndre Felt
Site n°	1.			1.			1.	
Age (centuries)	11-12 AD	12-14 AD	14-18 AD	11-12 AD	12-14 AD	14-17 AD	11-13 AD	11-17 AD
Recovery technique	s	s	s	h	h	h	s	h+s
MARINE SPECIES								
Smallspotted catshark	.	.	.	.	.	.	.	43
Spurdog	.	.	.	1	.	.	1	.
Shark, unspecified	.	7	.	.	.	.	11	.
Ray, unspecified	.	1	.	.	.	.	.	.
Herring	5	223	.	.	.	.	3366	.
Garpike	.	5	.	5	.	.	52	.
Gaddis, total	1	735	12	1028	6027	96	316	1457
Cod	.	302	8	857	4567	69	237	1025
Haddock	1	43	.	.	1	.	3	5
Whiting	.	94	.	.	.	.	.	.
Saithe	.	13	.	89	231	.	12	201
Ling	.	56	4	82	1228	27	59	226
Poor-cod	.	65	.	.	.	.	5	.
Norway pout	.	35	.	.	.	.	.	.
Torsk	.	26	.	.	.	.	.	.
Gadids, unspecified	.	1	.	.	.	.	.	.
Ballan wrasse	.	36	.	.	.	.	69	.
Atlantic mackerel	3	69	.	1	.	.	135	13
Atlantic bluefin tuna	.	.	.	.	.	2	.	.
Golden redfish	.	.	.	.	1	.	.	6
Flatfishes, unspecified	.	15	.	.	.	.	123	.
MIGRATORY SPECIES								
Salmon	.	.	.	.	4	.	.	2
Salmonids, unspecified	.	27	.	.	.	.	20	.
Eel	.	63	.	.	.	.	73	.
FRESHWATER SPECIES								
Pike	.	.	.	.	1	.	.	11
Cyprinids, total	.	26	.	.	.	.	.	1
Roach	.	.	.	.	.	.	.	1
Cyprinids, unspecified	.	26	.	.	.	.	.	.
Perch	.	.	.	.	.	.	26	.
Total	9	1107	12	1035	6033	98	4192	1533

TABLE 3

Numbers of identified fishbones from Norwegian sites. Recovery technique: h = hand-collected, s = sieved, ? = unknown.

in deeper waters than previously. Deep-water fishing is also indicated by the presence of large individuals, for example, 1.30 m ling and saithe greater than 1.00 m. The cod in the Medieval assemblages were 0.27-1.20 m long, mostly 0.30-0.60 m (Enghoff, 1995) and are thus larger than cod from Danish Stone Age sites (cf. Enghoff, 1994a).

At Medieval sites we see the first indications of fish trade, in the form of imported fish to monasteries and castles, where the inventory list for Øm Kloster, or the fish bone evidence (Pedersborg, Møhl unpublished letter, 1973) demonstrate that dried fish was imported. Furthermore, large-scale processing of fish is documented by the refuse from the herring industry at Selsø-Vestby.

Fishing equipment from Danish Medieval sites includes hooks (Holbæk, Dragør), a gorge (Holbæk), a leister prong (Tårnby), as well as net floats (Køge, Århus Søndervold) and a networking tool (Tårnby). These finds agree well with the evidence from the bone finds.

Written Medieval sources provide evidence of the importance of dried, salted fish during fast periods, as well as the incredibly rich herring fishery in the Øresund region which formed the basis for the Scania market. The Medieval fish bone finds reflect both these traits, but also reveal details of the less well-known, local day-to-day fishing.

NORWAY, INDIVIDUAL SITES

In the present review, only sites in southern Norway have been considered. Finds of pre-Middle Age bone assemblages in southern and eastern Norway are extremely scarce and mostly consist of small burnt fragments (A.-K. Hufthammer, pers. comm.).

The site number refers to Figure 7 (see Table 3 for detailed species lists).

Oslo, old city: Kanslergt. 10, Oslogt. 4, Søndre Felt, and Mindets Tomt (1)

Medieval fish bone assemblages are available from four sites in the old city of Oslo which was already an urban area during the Middle Ages. At three of the sites (Kanslergt. 10, Oslogt. 4, and Søndre Felt) material was obtained by sieving, whereas bones were hand-collected from Mindets Tomt. The Oslogt. 4 material is early Middle Ages: mid-11th to 13th centuries AD. The others cover longer periods: 11th-17th or even 11th-18th centuries AD. These are, however, divisable into shorter periods, as shown in Table 3. The fish bones from Mindets Tomt and Søndre Felt were studied by Lie (1988), those from Oslogt. 4 and Kanslergt. 10 by Lie (1991). Marine species make up the vast majority of fish bones at all sites, and gadids, especially cod, play an important role. Herring is also important at Kanslergt. 10 and dominates strongly at Oslogt. 10.

NORWAY, OVERVIEW

Taken as a whole, the southern Norwegian material covers the interval from the 11th century AD to well beyond the end of the study period.

Local influences on Norwegian fishing

Most of the marine species could have been caught in the Oslo Fjord. Three of the species on the list, viz., poor-cod, Norway pout and golden redfish, have not been found at any other sites under consideration here. The golden redfish is the only one among the species dealt with here (see Table 1) which has a northern distribution, being common in colder regions of the North Atlantic (Wheeler, 1978). The presence of torsk and ling in the Norwegian materials is also expected because Norwegian waters, including the Oslo Fjord, offer optimal conditions for catching these species.

Indications of fish trade in Norway

Lie (1988) mentioned that in the earliest period of the Mindets Tomt material (11th-12th centuries) "Both cod and ling are represented by vertebrae of fairly large individuals, and it is therefore reasonable to assume that this group of material, and in particular cod, have come from dried fish imported from the north". Lie (1988) noted, furthermore, that in the next period of the Mindets Tomt material, the importance of ling increased greatly, and since these ling are better represented by head bones than are the contemporaneous cod, a shift in preference from imported cod stockfish to locally caught ling may have taken place. Lie (1988) also drew special attention to the garfish which is not eaten in present-day Norway.

The absence of herring in the sieved material from Søndre Felt is striking, given its absolute

Site	Eketorp II	II/III	III	Varla			Fjälkinge	Gårdstånga	Birka[4]	Birka[5]	Sigtuna	Visby	Rinkaby	Oxie	Fo
Site n°	1.			2.			3.	4.	5.		6.	7.	8.	9.	
Age (centuries)	5-8 AD	5-8/11-14 AD	11-14 AD	5-9 AD	9-11 AD	11-13 AD	9-13 AD	10-11 AD	10 AD	10 AD	10-12 AD	10-13 AD	11 AD	11 AD	11
Recovery technique	h	h	h	?	?	?	s	s	?		?	?	?	?	
MARINE SPECIES															
Spurdog	.	.	.	.	.	4	.	.	.	.	.	.	.	.	
Thornback ray	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Skate	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Herring	558	623	54475	.	.	8	1195	+	22	542	+	.	.	80	
Garpike	.	.	1	.	.	.	.	.	.	.	.	.	.	.	
Hake	.	.	.	.	3	11	.	.	.	.	.	.	.	.	
Gadids, total	156	578	3117	5	4	41	2	+	.	2	+	65	.	56	
Cod	154	571	3106	5	4	12	2	+	.	2	+	65	.	56	
Haddock	.	.	4	.	.	.	.	.	.	.	.	.	.	.	
Whiting	.	.	.	.	.	14	.	.	.	.	.	.	.	.	
Saithe	.	2	.	.	.	1	.	.	.	.	.	.	.	.	
Ling	2	5	7	.	.	14	.	.	.	.	.	.	.	.	
Gadids, unspecified	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Atlantic mackerel	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Eelpout	.	.	1	.	.	.	.	.	.	.	.	.	.	.	
Bullrout	15	31	139	.	.	.	.	.	.	.	.	.	.	.	
Flatfishes, total	91	178	736	.	.	.	4	+	.	.	.	.	.	4	
Turbot	23	.	4	.	.	.	.	.	.	.	.	.	.	.	
Turbot/Brill	.	2[1]	10[2]	.	.	.	.	.	.	.	.	.	.	.	
Halibut	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Plaice	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Flounder	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Dab/Plaice/Flounder	68	176	722	.	.	.	4	.	.	.	.	.	.	4	
Flatfishes, unspecified	.	.	.	.	.	.	.	+	.	.	.	.	.	.	

Site	Eketorp II	II/III	III	Varla			Fjälkinge	Gårdstånga	Birka[6]	Birka[7]	Sigtuna	Visby	Rinkaby	Rinkaby	Fo
				5-9 AD	9-11 AD	11-13 AD									
MIGRATORY SPECIES															
Sturgeon	8	11	78	.	.	.	.	.	.	.	.	.	.	.	
Salmon	.	.	.	.	.	.	.	.	.	3	.	.	.	.	
Trout	.	.	.	.	.	.	.	.	.	12	.	.	.	.	
Trout/Salmon	1	2	4	.	.	.	.	.	.	4	.	.	.	.	
Whitefish	1	3	24	.	.	.	.	.	5	6	.	.	.	.	
Salmonids, unspecified	.	.	.	.	.	.	.	.	1	.	.	.	.	.	
Eel	3	19	66	.	.	.	1	.	2	8	+	.	.	.	
FRESHWATER SPECIES															
Pike	51	141	532	.	.	.	30	+	195	594	.	2	6	.	
Cyprinids, total	16	40	173	.	.	.	64	+	473	792	+	.	46	.	
Crucian carp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Tench	.	.	.	.	.	.	.	.	7	17	.	.	.	.	
Orfe	2	4	39	.	.	.	.	.	2	45	.	.	.	.	
Roach	.	.	2	.	.	.	6	.	10	28	.	.	.	.	
Rudd	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Common bream	2	4	36	.	.	.	58	.	352	526	.	.	46	.	
Zope	.	.	.	.	.	.	.	.	3	7	.	.	.	.	
Asp	.	.	.	.	.	.	.	.	.	.	.	.	.	.	
Cyprinids, unspecified	12	32	96	.	.	.	[3]	+	99	169	+	.	.	.	
Wels	.	.	.	.	.	.	.	.	.	1	.	.	.	.	
Burbot	.	.	.	.	.	.	.	.	3	6	.	.	.	.	
Perch	15	36	207	.	.	.	2	+	20	100	+	.	1	.	
Pikeperch	2	2	23	.	.	.	.	.	548	1363	+	.	.	.	
Total	917	1664	59576	5	7	64	1350	–	1269	3263	–	67	53	140	

[1] recorded as "Bothidae".
[2] recorded as "Bothidae".
[3] 932 scales.
[4] Ericson et al. (1988).
[5] L. Lougas (pers. comm.).
[6] Ericson et al. (1988).
[7] L. Lougas (pers. comm.).
[8] excluding 4 scales.

TA

Numbers of identified fishbones from Swedish sites. Rec

dominance at Oslogt. 4 (3366 out of 4192 fish bones) and frequent occurrence at Kanslergt. 10.

SWEDEN, INDIVIDUAL SITES

The review is based mostly on published evidence, supplemented by unpublished information put at my disposal by Annica Cardell (Ven, Minerva) and Lembi Lougas (Birka).

The site numbers refer to Figure 7 (see Table 4 for detailed species lists).

Eketorp (1)

A circular settlement at the island of Öland. Great numbers of fish bones were excavated during 1964-1974. They come from two phases: Eketorp II and Eketorp III. Eketorp II has been dated, by means of artifacts and radiocarbon analyses, to

Lund I 11. 11 (+13-14) AD ?	Lund II 11-14 AD ?	Kyrkheddinge 12. 11-15 AD h+s	Ven (Cardell) 13. 12-13 AD h+s	Simrishamn 14. 12-13 AD ?	Helsingborg 15. 12-13 AD s	Skara Rådhuset 16. 12-15 AD ?	Gamla Lödöse 17. 12-15 AD ?	Skara, kv. Sparbanken 16. 13-14 AD h	Uppsala 18. 13-17 AD h+s	Stockholm 19. 14 AD ?	15 AD ?	Borganäs 20 14-15 AD s
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	+	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
11	.	6538	4881	1436	+	.	12	.	.	.	+	.
.	.	2	9	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	191	1	.	.	.	.
1382	ca. 100	1364	843	62	+	24	222	13	552	+	+	11
1370	ca. 100	1359	842	62	+	22	95	3	549	+	+	11
11	.	2	.	.	.	.	.	.	1	.	.	.
.	.	2	1	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	43	.	.	.	.	.
1?	.	.	.	.	.	2	84	10	2	.	.	.
.	.	1	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	+	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
19	5	155	242	47	+	.	1	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	3	.	.	.	.	.	.	.	.	.	.
3	.	4	6	.	.	.	.	.	.	.	.	.
16	5	148	236	47	+	.	1	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.

Lund I	Lund II	Kyrkheddinge	Ven	Simrishamn	Helsingborg 12-13 AD	Skara Rådhuset 12-15 AD	Gamla Lödöse 12-15 AD	Skara, kv. Sparbanken 13-14	Uppsala 13-17 AD	Stockholm 14 AD	15 AD	Borganäs
2	.	.	.	.	.	.	.	.	.	.	.	.
3	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	+	.	.	.
.	.	.	.	.	.	.	.	.	.	+	+	.
.	.	.	.	.	.	.	.	.	+	.	+	1
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	114	74	1	.	.	.	.	+	.	+	.
30	.	4	.	.	.	3	1	2	1503	+	+	436
5	1?	2	2	.	.	1	1	.	+	+	+	133
.	.	.	.	.	.	.	.	.	+	.	.	.
.	.	.	.	.	.	1	.	.	+	.	.	.
1	1?	.	.	.	.	.	.	.	+	.	+	1
.	.	.	.	.	.	.	.	.	+	+	+	72
.	.	.	.	.	.	.	.	.	.	.	.	.
4	.	.	.	.	.	.	1[3]	.	+	+	+	1
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	+	.	.	.
.	.	2	.	.	.	.	.	.	.	.	.	59
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	+	.	.	.
3	1	79	.	.	.	.	2	.	+	+	+	348
.	.	.	.	.	.	8	.	2	+	.	+	2
1455	ca. 107	8258	6049	1546	81	36	430	18	>2055	+	+	931

; 4

' technique: h = hand-collected, s = sieved, ? = unknown.

the Germanic Iron Age, 5th-8th centuries AD. Eketorp III has been dated to the period extending from the end of the Viking Age to the late Middle Ages, 11th-14th centuries AD. During the intervening period of 300-400 years, the camp was not used. Part of the material cannot be referred to either phase but is a mixture of both ("Eketorp II/III"). The fish bone material was hand-collected, and in addition, large concentrations of herring bones from Eketorp III were collected as sediment samples which were subsequently sieved, (Boessneck, 1979; Hallström, 1979).

More than 62000 fish bones from Eketorp have been identified. Herring, cod, plaice/flounder/dab and pike were the most important species during both phases. Herring is represented by a large majority of the bones: 61% from Eketorp II, and 91% from Eketorp III. The herring remains from Eketorp III include two accumulations which have been interpreted as consisting mainly of herring

heads. The cod bones are partly from entire small specimens (< 0.5 m), partly (vertebrae) from large cod (>0.85 m for Eketorp II, 0.80-1.20/1.30 m for Eketorp III). The large cod seem thus to have been imported to Eketorp in a decapitated state. A few bones, one supracleithrum (a shoulder bone) and 13 vertebrae, of large ling (1.10-1.50 m) are present and represent both phases, whereas haddock does not appear until the Eketorp III phase. Two vertebrae of large saithe (1.20 m) were found in the Eketorp II/III material. In the plaice/flounder/dab group only flounder has been identified with certainty. The presence of sturgeon and whitefish in both phases (and in the mixed material) is also noteworthy.

Varla (2)

A site on the Swedish west coast with possibilities for fishing in the open sea as well as in the inlet, Kungsbacka Fjord. Bones were excavated during 1989-1993 from a former settlement area. The bone material was studied by Johansson (unpublished report) and can be allocated to one of three phases, viz., late Iron Age (5th-9th centuries AD), Viking Age (9th-11th centuries AD) and late Viking Age - early Medieval (11th-13th centuries AD). Unfortunately the fish bones are poorly preserved and the method of their recovery is not revealed. The best represented species in this small sample are whiting, cod and hake. Ling is also present. Most of the cod bones are from small specimens less than 0.40 m long; one vertebra is, however, from a ca. 0.80 m cod. Cod and hake are represented by bones from both head and trunk.

Fjälkinge (3)

A site on the east coast of Scania, with possibilities for fishing in large lakes nearby, as well as the Baltic Sea. In 1995 well-preserved fish bone material was excavated from a settlement area. The material was recovered by dry and wet sieving through a 3 mm mesh and was dated to the Viking Age/early Middle Ages, 9th-13th centuries AD.

The most frequent species is herring which constitutes 52% of the identified fish bones. There are bones from all regions of the herring's body, although head bones predominate. Cyprinids follow herring in abundance and are represented by common bream and roach. There are two bones of cod, representing individuals about 0.50 m long (Cardell, 1997).

Gårdstånga (4)

A site in Scania, southernmost Sweden, about 25 km from the coast. The material from Gårdstånga derives from a rescue excavation carried out in 1989. The fish bones were recovered by flotation and wet sieving. The bones were deposited during the Viking Age and early Middle Ages, 10th-11th centuries AD. Sten (1994) did not indicate the number of fish bones identified, but listed the species and provided a diagram showing the dominance of herring, the remains of which constitute about half of the identified fish bones. Herring is followed by flatfish, cod and a few freshwater species. The cod were apparently about 0.70 m long. According to Sten (1994) the bones indicate that the fish were taken home to the site in an entirely unprocessed state. Sten (1994) considered fish to have played an important role in the subsistence at Gårdstånga.

Birka (5)

An important Viking Age trading centre situated on the island of Björkö in the Lake Mälaren near the east coast of Sweden. Extensive bone material was excavated during 1969-1971 and a preliminary analysis was carried out by Ericson *et al.* (1988). The material was dated to the 10th century AD and was recovered by sieving. It is dominated by pikeperch, followed by common bream and pike. The finds have been interpreted as representing local fishing in the Lake Mälaren. The only dubious species in this respect is herring which is represented by 22 bones.

New excavations were conducted at Birka in 1993-1994, during which sieving through a fine mesh was carried out. This yielded still more fish bones of which 3263 have so far been identified by Lembi Lougas (pers. comm.). The results resemble closely those produced by Ericson *et al.* (1988). Cod (two bones) and wels (one bone) are new on the list. The newly-analyzed material is also dominated by pikeperch, followed by cyprinids (common bream) and pike. A significant difference is constituted by the large number of herring bones in the new material (542 bones, i.e. 17% of the bones, as opposed to 22/1269 = 1.7% in the former material).

Sigtuna, "kvarteret Trädgårdsmästaren 9 & 10" (6)

A site surrounded by fresh water, situated ca. 35 km from the Baltic coast north of Stockholm. Fish

bones were excavated during 1988-1990 and were dated to the 10th-12th centuries AD. The recovery technique was not given, (Hårding, 1990) nor is a complete list of species with numbers of identified bones available. Hårding (1990) mentioned pikeperch, perch and cyprinids as the most frequent species. Herring and eel are also mentioned. Layers from the 12th century contain many vertebrae of large cod, whereas bones from the cod's head are entirely absent. Hårding interpreted this as indicating the import of dried cod from the Atlantic, possibly from Norway.

Visby, "kvarteret Apoteket" (7)

A site on the island of Gotland. Fish bones were excavated during the 1970s from remains of Viking Age houses (recovery technique not given). The material has been dated to the 10th-13th centuries AD. Only 67 out of 367 excavated fish bones were identified, comprising 65 from cod and two from pike. Westholm and Sigvallius (1982) believed that more species are present among the unidentified bones.

Rinkaby (8)

A settlement on the east coast of Scania. Bone material dated to the 11th century AD has been excavated (Lepiksaar, 1961) but the recovery technique is not given. The fish bones are all from freshwater species, viz., common bream, pike and perch.

Oxie (9)

A grubenhaus settlement at the southern tip of Sweden, about 10 km from the coast of Øresund (Mandahl, 1974). The fish bone material was recovered from a grubenhaus dated to the 11th century AD. There is no mention of sieving being was employed. The fish bones derive from common marine species: herring, cod, and plaice/flounder/dab. Several cod are recorded as having been 0.50-0.60 m long, and bones from both head and trunk are present (Lepiksaar, 1974b).

Fosie SN, Trehögsparken (10)

A site in Scania facing Øresund. The material, dated to the 11th-12th centuries AD, was recovered from a grubenhaus and a pit; there is no indication of sieving being employed. Herring dominates the material, and the bones derive mainly from the head region. The estimated length of the herring is 0.24-0.30 m, and they are thought to have been caught in the Kattegat or even further north. In addition, there are a few bones of cod and plaice/flounder/dab (Lepiksaar, 1974a).

Lund I, the Thule area (11)

Lund is a town in Scania, southernmost Sweden. Fish bone material from the Thule area of Lund was excavated during the 1960s (recovery technique not given). The material has been dated to the 11th century AD. A small amount of material was also recovered from 13th-14th century wells. However, the two samples were not kept separate (Ekman, 1971). Most of the fish bones are from cod, estimated to have been 0.39-1.15 m long; all body regions are represented. Other gadids present are haddock and perhaps a single bone of ling. In addition there are a number of freshwater species, as well as flounder, herring and sturgeon. According to Ekman (1971), fishing was important at this site and took place locally in the surrounding fresh waters (rivers) and in Øresund where, for example, the cod are thought to have been caught on hooks.

Lund II, Stortorget (the Marketplace) and plot no. 5 of the Färgaren block (11)

The majority of this material from the town of Lund (see above) was recovered during excavations of the Marketplace. The entire material is dated archaeologically to the period AD 1020-1400. About 90% of the fish bones are, however, from the 11th-12th centuries. The recovery technique is not given (sieving seems, however, improbable). Most of the bones are from cod, and these are almost exclusively from the head, plus the foremost vertebrae. Severed heads appear therefore to have been the source of the bones. In addition there are a few bones of flatfish, perch and cyprinids (Bergquist & Lepiksaar, 1957).

Kyrkheddinge (12)

A Medieval town site in Scania, about 12 km from the Swedish west coast. A large amount of bone material was excavated in 1995. The majority of the fish bones were found in floor layers inside houses and have been dated to the 13th-15th

centuries AD. A minor portion is dated to 11th-12th centuries AD. Fish bones were recovered both by hand-collection and by sieving. All the sediment from the above-mentioned floor layers was wet sieved through a 3 mm mesh. The bones are very well preserved. Herring dominates, constituting 80% of the identified bones. The entire herring skeleton is represented, although there seems to be a preponderance of vertebrae. Cod is the second most frequent species and is also represented by the entire skeleton. The lengths of the cod are estimated to 0.28-0.90 m. Haddock and whiting are also present. The marine species are thought to have been caught in the Øresund or perhaps bought at market places or the like. There are a few bones of freshwater species; these could have been caught in a nearby stream (Cardell, unpublished report c).

Ven (13)

A number of early Medieval farms were excavated in 1989 in Tuna village on Ven, a small island in Øresund. The fish bone material has been dated to the 12th-13th centuries AD. The bones are very well preserved, and only a few are burnt. Fish bones were partly hand-collected, partly recovered by sieving through a fine mesh. All in all, 42 bones of herring, cod, plaice/flounder/dab and garfish were recovered (Sten & Ericson, 1989). Furthermore, a "fish bone layer " collected *in toto* was later analyzed by Annica Cardell (unpublished report b) who identified 6049 bones. Cardell's analysis shows a great dominance of herring. In addition there are quite a number of cod. Both herring and cod are represented by all body regions. Most of the cod were about 0.50 m or less in length. Some large cod (less than 1 m, however) are also represented.

Simrishamn, kvarteret Taltrasten 60 (14)

A town on the Baltic coast of Scania. A number of so-called "lerbottnar" (literally: clay-bottoms) were excavated in 1982. The "lerbottnar" are thought to have been connected with the Medieval herring fishing in the Øresund, although their function has not yet been identified. The "lerbottnar" in question have been dated to the 12th-13th centuries AD and have yielded well-preserved fish bones. No information is given about whether sieving was used for the recovery. Most of the fish bones are from herring, represented by the entire skeleton. In addition there are bones of cod, plaice/flounder/dab and eel, of which head bones seem to be best represented. The cod are small, mostly 0.21-0.29 m long (Cardell, 1995).

Helsingborg, kvarteret Minerva (15)

A town on the Øresund coast, situated at the narrowest part of Øresund. The material comes from a "lerbotten" (see Simrishamn, above) and has been dated to the 12th-13th centuries AD. The fish bones were recovered by sieving through 0.5 mm and 3 mm meshes. Herring, cod and plaice/flounder/dab are represented. The cod bones are from individuals less than 0.35 m long. The fish were probably caught locally (Cardell, unpublished report a).

Skara, kvarteret Rådhuset, Tellus 2, Tellus 14 A and B (16)

A town in west Sweden ca. 120 km from the coast. Fish bones were excavated during 1970-72 in Medieval Skara; they are dated archaeologically to the 12th-15th centuries AD. The method of recovery is not recorded but sieving seems improbable. Only a small number of fish bones were found, many of which are from cod. Ling, pikeperch, pike and tench are also represented. Lepiksaar (1976) regarded the cod and ling as having been imported as stockfish from the port of Gamla Lödöse.

Gamla Lödöse (17)

A town of the 12th-15th centuries on the Swedish west coast. The material was excavated in the early 1960s, the recovery method has not been published but hand-collecting seems probable. The dominating species is hake (total length 0.66-1.04 m), followed by ling (1.16-1.20 m), cod (0.95 m) and saithe (0.82-1.07 m). The estimated lengths all indicate large individuals of these gadid species. Lepiksaar (1965) thought fish were imported, including hake from more westerly waters, and ling perhaps from Norway (see, however, the regional overview).

Skara, kvarteret Sparbanken (16)

Fish bones were recovered by hand-collecting from refuse dated to the 13th-14th centuries AD in the inland town of Skara (see above). The small

amount of material contains the same species as the material from kvarteret Rådhuset in Skara with the interesting exception of a single bone of hake (Vretemark, 1984).

Uppsala, kvarteret Kransen (18)

A town in eastern Sweden, north of Stockholm, situated about 80 km from the Baltic coast with possibilities for fishing in nearby rivers. A large amount of bone material was excavated in 1978 in "kvarteret Kransen" in Uppsala. The fish bones are of Medieval age and are assignable to seven phases, covering the period from the late 13th to early 17th centuries AD. Both hand-collecting and sieving were employed, and the conditions for bone preservation were good. Although a complete species list giving the number of bones of each species was not included in the publications by Jonsson (1984, 1986), it was mentioned that 3000-4000 fish bones were excavated, and that the majority (1503) are from pike, followed by cod. Haddock and ling are also present, as well as a considerable number of freshwater and migratory species. Herring is not very frequent. Total length and representation of single bone elements have been calculated for the two most frequent species, pike and cod, for each of the seven phases. Through the entire period, pike of all sizes are present, and the number of vertebrae is low in comparison with the number of head and shoulder bones. This is interpreted as showing that the bones are remains of dried pike, a conclusion supported by characteristic cutmarks on the dentary bones which must be the result of gill removal. The cod appear to fall into two sized classes throughout the entire period: large (0.70-1.30 m long, average about 1.00 m) of which vertebrae are overrepresented, and small (0.20-0.70 m, average 0.40 m) represented by head and shoulder bones. Considering the long distance to the coast, the cod from Uppsala were probably imported in a preserved condition. Jonsson's opinion is that the large cod were imported from the west coast of Scandinavia (probably Lofoten, Norway) in a decapitated, dried, and possible even salted condition. The smaller cod were probably caught in the Baltic or the Botten Sea and were dried in the same way as the pike (cf. the representation of bone elements). Large cod dominate in layers from the late 13th to early 14th centuries, thereafter their frequency is low. Small cod become increasingly frequent throughout the entire suite of layers. The frequency of pike decreases from the 13th to the early 14th centuries whereafter it increases exponentially (Jonsson, 1984, 1986).

Stockholm, Helgeandsholmen (19)

Material consisting primarily of kitchen rubbish thrown into a watercourse from the institution Helgeandshuset (an asylum for sick and elderly people) in the city of Stockholm. This material has been dated to the 14th century AD. In addition there is a smaller amount of material, dated to the 15th century. The latter was collected as sediment samples. The recovery technique for the 14th century material is not recorded but sieving was not used. There is no record of the number of identified fish bones, but the material from the 14th century includes pike, cod, perch, common bream, roach, salmon and thornback ray. Pike is by far the most frequent species, constituing 75% of the bones. Most of the pike are estimated to have been 0.20-0.50 m long. The majority of the pike dentary bones were cut in the same way as seen in the Uppsala material (Jonsson, 1986). The length of the cod has been estimated to a maximum of 0.50 m. This species is therefore thought to have been caught locally in the Baltic Sea. An interesting element is the single dermal denticle of thornback ray. This species was regarded as a great delicacy, reserved for the upper class.

The 15th century material contains more species, possibly as a function of a more meticulous recovery technique. The most frequent species are perch, cod and pike.

Cod bones in the Helgeandsholmen material show an overrepresentation of vertebrae, and the cod is therefore thought to have arrived at the site in a preserved condition. Perch and pike, on the other hand, seem to have been cleaned on site (Vretemark, 1982).

Borganäs (20)

A castle on the river Dalälven about 100 km from the Baltic coast. The bone material was recovered by wet sieving through a 2 mm mesh in 1985 and is dated to ca. AD 1390-1434 (Sten, 1988, pers. comm.). The most frequent species by far are pike and perch. All the species could have been caught in Dalälven except cod which must have been imported. The dentary bones of pike are cut in the same way as seen in the material from Uppsala and Helgeandsholmen.

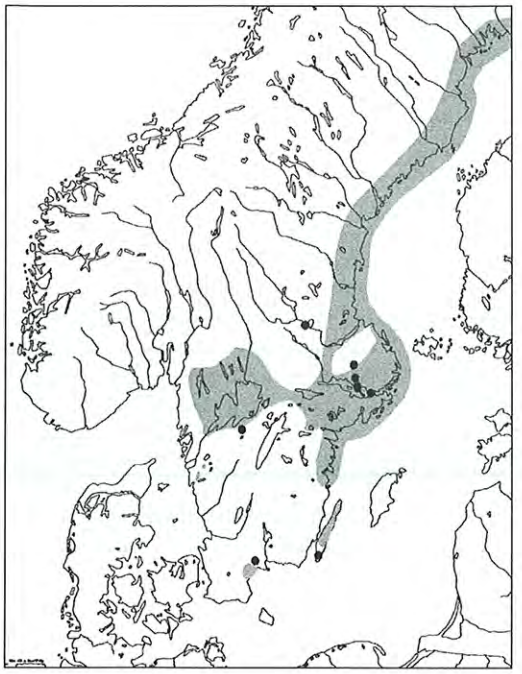

FIGURE 8

Map of Sweden, showing the present distribution of pikeperch (from Curry-Lindahl (1985), hatched) and the sites on which pikeperch bones have been found (dots).

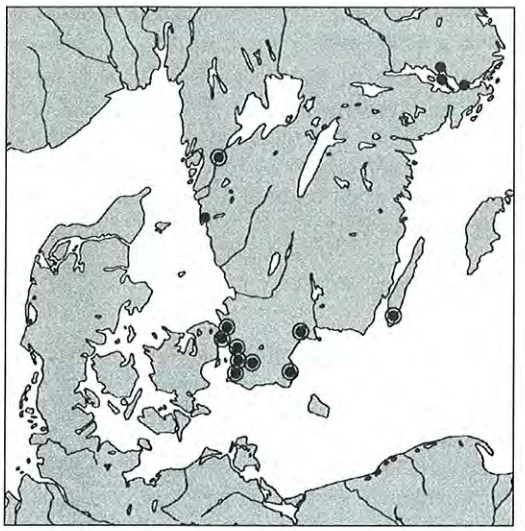

FIGURE 9

Map of Sweden, showing the sites where bones of herring (dots) and plaice/flounder/dab (circles) have been found.

SWEDEN, OVERVIEW

The Swedish material covers the 5th-17th centuries AD. Thus the Iron Age, Viking Age and Middle Ages are represented. The Iron Age is, however, represented at only two sites, viz., Eketorp and Varla, the latter sample being unfortunately quite small.

Local influences on Swedish fishing

Pikeperch is present in the material from Borganäs, Uppsala, Sigtuna, Birka, Stockholm, Eketorp, Fjälkinge and Skara. The geographical location of these sites agrees to an astonishing extent, even in detail, with the present-day, quite well-defined distribution of pikeperch in Sweden (Figure 8).

Pike was of very great importance within a delimited part of the country, i.e., at the sites Borganäs, Uppsala, Birka and Stockholm which are all situated in the southern-central part of eastern Sweden. Pike abounds in fresh water all over Sweden but is also common in brackish water along the coasts of the Baltic Sea, including the Botten Sea, as far as 90 km from the coast (Curry-Lindahl, 1985). Pike bones are also present at many other Swedish sites but they are much less numerous than at the above-mentioned localities.

Herring is present at most of the Swedish Iron Age, Viking Age and Medieval coastal sites, from Gamla Lödöse on the west coast to Stockholm on the east coast (Figure 9). Herring is conspicuously absent at the inland sites of Skara, Uppsala and Borganäs. Nowadays, herring occurs in all waters off the Swedish coast, including the innermost Baltic Sea. Quite overwhelming numbers of herring bones are present in the material from both phases at Eketorp, although the quantity is greater during the Medieval phase from which more than 54000 herring bones have been recovered. Herring bones are also particularly abundant at the towns of Kyrkheddinge, Simrishamn and Fjälkinge on the coast of Scania (southernmost Sweden).

Most bones of the plaice/flounder/dab group cannot be identified to species and are therefore reported collectively. This group of species has too a characteristic distribution in the Swedish material. They occur at Gamla Lödöse on the Swedish west coast, at the majority of towns along the Øresund, further up the eastern coast of Scania and as far into the Baltic as Eketorp on the island of

Öland (Figure 9). At the latter site, only flounder has been identified with certainty. Dab, flounder and plaice are all marine species, but flounder can survive in very brackish water or even fresh water. All three are common in the Kattegat, Øresund and southern Baltic, but flounder occurs further north in the Baltic (nowadays as far as Stockholm) than the two others (Curry-Lindahl, 1985).

The occurrence of wels at Birka should also be noted, this site being slightly to the north of the present-day distribution of this species. Sturgeon has only been found at Eketorp and Lund.

Bones of gadids have been found at all sites except Rinkaby (but the bone material here was very small and possibly not representative). The commonest gadid, cod, occurs in all Swedish marine waters from the Skagerrak to the Botten Sea. Many of the publications dealing with fish bone analyses from the Swedish sites reach the conclusion, based on the representation of individual bone elements, that the cod in question were entire, often small, specimens. This is true, for example, at Varla, Fjälkinge, Oxie, Kyrkheddinge, Simrishamn, and in part at Eketorp. Therefore cod remains found at these sites probably represent local fishing. There are, however, also towns where remains of entire large cod have been found, for example, Gamla Lödöse (0.70-1.00 m). At this site many bones of large hake, ling and saithe were also found. Lepiksaar (1965) suggested that these species were imported; hake from more westerly waters and ling from Norway. It should, however, be mentioned that Gamla Lödöse is located exactly in that part of Sweden from where all the above-mentioned species could have been caught. For instance, hake occurs every year in the Skagerrak, albeit with varying abundance, and also off the coast of the province of Bohuslän (where Gamla Lödöse is situated). Hake also occurs in the Kattegat and sometimes in the Øresund (Curry-Lindahl, 1985). Otterstrøm (1914) recorded a similar distribution of hake and mentioned that the species occurs in the Kattegat and the northern Øresund, especially in the autumn (confirmed by N. Bødker Thomsen, fishing skipper, pers. comm.). Ling and saithe may occur as far south as the Øresund (Curry-Lindahl, 1985; Otterstrøm, 1914). It therefore appears more straightforward to suggest that cod, hake, ling and saithe were fished for locally at Gamla Lödöse. This suggestion is supported by the fact that the only other finds of hake in material from the same period are from Varla, which lies just south of Gamla Lödöse, and from Skara, to where fish is thought to have been imported from Gamla Lödöse. The Varla material includes hake from the Viking Age and both hake and ling from the Middle Ages. Further support is provided by the finding by Vretemark (pers. comm.) of 41 hake bones in material from Kungahälla (12^{th}-13^{th} centuries AD), another town near the Bohuslän coast.

To summarize, the fish bone assemblages from Iron Age, Viking Age and Medieval Sweden are generally characterized by a strong local element. For many of the towns in question all the fish on the species list could theoretically have been caught locally. This is true, for example, of the trading centre Birka, but also of the majority of towns along the Scanian coast, as well as Gamla Lödöse and Varla.

Remains of fishing equipment from Swedish sites

Several of the Swedish sites have yielded finds of fishing equipment. Net sinkers, hooks and leisters have been found at Birka and Eketorp III. Hooks and bark floats are reported from Sigtuna. The tools found suggest varied fishing, consistent with the species lists.

Indications of fish trade in Sweden

Some assemblages which include the remains of large cod show an over-representation of vertebrae (or vertebrae may be the only bone elements present). This is true of Eketorp, Sigtuna (12^{th} century AD) and Uppsala. In both phases at Eketorp (II and III) there are remains of entire, small cod (see above) together with vertebrae of large cod (0.80-1.30 m). In the 13^{th}-14^{th} century material from Uppsala, vertebrae of cod estimated to have been 0.70-1.30 m long are very common. These large cod, represented only by vertebrae, are interpreted as the remains of dried, perhaps salted fish, i.e., stockfish. Hårding (1990) and Jonsson (1986) suggested that these cod may have come from the Atlantic Ocean and were probably imported from Norway. It should be taken into consideration, however, that large cod are available from waters closer to Sweden, as are ling and hake, which are also thought to have been imported from other countries (see above).

Bones of haddock have been found at a few sites: Eketorp, Lund, Kyrkheddinge and Uppsala, i.e., there are no finds of haddock until the 11^{th} century

AD. Haddock and ling are often conspicuously linked in the assemblages. This might be taken as indicating the importing of both species. Finds of haddock and ling in Uppsala and Eketorp must, in any case, be regarded as a result of trade, whereas local fishing of these species was at least theoretically possible from Lund, Kyrkheddinge and Varla.

The importing of gadids is further documented in material from the inland sites of Skara and Borganäs.

The great importance of pike at Borganäs, Uppsala and Stockholm was mentioned above. It is characteristic of these finds that a large proportion of the dentary bones (ca. 50% at Uppsala) have been cut in two. Jonsson (1986) interpreted this as being the result of processing the pike for drying; he presumed that the pike were opened and had their gills removed with a special cut which divided one of the dentary bones. Jonsson thought that the pike were imported from Norrland (northern Sweden). He also thought that the small cod from Uppsala were processed and preserved in the same way.

The thornback ray from Stockholm must have been imported. Since this species was at the time regarded as a great delicacy more or less reserved for the upper class (Sten, 1995) it appears strange that it was found in material deriving from an institution for poor and elderly people.

On the negative side, it is worth noting that, even though herring is common at coastal sites, there is no indication of the importing of herring to inland sites. The same is true of plaice/flounder/dab (Figure 9).

The material from Eketorp and Uppsala belongs to a number of phases and therefore offers an opportunity to trace possible historical developments in fishing and trade. At Eketorp the same impression is gained from both phases; herring fishing was by far the most important. Large cod and ling also seem to have been imported in both phases, whereas haddock does not appear until the later phase (11th-14th centuries AD). At Uppsala, large imported cod dominate from the 13th to the beginning of the 14th century AD, later their frequency is low. Small cod, which are regarded as a result of local trade, occur with increasing frequency throughout the phases. The frequency of

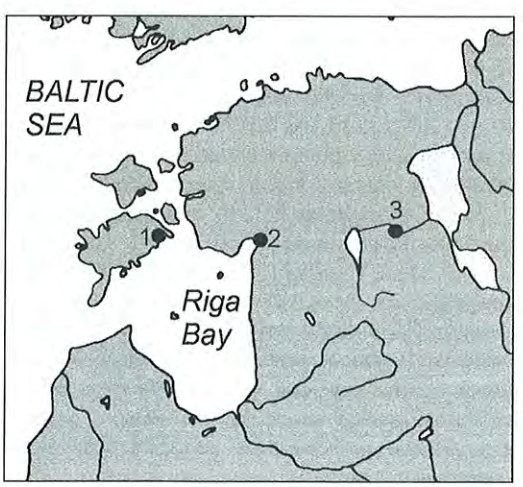

FIGURE 10

Map of Estonia, showing the location of the reviewed sites. Site numbers refer to the section "Estonia, individual sites".

Site	Pöide	Pärnu	Tartu
Site n°	1.	2.	3.
Age (centuries)	8-9 AD	14-16 AD	14-16 AD
Recovery technique	h	h+s	h
MARINE SPECIES			
Herring	.	120	.
Gadids, total	.	51	5
Cod	.	51	5
Flatfishes, total	.	7	.
Flounder	.	7	.
MIGRATORY SPECIES			
Sturgeon	.	1	.
Trout/Salmon	.	3	.
Whitefish	.	6	.
Eel	.	3	.
FRESHWATER SPECIES			
Pike	1	32[1]	43
Cyprinids, total	1	143	37
Tench	.	.	1
Dace	.	1	.
Orfe	.	13	2
Roach	1	115	1
Common bream	.	.	32
Zährte	.	5	1
Cyprinids, unspecified	.	9[2]	.
Wels	.	.	1
Burbot	.	.	2
Pikeperch	.	160[3]	4
Perch	12[4]	391[5]	76
Total	14	917	168

[1] excluding 77 scales.
[2] excluding 33 scales.
[3] excluding 31 scales.
[4] excluding 148 scales.
[5] excluding 2649 scales.

TABLE 5

Numbers of identified fishbones from Estonian sites. Recovery technique: h = hand-collected, s = sieved, ? = unknown.

pike, on the other hand, falls from the 13th to the beginning of the 14th century AD; later it increases exponentially. Sten (1995) discussed trade with fish in Medieval Sweden using examples from several of the above-mentioned towns.

ESTONIA, INDIVIDUAL SITES

The information for Estonia has been provided by Lembi Lougas (pers. comm.).

The site numbers refer to Figure 10 (see Table 5 for detailed species lists).

Pöide (1)

A Viking Age hillfort on the island of Saaremaa (Ösel), which was apparently used only in cases of emergency. A small amount of material, dated to the 8th-9th centuries AD, has been hand-collected at this site. All the bones are from freshwater species, mostly perch.

Pärnu (2)

A Medieval town situated on an estuary on the coast of Riga Bay. Material dated to the 14th-16th centuries AD has been recovered here by hand-collection, as well as sieving at places where the concentration of fish bones was greatest. The material includes marine, migratory and freshwater species, all of which could have been caught from a base at Pärnu. Perch is most common, followed by pikeperch and herring. The presence of sturgeon is noteworthy.

Tartu (3)

An inland town situated on the banks of a river. Fish bones dated to 14th-16th centuries AD have been hand-collected. They are almost exclusively from freshwater species, but there are five bones of cod which must have been imported. The most frequent species are perch, pike and common bream.

ESTONIA, OVERVIEW

From Estonia we have a small amount of material from a Viking Age site and two larger assemblages from Medieval sites, one from the coast, one from inland. All three sites are characterized by spe-

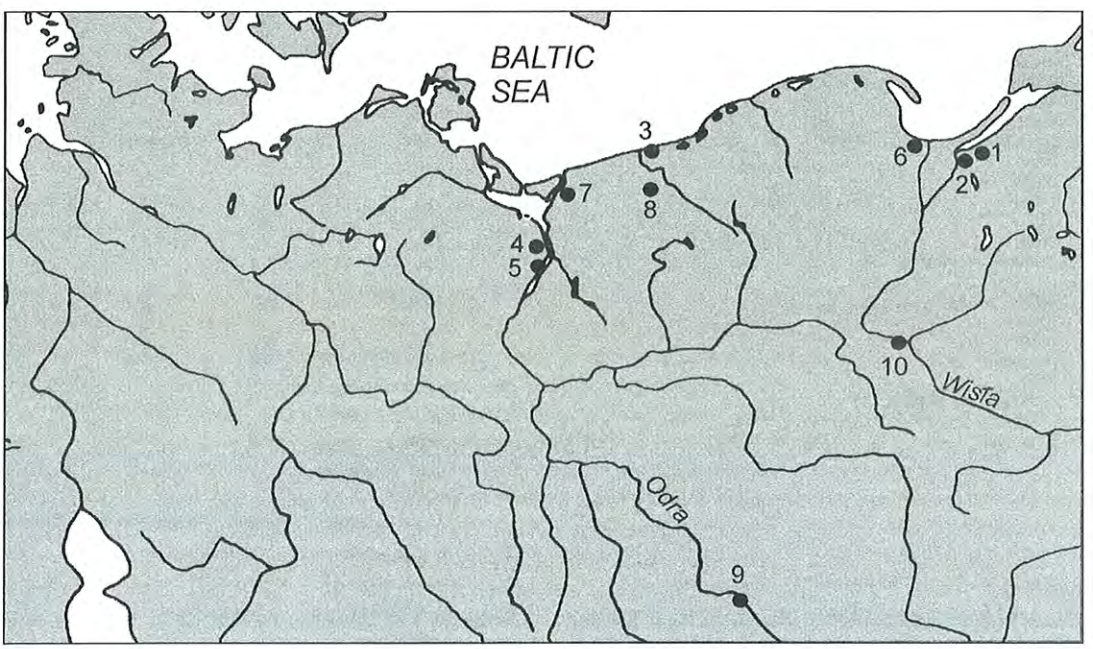

FIGURE 11

Map of northern Poland, showing the location of the reviewed sites. Site numbers refer to the section "Poland, individual sites".

Site	Tolkmicko	Łęcze	Kolobrzeg-Budzistowa	Szczecin-Mścięcino	Szczecin Rynek Warzywny	Gdansk I	Gdansk II Prince's Quarter
Site n°	1.	2.	3.	4.	5.	6.	
Age (centuries)	7-5 BC	7-5 BC	8/9-11/12 AD	9-11 AD	9/10-13 AD	10-13 AD	Early Medieval
Recovery technique	?	?	?	?	?	?	?
MARINE SPECIES							
Herring	.	.	.	.	.	.	.
Clupeids, unspecified	.	.	3235	.	+[2]	342	.
Gadids, total	.	.	3	.	.	10	.
Cod	.	.	3	.	.	10	.
Gadids, unspecified	.	.	.	.	.	.	.
Flatfishes, total	.	.	16	.	.	42	.
Dab/Plaice/Flounder	.	.	16	.	.	42	.
Flatfishes, unspecified	.	.	.	.	.	.	.
MIGRATORY SPECIES							
Sturgeon	36	1	60	101	214	4994	432
Twaite shad	.	.	.	.	.	.	.
Salmon	.	.	.	.	.	.	.
Trout	.	.	.	.	.	.	.
Trout/Salmon	1	3	3	.	.	3	.
Whitefish	.	.	.	.	.	1	.
Salmonids, unspecified	.	.	.	.	.	.	.
Smelt	.	.	.	.	.	.	.
Eel	.	.	1	14	56	4	1

Site	Tolkmicko	Łęcze	Kolobrzeg-Budzistowa	Szczecin-Mścięcino	Szczecin Rynek Warzywny	Gdansk I	Gdansk II Prince's Quarter
FRESHWATER SPECIES							
Pike	45	.	18	10	264	331	1
Cyprinids, total	3190	41	62	175	3431	3954	17
Common carp	.	.	.	.	.	.	.
Crusian carp	1	.	.	.	18	13	[4]
Barbel	.	.	.	.	.	.	.
Tench	.	.	.	25	704	297	2
Dace	.	.	.	.	.	.	.
Chub	.	.	.	.	10	5	.
Orfe	1	.	.	.	27	16	.
Dace/Chub/Orfe	.	.	.	.	.	83	.
Roach	215	4	32	81	979	171	2
Rudd	.	.	.	.	12	14	.
White bream	92	1	.	.	3	42	.
Common bream	2757	34	29	66	1553	1454	12
Zope	.	.	.	.	21	.	.
Bream/Zope	.	.	.	.	.	157	.
Zährte	1	.	1	.	5	92	.
Asp	11	.	.	3	98	143	1
Ziege	112	2	.	.	1	12	.
Cyprinids, unspecified	.	.	.	.	.	1455	.
Wels	5	.	.	32	588	113	4
Burbot	2	.	.	.	.	3	.
Perch	55	.	7	13	292	234	2
Pikeperch	393	1	6	345	1101	2977	17
Ruffe	.	.	.	.	4	.	.
Bullhead/alpine bullhead	.	.	7	.	.	.	.
Total	3727[1]	46	3418	690[3]	5950	13008	474

T

Numbers of identified fishbones from Polish sites. Rec

cies which could have been caught in local fishing waters. Perch, pikeperch, cyprinids and pike are the most frequent species and are all very common in the inner Baltic Sea as well as in fresh waters in Estonia. The presence of herring at Pärnu is also very striking. Furthermore, it is worth noting that the flatfish are represented by the flounder, the flatfish species which extends furthest into the Baltic.

Quarter	Kamień-Pomorski	Kędrzyno	Wrocław	Mała
	7.	8.	9.	10.
	10-13 AD	early Med.	10-14 AD	14-15 AD
?	?	?	?	?
.	.	2	16[5]	.
.	.	.	.	.
.	.	.	.	561
.	.	.	.	561
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
.	.	.	.	.
71	.	1	1[6]	31
.	.	.	.	.
.	.	.	1[7]	.
.	.	20	2[8]	.
.	.	.	13[9]	.
1	.	.	.	.
.	.	.	4	.
.	.	.	.	.
3	.	.	.	.

Quarter	Kamień-Pomorski	Kędrzyno	Wrocław	Mała
05	3	60	30[10]	114
34	11	236	171	47
.	.	.	29[11]	.
5	.	.	8[12]	3
.	.	.	7[13]	.
76	4	68	12	.
.	.	.	3[14]	.
5	.	4	5[15]	.
5	.	1	19	.
.	.	.	.	.
43	3	31	6[16]	11
1	.	[17]	6	.
1	1	1	[18]	.
05	2	131	66[19]	32
.	.	.	.	.
.	.	.	8	.
3	1	[20]	[21]	.
37	.	.	2	1
2	.	.	.	.
.	.	.	.	.
02	.	.	11	5
3	.	4	[22]	.
17	2	255[23]	23[24]	9
61	20	52	14[25]	13
.	.	2	.	.
.	.	.	.	.
297	36	632	286	780

1 excluding 23,717 scales, mostly from saberfish.
2 present, not counted.
3 excluding scales.
4 scales.
5 excluding scales.
6 excluding scales.
7 excluding scales.
8 identified to subspecies fario, excluding scales.
9 excluding scales.
10 excluding 534 scales.
11 excluding scales. 18 bones tentatively identified.
12 excluding scales.
13 excluding scales.
14 excluding scales.
15 excluding scales.
16 excluding scales.
17 sporadic occurrence.
18 scales.
19 excluding 1334 scales.
20 sporadic occurrence.
21 scales.
22 scales.
23 frequent occurrence.
24 excluding 3814 scales.
25 excluding 211 scales.

6

echnique: h = hand-collected, s = sieved, ? = unknown.

The only deviation from the purely local impression given by the material is the presence of cod which must have been imported to Tartu and therefore documents trade with fish.

POLAND, INDIVIDUAL SITES

The review is based on published results. All the material was hand-collected.

The site numbers refer to Figure 11 (see Table 6 for detailed species lists).

Tolkmicko (1) and Leçze (2)

Two sites at Vistula Bay on the Baltic Sea. Two fish bone assemblages, both dated to the 7th-5th centuries BC, are available here. The Tolkmicku material is by far the largest and is strongly dominated by common bream. Pikeperch, roach and ziege were also important. The material from Leçze is very similar (Filuk, 1968).

Kolobrzeg-Budzistowa (3)

Kolobrzeg lies on the Baltic coast and has yielded fish bone assemblages dated to the 8th/9th to 11th/12th centuries AD. Most of the bones are from clupeids (herring/shad), the majority probably from herring. Other marine species include cod, and there are a number of migratory and freshwater species, particularly sturgeon. The species list was taken from Rulewicz (1994).

Szczecin-Msciecino (4)

A settlement situated immediately outside a castle, on a branch of the River Odra near the lagoon Szczeciner Haff. Fish bone material was excavated in 1954 and has been dated to the 9th-11th centuries AD. The bones are well-preserved and are regarded as kitchen refuse. Thirteen species of fish are represented, all of which, with the exception of sturgeon, are common in the Odra and/or Szczeciner Haff nowadays. The most frequent species is pikeperch, with sturgeon in second place (Chelkowski, 1959).

Szczecin, Rynek Warzywny (5)

Fish bone material is available from Medieval (9th/10th to 13th centuries AD) Szczecin in the Vegetable Market (Rynek Warzywny) area. Most of the identified fish bones are from common bream, pikeperch and roach, but there are also a good number of bones of wels. Clupeidae (herring/shad) are indicated as present, not counted. The species list was taken from Rulewicz (1994).

Gdansk I (6)

The city of Gdansk is situated near the coast of a large bay on the Baltic Sea near the River Wisla and its estuary. Extensive fish bone material, from 17 habitation levels dated to AD 980-1308, has been excavated in the old town of Gdansk. As there seems to be no change throughout these centuries, only the total number of bones of each species are shown in Table 6. It should, however, be emphasized that all ten bones of cod are from the 13th century. The most important species appear to have been sturgeon, pikeperch and common bream. All species on the list occur naturally in nearby waters. The majority of the fish bones are from migratory species, and Suslowska and Urbanowicz (1967) therefore thought that fishing took place near the Wisla estuary, in its branches, in bays and in coastal waters. Size estimations showed that the older layers contain larger individuals than the younger ones. Marine fish are represented merely by the clupeid family, and a small number of cod bones.

Gdansk II (6)

Suslowska (1966) reported on fish bone assemblages from two other sites in Gdansk, the Prince's Quarter and the Fishing Quarter, respectively. Both are early Medieval but no more precise datings are available. Suslowska (1966) compared the two assemblages and found them to be very similar. Only those species represented by a few bones in the large material (Fishing Quarter) are absent from the smaller material, presumably due to the numerical difference between the assemblages. Sturgeon dominates, followed by pikeperch and common bream. Suslowska (1966) warned that sturgeon tends to dominate fish bone assemblages because of its numerous large bony plates.

Kamien-Pomorski (7)

An early Medieval town close to the Baltic coast north of Szczecin. During a number of pilot excavations carried out in 1958 fish bone material was recovered from kitchen refuse from a settlement layer, spanning the 10th-13th centuries AD. The amount of material is small and it comprises exclusively freshwater species, mostly pikeperch (Chelkowski, 1960).

Kedrzyno (8)

A site in the Kolobrzeg district close to the Baltic coast north of Szczecin. Fish bones were recovered in 1959 from samples of kitchen refuse, dated

to the 8th-9th centuries AD (Lozinski, 1982), from an area with early Medieval castle walls. Most of the bones are from common bream and perch. The marine element is constituted by two herring bones (Chelkowski & Chelkowska, 1966).

Wroclaw "L'Ile-du-Dome" (9)

A city almost 400 km from the Baltic Sea. Fish bones and, in particular, fish scales dated to the 10th-14th centuries AD were recovered from the site of "L'Ile-du-Dome". Most bones and scales are from common bream, perch, pike and pikeperch. It is worth noting that herring is represented at this truly inland site - this species must have been imported, and that the domesticated common carp also occurs (Kozikowska, 1974).

Mala Nieszawka (10)

A site near Torun town on the River Wisla, about 160 km from the Baltic coast. Fish bones dated to the 14th and the first half of the 15th century AD were recovered within the former Teutonic castle. It is notable that most bones at this inland site are from cod, a marine species, but only head bones are represented. In addition there are bones of freshwater species and the migratory sturgeon (Iwaszkiewicz, 1991).

POLAND, OVERVIEW

The fish bone assemblages from Poland cover the period from the 7th century BC to the 15th century AD, i.e., from the early Iron Age to the Middle Ages. There is, however, a lacuna of more than 1000 years within this interval. The assemblages are strongly dominated by migratory species and fish of fresh and brackish water. In contrast, there are very few marine species present (cod, herring and plaice/flounder/dab).

Local influences on Polish fishing

The Polish fish bone assemblages bear very strong evidence of local conditions. In all cases, bones of pikeperch, sturgeon, pike and perch are very common. These species must have been of great importance for the human population. Pike and perch are absent from the material from Leçze, but this assemblage is, however, very small and hardly representative. Even today, pikeperch, pike and perch are very common in the Baltic Sea and in Polish fresh water. Although nowadays very rare, sturgeon was still common in the area in the 19th century. Suslowska and Urbanowicz (1967) and Zbierski (1976) were of the opinion that the large quantity of sturgeon bones in the assemblages is misleading with regard to the importance of this species. They argue that the sturgeon, unlike other fish, is armed with several rows of large bony plates along its body, therefore the probability of preservation in the soil, and subsequent retrieval of the plates is high. On the other hand, the cartilaginous skeleton of sturgeon has a very low probability of preservation. Furthermore, even though the number of individuals may be less than thought at first glance, each individual sturgeon is much bigger than most other fish. All in all, it must be assumed that sturgeon played an important role in prehistoric Poland.

Cyprinids are amply represented at most of the sites, a large number of species being present. This is most pronounced at Wroclaw far inland where 13 species of cyprinids have been found. Among the cyprinids, ziege deserves special mention; it is very common at Polish sites but is not found in the other countries under consideration.

Herring is common off the Baltic coast of Poland. Not surprisingly, bones of clupeids, probably mainly herring, are abundant in the material from the coastal site of Kolobrzeg-Budzistowa. Out of 3418 fish bones, 3235 are from clupeids, and there are only a few bones of freshwater species. Rulewicz (1994) drew attention to the existence of salty springs on Kolobrzeg islands, these would have facilitated the salting of herring at this site. Clupeid bones are less abundant in the material from Gdansk; they are also present at Szczecin, Kedrzyno and Wroclaw. The fact that even greater numbers of clupeid bones were not found, may be due to the recovery technique. This, unfortunately, is not known. If sieving has not been employed, the chances of the small herring bones having been lost are high. Zbierski (1976) suggested that the clupeid bones found in Gdansk are remains of every day consumption in the town, whereas most of the herring caught at the coast were probably exported. Suslowska and Urbanowicz (1967) speculated as to why so few herring bones have been found in Gdansk and suggested that this may be due to a concentration of herring fishing along the coast.

Two of the Polish assemblages are of early Iron Age date, viz., Tolkmicko and Leçze. In spite of

their considerably greater age they do not differ markedly from the younger material, with perhaps the exception that they contain no marine species. Both Iron Age sites are located near the Baltic Coast and the absence of a marine element may be fortuitous (the material from Lecze is quite small).

The Gdansk material includes 17 habitation levels dated to the period AD 980 to 1308. There seems to have been no change through time in the composition of species, except that cod is present only in 13th century layers. Suslowska and Urbanowicz (1967) mentioned, however, that the oldest habitation levels contain larger individuals of fish than the younger ones; they suggest that this may be due to a change in fishing technique. The difference may also reflect taphonomic processes (small bones disappear first), or overfishing may be responsible.

Variation in fishing is reflected by the finds of fishing equipment (see below) but also by the species lists. Rulewicz (1994) and Zbiersky (1976) discussed fishing from early Medieval Gdansk in relation to other towns in Pomorze (Pomerania) on the basis of archaeological and osteological evidence and written sources.

Remains of fishing equipment from Polish sites

Impressively rich finds of early Medieval fishing equipment have been made in the towns of Gdansk, Szczecin, Kolobrzeg-Budsistowa and Kamien-Pomorski (Rulewicz, 1994). The tools include fish-hooks, fish spears, harpoons, lines, needles for net-making, net sinkers, net floaters and many others. Net floaters in particular have been found in astonishing abundance. The tools testify to a varied fishing tradition; net-fishing in particular must have been of great importance.

Indications of fish trade in Poland

Trade with fish is proven beyond doubt by the material from Wroclaw. Although the town lies about 400 km from the sea, 16 herring bones were found. These herring must necessarily have been imported, probably from the Baltic coast. Considering the distance, the herring must have been preserved, probably salted, cf. the salty springs at Kolobrzeg mentioned above. Material from Poznan (12th century AD, 240 km from the sea) and Santok (13th century AD, 160 km from the sea) also contains remains of herring (Daniel Makowiecki pers. comm.).

The second inland assemblage dealt with here, i.e. from Mala, also includes evidence of fish trade. Out of a total of 780 fish bones from the remains of a Teutonic castle, 561 are from cod. The castle was situated on the banks of the River Wisla, so it would have been easy to transport cod from Gdansk to Mala along the Wisla. All the cod bones are from the head region. As the size of the cod, as well as the recovery technique, is not known, it is difficult to determine whether this uneven representation of bone elements is the result of butchering or a function of the recovery technique which did not retrieve the smaller vertebrae. In any case, it is thought-provoking that so many cod bones were found on a Teutonic site. The Teutonians were a Germanic tribe, and in Germany many cod bones have been found at contemporaneus Germanic settlements, whereas cod is largely absent from the Slavonic ones. Apart from Mala, the only other cod bones from Polish sites are ten from Gdansk (from where the cod were presumably exported to Mala) and three from Kolobrzeg-Budzistowa.

Pike is represented exclusively by bones from the head and shoulder girdle in the material from Gdansk, Tolkmicko and Szczecin-Msciecino. It is possible that these bones are the remains of dried pike, cf. the discussion of Swedish finds.

The only find of domesticated carp is from the inland site of Wroclaw.

The Polish material is partly from castles, partly from towns/villages. In the latter group, material from different areas, for example, the Prince's Quarter and the Fishermen's Quarter in Gdansk, can sometimes be distinguished. There is, however, no sign of any "social" difference between these areas, the same species being represented. Trout/salmon, which in the Middle Ages were highly esteemed fish and, according to written sources were more or less reserved for the upper class (Zbierski,1976) are found scattered throughout most of the assemblages. The only find which is distinguishable in this respect is the cod-dominated assemblage from the Teutonic castle in Mala.

GERMANY, INDIVIDUAL SITES

The review of German sites is based entirely on published results.

The site numbers refer to Figure 12 (see Table 7 for detailed species lists).

Drense, Kreis Prenzlau (1)

A Slavonic castle, dated archaeologically and by radiocarbon analysis to the 7th mid-13th centuries AD. The bone material was hand-collected, and as the bones are well-preserved, the small number of fish bones is ascribed to the recovery technique. The castle is situated inland, far from the coast.

Sturgeon and wels (found in the phase from the 11th-13th centuries AD) are regarded as having been imported, the remaining species live in nearby fresh water (Benecke & Prilloff, 1989).

Oldenburg, Starigard (2)

Remains of a castle in the town of Oldenburg, situated on a peninsula between Kieler Bucht and Mecklenburger Bucht. The castle was occupied during at least five Slavonic periods from AD 650 until AD 1150. A late Medieval Germanic occupation followed which lasted until AD 1260. Fish bones were mainly recovered by sieving (Prummel, 1986, 1991, 1993). The material can be assigned to different horizons.

Twenty-three species of fish are represented in this large assemblage, the most important ones being cyprinids, eel and herring. Freshwater fishing is seen as predominating. The species spectrum suggests that the inhabitants went fishing both in the surrounding fresh water and in the Baltic Sea. In general, the fish are represented by bones from all body regions, indicating that entire fish were brought into the castle. This is also true of the herring which have therefore not had their gills removed. It is difficult to determine whether the inhabitants of the castle caught the herring themselves or whether they purchased them. The presence of entire herring, combined with the presence of garfish and mackerel (possibly secondary catches from herring fisheries), is however interpreted as an indication that fishing by the inhabitants themselves is most likely. The five cod bones in the material represent individuals of 0.57-0.78 m in length which might have been caught in the Baltic Sea. There is no evidence of stockfish.

Hitzacker (3)

A Slavonic-Germanic castle situated inland, on the River Elbe. The material can be assigned to three phases; a Slavonic settlement from the 8th-11th centuries AD, a Slavonic-Germanic transition phase from the 11th/12th centuries AD, and a German settlement from the 12th-16th centuries AD.

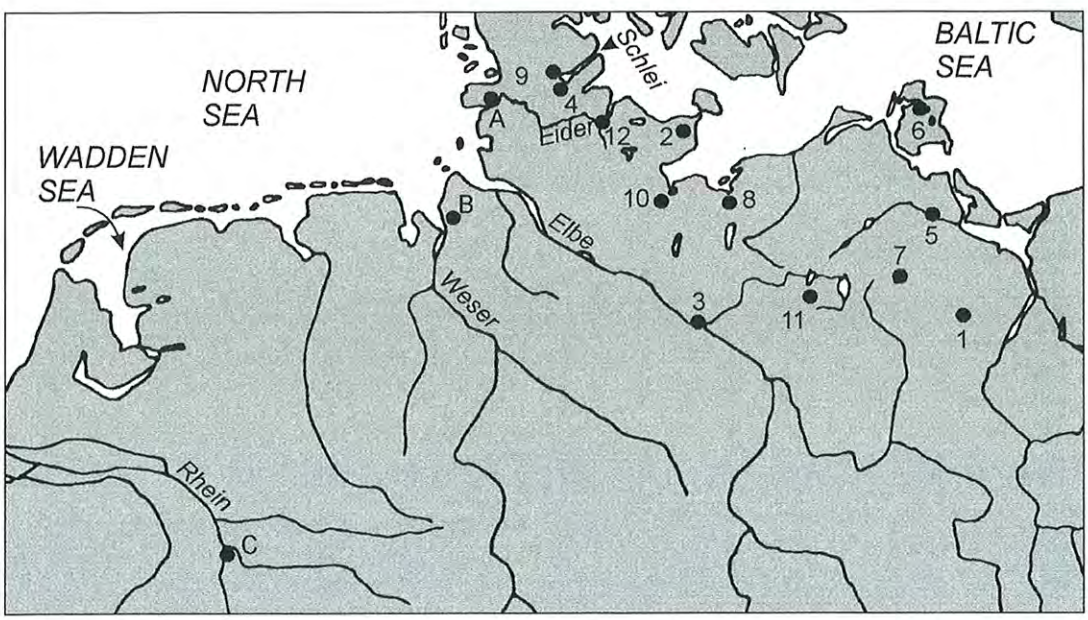

FIGURE 12

Map of northern Germany, showing the location of the reviewed sites. Site numbers refer to the section "Germany, individual sites". The three sites marked with A (Elisenhof), B (Feddersen Wierde) and C (Duisburg) are treated in detail elsewhere (Enghoff, submitted).

Site	Drense	Oldenburg	Hitzacker			Haithabu	Menzlin	Ralswiek	Lieps	Mecklenburg	Schlesv
Site n°	1.	2.	3.			4.	5.	6.	7.	8.	9.
Age (centuries)	7-13	7-13	8-11 AD	11/12 AD	12-16 AD	9-11 AD	9-10 AD	early Med.	10-13 AD	7-13 AD	11-12 A
Recovery technique	h?	h+s	?	?	?	s	h	s	h	h	h
MARINE SPECIES											
Porbeagle	.	.	.	.	.	1	.	.	.	.	.
Smoothhound	.	.	.	.	.	1[6]	.	.	.	.	.
Thornback ray	.	.	.	.	.	.	.	.	.	.	.
Starry skate	.	.	.	.	.	1	.	.	.	.	.
Sailray	.	.	.	.	.	.	.	.	.	.	.
Cartilaginous fishes, unspecified	.	.	.	.	.	.	.	.	.	.	.
Herring	.	1159	.	.	.	5337	6575	10506	3	1	51
Garpike	.	68	.	.	.	190	1	266	.	3	5
Hake	.	.	.	.	.	.	.	.	.	.	.
Gadids, total	.	5	.	5	5	116	.	.	.	.	584
Cod	.	5	.	3	5	109	.	.	.	.	565
Haddock	.	.	.	.	.	.	.	.	.	.	5
Saithe	.	.	.	.	.	2	.	.	.	.	.
Ling	.	.	.	2	.	5	.	.	.	.	9
Gadids, unspecified	.	.	.	.	.	.	.	.	.	.	5
Atlantic horsemackerel	.	17	.	.	.	.	.	.	.	.	.
Atlantic mackerel	.	.	.	.	.	4	.	2	.	.	.
Swordfish	.	1	.	.	.	.	.	.	.	.	.
Eelpout	.	1	.	.	.	.	.	.	.	.	.
Bullrout	.	4	.	.	.	.	.	.	.	.	.
Three-spined stickleback	.	10	.	.	.	.	.	.	.	.	.
Flatfishes, total	.	402	.	3	1	1026	.	2471	.	.	20
Turbot	.	.	.	.	.	.	.	.	.	.	1
Turbot/Brill	.	.	.	.	.	.	.	.	.	.	.
Halibut	.	.	.	.	.	3	.	.	.	.	.
Dab	.	1	.	.	.	.	.	.	.	.	.
Plaice	.	2	.	3	1	.	.	.	.	.	3
Flounder	.	7	.	.	.	.	.	.	.	.	1
Plaice/Flounder/Dab	.	392	.	.	.	1023	.	.	.	.	15
Flatfishes, unspecified			.	.	.	.	.	2471	.	.	.

Site	Drense	Oldenburg	Hitzacker			Haithabu	Menzlin	Ralswiek	Lieps	Mecklenburg	Schlesw
MIGRATORY SPECIES											
Sturgeon	1	2	36	80	98	2	225	50	.	.	3
Shad	.	.	.	.	.	.	.	.	.	.	.
Salmon	.	1	2	6	4	.	.	.	.	.	2
Trout	.	2	.	.	.	.	.	.	.	.	.
Trout/Salmon	.	65	.	.	.	129	.	10	.	.	1
Whitefish	.	. 2	.	.	.	382[7]	.	.	.	.	.
Salmonids, unspecified	.	.	.	.	.	.	.	.	.	.	.
Eel	.	1040	.	.	.	102	13	18	1	1	8
FRESHWATER SPECIES											
Pike	14	476	132	258	287	1535	81	104	42	37	82
Cyprinids, total	18	1044	86	181[4]	169	1458	1183	2933	67	41	119
Common carp	.	.	1	2	3	.	.	.	.	.	.
Crusian carp	.	.	.	.	.	.	.	.	1	4	.
Tench	2	32	6	10	22	6	6	.	10	18	.
Dace	.	.	.	1	1	.	.	.	.	.	.
Chub	.	.	6	7	10	.	.	.	.	.	.
Orfe	.	.	2	4	5	22	.	.	.	.	4
Dace/Chub/Orfe	.	.	2	4	5	.	.	.	.	.	.
Roach	.	106	2	8	6	85	94	.	4[8]	3[9]	4
Rudd	.	1	1	.	5	13	1	.	1	16[11]	.
Common bream	4	81	15	27	20	145	281	.	51[10]	.	52
Zope	.	.	.	1	1	.	.	.	.	.	.
Zährte	.	.	3	1	1	.	.	.	.	.	.
Asp	.	.	1	1	5	.	4	.	.	.	.
Cyprinids, unspecified	12[1]	824[2]	47	115	85	1187	797	2933	.	.	59
Wels	1	.	4	8	14	.	2	.	83	1	.
Burbot	.	.	.	.	2	.	.	.	.	.	.
Perch	2	453[3]	.	18[5]	11	3454	182	2566	31[12]	5[13]	183
Pikeperch	1	.	.	.	1	104	518	86	5[14]	2[15]	6
Ruffe	.	2	.	.	.	.	5	28	.	.	.
Total	37	4754	260	559	592	13842	8785	19040	232	91	1064

T

Numbers of identified fishbones from German sites. Rec

		Lübeck König-straße	Freyen-stein	Kiel	Lübeck Heiligen-Geist Hospital
		10.	11.	12.	10.
16 AD	15-16 AD	12-16 AD	13 AD	13 AD	13-20 AD
h	h	h	h	s	h
.	.	.	.	.	.
.	.	.	.	.	.
.	1	.	.	.	.
.	2?	.	.	.	.
.	2?	.	.	.	.
.	.	.	.	.	.
23	134	.	25	17	.
20	.	.	.	.	.
1	.	.	.	.	.
325	206	20	16	10	100
324	10	20	16	.	100
85	193	.	.	.	.
7	.	.	.	.	.
6	3	.	.	.	.
3	.	.	.	10	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
13	6	3	.	30	.
7	.	.	.	4	.
.	.	.	.	.	.
.	.	.	.	.	.
1	.	.	.	.	.
25	.	.	.	.	.
4	.	3	.	.	.
76	6	.	.	26	.
.	.	.	.	.	.
		Lübeck Königstr.	Freyen-stein	Kiel	Lübeck Heiligen-Geist Hospital
18	.	1	.	.	.
.	.	.	.	.	.
1	.	.	.	.	.
6	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
1	4	.	.	14	.
57	.	3	11[16]	.	.
360	2	4	8	17	.
.	.	3	.	.	.
.	.	.	.	.	.
26	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
2	.	.	.	.	.
.	.	.	.	.	.
9	.	.	.	1	.
1	.	.	.	.	.
19	.	.	7	.	.
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
03	2	.	1[17]	16[18]	.
.	.	.	.	.	.
.	.	.	.	.	.
154	83	.	2[19]	26[20]	.
.	.	.	.	.	.
.	.	.	.	.	.
679	440	31	62	114	100

[1] excluding 150 scales.
[2] excluding 3354 scales.
[3] excluding 80 scales.
[4] excluding 30 scales.
[5] excluding 1 scale.
[6] orig. ref.: spurdog, revised by IBE.
[7] excluding 1400 scales.
[8] excluding 20 scales.
[9] excluding a few scales.
[10] excluding 1950 scales.
[11] excluding 1300 scales.
[12] excluding 140 scales.
[13] excluding a few scales.
[14] excluding 15 scales.
[15] excluding a few scales.
[16] excluding scales.
[17] excluding scales.
[18] excluding scales.
[19] excluding scales.
[20] excluding scales.

echnique: h = hand-collected, s = sieved, ? = unknown.

The recovery technique was not recorded (von den Driesch, 1982). The location of the castle was optimal for freshwater fishing in the Rivers Elbe and Jeetzel as well as in nearby marsh areas. Accordingly, most fish bones derive from freshwater fish: about half of the identified fish bones are from pike, and about a third from cyprinids. The numerous bones of sturgeon are noteworthy; sturgeon have been caught in the Elbe even in historic times (von den Driesch, 1982). Of particular interest are bones of common carp found in layers dated as early as the 9th-10th centuries AD. These represent the oldest find of common carp from the Elbe area. Marine fish do not appear until the 11th/12th century material and they were probably imported to the castle dried and salted. Von den Drisch (1982) concluded that fish were not of major importance for the inhabitants of the castle.

Haithabu (4)

A famous trading center located on the southern shore of the inner Schlei estuary, close by the main road leading to Jylland, Denmark. Also known under the Danish name of Hedeby. Through the brackish Schlei there was easy access from Haithabu to the Baltic Sea, where a somewhat higher salinity prevailed. To the west, access to the North Sea was relatively easy down the River Treene. Haithabu's location was thus very central and, at the same time, ideal for fishing.

The fish bone material dates from the 9th-11th centuries AD and was mostly recovered by wet-sieving (mesh size unknown). Lepiksaar and Heinrich (1977) provided an extremely thorough analysis of the material. The highly diverse assemblage includes 26 species of fish. Herring is on the whole the most frequent species, constituting 38.6% of the bones. It is followed by perch (24.9%) and pike (11.1%). The vertical distribution of the bones shows that marine species, especially herring, are more frequent in older layers. Size estimates of the herring do not exclude the possibility that they could have been caught in the Schlei. Lepiksaar and Heinrich emphasized that the oldest known "herring period" around AD 1000 is contemporaneous with Haithabu. The herring bones are very well-preserved and the entire herring skeleton is represented. This means that entire herring were brought to Haithabu.

Local fishing at Haithabu is demonstrated, not only by the herring but also by the presence of such species as, for example, perch, roach, common bream and whitefish which are all common in the Schlei. Halibut, saithe and ling, on the other hand, could not have been caught in nearby waters and are thought to have been travellers' provision brought to Haithabu by strangers. Cod was not of major importance and the relatively few cod bones in the material may also derive from travellers' provision. The presence of garfish provides evidence for fishing during the summer half of the year.

Menzlin (5)

A center for crafts and trade located on the bank of the River Peene 40-50 km from the Baltic coast. The fish bone material dates from the 9th-10th centuries AD and was hand-collected (Benecke, 1987).

The varied material is strongly dominated by herring: 75% of the bones. Most of the herring bones were found in the form of a concentration inside one of the prehistoric houses. Benecke (1987) thought that the bones represent severed herring heads. These herring were probably caught in the Baltic Sea around the island of Rügen, and were presumably salted before being transported to Menzlin. Since the size spectrum of the herring is limited (0.22-0.32 m) Benecke suggested that some sorting took place.

Cyprinids are second to herring in frequency; a considerable number of sturgeon bones are also worth noting.

Ralswiek (6)

A Slavonic trading centre on the island of Rügen, located on a brackish inlet opening into the Baltic Sea. Benecke (Benecke, 1983) analyzed fish bones from Ralswiek, but as I have been unable to consult this thesis, I have obtained information about Ralswiek from Benecke (1982) and Prummel (1986). The material is dated to the early Middle Ages (more precise dating was unavailable) and was recovered by sieving.

More than half of the fish bones derive from herring, but cyprinids, perch and flatfish were also of major importance.

Lieps (7)

Five Slavonic settlements on islands in the southern part of the lake Tollensesee. The bones were hand-collected. They are dated to the early Middle Ages (10th - 13th centuries AD) and repre-

sent 11 species (Benecke, 1984b). There is only one marine species, viz., herring. Since these settlements are far from the sea the herring bones must derive from imported, probably salted herring. Common bream appears to have been the most important freshwater species. The material also includes many bones of wels but Benecke (1984b) interpreted the relative dominance of these large bones as a function of the recovery technique.

Mecklenburg (8)

A major Obodrith (Slavonian) castle in Kreis Wismar, about 7 km from the Baltic coast (Wismarer Bucht). The small assemblage dates from the 7th to13th centuries AD and was hand-collected. Most of the bones represent freshwater species. Pike, tench and common bream seem to have been most important, but the material is really too small to be regarded as representative. There is one bone of herring and three of garfish, tentatively suggesting fishing in the Baltic Sea (herring fishing with garfish as a secondary catch?). All the species might have been caught in nearby waters (Benecke, 1984a).

Schleswig (9)

A town on the northern shores of the Schlei estuary, i.e. the same optimal location as Haithabu which it gradually replaced. The fish bone material derives from the 11th to mid-14th centuries. Heinrich (1987) divided the material into two phases, an early phase (11th-12th centuries) and a late phase (13th-14th centuries). In addition, a minor amount of material was collected from a cesspit dating from the 15th/16th centuries. The fish bones were hand-collected and were analyzed in great detail by Heinrich (1987).

The 11th-14th century material is in general dominated by gadids, followed by perch, cyprinids and pike. Sturgeon is also present. Since the material was hand-collected, one must bear in mind that small fish could have been much more frequent than suggested by the analysis. This might for instance be true of herring, cf. the importance of herring at Haithabu where fish bones were recovered by sieving.

Gadids are most frequent during the early phase, whereas the importance of freshwater fish, primarily perch, is greater during the late phase. Neither do haddock, saithe, ling or cod as large as those found (0.80-1.50 m) occur in the Schlei or in the western Baltic Sea. Heinrich (1987) therefore regarded the gadids as having been imported to Schleswig from the North Sea or from even more distant places.

Cod from the late phase had an estimated length of 0.46-0.85 m based on the dentary and cleithrum (bones from head and shoulder, respectively) and 0.70-1.30 m based on vertebrae. Since only the smaller cod (0.46-0.85 m) are represented by head and shoulder girdle bones they may represent local fishing in the western Baltic, whereas the larger cod, represented mainly by bones from the trunk, may have been imported as in a dried, salted and headless state (Heinrich, 1987).

Haddock was much more important during the late than during the early phase.

The pike remains show an interesting dominance of bones from the head and shoulder girdle (only five vertebrae out of 239 pike bones). This discrepancy may be due to the recovery technique, or the pike bones may represent refuse from processing, or from dried fish (cf. discussion of pike from certain Swedish and Polish sites).

The herring seem to have been brought to Schleswig in an entire state.

Most of the fish bones in the refuse from the 15th/16th century cesspit are from gadids, almost exclusively haddock. It thus appears as if the increase in importance of haddock from the early to the late phase was maintained. The representation of haddock bone elements supports the idea that this fish was imported in a processed condition. The cesspit contains, furthermore, a large number of herring bones and an unusual element of cartilaginous fish.

Lübeck (10)

A town on the River Trave which flows into the Baltic Sea. Lübeck succeded Schleswig as the most important trading centre in the western Baltic. Medieval Lübeck has provided two fish bone assemblages.

A minor amount of material was hand-collected during excavations in Königstrasse 59-63. It was dated on the basis of ceramics to the 12th-16th centuries AD. This material is dominated by cod, but a single find of sturgeon is also of note (Paul, 1980).

Another small amount of material was hand-collected at the site Heiligen-Geist Hospital and was dated on the basis of ceramics to the 13th-20th centuries AD. This material consists of 100 cod bones (Pudek, 1980).

Freyenstein (11)

The site is situated far from both the Baltic and the North Sea. Sixty-two fish bones dated to the 13th century AD were hand-collected and cannot be regarded as representative (Benecke, 1989). It is, however, interesting that both herring and cod are represented. These species must have been imported to Freyenstein, and considering the distance to the coast they were probably in a preserved a state.

Kiel (12)

Fish bones dated to the 13th century AD were recovered from Medieval Kiel on the Baltic coast. They were recovered as a secondary find during sieving for plant remains through 0.3 mm, 0.5 mm, 1.0 mm and 2.0 mm meshes. Due to these special circumstances the sample sizes are small, and so are the individual fish remains. The bones represent freshwater, migratory and marine species which may all have been caught in nearby waters (Heinrich *et al.*, 1993/1994).

GERMANY, OVERVIEW

The German material covers the period from the 7th to the 16th centuries AD; one of the sites even extends up into the 20th century. Three sites located on the German North Sea coast or in the North Sea hinterland (Feddersen Wierde, Elisenhof and Duisburg) will be treated in detail by Enghoff (in press) but are included in the present discussion where relevant.

Local influences on Baltic fishing in Germany

As already emphasized by Benecke (1982), herring has been heavily exploited in the Baltic part of Germany for a very long time. Herring bones have been found in Schleswig, Haithabu, Kiel, Oldenburg, Mecklenburg, Menzlin, Freyenstein, Lieps and Ralswiek. Some of these sites are situated on the Baltic coast, but others are inland sites far from the sea.

The large quantities of herring remains from Haithabu deserve particular mention. Based on size estimations, Lepiksaar and Heinrich (1977) interpreted this find as representing herring caught in the Schlei estuary. The entire herring skeleton is represented, which means that removal of gills did not form part of any processing method used. Fish weir complexes ("Heringszäune") are known to have been placed in the Schlei during the late Middle Ages. These are fish traps built from stakes and wickerwork and equipped with two converging weirs with a catching net in the angle where they meet. Radtke (1977) assumed that traps such as these might also have been used earlier, i.e. in Haithabu. Special mention should also be made of the finds from Menzlin, where remains of severed herring heads were found (Benecke, 1987), and Ralswiek, where herring seem to have been landed together with a secondary catch of garfish and mackerel (Benecke, 1982).

Perch is another species which has played a major role at sites on the southern Baltic coast. In the assemblages from Kiel, Schleswig and Haithabu, perch is the most or second most frequent species. Perch occurs in both fresh and brackish water and is very common along the coasts of the Baltic Sea (Muus & Dahlstrøm, 1967). Benecke (1987) further discussed the role of perch in material from Baltic Germany.

Local fishing is extremely well documented in the very large amount of material from Haithabu, not only by remains of herring and perch, but also by species like roach, common bream and whitefish which can all be caught in the Schlei. Whitefish bones are known to preserve poorly in the soil, the 382 whitefish bones found at Haithabu represent, therefore, an unusually large sample.

Naturally enough, cyprinids and pike are generally frequent both at sites on the Baltic coast and those further inland. Heinrich (1987) discussed finds of pike from northern German sites, where there seem to be great differences in the representation of the different bone elements. It is, however, difficult to determine whether this is due to differences in recovery technique, or to processing of the fish.

The site of Oldenburg is distinguished by a particularly large number of eel bones. Prummel (1986, 1991, 1993) saw the dominance of eel as being a result of the site's location near eel-rich waters suitable for trapping.

In conclusion, the sites on the Baltic Sea and in the Baltic hinterlands are mostly characterized by fresh and brackish water species caught partly in the Baltic itself, partly in its inlets, bays and estuaries, and partly in rivers and lakes.

Remains of fishing equipment from German sites

One gorge, 4-6 iron barbs from fish spears, and possibly a huge iron hook were found at the site of Oldenburg.

The weir complexes ("Heringszäune") in the Schlei have also been referred to above, under the discussion of Haithabu.

Four fragments of fish spears, thought to have been used for fishing for pikeperch and perch (Benecke, 1987), were found at Menzlin.

Indications of fish trade in Germany

There is evidence of trade in many of the German fish bone samples.

The settlements on the Baltic Sea are characterized by finds of herring bones, often in great quantity. Furthermore, herring were obviously imported to inland sites in the Baltic hinterland, for example, Menzlin, Lieps and Freyenstein. The latter lies more than 100 km from the nearest coast. Transport over such a long distance has required preservation of the fish, probably by salting. Lepiksaar and Heinrich (1977) believed that salting is the explanation for the fine preservation of herring bones seen at Haithabu. Benecke (1987) suggested that the herring found in Menzlin were sorted before being transported inland, since only certain sizes of herring are represented. All in all, extensive trade with salted herring seems to have taken place. Processing of the herring in the form of gill removal, as seen in the Danish material from Selsø-Vestby (12^{th}-13^{th} centuries AD) has, however, not been documented in Germany.

Even though the sites on the Baltic are strongly dominated by local fishing they also contain a supplement of marine species, in particular gadids. The species in question are ling, saithe, haddock and large cod; these could not have been caught in the Baltic, but must have been imported from the North Sea. A chronological development in this trade with gadids can be traced, for example in the consecutive materials from Haithabu, Schleswig and Lübeck (Heinrich, 1983, 1987). In Haithabu local fishing in the Schlei dominated, and gadids were of no importance: the few gadid bones may well be remains of provisions brought to the town by travellers (Lepiksaar & Heinrich, 1977). In the Schleswig material, by contrast, bones of large gadids dominate[1]; these could not have been caught locally and must represent imported stockfish. The large gadids were most important in Schleswig during the oldest phase (11^{th}-12^{th} centuries AD). This was followed by a younger phase (13^{th}-14^{th} centuries AD) where the frequency of gadid bones decreases somewhat, whereas that of freshwater fish increases. The gadids from the younger phase included both large and small individuals, unlike those from the older phase. This gives the impression that long-distance trade had decreased while local fishing and trade flourished (Heinrich, 1987). The two, slightly younger assemblages from Lübeck are dominated by large cod bones, presumably coming from imported fish. The frequency of the different gadid species also varies with time. Haddock thus seems to gain in importance from older to younger samples. No haddock bones were found in Haithabu, in the older phase of Schleswig (11^{th}-12^{th} centuries AD) there are several, in the following phase (13^{th}-14^{th} centuries AD) still more, and in the cesspit from 15^{th}-16^{th} centuries AD (admittedly a small and very special sample) almost all gadid bones are from haddock. This increase in haddock through the Middle Ages seems to be a general phenomenon in Germany (Heinrich, 1986, 1992, 1994).

Gadid remains are absent from a number of the analyzed sites, including Mecklenburg, Lieps, Ralswiek and Drense, most of which are Slavonic. Heinrich (1986, 1987) noted this lack of gadids from Slavonic sites. This is illustrated, for example, by the material from the castle Hitzacker on the river Elbe, far inland (von den Driesch, 1982). This can be divided into a Slavonic, a transitory Slavonic/Germanic and a Germanic phase. Gadids are absent in the Slavonic phase, in the transitory material there are three gadid bones, and in the German phase, five.

Bones of sturgeon are present at nearly all sites included in the present analysis, and in most cases, sturgeon may have been caught locally. Drense is an exception, and Benecke and Prilloff (1989) thought that sturgeon was imported to this site. Heinrich (1987) and Benecke (1986) discussed the importance of sturgeon at a number of Medieval sites on the southern Baltic Sea. Benecke showed that fishing for sturgeon decreased in the course of the Middle Ages and hypothesized that the decline was due to overfishing.

[1] It must be remembered, however, that small species like herring may be underrepresented in the Schleswig material as the material was not recovered by sieving.

REGIONAL OVERVIEW

In the preceding sections, archaeo-osteological evidence for fishing in the Baltic region in the period from the 5th century BC to the 16th century AD has been reviewed on a national basis. This compilation of a considerable amount of evidence from a number of sources has revealed some regional trends concerning the influence of local conditions on fishing.

When individual sites are referred to below outside a national context, the country in question is indicated with the same letter codes as those used in Table 1.

Local fishing for local fish

Virtually all the fish bone assemblages included in the present review contain species which could have occurred in local waters, suggesting that fishing was conducted locally. This general interpretation is supported by a number of more specific examples of local influence.

For some species, their occurrence in the subfossil material reflects their present-day distribution, and in some cases with an amazing degree of accuracy. This is for instance the case with pikeperch, a freshwater species with an eastern distribution in Europe which has been found in subfossil material from Sweden, Estonia, Poland and Germany, just the countries (among those considered here) where it occurs naturally today. In Sweden where pikeperch is now very locally distributed (Curry-Lindahl, 1985) there is virtually perfect correlation between the present-day distribution and the subfossil finds.

An other freshwater fish with a limited distribution in Europe, reflected in the subfossil finds and which has been found in Swedish, Polish and German material is asp. Ziege occurs - within the region under consideration - in Poland, Lithuania, Latvia and Estonia; in the subfossil material it is abundantly represented in Poland and nowhere else. Zährte is a further example of a species with a limited distribution, i.e. the countries around the Baltic Sea plus western Germany. It has been found in Estonian, Polish and German assemblages.

Turning to the marine species, the subfossil occurrences of herring show some very clear tendencies. Herring bones occur abundantly in assemblages from eastern Denmark and further along the Danish and Swedish Øresund coasts, as well as in material from the countries on the Baltic Sea. Herring abundance is known to oscillate dramatically. At certain intervals, so-called herring periods occur during which the availability of herring is immense. These herring periods have significantly influenced the course of European history and are well documented in historic manuscripts. The oldest known herring period was around AD 1000, i.e. contemporaneous with Haithabu (D) where huge numbers of herring bones have accordingly been found (Lepiksaar & Heinrich, 1977). The extremely rich Medieval occurrence of herring in Øresund (ca. AD 1150-1550) between modern Denmark and Sweden is particularly famous (Jensen & Olsen, 1991). The autumn passage of herring through Øresund into the spawning grounds in the Baltic Sea gave opportunities for herring fishing of incredible dimensions. The abundance of herring is reflected in the material from Danish and Swedish Medieval sites but also in contemporaneous material from sites on the Baltic coast where the extra input of herring from Øresund supplemented the local breeding stocks.

As a last detail it should be noted that material from Poland and Estonia contains very few marine species: only herring, cod and flounder. All three species live in the Baltic Sea and the latter two are known to tolerate brackish conditions, with flounder even being found in fresh water.

Fishing methods

The finds of a rich selection of fish species, especially at coastal sites, indicate that many different fishing methods have been used. The most important methods seem to have been net fishing, hook-and-line fishing and the use of fishweirs. Further equipment, such as fish traps and leisters, were probably used on a smaller scale.

NET FISHING

The very extensive catches of herring seen in several countries must have been secured by an efficient method such as net fishing.

In eastern Denmark, large herring catches such as these appear as early as the Iron Age (Sorte Muld, 6th-7th centuries AD). This is in stark contrast to older Danish finds which have yielded only a few herring bones in spite of extensive sieving. Consistent with the large herring assemblages we have sev-

eral finds of net sinkers from Denmark, for example from Nørre Fjand (2nd century BC - 2nd century AD) and Ribe (8th-9th centuries AD) (Enghoff, submitted). There are also finds of net floats, for example from Køge (13th-14th centuries AD) and Århus Søndervold (14th century AD). Even a tool for net-making has been found at Medieval Tårnby.

It is characteristic of the large finds of herring bones from the Danish island of Bornholm (Møllebjerg, Munkerup, Kobbegård, all 11th century AD) that they are accompanied by bones of small cod. A similar combination is seen at several Swedish sites from the same general area (Øresund and western Baltic Sea): Ven, Helsingborg, and Simrishamn (all 12th-13th centuries AD). The small cod were presumably a secondary catch when fishing for herring with nets. This contrasts with older (Mesolithic) finds of cod from Bornholm where the individuals were relatively large and were interpreted as having been caught with hook and line (Enghoff, 1994a).

Benecke (1982) thinks that the advance of the herring fishing in the Baltic Sea is due to advances in fishing technique. The herring remains from early Medieval Ralswiek (D) are accompanied by bones of Atlantic mackerel and garfish. The same picture is seen at another German site, viz., Oldenburg (7th-13th centuries AD) where Prummel (1993) interpreted the presence of this secondary catch as indicating local herring fishing.

Herring fishing with nets from Poland is strongly suggested by finds of numerous net floats, pieces of nets and net-making tools in Gdansk (10th-13th centuries AD) (Rulewicz, 1994).

Fishing nets were of course used for catching many species other than herring. Atlantic mackerel, garfish and small cod have already been mentioned. In the Limfjord region, Denmark, we see a change from fishing predominantly after eels in the Stone Age to fishing predominantly after flounder in the Iron Age onwards. This probably reflects a change from traps for eels to ground nets for flounder. The large finds of plaice/flounder/dab at Ribe (DK) may also be a result of net fishing (net sinkers have been found in Ribe) (Enghoff, submitted).

HOOK-AND-LINE FISHING

Large individuals of gadids (cod, haddock, ling) and/or hake are known from most of the countries. These fish mainly occur in not-too-shallow waters where they roam close to the sea-bottom and would have been most efficiently caught using hooks attached to long lines.

In Denmark the gadids represented in the finds became larger during the course of the Viking Age and Middle Ages, and species other than cod appeared, viz., haddock, ling and hake. Both tendencies indicate fishing at greater depths, probably using hooks. Hook fishing is most efficiently conducted using long lines to which several hooks are attached. Except on very steep coasts, the lines must be laid out from a fishing boat. Starting with the Iron Age, boats were available which would have made it possible to sail to the places where the large fish live - this is neatly reflected in the fish bone assemblages. Finds of fish-hooks at Århus Søndervold (10th-12th centuries AD) and Holbæk (13th-15th centuries AD) support this interpretation.

Several assemblages from the Swedish west coast include large gadids, for instance Varla (11th-13th centuries AD) and Gamla Lödöse (12th-15th centuries AD) where large ling and hake were probably caught using hook and line. The Swedish west coast is rocky in this region and it is probably no coincidence that fishing for large gadids, including ling, took place already during the Stone Age from the settlement Bua Västergård in the same general area (Lepiksaar, 1983). Further south on the Swedish west coast there are the remains of large cod in the material from Lund; these were probably caught on hooks.

Lie (1988) found evidence in the material from Oslo (Mindets Tomt), Norway, that large cod and ling were probably imported during the 11th-12th centuries AD but that a shift in preference took place in favour of locally caught large ling in the 12th-14th centuries AD.

Fish-hooks were probably also used for catching other species than gadids, such as sharks which were caught from several sites, for example, Smedegård (DK, 4th century BC - 2nd century AD) and Oslo (N, 11th-14th centuries AD).

FISHING WITH WEIRS

A weir is a kind of barrier that leads the fish to a spot where they can easily be caught and taken out of the water. Very large catches may be obtained using weirs, which would typically be placed in running water such as rivers, estuaries, or on tidal coasts.

The important herring fishery in the Schlei estuary at Haithabu (D, 9th-11th centuries AD) possibly involved the use of weirs, because these are known to have existed at the site in somewhat later periods (Radtke, 1977).

OTHER METHODS

Stationary fish traps were regarded by Enghoff (1994a) as the most important means of fishing in the Danish Mesolithic. Traps were probably still used in the period discussed here but on a smaller scale than net and hook fishing. They would still have been useful, for example for eel fishing. The relatively large numbers of eel bones found at Oldenburg (D, 7th-13th centuries AD) are thus interpreted as resulting from trapping (Prummel, 1993). Leister prongs have been found at sites in several countries. At Sebbersund (DK, 10th century AD) for instance where they were probably used to impale flounder. Benecke (1987) supposed that leister prongs found at Menzlin (D, 9th-10th centuries AD) were used for catching pikeperch and perch.

CONCLUDING REMARKS

The fish bone assemblages reviewed here indicate a chronological development in Baltic fishing. Despite this, the fishing retained a strong local character. For this reason, the fish bone assemblages provide an insight into the former distribution of species which nowadays have a restricted geographical distribution. The fish bone assemblages also provide clues to fish trade; this aspect will be discussed in greater detail in a forthcoming paper (Enghoff, submitted).

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APPENDIX

This review is based on literature known to the author as per october 1996. Since then, a few additional papers have come to attention which are of relevance for the subject matter.

Nicholson (1998) reported on fish bones in primarily latrine deposits from Viborg Søndersø, Denmark, 11th to 14th centuries AD. Viborg Søndersø is situated ca. midway between sites n°s 10 and 23 on Figure 2. A total of 320 fish bones ere identified. Eel, herring and perch were the most numerous species in the samples.

Vretemark (1997) discussed fish and other animal bone material from Medieval Sweden, with particular emphasis on Skara. Many of the assemblages treated by Vretemark are also covered by the present review.

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