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Bird bones from Jettböle I, a site in the Neolithic Åland archipelago in the northern Baltic

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Abstract. During the Middle Neolithic the Åland archipelago consisted of a group of small islands. The distance to the nearest shore of the mainland was over 100 km. The archipelago was occupied by the Pitted Ware people. This paper presents the bird bones found on the site of Jettböle I (c. 3400-2800 cal BC) in Jomala, one of the largest Pitted Ware basecamps on the islands. The economy was based on marine resources (mainly seals), and fishing and fowling were an important constituent part. My aim is to draw a picture of fowling at the Jettböle I based on the avian remains found at the site. The total number of bird bone fragments identified at the site is over 1200 and the number of different bird species is at least 15. The Eider *Somateria mollissima* was the most important bird species hunted, followed by the Velvet Scoter *Melanitta fusca*. The bone material from Jettböle I is the largest and the best preserved bone sample found in Stone Age Finland.

Key words: bird osteology, Neolithic, Åland, Finland, *Somateria mollissima*, *Melanitta fusca*.

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I. INTRODUCTION

The available information on the history of the northern Baltic bird fauna and its prehistoric exploitation is sparse. ERICSON & HERNÁNDEZ (1997) dealt with the prehistory of the Cormorant *Phalacrocorax carbo* in the Baltic Sea, and ERICSON (1987a, 1987b) has studied the faunal history of the Eider *Somateria mollissima* in the Baltic, and the exploitation of the Eider in the Viking Age town of Birka. BOESSNECK & VON DEN DRIESCH (1979) describe the bird bones found in the Iron Age fortification of Eketorp on Öland Island, eastern Sweden. TYRBERG & ERICSON (1991) discuss the history of birds and fowling in Uppland, eastern Sweden. ERICSON & TYRBERG (in prep.) present a catalogue and the interpretation of archaeological and subfossil bird bones from Sweden. Most of the published osteological studies from the northern Baltic area concentrate on mammalian faunas, and bird finds have not been interpreted on a larger scale (WELINDER 1976; AARIS-SØRENSEN 1978; EKMAN & IREGREN 1984; MOORA & LÕUGAS 1995; LÕUGAS et al. 1996; UKKONEN 1996, 1997, 2001, in press).

The Baltic birds are, however, interesting both faunistically and archaeologically. Osteology can help us to reconstruct how the Baltic Sea got its characteristic breeding bird assemblage – with such species as the Velvet Scoter *Melanitta fusca,* normally associated with boreal forest and tundra lake ecosystems (CRAMP & SIMMONS 1977). Coastal dwelling sites in northern Scandinavia are highly suitable for archaeological studies due to land uplift, which has caused the movement of settlements according to the changing shore line (SIIRIÄINEN 1987).

The aim of this paper is to present the results of research on subfossil bird bones from the Middle Neolithic site Jettböle I in the Jomala parish, Åland, Finland. The ongoing study is the first large study of bird bones from a Finnish Stone Age site, and the material is the largest sample of prehistoric bird bones found in Finland. The utilisation of seabirds at the Jettböle site is studied. The avian fauna is used to reconstruct the environmental setting in the area and to draw conclusions about the faunal history of birds in the area. The fowling season is also studied based on the presence of the medullary bone and juvenile individuals, and movements of the recent bird fauna. The taphonomic history of the Jettböle I assemblage will also be discussed. Finnish osteology has a relatively short history due to the poorly preserved bone material found in the acid rich soil (FORSTÉN 1972; UKKONEN 2001; NUÑEZ 1991). In this paper I also present some of the main features of the archaeological bird finds from the Finnish mainland. Bird bone material from Jettböle I is compared with the archaeological avian fauna from the Finnish mainland.

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II. MATERIAL AND METHODS

The site and its research history

The Åland Islands are situated between Sweden and Finland (Fig. 1). During the Stone Age the area was a small isolated archipelago. The size of the islets grew while the land, previously depressed by continental ice, slowly rose up. The distance to the nearest mainland coast was over 100 kilometres (LIDÉN et al. 1995). The Jettböle site was situated on the shore of one of the biggest islands (Fig. 2). The site represents the Pitted Ware culture (LIDÉN et al. 1995; EDENMO et al. 1997). Two chronological stages, Jettböle I and Jettböle II, have been distinguished in the Jettböle area (STENBÄCK 1998; GÖTHERSTRÖM et al. 2002). All material used in this study belongs to the older stage of occupation and is dated approximately to 4500-4100 BP (approximately 3400-2800 cal BC) (LIDÉN et al. 1995; STORÅ 2000; 2002; GÖTHERSTRÖM et al. 2002).

The first excavations at the site took place in 1905, immediately after it was recognised for the first time (CEDERHVARF 1912; STORÅ 2000). Further excavations were carried out in 1906, 1908 and 1911. The site is about 2 ha large, of which only about 10 percent was excavated (LIDÉN et al. 1995). Large amounts of ceramics, stone flakes and unburned bones were found during these excavations. A relatively small sample of bone material was analysed by WINGE (1914). After WINGE's work the mammalian bones were studied by STORÅ (2000, 2001, GÖTHERSTRÖM et al. 2002). Archaeological excavations at Jettböle I were also performed in 1999 and 2000 (STORÅ 2001), but bird bones from these excavations are not included in this paper.

Because of its large size and the thick cultural layer in the excavated area, Jettböle I has been considered to be a permanent settlement (LIDÉN et al. 1995; NUÑEZ & STORÅ 1997, GÖTHERSTRÖM et al. 2002). It has also been suggested that Jettböle I may have been a dominant centre of special character in the Middle Neolithic Åland archipelago (GÖTHERSTRÖM et al. 2002). A strong dependence on marine resources is evident on Jettböle I (LIDÉN et al. 1995; STORÅ 2000; STORÅ, 2002). According to the bone analyses the most important species at Jettböle I was the Harp Seal *Phoca groenlandica* ERXLEBEN 1777 (STORÅ 2000). Other mammals identified in the material are the Ringed Seal *Phoca hispida* SCHREBER 1775, the Arctic Hare *Lepus timidus* LINNAEUS 1758 , the Dog *Canis familiaris*, the European Elk *Alces alces* (LINNAEUS 1758) and the Pig *Sus scrofa*

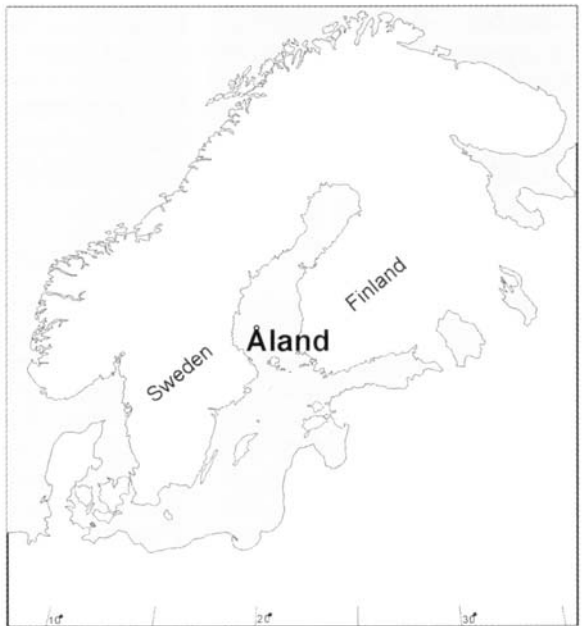

Fig. 1. The location of the Åland Islands, Finland.

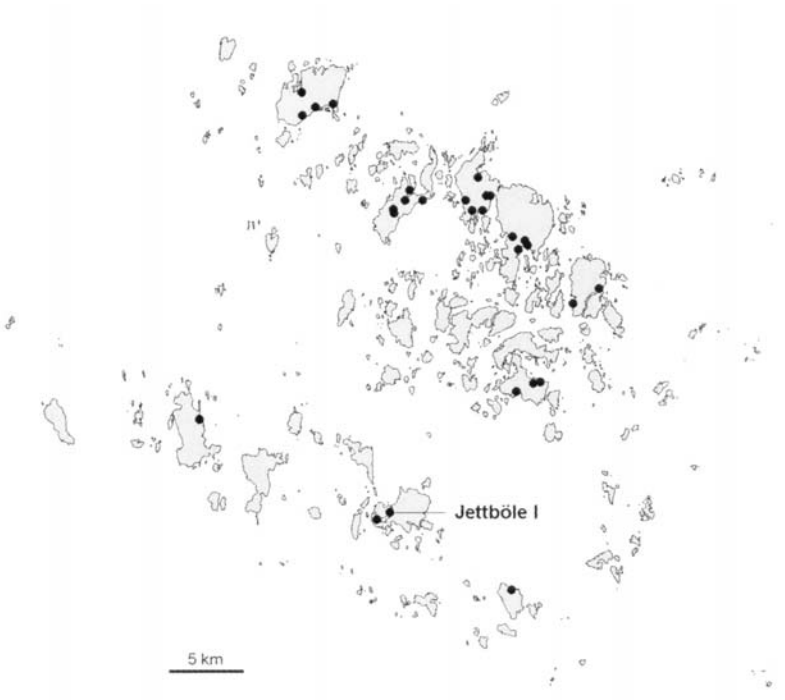

Fig. 2. The Åland archipelago during the Middle Neolithic and all Pitted Ware settlements. The shoreline follows 30 m.a.s.l. roughly dated to the younger phase of Jettböle (Jettböle II). Drawing by Jan-Erik TOMTLUND.

(STORÅ 2000). Among the fish bones the Pike *Esox lucius* LINNAEUS 1758, the Atlantic Cod *Gadus morhua* (LINNAEUS 1758), flatfish (Pleuronectidae sp.) and the Baltic Herring *Clupea harengus* LINNAEUS 1758 have been recognised (WINGE 1914). The few Pig bones might come from animals kept on the islands, but bones from European Elk most likely represent imported goods from the continent (STORÅ 2000). Nevertheless, Pig and Elk cannot be considered to be an important part of the economy of Jettböle I (STORÅ 2000). The collection of plants and nuts also formed part of the economy (LIDÉN et al. 1995).

The osteological analysis of the avian bones from Jettböle I

The studied bird bone material derive from the excavations of 1905, 1906, 1908 and 1911. It is stored at the Museum of Åland, but was temporarily transported to Helsinki for analysis. The osteological analysis was carried out with the help of the museum collections of bird skeletons at the Zoological Museum of the Finnish Museum of Natural History, University of Helsinki. Identification of some samples was confirmed with the museum collections in the Swedish Museum of Natural History and in the Zoological Museum of the University of Copenhagen. The skeletal material in Helsinki is not complete, and as such not ideal for use as comparative material. The limited amount of comparative skeletons has affected the possibility of separating the species in the genera *Mergus* and *Melanitta*, and the identification of bones from juvenile and subadult individuals. Unpublished dissertations by WOELFLE (1967) and BACHER (1967), as well as bird bone atlases like COHEN & SERJEANTSON (1996) and GILBERT et al. (1996) were in some cases consulted during the analysis. Complete or nearly complete bones have been measured in order to distinguish between different species.

Bones were identified as to skeletal element and species, genus or family. Exceptions were the bones from toes (phalanges and tarsi), from the vertebral column (vertebrae) and ribs (costae). The minimum number of specimens (NISP) was calculated for each species. This is the same as the number of identifiable bones or fragments of bones of each species (KLEIN & CRUZ-URIBE 1983). An estimate of the minimum number of individuals (MNI) for each species was derived from the maximum count obtained for a particular bone. Two age categories for birds were used in the analysis: adult (shafts completely ossified) and juvenile (shafts incompletely ossified).

WINGE (1914) recognised 139 bird bone fragments in his analysis. This sample is included in the present study, but the species were not re-identified. In the original manuscript (WINGE 1914) only the identified species and the skeletal elements are given. I checked the side (left/right) and the part of element (distal/proximal/diaphyseal) for each bone.

Medullary bone is a form of secondary bone that in birds is used as a calcium store during the production of eggshells. It is thus limited to female individuals (SIMKISS 1967; DRIVER 1982; DACKE et al. 1993). However, the absence of medullary bone cannot be interpreted as an indicator of a male individual. The deposition of this granular deposit begins a couple of weeks before the eggs are laid and the normal internal structure of the bone is regained shortly after the last egg is laid (SIMKISS 1967; DRIVER 1982; GILBERT et al. 1996; DACKE et al. 1993). The medullary bone has been used in determinations of hunting season and sex in a number of archaeological studies (DRIVER 1982; ERICSON 1987a; LENTACKER & VAN NEER 1996). In the Jettböle I material the existence of medullary bone was determined by the naked eye or with the help of a binocular microscope.

Young individuals or medullary bone can be used as an indication of the fowling season (MORALES MUÑIZ 1998). The presence of migratory bird species can also indicate the fowling season (BOGUCKI 1979; GRIGSON 1985; LÕUGAS 1996; MORALES MUÑIZ 1998). It is not known, if the migration patterns of birds were the same during the Middle Neolithic as they are today. In this study I assume that the breeding and nesting habitats and migration patterns of the different bird species have remained more or less unchanged from the Middle Neolithic, and I therefore use some of the bird species as indicators of the season during which they were caught.

III. RESULTS

Bird species from Jettböle I

A total of 1240 bird bones or bone fragments have been analysed and identified as to a skeletal element. About 58% (724 fragments) have been determined according to species, 5% (65 fragments) to genus and 13% (159 fragments) to family. About 24% (292 fragments) could only be recognised as belonging to the class Aves and not identified further.

The list of recognised species, the NISP and the MNI from each species is given in Table I. The most abundant species according to the NISP and the MNI is the Eider. The Velvet Scoter is the second most numerous species. About 73% of the recognised specimens derive from species in the family Anatidae. The relative amount of identified specimens from other families is only 3%. The number of species identified from the family Anatidae is seven (Table II). At least one Whooper Swan *Cygnus cygnus* is identified in the material. A number of swan bones could not be morphologically determined to species, but most probably these also belong to the Whooper Swan. One

Table I

Bird taxa from the Middle Neolithic site Jettböle I, the Åland Islands. The number of identified specimens (NISP) and the minimum number of individuals (MNI) are given. The number of juvenile individuals are included in the NISP

Taxa	NISP	MNI	Juvenile (NISP)
Phalacrocorax carbo (LINNAEUS, 1758) – Cormorant	7	3	–
Cygnus cygnus (LINNAEUS, 1758) – Whooper Swan	18	1	–
Anser sp.	2	–	–
Anser sp./*Branta* sp.	1	1	–
Anas platyrhynchos LINNAEUS, 1758 – Mallard	4	1	–
Anas sp.	2	–	–
Somateria mollissima (LINNAEUS, 1758) – Eider	578	34	–
Somateria mollissima?	10	–	–
Melanitta nigra (LINNAEUS, 1758) – Common Scoter	2	1	–
Melanitta fusca (LINNAEUS, 1758) – Velvet Scoter	104	11	–
Melanitta sp.	17	–	–
Mergus serrator LINNAEUS, 1758 – Red-breasted Merganser	3	1	–
Mergus merganser LINNAEUS, 1758 – Goosander	8	2	–
Mergus sp.	16	–	–
Mergus sp./*Melanitta* sp	8	–	–
Anatidae sp.	136	–	7
Haliaeetus albicilla (LINNAEUS, 1758) – White-tailed Sea Eagle	3	1	–
Haliaeetus albicilla?	2		–
Arenaria interpres (LINNAEUS, 1758) – Turnstone	1	1	–
Numenius arquata (LINNAEUS, 1758) – Curlew	2	1	–
Philomachus pugnax (LINNAEUS, 1758) – Ruff	1	1	–
Larus canus LINNAEUS, 1758 – Common Gull?	2	1	–
Larus fuscus LINNAEUS, 1758 /*Larus argentatus* PONTOPPIDAN, 1763 – Lesser Black-backed Gull/Herring Gull	4	2	3
Laridae sp.	1	–	1
Cepphus grylle (LINNAEUS, 1758) – Black Guillemot	13	2	5
Cepphus grylle?	1	–	–
Alca torda LINNAEUS, 1758 – Razorbill	1	1	–
Corvus corone LINNAEUS, 1758 – Hooded Crow	1	1	–
Aves sp.	292	–	16
Total	**1240**	**66**	**32**

species of the family Phalacrocoracidae, the Cormorant is present. The White-tailed Sea Eagle *Haliaeetus albicilla* is the only bird of prey and representantive of the family Accipitridae found in material. Three species of the family Scolopacidae are present: the Turnstone *Arenaria interpres*, the Curlew *Numenius arquata* and the Ruff *Philomachus pugnax*. One species of the family Corvidae, the Hooded Crow *Corvus corone* and two species of the family Alciidae, the Black Guillemot *Cepphus grylle* and the Razorbill *Alca torda* were determined in the material. The family Laridae is also represented in the material.

Table II

Identified avian families from the Middle Neolithic site Jettböle I, the Åland Islands

Family	Number of identified species	Number of identified specimens
Anatidae	7	908
Phalacrocoracidae	1	7
Accipitridae	1	5
Scolopacidae	3	4
Alcidae	2	14
Laridae	–	7
Corvidae	1	1
Total	**15**	**946**

A total of 32 bones from juvenile individuals were observed in the material (Table I). It was almost impossible to identify the species of the juvenile bones due to incomplete comparative material. However, five bones from juvenile individuals of the Black Guillemot, seven from a species in the family Anatidae and four from a species in the family Laridae could be recognised. Some 6% (73 fragments) were burned or partially burned (Table III). One partially burned bone belongs to a young undetermined individual.

Table III

The amount of burned or partially burned bones or bone fragments from the Middle Neolithic site Jettböle I, the Åland Islands

Taxa	NISP
Aves sp.	32
Anatidae sp.	25
Somateria mollissima	8
Melanitta sp.	3
Melanitta fusca	2
Mergus merganser	1
Cepphus grylle	1
Alca torda	1
Total	**73**

Medullary bone was observed in 27 specimens. Species with medullary bone and the skeletal elements in which it has been recognised are given in Table IV. All these bones are unburned.

Table IV

The observations of medullary bone at the Middle Neolithic Jettböle I, the Åland Islands

Species	coracoid	humerus	femur	tibiotarsus	Total
Melanitta fusca		1	1		**2**
Numenius arquata		1			**1**
Somateria mollissima	5	4	13		**22**
Somateria mollissima/ *Melanitta fusca*				2	**2**
Total	**5**	**6**	**14**	**2**	**27**

Modifications on bird bones

Possible cutmarks were observed on two bones. One humerus from a Whooper Swan has several light marks on its distal end, and one humerus from an Eider has a cutmark on its supraproximal part. The amount of bone artefacts is three (two humeri and one tibiotarsus), all made from bones of the Eider and the Cormorant. There were small holes in three bones. These holes were very similar to the ones seen nowadays in the bones of birds eaten by the White-tailed Sea Eagle or the Eagle Owl *Bubo bubo*. These holes might be marks from the claws of some bird of prey, but this could not be verified.

The anatomic composition of the sample

All elements of a bird skeleton have been recognised in the Jettböle I material.

The most common bone elements are carpometacarpus, coracoideum, humerus, vertebrae, femur, tibiotarsus and tarsometatarsus (Table V). The number of wing elements together (humerus, ulna, carpometacarpus) is only slightly larger than the number of leg elements together (femur, tibiotarsus, tarsometatarsus). The distribution of wing and leg elements for the most common species, the Eider, is very similar to that for all species together. However, the element distribution for the Velvet Scoter is different. In that species wing elements are more numerous than the leg elements (Fig. 3).

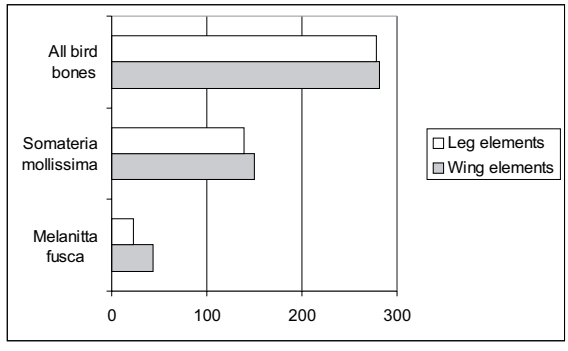

Fig. 3. The distribution of elements from the wing (humerus, ulna, carpometacarpus) and the leg (femur, tibiotarsus, tarsometatarsus) for all bird bones and the two most common species at Jettböle I.

Table V

Skeletal part frequencies of bird bones from the Middle Neolithic Jettböle I, the Åland Islands

Taxa	Skeletal elements																					
	cranium	dentale	vertebra	furcula	coracoid	scapula	sternum	costa	humerus	radius	ulna	cmc	radiale	ulnare	pelvis	femur	tibiotarsus	fibula	tmt	phal. carpi	phal. tarsi	unident.
Phalacrocorax carbo	2								1						3	1						
Cygnus cygnus			2		1	1			2	2	1	2			1	1	1		1		2	
Anser sp.			1						1													
Anser sp./Branta sp.																	1					
Anas platyrhynchos									1		1					1	1					
Anas sp.									1								1					
Somateria mollissima	22	26	27	20	76	42			59	16	33	58	2	5	14	46	53		40	34		
Somateria mollissima?						1									1		5		2	1		
Melanitta nigra									1										1			
Melanitta fusca	2			3	20	7	1		18	1	8	17			1	8	8		7	1		
Melanitta sp.	1	1				2			4	1	2	4			1	2	3		2			
Mergus serrator					1				1													
Mergus merganser				1						1		2			1				1	2		
Mergus sp.	3				1	2			1			1			1	2	2		1	2		
Mergus sp./ Melanitta sp.					1	2						1								4		
Anatidae sp.		2	7	1	11	9	1		6	18	13	15			2	10	23	4	8	4		
Haliaeetus albicilla												1								2		
Haliaeetus albicilla?																			1		1	
Arenaria interpres																			1			
Numenius arquata									1		1											
Philomachus pugnax									1													
Larus canus?									2													
Larus fuscus/Larus argentatus					2					1												
Laridae sp.					1																	
Cepphus grylle				1	1	1			1	1	2					3	1		1			
Cepphus grylle?																	1					
Alca torda											1											
Corvus corone																	1					
Aves sp.	1	2	107	2	5	2	19	21	6	11	3	8	1	2	9	4	20	10	14	17	24	6
No. of specimens (NISP)	31	31	144	28	120	69	21	21	108	52	65	109	3	7	37	78	121	14	80	67	28	6

Modern distribution of bird fauna in the Åland archipelago

Thirteen of all the species recognised at Jettböle I are seasonal migrants. The Hooded Crow and the White-tailed Sea Eagle are the only more or less resident bird species recognised in the material.

Young White-tailed Sea Eagles winter in the more southern areas, but old individuals stay on Åland all year round (HILDÉN & HARIO 1993). Other species that might also winter on the Åland archipelago are the Cormorant, the Mallard and the Goosander (HILDÉN & HARIO 1993, HARIO et al. 1993). The modern presence month by month of the species in the Åland archipelago is presented in Table VI. Eleven of all species recognised at Jettböle I breed in the Åland archipelago during the summer season. Two species, the Ruff and the Common Scoter are found on Åland as passage migrants (VÄISÄNEN et al. 1998), although a small number of non-breeding Common Scoters spend their summers in the archipelago. The Cormorant does not breed on Åland today (RUSANEN 1998). The prehistoric breeding of the Cormorant in the Baltic has been indicated based on archaeological finds from the island of Stora Karlsö (off Gotland) and in the modern lake Mälaren (ERICSON & HERNÁNDEZ 1997), so it is possible that the Cormorant was also breeding in the Åland archipelago during the Middle Neolithic.

Table VI

The modern occurrence of bird species found at the Middle Neolithic Jettböle I on the Åland Islands today during subsequent months of the year. Parentheses indicate possible occurrence of the species (HILDÉN & HARIO 1993; VÄISÄNEN et al. 1998)

Species	J	F	M	A	M	J	J	A	S	O	N	D
Phalacrocorax carbo	(x)	(x)	x	x	x	x	x	x	x	x	(x)	(x)
Cygnus cygnus			x	x	(x)	(x)	(x)	(x)	x	x	x	
Anas platyrhynchos			x	x	x	x	x	x	x	x	x	
Somateria mollissima			x	x	x	x	x	x	x			
Melanitta nigra				x	x	(x)	(x)	x	x			
Melanitta fusca				x	x	x	x	x	x	x		
Mergus serrator				x	x	x	x	x	x	x	x	
Mergus merganser	(x)	x	x	x	x	x	x	x	x	x	x	(x)
Haliaeetus albicilla	x	x	x	x	x	x	x	x	x	x	x	x
Arenaria interpres					x	x	x	x				
Numenius arquata				x	x	x	x					
Philomachus pugnax					x	x	x	x				
Cepphus grylle			x	x	x	x	x	x				
Alca torda			x	x	x	x	x	x				
Corvus corone	x	x	x	x	x	x	x	x	x	x	x	x

IV. DISCUSSION

Taphonomic aspects

According to the context in which the bones were found and the thick culture layer at the Jettböle I, most of the bird bones were deposited on the site because of human utilisation. However, the taphonomic aspects of breakage and the preservation of bones (ERICSON 1987c; LIVINGSTON 1989; HIGGINS 1999) have to be considered when interpreting the fowling. A general trend for differential survival for wing and leg elements in natural composed material has been suggested in earlier studies (LIVINGSTON 1989; HIGGINS 1999). This is due to the differences in the density of different bones. More detailed taphonomic study on element representation in the Jettböle I material might give information about preservation circumstances. However, a similar representation for wing and

leg elements for all identified bones and for the Eider does not support differential survival rates for bones from wings and legs. It has also to be considered, that natural processes, like waves on a coast, might have gathered dead birds on the beaches near Jettböle I. Animals like gulls and birds of prey might have left the remnants of their prey in the area. For example, the Eider and the species in the genera *Mergus* and *Melanitta* are the most common bird species in the diet of the White-tailed Sea Eagles on the Åland Islands today (SULKAVA et al. 1997). It is not possible to determine the proportion of bones that are not the result of human activities, but the proportion is probably low. Direct indications of the human utilisation of birds at Jettböle I are cutmarks, traces of burning on bones, and artefacts made from bird bones.

Fowling at Jettböle I

The number of bird bones indicates that fowling was widely practised at Jettböle I. The importance of birds at Jettböle I is not surprising when the environmental setting of the site is considered. On isolated islands of limited land area marine mammals, fishes and birds were the only source of meat available. Domesticated mammals played only a marginal part in the economy of Jettböle I.

The bird material from Jettböle I consists of bird species that are also represented in the recent Baltic Sea avian fauna. The Eider and the Velvet Scoter were the most important species exploited at the site. All other bird species are represented by few specimens or individuals (according to MNI), and thus most probably have had less significance for the people at the site. According to the element distribution, the Eiders and Velvet Scoters were brought to the site as complete carcasses. No details of hunting or slaughtering methods used at the site can be inferred from the bone sample. The different element distribution for the Velvet Scoter and the Eider might indicate different methods of slaughtering or use, but this subject has to be investigated more thoroughly. The MNI for the Eider and the Velvet Scoter does not necessarily indicate massive hunting with nets. This fowling method has been largely used in the Northern Hemisphere at least from the Viking Age (OLAUS MAGNUS 1555; STORÅ 1968; ERICSON 1987a). Other methods of trapping could have been used. Female Eiders are quite easy to trap even without any equipment during incubation.

The burned bones found in archaeological sites can be interpreted as food refuse (ZEILER & CLASON 1993; SERJEANTSON 1997). At least Eiders, Velvet Scoters, Goosanders, Black Guillemots and Razorbills were probably eaten at Jettböle I. However, all bird species found at the site might have been used as food. For example, White-tailed Sea Eagles are highly palatable (COTT 1947). The archaeological sample from the Dutch Neolithic site of Hazendonk indicates that White-tailed Sea Eagles were eaten (ZEILER & CLASON 1993).

The seasonality of seal hunting at Jettböle I has been studied by STORÅ (2002). Based on the size-distribution of the Harp Seal and the Ringed Seal bones, the hunting season was long, probably from early spring to early winter (STORÅ 2002). Bird bones from Jettböle I point to a shorter hunting period. According to the recent bird fauna in the area, and the presence of young individuals and the medullary bone, the main fowling season at Jettböle lasted at least from early spring to early autumn. The Eider lays its eggs in (April and) May, and the Velvet Scoter in early June, some females may begin in late May (HILDÉN & HARIO 1993). The Curlew lays its eggs at the end of May. Female Curlews leave the area already in June, and the male takes care of the chicks. The only species of which young individuals were identified is the Black Guillemot. The bones which were not completely developed were nearly the same size as the bones from adult reference skeletons. These young Black Guillemots were most probably hunted in the late July or early August, most likely from their nesting holes.

Medullary bone was recognised only in some bones of the Eider, the Velvet Scoter and the Curlew. Generally, medullary bone seems to have a great resistance to destruction (ERICSON 1987a). In the case of the broken specimens, it is possible that medullary bones are separated from the surrounding cortical wall by weathering and other taphonomic factors (DRIVER 1982). I assume that in the Jettböle I sample, a number of medullary bearing bones were not observed due to taphonomic factors and the research method applied. The medullary bone was always observed in broken speci-

mens and in most cases in their distal or proximal ends. However, in many of these cases it was not observed in the diaphyseal part of the same bone. I suggest that in these cases the medullary bone has dropped out of the tube of bone forming the diaphysis. Most typically, the long bones of birds are broken in their diaphyseal part in the Jettböle I material. Both ends of a bone are often complete and thus it was not possible to directly observe this phenomenon.

Comments on the faunal history of birds and the environmental setting in the area

As already mentioned, the bird material from Jettböle I is similar to modern bird fauna of the Åland archipelago. The presence of medullary bone can be interpreted as an indication of a breeding population (ERICSON 1987a). However, the precise timing of the development and formation of medullary bone in different species remains to be determined.

In the Middle Neolithic the sea around the Åland archipelago was brackish and, according to the medullary bones found, the Velvet Scoter was a breeding species on the Åland Islands. The Velvet Scoter has been recognised at other Neolithic sites in the northern Baltic Sea (LEPIKSAAR 1974; AARIS-SØRENSEN 1978; LÕUGAS et al. 1996; UKKONEN, in press), but the only indication of a breeding population is from Jettböle I.

Bird species at Jettböle I are good representatives of the ecological setting of the area. One common species in the modern Baltic that is lacking at Jettböle I is the Tufted Duck *Aythya fuligula*. It is a species that nowadays breeds in coastal areas and inland lakes. Today, the Tufted Duck is the second most common breeding bird species in the Finnish archipelago area after the Eider (HILDÉN & HARIO 1993; VÄISÄNEN et al. 1998). It seems that the Tufted Duck was not common in the Baltic in the Middle Neolithic. According to ERICSON & TYRBERG (in press), it has spread throughout northern Europe during the later part of the Holocene. It has become very numerous only during the last hundred years (HILDÉN & HARIO 1993; VÄISÄNEN et al. 1998). Another very numerous bird species during spring migration is the Long-tailed Duck *Clangula hyemalis*, which has not been recorded at all at Jettböle I. Neither has the hole-nesting Goldeneye *Bucephala clangula* been found.

Bird material from Jettböle I and adjacent areas compared with archaeological avian remains from the Finnish mainland

About 2400 archaeological bird bones dating to the Stone or Bronze Age have been identified in Finland (MANNERMAA, in prep.). The bird bone sample from Jettböle I forms more than half of this material. The most common family represented in the archaeological deposits on the Finnish mainland and on Åland is the Anatidae. However, due to the limited possibilities for the identification of burned bones, the species in this family are not often identifiable, but the most common species recognised in the family Anatidae are the Whooper Swan, the Mallard and the Teal *Anas crecca*. The overall most common species in Finnish burned bird materials are the Willow Grouse *Lagopus lagopus*, the Capercaillie *Tetrao urogallus* and the Black Grouse *Tetrao tetrix*.

The Eider is identified only at seven Stone Age sites in Finland and on Åland (Fig. 4) (MANNERMAA, in prep.). The only site where a significant number of bones from this species have been found is Jettböle I. When considering the significance of the Eider at Jettböle I, the very small numbers of this bird from the Finnish mainland is surprising. The reason for this should perhaps be looked for in the taphonomic aspects and, especially in the identification problems of burned bones. One may suspect also the possibility that the coastal Stone Age cultures in Finland were not as marine as the Neolithic culture on the Åland Islands. The Eider is present at several other Neolithic sites on the northern Baltic Sea (LEPIKSAAR 1974; AARIS-SØRENSEN 1978; MOORA & LÕUGAS 1995; LÕUGAS et al. 1996), but nowhere is it as numerous as at Jettböle I.

The sample from Jettböle I includes five new bird species for the Finnish Stone Age: the Cormorant, the Ruff, the Curlew, the Turnstone, the Razorbill and the Hooded Crow. The Turnstone at Jettböle I is so far the earliest observation in the Baltic Sea countries. The earliest observation of the Turnstone in Sweden is dated to the Iron Age (ERICSON & TYRBERG, in prep.). All other bird spe-

Fig. 4. Map showing the archaeological bone finds from the Eider *Somateria mollissima* (star symbols) from the Stone Age in Finland. The numbers refer to names of the sites. Numbers of identified specimens for the Eider are in parentheses. 1=Ylikiiminki Vepsänkangas (1), 2=Jomala Jettböle I (578), 3=Vantaa Maarinkunnas (1), 4=Vantaa Jokiniemi (1), 5=Vantaa Jokiniemi Sandliden (1), 6=Porvoo Böle (1), 7=Espoo Bosmalm (1). Each black dot stands for a Stone Age site where bird bones have been found.

cies have been recognised in samples from the Middle Neolithic or earlier archaeological sites in the Baltic Sea area (RYDH 1931; LEPIKSAAR 1974; WELINDER 1976; AARIS-SØRENSEN 1978; TYRBERG & ERICSON 1991; MOORA & LÕUGAS 1995; LÕUGAS 1996; LÕUGAS et al. 1996; ERICSON & HERNÁNDEZ 1997; BILSKIENE & DAUGNORA 2000; ERICSON & TYRBERG, in prep.).

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