

SVERIGES GEOLOGISKA UNDERSÖKNING

SERIE C NR 710

AVHANDLINGAR OCH UPPSATSER

ÅRSBOK 69 NR 2

CURT FREDÉN

SUBFOSSIL FINDS OF ARCTIC
WHALES AND SEALS
IN SWEDEN

APPENDIX

RADIOCARBON DETERMINATIONS OF MISCELLANEOUS
SUBFOSSIL FINDS OF THE SWEDISH WEST COAST



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ABSTRACT

The paper reviews subfossil finds of Greenland right whale (*Balaena mysticetus*), Swedenborg's whale (*Eubalaena swedenborgii*), white whale (*Delphinapterus leucas*), bearded seal (*Erignathus barbatus*), harp seal (*Pagophilus groenlandicus*) and ringed seal (*Pusa hispida*). The ages of some of the finds were radiocarbon determined. Most of the finds were deposited during the Late-Glacial time (from the deglaciation up to the end of the Younger Dryas period). The harp seal returned to the Swedish coasts in Litorina times. The ringed seal is relict in the northern part of the Baltic basin.

INTRODUCTION

The present paper is made possible by courtesy of some Museums of natural-history in Sweden, chiefly those in Göteborg and Stockholm. The majority of all subfossil finds of arctic whales and seals are found in west Sweden and most of the finds are kept at the Museum of natural-history in Göteborg.

In 1970 the two-year old Göteborg branch office of the Geological survey of Sweden received part of a jaw-bone of a Greenland right whale. The find had been discovered when foundations were being laid for the new suburban area, Lövgärdet, north of Göteborg. The following year subfossil finds of a grey seal were received. All finds were identified by Dr Johannes Lepiksaar and donated to the Museum of natural-history in Göteborg.

As west Sweden is characterized by a bare bedrock landscape with ice-marginal deposits and non-varved clays, the subfossil finds provide valuable evidence of the Late Quaternary evolution of the region. The museum in Göteborg is in some respects well supplied with subfossil finds of geological interest. In cooperation with Dr Johannes Lepiksaar an inventory was made in order to examine the possibilities of C^{14} age-determinations of some of the finds. As the project expanded, Dr Greta Westergren at the Royal museum of natural-history in Stockholm became involved.

Originally the purpose was to give descriptions of most of the recorded subfossil finds. After some time it became obvious that the task had to be limited. The inventory was restricted to species solely arctic in character though there are many other interesting finds at the museums. Some of the latter were dated and the results are listed in an appendix. Later perhaps inventories can be made of other subfossil finds, for example, of polar bear and reindeer.

Zoological studies of the greater part of the material have been made by Lepiksaar (1964 a, 1966), Nybelin (1938 b, 1942 b, 1946) and Oleröd (1958). To some extent this was a great help. In checking the material, however, the provenances of several of the finds were found to be rather doubtful and there was insufficient geological information concerning some of the finds. In the geological literature additional finds were reported that could not be traced to any museum. Furthermore, most of the solitary finds reported were not recorded at the stated museums.

Some of the museums have moved at least once, and all fossils and subfossils are not yet unpacked as the museums soon had restrictions of space. "Disappeared" finds may show up later.

Many of the described finds were discovered long ago. The present mechanical-excavation technique gives a biased distribution of finds in relation to the large numbers of developed areas around the cities.

Many people have been involved in obtaining correct information about the

exact finding-place, depth, deposit etc. Inquiries have been made at parish authorities and even local newspapers have been used in the effort to obtain information.

In the course of these inquiries the word was spread around and new unknown subfossil finds were reported and delivered to Dr Lepiksaar for examination.

To accompany the listed subfossil finds very brief reviews of the known geology and the Late Quaternary evolution are given. For further details the reader is referred to J. Lundqvist (1965), Magnusson *et al.* (1963) and Lundegårdh *et al.* (1974).

GEOLOGY AND TOPOGRAPHY IN GENERAL

West Sweden is characterized by bare bedrock, morainic deposits along ice marginal lines, and considerable amounts of clay.

South of the Göteborg area, in the province of Halland, there is a flat coastal plain some tens of kilometres in width, with clays and overlying sands. From the South Swedish Highlands several valleys lead to the coast. Large quantities of glaciofluvial material have been deposited in the valleys and along the border zone between the highlands and the coast.

The bare *bedrock* area around Göteborg and in Bohuslän is characterized by fissure and fault valleys producing a dissected landscape. Between the coast and the Väner basin there are areas with rather flat surfaces at some tens of metres below the highest shore-line.

The Väner basin is extremely flat and surrounded by areas of marked relief; in the west by elevated overthrusts and in the east by the South Swedish Highlands and the Tiveden hills. On the peneplain south and east of Lake Vänern, Cambro-Silurian table mountains are preserved by diabase.

North—south orientated *morainic deposits* form ice marginal lines in Halland and in parts of Bohuslän. Some of the deposits are deltas but most are well marked discontinuous ridges of till and/or glaciofluvial material. The ridges often block the valleys. In the Väner region the lines are orientated east—west and the ridges are not so pronounced, though they are prominent features of the flat type of landscape.

In the valleys and basins there are considerable layers of *clays* deposited by symmict sedimentation. In the Göteborg region a thickness of more than 100 m is recorded. There are no significant differences between postglacial and glacial clays. In the coastal areas the age of postglacial clay is mostly proved by underlying units of shell or sand layers. Around the Väner basin most of the clay deposits below 65 m a.s.l. are evenly laminated from bottom to top. In exceptional cases some tens of diffuse varves can be observed in the basal parts. In areas above 65 m a.s.l. the clay is definitely glacial in origin. In the eastern parts varved clay at the surface can be observed in clay-pits.

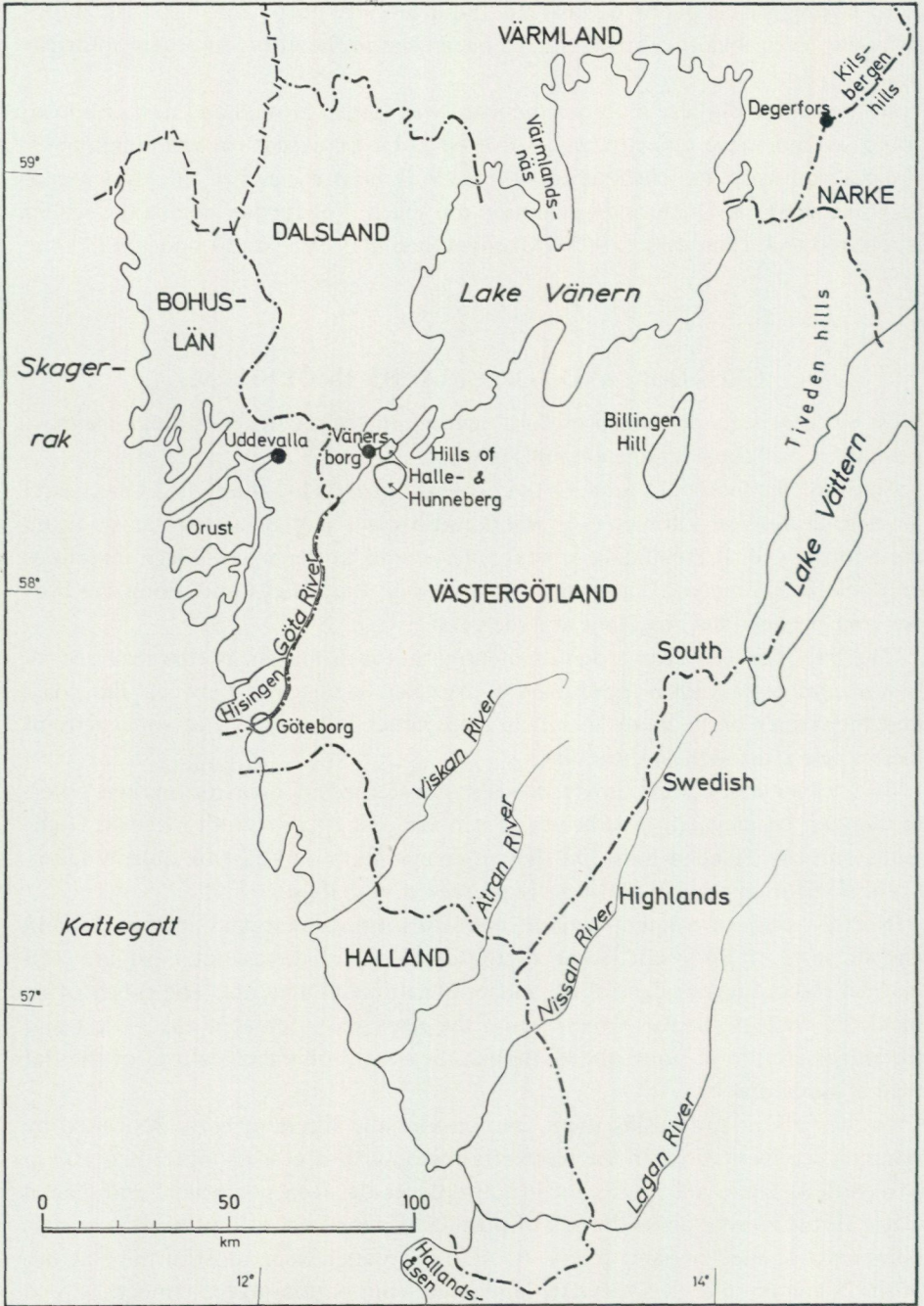


Fig. 1. Key map showing the provinces and localities mentioned in text.

LATE-GLACIAL CHRONOLOGY

As opinions differ about which deposits form ice marginal lines, created at the times of the main stadials, zones with terminal morainic deposits are shown in Fig. 2. The deposits of the Oldest Dryas Stadial are found in the Göteborg terminal moraine zone, those of the Older Dryas Stadial in the Berghem-Moslätt terminal moraine zone and those of the Younger Dryas Stadial in the Fennoscandian terminal moraine zone. Deposits of the last-mentioned zone in Finland are represented by the Salpaussälkäs and in Norway by the Raerna.

According to Berglund (1971, p. 41), Mörner (1969, p. 11 and 505; 1970, 1971) and Tauber (1970, Table 5) the ages of the Stadials and Interstadials in Sweden are as follows (given in round figures):

	onset		end	
Younger Dryas Stadial	11 000 B.P.	9 050 B.C.	10 100 B.P.	8 150 B.C.
Alleröd Interstadial				
Older Dryas Stadial	12 000 B.P.	10 050 B.C.	11 800 B.P.	9 850 B.C.
Bölling Interstadial				
Oldest Dryas Stadial	12 400 B.P.	10 450 B.C.	12 300 B.P.	10 350 B.C.

Similar dating of the end of the Younger Dryas Stadial is recently discussed in Finland by Hyvärinen (1973) and in Norway by Mangerud (1970, pp. 132—134), Anundsen (1972) and Aarseth & Mangerud (1974).

The term Late-Glacial as used in this paper denotes the time from the beginning of deglaciation up to the end of the Younger Dryas Stadial. For the time after the Younger Dryas Stadial, the term Holocene is used (*cf.* Feyling-Hansen 1972).

SHORE-LINE DISPLACEMENT

In recording subfossil finds of arctic marine species it is desirable to know Late-Glacial palaeogeographical conditions. As relevant information for west Sweden is scarce the task of preparing a palaeogeographical map is formidable. The two maps, Figs. 2 and 3, have been constructed on accessible information, superimposed on the *Topografisk karta över Sverige* (contour intervals of 5 m).

The purpose in constructing a map for the isobases of the highest shore-line is to give the reader an idea of the approximate maximum water depth at the described localities. Due to the large expanses of bare bedrock landscape few reliable values are available. Even the delta surfaces in the moranic zones are uncertain as land uplift continued at the same time as the ice front was more or less stationary. As stated by Wedel (1971, p. 77) the determination of the marine limit is very difficult. Research now in progress at the Department of Geology

in Göteborg, and modern geological maps, will in the future modify the provisional outlines.

The construction of the isobases in Fig. 2 is based upon the compilation of the deglaciation and the highest shore-line in Sweden (G. Lundqvist 1961, p. 101 and map) together with later works concerning Halland (Hillefors 1969, Mörner 1969, von Post 1968, Wedel 1967 and 1971), and parts of Bohuslän and Västergötland (Hillefors 1969, Mörner 1969). It is implied that throughout west Sweden values up to 100 years old are included in the isobase system. As opinions differ even in the most recent papers (see Wedel 1971, pp. 74—75), it is impossible to establish a map which is correct in every detail. In some areas where the determination of the highest shore-line is discussed, for instance in the Fennoscandian terminal moraine zone (Strömberg 1969, p. 25; 1971, p. 126) the values from Lundqvist's map are given.

Two principal divergences from the map by Lundqvist (1961) require explanation. While mapping the sheet Vänersborg NO (Fredén 1974) a check was made in the vicinity of two localities which showed divergences from a regular pattern.

The highest shore-line on the Cambro-Silurian hills of Halle- and Hunneberg lies at 130—135 m a.s.l. At the minor road junction (Prästeklev) 1 200 m south-west of V. Tunhem's church there has been a glaciofluvial deposit with a flat surface at a level of 128 m. (Hillefors 1969, p. 258 and others). At the outlet of Lake Eldmörjan (96 m a.s.l.) on the Hunneberg hill the following balanides and molluscs have been identified (Hägg 1952, p. 135): *Balanus balanus*, *Balanus hameri*, *Astarte borealis*, *Astarte elliptica*, *Astarte montagui*, *Chlamys islandicus*, *Macoma calcarea*, *Mya truncata*, *Mytilus edulis*, *Saxicava arctica*, *Saxicava arctica v. uddevallensis*, *Buccinum undatum* and *Trophon clathratus*. In the interior no other locality is known to have more species (Hägg *op. cit.*). Compared with the deposits in the Uddevalla region (Fredén 1975), such a fauna needs some tens of metres of water depth to be established. Hence the local depression at 110 m a.s.l. on Lundqvist's map must be removed from the highest shore-line list.

On the hill Limsjöberget, north of Uddevalla, the highest shore-line has been levelled at one point at 154 m a.s.l. (Sandegren 1931, p. 77). However, the point concerned does not show any special features different from the rest of the bare bedrock landscape and consequently this locality is excluded.

In Fig. 3 an attempt is made to show the sea-land-ice conditions at the end of the Younger Dryas Stadial. Obviously a palaeogeographical map for a certain time can be established only if curves of the shore-line displacement are known. This is not the case for the whole area of west Sweden. The purpose of the map is to show the main topographical features of the landscape with respect to the living space of the marine fauna. Approximate isobases for the estimated land uplift in metres below the highest shore-line were drawn and then the topographical units above or close to the supposed water surface were generalized.

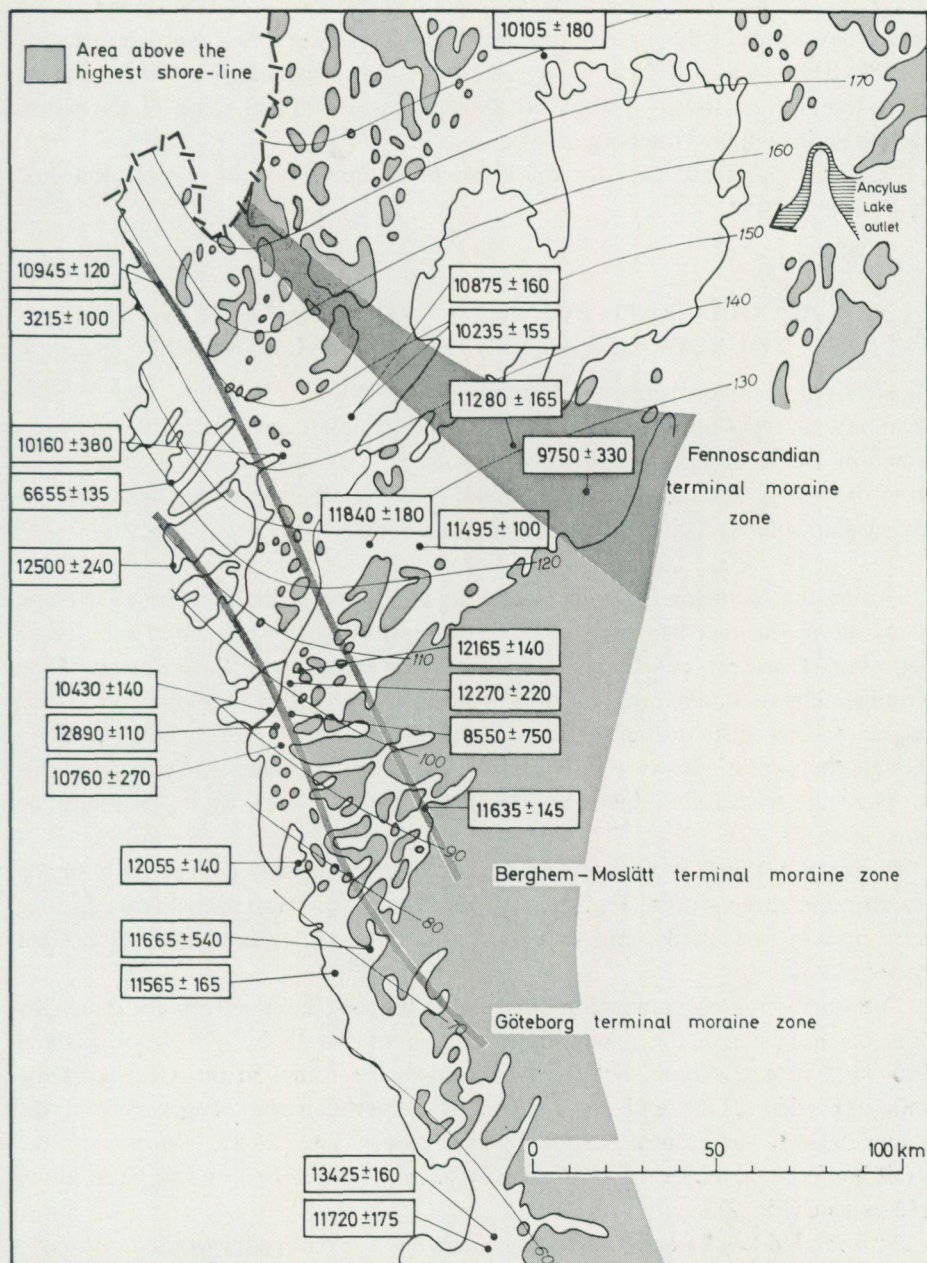


Fig. 2. Locations of radiocarbon-dated subfossil finds of arctic whales and seals. The ages are not corrected for the apparent age of the sea water. Lab. nos 4884 and 4887 in Table 1 are not reproduced. In the map are shown the main features of the Late Quaternary evolution of west Sweden up to the last connection with the Baltic basin. The isobases for the highest shore-line in m a.s.l. are given in rough outline. The extension of the moraine zones is shown only for areas below the highest shore-line.

According to the curve by Mörner (1969, p. 412, pp. 144—146) and his opinion of the development during Alleröd and Younger Dryas times, isobases roughly parallel to those in Fig. 2. were suggested as follows: Billingen hill 0 m (highest shore-line), Vänersborg —30 m and Göteborg —50 m (*cf.* some of the radio-carbon datings in the Göteborg area).

Palaeogeographical maps for the Uddevalla-Vänersborg area were published by Björsjö in 1953.

PALAEOGEOGRAPHY OF THE MARINE AREA DURING THE YOUNGER DRYAS AND PRE-BOREAL PERIODS

Biostratigraphical investigations, mainly pollen-analytical studies, and C^{14} determinations from the Alleröd and Bölling interstadials have recently been published by Berglund (1971) and Robertsson (1973). At the time of the ice retreat from the Väner basin a change in climatic, hydrographical and deglaciation conditions had a marked influence on the marine fauna.

During the Younger Dryas period postglacial-type sedimentation was taking place along the Swedish west coast; *e. g.* wave-washed sediments were being deposited. However, conditions in the sea still were arctic as the ice front of the Younger Dryas Stadial was situated in the coastal area of Norway (Fig. 3). In the view of Swedish stratigraphers, some subfossil finds are postglacial in origin though they definitely were deposited in glacial environments. To resolve this problem the term Late-Glacial will be used both as a time and a stratigraphic unit (see p. 7).

During the Younger Dryas period the Väner basin was connected with the sea through three straits (Fig. 3). Surface streams of fresh water from the ice were flowing westwards, and into the basin salt water was coming as bottom currents.

The northernmost connection was rather narrow, bounded on the north by hills reaching above the marine limit and in the south by a bedrock plateau 100—125 m a.s.l. Some shells in small lenses are found in the vicinity of the valley (Fredén 1975) and, as the watershed between the Skagerrak and the Väner basin in the eastern part of the valley has a level of 85—90 m a.s.l., the strait has been of minor importance. The marine limit is believed to lie at about 150 m a.s.l. (Fig. 2).

Between Uddevalla and Lake Vänern there is a broad valley orientated east—west. The surface of the valley-floor varies between 50 and 55 m a.s.l. East of Uddevalla, the valley is narrow and steep-sided with small hills on its floor. To the north and to the south it is bordered by a dissected landscape extending from about 100 m a.s.l. to above the marine limit, which is thought to occur at about 140 m a.s.l. In this narrow part of the valley the famous Uddevalla shellbanks

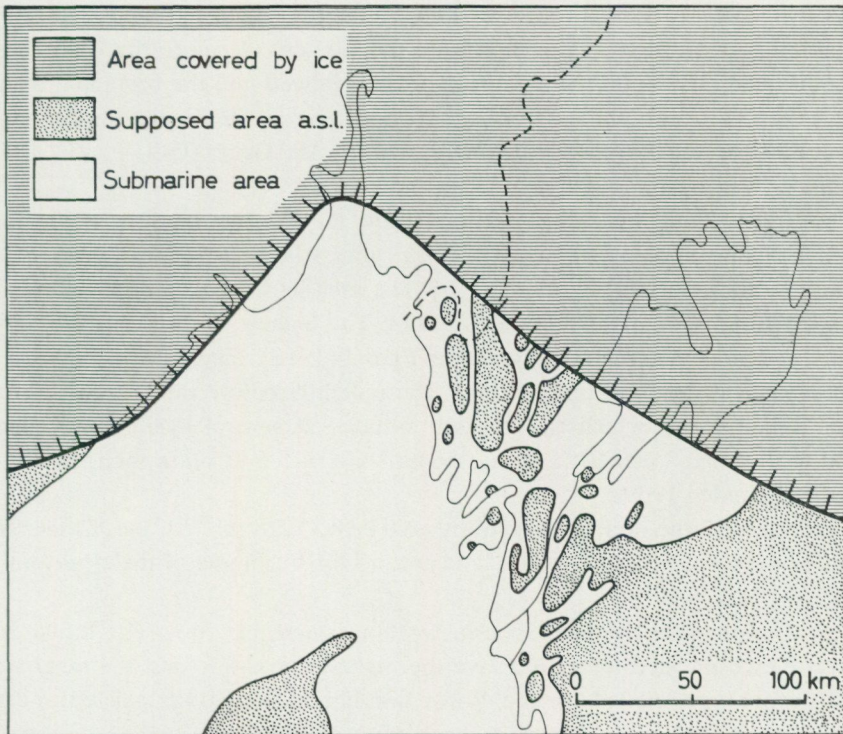


Fig. 3. Outline of the palaeogeography at the end of the Younger Dryas Period showing the supposed sea-land-ice conditions.

were deposited. The abundance of subfossil molluscs and parts of skeletons of marine vertebrate animals gives a good picture of the Late-Glacial marine fauna (Fredén 1975). As the western and north-western parts of the Väner basin lack varved clays it is very probable that the main water exchange took place through this strait.

The southernmost connection was provided by the nearly north—south fault valley of the Göta river. This valley is surrounded by hilly areas up to and above the marine limit (Fig. 2). The threshold at the outlet of Lake Vänern lies at a level of approximately 44 m a.s.l.

A very important factor in the evolution of the marine fauna was when the connection between the North Sea and the English Channel was established. According to the evidence of subfossils in the shellbanks in the Uddevalla region this event is likely to have taken place in Late-Glacial time.

After Younger Dryas times the climate improved rapidly during the succeeding Pre-Boreal period. The ice recession was rather fast across the relatively low land of central Sweden (*cf.* p. 51). North of the Väner basin deglaciation took place in areas above the highest shore-line.

When the ice receded from the Fennoscandian terminal moraine zone at Billingen hill a connection was opened from the Western Ocean to the Baltic basin, and thus began the Yoldia Sea stage. Salt water flowed into the basin and for just longer than 100 years the environmental conditions in the Stockholm area were favourable for the mollusc *Portlandia arctica* (De Geer 1940, p. 103). This mollusc now is to be found in high-arctic marine areas.

The Yoldia strait was rather shallow across the Tiveden highlands. The main water exchange took place south of Degerfors where the lowest parts of the Atlantic—Baltic watershed are situated. The area between 105 and 110 m a.s.l. has a length of about 15 km (Fredén 1968). The highest shore-line at Degerfors occurs at 160 m a.s.l. (Fig. 2; see also Fredén 1968). The lowest parts of the watershed were dried up through land uplift slightly before the beginning of the *Alnus* pollen curve, which is radiocarbon-dated at several localities to around 8 900 years B.P., 7 000 B.C., using the half-life of 5 570 years for radiocarbon (Olsson & Fredén 1969).

According to one pollen diagram by von Post (1928, p. 55), the Väner basin seems to have been isolated at the time around the beginning of the *Alnus* pollen curve.

The conditions in the Väner basin were unfavourable for arctic fauna even before the ice receded to areas above the highest shore-line and the deep strait at Degerfors was opened. In the North Sea boreal conditions existed and the straits to the Väner basin became more and more shallow. Probably some species got trapped and could not survive due to the milder climate and change in hydrographical conditions which, of course, influenced the supply and demand of food.

The mollusc *Arctica islandica* (formerly *Cyprina islandica*) is known from Dalsland (see p. 43) and Värmland (Hägg 1947, 1952). The occurrence of this mollusc in the Väner basin is quite interesting as it is rather common in Holocene shell deposits along the west coast. The species today is distributed from Iceland to the Bay of Biscay (Tebble 1966, p. 93), *i. e.* outside the arctic region.

Of the arctic whales and seals only the ringed seal is known to have existed in the Baltic basin before Litorina times.

RADIOCARBON MEASUREMENTS

All the measurements shown in Table 1 and on Fig. 2 were carried out by the Laboratory for Isotope Geology in Stockholm. The collagen content of the sub-fossil bone material was treated and measured according to the technique described by Sellstedt, Engstrand and Gejvall (1966). The treatment of bone samples for radiocarbon determination is discussed by Olsson *et al.* (1974), and problems concerning C^{14} dating of the skeleton parts of whales in general are discussed by Birkenmayer & Olsson (1972, pp. 28—30).

As the radiocarbon measurements are dependent on the collagen content, which is independent of the weight of the subfossil, a careful selection of samples at the museums had to be made. Furthermore, formerly it was common to preserve the subfossils with solutions which now are regarded as unsuitable. Most of the cranium are thin and easily affected by later processes, and in porous skeleton parts solutions can penetrate deeply. As far as possible, attention was paid to this problem. However, in the preparation some specimens showed contamination which diminished the serviceableness and the value of the statistical error became quite high. This contamination does not only take place indoors but also outside as soon as a skeletal part is exposed (see *Balaena mysticetus*, loc. 9). The sample from Uddevalla (St 4239) is affected by the calcareous environment (shell deposit), while the other three samples (St 3612, 4046 and 4114) are contaminated by solutions, whose effect on the subfossils were hardly visible.

Skeletal parts which are suitable for radiocarbon measurement and are geologically interesting were not always available as they were too valuable from a zoological point of view. In the future when more subfossils are found, perhaps some of the wanted pieces can be successfully fitted into place in the jig-saw puzzle of the Late Quaternary evolution.

The radiocarbon determinations are listed in chronological order in Table 1. Most of them are not corrected and all the values on Fig. 2 are uncorrected for the reasons mentioned below.

Without δC^{13} values no correction for the apparent age of sea water can be obtained. The apparent ages of whale bones are discussed by Olsson *et al.* (1974 pp. 179—180). The δC^{13} of bones often yields values close to -17‰ according to Olsson *et al.* (*op. cit.*), and to -19‰ according to an International conference (Olsson 1974, p. 43). Earlier there was also one suggestion that for jaw-bones of *Mysticeti*, correction only for the age of the surface water should be sufficient, as those whales feed on surface or sub-surface plankton (Birkenmajer & Olsson, 1971, p. 28).

Problems concerned with the calculations of the apparent age of sea water are among others discussed by Mangerud (1972). There are several opinions about the value. To give the reader an idea of the total correction expressed in years on some of the dated specimens, a value of -400 years was chosen, which is equal to the age of the surface water close to Spitsbergen (see Birkenmajer & Olsson 1971, p. 28).

In the future when values of both δC^{13} and of the apparent age of sea water are modified or internationally standardized, corrections can easily be applied to the results in Table 1. Probably, or hopefully, the revised corrected values will stay in the margin of the statistical error. Until then a subtraction of around 250 years can be used on the uncorrected values close to the corrected ones.

For further Swedish C^{14} determinations of Late-Glacial age, see Robertsson 1973, p. 32.

TABLE 1. Radiocarbon age measurements of arctic whales and seals. All determinations were made on bone material and were carried out at the Laboratory for Isotope Geology in Stockholm. Half-life of radiocarbon $5\,568 \pm 30$ years. Age expressed in B. P. means before A.D. 1950.

LAB. NR ST	SPECIES (REF. NR IN TEXT)	LOCALITY	GREENWICH		AGE IN YEARS B.P. \pm STAT. ERR.	δ C ¹³ ‰ PDB	APPARENT AGE OF SEA WATER	TOTAL CORR. IN YEARS	CORRECTED AGES	
			LAT. N	LONG. E					B.P.	B.C.
3606	<i>Pusa hispida</i> (11)	LAHOLM	56° 31'	13° 3'	13 425 \pm 160					
3596	<i>Balaena mysticetus</i> (17)	GÖTEBORG	57° 41'	11° 59'	12 890 \pm 110					
3620	<i>Balaena mysticetus</i> (7)	EDSHULTSHALL	58° 7'	11° 28'	12 500 \pm 240					
4083	<i>Delphinapterus leucas</i> (6)	AGNESBERG	57° 47'	12° 1'	12 270 \pm 220					
3595	<i>Balaena mysticetus</i> (14)	GÖTEBORG	57° 49'	12° 2'	12 165 \pm 140					
3609	<i>Delphinapterus leucas</i> (15)	ÖLMANÄS	57° 21'	12° 6'	12 055 \pm 140					
4060	<i>Erignathus barbatus</i> (5)	LAGMANSERED	58° 8'	12° 25'	11 840 \pm 180					
4884	<i>Balaena mysticetus</i> (8)	SVENSHÖGEN	57° 58'	11° 57'	11 785 \pm 155	-15.2	-400	-260	11 525 \pm 155	9 575 \pm 155
4403	<i>Pagophilus groenlandicus</i> (10)	VÅXTORP	56° 25'	13° 4'	11 720 \pm 175					
3612	<i>Delphinapterus leucas</i> (17)	ROLFSTORP	57° 9'	12° 26'	11 665 \pm 540					
3615	<i>Delphinapterus leucas</i> (16)	BERGHEM	57° 28'	12° 37'	11 635 \pm 145					
4812	<i>Eubalaena swedenborgii</i> (6)	TVÅÅKER	57° 3'	12° 25'	11 565 \pm 165	-16.8	-400	-265	11 300 \pm 165	9 350 \pm 165
3626	<i>Balaena mysticetus</i> (11)	ESSUNGA	58° 11'	12° 47'	11 495 \pm 100					
4887	<i>Balaena mysticetus</i> (10)	RISHAGERÖD	58° 8'	12° 0'	11 440 \pm 155	-14.6	-400	-240	11 200 \pm 155	9 250 \pm 155
4997	<i>Pagophilus groenlandicus</i> (8)	SKÖTTORP	58° 24'	13° 4'	11 280 \pm 165	-19.4	-400	-295	10 985 \pm 165	9 035 \pm 165
3625	<i>Balaena mysticetus</i> (2)	TANUM	58° 44'	11° 20'	10 945 \pm 120					
4402	<i>Pagophilus groenlandicus</i> (7)	HÄSTEFJORDEN	58° 27'	12° 10'	10 875 \pm 160					
4102	<i>Pusa hispida</i> (7)	MÖLNDAL	57° 40'	12° 0'	10 760 \pm 270					
4049	<i>Delphinapterus leucas</i> (8)	GÖTEBORG	57° 44'	11° 56'	10 430 \pm 140					
4811	<i>Pagophilus groenlandicus</i> (7)	HÄSTEFJORDEN	58° 27'	12° 10'	10 235 \pm 155	-19.5	-400	-350	9 885 \pm 155	7 935 \pm 155
4239	<i>Delphinapterus leucas</i> (2)	UDDEVALLA	58° 21'	11° 55'	10 160 \pm 380					
4064	<i>Erignathus barbatus</i> (1)	GRUMS	59° 30'	13° 5'	10 105 \pm 180					
4046	<i>Eubalaena swedenborgii</i> (2)	N. VÅNGA	58° 15'	13° 17'	9 750 \pm 330					
4114	<i>Delphinapterus leucas</i> (9)	GÖTEBORG	57° 43'	12° 2'	8 550 \pm 750					
4755	<i>Balaena mysticetus</i> (4)	LYSEKIL	58° 17'	11° 26'	6 655 \pm 135					
4404	<i>Pusa hispida</i>	BJÄRTRÅ	62° 59'	17° 35'	6 085 \pm 115					
3603	<i>Pagophilus groenlandicus</i> (1)	OTTERÖN	58° 39'	11° 14'	3 215 \pm 100					

ERRORS AND MISINTERPRETATIONS OF SUBFOSSIL FINDS

In making the inventory, as many localities as possible have been checked, which is time-consuming work. Usually old finds have no details about the finding-place and the circumstances; often only the name of the parish and the finding-year are noted on the labels and in the catalogue. On the other hand there are many zoological details about the finds — but they are of no help in this case.

Source of errors are:

1. Souvenirs. Formerly when whale-fishing was very common souvenirs were brought to places far from the sea. When people got tired of their curiosities they threw them somewhere, later causing problems for scientists.

A vertebra of unknown provenance was brought from Dalsland to the museum in Göteborg and said to have been kept by a family for at least 40 years. Nybelin (1942 b, p. 18—19) found dried soft material on the vertebra (see p. 25). Consequently it was concluded that the vertebra had not been deposited on the donor's land.

2. Waste products. Neolithic seal-hunters and others have left litter throughout the countryside especially on shellbanks. Also in many fishing villages there have been mills for bone-meal production.

The shellbanks around Uddevalla are proved to have served as refuse heaps for parts of skeleton of cattle in recent times (Fredén 1975). Parts of a skeleton of *Balaena mysticetus* were found on the Hisingen island at a depth of 0.9 m in a filling of bricks, wood, pieces of glass and pottery, together with parts of skeletons belonging to domestic animals (Nybelin 1942, p. 9).

3. Subfossil finds from redeposited material must be carefully inspected. As the finds usually are discovered in the bottom of a pit there are no stratigraphical data available.

In the literature some finds are described as subfossil but are later proved to be subrecent. The following finds have been misinterpreted and in future shall not be regarded as subfossil:

1. A find of a rib at Hyby, ca 15 km south-south-east of Lund, Scania (Aurivillius 1888, p. 56). The area has not been invaded by marine water (K. Nilsson 1973). At the Museum in Lund there is no record of the rib.

2. According to Malm (1871, p. 34), he bought a left shoulder-blade of a *Balaena mysticetus* from a miller at Gammelstorp, north of Hässleholm town in Scania. The people of the parish told him that the bone had been hanging on the mill for a very long time. On the other hand, S. Nilsson (1847, p. 645) said that the shoulder-blade (*Balaena prisca*) had been found during the digging of a mill-pond. In any case, the parish of Farstorp is situated above the highest shore-line and moreover the find has disappeared.

It was suggested by Munthe (1940, p. 28) that these two finds in Scania, 1 and 2, came from disturbed interglacial layers.

3. Before 1845 the following parts of skeletons were brought to the Museum of Skokloster Castle from Lyckås, about 18 km south-south-west of Gränna on the eastern side of Lake Vättern (Aurivillius 1888, p. 56):

Two unsp. vertebrae (inventory nr 13743—44)

One rib of Common Rorqual, (*Balaenoptera physalus*), (13745)

One rib of a Greenland right whale (13746)

One shoulder-blade of a Greenland right whale (13747)

Dr C.-F. Lundevall at the Royal museum of natural-history in Stockholm says that the shoulder-blade shows no sign of having been deposited in earth and one of the vertebrae (13743) seems to have been sawed. In Skokloster Castle there is a painting, signed by A. R. Spoeck 1634, showing whale-fishing and a whale factory ship at Jan Mayen/Svalbard (Dahlgård 1962, p. 381). Evidence of the Late-Glacial evolution of Lake Vättern suggests that the surface level at Lyckås, 150—160 m a.s.l., corresponds with melt-water phases older than the Baltic Ice Lake stage (Norrman 1964, p. 31).

4. At Örberga church, ca 5 km west-south-west of Vadstena, a rib fragment is reported as originating from a whale, which, by hearsay, ran ashore long ago (Aurivillius 1888, p. 57). The altitude of the church, 123 m a.s.l., lies about the highest Yoldia Sea level (Norrman 1964, pp. 31—32) and the supposed finding-place is situated in an area of boulder clay (pers. comm. by Dr H. G. Johansson, who is mapping the sheet 8E Hjo NO). The further fate of the find is unknown today.

5. When dredging at Carlsro in the entrance to the Norrköping harbour a fragment of a skeletal part of a Greenland right whale was found (Askund 1930, p. 140). The fragment is not present or even recorded at the Museum of Norrköping. If the find had been of a subfossil specimen there is no doubt that Askund would have described it for geologists.

DESCRIPTIONS OF THE SUBFOSSIL FINDS

Where no reference appears in the text the details refer to the general catalogue. This applies also to the yearly reports, which are very brief.

The appropriate topographical map sheet is given, after the name of the locality, together with a figure and a small letter referring to the quadrangle division in the frame of the map.

The catalogue number is that of NMG (Museum of Natural-history in Göteborg).

The former names of finding-places have been revised and in some cases have been replaced by the name in *Topografisk karta över Sverige* (scale 1:50 000).

Subfossil finds along the seashore are excluded.

General zoological characteristics:

The whales are usually divided into two groups. The whalebone whales, *Mysticoceti*, are in general large and live close to the water surface. Through the whalebones, surface or sub-surface zoo-plankton are filtered. Some of the species also feed partly on fish. To this group belong the Greenland right whale (p. 17) and Swedenborg's whale (p. 25).

The toothed whales, *Odontoceti*, are in general smaller than the whalebone whales, and their food consists of seals, fishes and cephalopoda. To this group belongs the white whale (p. 28).

Of the four species of seals, *Phocidae*, which are domiciled in arctic regions today, three genera are found in Late-Glacial deposits in Sweden. The bearded seal (p. 37) feeds on the sea floor. The ringed seal (p. 45) is believed to dive very deep for food, but like the harp seal (p. 40), it mostly feeds on pelagic fish. The ringed seal also feeds on crustaceans.

BALAENA MYSTICETUS

Greenland right whale. F: *Baleine franche*. G: *Grönlandswal*. Sw: *Grönlandswal*

The Greenland right whale is an arctic, pelagic species living in the area of drift-ice. It is the commonest of all arctic subfossils (Fig. 4). Most finds come from outside the ice marginal zones of the Older and Oldest Dryas Stadials. Some of the finds are younger but, as indicated on p. 10, the sea conditions outside the northern part of the west coast were arctic up to 10 000 years ago, *i. e.* until the ice retreated from the Fennoscandian terminal moraines. In addition to the finds listed here, see also p. 33.

An earlier review was made by Oleröd in 1958.

1. Norra Långön
NMG 1937—7164

9 A Strömstad NO 9f—g

Parts of jaw-bones were found in 1937 during the digging of a well on the property Långö N 1¹⁷, 300 m south of Alaska. The find was made at the top of a 1.5 m thick clay overlain by sand and underlain by bedrock (article in newspaper Norra Bohuslän Aug., 31, 1937). The surface of the finding-place lies about 10 m a.s.l.

2. Tanum
Radiocarbon age: see p. 12
Dated material: jaw-fragment
NMG 1969—12 551

9 A Strömstad SO 4h—i

Parts of a skeleton were found in clay at a depth of 2.5 m, *ca* 100 m west of

BALAENA MYSTICETUS

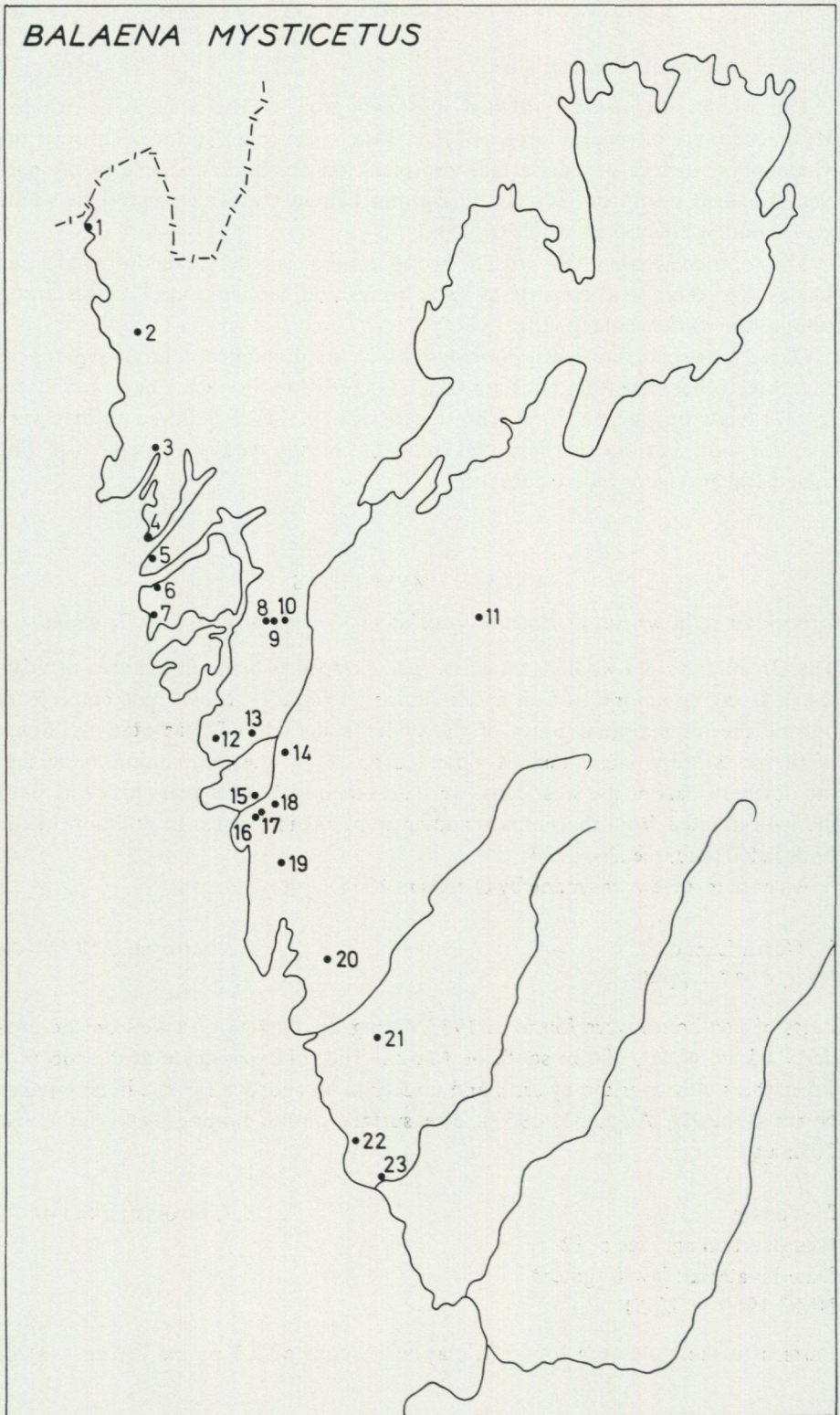


Fig. 4. Locations of subfossil finds of Greenland right whale. Numbers according to descriptions in text.

Tanumshede along the road to Grebbestad (Hansson 1970, p. 15). The locality is situated at a level of 36 m a.s.l.

At a level of *ca* 20 m a.s.l. parts of a juvenile skeleton (NMG coll. an. 8617) were found in 1951 at the river Tanumsälven on land belonging to the vicarage of Tanum (Bergquist 1955). The find was made in clay at a depth of 1.5 m. Drillings in the valley showed 2—7 m of clay underlain by 1—8 m thick stony gravel. The locality is situated on the distal part of a terminal morainic deposit in the Berghem-Moslätt zone. The surface of the moraine reaches the level of 50 m a.s.l.

3. Tossene

8 A Lysekil NO 8j

NMG 1934—6334

In 1934 a *bulla ossea* was found in shell-bearing sand in a ditch at Gerrebo (Genebo), 1 km north-west of the firth of Åbyfjorden (Nybelin 1946, p. 112). The finding-place is situated between 50 and 70 m a.s.l.

4. Lysekil

8 A Lysekil SO 3i

Radiocarbon age: see p. 12

Dated material: part of a vertebra

The Bohusmuseum of Vikarvet 1908—41

To establish a water reservoir for Lysekil town, diggings were started in 1883 at the former pond of Färgaredammen, 500 m north-west of the railway station. When the work was finished in 1908 several vertebrae were given to the museum of Vikarvet. The circumstances about the finds are unknown. It is obvious, however, that all the vertebrae belonged to the same specimen. The water surface of the reservoir, which was dried out in 1970, had been at a level of 29 m a.s.l.

In 1974 one vertebra was donated to NMG. A part of it was sawn out like a piece of cake. The inner part was cut off for radiocarbon measurement and then the piece was re-inserted; *i. e.* the exterior of the vertebra is still intact.

Obviously the Greenland right whale was stranded at Lysekil in Holocene times. Compared with Persson's (1973) investigations in southern Bohuslän the shoreline at the given time (corrected to *ca* 6 450 ± 135 years B.P., see p. 13) would be at a level of slightly more than 30 m a.s.l.

5. Skaftö

8 A Lysekil SO 2i

NMG 1932—5766

Parts of a shoulder-blade were found in 1932 at the clearing out of the Dammarna (the Ponds) (Jägerskiöld 1936, p. 7). Dammarna is a small basin in a bare bedrock terrain close to the sea. It is situated at a level of approximately 15 m a.s.l. about 1 km north-north-east of Grundsund chapel. The shallow basin has served as a water reservoir for the mills along the road to the fishing harbour

(Johansson 1971). Whether the find is a subfossil or a subrecent one is not clear. The stratigraphy on the Skaftö island is in general: about one metre of sand underlain by some decimetres of shell layers on clay. In the Dammarna basin shoulder-blade finds have also been found of a cachlot, *Physeter catodon* (NMG 6347), the only "subfossil" of this species in Sweden, and a harbour seal. Three finds of shoulder-blades of different species at the same locality is indeed a remarkable coincidence. Furthermore, parts of crania of a red deer and a cow have been found. However, the finds of the Greenland right whale cannot be removed from the subfossil list without further evidence.

At Munkevik, north of Dammarna, large vertebrae from *Balaena* sp. have been dredged in the 1950's (Johansson 1971).

6. Ellös

8 A Lysekil SO 1i

NMG 1931—5538

Parts of a skeleton have been found at Tofta. No more details are available. In the beginning of the 1930's a flat area south-west of Tofta was drained. In a narrow passage 1200 m south-west of Tofta shell-bearing sediments were found at a depth of one metre. The cultivated areas of Tofta lie 0—5 m a.s.l.

In the neighbourhood, two defective vertebrae and two fragments of a cranium of *Balaenoptera* sp. (NMG 1942—7949) have been found at the Backa gravel-pit (Nybelin 1943, p. 9). From the same pit subrecent or recent skeleton finds of cattle are recorded. Since the beginning of the century vertebrae found in the pit have been collected as curiosities (pers. comm. Mr Olof Olsson, Hästekälla). Shells are to be found in the sandy material.

At Mollösund on the south-west side of the island of Orust there has been a mill for bone meal (pers. comm. Olsson).

7. Edshultshall

8 A Lysekil SO 0i

Radiocarbon age: see p. 12

Dated material: fragment of the cranium

NMG 1968—12 378

On the west side of the island Orust a skeleton was found in 1968 at the property Edshultshall 17. According to Drs Kjerstin Cullberg and Hasse Olsson of the Archaeological museum of Göteborg, the stratigraphy was as follows:

0—0.5 m wave-washed sand

—1.0 shell-bearing sand

>2.0 blue clay with rare occurrence of shells.

Surface at 2.75 m a.s.l.

The skeleton was found at a depth of 1.4—1.7 m. The spinal column was in some places surrounded by 2—3 cm thick gravelly layers which occur here and

there in the visible part of the clay. Even stones, 10—15 cm thick, were observed in the clay.

The finding-place is situated close to the highland "Storehamn", a large plateau above 100 m a.s.l. with peaks reaching 116.4 m in the south and 114.4 m a.s.l. in the north.

The find is also discussed on p. 50.

8. Svenshögen

8 B Vänersborg SV 0e

Radiocarbon age: see p. 12

Dated material: a part of a rib

NMG 1942—7926

During the construction of the railroad Göteborg—Uddevalla a rib fragment was found at Bua, 2 km south-south-east of Svenshögen railway station (Nybelin 1943, p. 9). The locality is situated 50 m a.s.l. in a basin occupied by lake Hällungen and surrounded by bedrock hills 75—140 m a.s.l. The lake is drained to the North Sea through a narrow valley.

9. Huveröd

8 B Vänersborg SV 0e

NMG

Finds of ribs and vertebrae in wave-washed material at a depth of 4.5 m on the western slope of the Huveröd delta (126 m a.s.l.) are described by Björsjö (1953 b). The finding-place is situated along the road to Svenshögen about 400 m from the E 6 junction. The find-layer was levelled to 101 m a.s.l.

This is the highest situated finding-place in Sweden of an arctic whale or seal. Unfortunately souvenir hunters were first on the spot and only a fragment of one rib (identified by Dr Lepiksaar) could be obtained. The greater part of it was used for radiocarbon measurement (St 2352): $7\ 690 \pm 180$ years B.P., 5740 B.C., (Mörner 1969, pp. 132 and 478). As pointed out by Mörner the result does not fit with the supposed age of deposition. The finds had been exposed to wind and weather (CO₂) for some time and as the rib was deteriorating (becoming spongy) it had been treated at the NMG with sodium silicate.

Compare locality 8 above (2.5 km westwards) and locality 10 below (2 km north-eastwards).

10. Rishageröd

8 B Vänersborg SO 0f

Radiocarbon age: see p. 12

Dated material: a sawn out piece of a vertebra

Hjärtum old homestead museum

When constructing a bridge over the outlet from lake Rishageröd vatten, 97.3 m a.s.l., a vertebra was found in 1933 at a depth of 2 m in clay.

Shells of *Mya truncata* found in varved clay at Hjærtum, ca 7.5 km to the

north-east, yielded ages of $11\,540 \pm 100$ (Lu 199) and $11\,590 \pm 100$ (Lu 200) years B.P. (Hillefors 1969, p. 271). No correction for the apparent age of sea water is made. A supposed total correction of slightly more than -100 years is probable. In any case the shells are about 200 years older than the whale vertebra.

According to Hillefors (*op. cit.* p. 257) the highest shore-line west of lake Rishageröd vatten is situated at a level of *ca* 120 m a.s.l. This value seems to be 5—10 m too low. About 1.5 km to the south-west the surface of the Huveröd delta, see locality 9 above, lies at 126 m a.s.l. and about 5 km to the north-west the surface of the Backamo delta lies at nearly 130 m a.s.l. (Björnsjö 1949, pp. 147—148).

11. Essunga

8 C Lidköping SV 0e—1e

Radiocarbon age: see p. 12

Dated material: fragment of a jaw-bone

NMG coll. an. 1345

In 1876 parts of a cranium were found in clay at a depth of 3.6 m south-east of Essunga church. The clay was overlain by three metres of shell-bearing layers and sand (Aurivillius 1888, p. 56; Lindström 1887, p. 52). According to Oleröd (p. 19), the correct level of the surface is *ca* 85 m a.s.l. The molluscs were identified as *Mya truncata*, *Saxicava arctica*, *Tellina lata* and *Astarte corrugata* (Aurivillius *op. cit.*).

In the area the ice retreat is supposed to have had a temporarily stop at about 9 400 years B.C. (G. Lundqvist 1958). The terminal moraine zone is not investigated in detail.

12. Torsby

7 B Göteborg SV 3c

NMG coll. an. 386

In 1868 a fragment of a vertebra was found in clay below 2 m of peat (Malm 1871, p. 34). The locality (Lycke) is probably situated 2.5 km north-west of the church of Torsby at an altitude of *ca* 30 m a.s.l.

13. Ytterby

7 B Göteborg SV 4d

NMG coll. an. 1315

Parts of a jaw-bone were found in 1876 in a shell deposit in the western valley between Skidammen and Långemossen, 4 km west-north-west of Ytterby church (pers. comm. by Mr John Magnusson, Kuröd, whose grandfather found the jaw-bone). The finding-place is situated 55—60 m a.s.l. at the western edge of the supposed Göteborg terminal moraine zone. Unfortunately the finds have been treated with some preserving substance. The shell deposit is overgrown and nearly totally exploited.

14. Göteborg, Lövgärdet 7 B Göteborg SO 3f
 Radiocarbon age: see p. 12
 Dated material: part of a jaw-bone
 NMG coll. an. 11 056

During the construction of a new suburban area of Göteborg, the Geological survey received a jaw-bone of a Greenland right whale in September 1970.

The find had been made at a depth of 4 m in bluish heavy clay 300 m east of Keiller's pond. The surface of the finding-place is situated at 64.5 m a.s.l. and the thickness of the clay is about 20 m. In the walls of the shaft, isolated shells were found. *Balanus balanus* was common in the upper part while large thick shells of *Mytilus edulis* were commonest in the lower part. Throughout the sequence *Saxicava arctica* and *Saxicava arctica* v. *uddevallensis* were found. Some specimens of *Macoma calcarea* and *Natica nitida* occurred. Lenses of up to five shells were observed. It is quite possible that more parts of the skeleton are embedded in the clay.

The valley is parallel to the Göta River valley, surrounded by bedrock highlands and opening to the south. The find was made in the most northern part.

15. Göteborg, Oslogatan 7 B Göteborg SV 0d
 NMG 1939—7502

At the Bräcke allotment-garden area parts of the left side of a skeleton were found in clay at a depth of 2.75 m (Nybelin 1940, p. 10). The exact finding-place is situated 45 m north of Oslogatan some metres east of the former tram stop and the surface lies at a level of 18.5 m a.s.l. (letter by Mr Arnell to NMG in 1939).

16. Göteborg, Sahlgrenska hospital 7 B Göteborg SV 0e
 NMG 1938—7384

When constructing the central-heating system, part of a rib was found in clay at a depth of 5 m (Nybelin 1939, p. 10). The surface lies about 35 m a.s.l.

17. Göteborg, Guldheden 7 B Göteborg SV 0e
 Radiocarbon age: see p. 12
 Dated material: a rib-fragment
 NMG 1946—8373

The finds of ribs and fragments of ribs and vertebrae are described by Nybelin (1946, pp. 103—104). The finds were made in a 9 m deep well in block nr 16 "Palmiljan", 200 m south-west of Guldhedstorget. The subfossils were found in the lowest part of a soft clay underlain by till. The surface lies at 53.6 m a.s.l.

18. Göteborg, Fräntorpsgatan
NMG 1936—6737

7 B Göteborg SO 1f

In 1936 parts of a juvenile skeleton were found in clay at a depth of 2.5 m. In the clay, shells of *Mya truncata* and *Saxicava arctica* were identified. More finds, NMG coll. an. 8219—22, were found later (Nybelin 1956, p. 5). The locality, 18 Fräntorp street, is situated at a level of 37 m a.s.l. All details given are according to Nybelin (1938, 1946).

19. Lindome
NMG coll. an. 2719

6 B Kungsbacka NO 8f

At Fagared, 1500 m west of Lindome railway station, a 555 cm long jaw-bone were found in clay in 1904 (Jägerskiöld 1905, p. 8; 1909, p. 22). The finding-place lies at a level of approximately 40 m a.s.l.

20. Gällinge
NMG 1942—7931

6 B Kungsbacka SO 3h

When constructing a bridge over the "Stockared Canal", 2 km east of Gällinge church, a rib-fragment was found probably in 1931 (Nybelin 1943, p. 9). The find was lying in clay with shells of *Mytilus*. The bottom of the canal is now 2.5—2.6 m below the surface, which lies at a level of 54 m a.s.l. (Oleröd, p. 11).

21. Stannared
The Museum of Varberg, inv.nr 26 452

5 B Varberg NO 9i

While constructing the "Hulta Canal", approx. 2 km south-west of Stannared church, a rib was discovered in 1938 in clay at a depth of 3 m (Lepiksaar 1964 b). The ground surface at the finding-place is at a level of 20—25 m a.s.l.

22. Morup
NMG coll. an. 384—385

5 B Varberg SO 4i

Two vertebra fragments were found in 1852 "at several fathoms depth" (Malm 1869, p. 34). Later a rib of *Eubalaena swedenborgii* was found, see p. 27.

23. Falkenberg
NMG 1915—2751

5 B Varberg SO 2j

At a depth of 11 m a vertebra was found in clay at the Fajan's brickyard. The surface lies at about 10 m a.s.l. and the finding-place is situated 50 m from the River Ätran (Jägerskiöld 1916, p. 33). See also *Delphinapterus leucas* on p. 32.

EUBALAENA SWEDENBORGII

Swedenborg's whale

Finds of one particular whale in the *Balaenidae* family have been made in Sweden (Fig. 5). This whale, *Eubalaena swedenborgii*, has not been fully proved to be recent. One vertebra delivered in 1941 to the NMG was proved by Nybelin (1942, 1946) to belong to a Swedenborg's whale. As he found dried soft parts on it the vertebra must be recent. Unfortunately the other circumstances about the find are unknown (see p. 15).

Zoologists are uncertain whether Swedenborg's whale is an extinct species of its own or if it is a subspecies of the Greenland right whale or more probably of the Biscayan right whale (North atlantic right whale), *Eubalaena glacialis* (F: *Baleine des Basques*. G: *Nordkaper*. Sw: *Nordkapare*). The latter species is pelagic in the Gulf Stream area between 30°N and 60°N (van den Brink 1958, p. 201). One subfossil find was made in Sweden (vertebrae NMG coll. an. 6078) in the Soten canal in 1932 (Jägerskiöld 1934, p. 34).

With one exception the finds occur in glacial clay and Swedenborg's whale is thus referred to arctic species. The find at Uddevalla is Late-Glacial in age.

Reviews of Swedenborg's whale have been made by Nybelin (1942 b, 1946 b), Oleröd (1958) and Lepiksaar (1964 b).

1. Uddevalla
NMG 1932—5633

8 B Vänersborg NO 5f

In 1932 a find of *bullae ossea* was made in the Bräcke shellbank (Jägerskiöld 1933, p. 92; Nybelin 1946, p. 112).

2. Norra Vånga
Radiocarbon age: see p. 12

8 D Skara SV 2a

Dated material: a rib-fragment

Zoological museum, University of Uppsala

This is the first recorded subfossil find in Sweden. The find was made in 1705 at Norra Vånga, ca 15 km south-west of Skara town, and consisted of 12 vertebrae, a shoulder blade, a breastbone and 23 rib-fragments (Aurivillius 1888, p. 3). In 1719 Swedenborg used the find as number 12 of his 17 proofs of an earlier greater extension of the sea. After examination in 1862 by Lilljeborg the ribs were said to belong to *Hunterius Swedenborgii*. Later the name was changed to *Eubalaena Swedenborgii* (Aurivillius 1888, pp. 31—34). In 1823 a vertebra was found probably 700 m north-west of Glättestorp in the valley of the Glättestorp brook (earlier named Fjölbro brook). The location was determined according to information given by Munthe (1901, p. 22, 1906, pp. 9 and 85) and it is discussed by Nybelin (1942, pp. 7—8).

EUBALAENA SWEDENBORGII

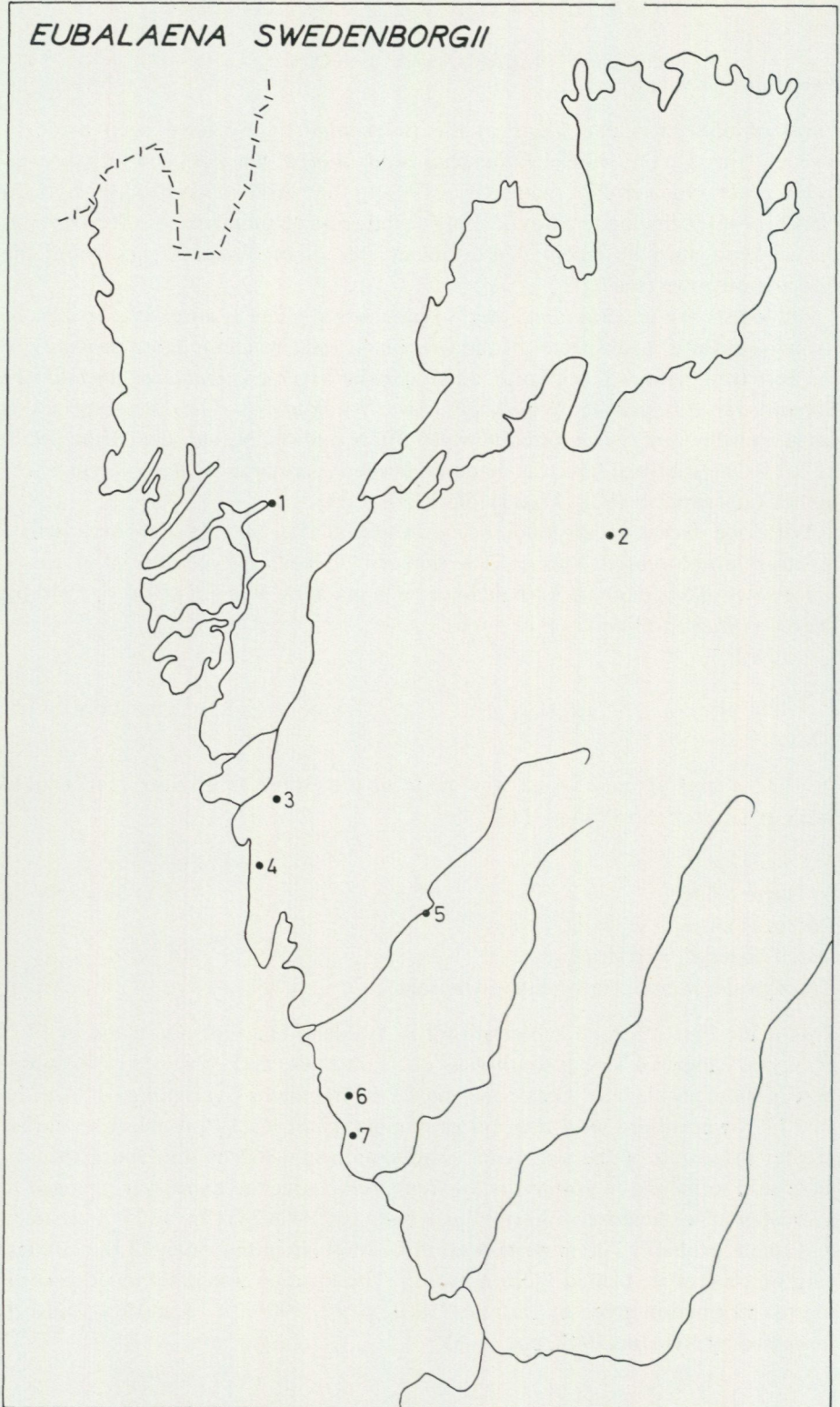


Fig. 5. Locations of subfossil finds of Swedenborg's whale. Numbers according to descriptions in text.

The surface of the surrounding glacial-clay fields has a level of about 105 m a.s.l. and the brook has cut 7 m into the clay.

The finding-place is situated in the broad zone of the Fennoscandian terminal moraines.

3. Göteborg 7 B Göteborg SV 1e
NMG 1944—8221

In a gravel pit at Landerigatan a left rib was found in 1943 (Nybelin 1945, p. 10 and 1946, pp. 110—112). The subfossil probably had been lying in the wave-washed material at the top of the deposit *i.e.* at a level of 53 m a.s.l.

4. Släp 6 B Kungsbacka NV 7e
NMG coll. an. 1316

Two rib-fragments were found in 1876 in a marl-pit at Bångsbo, 5 km north of Släp church.

5. Berghem 6 C Kinna NV 5b
NMG 1946—8380

A right temple bone was found before 1946 at the Hulta brickyard (Nybelin 1947). No other details are known. For stratigraphy of the clay-pit at Hulta see p. 36.

6. Tvååker 5 B Varberg NO 5i
Radiocarbon age: see p. 12
Dated material: part of a rib
Zoological museum, University of Uppsala

A nearly complete skeleton was found in calcareous glacial clay at a depth of 3 m (Aurivillius 1888, p. 3; Nybelin 1942, p. 10). The find was made close to the vicarage about 15 m a.s.l. The clay contained some molluscs which were identified by G. De Geer as *Mytilus*, *Balanus*, *Saxicava*, fragments of *Tellina* (= *Macoma*) and *Neptunea* (Aurivillius 1888, pp. 4—5).

7. Morup 5 B Varberg SO 4i
NMG coll. an. 1500

A rib was found in 1879 (Nybelin 1946, pp. 109—110).

DELPHINAPTERUS LEUCAS

White whale, Beluga, F: *Beluga vrai*, *Delphinatère blanc*. G: *Weisswal*. Sw: *Vitval*
Subfossil finds of the white whale are known from 18 localities (Fig. 6). The white whale is a circumpolar arctic species of the *Monodontidae* family. It has a preference for shallow water in coastal areas. A survey of subfossil and other finds was published by Lepiksaar in 1966.

Individual white whales have been observed occasionally at the west coast and in the Baltic Sea. In 1964 for instance, one or perhaps three individuals were reported from various localities west of Uddevalla.

One find of *Monodon monoceros* (Narwahl) is mentioned on p. 36.

1. Häggvall 8 A Lysekil NO 5j
NMG coll. an. 6953

In 1938 a practically complete skeleton was found in clay at Sörkila, ca 2 km west of Häggvall (Nybelin 1939, p. 10). The surface of the finding-place lies 0—5 m a.s.l.

2. Uddevalla 8 B Vänersborg NO 5f
Radiocarbon age: see p. 12
Dated material: defective vertebra
NMG coll. an. 6911

The dated material was found in the Bräcke shellbank in 1937 (Nybelin 1938, p. 10). In the Bräcke and Kuröd shellbanks parts of a cranium (NMG coll. an. 5477) and other parts of a skeleton, probably belonging to different individuals, were found in the years 1927—28 (Ringström 1928, pp. 5—6).

3. Tun 8 C Lidköping NV 6d
NMG coll. an. 7229

Under the drainage works of the Kilja bog in 1944 a vertebra was found in clay at a depth of more than one metre. The clay was overlain by peat. The surface of the former bog lies today at a level of 45—50 m a.s.l.

4. Norum 7 B Göteborg NV 8d
NMG coll. an. 6275

Six vertebrae have been found in clay (Jägerskiöld 1935, p. 7).

5. Jörlanda 7 B Göteborg NV 7d
NMG coll. an. 451

A vertebra of a juvenile was found in 1868 at a depth of about 2 m at Gröne mosse (Grömosse) at Raröd (Röröd), 3.5 km east of Jörlanda (Malm 1871, *Beluga catodon*).

DELPHINAPTERUS LEUCAS

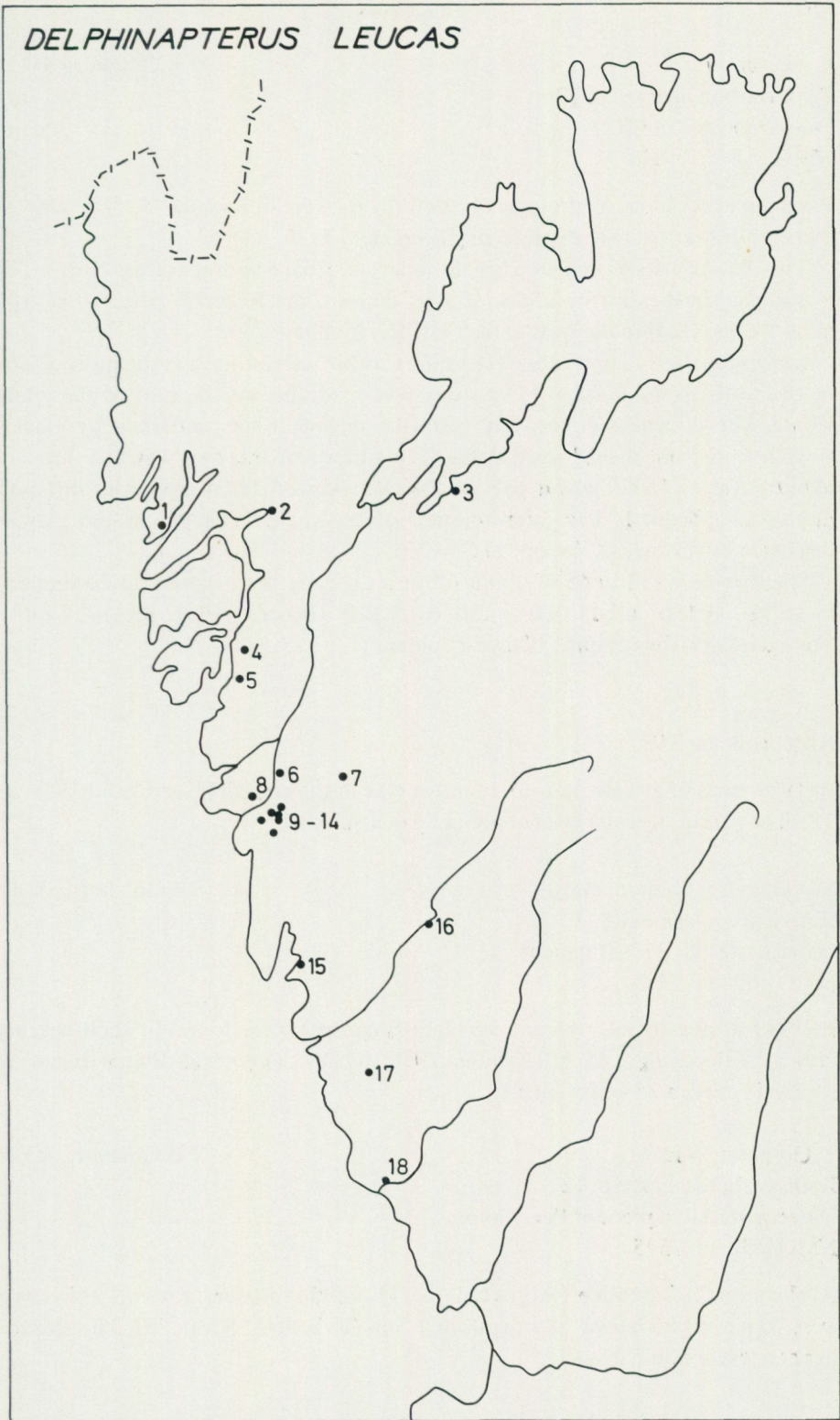


Fig. 6. Locations of subfossil finds of white whale. Numbers according to descriptions in text.

6. Agnesberg

7 B Göteborg SV 2e

Radiocarbon age: see p. 12

Dated material: a rib

NMG coll. an. 4840

Parts of a skeleton, pathologically deformed, were found in 1925 in clay at Steken brickyard at a depth of 15 m (Jägerskiöld 1928, p. 20).

The clay-pit is situated in a small valley in a bare bedrock area. The valley is bounded in the east by a glaciofluvial deposit, the Rösered delta (about 100 m a.s.l.), and leads in the west to the Göta River valley.

Sandegren (1931, pp. 126—128) refers to an interesting investigation of one of the walls in the clay-pit. The study was made before the find of the white whale. The thickness of the clay was 10.6 m and it was underlain by glaciofluvial sand from the Rösered delta. The surface of the clay was at a level of about 30 m a.s.l. The lower part of the clay showed 105 varves with different molluscs embedded. The interpretation of the faunal changes in the clay is discussed by Mörner (1969, pp. 171—173).

Shells from an altitude of about 60 m a.s.l. have been dated (no correction) to $10\ 980 \pm 130$ and $11\ 010 \pm 130$ years B.P. (Brotzen 1961, pp. 145—146). The skeleton is thus about 1 000 years older.

7. Lerum

7 B Göteborg SO 2i

NMG coll. an. 5570

In 1929 parts of a skeleton were found in clay at the church (Jägerskiöld 1930, p. 15). The surface lies at a level of about 25 m a.s.l.

8. Göteborg, Slätta damm

7 B Göteborg SV 1d

Radiocarbon age: see p. 12

Dated material: a rib-fragment

NMG coll. an. 7396

In 1949 a breastbone, ribs and vertebra-fragments were found in shell-bearing clay at a depth of 2.45 m (Nybelin 1950, p. 20). The pond, Slätta damm, is situated between 25 and 30 m a.s.l.

9. Göteborg, Vidkärr

7 B Göteborg SO 1f

Radiocarbon age: see p. 12

Dated material: a piece of the cranium

NMG coll. an. 7395

At the street 3 Ulveliden (property 2 in 111 Kalkbrännaren) parts of a skeleton were found in sandy clay at a depth of 1.5 m (Nybelin 1950, p. 20). The surface lies at a level of 36.5 m a.s.l.

The find occurred in a postglacial clay. From what is known about the shore-line displacement in Göteborg (Persson 1973, p. 36), the age of the subfossil ought to be at least around 9 000 years B.P.

10. Göteborg, Kålltorp 7 B Göteborg SV 1e
NMG coll. an. 4575

In the street of Lokförargatan opposite the street of Assesorsgatan, about 500 m south-south-west of Härlanda church, a vertebra was found in 1924 together with subfossil parts of an eider in sandy clay with shells at a depth of 2.2 m (Jägerskiöld 1925, pp. 30—31). According to a letter from the finder, Mr Hultman, the surface lies at a level of 27 m a.s.l.

11. Göteborg, Örgryte 7 B Göteborg SV 0e
NMG coll. an. 450

At Överås in the neighbourhood of Örgryte old church a vertebra of a juvenile individual was found in shell-bearing clay in 1860 (Malm 1871, *Beluga catodon*). This was the first subfossil find of *Mammalia* in Göteborg.

12. Göteborg, Skår 7 B Göteborg SV 0e
NMG coll. an. 6103

At the corner of the streets of Olov Skötikonungsgatan and Skårgatan ribs were found in clay at a depth of 3.3 m in 1933 (Jägerskiöld 1934, p. 53). The surface lies about 25 m a.s.l. See also *Erignathus barbatus* on p. 39. Another find, NMG coll. an. 6106, reported from Böö in the same year probably is from the mentioned locality.

13. Göteborg, Sahlgrenska hospital 7 B Göteborg SV 0e
NMG coll. an. 6890

During the construction of the clinics of aural and eye diseases three vertebrae were found in 1937 in blue clay at a depth of 2.8 m (Nybelin 1938 b). The surface level lies at 35 m a.s.l. See also *Balaena mysticetus* on p. 23.

14. Mölndal 6 B Kungsbacka NV 9e
NMG coll. an. 452—457

Parts of a skeleton (Malm 1871, *Beluga catodon* f. *mölnadalensis*).

15. Ölmanäs 6 B Kungsbacka SO 3f
Radiocarbon age: see p. 12
Dated material: a vertebra
NMG coll. an. 4712

A pathologically-deformed skeleton was found before 1904 in shell-bearing clay (Lepiksaar 1966, p. 12).

16. Berghem

6 C Kinna NV 5b

Radiocarbon age: see p. 12

Dated material: rib-fragments

NMG coll.an. 7308

In 1946 a skeleton was found in blue clay at a depth of 5 m at Hulta brickyard (Nybelin 1947, p. 10).

In 1949 a defective cranium and other parts of a skeleton, NMG coll. an. 7375, were found at the same depth (Nybelin 1950, p. 20).

See also *Eubalaena swedenborgii* on p. 27 and stratigraphy on p. 36.

The locality is situated at a level of 25—30 m a.s.l. in the Viskan valley which is surrounded by areas above the marine limit which is said to be at 83 m a.s.l. at Berghem (von Post 1968, pp. 104—105).

The radiocarbon age is of great interest as the Berghem-Moslätt terminal moraine zone crosses the Viskan valley at Berghem. The Older Dryas Stadial ended about 11 800 years ago.

A horn of a reindeer found at Edared (6 B Kungsbacka NO, 5f) about 10 km west-north-west of Berghem was radiocarbon dated (St 2470) to 11 265 \pm 100 B.P., 9 315 B.C. (Mörner 1969, p. 154).

17. Rolfstorp

5 B Varberg NO 8j

Radiocarbon age: see p. 12

Dated material: a vertebra

NMG coll. an. 4397

At Aleslöv, about 1 500 m north-west of Rolfstorp's church, a skeleton was found in clay in 1905. Surface level at 25—30 m a.s.l.

According to a notification, another skeleton has been found at Stenstorp, about 3 km west of Rolfstorp's church. It was received by the Royal museum of natural-history in Stockholm (nr 908) in 1882. Surface level at 15—20 m a.s.l.

18. Falkenberg

5 B Varberg SO 2j

NMG coll. an. 6973

In 1936 parts of a juvenile cranium were found at the Fajan's brickyard (Ask-lund 1936, pp. 13—15; Nybelin 1939, p. 10). According to a letter (from Mr R. Stahl to NMG) the find was made in clay at a depth of 11 m. The clay was overlain by 7 m of sand. The surface of the finding-place lies at a level of 10—15 m a.s.l.

Shells from the basal parts of the clay have been radiocarbon-dated (Mörner 1969, p. 168). Shells of *Neptunea despecta* were dated to 12 930 \pm 280 years B.P., 10 980 B.C. (St 2333), and shells of *Balanus* sp., *Natica clausa* and *Lunatia pallida* were dated to 12 970 \pm 280 years B.P., 11 020 B.C. (St 2334). Corrections for C¹³ and for the apparent age of sea water more or less compensate

each other. Mörner (*op. cit.* p. 16) made preliminary corrections only according to the retarded carbon cycle in the sea (-305 ± 25 years). Mörner's corrected ages are thus too young.

Parts of a skeleton of a red deer (*Cervus elaphus*) were later found in a layer of humified peat between the clay and the sand. This peat layer situated 4.5 m a.s.l. was radiocarbon-dated to $8\,200 \pm 140$ years B.P., 6 250 B.C., (Caldenius *et al.* 1960, p. 33). According to his shore level displacement scheme, Mörner (1969, p. 253) considers the age to be 400 years too old "probably due either to contamination by older material or to the presence of a hiatus".

See also *Balaena mysticetus* on p. 24.

SUBFOSSIL FINDS OF SPECIFIED WHALES NOT REGISTERED AT MUSEUMS, AND SUBFOSSIL FINDS OF UNSPECIFIED WHALES

More subfossil finds of arctic whales than those listed above are known (Fig. 7). In the literature, six more localities of *Balaena mysticetus* are reported. These finds were made before 1900 and cannot be traced to the stated museums. Together with these finds are listed below finds of unspecified whales. All details are given as the situation was during compilation of the inventory. This means that in the future perhaps some of the finds of unspecified whales may be identified successfully.

Most of the finds were discovered in glacial deposits and consequently they must be regarded as subfossil parts of skeletons of arctic whales. All these finds combined with those of *Balaena mysticetus*, *Eubalaena swedenborgii* and *Delphinapterus leucas* give a very good picture of the abundant frequency of arctic whales which, for the most part, lived close to the retreating ice front.

1. Tjärnö 9 A Strömstad NO 7g
NMG coll. an. 5555

Part of a cranium of an unspecified whale found at Tjärnöbo (Tjärnebo) (Jägerskiöld 1930, p. 15).

2. Fjällbacka 9 A Strömstad SO 1h
NMG 1938—7345

Parts of a skeleton of an unspecified whale found in a shellbank on the Valö island (letter from Mr. Stubelius to NMG; Nybelin 1939, p. 19).

3. Sotenkanalen 8 A Lysekil NO 7g—h
NMG coll. an. 7172

A defective vertebra of *Balaena* sp. (Nybelin 1943, p. 9).

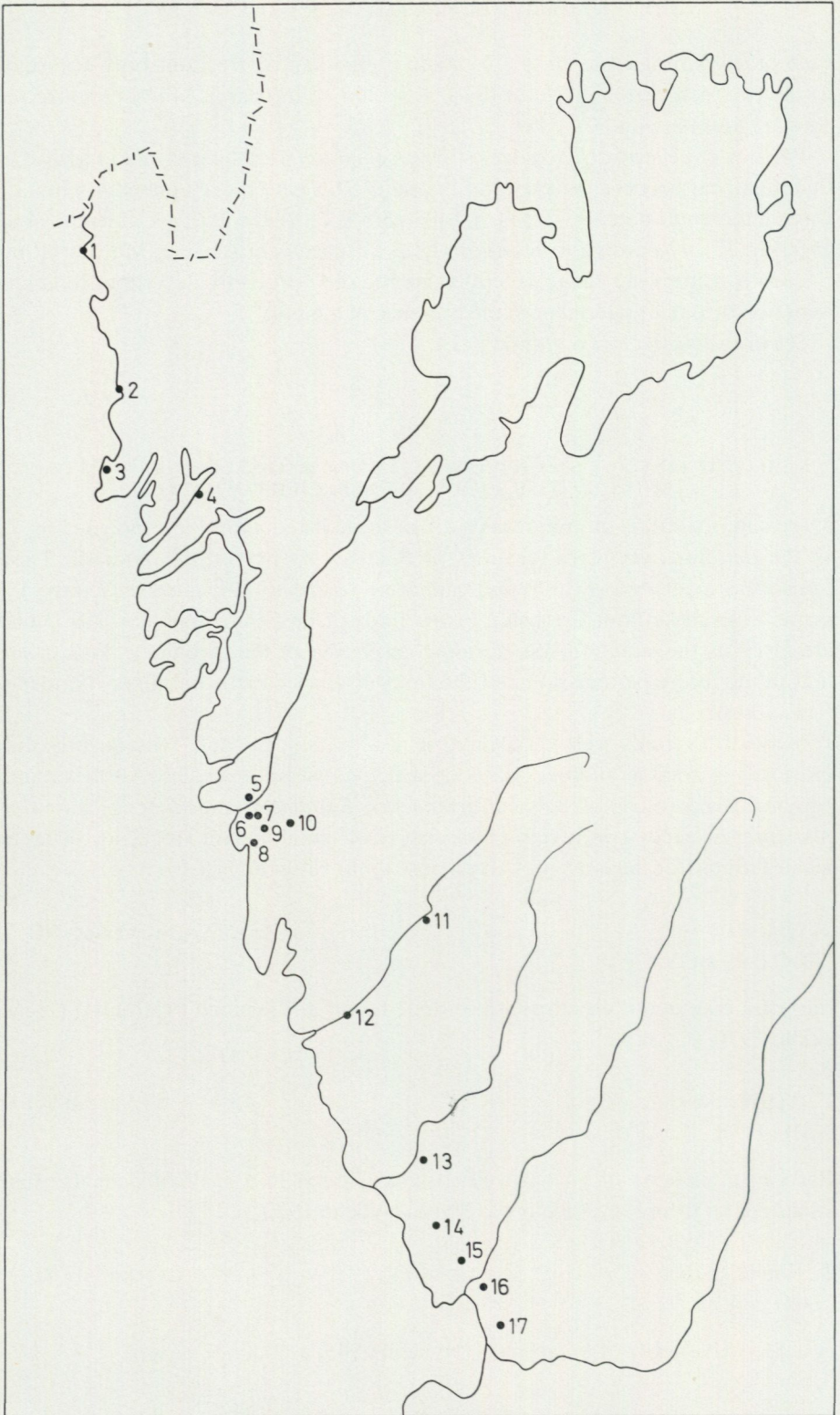


Fig. 7. Locations of subfossil finds of specified whales not registered at museums, and subfossil finds of unspecified whales. Numbers according to descriptions in text.

4. Skredsvik 8 B Vänersborg NV 6b

In 1885 a left rib of *Balaena mysticetus* was found at one metre's depth in a shell deposit (Aurivillius 1888, p. 55; Lindström 1902, p. 77). The finding-place probably was the shellbank 1300 m south-south-west of Gullmarsberg. The supposed finding-place has a level of 50—55 m a.s.l. See also *Pagophilus groenlandicus* on p. 42.

5. Göteborg, Hisingen island 7 B Göteborg SV 0d

At the former Pölsebo (east of Rya forest) parts of a skeleton of an unspecified whale were found at a depth of 2 m in a sand-pit (Nybelin 1938 b).

6. Göteborg, Rosengatan 7 B Göteborg SV 0d—e
NMG coll. an. 5499

Close to the Museum of natural-history a rib of an unspecified whale was found at a depth of 6 m (Jägerskiöld 1930, p. 15; Nybelin 1938 b).

7. Göteborg, Landala mosse 7 B Göteborg SV 0e

At a depth of 2.5 m in the bog south of the Chalmers technical university parts of an unspecified whale were found (Nybelin 1938 b).

8. Askim, Trollåsen 6 B Kungsbacka NV 9d
NMG coll. an. 6896

A vertebra of *Balaena* sp. (Nybelin 1938, p. 10; Lepiksaar 1964 b, pp. 29—30).

9. Göteborg, Sjövik estate 7 B Göteborg SV 0e
NMG coll. an. 8223

Close to the border of Mölndal town on the property 10 741 A one defective vertebra of *Balaena* sp. was found at a depth of 1.6 m in clay with sand and shells (Nybelin 1956, p. 5). The clay was overlain by gravel and the surface lies about 80 m a.s.l.

10. Mölnlycke 6 B Kungsbacka NO 9f—g
NMG coll. an. 930

Part of a left jaw-bone of a *Balaena mysticetus?* was found in 1871 at a depth of 3 m in shell-bearing clay.

11. Berghem

6 C Kinna NV 5b

A mandible of *Balaena mysticetus* was found in 1900 at Hulta brickyard. Stratigraphy according to Munthe (1902, p. 16):

0—0.6 m brownish sand

—1.8 m brownish and blue-grey shell-bearing clay mixed with sand

>20 m varved blue-grey shell-bearing clay with thin lenses of sand.

Surface, according to Munthe, at 35 m a.s.l.

The mandible was found below a depth of 3 m. The molluscs were identified as *Mytilus edulis*, *Portlandia arctica*, *Macoma calcarea*, *Macoma baltica* and fragments of *Balanidae* (Munthe *op. cit.*).

See also *Eubalaena swedenborgii* on p. 27 and *Delphinapterus leucas* on p. 32.

12. Veddige, Veselången

6 B Kungsbacka SO 1j

At the south end of the former lake Veselången in the Viskan valley finds of two ribs and part of a vertebra of *Balaena mysticetus* were reported by Erdmann (1868, p. 158).

13. Sannarp

5 C Ullared SV 3b

Parts of a skeleton of an unspecified whale (Erdmann 1868, p. 158). The find was later identified as belonging to pike whale (*Balaenoptera acutorostrata*) (Lilljeborg 1874, pp. 941—942).

14. Getinge

5 C Ullared SV 0b

Vertebrae of *Balaena mysticetus* were found in the 1870's in a clay-pit at Stensjö, 15 m a.s.l.

Parts of a skeleton of an unspecified whale have been found in glacial clay at Undars mosse, east of Stensjö, and at Mostorp, 2.5 km north of Getinge (Erdmann 1868, p. 158; Lundbohm 1887, pp. 36—37; Caldenius *et al.* 1966, p. 87).

15. Holm

4 C Halmstad NV 8d

Part of a jaw-bone of *Balaena mysticetus* in marl-pit at Holm estate (Lundbohm 1887, p. 37).

The reported find of a defective vertebra of *Monodon monoceros*, Narwhal, found in a marl-pit at the Nyrebäcken brook south of Tiarp, ca 5.5 km southwest of Holm (Lundbohm *op. cit.*), is the only find of this species in Sweden. The vertebra is no longer available for checking.

16. Snöstorp

4 C Halmstad NV 7e

Parts of a skeleton of an unspecified whale found at the Fylle river (Lundbohm 1887, p. 37).

17. Eldsberga

4 C Halmstad NO 5f

A vertebra of an unspecified whale found at a depth of slightly more than 3 m in calcareous clay (Lundbohm 1887, p. 37). The area is scattered with marl-pits between 15 and 25 m a.s.l.

ERIGNATHUS BARBATUS

Bearded seal. F: *Phoque barbu*. G: *Bartrobbe*. Sw: *Storsäl*

The bearded seal occurs in the Arctic Ocean and is very rare outside this region.

The localities with subfossil finds are shown in Fig. 8.

All finds except that at Uddevalla were found in glacial clay. The northernmost find of arctic whales and seals in west Sweden occurred at Grums.

No Neolithic finds are known.

A review was published by Lepiksaar in 1964.

1. Grums

10 C Åmål NO and 11 C Arvika SO

Radiocarbon age: see p. 12

Dated material: elbow-bone

Sundsta school, Karlstad

Parts of a skeleton were found in 1892 in glacial clay between lake Lill-Emsen (11 C 0j) and the former lake Lillsjön (10 C 9i) during the lowering of the latter's surface, about 80 m a.s.l. The donor of the finds lived at Berg, south-west of Lill-Emsen. The dated elbow-bone was the only remnant from the original finds. Copies of the *ulna* in plaster are kept at the museum of the Sundsta school in Karlstad and at the Museum of natural-history in Göteborg.

2. Hästefjorden

8 B Vänersborg NO 7h

Royal museum of natural-history, Stockholm

While constructing the Futton canal between St. Hästefjorden and Ö. Hästefjorden in 1867—68 a vertebra was found (Kinberg 1869, pp. 15—16; Lindström 1887, p. 52). See also *Pagophilus groenlandicus* on p. 43.

3. Uddevalla

8 B Vänersborg NO 5f

NMG coll.an. 10 086

Only one identified find, *astra galus* (Lepiksaar 1964, p. 260), has hitherto been found in the shellbanks of Bräcke and Kuröd, cf. *Pagophilus groenlandicus* on p. 42, and *Phocoena phocoena* on p. 47.

4. Naum

8 C Lidköping SO 1f

Royal museum of natural-history, Stockholm

A nearly complete skeleton (Fig. 9) was found in 1901 at a depth of 3 m in blue

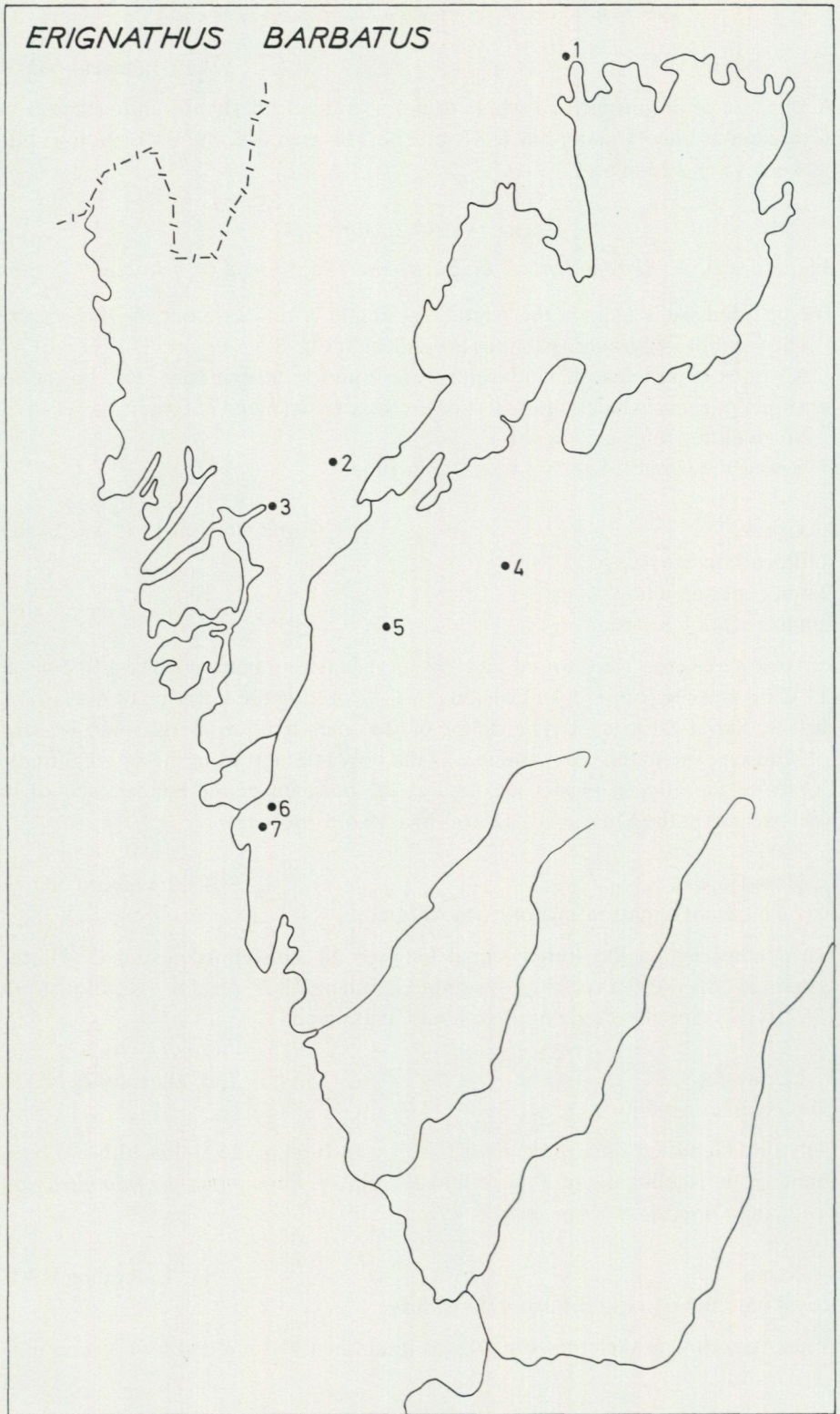


Fig. 8. Locations of subfossil finds of bearded seal. Numbers according to descriptions in text.

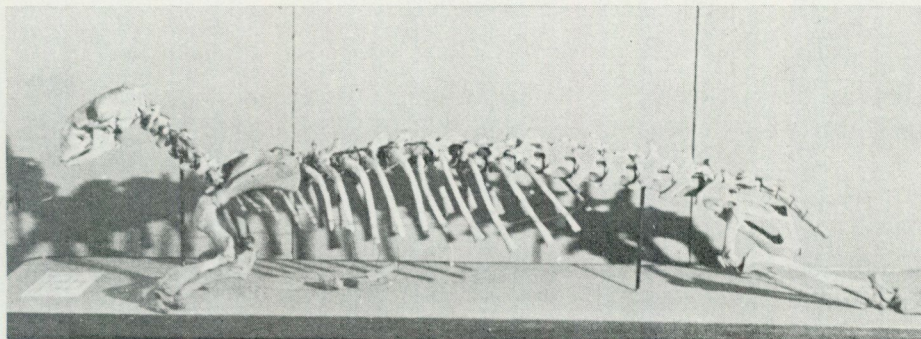


Fig.9 . Preconstructed subfossil skeleton parts of the bearded seal found outside Naum (locality 4). Exhibited at the Royal museum of natural-history in Stockholm. — Photo by Staffan Söderberg 1974.

clay (Munthe 1902, pp. 3—10). The finding-place is situated at St. Grönelund (Grönelid), 4.5 km south-west of Naum church. Munthe (*op.cit.*) estimated the surface level to be 75 m a.s.l. According to the topographical map it should be around 90 m a.s.l. About 500 m to the north-east there is a marl-pit in which a species of *Pagophilus groenlandicus* (p. 44) previously had been found.

5. Lagmansered

8 C Lidköping SV 0a

Radiocarbon age: see p. 12

Dated material: part of a pelvis-bone

NMG coll. an. 4713

Parts of a skeleton were found in 1884 at a depth of 6.5 m in clay 500—600 m south of the ruined church, about 2 km east-south-east of Lagmansered church (Lindström 1887, p. 52; Munthe 1902, p. 9; Jägerskiöld 1928, p. 20). The surface is said to lie at 89 m a.s.l. but according to the topographical map it should be 5—10 m higher. Shells of *Mya truncata* and *Balanus hameri* are recorded from the finding-place (Hägg 1952, p. 142).

6. Göteborg

7 B Göteborg SV 0e

NMG coll. an. 6083

A thigh-bone has been found at the street-corner of Olov Skötkonungsgatan and Skårgsgatan (Jägerskiöld 1934, p. 53). See also *Delphinapterus leucas* on p. 31.

7. Fässberg

6 B Kungsbacka NV 9e

NMG coll. an. 2005

In 1898 parts of a cranium were found in clay at about 6 m depth. The exact finding-place is unknown.

PAGOPHILUS GROENLANDICUS

Harp seal. F: *Phoque du Groenland*. G: *Sattelrobbe*. Sw: *Grönlandssäl*

Subfossil finds of the harp seal are known from 10 localities on the west coast (Fig. 10). A review of all finds in west Sweden was published by Lepiksaar in 1964.

The harp seal has its habitat in the drift-ice region in open sea.

The species existed along the coast of west Sweden in Late-Glacial times and also for a time during the Holocene epoch (*cf.* locality 1 below). The Stone Age people were good seal hunters as is shown by skeleton parts of harp seal from the following Neolithic sites:

Dafter (Fredsjö 1963)	9 A Strömstad NO 8g
Rörvik (Henrici 1936)	9 A Strömstad SO 0h
Kullen (Retzius & Wallengren 1903)	3 B Höganäs NO 9i

Finds of the harp seal have not been recorded from *Ancylus* or *Yoldia* deposits in the Baltic basin. The species is known to have lived in the Baltic and in the Gulf of Bothnia during the *Litorina* stage, and also later. Subfossil finds have been made at Sundsvall (Adlerz 1906; Munthe 1929, pp. 245—246) and at Söderhamn (Munthe 1929). The reported find of a ringed seal at Norrköping (Lönnberg 1908, pp. 1—12) was later identified as a harp seal (Ekman 1922, p. 384, footnote 1).

The find of a nearly complete skeleton of a harp seal in 1868 in Stockholm was regarded by Munthe (1940) as being from the *Yoldia* sea stage. On the basis of the osteological evidence of the skeleton, Lepiksaar (1964 a, p. 261) feels justified in suggesting that it must be younger. These contradictory views require brief elucidation.

The find was made at a depth of one metre in clay east of Jakob's church at the park Kungsträdgården. The level of the park is 5—10 m a.s.l. Kinberg (1869, p. 14) did not describe the clay as varved but assumed it to be glacial. According to the geological map of 1964 (Möller & Stålhös) the dominant clay on the map-sheet is postglacial in origin. In low land it can be black striped by iron sulphide (*op. cit.* p. 115). Kinberg was no geologist and De Geer (1932, p. 14) did not pay great attention to the determination of the nature of the clay, or perhaps he was misled by the "arctic" harp seal. In any case, zoological and geological circumstantial evidence suggests a *Litorina* age. It is hoped that this can be verified by C^{14} determination in the future.

Remains of harp seals are abundant among refuse from Neolithic sites, especially on the Island of Gotland (Holmquist 1912; Pira 1928; Lepiksaar 1974), but finds in later deposits are rare. Three earbones found on the Island of Öland yielded ages of $1\ 230 \pm 80$ (St 2046) and $2\ 080 \pm 105$ (St 2048) years (Sellstedt *et al.* p. 7).

PAGOPHILUS GROENLANDICUS

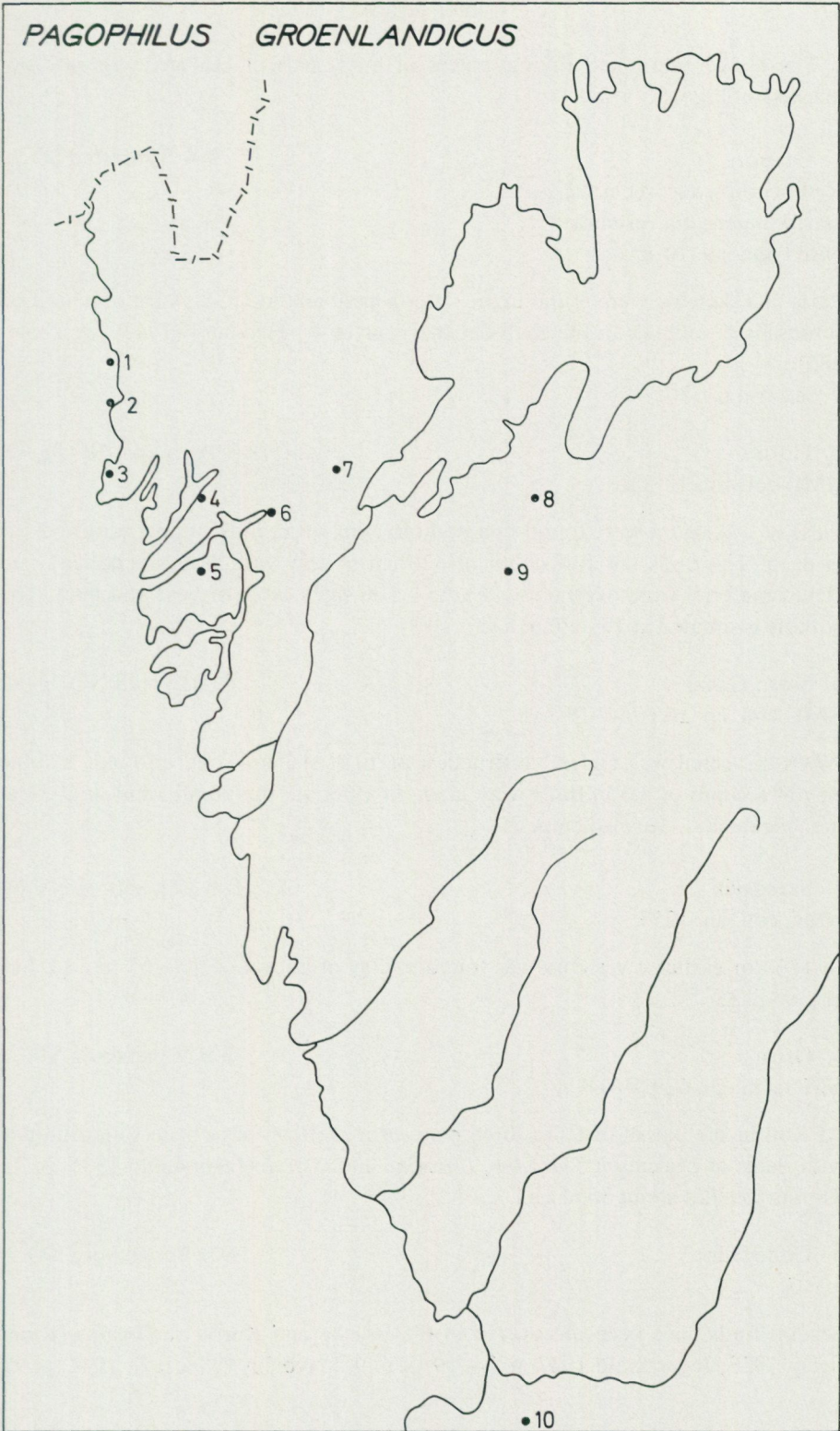


Fig. 10. Locations of subfossil finds of harp seal. Numbers according to descriptions in text.

The above mentioned finding-places of harp seals of Holocene age are not marked on Fig. 10.

1. Otterön 9 A Strömstad SO 2g
 Radiocarbon age: see p. 12
 Dated material: a vertebra
 NMG coll. an. 10 153

Parts of a skeleton were found in the Otterö shellbank in 1935. A list of identified subfossils of animals in the shell deposit is given by Hessland (1943, pp. 285—286).

See also p. 57.

2. Hornö 8 A Lysekil NO 9g—h
 NMG coll. an. 10 022

Parts of a skeleton were found in a pothole, 9 m × 6 m in the upper part and 5.5 m deep. The finds lay at a depth of 320 cm in clay with stones. The clay and clayey material were overlain by a nearly 1 m thick layer of peat and mud. The pothole is situated at 15—20 m a.s.l.

3. Soten Canal 8 A Lysekil NO 7g—h
 NMG coll. an. 10 076—78

When the canal was under construction parts of skeletons were found. In blue clay at a depth of 4.5 m finds were made in 1932 at "the pump" and in 1934 at the "big dump". See also on p. 25.

4. Skredsvik 8 B Vänersborg NV 6b
 NMG coll. an. 1253

In 1863 or earlier a vertebra was found in clay at a level of 50—65 m a.s.l. See also on p. 35.

5. Orust 8 B Vänersborg SV 2a
 NMG coll. an. 6292—94

At Röd in the parish of Röra three parts of a skeleton have been found in clay with shells of *Buccinum*, *Cardium*, *Littorina* and *Ostrea* (Jägerskiöld 1935, p. 7). The surface lies about 30 m a.s.l.

6. Uddevalla 8 B Vänersborg NO 5f
 NMG

Several finds have been discovered in the Bräcke and Kuröd shellbanks (Ringström 1928; Jägerskiöld 1932, p. 34, 1933, p. 91; Nybelin 1938, p. 9, 1941, p. 9).

At least three of the finds are authentic (Lepiksaar 1964, p. 262). South of the former shell deposit at Kapellbackarna one find is recorded (Jägerskiöld 1936, p. 7).

7. Hästefjorden

8 B Vänersborg NO 7h

Radiocarbon ages: see p. 12

Dated material: a rib and a part of a hip-bone (St 4402) found in 1867, a rib and a vertebra (St 4811) found in 1868

Royal museum of natural-history, Stockholm

When the Futton canal between the lakes of St. Hästefjorden and Ö. Hästefjorden was under construction in 1867—68, four nearly-complete skeletons were found. According to Sidenbladh (1870, p. 83) the following finds were made in the clay from west to east:

Skeleton parts of harp seal at a depth of 6.8 m (found 1867),

skeleton of a cod at a depth of 4.5 m,

skeleton of a harp seal at a depth of 2.4 m (found 1868).

The skeleton parts were identified as belonging to three individuals (Kinberg 1869, pp. 15—16). The clay is overlain by the peat of a raised bog with a thickness of 4—5 m.

The radiocarbon datings are discussed on p. 50.

From the same locality Hägg (1947, p. 472; 1952, p. 133) has identified shells of *Buccinum groenlandicum*, *Cyprina islandica* now altered to its original name *Arctica islandica* (Tebble 1966, p. 92), *Neptunea despecta*, *Sipho latericeus*, *Sipho togathus* and *Trophon clathratus*.

See also *Erignathus barbatus* on p. 37.

8. Sköttorp

8 C Lidköping NO 5h

Radiocarbon age: see p. 12

Dated material: right shin-bone

NMG 10 152

In the night between February 1st and 2nd in 1946, a large landslide occurred on the west bank of river Lidån about 500 m south-south-east of Sköttorp. In the south part of the slide area, shells and skeletal parts were visible in the clay about 20 m below surface. It seemed that the subfossils were directly underlain by bedrock. All the information given above was obtained from Mr Robert Fahlström living at nearby Kristiansgården. Fahlström collected the shells, the skeletal parts and a claw of a crustacean, probably of a lobster. Unfortunately the latter has disappeared. The shells are kept by Fahlström and the skeletal parts were donated to the Museum in Skara which later delivered them to NMG, where Dr Lepiksaar identified them as back extremities of a juvenile species. The skeletal parts were embedded in marly clay.

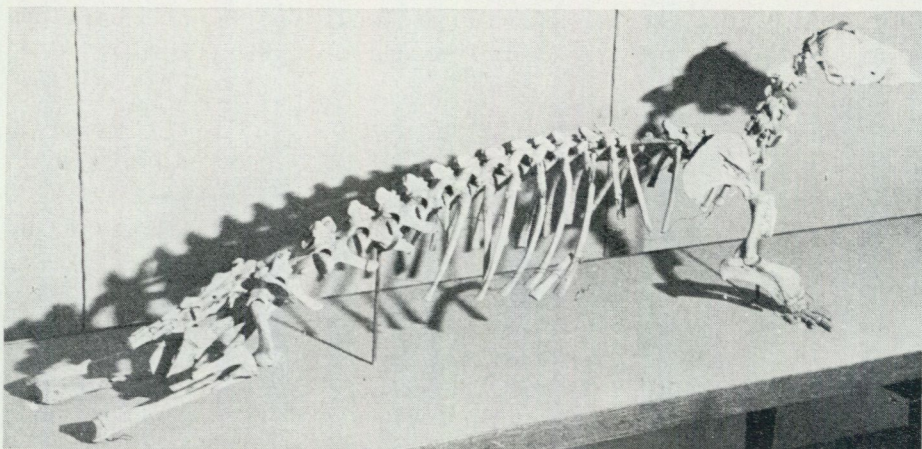


Fig. 11. Preconstructed subfossil skeleton parts of the harp seal found outside Naum (locality 9). Exhibited at the Royal museum of natural-history in Stockholm. — Photo by Staffan Söderberg 1974.

The landslide itself was described by Odenstad in 1951. The surface is situated about 64 m a.s.l. Below a top layer of 1—2 m of silt and fine sand, clays with varying thicknesses between 15 and 35 m occurred underlain by bedrock (Odenstad, p. 18). Two cores from the slide area were examined by Dr Caldenius of the Geological survey. Both cores extended over nearly 22 m and the lowest 4—5 m consisted of varved clay, the bottommost part "beautifully varved clay" (*op. cit.* pp. 39—40). There are no notes about shells in the descriptions.

Determination of the radiocarbon age is at present being undertaken, thus no result can be reported at this stage.

9. Naum

8 C Lidköping SO 1f

Royal museum of natural-history, Stockholm

A nearly complete skeleton (Fig. 11) was found in a marl-pit 600 m south-east of Svartemad, 3.5 km south-west of Naum church. The skeleton lay at a depth of 5.7 m in blue-grey calcareous clay (Munthe 1901). The clay was overlain by 2 m of sand. The surface of the finding-place lies at about 90 m a.s.l.

See also *Erignathus barbatus* on p. 39.

10. Våxtorp

4 C Halmstad SO 1g

Radiocarbon age: see p. 12

Dated material: 2 vertebrae and part of the upper arm bone

Royal museum of natural-history, Stockholm

Parts of a skeleton were found in 1875 at a depth of nearly 5 m in a marl-pit at St. Menlösa (Mällösa). No other details are known about the finding-place.

On the domains of St. Menlösa there are 5—6 marl-pits, and east of the yard a 8—10 m deep clay-pit is situated, being the remains of a former brickyard. In general the clay is overlain by a couple of metres of sand, but in small patches the clay is superficial. The thickness of the clay is at least 10 m. The surface varies between 15 and 25 m a.s.l.

The find is discussed on p. 52.

PUSA HISPIDA

Ringed seal. F: *Phouque marbré*. G: *Ringelrobbe*. Sw. *Vikare*

A survey was given by Lepiksaar in 1964. The ringed seal lives in the Arctic Ocean but occasionally visits the waters of the Swedish west coast.

Most of the subfossils along the west coast (Fig. 12) were deposited in the vicinity of the retreating ice front. In addition to the listed localities one find from "southern Halland" is kept at the Royal museum of natural-history in Stockholm.

Like the harp seal, the ringed seal occurred on the Swedish west coast in Holocene times (Lepiksaar 1964 a, p. 264). Finds are reported from the following Neolithic sites (Lepiksaar *op. cit.*):

Dafter 9 A Strömstad SO 2g

For description of the site see Fredsjö (1963)

Rörvik (Henrici 1936) 9 A Strömstad SO 0h

Grönninge 6 B Kungsbacka NV 6e

By contrast with the harp seal, the ringed seal is relict from the Yoldia stage in the northern part of the Baltic Sea. Several finds have been made along the Swedish coast, partly in deposits older than the Litorina stage. Subfossil finds are known from Skattmansö (Nathorst 1893, pp. 567—568; Munthe 1900), Åbyfors, 7 km west-south-west of Gävle (Sandegren *et al.* 1939, p. 112), Trönö, north-west of Söderhamn (Lönnberg 1909, pp. 9—12), Sidsjön, Sundsvall (Blomqvist 1943), Nyland (Munthe 1893, p. 282) and Luleå (Lönnberg 1909, pp. 12—17).

Parts of a skeleton (NMG coll. an. 7134) found in clay at a depth of 1.3 m at Björn's brickyard at Sunderbyn, Nederluleå, are kept at the Museum of natural-history in Göteborg (Nybelin 1943, p. 9). According to Fromm (1965, pp. 67, 158) the clay is of Litorina age.

One Bothnian find has been dated:

Bjärträ 18 J Kramfors NV

Radiocarbon age: see p. 12

Dated material: 3 ribs and a vertebra

Royal museum of natural-history, Stockholm

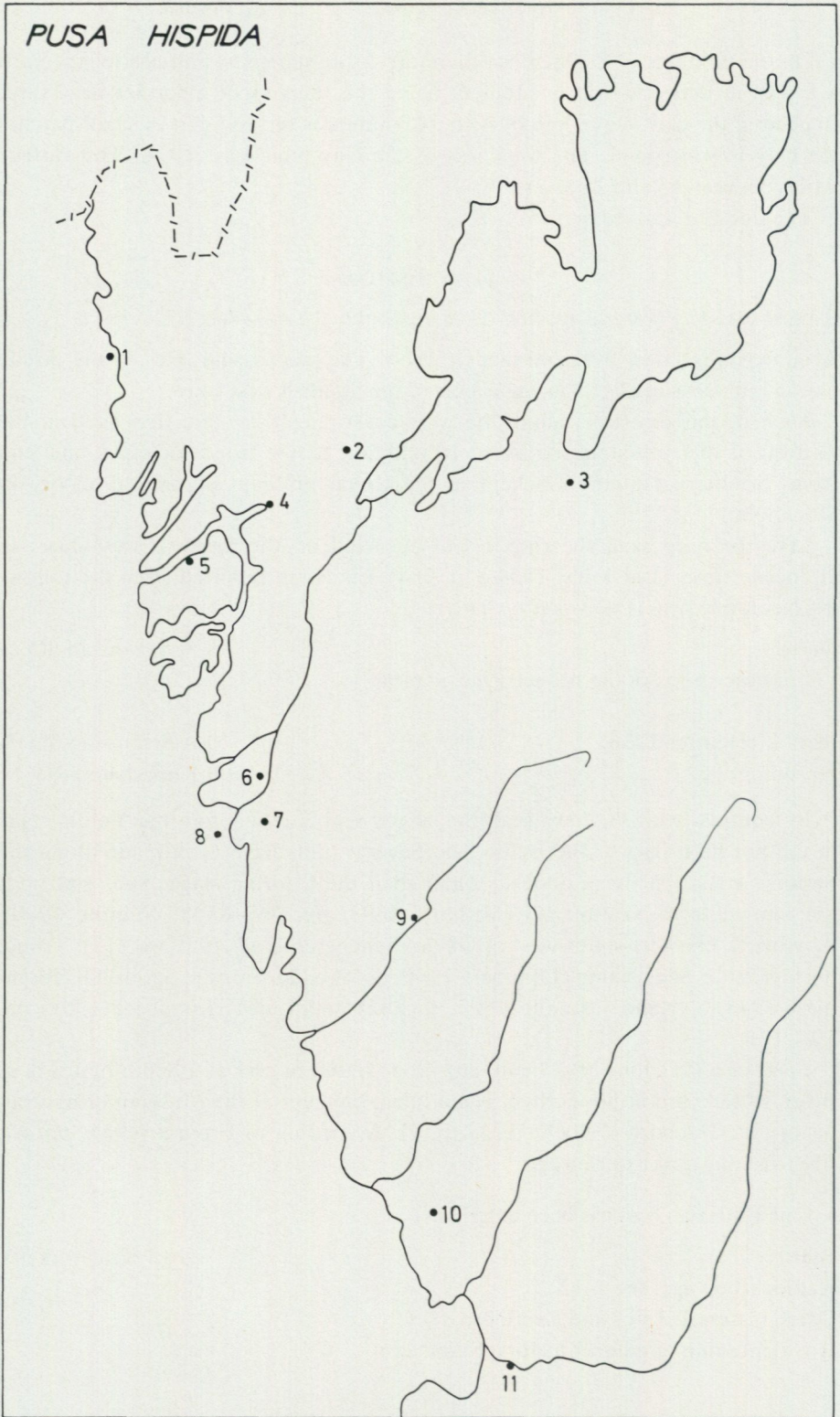


Fig. 12. Locations of subfossil finds of ringed seal. Numbers according to descriptions in text.

At a depth of 2.2 m in bluish clay parts of a skeleton were found in 1961 at Strinne.

Also there are several finds known from archaeological sites (Nordenskiöld 1901; Almgren 1906; Holmquist 1912; Ekholm 1917; Pira 1928; Lepiksaar 1974).

The above-mentioned localities are not marked on Fig. 12.

1. Otterön 9 A Strömstad SO 2g
Palaeontological Museum, University of Uppsala

Parts of a skeleton collected by Prof. Hessland and identified by Lepiksaar (1964) *cf.* the age of *Pagophilus groenlandicus* on p. 42.

2. Frändefors 8 B Vänersborg NO 8i
NMG coll. an. 2051

Part of a shoulder-blade was found in 1900 at a depth of 5—6 m. According to the Quaternary map (Fredén 1974) the find must have been discovered in glacial clay. The surface of the flat clay fields varies between 60 and 65 m a.s.l. Finds of harp seal and bearded seal have been made in the vicinity (Hästefjorden, see p. 43 and 37).

3. N. Härene 8 C Lidköping NO 6j
NMG 1974—13 903

Fragmentary skeletal parts of a harp seal were found in 1922 at Rotegårdstomt, 2.5 km south of N. Härene church. At a drilling (diam. 45 cm) *ca* 50 m north-west of the cottage the following stratigraphy was recorded (Nordwall 1924):

0— 1.0 m sand

— 6.0 m clay with thin layers of sand

—21.5 m blue-grey soapy clay, underlain by gravel.

The skeletal parts were found in the clay 12 m below the surface, which has a level of 65—70 m a.s.l. Fragments of the arctic mollusc *Portlandia arctica* were found in the enclosed clay. Rotegårdstomt is situated very close to the northern boundary of the Fennoscandian terminal moraine zone.

Previously, the identification of the subfossil finds were not quite clear. The finds were donated to Skara training school and recently given to NMG where Dr Lepiksaar identified them as belonging to a harp seal.

4. Uddevalla 8 B Vänersborg NO 5f
NMG

In the shellbanks of Bräcke and Kuröd 57 finds, from at least 21 individuals, have been discovered (Lepiksaar 1964, p. 264).

5. Orust 8 B Vänersborg SV 3a
NMG coll. an. 2081

Parts of a skeleton have been found in clay at a depth of 2 m at Svineviken, nearly 6 km north of Röra church. The surface is situated below 15 m a.s.l.

6. Göteborg, Bäckebo 7 B Göteborg SV 2e
NMG coll. an. 8921

In the Göteborg terminal moraine zone, a find was made by Hillefors in a gravel-pit at Bäckebo on the Hisingen island. The subfossil probably had been lying in a shell-bearing deposit at the top of the accumulation, about 70 m a.s.l. (Hillefors pers. comm.). The stratigraphy of the pit and photographs of the shell layers are found in Hillefors's thesis (1969, pp. 154—156).

7. Mölndal 6 B Kungsbacka NV 9e
Radiocarbon age: see p. 12
Dated material: right shin-bone and part of a pelvis-bone
NMG coll. an. 6290

A nearly complete skeleton was found at Toltorpsgatan 35 at a depth of 2.5 m in clay (Jägerskiöld 1935, p. 7; Nybelin 1938 b). The surface lies at about 50 m a.s.l.

8. St. Käsö 6 B Kungsbacka NV 9b
NMG coll. an. 10 150

A skeletal part found at a well cutting on property Käsö 20.

9. Skene 6 C Kinna NV 5c
NMG coll. an. 10 156

At a depth of 6 m fragmentary skeletal parts were found in varved clay during the enlarging of the Skene hospital in 1968. The clay was overlain by a one metre thick layer of gravel. The surface lies between 50 and 55 m a.s.l.

10. Getinge 5 C Ullared SV 0c
NMG coll. an. 7186

At the brickyard the left *radius* and *ulna* were found in clay at 6 m depth. (Nybelin 1944, p. 6.)

11. Laholm 4 C Halmstad SO 3g
Radiocarbon age: see p. 12
Dated material: a vertebra
NMG coll. an. 10 103

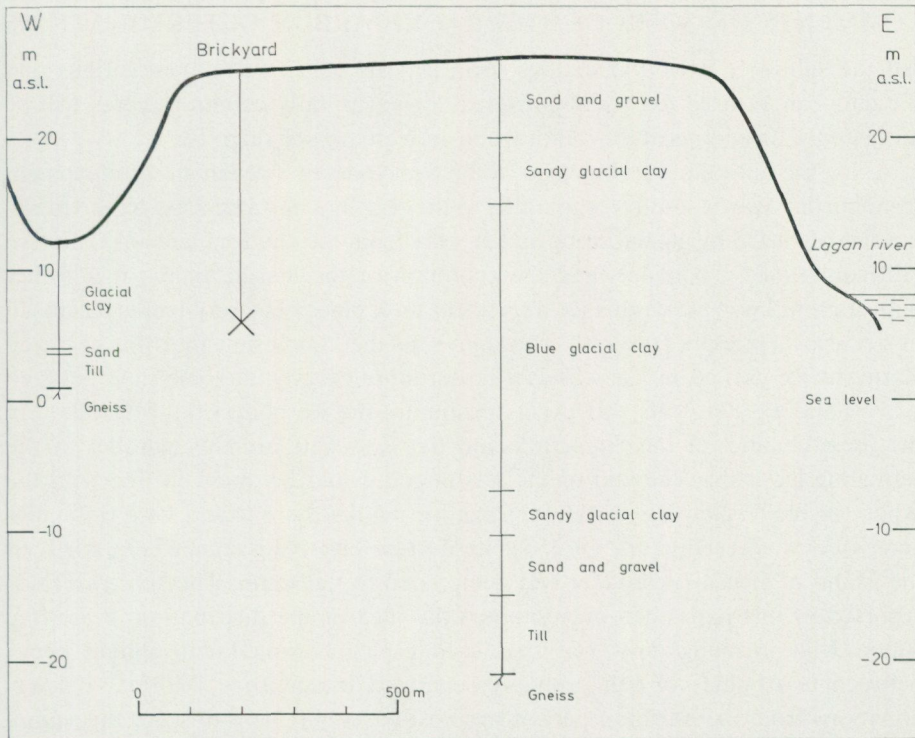


Fig. 13. Section in the east part of Laholm between the ravine at Tivolitorget and the Lagan valley. Finding depth of the ringed seal is marked by a cross. Stratigraphy according to Mohrén & Larsson (1968, pp. 121—122) and levels according to Laholm building office. The location of the section is shown in Fig. 14.

A nearly complete skeleton was found in 1936 in clay at 19 m depth at the former brickyard south-east of the railway station. The surface of the finding-place is around 25 m a.s.l. According to a letter from Dr Jägerskiöld at NMG to the director general of the Geological survey in Stockholm, the find was discovered in a non-varved glacial clay with no signs of shells. In the clay, about 4.5 m above the finding-place, a gravelly layer with shells was visible. According to the building office at Laholm the clay around the clay-pit is overlain by 0.5—3.0 m of sand.

Of all the finds dealt with in this paper the find at Laholm is the oldest and it is also the greatest recorded depth of a subfossil marine vertebrate. No complete stratigraphy is recorded from the clay-pit. A schematic section across the brickyard is shown in Fig. 13. The position of the bedrock is unknown at the actual locality but it seems that the skeleton of the ringed seal might have been found in the lower part of the relatively thick clay layer. Anyhow, the find was underlain by clay which means that sedimentation of clay particles started before the ringed seal was deposited.

The find is further discussed on p. 51.

COMMENTS ON SOME OF THE RADIOCARBON DETERMINATIONS

All the subfossil finds and datings form a basis for further investigations and the data can be used for many purposes. However, only certain features will be discussed. Corrections of the radiocarbon ages are treated on p. 12.

Along the outermost archipelago of the west coast of Sweden an ice movement from north towards south (*i. e.* parallel to the terminal moraine zone on the mainland) is recorded by glacial striae and erratics from the environments of Oslo (see Hillefors 1968). To understand the evolution of the marine fauna, it is rather important to know when this ice movement took place. The problem is discussed in detail by Hillefors (*op. cit.*), who comes to the conclusion that the so-called Kattegatt ice existed in Late-Glacial times, more exactly, at some time between 12 700 and 12 000 years ago. At its maximum the ice body would have lain in the deep channel of the Skagerrak and the Kattegatt, roughly parallel to the retreating ice front. The end of the ice-tongue would be about in line with the mouth of the Viskan River. Between the ice masses there would be a triangular zone free of ice (Hillefors, p. 335), its narrow end lying somewhere north of the island of Orust, its broader end being open to the south. The subfossil finds reported in this paper can only support the idea of the distribution of ice-free water. It is puzzling, however, that such a rich marine fauna should occur between two bodies of ice, probably separated by shelf-ice. More C^{14} determinations from the northern part of the west coast may help to solve this somewhat intricate problem. The possibility that the striae were formed in early Weichsel times is implied by J. Lundqvist (1974, p. 330).

The continuation of the Göteborg moraine (formed during Oldest Dryas times, 12 400—12 300 years B.P.) to the north of Göteborg has been a controversial question due to the lack of distinct ice-marginal deposits in the coastal areas of Bohuslän. There have been several suggestions for the northward continuation of the moraine after it crosses the Göta River Valley at Bäckebo (Hillefors 1969, pp. 154 and 270; Mörner 1969, p. 122). The radiocarbon age-determination, $12\ 500 \pm 240$, 10 550 B.C. (a total correction of 200 years gives the figure 12 300 B.P.), of the find of a Greenland right whale at Edshultshall (see p. 20), indicates that the glaciofluvial deposit at Morlanda (Hillefors 1969, pp. 160—161) on the island of Orust may be included in the moraine zone. This could verify Mörner's (1969, p. 123) assumption that the line of the ice margin roughly should follow Björsjö's (1949) A 3 line.

Beyond the ice front there was rapid sedimentation of clay particles (*cf.* p. 5). The rate of sedimentation during the Younger Dryas Stadial can be estimated owing to the finds of harp seals at Hästefjorden (p. 43). With regard to sources of error, only a rough estimate can be done. During *ca* 600 years around 4 m of clay was deposited. As a mean value, the rate of sedimentation of clay particles can be estimated to slightly more than 0.6 m per 100 years. With a knowledge of the clay thickness, calculations can be made on other finding-places of subfossils.

Due to their weight, the animal or the skeletal parts of it sank into older layers at the time of their accumulation. Consequently the finding depth represents a maximum value for the amount of later sedimentation. By this reasoning it is evident that postglacial clay sedimentation over large areas is rather insignificant or has not taken place. Consequently, glacial clay sedimentation was confined to the valleys from the beginning. As even coarser wave-washed sediments are not present, it is obvious that the bare bedrock landscape has not been covered by deposits, at least not to a great thickness. A detailed discussion of the origin of the bare bedrock landscape in Fennoscandia was published by Rudberg in 1967.

Most of the subfossil finds from the interior areas were discovered at relatively high altitudes. The radiocarbon determinations indicate that the skeletal parts of some of the subfossil whales and seals were deposited close to the ice front. There were minor ice-marginal lines formed during the Alleröd Interstadial, and perhaps in the future these occasional breaks of the ice retreat can be identified (see p. 22). In the vicinity of the South Swedish Highlands varved clays occur (E. Nilsson 1968).

The age of the bearded seal at Grums (see p. 37) is valuable evidence. As varved clays are missing west of Lake Vänern, this is up to now the only absolute date for deposits in this region. No valid conclusions can be drawn on the basis of only one dating, but it is known that the ice retreat from the Fennoscandian terminal moraines to the north was very rapid. (J. Lundqvist 1965, p. 168). In the description of Värmland, J. Lundqvist (1958, p. 17) claimed that the ice retreat was more rapid in the Väner basin than in the highlands west of it. As indicated by the age of the bearded seal, the striae of Värmlandsnäs and in the coastal areas north-east of Lake Vänern (*op. cit.* pp. 12—13), an extensive ice-calving has taken place in the basin.

The two radiocarbon datings from the southern part of Halland are very worthwhile and interesting. As they originate from different times no final conclusions can be drawn. A comparison, however, with Mörner's (1969) deglaciation chronology and Late Quaternary shore-line displacement would not be out of place. For the Laholm plains, Mörner (*op. cit.* Fig. 29, pp. 94—105) has constructed ice-marginal lines and calculated their ages (pp. 108—109). In Fig. 14 Mörner's map is reproduced together with the finding-places and ages of the ringed seal at Laholm and the harp seal at Våxtorp. According to Mörner (p. 96 resp. p. 101) the highest shore-line on the northern slope of Hallandsåsen hill lies at 53 m a.s.l. and at Tjärby nearly 59 m a.s.l.

As is evident from Fig. 14, the dating of the ringed seal at Laholm does not fit very well in Mörner's deglaciation scheme. The age is corrected by —250 years, which is a supposed maximum total value (*cf.* p. 13). By means of one absolute dating no modifications can be applied. It should be noted, however, that Mörner's lines are constructed on the basis of known glaciofluvial and mo-

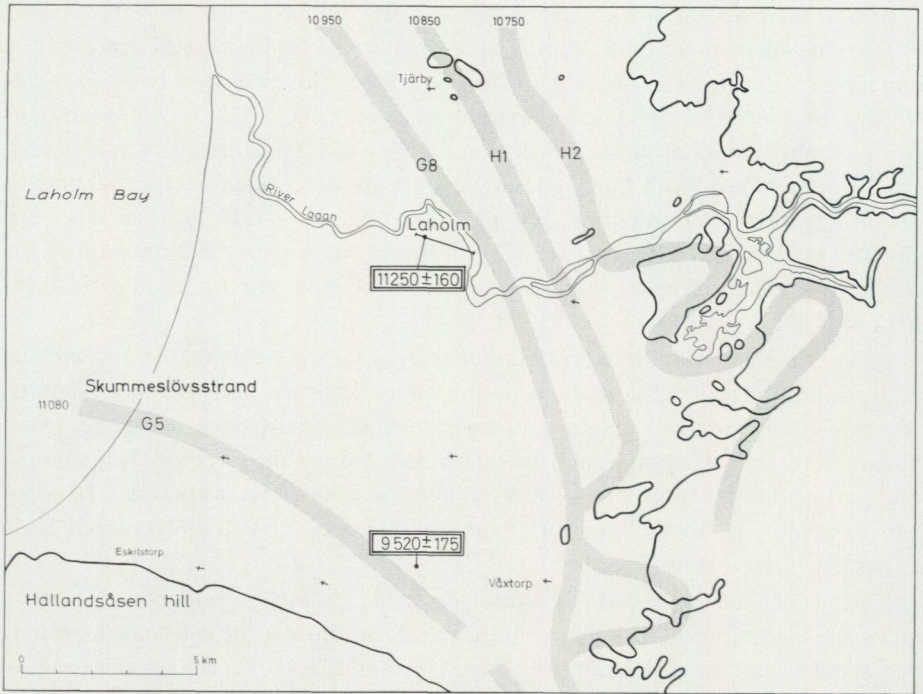


Fig. 14. Locations and ages of the subfossil at Laholm and at Våxtorp, and a reproduced map of ice marginal lines on the Laholm plain as suggested by Mörner in 1969. All ages are in years B.C. The thick line represents the highest shore-line. The section at Laholm is shown in Fig. 13. Godkänd ur sekretessynpunkt för spridning. Statens lantmäteriverk 1975-04-02.

rairie deposits. As these are discontinuous, *e. g.* in the G8 line no deposits are known in the area between Våxtorp and west of Tjärby, there is no support for the idea that they have been formed simultaneously. The broad and flat landscape suggests an early estuary.

The age of the harp seal west of Våxtorp is also interesting. In Fig. 14 the age is corrected by -250 years (see Table 1, p. 13). Unfortunately there is no information of the exact finding-place or of the stratigraphy. The find was unknown by the tenant. It is clear, however, that the skeletal parts were found in the top layer of the clay. The surface of the finding-place probably had a level of around 15 m a.s.l. According to Mörner (1969, Pl. 4) the shore-line level around 9 500 years B.C. falls at *ca* 12 m a.s.l. and around 9 700 years B.C. at *ca* 18 m a.s.l. At Eskilstorp (*op. cit.* p. 333) a distinct shore cut at around 13 m a.s.l. would correspond to a shore-line age of 9 650 years B.C. (*op. cit.* p. 166).

As is seen from the discussion, there is a substantial lack of subfossil skeletal parts in the southern part of Halland.

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APPENDIX

**Radiocarbon determinations of miscellaneous subfossil finds
of the Swedish west coast**

Abstract. The ages of subfossil finds of miscellaneous species from ten localities along the Swedish west coast have been C^{14} determined.

During the preparation of the inventory of subfossil skeleton parts of arctic whales and seals suitable for radiocarbon measurement (Fredén 1975), it was noted that there were other subfossil finds of which the radiocarbon ages would be of geological and zoological interest.

Of the dated species (Table 1), seven are to be regarded as originating in Holocene times, the remaining three in Late-Glacial times (see Fredén, p. 7).

Papers concerning the postglacial transgressions on the west coast have been published, for the northern part by Persson (1973), and for the southern part by Mörner (1969).

The localities are shown in Fig. 1. All the dated material is taken from the Museum of natural-history in Göteborg (NMG) and has been checked by Dr Johannes Lepiksaar.

1. Otterön Topographical map sheet: 9 A Strömstad SO 2g

Lagenorhynchus acutus

White-sided dolphin. F: *Lagénorhynche à flancs blancs*. G: *Weisseitendelphin*.

Sw: *Vitsiding*

Dated material: two vertebrae

NMG 1920—3602

A nearly complete skeleton was found in 1920 in a shellbank together with a cranium of *Lagenorhynchus albirostris*, White-beaked Dolphin. F: *Lagénorhynche à bec blanc*. G: *Langfinnendelphin*. Sw: *Vitnos*. (Jägerskiöld 1921, p. 41.) The find of the white-sided dolphin is the only subfossil in Sweden of this species. It is not found living along the west coast. Isolated species have been reported stranded (Lepiksaar 1966, p. 15). As the skeleton was nearly complete the shell deposit is believed to be of about the same age.

2. Uddevalla

8 Vänersborg NO 5f

Halichoerus grypus

Grey seal, Atlantic seal. F: *Phoque gris*. G: *Kegelrobbe*. Sw: *Gråsäl*

Dated material: two vertebrae

Two vertebrae, identified by Lepiksaar, were found in 1959 in either the Bräcke

TABLE 1. Radiocarbon determinations of miscellaneous subfossil finds. Half-life of radiocarbon $5\,568 \pm 30$ years. All determinations were made on bone material and carried out at Laboratory for Isotope Geology in Stockholm. For species concerned no correction for the apparent age of sea water is applied.

Nr	Lab.nr St	Species	Locality	Greenwich		Age in years \pm stat. err.	
				Lat. N	Long E	B.P.	B.C.
1	4050	<i>Lagenorhynchus acutus</i>	Otterön	58°39'	11°14'	7 975 \pm 120	6 025 \pm 120
2	4104	<i>Halichoerus grypus</i>	Uddevalla	58°21'	11°55'	10 170 \pm 215	8 220 \pm 215
3	4062	<i>Cervus elaphus</i>	Nol	55° 0'	12° 4'	3 735 \pm 120	1 785 \pm 120
4	4047	<i>Halichoerus grypus</i>	Göteborg	57°46'	11°56'	10 140 \pm 150	8 190 \pm 150
5	3606	<i>Larus marinus</i> & <i>Larus argentatus</i>	Göteborg	57°43'	11°43'	9 590 \pm 120	7 640 \pm 120
5	3636	<i>Gadus morrhua</i>				8 880 \pm 160	6 930 \pm 160
6	4105	<i>Cervus elaphus</i>	Göteborg	57°42'	11°52'	1 875 \pm 100	
7	4048	<i>Phocoena phocoena</i>	Göteborg	57°44'	12° 1'	7 595 \pm 140	5 645 \pm 140
8	4106	<i>Cervus elaphus</i>	Göteborg	57°42'	12° 0'	3 810 \pm 115	1 860 \pm 115
9	3583	<i>Halichoerus grypus</i>	V. Frölunda	57°40'	11°56'	9 410 \pm 100	7 460 \pm 100
10	4061	<i>Phocoena phocoena</i>	Kyvik	57°33'	11°57'	10 880 \pm 350	8 930 \pm 350

or Kuröd shellbank. A subfossil find of a white whale, found in the Bräcke shellbank, yielded similar age (Fredén, 1975, p. 14).

The grey seal is known subfossil from the end of the Younger Dryas period and finds are common at Mesolithic and Neolithic sites (Lepiksaar 1964, pp. 258, 265). See also locality 4 and 9.

3. Nol

7 B Göteborg NO 5f

*Cervus elaphus*Red deer. F: *Cerf rouge*. G: *Rothirsch*. Sw: *Kronhjort*

Dated material: one vertebra and one rib

NMG 1953—9150

At some distance south of the railway station ditchers found in 1953 a nearly complete skeleton in clay, 30—40 cm below the surface (Nybelin 1954, p. 3). The locality is situated close to the Göta river, 2—3 m a.s.l. See also localities 6 and 8 below and Fredén 1975, p. 33.

4. Göteborg, Tuve

7 B Göteborg SV 2d

Halichoerus grypus

See locality 2 above

Dated material: left shinbone

NMG coll. an. 9516

In 1965 parts of a skeleton were found in blue clay at a depth of 3.5 m near the centre of Tuve at Glöstorp. The surface is situated 23—24 m a.s.l.

5. Göteborg, Hästevik

7 B Göteborg SV 1b

Larus marinus & *L. argentatus*Gulls. F: *Goéland*. G: *Möwe*. Sw: *Trutar*

Dated material: bones of young species

*Gadus morrhua*Cod. F: *Morue*. G: *Kabeljau, Dorsch*. Sw: *Torsk*

Dated material: vertebrae

NMG 1967—12 091

When digging a well in a small dried pond with its surface at 33 m a.s.l. many subfossil parts of skeletons were found in a one metre thick shell deposit overlain by hard packed layers of peat, mostly *Zostera*. The subfossils were identified by Nybelin and Lepiksaar as belonging to grey seals, birds from at least 15 species, both aquatic and terrestrial ones, and to many species of marine fishes.

The locality is situated quite close to the sea in a bare bedrock area on the south-west side of the Hisingen island.

6. Göteborg, Skarvik

7 B Göteborg SV 0d

Cervus elaphus

See locality 3 above

Dated material: a vertebra

NMG coll. an. 8985

Parts of a skeleton found in dredged clay at the Skarvik harbour in 1959.

7. Göteborg, Gamlestaden

7 B Göteborg SV 1e

*Phocoena phocoena*Common porpoise. F: *Marsouin*. G: *Tümmeler*, *Schweinswal*. Sw: *Tumlare*

Dated material: parts of vertebrae and ribs

NMG 1916—2995

Parts of a defective skeleton were found in clay at a depth of 1.8 m in 1916 at the construction works of the workers dwellings at the ball-bearing factory (Jägerskiöld 1917, p. 35; Munthe *et al.* 1923, p. 234). The locality is situated north of Sävån river at a level of 5—10 m a.s.l.

A review of the finds of the common porpoise was published by Lepiksaar (1964, Fig. 2, pp. 12—13). The species today is found along the west coast and in the Baltic basin. Apart from finds at Neolithic sites along the coast of the Baltic, subfossil parts have been found in the shellbanks of Otterön and Uddevalla and in clay at two localities south of Göteborg, Kyvik (see locality 10 below) and Lindome (Lepiksaar, *op. cit.*).

8. Göteborg, Jakobsdal

7 B Göteborg SV 0e

Cervus elaphus

See locality 3 above

Dated material: one vertebra

NMG coll. an. 3560

Parts of a skeleton found 1.8 m below the surface (Jägerskiöld 1917, p. 35).

9. V. Frölunda

6 B Kungsbacka NV 9d

Haliochoerus grypus

See locality 2 above

Dated material: right shinbone

NMG 72—13 404

Parts of a skeleton were found in 1970 at a depth of 5.5 m in clay about 100 m north-west of the Marconi roundabout. The finds were later delivered to the Geological survey and identified by Lepiksaar. The surface of the finding-place lies 15.5 m a.s.l.

10. Kyvik

6 B Kungsbacka NV 7d

Phocoena phocoena

See locality 7 above

Dated material: parts of vertebrae and ribs

NMG coll. an. 1204

In 1874 parts of a skeleton were found during well-digging on the Kyvik's estate. The find was made in clay at a depth of nearly 4 m.

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