

# PROJECT EASTERN SVEALAND: DEVELOPMENT OF THE HOLOCENE LANDSCAPE

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## Abstract

Stratigraphical studies connected with archaeological excavations in the Stockholm region and Eastern Svealand have resulted in a preliminary reassessment of the holocene development. An apparent interaction of climate, shore displacement and altitudes of dwelling sites has been traced. The main aim of the project is to construct a reliable curve of shore displacement for the time period 9 000 B.P. to modern times.

The investigation has started in the Södertörn area south of Stockholm. Reference areas north of Stockholm, north of Uppsala and west of Nyköping have been included in the project.

At present stratigraphical studies combined with diatom analysis, organic carbon measurements and radiocarbon datings are being carried out on sediment cores from 20 lakes in the Södertörn area. The lakes investigated are situated between the altitude of 85 m a.s.l. and down to the present sea-level. Furthermore the study will be completed with vegetational development by means of pollen analysis. Some of the lakes studied also contain varved sediments which can be used for counting and absolute dating.

The investigation is included in the IGCP (International Geological Correlation Programme) 158 B project »Palaeohydrological changes in the temperate zone in the last 15 000 years. B. Lake and mire environments», in which the Stockholm region is a reference area.

## Introduction

A preliminary shore displacement curve for the Stockholm region has been constructed on the basis of stratigraphical investigations carried out in conjunction with archaeological excavations during 1970—1980. An apparent interaction of climate, shore displacement and altitudes of prehistoric dwelling sites has been traced by biostratigraphical studies combined with radiocarbon datings (Miller & Robertsson 1981, 1982, Miller 1982 a).

The material studied was sampled from sites of different character: lakes, mires and archaeological excavation areas. Different methods of sampling were used as these studies range over a decennium. The samples that have been radiocarbon dated are of varying scientific quality and therefore from the geological aspect not very satisfactory. A geologically and chronostratigraphically reliable shore displacement curve has to be based on studies of sites with comparable sedimentological conditions.

The main aim of the project Eastern Svealand is to test the reliability of the preliminary shore displacement curve of the Stockholm region. Sediment samples representing comparable phases of development and lithological composition have to be studied and radiocarbon dated in a uniform way.

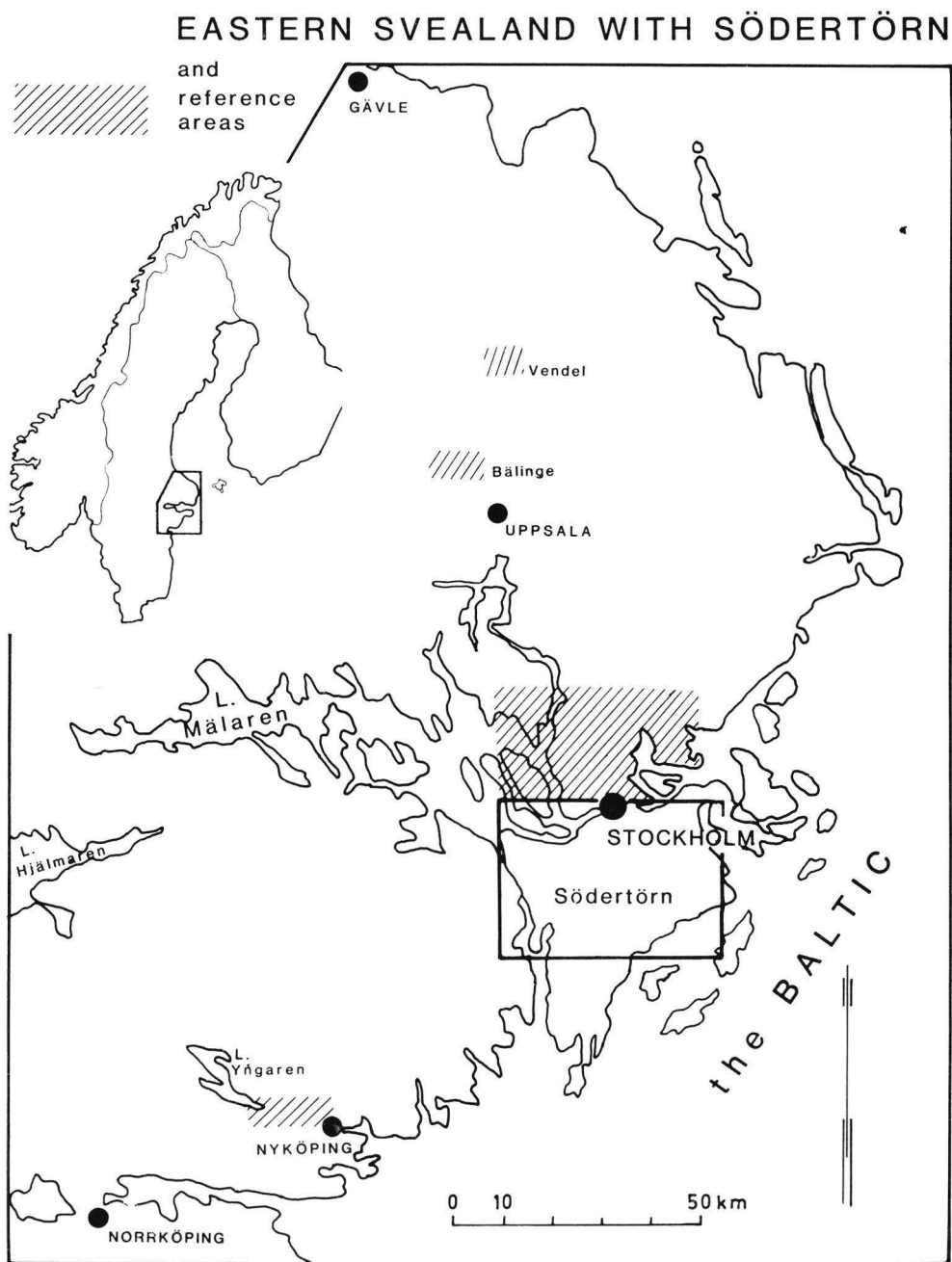


Fig. 1. Location map. Eastern Svealand with the southern Stockholm region (Södertörn) and reference areas: northern Stockholm region, northern Uppland (Bälinge and Vendel) and Nyköping region.

Corrections and calibrations of radiocarbon datings of geological material have to be discussed against the palaeoecological background and compared with archaeological datings on material from coastal dwelling sites. The adaption of the datings

to the geologically reliable shore displacement curve, is one of the main problems in common for both geologists and archaeologists.

### Scope of the investigation and collaboration. (Investigation areas)

At present the geological studies are concentrated on the Södertörn area in the southern Stockholm region (Fig. 1). The next step will be an incorporation of the northern Stockholm region where about ten lake basins are planned to be included in the project.

Several current archaeological excavations and investigations in Eastern Svealand have resulted in intensive collaboration with archaeologists as follows (Table).

Table 1

Site	Archaeological age	Archaeologists collaborators	Institutes
<i>Stockholm region:</i>			
Masmo, L. Albysjön	L. Mesolithic/E.	A. Åkerlund	Central Office of
St. Botvid	Neolithic — Iron Age	E. Olsson	National Antiquities
Helgeandsholmen- Klara Kloster	Iron Age-Medieval	A. Ödman S. Bennett A.-M. Robertson	Stockholms City Museum Geol. Survey of Sweden
<i>N. Uppland region:</i>			
Oxsåtra, Bälinge	Neolithic	A. Segerberg	Archaeological Inst., Univ. Uppsala
Vendel	Iron Age	B. Arrhenius	Archaeol. Research Lab. Univ. Stockholm
<i>Nyköping region:</i>			
Skällsta, Lunda Släbroparken	Late Neolithic- Bronze Age	S. Wigren	Central Office of National Antiquities

Each of these archaeological sites is complemented with studies of adjacent geological sites, mainly represented by lake basins with thresholds around the same altitudes as the dwelling sites and settlements excavated. In this way the shore displacement in Eastern Svealand during the last 5 000 years also will be anchored to the coastal dwellings existing from the transition Late Mesolithic/Early Neolithic to the Medieval times.

Two doctorate projects at the Department of Quaternary Research, University of Stockholm, are incorporated in the project: Jan Risberg with the Södertörn area and Helen Atkinson with the Vendel area. Risberg's study comprises the shore displacement and palaeoenvironmental changes in the Södertörn area during the Ancylus and Litorina stages of the Baltic (9 000—3 000 B.P.). Two lakes, Ådran and Rudträsket, have already been investigated (Annerberg and Risberg (1982; 1984).

Atkinson's study is concentrated to the palaeoenvironmental changes in the Vendel area, northern Uppland, during the last 3 000 years.

The Eastern Svealand Project is included in the International Geological Correlation

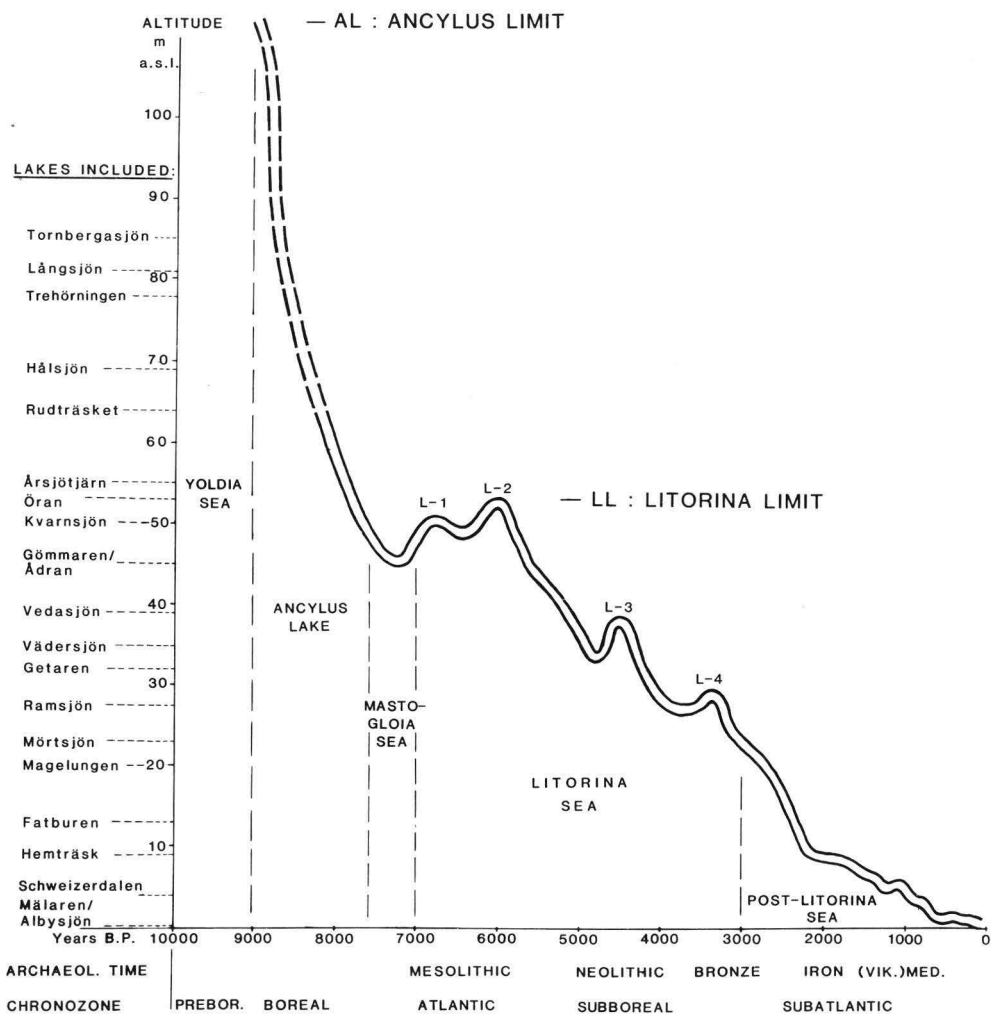


Fig. 2. Preliminary shore displacement curve for the Stockholm region (constructed by U. Miller 1981—84) and the altitudes of the 20 lake basins in the Södertörn area, included in the Eastern Svealand Project.

Programme IGCP Project 158 B (Berglund, 1979): »Palaeohydrological changes in the temperate zone in the last 15 000 years. Lakes and mire environments», in which the Stockholm region is a reference area.

### Material and methods

The Eastern Svealand Project has started with stratigraphical studies of 20 lake basins in the Södertörn area south of Stockholm. The lakes chosen are situated at 5 m altitude intervals from 85 m down to present sea level. Their position in relation to the preliminary shore displacement curve is shown in Fig. 2.

All the lake basins in Eastern Svealand have previously been bays of the ancient Baltic. At their transition from bays to lakes a characteristic isolation phase is regis-

tered in the sediments (Ingmar 1973). It starts with lagoonal conditions, when the threshold at low-water level begins to bar the entrance of sea water to the bay, and ends with the final isolation, when the threshold rises above the level of high water. Generally the isolation layer is assumed to correspond to the transition from minerogenic to organogenic sediments (clay/gyttja contact), which is too rough a generalization. A much more precise development of the lake basin can be reconstructed by diatom-analytical studies of the sediments.

A summarized content of the stratigraphical methods applied to the Eastern Svealand Project is as follows:

- 1) Profile borings using the Russian peat sampler show the stratigraphic sequence of the sediments in the lake basin. It is necessary to avoid *hiatus* in the isolation layers at the point where the cores are taken.
- 2) The cores are studied by diatom and pollen analysis. Measurements of organic carbon content in the sediment cores are carried out. Samples for radiocarbon dating are chosen on the basis of the analytical results.

Diatom analysis indicates the level of the isolation contact in the sedimentary strata. Pollen analysis gives an approximative »dating» of the isolation sediments as the ages of the main vegetational development of the forest history are known (e.g. the isolation took place before the immigration of *Tilia*, in the Stockholm region c. 7 000 B.P.). Diatom analysis combined with organic carbon measurements give the record of sea level (or lake level) fluctuations, i.e. transgressions and regressions or phases of equilibrium, registered in the sediments of the basin studied.

- 3) Exact levelling of lake thresholds is an essential requirement for stratigraphical studies in shore displacement. Preferably basins with narrow and distinct thresholds ought to be chosen.

#### **Discussion on the reliability of the methods. (Sources of error).**

Usually the combination of scientific methods described above is considered to be the most reliable one for constructing the shore displacement curve for a region as Eastern Svealand. Södertörn, where the studies have started has from a geological point of view the advantage of a hilly landscape with lake basins present at most altitudes from 85 meters down to present sea-level. The numerous sites available, within a geographically limited area at close intervals of height, give a reliable background material for checking the datings of the guide levels by comparing the values between different sites within the area.

The composition of the diatom flora is very sensitive to changes in environmental conditions (salinity, acidity, pH, water depth, transparency, turbulency, erosion, redeposition, etc.). By means of diatom analysis these changes can be traced in the sedimentary strata (Miller 1981).

Another methodological advantage is that the topographical and stratigraphical studies of the sites and analysis of the sediments are performed in a uniform way.

Nevertheless there exists several disadvantages and sources of error which have to be taken into consideration.

- 1) Redeposition of diatoms by erosion (waves, winds, human and animal activities).
- 2) Values of radiocarbon datings are influenced by the reservoir effect in lakes and sea water, bioturbation, isotope fractioning, natural variations in the content of  $^{14}\text{C}$  in the atmosphere and hard water effect (Olsson 1979).
- 3) The altitude of a threshold is always given as a minimum value as it is difficult to

estimate the degree of erosion. At the levelling of the threshold the type of soil (till, gravel, sand, silt, clay) is of great importance and should always be noted. Rock thresholds are the most reliable, but not often present. Till is considered to be good for levelling. In case of gravel and sand the risk of wave erosion and formation of younger beach sediments has to be taken into consideration. Silt and clay are easily eroded and therefore preferably avoided.

- 4) In Eastern Svealand the difference in the present land uplift in N.-S. direction is greater than in E.-W. direction. For that reason, an investigation area with more or less the same rate of land uplift has to be chosen. That is, the investigation area should be spread out in an east-westerly direction.

### **An outline of coastal dwelling and shore displacement in the Stockholm region (based on earlier investigations and some new preliminary results)**

The main part of the prehistoric settlements and dwelling sites in the Stockholm region have been dependent on the shore displacement caused by the isostatic land uplift and influenced by the eustatic sea-level changes in the Baltic basin. There exists a close connection between the shore level and the altitude of dwelling sites and settlements from the Late Mesolithic to The Mediaeval times (Granlund 1928, Florin 1944, Åse 1970, 1980 a, b, Ambrosiani 1981, 1982, Miller & Robertsson 1981, Miller 1982 a, b).

Four transgressive phases of the Litorina Sea (L 1 — L 4) have been stratigraphically established in the Stockholm region. The two younger ones L 3 and L 4 have also been confirmed by archaeological sites. The oldest dwelling sites known in the Stockholm region were situated at the shore of the Litorina Sea, below the highest Litorina Limit (LL), at altitudes of 40—45 m a.s.l. In the Stockholm region the LL corresponds to the L 2 transgression (50—55 m, about 6 000 B.P.). The oldest dwelling sites are c. 5 000 years old and of the same character as the Early Neolithic Vrå-culture (Florin 1958). The Litorina Sea stage coincides with the Holocene climatic optimum during the Atlantic and Sub-boreal and is characterized by intensive interaction of the eustatic changes of the world sea-level and the isostatic land uplift (Florin 1944). The Middle-Neolithic dwelling sites in the Stockholm region are situated at 30—35 m a.s.l. and dated to 4 500—4 000 B.P. The Late Neolithic and Early Bronze Age (4 000—3 000 B.P.) dwelling sites are of rare occurrence. The few sites known show reversed altitudes, Late Neolithic around 30 m and Early Bronze Age around 35 m (Miller 1973).

The post-Litorina stage of the Baltic started about 3 000 years ago with a climatic deterioration (Sernander 1926, Granlund 1932, v. Post 1933). This is in good agreement with the rapid regressive shore displacement. The shore line, which in the Early Bronze Age was situated at about 30 m a.s.l., as a result of the L 4 transgression, had dropped to c. 10 m a.s.l. in the beginning of the Iron Age about 2 500 B.P.

During the Iron Age and Early Medieval times the rate of the shore displacement slowed down. In the end of the Iron Age (Viking time) there are indications of a minor transgressive phase, which was of importance as a prolonging factor of the isolation of Lake Mälaren from the Baltic. During A.D. 800—1 200 the sea-level fluctuated between 5 and 3 m a.s.l. The final isolation of L. Mälaren was deferred with several centuries to the middle of the 13th century, when a new period of rapid shore displacement started and accelerated during the following centuries (A.D. 1 300—1 500). This agrees well with the climate, which deteriorated markedly. In the beginning of the 16th century the shore line was 1—1,5 m above the present (Miller & Robertsson 1982).

There seems to be an apparent interaction between coastal dwelling, phases of slow

shore displacement rate and favourable climate conditions. A more or less stable sea-level combined with mild climate seems to be the primary requirement for the establishment of a permanent coastal settlement (Miller 1982 a, b).

As seen of the outline given above the landscape of Eastern Svealand is very well suited to interdisciplinary studies of Holocene stratigraphy, archaeology and human geography. The collaboration is of great value for all the disciplines involved in the problems of reconstructing the palaeoenvironment.

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