

<i>Eiszeitalter u. Gegenwart</i>	35	119—133 6 fig., 2 tab.	<i>Hannover 1985</i>
----------------------------------	----	---------------------------	----------------------

Some Preliminary Results on the Early Holocene Shore Displacement in the Oskarshamn Area, South Eastern Sweden

NILS-OLOF SVENSSON *)

Morphodynamics, shore displacement, lacustrine sedimentation, pollen diagram, C14 dating.
South Eastern Sweden, Oskarshamn Area

A b s t r a c t : Pollen and sediment analyzes have been done in two lakes 16 and 26 m above sea level. The beginning of the Preboreal Chronozone is characterized by a regression, probably interrupted by a shortlasting transgression.

A rapid and quite significant transgression correlated with the Ancylus transgression begins ca. 9500 yr. B. P. at both localities. Between ca. 9000 and 8500 yr B. P. the two sites were isolated, but at what altitude this regression ended is not yet known.

[Einige vorläufige Ergebnisse über die frühholozänen Strandverschiebungen im Oskarshamn Gebiet, südöstliches Schweden]

K u r z f a s s u n g : In zwei 16 bzw. 26 m über Meeresspiegel gelegenen Seen sind Pollen- und Sedimentanalysen durchgeführt worden. Der Beginn der präborealen Chronozone ist hier durch eine Regression gekennzeichnet, die wahrscheinlich durch eine kurz dauernde Transgression unterbrochen gewesen ist.

Eine rasche und recht bedeutsame Transgression, die mit der Ancylus-Transgression korreliert wird, setzte in beiden Lokalitäten um ca. 9000 v. h. ein. Zwischen ca. 9500 und 8500 v. h. wurden beide Seen vom Meer abgeschnürt, aber es ist bislang unbekannt, in welcher Höhenlage diese Regression ausgeklungen ist.

Introduction

The early Holocene shore displacement in the vicinity of the investigation area has been studied by MUNTHER (1902, 1904) who during the geological mapping of the Kalmar Oskarshamn area and the island of Öland levelled the beach ridge corresponding to the Ancylus transgression. THOMASSON (1927) divided the early Baltic development in the Kalmar area into phases based on pollen and diatom stratigraphy. In THOMASSON (1935) the phases are further subdivided. On Öland LUNDQVIST (1928) made pollen-analytical dating on organic layers below beach deposits corresponding to the Ancylus Lake, as well as on lake sediments with transgression sequences.

*) Address of the author: N.-O. SVENSSON, Fil. Kand, University of Lund, Dept. of Quaternary Geology, Tornavägen 13, S—223 63 Lund.

KÖNIGSSON (1968) dates the *Ancylus* transgression on Öland with radiocarbon datings on pollen analysed profiles. This paper deals with the preliminary results from two out of several localities that will be used to determine the Late Weichselian and early Holocene shore displacement in the Oskarshamn area. Further work will be done on these two lakes with closer and deeper pollen analyses as well as diatom and grain size analyses. For comparison a study with the same aim is done on the island of Gotland (SVENSSON, in prep.).

The investigated lakes are situated west and southwest of Oskarshamn (Fig. 1) in a hummocky terrain with a granitic bedrock, mostly covered by thin till.

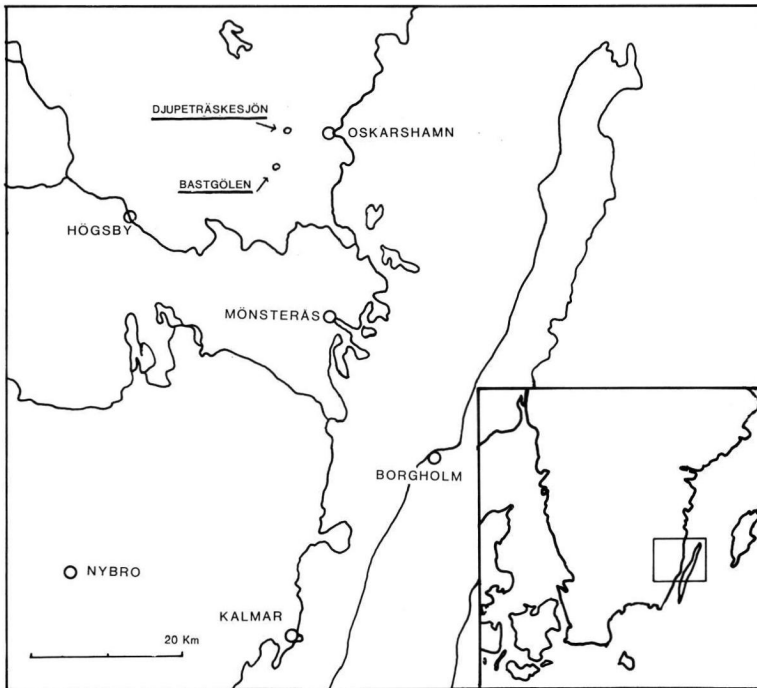


Fig. 1: Geographical position of the investigation area.

Field and laboratory methods

The coring was done by the Russian type of corer. The sediment is described according to TROELS-SMITH (1955). Pollen samples of 1 cc. were taken with a cut syringe, tablets with *Lycopodium* spores were added to determine pollen concentration according to STOCKMARR (1971). Pollen preparation was made in the usual way with NaOH, hydrofluoric acid and acetolysis and mounting in glycerol. During preparation some extra steps were introduced. After boiling in 10% NaOH and centrifuging, the remaining liquid was measured in a colourimeter to determine the relative amount of dissolved humic acids. After the NaOH treatment a careful decanting of the sample was done to separate the coarse minerogenic matter. The amount of this was measured and

used to calculate the content of sand and coarse silt in the sediment. After acetolysis the clayey samples were sieved over a 7 μm net to get rid of finer material. The method is slightly modified after CWYNAR et al. (1979).

The pollen diagrams were computer drawn ('polldata' BIRKS 1979). Pollen sum and the composite diagram is based on all terrestrial pollen.

Indicators of isolation and inundation during early Holocene time

Loss on ignition is a good indicator and it always seems to rise during and after the isolation. The amount of humic acids shown by colour of NaOH extract reacts as 'loss on ignition' on isolation, but seems to be more sensitive.

BJÖRCK (1979) and BJÖRCK et al. (1982) shows that susceptibility reaches higher values just before the isolation, and decreases thereafter. The amount of sand and coarse silt seems to be directly related to susceptibility.

Pediastrum is often a good indicator, increasing close to and after isolation because of a more favourable environment (BERGLUND 1966).

Pollen concentration does also seem to be a good indicator, probably because of the regression bringing the vegetation closer to the coring point, and that the sedimentation rate is normally higher during the Baltic stages thus diluting the pollen.

Djupeträskesjön

(UTM coord. zone 33 x = 634340 y = 57950.)

The lake is situated in a small valley with a narrow outlet, 5 km north of Oskarshamn. The lake area is 110 000 m². Maximum depth in the eastern part is 15 m and in the western bay where the corings were carried out the depth is around 6 m.

The altitude noted on the map 'flygfotokartan' is 16 m a. s. l. and the threshold has not yet been investigated.

Description of the local pollen assemblage zones

Zone D 1 (Fig. 2) named *Betula-Pinus*. Relatively high *Betula*, dominated by *Pinus*, *Empetrum* reaches its highest value in this zone. *Poaceae* and *Cyperaceae* are the dominating herbs.

Zone D 2 named *Betula-Pinus-Hippophaë-Juniperus-Polypodiaceae*. *Betula* is relatively high. The *Hippophaë* maximum and the high *Juniperus* values are characteristic. Spores of *Polypodiaceae* expands here.

Zone D 3 named *Betula-Juniperus*. Characterized by a marked *Betula* peak and high *Juniperus* values. At the end of the zone *Betula* and *Juniperus* decrease markedly and the *Pinus* values increase. *Artemisia* almost disappears at the end of the zone and *Ulmus* attains low values.

DJUPETRÄSKESJÖN

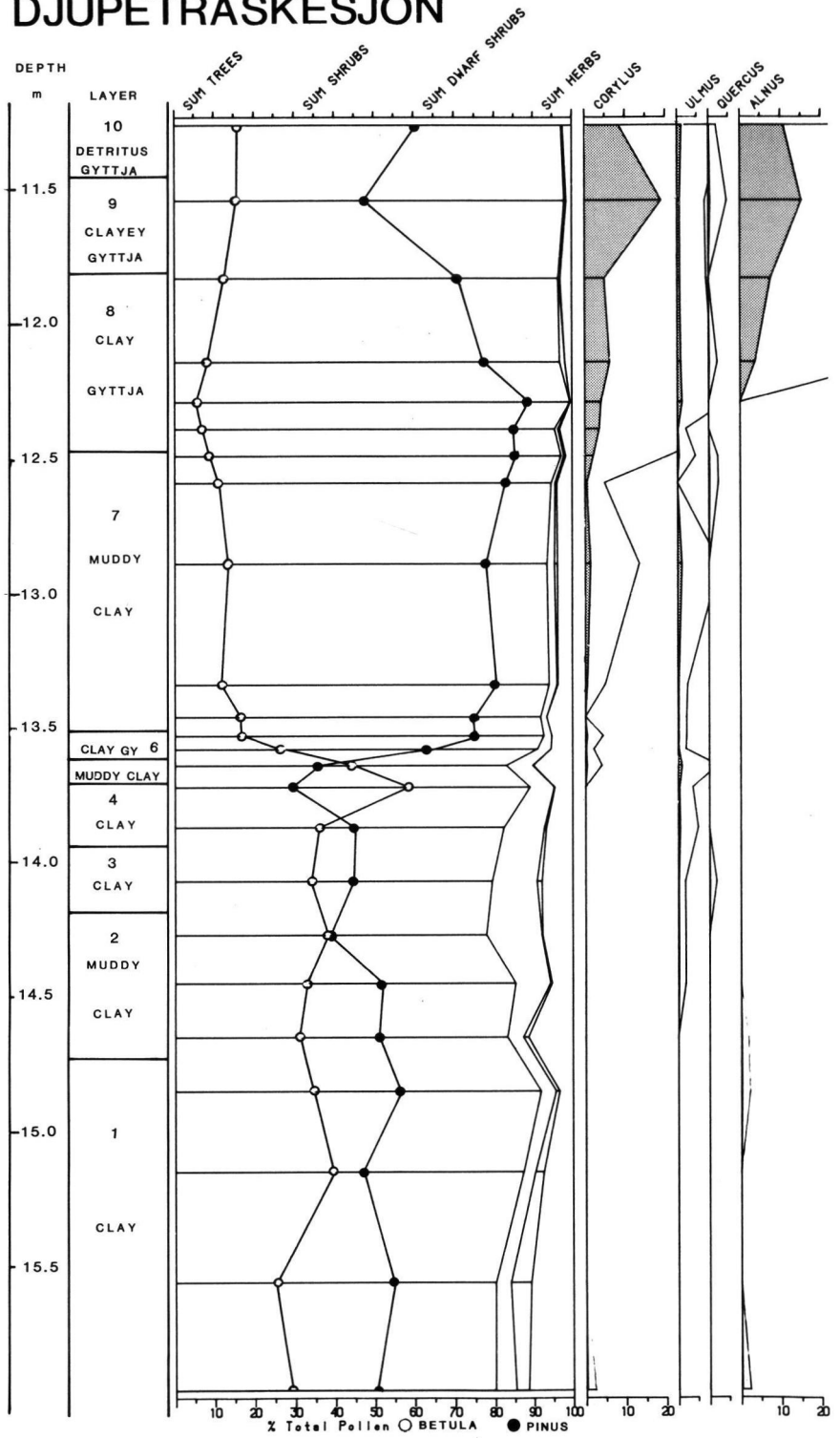
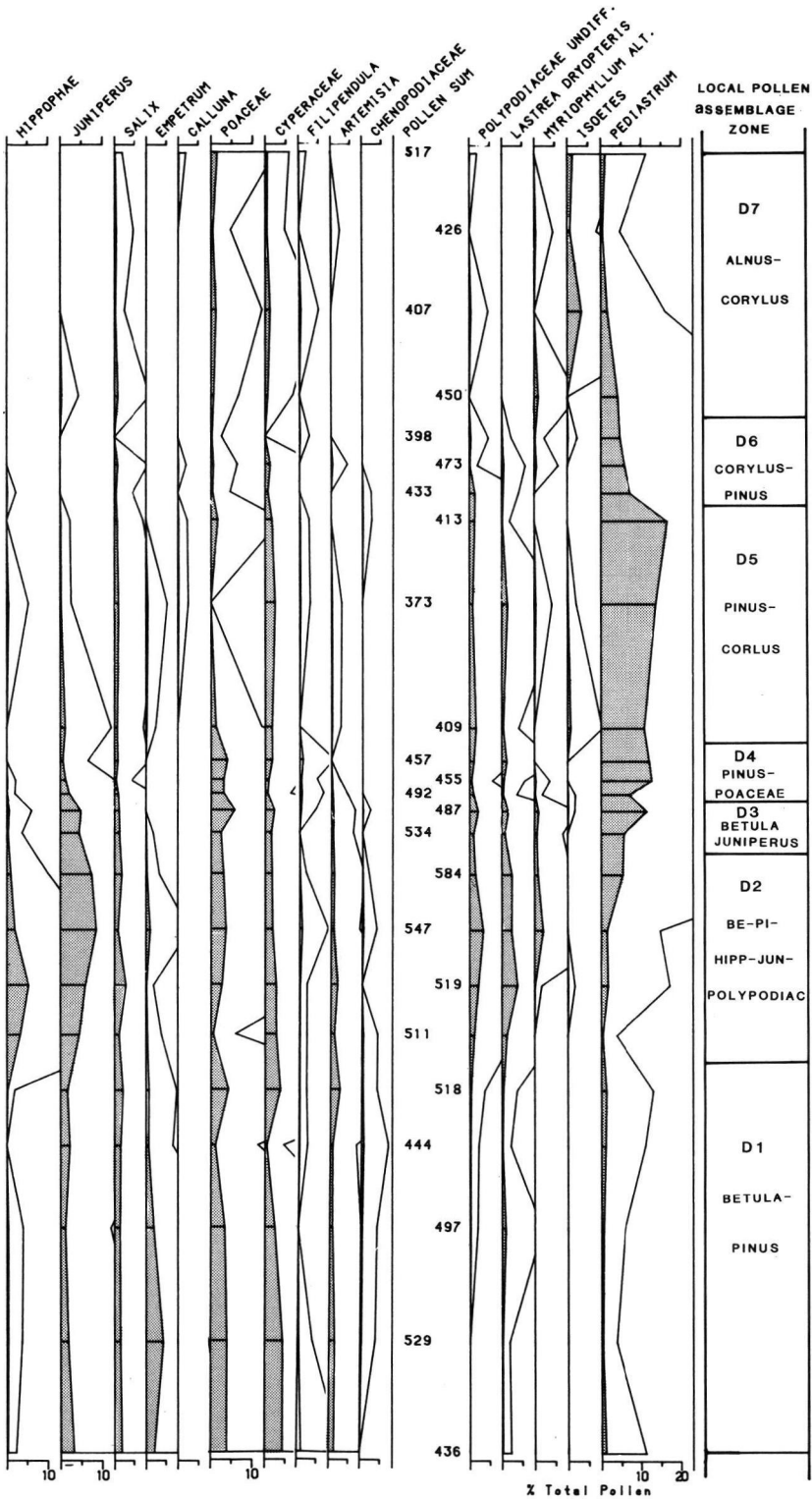


Fig. 2: Pollen diagram from Djupeträskesjön



Tab. 1: Stratigraphy of the Djupeträskesjön cores

Depth below surface (m)	layer no.	Description
0— 6.73		Water
6.73—10.00		Not investigated
10.00—11.45	10	Fine detritus gyttja, brown Composition: Ld 4, elas 2
11.45—11.81	9	Clayey gyttja, brown Composition: Ld 3, As 1, Ag +, elas 2, limes sup. 2
11.81—12.45	8	Clay gyttja, FeS laminated, dark grey Composition: As 3, Ld 1, Ag +, elas 2, limes sup. 0
12.45—13.52	7	Muddy clay, slight FeS laminated, grey Composition: As 4, Ld +, elas 1, limes sup. 0
13.52—13.63	6	Clay gyttja, finely laminated, partly indistinct mean thickness of 24 lamina 0.65 mm, dark brownish grey Composition: As 3, Ld 1, Ag +, elas 2.5, limes sup. 0
13.63—13.71	5	Muddy clay, slight FeS laminated, light brownish grey Composition: As 4, Ld +, Ag +, elas 1, limes sup. 3
13.71—13.92	4	Silty clay, grey Composition: As 4, Ag +, Ga +, Ld(+), elas 0, limes sup. 0
13.92—14.19	3	Clay, slight FeS laminated, grey Composition: As 4, Ag +, Ld(+), elas 0, limes sup. 0
14.19—14.73	2	Muddy clay, Heavy FeS coloured, dark grey Composition: As 4, Ag +, Ld +, elas 1, limes sup. 0
14.73—16.25	1	Clay, with sparse thin diatom layers, grey Composition: As 4, Ag +, elas 0, limes sup. 0
16.25—19.39		Not yet investigated

Zone D 4 named *Pinus-Poaceae*. Dominated by rising *Pinus* values and relatively high *Poaceae* and *Filipendula* frequencies which both decrease at the end of the zone.

Zone D 5 named *Pinus-Corylus*. Dominated by *Pinus* and characterized by low but continuous *Corylus* values.

Zone D 6 named *Corylus-Pinus*. *Corylus* values are rising. *Polypodiaceae* is decreasing.

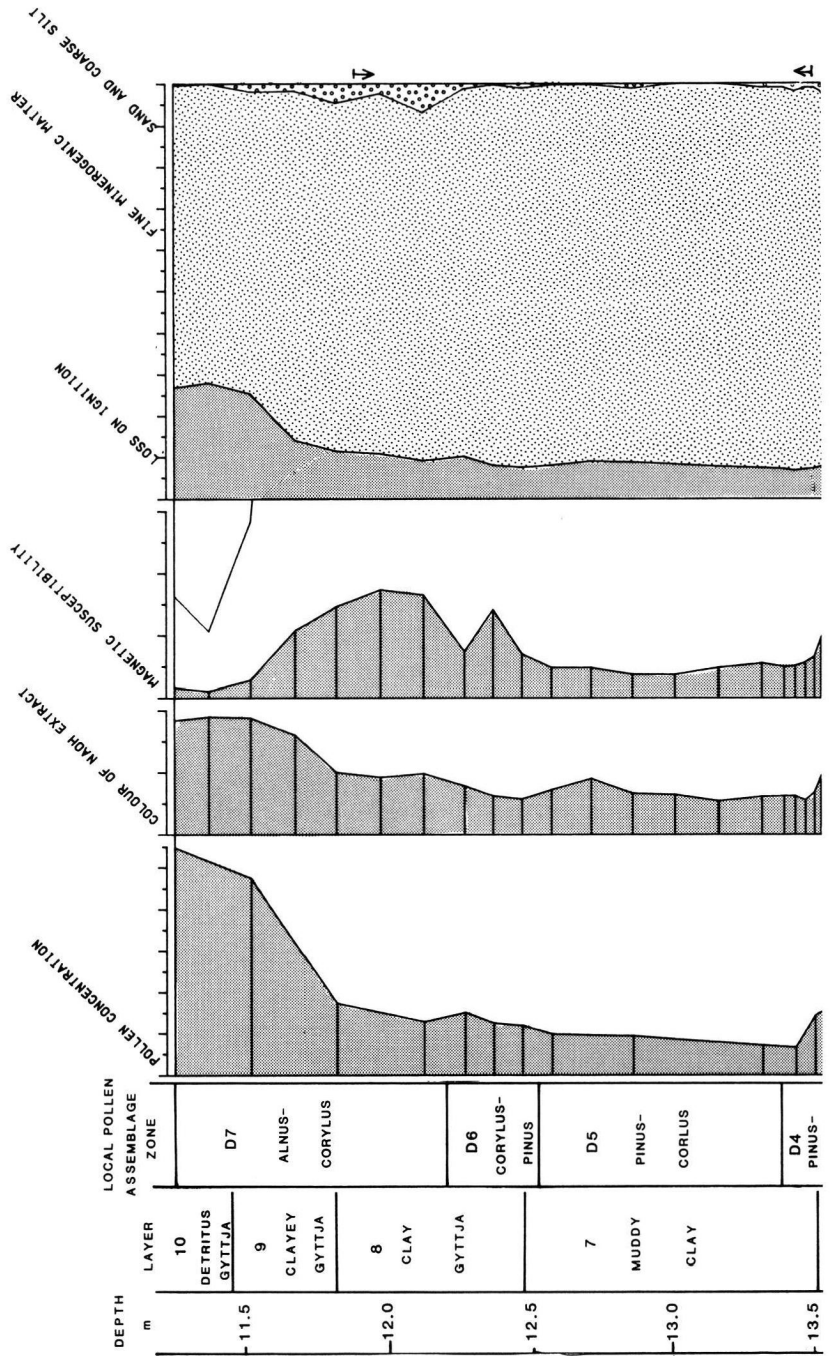
Zone D 7 named *Alnus-Corylus*. Characterized by rapidly rising *Alnus* values and a further increase of *Corylus* frequencies.

Interpretation

The clay in layer 1 (Tab. 1) indicates sedimentation in deep water. Layer 2, muddy clay with a slightly rising organic content (not discernible in the loss on ignition curve) and slightly higher pollen concentration (Fig. 3) together with high values of humic acids and susceptibility, seems to indicate a lower water level in first part of pollenzone D 2. The clay in layer 3 and 4 with low pollen concentration and low susceptibility indicates sedimentation in deeper water thus probably showing a minor transgression.

Tab. 2: Stratigraphy of the Bastgölen cores

Depth below surface (m)	layer no.	Description
0.00—1.20		Water
1.20—3.00		Not investigated
3.00—3.28		Coarse detritus gyttja
3.28—4.74	8	Fine detritus gyttja, brown Composition: Ld 4, Ag +, elas 3
4.74—4.82	7	Clayey silty gyttja, brown Composition: Ld 2, As 1, Ag 1, Ga +, elas 2, limes sup. 1
4.82—4.99	6	Clayey gyttja, brown Composition: Ld 3, As 1, Ag +, elas 3, limes sup. 0
4.99—5.11	5	Fine detritus gyttja, darkbrown Composition: Ld 4, As +, Ag +, elas 4, limes sup. 1
5.11—5.15	4	Clay-gyttja, brown As 2, Ld 2, Ag +, elas 1, limes sup. 0
5.15—5.21	3	Muddy clay, light brown Composition: As 4, Ld +, Ag +, elas 1, limes sup. 0
5.21—5.49	2	Clay, grey Composition: As 4, Ag +, elas 0, limes sup. 1
5.49—6.05	1	Clay, silt and sand in layers, grey Composition: As 2, Ag 1, Ga 1, elas 0, limes sup. 3 Cored to stop



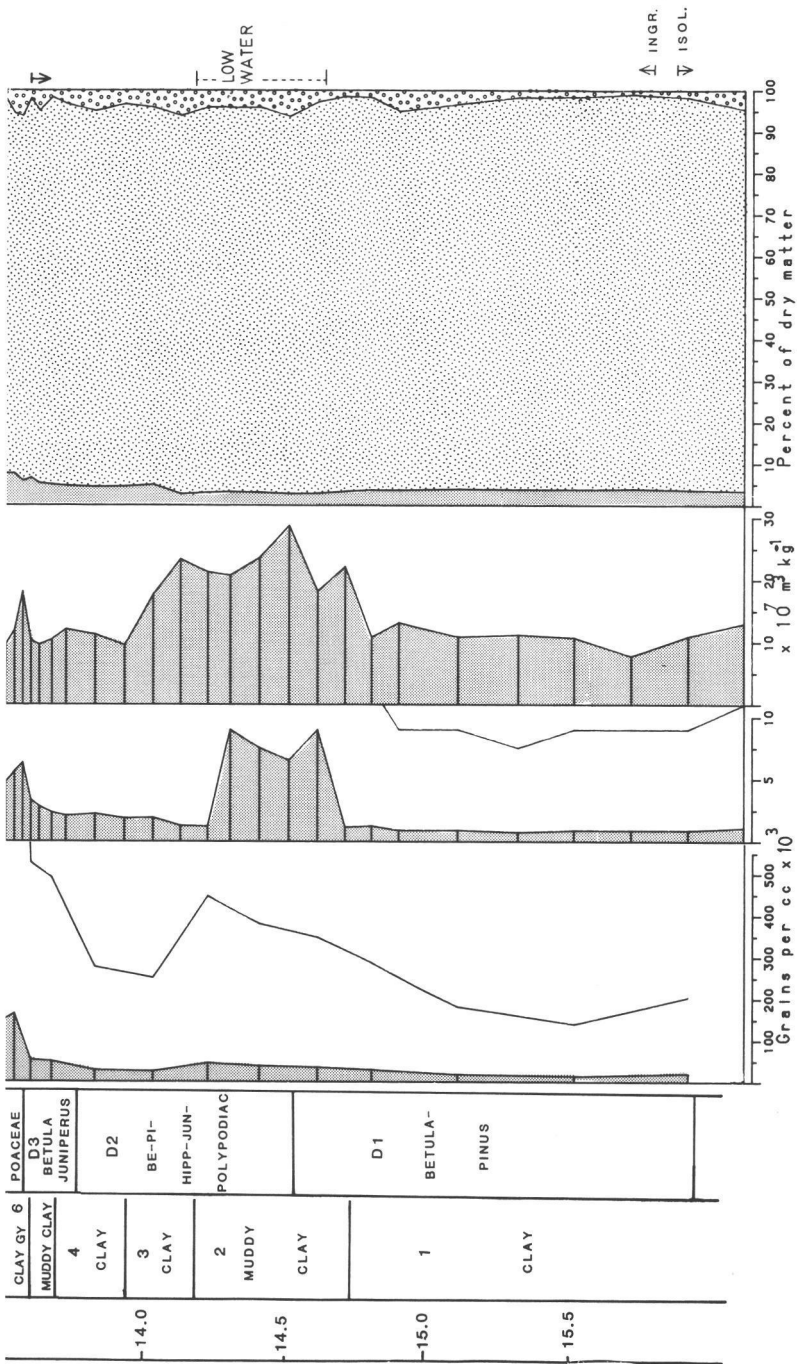


Fig. 3: Sediment properties of Djupeträskesjön.

BASTGÖLEN

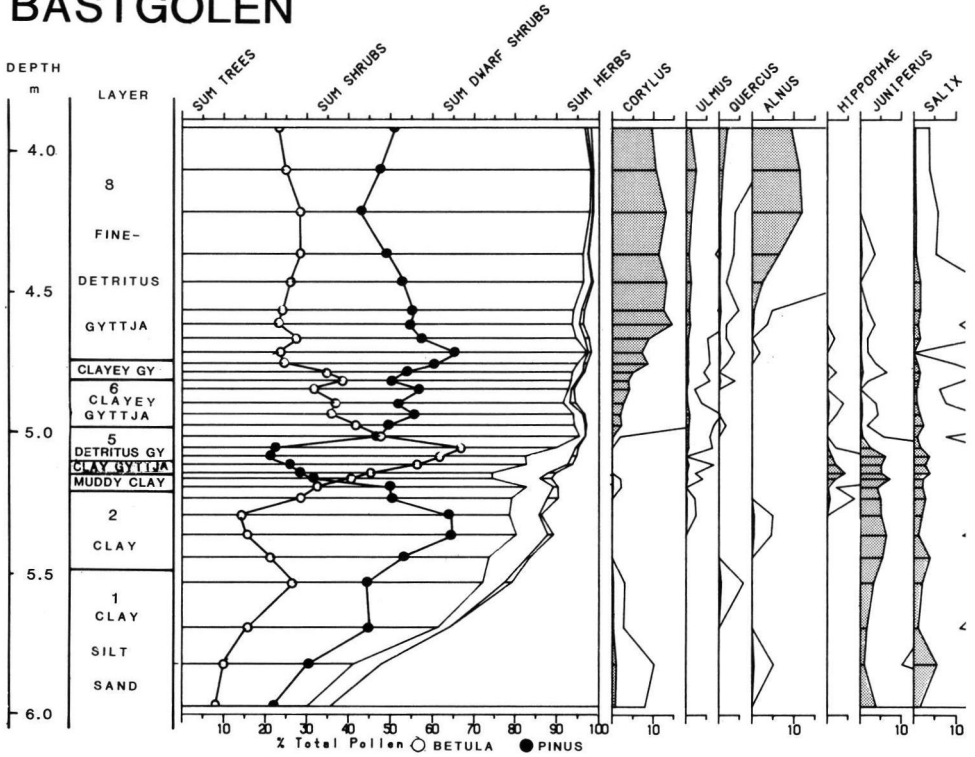


Fig. 4: Pollen diagram from Bastgölen.

In layer 5, muddy clay, the loss on ignition is slightly rising and magnetic susceptibility reaches a peak. It is possible that the basin is isolated from the Baltic in the upper part of this layer, that is in the upper part of pollen zone D 3. The low loss on ignition together with a relatively high amount of coarse minerogenic matter in layer 6 could indicate that the basin was a sheltered lagoon, never completely isolated. The high minerogenic content could else perhaps be explained by erosion of clayey sediments in the surroundings of the isolated lake.

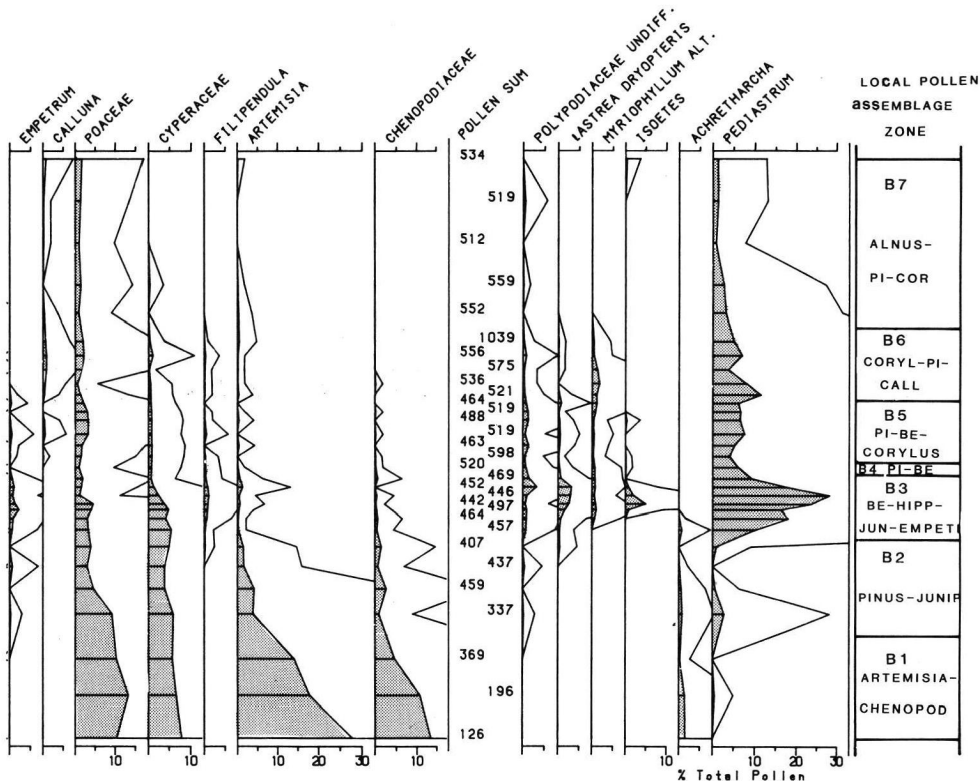
The lamina in layer 6 is interpreted as annual varves, their mean thickness is 0.65 mm indicating that the layer is deposited in 150–200 years.

A transgression of the Baltic into the basin is indicated by layer 7 and layer 8 shows on a more shallow water with an isolation in the upper part, indicated mainly by the rising loss on ignition and the preceding high values of susceptibility. The isolation takes place in pollen zone D 7.

Bastgölen

(UTM coordinates zone 33 x = 634340 y = 57950)

The lake is situated 10 km west of Oskarshamn. The area of the lake is 60 000 m² and the water depth at the coring point in the eastern bay is 1.2 m. The altitude of



the lake is 24 m a. s. l. on the topographic map and the threshold seems to have been deepened with ca. 1.5 m.

Two radiocarbon datings have been done, one in the uppermost part of layer 4, 5.10—5.145 m below surface (9840 ± 90 yr B.P.), the second in the upper part of layer 6, 4.81—4.84 m below surface (9610 ± 90 yr B.P.).

Description of the local pollen assemblage zones

Zone B1 (Fig. 4) named *Artemisia-Chenopodiaceae-Pinus*. High values of *Artemisia* *Chenopodiaceae*, *Poaceae* and low tree pollen values.

Zone B2 named *Pinus-Juniperus*. Rising and high values of *Pinus*, high *Juniperus* and decreasing *Artemisia* values.

Zone B3 named *Betula-Hippophaë-Juniperus-Empetrum*. *Betula* is abundant (70%). In this zone *Hippophaë* has a marked maximum as well as other shrubs (*Juniperus*, *Salix* and *Empetrum*) and *Filipendula*. All these are decreasing markedly towards the upper part of the zone. Spores of *Polypodiaceae* begin to occur frequently at the beginning of the zone. *Ulmus* is found regularly in the upper part. Worth to notify is the occurrence of pollen and spores of waterplants as *Isoetes* and *Myriophyllum alterniflorum* together with high *Pediastrum* values.

Zone B 4 named *Pinus-Betula*. *Betula* is decreasing and *Pinus* increasing markedly.

Zone B 5 named *Pinus-Betula-Corylus*. *Pinus* reaches high values and *Betula* is still decreasing. *Corylus* has relatively low values until the end of the zone where it increases. *Polypodiaceae* almost disappears at the end of the zone.

Zone B 6 named *Corylus-Pinus-Calluna*. Increasing values of *Corylus* and decreasing values of *Pinus*. Scattered pollen of *Alnus* occurs and *Calluna* reaches a maximum.

Zone B 7 named *Alnus-Pinus-Corylus*. *Alnus* occurs frequently and increases in the upper part of the diagram where some finds of *Tilia* and *Fraxinus* occur together with increasing but low *Quercus* values.

Interpretation

The rising loss on ignition values and the maximum in susceptibility (Fig. 5) together with the *Pediastrum* rise show that the isolation takes place in layer 4 of pollen zone B 3.

The sediment change between layers 5 and 6 (Tab. 2) with decreasing loss on ignition shows a transgression of the Baltic during the first part of pollen zone B 4.

The second isolation takes place between layers 7 and 8 indicated by high values of susceptibility and coarse minerogenic matter.

Correlation and dating of the local pollen zones

Datings of the rational limit of *Corylus* and *Alnus* in south Sweden is shown in DIGERFELDT (1982). Ten datings of *Corylus* rational limit between 9720 and 9360 yr B.P. gives a mean of 9500 yr B.P. *Alnus* rational limit is dated by 16 C-14 datings between 9320 and 8420 yr B.P., with a mean of 8700 yr B.P. Ten of those are within the 8500—8900 yr B.P. interval. These mean values of the rational limits of *Alnus* and *Corylus* are used in Fig. 6.

The C-14 date in layer 4 in Bastgölen (9840 ± 90 yr B.P.) dates the upper part of the *Hippophaë* maximum. *Hippophaë* seems to appear approximately at the same time in the whole of S Sweden (cf BjÖRCK 1979, 1981; BjÖRCK & DIGERFELDT 1982).

The dating of the uppermost part of layer 6 in Bastgölen (9610 ± 90 yr B.P.) seems to be too old to indicate that layer 7 is deposited during a long time or partly eroded. A reason for the dating to be too old is that the sediment is deposited in the Ancylus Lake during or immediately after the transgression maximum. This transgression inundates areas with vegetation, mostly *Pinus* and *Betula* forest, and great amounts of older organic material must have been eroded and partly incorporated in the sediment.

Zone B 1, *Artemisia-Chenopodiaceae*, is correlated with zone 5 in Blekinge (BjÖRCK 1979), and its upper part is assumed to be ca. 10 400—10 500 yr B.P. In fig. 6 the local pollen zones are correlated and dated by comparisons and correlations with nearby investigations.

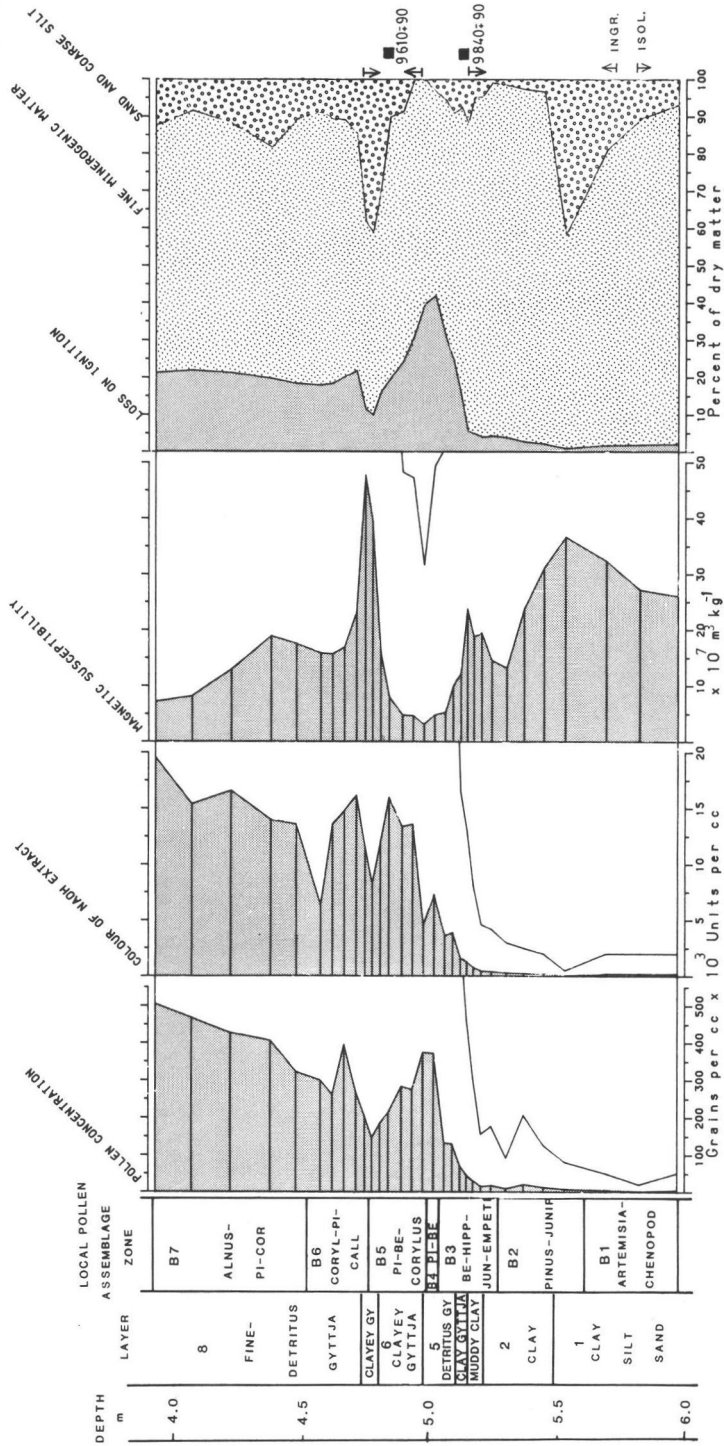


Fig. 5: Sediment properties of Bastgölen.

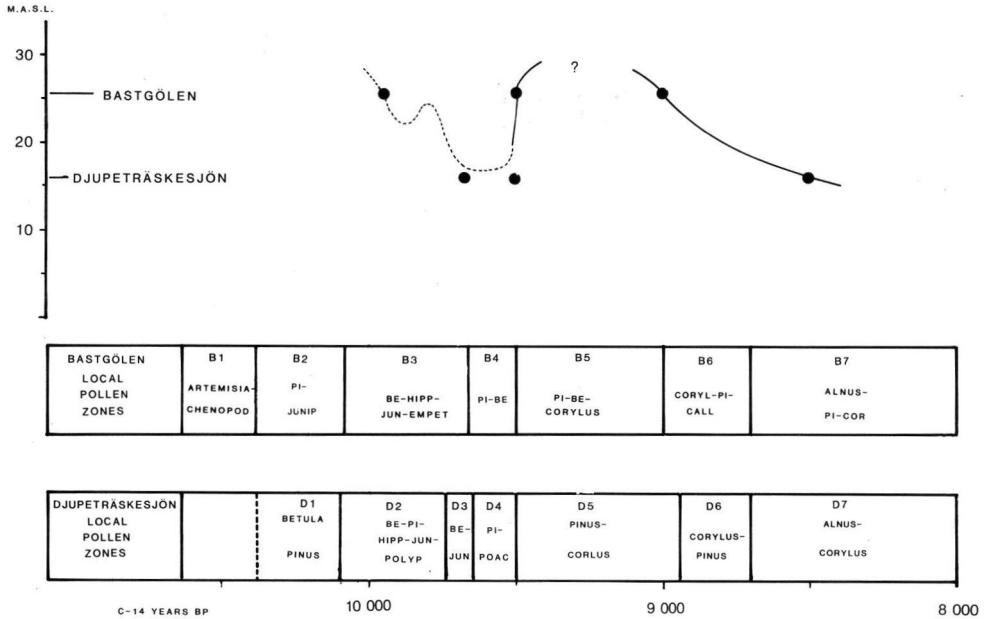


Fig. 6: Correlation and dating of pollen zones and a preliminary shore displacement curve 10,000—8500 yr B. P.

Shore displacement

The resulting shoreline displacement curve is shown in Fig. 6. The oldest part of the curve shows a regression from Bastgölen. This regression seems to be interrupted by a transgression indicated by the stratigraphy in Djupeträskesjön. This transgression could probably be correlated with the transgressive 'Gyrosigmasjön'. THOMASSON (1927), as well as with the Yoldia transgression in Estonia (KESSEL & RAUKAS 1979).

It seems probable that Djupeträskesjön 16 m a. s. l., was never isolated during the following regression. Instead it formed a lagoon during 150—200 years. During this time a varved clay gyttja was deposited.

After this low water period a rapid transgression, correlated with the *Ancylus* transgression reached both Djupeträskesjön and Bastgölen without any discernible difference in time. The transgression took place at the same time as *Corylus* appears. Thus the transgression is dated to ca. 9500 yr B.P. This age corresponds well with Finnish investigations (GLÜCKERT & RISTANIEMI 1982; ERONEN & HAILA 1982) on the *Ancylus* transgression in South Finland. The altitude of the transgression maximum is not known in detail but according to a isobase map in MUNTHE (1904) it should reach ca. 35 m a. s. l.

The *Ancylus* regression seems to begin early, probably around 9000 yr B.P. Djupeträskesjön is isolated around 8500 and the regression seems to have been slow at this altitude.

Acknowledgements

I wish to thank my supervisor Dr. SVANTE BJÖRCK for critically reading and discussing the manuscript and for his help during field work, Dr. PER SANDGREN for field assistance and GUNNEL ARNESSON for improving the illustrations. This work is financially supported by the Swedish Natural Science Research council (NFR).

References

- BERGLUND, B. E. (1966): Late-Quaternary vegetation in eastern Blekinge, southeastern Sweden. I. Late-Glacial time. — *Opera Botanica* 12 (2): 180 pp; Lund.
- BIRKS, H. J. (1979): Numerical methods for zonation and correlation of biostratigraphical data. — In: Project guide I Dept. of Quat. Geol. Lund, I: 99—123; Lund.
- BJÖRCK, S. (1979): Late Weichselian stratigraphy of Blekinge, SE Sweden and waterlevel changes in the Baltic Ice Lake. — Univ. of Lund, Dept. of Quat. Geol. Thesis 7: 245 pp; Lund.
- (1981): A stratigraphic study of Late Weichselian deglaciation, shore displacement and vegetation history in south-eastern Sweden. — *Fossils and Strata*, 14: 93 pp; Oslo.
- , DEARING, J. A. & JONSSON, A. (1982): Magnetic susceptibility of Late Weichselian deposits in southeastern Sweden. — *Boreas*, 11: 99—111; Oslo.
- & DIGERFELDT, G. (1982): Late Weichselian shore displacement at Hunneberg, southern Sweden, indicating complex uplift. — *Geol. fören. Stockh. förh.*, 104: 132—155; Stockholm.
- CWYNAR, L. C., BURDEN, E. & ANDREWS, J. H. (1979): An inexpensive sieving method for concentrating pollen and spores from fine-grained sediments. — *Can. J. Earth Sci.*, 16: 1115—1120; Calgary.
- DIGERFELDT, G. (1982): The Holocene development of Lake Sämbojön. 1. the regional vegetation history. — Univ. of Lund, Dept. of Quat. Geol. Report 23: 24 pp; Lund.
- ERONEN, M. & HAILA, H. (1982): Shoreline displacement near Helsinki, southern Finland during the Ancyclus Lake stage. — *Ann. Acad. Sci. Fenn.*, ser. A III, 134: 111—140; Helsinki.
- GLÜCKERT, G. & RISTANIEMI, O. (1982): The Ancyclus transgression west of Helsinki South Finland-A preliminary report. — *Ann. Sci. Fenn. ser. A III*, 134: 99—110; Helsinki.
- KESSEL, H. & RAUKAS, A. (1979): The Quaternary history of the Baltic. Estonia. — In V. GUDELIS and L. K. KÖNIGSSON (editors), *The Quaternary history of the Baltic*. — *Acta Univ. Ups. Symp. Univ. Ups. Ann. Quing. Cel.* 1: 127—146; Uppsala.
- KÖNIGSSON, L.-K. (1968): The Ancyclus transgression in the Skede mose area, Öland. — *Geol. Fören. Stockh. Förh.*, 90: 5—36; Stockholm.
- LUNDQVIST, G. (1928): Studier i Ölands myrmarker. — *Sver. Geol. Unders.*, C 353: 177 pp; Stockholm.
- MUNTHE, H. (1902): Beskrivning till kartbladet Kalmar. — *Sver. Geol. unders.*, Ac 6: 119 pp; Stockholm.
- (1904): Beskrivning till kartbladet Mönsterås med Högsby. — *Sver. Geol. unders.*, Ac 8: 132 pp; Stockholm.

- STOCKMARR, J. (1971): Tablets with spores used in absolute pollen analysis. — *Pollen et Spores*, **13**: 615—621; Paris.
- THOMASSON, H. (1927): Baltiska tidsbestämningar och baltisk tidsindelning vid Kalmarsund. — *Geol. Fören. Stockh. Förh.*, **49**: 21—76; Stockholm.
- (1935): Äldre baltiska skeden. — *Geol. Fören. Stockh. Förh.*, **57**: 599—625; Stockholm.
- TROELS-SMITH, J. (1955): Karakterisering af løse jordarter. — *Danm. Geol. Unders. IV. series Vol 3 no 10*: 38—73; København.

Manuscript accepted October 1984