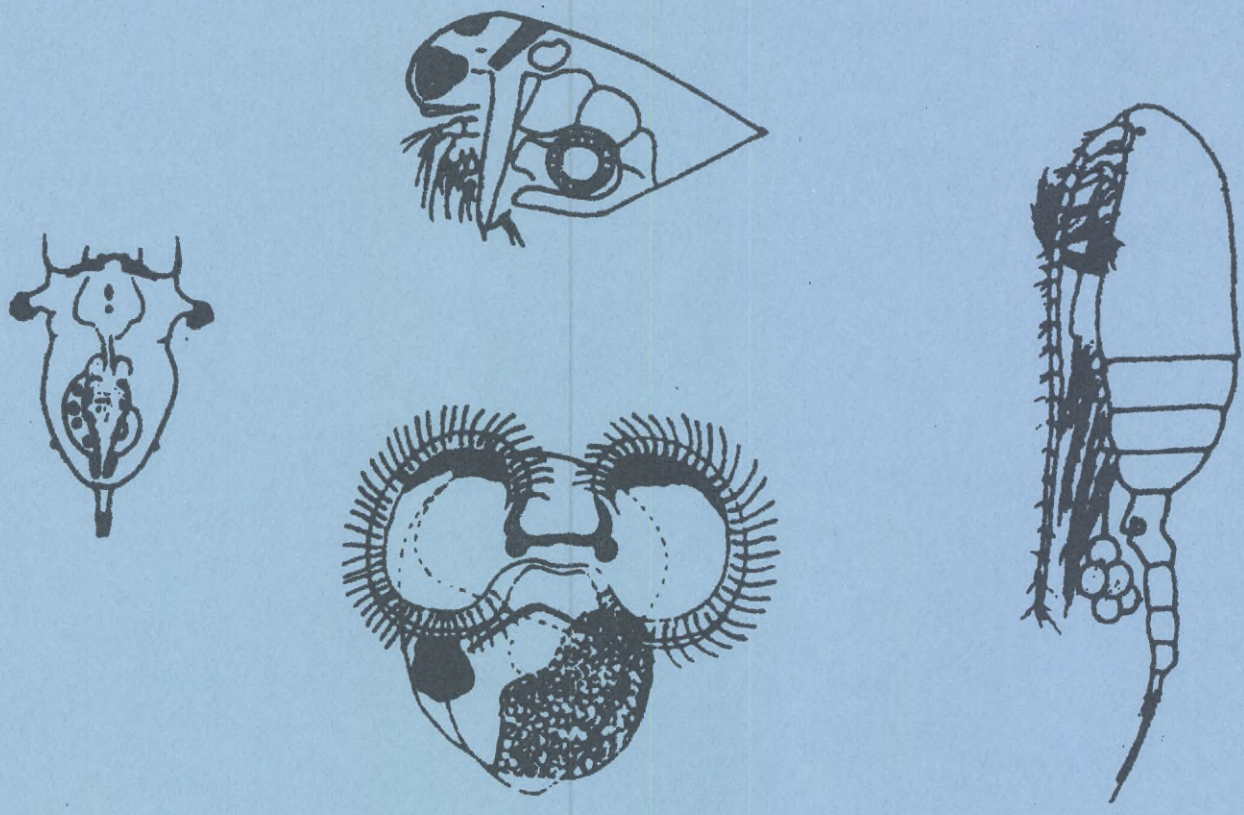

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186

Studies on the primary and secondary production of plankton in the Baltic

(Contribution to ICES "Annales Biologiques" No.31)

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Primary production, chlorophyll and phytoplankton studies were carried out at four offshore stations in the Baltic from the Hanö Bight in the south (N 55°40' E 15°20') to Sydostbrotten in the north (N 63°25' E 20°20')(fig.1). The sampling occurred at 50 occasions from February to November in 1973.

The winter was comparatively mild in 1973 and the water temperature was in general higher than previous years. No fast ice occurred in the winter. The summer temperature was in the range of 14-20°C. The salinity was rather homogenous from surface down to 20 m depth and fluctuated at the various stations and seasons between 4.5 and 9.5 ‰.

The primary production was measured with the ^{14}C-technique in situ using 4-hours incubation-time at 10 depths. The production at the most southern station in the Hanö Bight (station 1) was 105 g C m^{-2} $year^{-1}$, at station 2 east of Gotland 91 g C m^{-2} $year^{-1}$, at station 3 in the Åland Sea 94 g C m^{-2} $year^{-1}$ and at the most northern station (station 4) 71 g C m^{-2} $year^{-1}$ (table 1). The third quarter of the year (July-September) was the most productive or about 50 % of the yearly production. On cloudy days the maximum production appeared at 1-2 m level and on bright days at 3-6 m level. The main part of the production occurred above the level, where 15 % of the subsurface light was still available; in general above 6-12 m level. Below 20 m level the production was negligible. The maximum production at any level was 10.3 mg C m^{-3} h^{-1} and the highest daily production was 725 mg C m^{-2}, which occurred in August.

The chlorophyll values were in the magnitude 10-20 mg m^{-2} at the three southern stations and 20-30 mg m^{-2} at the most northern station. In March, April and May the values were higher at the two most northern stations where maximum values of 50-60 mg m^{-2} appeared.

The phytoplankton biomass was very low at the two southern stations; on most sampling occasions in the range 1-2 g m^{-2} (wwt). At the two northern stations there were a conspicuous spring bloom. The biomass fluctuated between 10 and 17 g m^{-2}. The dominating phytoplankton species were the diatoms (Sceletonema costatum, Chaetoceras spp., Thalassiosira baltica, Achnantes taeniata) at station 4, blue-green algae (Aphanizomenon flos-aquae, Nodularia spumigena) at stations 1-3, dinoflagellates (Dinophysis spp., Gonyaulax catenata, Gyrodinium spirale) at stations 2-4 and monads at stations 1 and 3.

In 1974 sampling were carried out 42 times altogether at the same four stations. The winter 1974 was also comparatively mild with ice at sea only in the very northern part of the Bothnian Sea. The summer water temperature in 1974, however, was lower than in 1973 and ranged between 14 and 16°C.

The primary production was measured in the same way as in 1973. The annual production has been calculated: in the Hanö Bight (station 1) 121 g C m^{-2} $year^{-1}$, east of Gotland (station 2) 116 g C m^{-2} $year^{-1}$ and in the Sydostbrotten area (station 4) 70 g C m^{-2} $year^{-1}$ (table 1). It has not been possible to calculate the annual production for 1974 in the Åland Sea since too few measurements have been carried out. Compared with 1973 the calculated production was about 15 % higher at station 1 and 2, while the calculated production at station 4 was almost the same. At the two southerly stations it was the spring bloom which mostly contributed to the increase. At the northern station the spring bloom was lower in 1974 but this was compensated by a higher summer production. In 1974 the third quarter was still found to be the most productive one. The highest daily production measured in 1974 was 976 mg C m^{-2} d^{-1}. This occurred at station 1 in April.

The chlorophyll a fluctuated almost like in 1973. Unfortunately there have until now been no time for phytoplankton biomass and species analyses of the 1974-samples.

In 1974 the zooplankton investigations were concentrated on two main subjects: Methodological questions including both laboratory and field methods and a joint zooplankton biomass investigation. Both investigations were carried out in the mid-western Baltic proper during cruises in May, August and October.

The methodological studies covered comparative sampling with the UNESCO-WP-II net and the Nansen net during different seasons. In order to study the influence of the mesh-size used, three nets were tested on each sampling occasion: WP-II 90 µ, WP-II 200 µ and Nansen 90 µ. The preliminary results show that qualitatively, the WP-II 90 µ and the Nansen 90 µ-net sampled the same species and size-fractions while the WP-II 200 µ-net missed 96-100 % of the nauplii and rotifers caught in the 90 µ-net.

Quantitatively, rather large differences were observed between the different nets and mesh-sizes. The biomass, which was calculated according to the displacement volume technique, was at all times highest in the WP-II 90 µ-net. The values from the WP-II 200 µ-net were about 20 % less while the

values from the Nansen 90 µ-net fluctuated between 25-70 % of the WP-II 90 µ values. The differences between the different nets and mesh-sizes were more pronounced in the long hauls (bottom-surface) than in the shorter ones (25-0 m). It was furthermore noticed, that the Nansen 90 µ-net was very sensitive to the amount of phytoplankton present. A phytoplanktonbloom reduced the filtering capacity of the net sharply. This reduction was not as obvious in the WP-II 90 µ-net. This investigation will continue during periods of low productivity since the present results have indicated a reduction of the differences at seasons of low biomass. A Nansen 160 µ-net will also be included in the comparative studies.

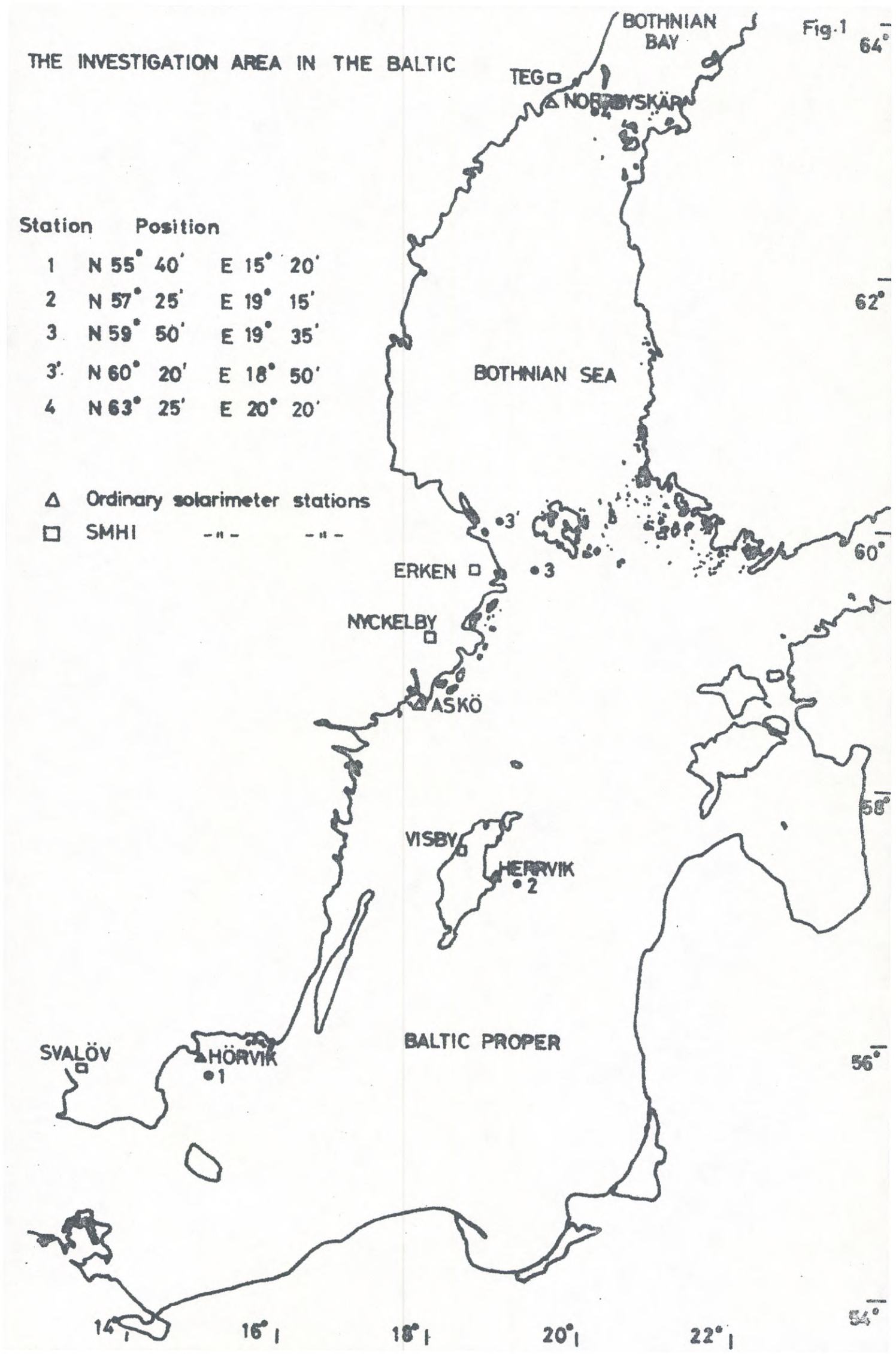
The zooplankton biomass investigation was carried out as a joint program together with other Baltic nations. Oblique hauls with a Bongo-net (300 µ and 500 µ) should be used. Each participating country was responsible for one sub-area of the Baltic proper and the investigations should be concentrated to the months of March, May, August and November. The biomass should be determined according to the displacement volume technique.

The Swedish participation in this program was concentrated to 10 stations in the mid-western Baltic proper. The area was visited in May, August and October.

The mean biomass values for the investigated area were: May 0.019 ml m^{-3}, August 0.091 ml m^{-3} and October 0.049 ml m^{-3}. The dominating species were Acartia bifilosa, A. longiremis, Temora longicornis, Pseudocalanus m. elongatus and Evadne nordmanni. In connection with the oblique Bongo-hauls, vertical hauls with a UNESCO WP-II 90 µ-net were made. The mean biomass values obtained from these hauls were 0.230, 0.497 and 0.235 ml m^{-3} resp. These values are in much better accordance with the authors' previous experience from the Baltic proper than the surprisingly low Bongo-values. The most probable reasons for the low Bongo-values are primarily the coarse meshes of the Bongo-net which permits important groups like nauplii, rotifers and younger copepodites to pass and secondly the fact that the oblique hauls were not always performing a perfect curve from surface to bottom and back to surface. Due to the risk of hitting the bottom the hauls were sometimes rather shallow and as a consequence of this larger part of the Pseudocalanus population was not reached. This species is the largest of the common copepods in the Baltic proper and thus of great importance to the biomass.

Table 1. Primary production was measured at four stations in the Baltic (see fig. 1) in 1973 and 1974. The figures show the quarterly and yearly production in g C m^{-2}.

	I quarter		II quarter		III quarter		IV quarter		The yearly production	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
Station 1	6	8	34	50	53	54	12	9	105	121
Station 2	4	6	25	37	50	64	12	9	91	116
Station 3	8	7	37	-	41	-	8	-	94	-
Station 4	3	~0 (ice)	29	17	36	47	4	6	71	70


THE INVESTIGATION AREA IN THE BALTIC
Fig.1
BOTHNIAN BAY
TEG
NORRBYSKÄR
Station Position
1 N 55° 40' E 15° 20'
2 N 57° 25' E 19° 15'
3 N 59° 50' E 19° 35'
3' N 60° 20' E 18° 50'
4 N 63° 25' E 20° 20'
△ Ordinary solarimeter stations
□ SMHI -"- -"-
BOTHNIAN SEA
ERKEN
NYCKELBY
ASKÖ
VISBY
HERRVIK
SVALÖV
HÖRVIK
BALTIC PROPER
64°
62°
60°
58°
56°
54°
14°
16°
18°
20°
22°