Ödsmål, Kville sn, Bohuslän

Hällristning
Fiskare från
bronsåldern

Rock carving
Bronze age
fishermen

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On long time variations of phosphorus in Baltic surface water.

by Stig H. Fonselius

September 1980

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18 Sammanfattning av projektet/rapporten (ange gärna målsättning, metod, teknik resultat m m)
Årsmedelvärden för fosfat i Östersjöns centralbäckens omblandade ytvatten har beräknats för vintermånaderna på 36 stationer från 1958 till 1980. Den observerade fosfatökningen från 1969 beskrivs med diagram och möjliga orsaker till ökningen diskuteras

19 Sammanfattningen skriven av
S.H. Fonselius

20 Förslag till nyckelord
Östersjön, ytvatten, fosfatmedeltal, fosfatökning

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On long time variations of phosphorus in Baltic surface water

by

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Abstract: Annual mean values of phosphate in the mixed surface layer in the Baltic Central Basin have been computed for the winter months at 36 deep stations from 1958 to 1980. The observed increase of phosphate from 1969 is described by help of diagrams and possible reasons for the increase are discussed.

During the last 10 years there has been a lot of discussion regarding the possible increasing of phosphate concentrations in the Baltic surface water after World War II (e.g. Fonselius 1969, 1970, 1972, 1976, 1978). In the deep water the trend is easy to see (Fonselius 1969) but in the surface water it is difficult to detect, because the biological activity decreases the phosphate concentration in the photic zone down to values close to zero during the summer. Nehring (1979) used winter values for nutrients in the southern and eastern Baltic surface water at selected stations and showed that a statistically significant increasing had occurred.

In the present paper I have extended Nehrings work to the whole Baltic Central Basin. Annual mean values of phosphate in the mixed surface layer have been computed for 36 deep stations in the Eastern Gotland Basin, the Northern Central Basin and the Western Gotland Basin using only data for January, February and March. Generally only data from a single expedition have been available for every year. The first phosphate values are from 1958 and data exist for almost every year including 1980. Mostly Swedish results have been used, but when available, data from USSR, GDR and Poland have been included. When data from several expeditions have been found, mean values for the winter have been computed. Annual mean values for the three basins mentioned above were computed using the results of January, February and March

from the deep stations in the basins. The results are presented in figs 1-3. These mean values were then used for calculating an annual grand mean for the whole Gentral Basin (fig. 4). The results from the Arkona Basin and the Bornholm Basin were excluded from the present paper. The conditions have been described by Nehring (1979) and my results only confirmed his findings. These basins do not belong to the Central Basin and they are more directly influenced by inflows of surface water from the Danish sounds.

From the figures it can clearly be seen that the surface values of phosphate have increased during the last 20 years and that the increasing begun around 1969 in the whole Central Basin. The concentrations during the winter are now at least twice as high as at the end of the 1960ies. Nehring (1979) got somewhat higher results, but this is not surprising, because he only used results from a part of the Central Basin and also included the Gdansk Deep, which is excluded in my work. The extremely high values in 1962 are found at almost every station, but unfortunately these results are all from the same expedition with the R/V SKAGERAK and I have not been able to find any resluts from other countries during that winter, which could confirm the results. Therefore there may exist a possiblility that something was wrong with the calibration or the reagents. The high values, however, appeared during the winter after the turnover of the bottom water in the central Baltic at the end of the long stagnation period 1952-1961 (Fonselius 1962). Such high concentrations of phosphate in the surface water have not been observed later.

The increasing phosphate concentrations in the surface water may change the Baltic Sea from an obligotrophic sea to an eutrophic one. Other nutrient concentrations, e.g. nitrate, have also increased (Nehring 1979) and therefore one would expect an increased primary production in the water. Several authors have also claimed that they have observed such an increased productivity (Fonselius 1972, Sen Gupta 1972, Schulz et al 1974, Niemi 1979). The primary production is regulated by several different factors and therefore one should not expect a doubling

of the production because of a doubling of available phosphorus. The present methods for primary production measurements are not exact enough to establish a trend during the short time the methods have been used.

Several authors (Jansson 1978, Matthäus 1973) have claimed that the increasing stagnant conditions in the Baltic surface water have been caused by Man. This is a very difficult problem to solve. We know that the salinity of the Baltic Sea has increased since the beginning of the century, while the oxygen concentration in the deep water has decreased (Fonselius 1969). The salinity change cannot have been caused by Man, unless Man has changed the climate of the earth. It has been shown (Fonselius 1969) that the increased salinity of the Baltic Sea has caused stagnation in the deep water and that irregular inflows of water with high density cause overturning of the deep water, forcing accumulated phosphate up into the surface layers. Man may also to some extent have contributed to the increasing surface values, but most of this phosphate is certainly removed from the water phase through biological filtering in the near shore areas. The increased salinity is of course caused by inflows from the Kattegat, but this water cannot itself contribute considerably to the increased phosphate concentration. Simple mixing calculations show that the amount of water needed for increasing the salinity by 0.5 ‰, has to have an unrealistic concentration of phosphate in order to double the phosphate concentration in the Baltic surface water. It is more likely that the increasing stagnation prevents phosphate from being deposited in the sediments in the deep water areas. Stagnant basins normally act as nutrient traps, but in the semistagnant Baltic Sea, the turnovers of the deep water occasionally transport nutrient back to the surface layers. The increasing changes between stagnations and water turnovers most probably is the reason for the increasing phosphate values.

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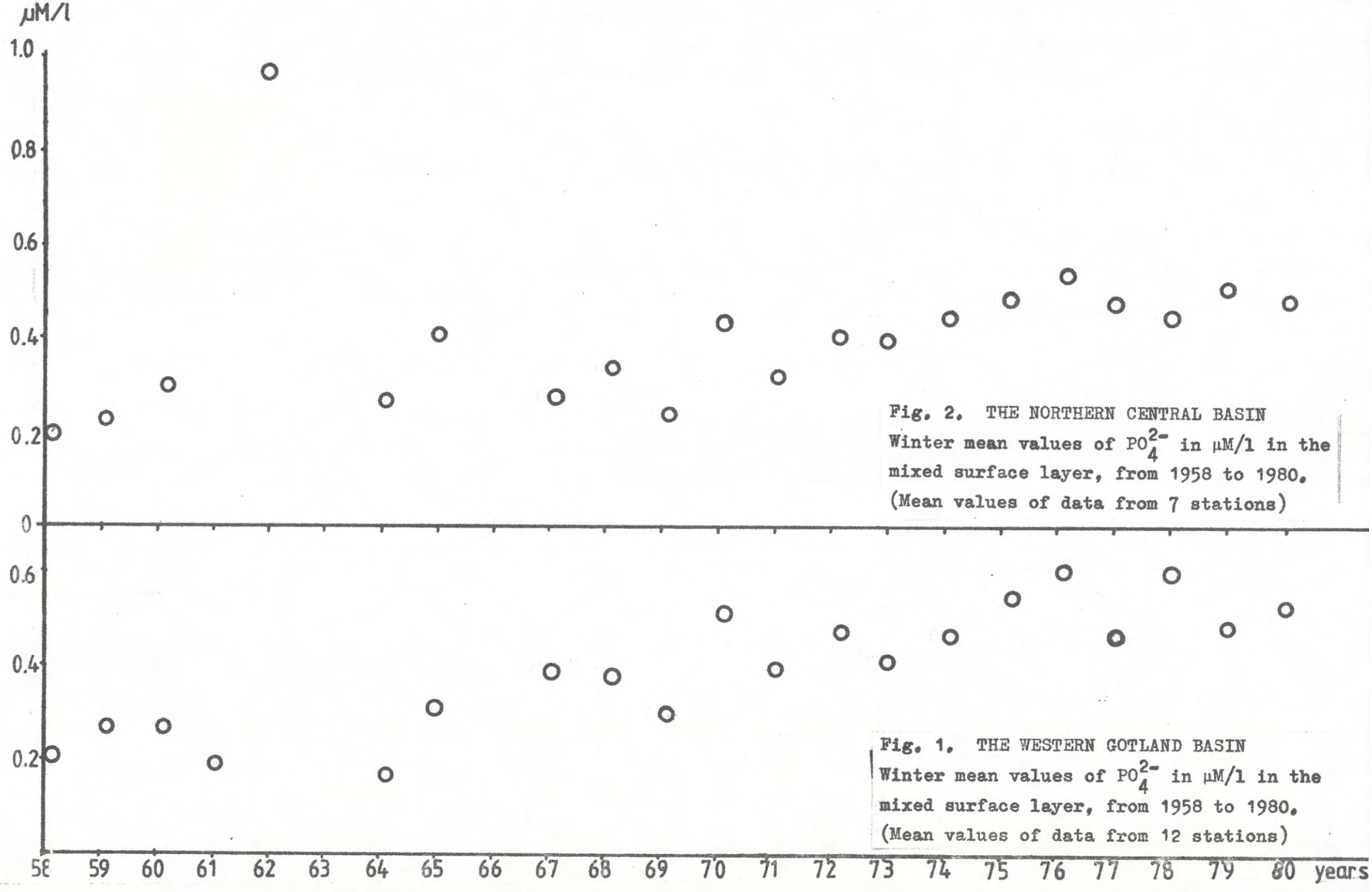

Fig. 2. THE NORTHERN CENTRAL BASIN
Winter mean values of PO_4^{2-} in µM/l in the mixed surface layer, from 1958 to 1980.
(Mean values of data from 7 stations)

Fig. 1. THE WESTERN GOTLAND BASIN
Winter mean values of PO_4^{2-} in µM/l in the mixed surface layer, from 1958 to 1980.
(Mean values of data from 12 stations)

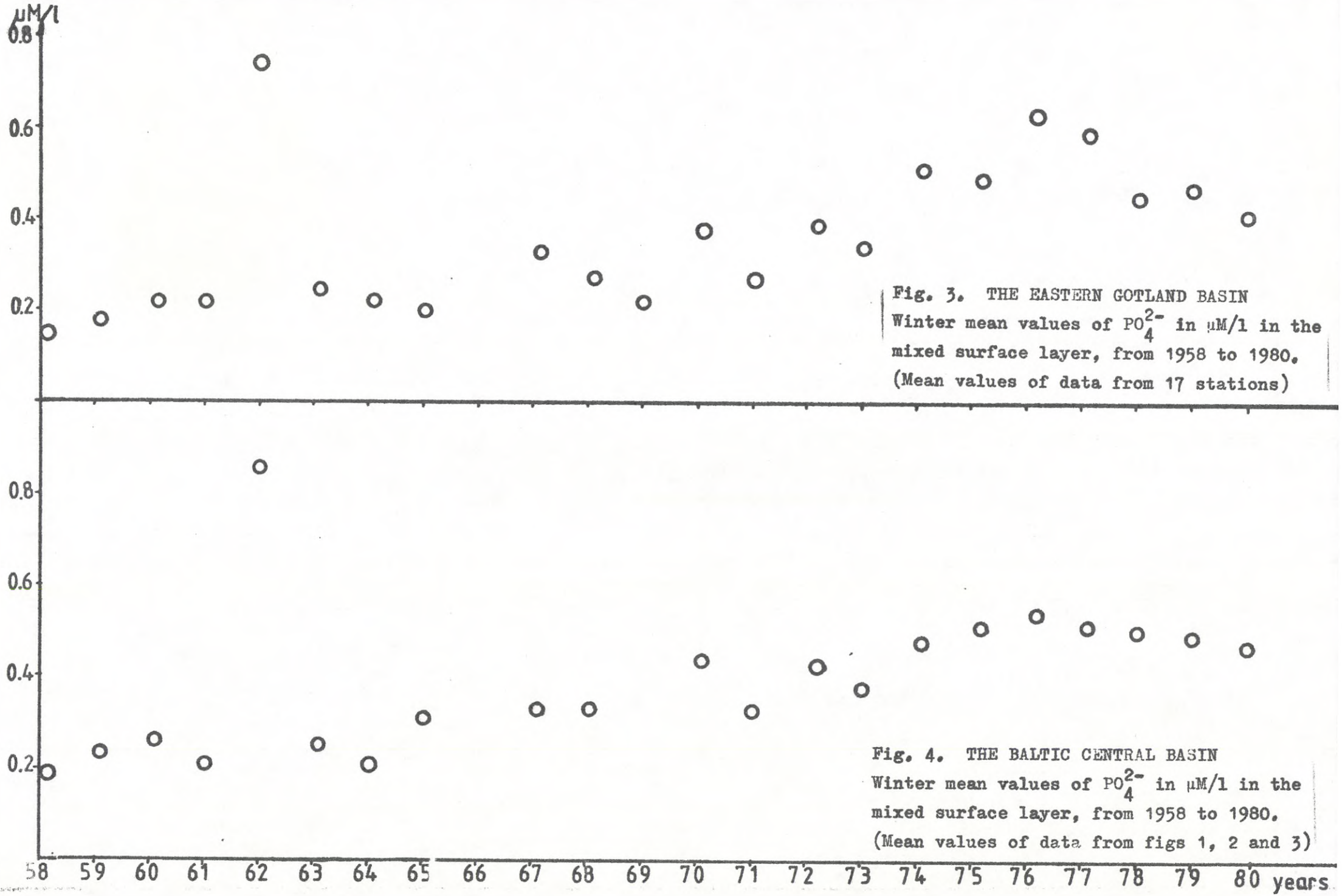

Fig. 3. THE EASTERN GOTLAND BASIN
Winter mean values of PO_4^{2-} in µM/l in the mixed surface layer, from 1958 to 1980.
(Mean values of data from 17 stations)

Fig. 4. THE BALTIC CENTRAL BASIN
Winter mean values of PO_4^{2-} in µM/l in the mixed surface layer, from 1958 to 1980.
(Mean values of data from figs 1, 2 and 3)