Ödsmål, Kville sn, Bohuslän

Hällristning Rock carving
Fiskare från Bronze age
bronsåldern fishermen

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Biological views on oceanographical investigations in the Baltic.

By

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The Baltic Year 1969. - A thorough knowledge of the hydrography of the sea is very important for fishery biologists (and, indeed, for all marine biologists). The occurrence of fish, the primary production and nutriment production in general are dependent on environmental conditions. For the biologist descriptive hydrography is of prime interest, while the hydrographer studies preferably the causal connections of physical and chemical phenomena. To elucidate fishery-biological problems, however, greater co-operation is urgently needed between hydrographers and biologists. When we are concerned with descriptive hydrography, increased international collaboration, use of automatically registering hydrographic stations and data processing of the material make new research advances possible. The Baltic is an ideal study object, and co-operation between the countries surrounding it is well-established through the International Council for the Exploration of the Sea (ICES) and the Conferences of the Baltic Oceanographers (CBO). From the aspect of biology, a project such as the CBO Baltic Year 1969 is therefore extremely stimulating. To test hydrodynamic theories and the like is naturally also important from the viewpoint of theoretical hydrography - although a biologist would appreciate reports of the findings in a language intelligible to him as a layman in this field.

The activities planned for the Baltic Year 1969, with frequent hydrographical surveys of the Baltic proper, will not only facilitate simultaneous studies of plankton etc., but also a study of the relation between fish migration and the hydrographical factors during a year. In the previous ICES Baltic-Belt Seas Committee, I proposed, with this end in view, that a "Baltic Year" should be combined with a large-scale cod tagging in the whole of the region concerned. In Sweden we are prepared to begin tagging in December 1968, and to continue during 1969 in collaboration with other countries. The tagging expeditions will be made separately to avoid encroaching upon the hydrographical investigations. It is easy to understand that fishery biologists want as frequent hydrographical surveys as possible. The plans of the tagging project will be discussed further at the ICES meeting in the autumn of 1968.

Thus the Baltic year 1969 will offer posibilities of studying the relations

between c u r r e n t hydrographical and meteorological factors and their effects on the fish and plankton. The biologists have hitherto had to rely upon, so to say, largely "historical" hydrography.

The water exchange at the thresholds of the Belt Sea and the Sound. - Another urgent problem from the fishery-biological aspect is the exchange of water between the Baltic and the regions west and north of the thresholds of the Belt Sea and the Sound. A detailed study of the passage of water especially to and from the Belt Sea between Darsser Ort and Gedser is justified by our incomplete knowledge of the currents, which is based on one-point observations and measurements mainly of surface currents only.

Danish observations made at the Gedser Rev light-vessel (bottom depth c. 20 m) show, as will be seen from Figure 1, that considerable changes have occurred in the salinity near the bottom (15 m) immediately west of the Darsser threshold (17-18 m deep) during the last three decades. Even though we are concerned here with means of monthly means, with great variations between the individual years, the tendency is clear, with a general increase in salinity, during high summer and early autumn up to 3-4°/oo. - The salinity of the surface water also rises during the corresponding period (mainly in September-October, however). A reduction is noted for November, due probably to increased passage of Baltic surface water from the east.

During the first half of the year, surface salinity at Gedser Rev remains largely unchanged between the periods in question. At Drogden light (depth 8 m) south of Saltholm in the Sound, only surface salinity is measured nowadays. It has generally increased somewhat during the past thirty years, most in September to October, and, as at Gedser, a distinct reduction can be observed in November (cf. Fig. 2). There is a decline here during January, too. That the positive changes in surface salinity at Drogden are more dispersed over the months of the year than at Gedser Rev must be related to the greater mixing of the water in the narrow and, in the south, shallow waters of the Sound - surface salinity here being more affected by deep water from the north. For comparison, Figure 2 gives surface salinity at Gedser Rev, where consistently lower values were obtained during summer and autumn than at Drogden - obviously a consequence of smaller mixing of the water in the wider and deeper passage leading to the Belt Sea.

But the salinity figures from a depth of 15 m at Gedser Rev light-vessel reveal another thing. Salinity has not only increased, but has also altered its distribution during the year. In the period 1920-31 it was highest during the winter and spring months and lowest during late summer - autumn. During the period 1931-60 it was highest in summer and autumn, with, however, a marked decline in November.

Figures 3 and 4 give the mean monthly temperatures of different periods at Gedser Rev and Drogden. The temperature, like the salinity, was measured at 8 a.m. Danish time (07.00 GMT). All diagrams of temperature show a rise in the mean temperature 1931-60 during the period summer to early winter, by a maximum of about 1°C (the rise in January is clear only at Drogden). At Gedser Rev at a depth of 15 m the temperature dropped somewhat in February-March, otherwise it remained relatively unaltered during winter and spring. The difference in the mean temperature of the surface water between Drogden and Gedser Rev is quite insignificant (cf. Fig. 4).

The rise in temperature at both places coincide on the whole with the rise in salinity from one period to the other. It should be observed, however, that the rise in temperature is valid for November, too - probably a consequence of an increased passage of Baltic surface water (cf. above p. 2). The mean surface temperature of November is in the south-western Baltic (for instance at Falsterborev light-vessel) somewhat higher than in the Kattegat (following slow cooling of the thick surface layer of the Baltic). This holds true for late autumn and early winter surface temperature in general.

Figures 1 - 4 are based on mean values already calculated for the periods in question by Det Danske Meteorologiske Institut (cf. Naut.-meteorol. Aarbog 1932/1933/and Oceanogr. Observationer 1966/1967/). The diagrams give of course only a rough idea of the development. The yearly Danish reports show large variations between different years and periods, e.g. for the five-year period 1956-60 the mean salinity at a depth of 15 m at Gedser Rev, is showing only moderate deviations from the mean values for the period 1920-31 (yearly mean 13,2 and 12,9 ‰, respectively). Individual years with very high salinities are, for example, 1951 and 1963.

The trends observed in salinity and temperature do not, in themselves, say much definitively about the flow of salt water into the Baltic Sea, since we have no regular measurements of currents except at the surface. It is obvious, however, that the salinity increase noted is one of the conditions for the well-known rise in salinity in the Baltic during recent decades. Both phenomena are in turn dependent on the increase in the atmospheric circulation and in the circulation of Atlantic and North Sea water during the same period.

A closer analysis of the present material, and a detailed study covering a longer period, especially at the Darsser threshold, are urgently needed. It may, perhaps, be possible to do something in this line during the Baltic Year 1969.

Some general aspects of the water balance of the Baltic. - When considering the water and salt balance of the Baltic we have to think not only of the water exchange through the Danish sounds but also of the river inflow into the area, furthermore of the precipitation and evaporation over the sea and of the exchange between the different basins and depths. The variations and changes in river inflow due to precipitation over land areas and to human regulations of the water-supply of the rivers has already received attention from the CBO. I will here mention briefly some further features of the water exchange of the Baltic.

The inflow of salter water through the Belt Sea and the Sound consists to a great extent of surface water from the areas around the Danish islands or such water mixed up with water from the Kattegat. Passing the thresholds the salt water is largely transformed into deep water in the Baltic - depending on its higher salinity, compared with the Baltic surface water. There are strong indications that the inflow during recent decades more frequently has occurred during the latter and warmer half of the year (high deep water salinities in the Arkona Basin etc.). High bottom temperatures have prevailed in the Bornholm Deep (usually 5-9°C) and in the central depths of the Baltic proper. Furthermore the last thirty-forty years generally show a mild climatic type.

Combined with increased stability, following the rising salinity, the high temperature of the deep water must be an important factor related to the decreasing oxygen content of the deep waters studied by Fonselius and others. Attention may here be drawn to cold periods, e.g. the 1870ies and early 1890ies when bottom temperatures of 2 - 3°C were noted in the Bornholm Deep. - The temperature factor and changes in the halocline demand more attention in Baltic oceanographical research.

Low oxygen values in the bottom waters of the Arkona Basin during late summer and autumn may be due to high content of nutritive salts, i.a. through pollution in the waters around the Danish islands.

A change in time period of the passage of salt water into the Baltic must be of very great importance to fish species entirely or partly recruited by drifting eggs and larvae from the Danish sounds. Probably this is the explanation of the puzzling drastic decline of the stock of common dab in the Bornholm area and adjacent waters of the southern Baltic since the 1930ies.

Recently the Baltic water exchange has been actualized by Swedish proposals for introducing super-tankers (draught c. 16 m) in the Baltic which will necessitate dredging in the threshold of the Belt Sea. This is a dangerous problem entailing the risks of oil pollution and of disturbing the salt water balance. In my opinion oceanographers have to pay even more attention to the risks of sea pollution etc. in addition to traditional hydrographical and biological problems.

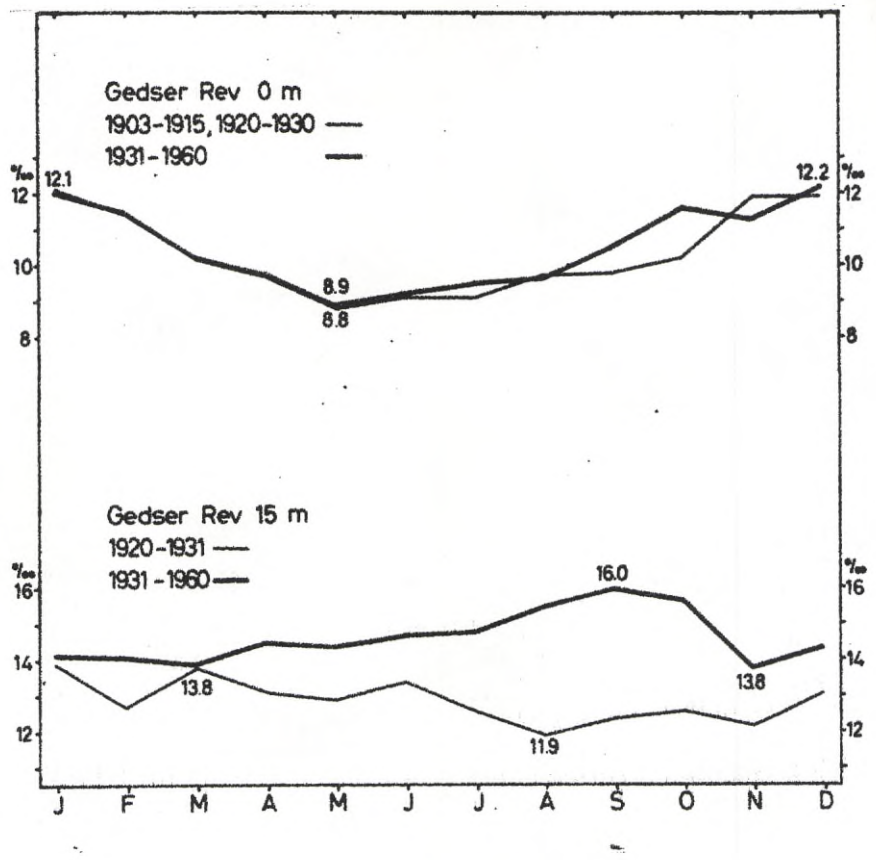

Fig. 1. Mean monthly salinity for two periods at Gedser Rev light-vessel measured at the surface (above) and at a depth of 15 m (below). Sources for Figs. 1-4: Naut.-Meteor. Årbog and Oceanogr. Observ., ed. by Det Danske Meteorol. Inst.

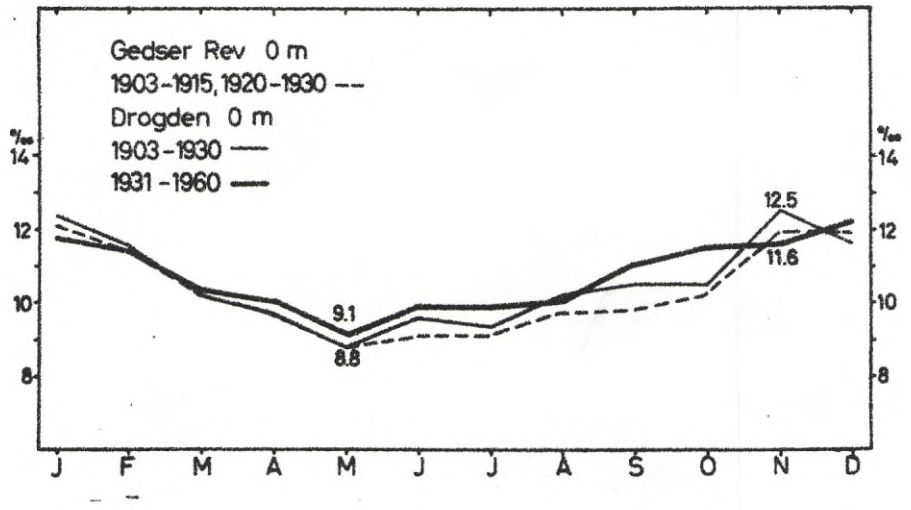

Fig. 2. Mean monthly surface salinity for two periods at Drogden. Corresponding values at Gedser Rev light-vessel are given for one of the periods.

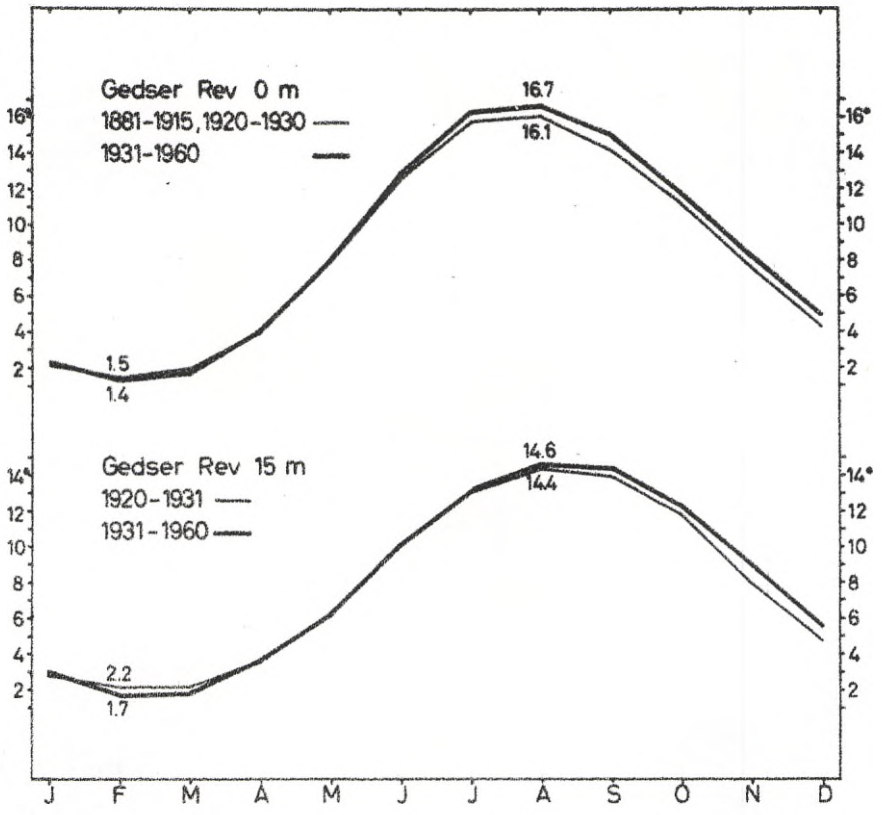

Fig. 3. Mean monthly temperature at Gedser Rev light-vessel (at the surface and at a depth of 15 m) according to the Danish observations (cf. Fig. 1).

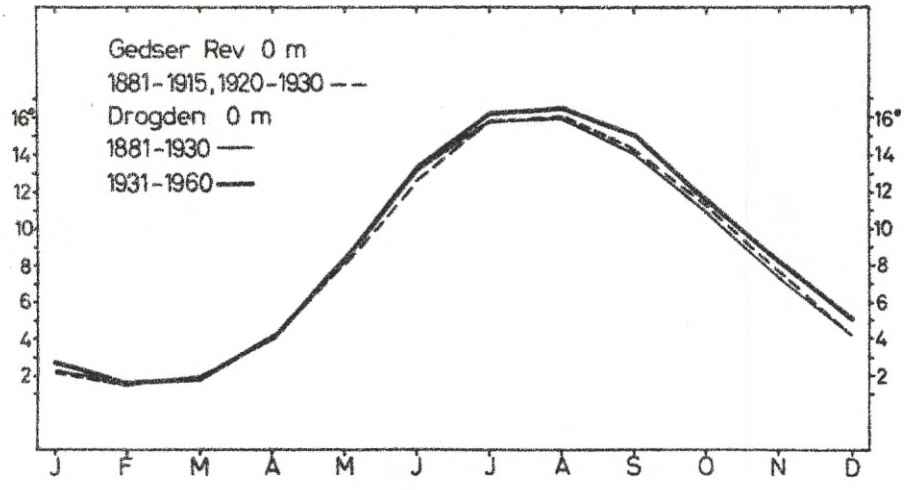

Fig. 4. Mean monthly surface temperature at Drogden (and Gedser Rev light-vessel) for the same periods as in Fig. 3.