

The hydrographical background for regional differences in
phytoplankton abundance and specific composition within
the Hardangerfjord area.

by
Trygve Braarud

In 1955-56 an orientative survey of the Hardangerfjord area south of Bergen, Norway, was organized by the Norwegian Association of Oceanographers.

The report on the phytoplankton will be published by T. Braarud, Björg Föyn, P. Hjelmfoss, and Aa-K. Överland in Sarsia in the series: The natural history of the Hardangerfjord.

The communication to the Plankton Committee deals with certain aspects only of the results from the survey.

The area of investigation comprises an offshore area, the archipelago and the Hardangerfjord proper. Within this area there is very pronounced gradient in exposure, from the offshore region to the very sheltered innermost part of the fjord, surrounded by high mountains. In the summer, floods in glacier-fed rivers, discharged in the inner part, lead to the formation of a brackish surface layer with very high turbidity, due to glacial silt.

The following details of the phytoplankton distribution will be discussed.

1. The difference in the quantitative distribution offshore and in the fjord waters during autumn, midwinter and early spring.

In the offshore waters minimal populations prevail during autumn and winter until a spring diatom bloom occurs in late March. In the fjord an autumn diatom maximum in October-November is succeeded by a winter minimum in December-January. The spring diatom bloom occurs as early as in mid-February.

2. A pronounced difference as to specific composition during the spring bloom offshore and within the fjord.

In both parts, Skeletonema costatum is the predominant species during the spring bloom. The extreme poverty in diatom species accompanying Skeletonema in the innermost part is contrasted by a varied diatom society in offshore waters.

3. The different distribution pattern of diatoms, dinoflagellates and coccolithophorids within the area when all seasons are considered.

The inner fjord waters are characterized by a general poverty in diatom species as compared with the waters of the outer part, while the dinoflagellates exhibit as great a diversity in the fjord as in the outer part. The occurrence of coccolithophorid populations in the fjord depends upon introduction of initial populations from outside the fjord.

4. The larger concentrations of brown dinoflagellates in the innermost fjord area during April-September.

Two mechanisms are suggested which may be active in producing this distribution pattern.

a) An amelioration of the trophic conditions in the innermost part due to counter current transport at levels where submarine light in the inner part becomes inadequate for photosynthesis, so mineralization prevails.

b) A physical concentration of phototactic dinoflagellates in the innermost part through the combined effect of phototactic vertical migration and transport in counter currents.

5. Horizontal transports by currents.

a) The distribution of diatoms in March and June indicate transport of populations from the outer fjord area to the inner, but not to the innermost part.

b) An extensive transport even into the innermost part of outside-populations was due to a large scale water exchange between the August and September cruises.

For each of these features the hydrographical background is discussed, with main emphasis on the effects of the spatial differences in the exposure factor upon turbulence conditions, and the effect of the brackish layer in summer upon turbulence horizontal transport and submarine light conditions.

On the background of the definite "fjord effect" upon the phytoplankton in the Hardangerfjord, comparison is made with other Norwegian fjords where all-year phytoplankton investigations have been made.