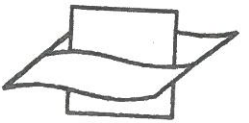
Salinity and Temperature as Controlling Factors for Distribution and Mass Occurrence of Ceratia

By
ERLING NORDLI



SÆRTRYKK AV BLYTTIA, BIND 11, OSLO 1953

Salinity and Temperature as Controlling Factors for Distribution and Mass Occurrence of Ceratia.

By

ERLING NORDLI

While the cultivation of diatoms and of the small dinoflagellates has been successful when using the classical method of Allen and Nelson (1910), the persistent culturing of most of the species of the genus *Ceratium* has resisted all efforts. In recent years, however, the author has succeeded in culturing and carrying out experimental work on some species of the genus.

The effect of different temperatures and salinities upon growth has been studied in a few species, and examples of growth rate curves are given in Figs. 1 and 2. The curves show that the salinity optima for C. *fusus,* C. *furca,* and C. *tripos* lie far below what is commonly found in the sea, and that the temperature optima for *C. furca* and *C. fusus* lie at a level which, at our latitudes, is recorded only from restricted areas.

The annual amplitude of surface temperature and salinity is relatively large along the Norwegian coast and in the Transition Area, where in summer, temperature reaches a maximum of 18—20° C and salinity reaches minima of less than 18 ‰. At the entrance to the Baltic the salinity may go down to 7 ‰. The maps in Figs. 3 and 4 give average August surface isotherms and isohalines for the southern part of these areas. In the greater part of these areas, ceratia are abundant in summer and occasionally so numerous as to cause «red water».

Ceratium tripos, as may be seen from Fig. 2, has a considerable growth at a salinity of 10 ‰, while *C. fusus* and *C. furca* do not grow at this low salinity. *C. tripos* is commonly recorded eastward to Rügen, where the other two species have not been regularly observed. This indicates that the low salinity restricts their distribution in this direction. Single specimens, occasionally carried by currents, are, however, recorded farther east.

In the Oslofjord, an area repeatedly investigated for years, ceratia are always found in summer and, as a rule, in great numbers. From samples taken in this locality the author has found

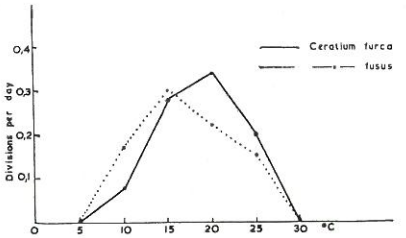


Fig. 1. Growth rates at different temperatures. Veksthastigheter ved forskjellige temperaturer.

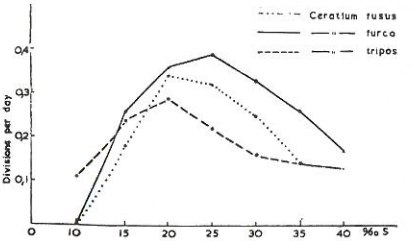


Fig. 2. Growth rates at different salinities. Veksthastighet ved forskjellig saltholdighet.

C. furca and *C. fusus* in numbers exceeding 100,000 cells per litre and more than 33,000 cells per litre of *C. tripos,* which are the densest populations ever recorded for these organisms.

When the growth curves for salinity and temperature are taken into account, the Oslofjord during summer would seem to offer particularly good conditions for growth. Other factors are, however, of great importance i. e., the abundance of nutrient salts caused by the sewage supply from the city of Oslo and the products of plankton metabolism, the influence of which is not cleared pu to date.

The third area to be discussed is the Norwegian coastal waters from 62° to 70° N. lat. to a distance of 300—400 km. off the coast. This area is practically identical with the «Tripos-region» of Gran (1902). In summer it is limited westward by the 35 $^{0}/_{00}$ isohaline and the 12° isotherm. The area is, according to Gran, characterized by temperate atlantic-oceanic plankton elements, among which *C. macroceros, C. tripos* and *C. fusus* are leading species.

The area is less saline and has a higher temperature than true oceanic water outside the region above. The growth curves for temperature and salinity and experimental evidence show that the «Tripos-region» would offer more favourable conditions for growth of ceratia than the waters further offshore. It may be assumed from these data that the «Tripos-region» could be a biogeographical area limited by summer temperature and salinity borders.

It should be noted that the ceratia mentioned will grow under natural conditions at both lower and higher temperatures than has hitherto been possible in cultures.

A more detailed report on these and other experiments on ceratia will be published elsewhere.

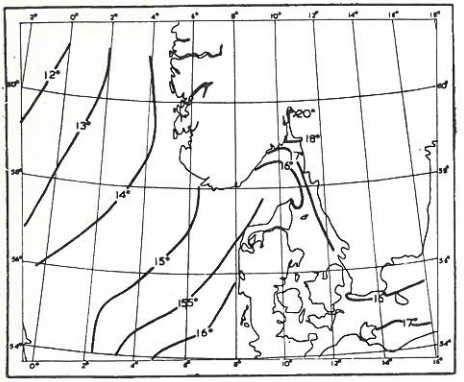


Fig. 3. Surface isotherms for August.
Overflateisotermer for august.

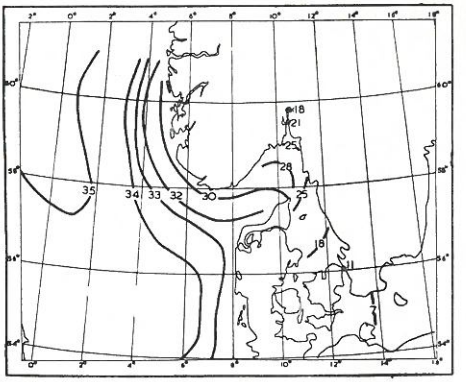


Fig. 4. Surface isohalines for August.
Overflateisohaliner for august.

NORSK SAMMENDRAG

Saltholdighet og temperatur som kontrollerende faktorer for utbredelse og masseforekomst av ceratier.

Kulturforsøk med de marine dinoflagellatene *Ceratium tripos, C. fusus* og *C. furca* har vist at disse arter har et lavere saltholdighetsoptimum og et høyere temperaturoptimum enn hva en vanligvis finner i sjøen på våre breddegrader. Det er foretatt en sammenligning mellom forsøksresultatene og observasjoner fra sjøen i tre områder: den vestlige delen av Østersjøen, Oslofjorden og de norske kystfarvann fra 62° N til 70° N. Sammenligningen gir grunn for å anta at den lave saltholdigheten begrenser artenes utbredelse mot Østersjøen, at masseforekomsten av ceratier i Oslofjorden om sommeren bl. a. beror på de gunstige temperatur- og saltholdighetsforhold, og at de norske kystfarvann, Gran's «Tripos-region», er et biogeografisk område som byr ceratiene bedre vekstbetingelser enn det saltere og kaldere oceaniske vannet vestenfor.

REFERENCES

Allen, E. J. and *Nelson, E. W.*, 1910: On the Artificial Culture of Marine Plankton Organisms. — Journ. Mar. Biol. Assoc. VIII.

Gran, H. H., 1902: Das Plankton des norwegischen Nordmeeres. — Report on Norwegian Fishery- and Marine-Investigations. Vol. II. 1902 No. 5. Bergen.

Maps Based on various sources, mainly: Atlas de température et salinité moyenne de l'eau de surface de la Mer du Nord et de la Manche. Conseil Perm. Int. p. l'Expl. d. l. Mer. Copenhague 1933.

LYCHE TRYKK