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GROWTH INHIBITION IN ESTUARINE ZOOPLANKTERS DUE TO BLUE-GREEN ALGAE

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ABSTRACT

Calanoid copepod, phyllopod and rotifer biomasses in the Darss-Zingst estuary (southern Baltic Sea) were reduced in late summer. A bloom of the blue-green alga *Oscillatoria limnetica* developed during this time. A reduced digestibility of blue-greens was shown in the case of copepods.

INTRODUCTION

Eutrophication usually leads to a shift in the biomass ratio between phytoplankton and zooplankton in favour of the former (Hillbricht-Ilkowska *et al.* 1979). This is considered to be a consequence of changes in the structure of the phytoplankton population and, in particular, the development of planktonic blue-green blooms. The blue-greens can inhibit zooplankton development by means of toxins (Scharf *et al.* 1979, Lampert 1981) or by being unsuitable as a food source on account of their morphology or poor digestibility (Arnold 1971). The blue-green algae predominate among the summer plankton in the Darss-Zingst estuary (southern Baltic Sea, Fig. 1) every year. Zooplankton biomass and the efficiency of the planktonic food chain are low during this period (Heerkloss *et al.* 1983). In order to obtain a better insight into the role played by the blue-greens during summer, the seasonal variation in the biomasses of the principal zooplankton and Cyanophyta species were investigated in 1981 and 1982 and the digestibilities of phytoplankton and cultured algae for copepods were studied.

We wish to thank Dr M. Henning for kindly providing strains of cultured algae.

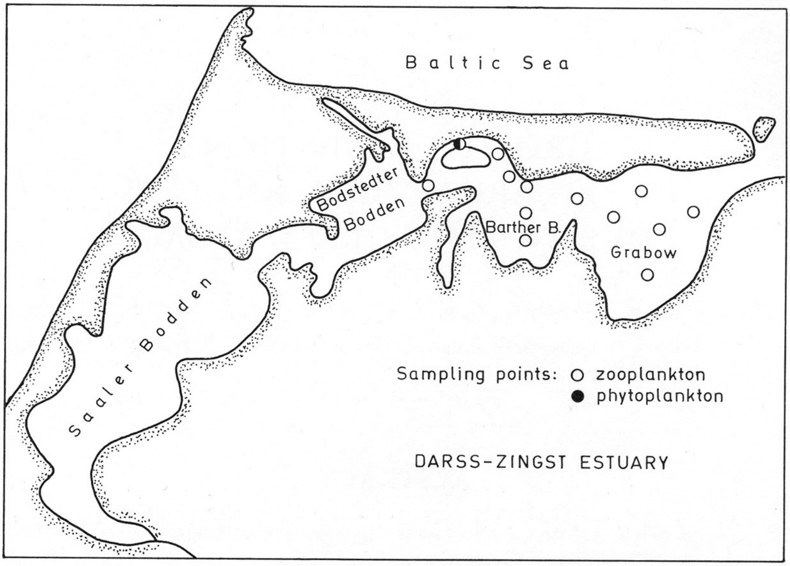

FIG. 1. The area of investigations.

MATERIAL AND METHODS

The phytoplankton biomass data (Fig. 3) were derived from single samples at one station in the waters concerned (Fig. 1). Due to variable hydrographic conditions (cf. salinity, Fig. 2), they exhibit some irregularity. The zooplankton biomass data were more regular because they were obtained from integrated samples.

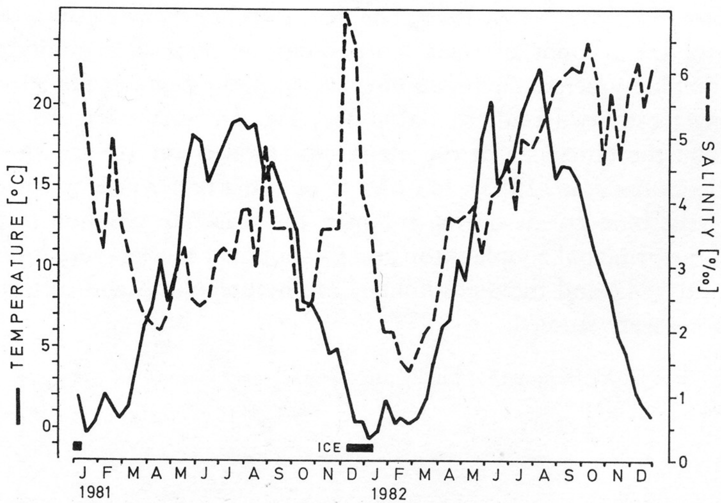

FIG. 2. Salinities and temperatures at the phytoplankton sampling station (cf. Fig. 1).

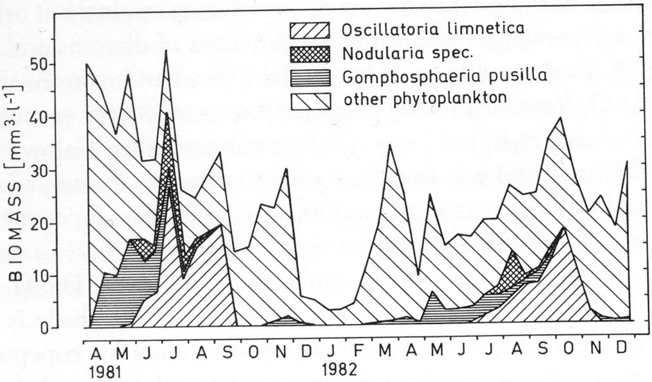

FIG. 3. Seasonal variation in phytoplankton biomass. *O. limnetica*, *G. pusilla* and *Nodularia* spp. account for 74-90 % of the total biomass of blue-greens.

The blue-green biomass was dominated by *Oscillatoria limnetica* Lemm., *Gomphosphaeria pusilla* (van Goor) Kom. and *Nodularia* spp. (Fig. 3). While a bloom of *O. limnetica* accompanied by *Nodularia* spp. developed during the late summer, the zooplankton biomass at this time was much lower than during the spring (Fig. 4). This contrast between the seasonal curves was particularly striking in the case of phyllopods. It seems likely that the blue-green algae had some sort of inhibitory effect.

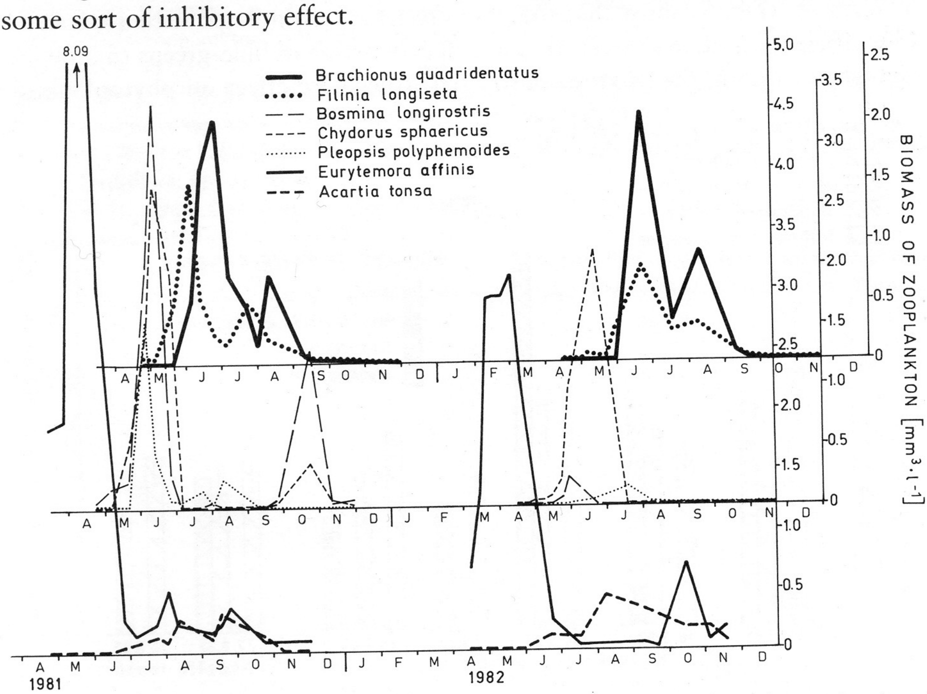

FIG. 4. Seasonal variations in the biomass of the dominant zooplankters. The species shown account for 73-95 % of the total zooplankton biomass.

O. limnetica is not known to have toxin producing strains, but other *Oscillatoria* species are known to inhibit the development of diatoms and phyllopods (Keating 1978, Pankow 1964). It is, on the other hand, conceivable that the availability of *O. limnetica* to the zooplankton as an energy source is to some extent restricted due to its poor ingestibility or digestibility. Calow & Fletcher's (1972) $^{14}C/^{51}Cr$ method was therefore used to measure the assimilation efficiency of natural phytoplankton populations of different compositions and cultured *Oscillatoria redekei* and *Microcystis aeruginosa* Kütz. Concerning cell size and filament length *O. redekei* is similar to *O. limnetica*. The *M. aeruginosa* strain HUB 524 used for these experiments is toxic. Since little is known regarding the effects of blue-green algae as a food source for copepods, the experiments were performed with *Eurytemora affinis* (Poppe) and *Acartia tonsa* Dana. The degrees of adaptation and the age structures of these animals during the experiments differed because they were taken from live samples collected from the estuary. It was therefore necessary to measure the assimilation efficiency of a standard food source (*Chlorella vulgaris* Beij.) at the same time for use as a reference value.

RESULTS AND DISCUSSION

The results (Fig. 5) show that the blue-greens are assimilated with a relatively low efficiency and, moreover, that a high proportion of blue-greens (mainly *O. limnetica*) among the phytoplankton has a negative effect on phytoplankton

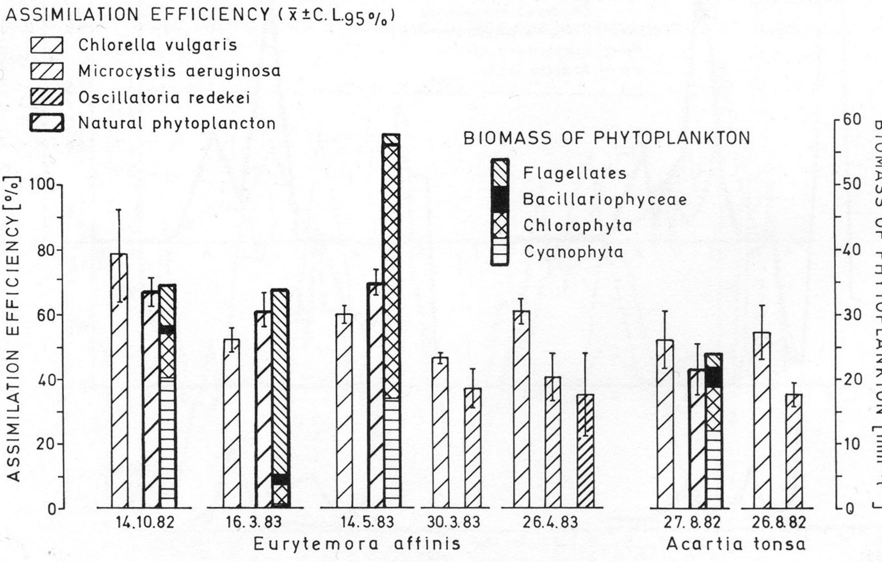

FIG. 5. Assimilation efficiencies of cultured algae and phytoplankton. Experimental conditions: temperature 10 °C, salinity 5 ‰, concentration of cultured algae ca. 16 mm^3/l.

digestibility. In the experiments with the toxic strain of *M. aeruginosa*, there was no sign of a reduction in food intake or of higher mortality during the feeding period of three hours. The relatively low assimilation efficiency of the blue-greens may be a cause of the inhibited development shown by the copepods. But it seems probable that other factors also play some role because the drawback of poor digestibility is at least partly compensated for by the large biomass of phytoplankton, that means a good supply of food. Long term feeding experiments have to show whether growth and reproduction are inhibited by these blue-greens too.

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