The Heterotrophic Phase of Plankton Succession in the Japan Sea

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Abstract

The vertical structure, composition and productivity of a plankton community was studied in the Japan Sea in June, 1972 during a period of thermocline formation; the parameters measured were: phytoplankton production and biomass; number, biomass, and production of planktonic bacteria; biomass of phagotrophic flagellates, ciliates and remaining microzooplankton. The concentration of micro- and mesozooplankton attained a basic maximum in a layer near the upper part of the thermocline. The biomass and calculated production of the heterotrophic part of the community exceeded considerably the amount of primary production. The heterotrophic phase of the seasonal succession of a plankton community in a temperate sea is described, when heterotrophic metabolism and production predominate. Heterotrophs at this stage use mostly energy from organic matter accumulated during the previous spring phytoplankton "bloom".

Introduction

Detailed studies on the seasonal succession of plankton communities in lakes of central Russia and the Kamchatka Peninsula, with special emphasis on the heterotrophic microplankton, revealed a heterotrophic phase of succession, which occurs in mid-summer between the spring and autumn phytoplankton "blooms" (Sorokin, 1969, 1972; Sorokin and Paveljeva, 1972). During this phase, heterotrophic metabolism largely dominates over autotrophic primary production. It decomposes the organic matter accumulated by the spring diatom bloom. This results in the mass production of small particulate food-items for zooplankters and thus supports their further development, as well as nutrient regeneration—a prerequisite for the autumn blooms of green or blue-green algae. Bacteria, planktonic protozoans and other microzooplankters play an extremely important role in these processes (Figs. 1 and 2). The same two spring and autumn phytoplankton maxima also occur in the temperate sea of Japan (Rakhmanova, 1933; Nakajima and Nishizawa, 1968; Ohwada, 1971; Konowalova, 1972). In this sea an extremely rich diatom bloom occurs at the end of winter-early spring, when heterotrophic processes are inhibited by low water temperatu-
Fig. 1. Seasonal changes in biomass and productivity of some main components of plankton community in Volga Strait of Rybinsk Reservoir. $P$: phytoplankton photosynthesis at the surface (mg C/l/day); $D_P$: ratio destruction:photosynthesis; $J$: biomass of Protozoa (mg/l); $C$: biomass of Crustacea (mg/l); $B$: production of bacterioplankton (mg C/l/day); $R$: biomass of Rotatoria (mg/l)

Fig. 2. Seasonal change in biomass and production of some main components of plankton community of Dalnee Lake (Kamchatka peninsula, USSR); maximum values (mg C/m$^2$) are shown on curves' maxima: $P_p$, $P_b$: phytoplankton and microbial production/day, respectively; $B_f$: heterotrophic flagellate biomass; $B_n$: nauplii biomass; $B_d$: Neutrodiaptomus angustilobis biomass

Fig. 3. Stations in Japan Sea

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