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# Influence of nutrients on bacterial production in enclosure experiments

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## Introduction

The main structures and functions of the pelagic food web were studied by enclosure experiments in the Darss-Zingst-Bodden chain. Previous bottum-up experiments have shown enhanced phytoplankton activity and increased biomass except of the bacterial biomass (SCHIEWER et al. 1990). In these experiments the addition of both anorganic nutrients (nitrate and phosphate) and organic matter (carbohydrates in form of glucose and malate and protein in form of pepton) is expected to lead to higher bacterial growth rates and activities. The uncoupling of the grazer pressure (see Fig. 1) by increased growth rates of bacteria will maintain higher bacterial numbers.

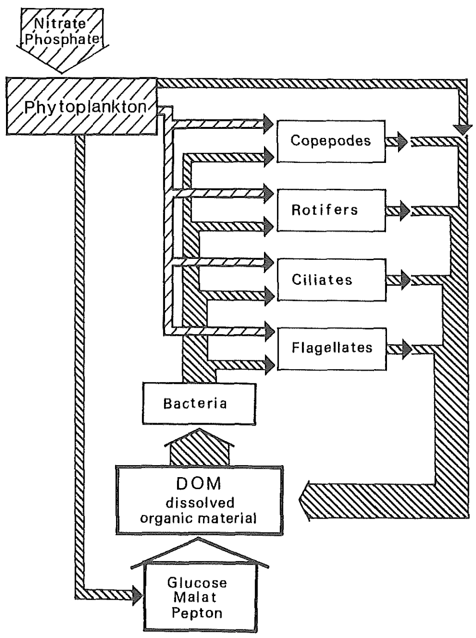


Fig. 1. The role of the dissolved organic material in the pelagic food web.

## Material and methods

In summer 1989 a three weeks mesocosm experiment was conducted in the Darss-Zingst-Bodden chain. Two 1 $m^3$ polyethylene bags were used as control (A) and loaded (B) mesocosm. The loads contained:

170 µmol $l^{-1}$ $NO_3^-$, 250 µmol $l^{-1}$ $PO_4^{3-}$ and 5 x 4 mg $l^{-1}$ glucose, 5 x 4 mg $l^{-1}$ malate, 5 x 0.5 mg $l^{-1}$ pepton.

The determined parameters are presented in Table 1.

| Parameter | Unit | Method | Author |
|---|---|---|---|
| Bacterial number | $10^6$ $ml^{-1}$ | Acridine orange staining, fluorescence microscopy | HOBBIE et al. 1977 |
| Bacterial volume | $\mu m^{-3}$ | scanning electron microscopy | |
| Bacterial biomass | µg C $l^{-1}$ | partial fresh weight (10 %) | JOST and BALLIN 1984 |
| Bacterial production | µg C $l^{-1}$ $h^{-1}$ | $^3$H-thymidine incorporation | FUHRMAN and AZAM 1982 |

## Results and discussion

The development of the bacterial number is shown in Fig. 2. There are no significant differences between the control (A) and the influenced mesocosm (B).

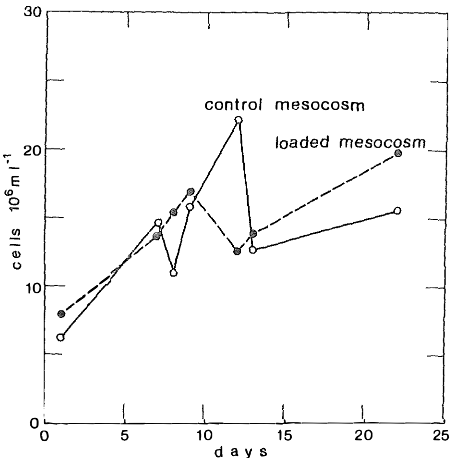


Fig. 2.

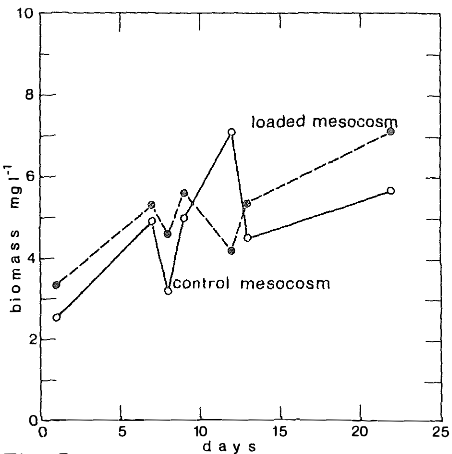


Fig. 3.

Fig. 2. The bacterial number ($10^6 ml^{-1}$) in the control mesocosm (open circles) and loaded mesocosm (closed circles).

Fig. 3. The bacterial biomass (mg $l^{-1}$) in the control mesocosm (open circles) and loaded mesocosm (closed circles).

Typically are high daily oscillations. They result from low generation times (4 - 10 h) and grazing effects (increasing flagellate abundances). The same holds for the bacterial biomass (Fig. 3). The bacterial volume shows no significant differences between the loaded and the control mesocosm. Detailed analyses of raster electron micrographs confirm this fact.

$^3$H-thymidine incorporation, which is a parameter for bacterial activity, indicates significant differences between the two mesocosms (Fig. 4). A threefold higher productivity was recorded in the loaded mesocosm over the whole time and can be correlated to the organic loads, a fact until now not observed in mesocosms with only anorganic N and P loads.

The contribution of the bacterial production to the carbon cycle of the pelagial is rather important and reaches up to 64.3 % of the daily primary production in the control mesocosm and up to 100.9 % in the loaded mesocosm respectively.

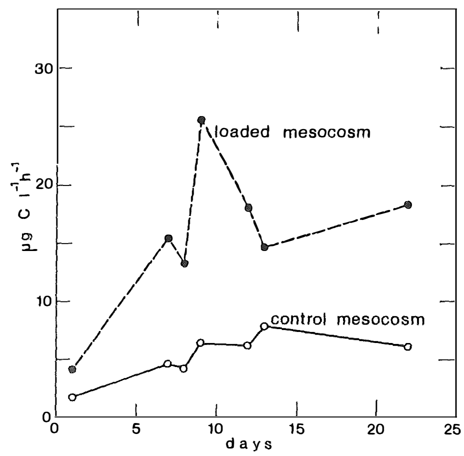


Fig. 4. The bacterial production in the control mesocosm (open circles) and loaded mesocosm (closed circles).

The double load with anorganic (nitrates and phosphates) and organic (glucose, malate and pepton) nutrients leads to enhanced phytoplankton and bacterioplankton activities. But cell numbers increase only in case of phytoplankton. We assume a higher grazing rate of heterotrophic flagellates. The biomass of heterotrophic flagellates varied in time and was sometimes threefold higher than in the unloaded mesocosm. That means the grazing pressure of flagellates can control the bacterial biomass. In further experiments the correlation between bacteria and heterotrophic flagellates will be proved by more detailed analysis of the samples.

## References


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