INVESTIGATIONS ON PRIMARY PRODUCTION IN MICROCOSMS CONTINUOUSLY EXPOSED TO THE ENDOCRINE DISRUPTOR NONYLPHENOL

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Introduction

The surfactant nonylphenol is one of the most relevant endocrine disruptors in the aquatic environment[1]. To estimate the effect of endocrine disruptors on the entire ecosystem, all parts of it have to be considered comprehensively, including possible (indirect) effects on the primary production, which is a central function in ecology. Therefore the development of the phytoplankton cell density and biomass as well as the species composition were studied in an outdoor microcosm experiment. To meet the conditions in natural systems the microcosms were continuously exposed to nonylphenol by a controlled release, a new developed method[2].

Methods and Material

The cylindrical microcosms (80cm high, 60cm wide) made of stainless steel were filled with littoral water (200 l) and sediment (10 cm) of an oligo-mesotrophic natural lake (Ammersee, Bavaria). After 4.5 weeks of relaxation, 4 microcosms were continuously exposed to different concentrations of nonylphenol by controlled release through a semipermeable LPDE-tube for 7 weeks (microcosms NP2, NP4, NP5, NP7). The nonylphenol used was a technical mixture. For the design of the exposure see Pfister et al.[2]. 2 microcosms served as controls (microcosms k2, k3). Samples were taken before, during and for 6 weeks after exposure. The samples were fixed with about 12 drops Lugol per 100 ml and sedimented in a plankton chamber. The algae cells were counted in an inverse microscope. The biomass was calculated following Hoehn et al. after identifying the species using Ettl et al.[3, 4]. To detect changes in the community structure, a Redundancy Analysis (RDA) with the computer program CANOCO was conducted

Results and Discussion

The nonylphenol concentration increased during the first weeks of exposition. The maximum concentrations reached were 30 μg/l for microcosm NP2, 60 μg/l for NP4, 90 μg/l for NP 5, and 120 μg/l for NP7. After the end of exposition it declines faster to a detection threshold within 2 weeks. For details of the concentration course see Severin et al.[5].

The cell density of the phytoplankton did not indicate clear effects during the time of exposition. In contrast, it seemed to be affected by the end of the exposition. Within the first week after finishing the exposition the total cell density increased in the control microcosms, whereas it decreased dose dependent in the exposed microcosms (Fig 1). The differences did not appear in the following weeks. The biomass show no changes which correlate unambiguously with the exposition to nonylphenol (Fig. 2). There was a large variability both in time and between the microcosms, which make it difficult to detect effects. The biomass tended to be dominated by one or a few large species that overlaid shifts of a higher number of small species. This may be a reason for the contrary findings of cell density and biomass.

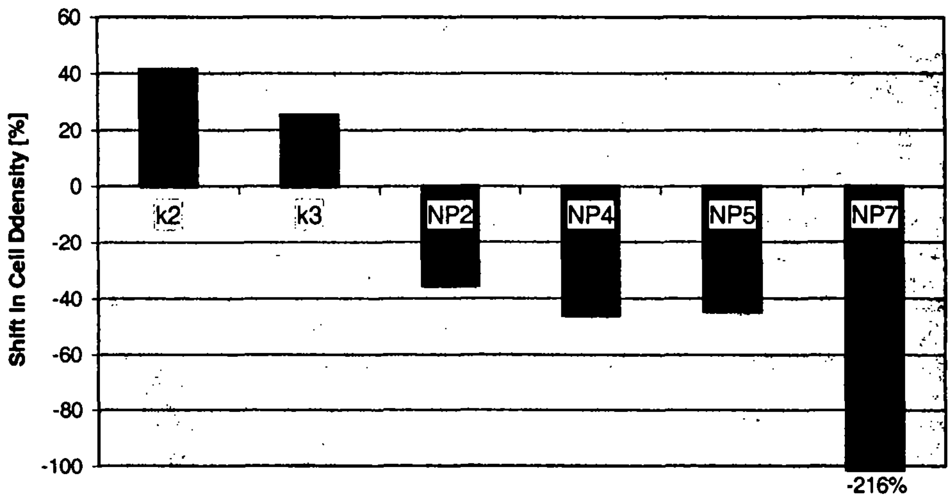

Fig. 1: Shifts in cell density within the first 7 days after the end of exposition

First results of the RDA show concentration dependent changes of the community composition, which seem to be strongest in the first time after the end of exposition and then recover.
Most of the published EC50 data for the effect of nonylphenol to algae in single species tests (Chlamydomonas segnis, Chlamydomonas reinhardii, Chlorella pyrenoidosa, Selenastrum capricornutum, Scenedesmus subspicatus) are distinctly higher than the concentrations reached by this study (450 >1500 μg/l)[6]. As nonylphenol is regarded as an endocrine disruptor for animals, it is possible that it affected the zoobiocenosis in the ecosystems rather than algae, which have a distinct endocrine system. Therefore, the found shifts in cell density at the end of the exposition may also be due to changes in the zooplankton community rather than direct toxic effects on the algae species. With regard to the zooplankton-phytoplankton interaction, these changes appear to be more relevant at the end of the exposition than at the beginning. For a interpretation of the results a detailed consideration of the development of the zooplancton as well as abiotic physico-chemical parameters will be performed.

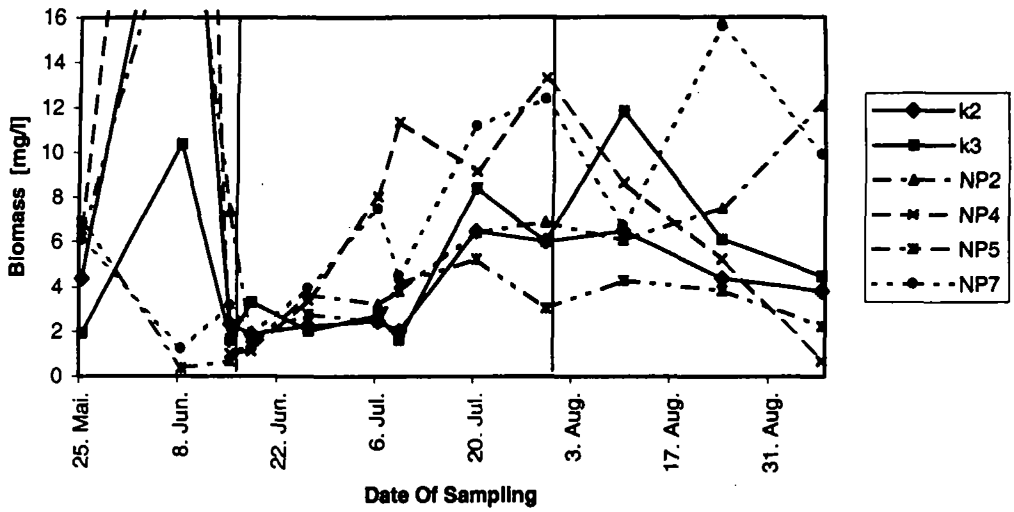

Fig. 2: Phytoplankton biomass; vertical lines: begining and end of exposition

As the phytoplankton biomass is an indicator for the primary productivity, a conclusion of this study is that the data provide no hint for an effect on the function of the ecosystem in the examined nonylphenol concentration range. Nevertheless, the shifts in the cell density seem to indicate at least a temporary influence on the ecosystem structure, which might occur even in lower concentration than used in this experiment.

References:

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