**Allelopathic effects of *Stratiotes aloides* L. (water soldier) on two green algae**

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This work was conducted in The Netherlands at the Netherlands Institute of Ecology, Centre for Limnology, under the supervision of Dr E. van Donk and with the collaboration of G. Mulderij.

Allelopathic effects of submerged macrophytes are proposed as one of the mechanisms that mediate low phytoplankton biomass in clear, shallow, macrophyte-dominated lakes. Four short-term laboratory experiments were conducted to test the effect of the submerged macrophyte *Stratiotes aloides* (water soldier) on green algae. Unfortunately, three of the experiments failed due to fungal infections, so the findings summarised here are based on the fourth experiment that was free from such infection.

Single phytoplankton species in batch cultures – *Chlamydomonas* sp. and *Scenedesmus obliquus* (Turpin) Kützing – were exposed to filtered water from a *S. aloides* culture (macrophyte treatment) and to water without macrophytes (control). Phytoplankton cultures in the 'macrophyte treatment' were periodically replenished with fresh *S. aloides* water and growth in all cultures was monitored by determining chlorophyll concentration and biovolume. The induction of colony formation was also monitored for *S. obliquus*. Exponential growth rates and the duration of the lag phase were estimated from the changes in chlorophyll concentration.

No inhibition or stimulation of growth was detected for either *Chlamydomonas* or *S. obliquus* when exposed to filtered *S. aloides* water. Similarly, introduction of *S. aloides* water did not induce colony formation in *S. obliquus*. However, allelopathic effects are described as being species-specific, so further research is needed to understand the nature of this process and the effect of *S. aloides* on other phytoplankton species.

**Shift from a clear to a turbid state in shallow lakes: the relative role of nitrogen and phosphorus**

This study was conducted under the supervision of Dr E. Jeppesen and with the participation of J. Gomà at the National Environmental Research Institute (NERI), in Silkeborg, Denmark. It comprised a mesocosm experiment to test the role of N and P in the shift from a clear (macrophyte-dominated) to a turbid (phytoplankton-dominated) state. In shallow lakes, this transition is believed to be triggered when P levels increase to more than 90 µg $l^{-1}$.

The experiment was conducted in the littoral zone of a shallow eutrophic lake (Lake Stigsholm, Denmark) in summer 2002, using 24 polyethylene enclosures and six nutrient treatments. As well as a control (without nutrient addition, natural lake concentration of 0.1 mg P $l^{-1}$, 2 mg N $l^{-1}$), treatments included a high phosphorus treatment (0.2 mg P $l^{-1}$), a low nitrogen treatment (4 mg N $l^{-1}$), a high nitrogen treatment (10 mg N $l^{-1}$), a treatment with high phosphorus and low nitrogen, and a treatment with high phosphorus and high nitrogen addition. Nutrients were added weekly to maintain the nutrient concentrations. Each enclosure was stocked with four ($1^+$) YOY perch (*Perca fluviatilis*) and macrophytes were removed at the beginning of the experiment. Every second week, water samples were taken for chemical, phytoplankton and zooplankton analysis.

Phytoplankton biomass, measured as the chlorophyll *a* concentration, increased during the experiment but was significantly higher in the treatments with the addition of both N and P. The same trend was observed for total suspended solids and Secchi disc depth, the latter revealing a significantly lower transparency in the high-P/low-N treatment compared with the control and the low-N treatment.

Even though the submerged macrophytes were removed at the beginning of the experiment, *Elodea canadensis* and *Potamogeton* spp. colonized the enclosures. Different plant biomasses occurred among treatments, with a significantly lower biomass in the two treatments with both N and P added.

The zooplankton community was initially dominated by cladocerans (mainly *Daphnia* sp.), with rotifers becoming dominant in the middle of the experiment, and *Ceriodaphnia* and cyclopoid copepodites at the end of the experiment. There was no difference in total zooplankton biomass (cladoceran, rotifer nor cyclopoid) between treatments, although some differences were observed in the percentage of biomass contributed by each species to each group. For cladocerans, the percentage *Daphnia* biomass was significantly higher in the high-P/low-N treatment and the percentage of *S. mucronata* was higher when both N and P were added. In contrast, the percentages of *Ceriodaphnia* and *Bosmina* did not show any difference between treatments. In the case of rotifers, the percentage of *Asplanchna* was significantly lower in the high-P/high-N than in the control and the percentage of *Polyarthra* was significantly lower when both N and P were added than in the low-N treatment. For the rest of the most abundant rotifer species *(K. cochlearis*, *K. quadrangula*, *Synchaeta* sp. and *F. longiseta*), no significant difference was detected between treatments. No difference was observed in the zooplankton:phytoplankton ratio among treatments.

Our findings suggest that both nutrients, N and P, are necessary to induce an increase in phytoplankton biomass and in consequence, increased turbidity. This implies that both nutrients are relevant for the shift from a clear to a turbid state in shallow lakes. Moreover, in our experiment only the addition of both nutrients prevented the colonization of macrophytes, suggesting that both N and P are involved in the loss of submerged plant in this type of system. The zooplankton were not able to escape from planktivorous fish predation and total zooplankton biomass did not change among treatments. In the case of daphnids, however, a higher nutrient level (i.e. more availability of food), resulted in an increase in *Daphnia* and *S. mucronata* biomass. Most of the changes in the rotifer assemblage were related to *Asplanchna* predation and not to a treatment effect.