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Spatial heterogeneity of diatom silification and growth in a
eutrophic reservoir

RNDr. Thesis

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Annotation

Silification and growth rates of diatoms were measured at two distinct sites along the longitudinal profile of the canyon-shaped eutrophic Římov Reservoir during April–November 2011, at 1–3 week intervals. Over the study season, the most abundant diatom species were *Asterionella formosa* and *Fragilaria crotonensis*, while *Aulacoseira italica*, *Nitzschia acicularis*, *Synedra acus* and *Stephanodiscus sp.* were less important. Silica deposition measured via PDMPO fluorescence technique was significantly related to growth rates of three diatom species (*Fragilaria crotonensis*, *Asterionella formosa*, *Aulacoseira italica*). Growth rates of the two most abundant diatom species were positively correlated with daily light exposure but not with nutrient concentrations.

Declaration [in Czech]

Prohlašuji, že svoji rigorózní práci jsem vypracovala samostatně pouze s použitím pramenů a literatury uvedených v seznamu citované literatury.

Prohlašuji, že v souladu s § 47b zákona č. 111/1998 Sb. v platném znění souhlasím se zveřejněním své rigorózní práce, a to v úpravě vzniklé vypuštěním vyznačených částí archivovaných Přírodovědeckou fakultou elektronickou cestou ve veřejně přístupné části databáze STAG provozované Jihočeskou univerzitou v Českých Budějovicích na jejich internetových stránkách, a to se zachováním mého autorského práva k odevzdanému textu této kvalifikační práce. Souhlasím dále s tím, aby toutéž elektronickou cestou byly v souladu s uvedeným ustanovením zákona č. 111/1998 Sb. zveřejněny posudky školitele a oponentů práce i záznam o průběhu a výsledku obhajoby kvalifikační práce. Rovněž souhlasím s porovnáním textu mé kvalifikační práce s databází kvalifikačních prací Theses.cz provozovanou Národním registrem vysokoškolských kvalifikačních prací a systémem na odhalování plagiátů.

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Co-authors agreement

The co-authors listed below fully acknowledge that Veronika Visocká significantly contributed to this publication. Veronika Visocká was responsible for collecting of the main data, namely measurement of PDMPO fluorescence of all siliceous organisms using image analysis and calculation of diatom growth rate based on changes in their cell counts during the 24-incubation with PDMPO. She also made statistical evaluation of results and reviewed most of scientific literature referred in this publication.

First author of the study Petr Znachor and all co-authors, hereby consent to the publication in the RNDr. Thesis of Veronika Visocká and support this statement with their signature (without academic titles):

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Spatial heterogeneity of diatom silicification and growth in a eutrophic reservoir

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SUMMARY

1. Diatoms are one of the most important phytoplankton groups. As they grow, diatoms use silicon to produce a siliceous frustule, which protects the cell. During April–November 2011, at 1–3 week intervals, we estimated diatom silicification rates at two distinct sites along the longitudinal profile of the canyon-shaped eutrophic Římov Reservoir (Czech Republic): (i) a nutrient-depleted lacustrine zone near the dam and (ii) a nutrient-rich transition zone upstream near the river inflow.
2. Diatom silicification was estimated using the 24-h *in situ* incubation of natural phytoplankton assemblage with a fluorophore 2-(4-pyridyl)-5-[[4-(2-dimethylaminoethyl-aminocarbonyl)methoxy]phenyl]oxazole (PDMPO) which fluorescently stains the newly synthesised diatom frustules.
3. Diatoms contributed an average *c.* 40% to the total phytoplankton biovolume in the lacustrine zone, but only *c.* 20% in the transition zone where a cyanobacterial bloom developed during summer. *Asterionella formosa* and *Fragilaria crotonensis* were the most abundant diatom species, while *Aulacoseira italica*, *Nitzschia acicularis*, *Synedra acus* and *Stephanodiscus* sp. were less important. Silicification rates of all diatom species were significantly higher in the transition zone than at the dam.
4. The intensity of PDMPO fluorescence per diatom cell was tightly related to the growth rates of three diatom species calculated from changes in cell counts during the incubation. The PDMPO technique can thus be used as a proxy for diatom growth.
5. Growth rates of the two most abundant diatom species were positively correlated with daily light exposure but not with nutrient concentrations.

Keywords: fluorescence, growth rate, PDMPO, phytoplankton, silica deposition

Introduction

Man-made reservoirs created by damming the original river valley represent a transition between lotic and lentic systems with pronounced longitudinal gradients in various physical, chemical and biological parameters. According to the reservoir zonation concept, three distinct zones can be recognised along a reservoir's longitudinal axis (Thornton, Kimmel & Payne, 1990). The shallow riverine zone close to the river inflow is characterised by high-flow, turbidity and nutrient concentration. Due to a short water residence time, phytoplankton is mostly of allochthonous origin. Thermal stratification is usually weak and often disrupted by high-flow episodes. In the transition part of a reservoir, phytoplankton biomass and pro-

duction increases due to decreasing flow velocity, increased water residence time and light penetration (Thornton *et al.*, 1990). Because both light and nutrients are usually available for phytoplankton, the transition zone is the most productive region of a reservoir, often experiencing cyanobacterial or algal blooms (Caputo *et al.*, 2008). The lacustrine zone is situated downstream near the dam and has the longest residence time, lowest nutrient concentration, highest transparency and deepest euphotic layer. Phytoplankton growth is usually nutrient-limited (Kimmel, Lind & Paulson, 1990).

Phytoplankton composition and biomass vary at both temporal and spatial scales. Seasonal succession of freshwater phytoplankton has been summarised in the PEG (Plankton Ecology Group) model as an annually

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