Hydrobiologia (2007) 578:29–36
DOI 10.1007/s10750-006-0430-7

PHYTOPLANKTON WORKSHOP

Photosynthetic efficiency as a function of thermal stratification and phytoplankton size structure in an oligotrophic alpine lake

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Abstract Allometric relationships of phytoplankton communities were studied on the basis of a five-year data-set in a deep oligotrophic alpine lake in Austria. The seasonal phytoplankton succession in Mondsee is characterised by diatoms during winter mixing and a distinct metalimnetic population of *Planktothrix rubescens* during stratification in summer. The variation of phytoplankton photosynthetic efficiency between seasons was assessed using in situ carbon-uptake rates (5 years data) and Fast Repetition Rate Fluorometry (FRRF) (2 years data). The light-saturated, chlorophyll-specific rate of photosynthesis (P^{*}_{max}), irradiance at the onset of saturation (E_k) and maximum light-utilisation efficiency (α^{*}) were determined for winter mixing and summer stratification. Fluorescence-based parameters as the functional absorption cross section of Photosystem II (σ_{PSII}) and the photochemical quantum yield (F_v/F_m) were additionally analysed in 2003 and 2004 to study the underlying physiological mechanisms for the variability in photosynthetic performance. Beyond their sensitivity to changing environmental conditions like thermal stratification, phytoplankton populations differ in their photosynthetic behaviour according to their size structure. Therefore Photosynthesis vs. Irradiance (P/E)-relationships were analysed in detail within a 1-year period from size fractionated cell counts, chlorophyll-*a* and carbon-uptake.

Keywords Primary productivity · P^{*}_{max} · E_k · Alpha · FRRF · Size classes

Guest editors: M. Albay, J. Padisák & L. Naselli-Flores
Morphological plasticity of phytoplankton under different environmental constraints.

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Introduction

Phytoplankton photosynthetic parameters in oligotrophic freshwaters are most commonly derived from in situ carbon-uptake rates. In order to provide an insight into the photosynthetic performance of phytoplankton assemblages in oligotrophic freshwaters, supplementary high resolution information on phytoplankton physiology can be obtained using Fast Repetition Rate Fluorometry (FRRF; Kolber et al., 1998), providing non-destructive, real time in situ estimates of