Aquat Ecol (2008) 42:379–389
DOI 10.1007/s10452-007-9095-1

A comparison of phytoplankton size-fractions in Mondsee, an alpine lake in Austria: distribution, pigment composition and primary production rates

Sonja Greisberger · Martin T. Dokulil · Katrin Teubner

Received: 20 October 2006 / Accepted: 7 April 2007 / Published online: 30 May 2007

Abstract Production rates, abundance, chlorophyll *a* (Chl *a*) concentrations and pigment composition were measured for three size classes (<2 μm, 2–11 μm and >11 μm) of phytoplankton from May to December 2000 in deep, mesotrophic, alpine lake Mondsee in Austria. The study focuses on differences among phytoplankton size fractions characterised by their surface area to volume ratio ([$mm^2\ l^{-1}$: $mm^3 l^{-1}$]), pigment distribution patterns and photosynthetic rates. Particular attention was paid to autotrophic picophytoplankton (APP, fraction <2 μm) since this size fraction differed significantly from the two larger size fractions. Among the three fractions, APP showed the highest surface area to volume ratios and a high persistence in the pattern of lipophilic pigments between temporarily and spatially successive samples (about 80% similarity of pigment composition between samples over seasons and depths). The epilimnetic abundance of APP varied seasonally with an annual maximum of 180×10^3 cells ml^{-1} in June (at 4–9 m). The minimum (October at 12 m) was more than an order of magnitude lower (4.9×10^3 ml^{-1}). APP peaked during autumn and contributed between 24% and 42% to the total area-integrated Chl *a* (10–23 mg m^{-2}) and between 16% and 58% to total area-integrated production (5–64 mg $m^{-2}\ h^{-1}$) throughout seasons.

Keywords Lipophilic pigments · Primary production rates · Picophytoplankton · Size fractions · Mesotrophic · APP

S. Greisberger (✉) · K. Teubner
Department of Freshwater Ecology, Faculty of Life Sciences, University Vienna, Althanstrasse 14, 1090 Vienna, Austria
e-mail: Sonja.Greisberger2@sbg.ac.at

K. Teubner
e-mail: Katrin.Teubner@univie.ac.at

M. T. Dokulil
Institute for Limnology, Austrian Academy of Science, Mondseestrasse 9, 5310 Mondsee, Austria
e-mail: Martin.Dokulil@oeaw.ac.at

Introduction

Phytoplankton growth- and photosynthetic rates (e.g. Smith and Kalff 1983; Happey-Wood 1993; Tang 1995; Tang and Peters 1995; Raven 1998), nutrient uptake (e.g. Lewis 1976; Grover 1989) and sinking velocity (Stoke's Law) are dependent on both cell size and cell shape. Many of these authors discuss the advantages of small phytoplankton cells over larger phytoplankton cells based on allometric principles. The greater success of relatively smaller phytoplankton species is usually determined by size-scaled rules: their sinking velocity is reduced according to Stoke's law; also they benefit from their higher surface area to volume ratio, which in turn affects physiological