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Water quality of Greek reservoirs: the impact of land cover and water resources management on phytoplankton

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Introduction

Natural and artificial lakes (reservoirs) are ecosystems of major importance; however, environmental pressures such as eutrophication, global warming and overexploitation of water resources put a pressure on them (Gaglio et al. 2017). Phytoplankton is an important element of aquatic ecosystems and a significant indicator of water quality as it responds directly to eutrophication pressure (Hajnal and Padisák 2008). The objectives of this study are: i) to present recent data on phytoplankton communities of Greek reservoirs; and ii) to investigate their correlation with land cover of river basin and water resources management.

Materials and methods

Sampling campaigns were carried out during the warm season of years 2013-2016 at 25 reservoirs in Greece. Phytoplankton samples were collected from the euphotic zone and were preserved with lugol's solution. Quantitative analysis was performed using the Utermöhl method (Utermöhl 1958). The 2012 Corine Land Cover spatial datasets were downloaded from the Copernicus Land Monitoring Service. For a subset of 23 reservoirs, data for residence time were collected (EYDAP S.A., PPC S.A. etc). Statistical analyses were performed with R (R Core team 2014).

Results and concluding remarks

Biovolume values of Greek reservoirs ranged from 0.02 mm^3/L to 35.25 mm^3/L; 64% of these values where <1 mm^3/L and 22.5% ranged between 1.00 and 3.13 mm^3/L. Three reservoirs (Adriani, Karla and Kerkini) displayed both high biovolume values and high variations between the years (6.40 - 35.25 mm^3/L). Phytoplankton was mostly formed by cyanobacteria in these three reservoirs; *Cylindrospermospis raciborskii*, *Aphanizomenon spp*. and *Anabaena spp.* were the most dominant.

Low values of total phytoplankton and cyanobacteria biovolume were observed in reservoirs located in river basins with a high cover of natural and semi-natural areas (Figure 1). This is expected as most reservoirs are located on mountainous and semi-mountainous areas, where forest and forested areas prevail and human settlements are scarce (Mavromati et al. 2018). On the contrary, high phytoplankton values appeared in river basins with a relatively large cover of intensive agriculture (>30%) (Figure 1).

Values of residence time varied considerably throughout the investigation period, ranging from 0.004 to 4.42 years, according to water resources management decisions. Although phytoplankton biovolume is thought to be related to residence time, in this dataset, this relationship was neither significant nor strong (R^2=0.015, p>0.05).

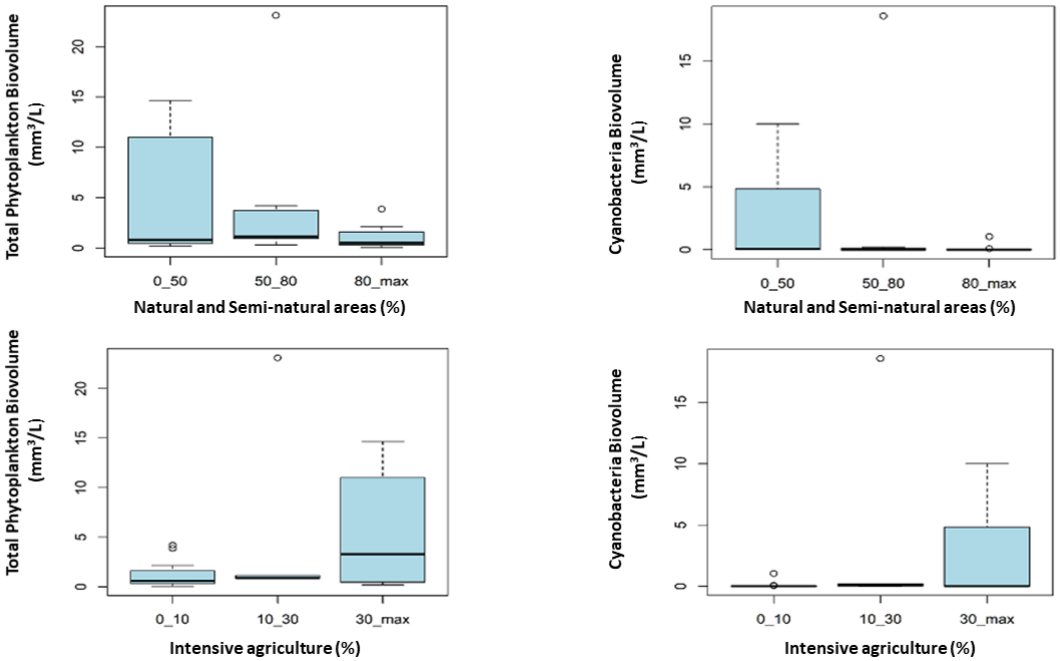

Figure 1. Box and Whisker Plots of natural semi-natural areas and intensive agriculture in relation to total phytoplankton biovolume and cyanobacteria biovolume.

Land cover of river basins has considerable impact on the physicochemical features of natural and artificial lakes in Greece (Mavromati et al. 2018). Surface inflows transfer nutrients from agriculture and other uses, enhancing eutrophication in aquatic ecosystems (Toporowska et al. 2018). This is also indicated by the phytoplankton results of Greek reservoirs in the present study. We recommend to focus management actions at river basin scale. An enlarged dataset from the continuation of monitoring may be required to better understand the link between phytoplankton and residence time in Greek reservoirs.

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