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Impact of meteorological forcing on seasonal phytoplankton succession in a peri-urban lake

Nicolas Clercin*, Brigitte Vinçon-Leite, Francesco Piccioni, Philippe Dubois, Mohamed Saad

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Context

As commonly assumed, global warming will increase water temperatures, strengthen water column thermal stratifications and subsequently lead to more frequent and more severe cyanobacterial blooms.

However, complex interplays between meteorological conditions and phytoplankton may result in different species assemblages, potentially outcompeting cyanobacteria.

A study conducted between 2019 and 2020 in Lake Champs-sur-Marne, a small peri-urban lake in Eastern Paris, revealed two different algal successions during the summer periods despite similar air temperatures.

Study site & Methodology

Lake Champs-sur-Marne (LDC) is a former gravel pit:

- small (12 ha) and shallow ($Z_{max} = 3m$);
- near the Marne River (Fig. 1).

Water temperatures: 0.5m and 2.5m; every 10 mins.

Water samples: at 1.5m, biweekly

Lab analyses:

- $N-NO_3$, $P-PO_4$,
- Chlorophyll (Chl) and Phycocyanin (PC),
- Phytoplankton identification and enumeration



Fig. 1 – Lac Champs-sur-Marne France

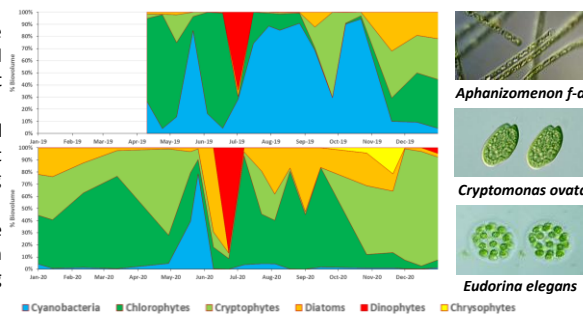


Fig. 2 – Algal dynamics in LDC, 2019-2020.

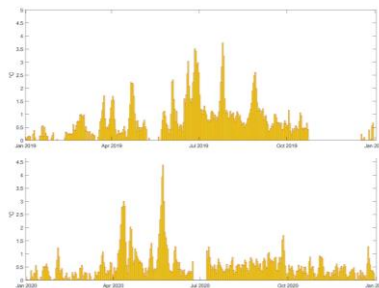


Fig. 3 – Temperature differences (Delta_Temp) between lake surface and bottom.

Algal successions

- During the summer 2019, a massive bloom of nitrogen-fixing cyanobacteria *Aphanizomenon flos-aquae* (Fig. 2).
- No cyanobacteria bloomed during summer 2020;
- A dominance of chlorophyceae (*Eudorina elegans* and *Dictyosphaerium pulchellum*) and later cryptophyceae (*Cryptomonas ovata* and *Chroomonas spp.*) species were observed.

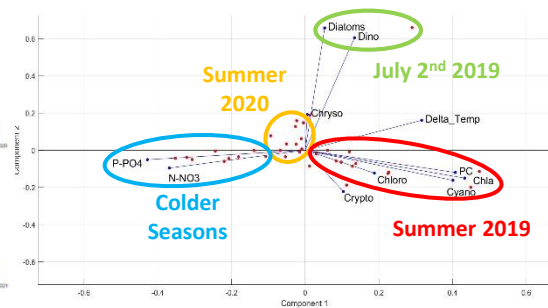


Fig. 4 – PCA of main algal groups versus environmental parameters. C1 and C2 axes represent 28.4% and 16.1%, respectively.

Environmental variables and phytoplankton

- Similar air temps and nutrient levels were measured throughout both summer periods;
- Weaker Delta_Temp values indicated more turbulent water columns in summer 2020 (Fig. 3);
- Interplay of these conditions were not favorable for cyanobacterial growth (Fig. 4).