Phytoplankton dynamics in a tropical tidal river impacted by a megacity: the case of the Saigon River (Southern Vietnam)

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INTRODUCTION

Phytoplankton including microalgae and cyanobacteria are primary producers in aquatic ecosystems. Global warming and anthropogenic activities (e.g. urbanization and anthropogenic emission) cause a degradation on water quality and the eutrophication of water bodies, consequently shift of phytoplankton community through enhancing the dominance of cyanobacterial abundance in rivers [1]. Saigon River in Southern Vietnam offers a considerable services to more than 10 million local people such as drinking water supplies, agriculture, aquaculture, navigation and recreational purposes [2]. In this study we investigated the spatial and temporal variation of phytoplankton and their correlation with environmental parameters in Saigon River in the context of urbanization contaminants from Ho Chi Minh City (HCMC). The main objectives are i) to assess the level of phytoplankton and diversity in Saigon River ii) to explain the spatio temporal variability along a river gradient iii) to find the main proxy explaining the phytoplankton dynamics, and iv) to evaluate the impact of the urban contamination on the phytoplankton dynamics.

METHODS

Sample collection and analyses

A bi-monthly monitoring was undertaken at 3 stations (SG01 or Phu Cuong, SG10 or Bach Dang, SG18 or Binh Khanh) from Oct. 2016 to Dec. 2017 in Saigon River (Fig. 1). Two longitudinal profiles during wet and dry seasons from upstream to downstream of HCMC were carried out to understand the spatial fluctuation of the level of phytoplankton and diversity in Saigon River (SG01–SG18). At each site, surface water was taken and in situ physico-chemical parameters were measured using a multi-parameter probe (WTW 3420®), e.g. pH, temperature, conductivity, salinity, and dissolved oxygen concentration. Water samples were used for environmental parameter analyses e.g. total suspended sediment, nutrients (total and dissolved N, total P, PO_4^{3-}, silicate), organic carbon, Chlorophyll-*a*, trace metals (ICP/MS), and phytoplankton abundance [3, 4] .

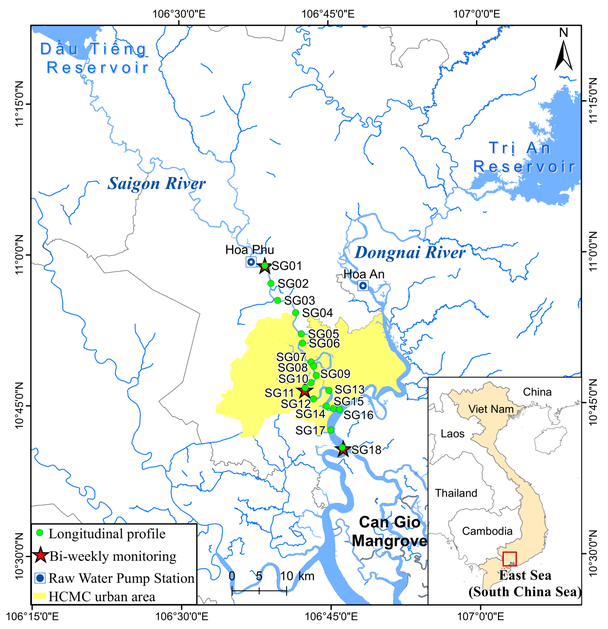

Fig. 1. Map of Saigon River and location of the sampling sites (SG01 – SG18)

Data treatment

Principle Component Analysis and Pearson tests were applied for correlation analyses

RESULTS & DISCUSSION

The longitudinal profiles along the River revealed contrasted phytoplankton densities between the two seasons (Fig. 2). In dry seasons, the most abundant phytoplankton groups were (i) diatoms dominated by *Leptocylindrus* (SG01-04, km0-13), *Cyclotella* (SG05-13), and (ii) cyanobacteria dominated by *Cylindrospermopsis* (SG14-18, km52-61). In contrast, in rainy season, the most abundant groups were (i) diatoms dominated by *Eunotia* (SG01), (ii) euglenoids dominated by *Trachelomonas* (SG02-12), and (iii) cyanobacteria dominated by *Cylindrospermopsis* (SG13-15), and *Microcystis* (SG16-18).

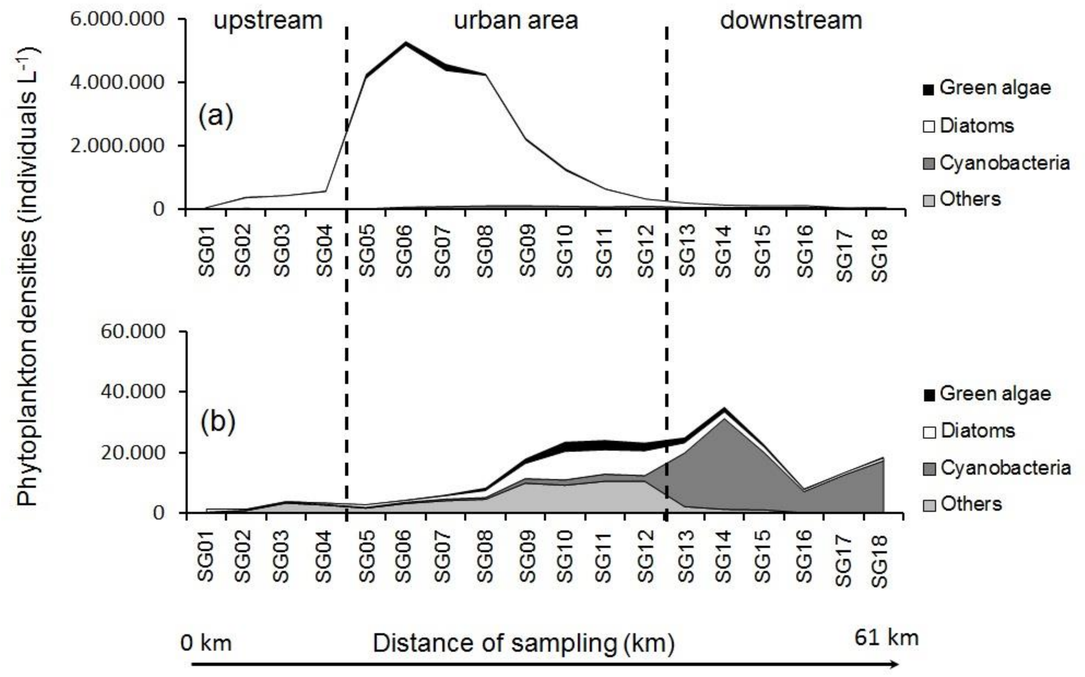

Fig. 2. Phytoplankton densities during longitudinal profile monitoring in dry season, April (a) and in rainy season, October (b) of 2017. Others include euglenoids, dinoflagellates and golden algae

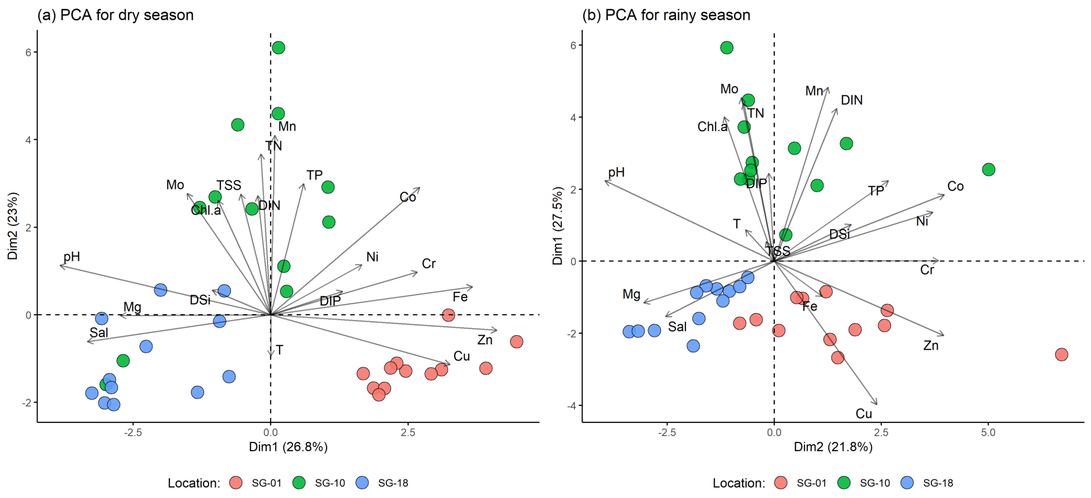

Fig. 4. The relationship of the loading physio-chemical parameters and the first two principal components (PC1, PC2) of the three sampling sites (SG01, SG10, and SG18) in (a) dry season and (b) rainy season in Saigon River. The environmental parameters with longer length are the controlling parameters

RESULTS & DISCUSSION

The phytoplankton densities varied between sites with several orders of magnitude (Fig. 3). The dominant phytoplankton species and genera varied among the sites and were globally characterized by diatoms, cyanobacteria, green algae, euglenoids, and dinoflagellates.

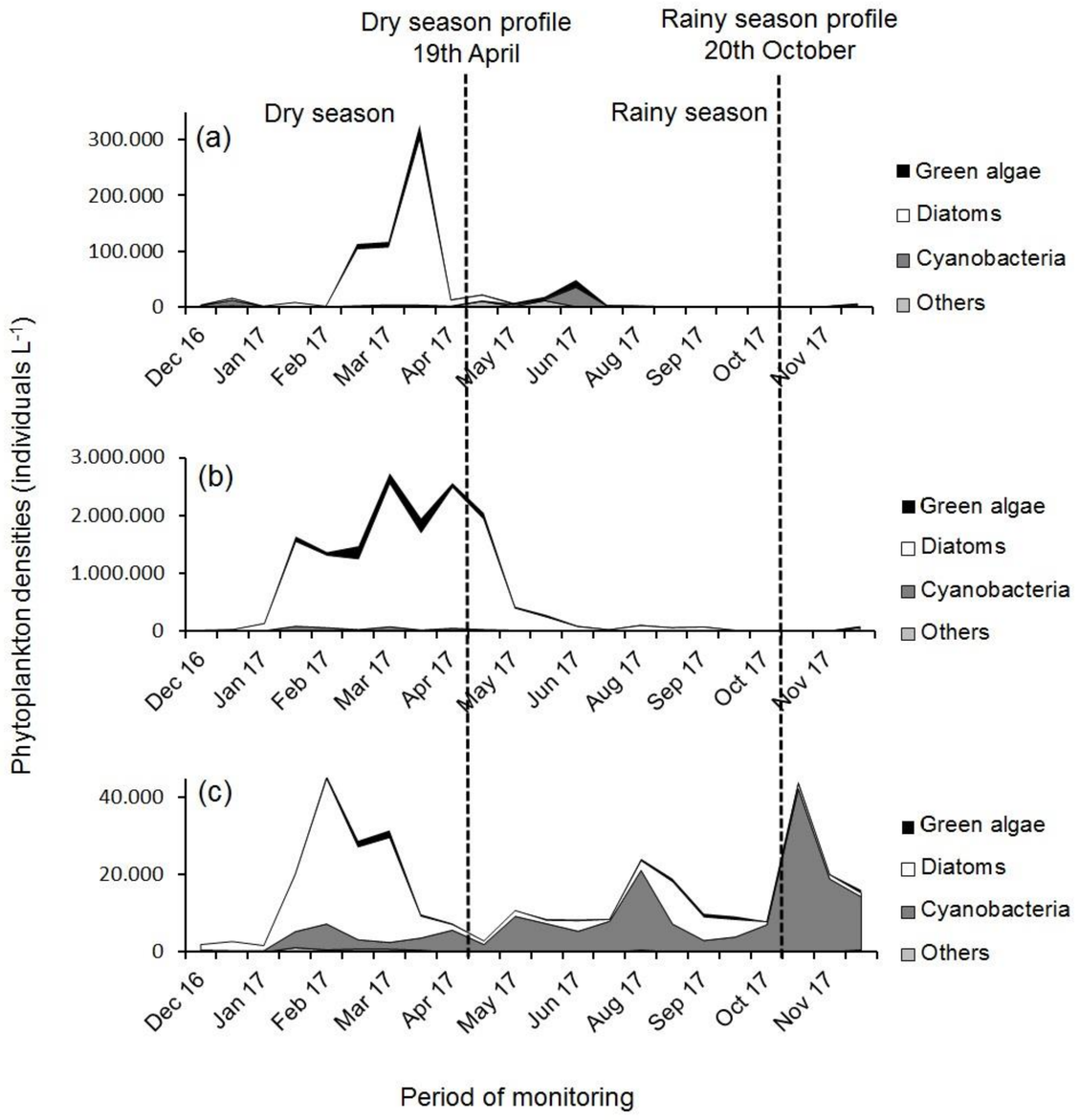

Fig. 3. Temporal phytoplankton densities at the sites SG01 (a), SG10 (b), and SG18 (c). Others include euglenoids, dinoflagellates and golden algae

The three diatoms, cyanobacteria and euglenoids mainly contributed into the total phytoplankton abundance or total chlorophyll which had a positive correlation with pH, temperature, DIN, Mo and Mn (Fig. 4).

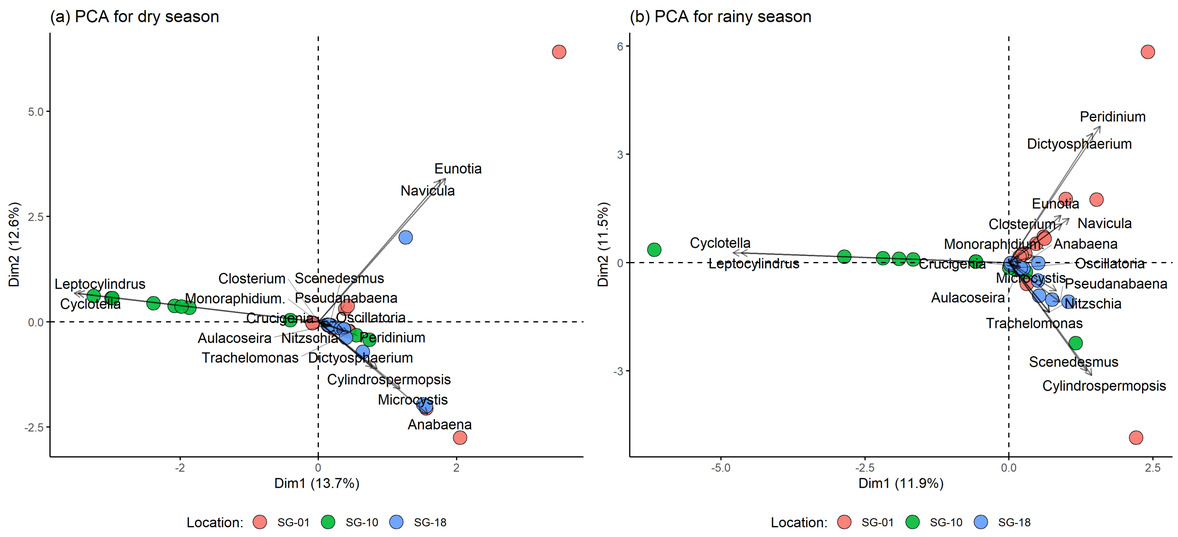

Fig. 5. The relationship of phytoplankton abundance of the three sampling sites (SG01, SG10, and SG18) in (a) dry season and (b) rainy season in the Saigon River.

CONCLUSIONS

- Phytoplankton pattern was seasonally varied, separated between the urban and the remaining area
- The phytoplankton abundance was much higher in dry season in the urban area of the Saigon River.
- The phytoplankton proliferation was closely linked to the water discharge from upstream, low residual water discharge in the urban area and nutrient inputs from canal and creeks, as megacity emission of HCMC
- Phytoplankton abundance was also positively correlated with nitrogen and phosphorus concentration, pH, TOC and some trace metals such as Co, Mo and Mn, and negatively correlated with Cu
- The cyanobacterial species *Cylindrospermopsis raciborskii* and *Microcystis* spp possessed a potential ecological health risk at the monitored stations

References

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