CAN EMERGENT MACROPHYTE STANDS BUFFER THE N:P RATIO OF SHALLOW LAKES?

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INTRODUCTION

Domestic sewage input is one of the main causes of artificial eutrophication in aquatic ecosystems, contributing to change both absolute nutrients concentrations and their ratios. Domestic sewage is rich in labile organic compounds due to high amount of (N) and (P) in its chemical composition (Prairie et al. 2002). Indicatives of organic matter quality may be obtained through C:N:P ratios, because less labile organic matter shows proportionally more carbon in relation to other nutrients. The composition of nutrient sources is the major determinant of N:P ratio in lakes (Downing and Mccauley 1992). It is well-recognized that mesotrophic and eutrophic lakes with sewage inputs have lower N:P ratios comparing to oligotrophic ones, since those lakes receive various mixtures of nutrients sources characterized by low N:P (Downing and Mccauley 1992).

Lakes are known as typical recipient ecosystems for N and P from sewage inputs in the watershed. In addition, the most part of global lakes are shallow (Downing et al. 2006) and densely colonized by emergent aquatic macrophytes (Wetzel 1990). This vegetation often retains nutrients from sewage (Costa-Pierce 1998), removing more P than N (Fisher and Acreman 2004). Shallow depth and domestic sewage discharges are conditions that favor emergent aquatic macrophytes growth, enhancing even more P removal in lakes (Miao et al. 2000). Thus, the important role of this vegetation can influence water column N:P ratios in shallow lakes.

The aim of this study was to evaluate temporal and spatial N:P ratio changes in a whole-lake approach. Our hypothesis was that the area densely colonized by emergent aquatic macrophytes of this lake would buffer the enhance of phosphorus input caused by the increase of domestic sewage discharge, keeping the N:P ratio of this area as high as it was in a more pristine condition.

MATERIAL AND METHODS

The studied tropical shallow lake was Imboassica lagoon (22^o 24' South and 42^o 42' West), a coastal ecosystem with mean depth of 1.4 m, area of 3.2 km^2 and situated at Macaé city (Rio de Janeiro State, Brazil). We collected in three sampling stations in Imboassica lagoon. The station located close to the sandbar that separates this lagoon from the ocean (PHY station), presented the highest turbulence among all stations. This condition associated with marine influence contributed to reduce aquatic macrophytes colonization in its margins. CEN station is located in the central area of the lagoon and THY station is the farthest station from the PHY. Colonization by aquatic macrophytes (mainly emergent Typha domingensis) at the margin of THY station is denser and turbulence is lower than other stations. This aquatic macrophytes stand has an area of approximately 0.5 km^2, almost 15% of total Imboassica lagoon area.

RESULTS AND DISCUSSION

The similar DN:DP ratios among sampling stations in both studied periods evidenced a low spatial heterogeneity for dissolved fraction of organic matter in Imboassica lagoon. Therein, we can infer that any differentiation found for total N:P ratio is probably related to the particulate fraction of the organic matter. This homogenous pattern is interrupted by the heterogeneity of physical conditions (wind and salinity), that is responsible for differential colonization by aquatic macrophytes. The emergent aquatic macrophyte *Typha domingensis* have low N:P tissue ratio due to phosphorus oversupply (Miao and Sklar 1998) and nutrients resorption from senescent biomass of *Typha domingensis* is diferential, being phosphorus resorption efficiency up to 50% higher than nitrogen resorption (Rejmankova 2005). Therefore, it can be inferred that the maintenance of high total N:P ratios in the water column of THY station during both periods is caused by differential absorption and resorption of these nutrients, since phosphorus is primarily more absorbed than nitrogen and the major part of phosphorus that would be released into water column by senescent

T. domingensis leaves may be reabsorbed through live biomass.

The high cholophyll-a concentrations and low COLOR:DOC ratio suggested that most of DOC originates from phytoplankton at the PHY station during the eutrophic period, while indicates a predominant influence from emergent aquatic macrophytes to water lake at THY station. This organic carbon production in Imboassica lagoon can also change the conditions of each station, since emergent aquatic macrophytes are constituted by less labile organic compounds than submerged macrophytes and algae. Thus, the more refractory organic carbon from aquatic macrophytes in THY station can enhance even more phosphorus sink by peat accretion, since the mineralization of the nutrients that constitutes this refractous biomass in much lower than in PHY station where carbon from algae is dominant. Peats can effectively store P in shallow aquatic ecossystems with areas colonized by emergent aquatic macrophytes, such as the Everglades wetland (Craft and Richardson 1993).

CONCLUSION

In conclusion, eutrophication from domestic sewage inputs may result in different intra-ecosystem N:P ratio responses in shallow lakes. The regions colonized by emergent macrophytes may show high N:P ratio, while regions without or with low density of this vegetation may show low N:P ratio. This study confirmed the hypothesis that the area densely colonized by emergent aquatic macrophytes of Imboassica lagoon buffers the enhance of phosphorus input caused by the increase of domestic sewage discharge, maintaining the N:P ratio of this area as high as it was in a more pristine condition. Imboassica lagoon shows high intra-ecosystem N:P ratio heterogeneity, even with a similar input of nutrients due to artificial eutrophication, showing that composition of nutrient sources might not be the major force determining N:P ratio in tropical shallow lakes. This study shows that autochthonous players can be of major importance for N:P general characterizations of shallow lakes even in a intra-lake scale.

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