Trophic interactions in three major lakes under human disturbances in Luzon Island (Philippines): A preliminary study

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The utilization of inland water bodies for anthropogenic use is a known necessity. However, an unfortunate counter-result includes ecological threats and disturbances due to the mismanagement of these aquatic resources. The present study investigates the possible implications to trophic interactions of the biota of three neighboring lakes with varying degrees of anthropogenic impact.

Research on Philippine lake ecosystems is still scarce

For decades, many inland water bodies in the Philippines have been significantly tapped as an economic resource. Most notable is the use of lakes for aquaculture starting in the 1970s. Since then, aquaculture had become the dominant source of fish supply in the Philippines, amounting to almost half of the total fish production in the country. Most of these cultured fish come from lakes in the south of Luzon Island: Laguna de Bay, Lake Taal, and Lake Sampaloc belonging to the Seven Lakes of San Pablo. Poor implementation of regulatory provisions for aquaculture had arguably produced a visible decline in water quality and ecosystem health in these three main lakes. However, the implications of anthropogenic disturbances in these three neighboring lakes are still poorly understood since information on many ecological processes, including trophic interactions of biota in each lake, is still scarce or nothing. The objective of the research was to characterize trophic interactions among biota representative to the three aforementioned lakes with varying degrees of anthropogenic impact.

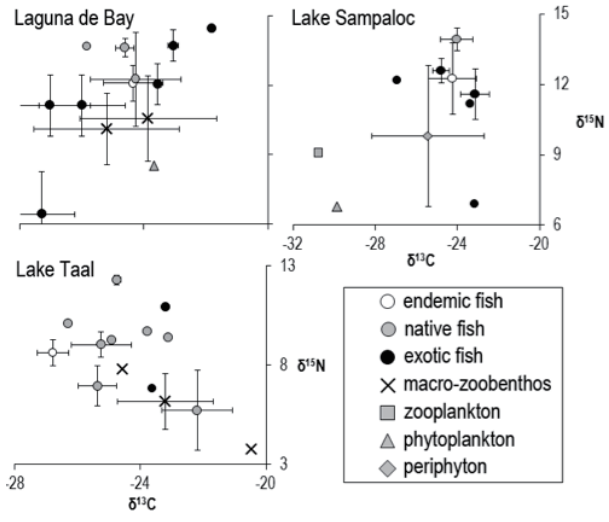

Figure 1. A dual isotope plot of $\delta^{13}C$ and $\delta^{15}N$ of selected flora and fauna from Laguna de Bay, Lake Sampaloc, and Lake Taal.

Methods

Representative floral and faunal species that highlight each lake were sampled, dried in 60°C for at least 24 hours, and grinded into a fine powder. Animal samples underwent an additional lipid extraction by immersion in chloroform: methanol (2:1) solution for 24 hours and dried again in 60°C for at least 24 hours. After sample processing, dry powder samples were weighed and wrapped in tin capsules. Their carbon and nitrogen stable isotope ratios were determined using an Isotope Ratio Mass Spectrometer (IRMS) and calibrated by working standards. Their values notated as $\delta^{13}C$ and $\delta^{15}N$ were expressed in permil (‰) deviation from international standards (Vienna Pee Dee belemnite for C and atmospheric nitrogen for N). These values were used to produce a dual isotope plot to delineate the trophic interactions of each lake system.

Results and Discussion

The results revealed clear differences in trophic interactions among the three neighboring lakes (Fig.1). In Laguna de Bay and Lake Taal, many fish species relied on zoobenthic diets. In Laguna de Bay as compared to the other two lakes, it is a cause for alarm that the majority of the C-N niche space is occupied mostly by introduced species, overlapping with the trophic niche of some native fish species. This suggests that there exist a potential competition for food resources between native and invasive species. This result may reveal certain mechanisms as to why, based on local reports, the population of native fish species has been declining in congruent with the population increase of exotic fish species in Laguna de Bay. In contrast, fish species in Lake Sampaloc were closely associated with periphyton, were highly enriched in $\delta^{13}C$ and had a shallower niche breadth, as compared to the two other lakes. This is attributed to the lack of a defined pelagic habitat for Lake Sampaloc, since it is the smallest of the three lakes being studied with only a total area coverage of 1.04 km2, as compared to Lake Taal (234.2 km^2) and Laguna de Bay (911 km^2). In closing, these results present a snapshot of the trophic interactions of major biota for each of the three lakes and provide baseline data by which certain ecological mechanisms maybe elucidated in the future. Aspects of interest for further studies would be of the effects of aquaculture-induced eutrophication and invasive species in these three lakes, which may be elucidated as soon as data on the productivity of each primary producer, the biomass of consumers, and the isotopic signatures of basal food sources are determined.