COMMUNITY STRUCTURE AND DYNAMICS IN COASTAL STREAMS OF THE ATLANTIC FOREST: THE ITANHAÉM RIVER BASIN

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Figure 1. Stand of the aquatic macrophyte Nymphaea rudgeana *in Preto River, Itanhaém – SP – Brazil). Photo by Antonio Camargo.*

Figure 2. Itanhaém River, Itanhaém, SP, Brazil. Photo by Antonio Camargo.

The factors governing the spatial structure and temporal dynamics of biodiversity involve a complex mix of ecological, biogeographic and evolutionary processes. The relative influence of these processes is at the heart of the current debate on biodiversity research. Since nature is dynamic, studies that consider sampling over time, including several generations of populations, are highly desirable and necessary for a better understanding of biodiversity patterns. Rivers and streams are discrete areas embedded in a terrestrial landscape - the watershed. Environmental changes in watersheds are very dynamic and occur at different time scales, and have both natural and anthropogenic causes. Among the natural causes, changes can occur due to seasonality with aquatic environments presenting different characteristics between summers and winters, for example. However, changes may occur at longer time scales due to rainy and dry annual cycles due to El Niño and La Niña. As for the anthropic changes, these occur in the long term, due, for example, to agricultural and urban expansion, deforestation, but also to sewage collection and treatment and reforestation. We have observed that these situations have been occurring in the last 20 years in Itanhaém, south coast of São Paulo. The selection of this river basin as a unit to develop ecological studies was motivated by the diversity of physiographic characteristics, diversity of use and occupation of the soil (conservation, agricultural and urban areas) and diversity of water types (white, clear, black and brackish). In addition, a geo-referenced database has allowed us to monitor and map changes in basin land use, especially in relation to the emergence of new anthropogenic impacts. Although this project has as its central theme the long-term ecological study of the Itanhaém river basin, it is composed of subprojects with independent objectives and themes. In general, this project attempted to answer questions such as: 1) How is the variation between communities in space and time maintained? 2) What generates this variation? 3) Are the species with wide distribution in the basin also species with great environmental tolerance? The answers to these questions are fundamental for the understanding of the functioning of these communities as well as the design of biomonitoring programs.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Until the beginning of 2017, our main findings are: 1) Stream macroinvertebrate beta diversity patterns can be studied in watersheds like this by using five subsamples per stream. This allows one to reduce subsampling and invest in making the spatial extent of the study larger by including more streams; 2) Phylogenies and traits provide distinct insights about the historical and contemporary assembly of aquatic insect communities. We suggest that both trait and phylogenetic approaches to community ecology should be kept in the ecologist toolbox, but phylogenetic distances should not be used as proxies of traits differences. Although the phylogenetic structure reveals processes operating at the evolutionary scale, only specific traits explained local processes operating in our communities; 3) Dispersal limitation, rather than species sorting, was the main driver for phylogenetic beta diversity in the stream macroinvertebrates. We suggest that life-history strategies and mainly voltinism drive the distance decay of similarity in the insect communities examined; 4) To estimate fish population size along a 1000 m extension in streams with high accuracy and precision we would need to sample at least half of this extension and ensure at least 50% of detection probability; 5) Rithron fishes are mainly structured by habitat selection while potamon fishes are structured by dispersal in downstream areas; 6) Systematic sampling provides good cost effective design to monitor fish diversities in these streams as it provides more precise estimates with smaller sample sizes. However, combining stratified sampling across sub-basin with systematic sampling along the environmental variation axis allows monitoring all range of variation in environmental characteristics and cover the entire basin area. Twelve sites are a reasonable sample size as it allows defining three sites per sub-basin and can be accomplish during a one-week of fieldwork; 7) The greater the distance from the river mouth, the lower is algal biomass. There is, thus, a longitudinal biomass gradient in the head-to-mouth direction, according to the River Continuum concept; 8) Abiotic stress (low nutrient availability) is responsible for the absence of *S. alterniflora* in the upper estuary and that the competition between the two species is responsible for the absence of *C. americanum* in the lower estuary; 9) Invasive species reduced the presence of rooted-submerged species, whereas native species facilitated the occurrence of rooted-submerged and free-submerged species. Thus, African signal-grass was able to change the composition of the macrophyte assemblage and can represent a threat to native communities of tropical freshwater ecosystems.

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