Sustainability exploration of key trophic interactions for a large-scale fish database using trait-based prey-predator matrices

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Introduction

This poster is part of a series on the diagnosis of the magnitude of ecological impacts in rivers, to eventually result in effective environmental management. It specifically investigates whether the food-web structure ("connectance") is scale-variant.

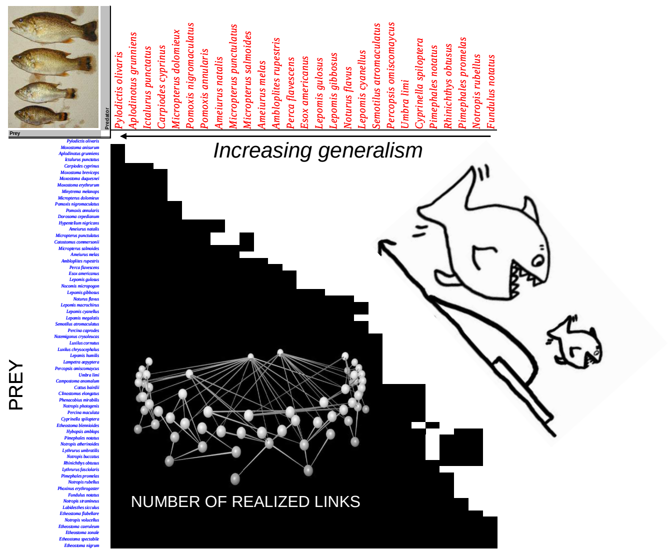
Each ecosystem or community exhibits a capacity to incorporate environmental changes. Such concrete systems, representative in their abiotic and biotic properties as well as their faunal composition for a range of real sites, can be defined as group of sites characterized by selected physical, chemical and biological attributes. Thus, even under environmental conditions that are hold constant for a certain time span, the ecosystem functioning is part of a continuous, dynamic process.

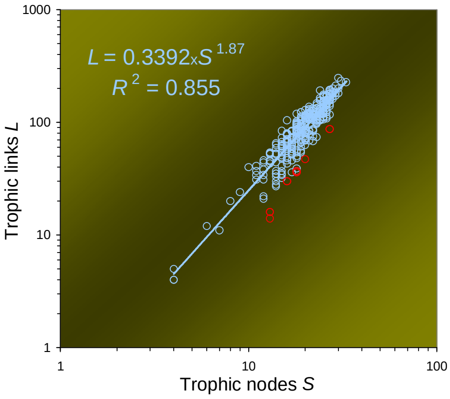
Using empirical evidence from field studies, we formulate a hypothesis to explain how the response of native fish species:

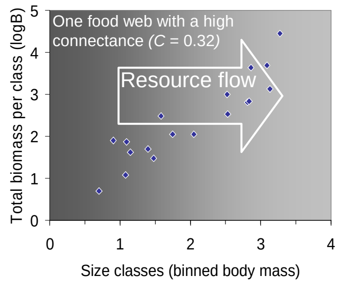
- reacts to incremental changes along multi-stress gradients, and
- enhances stability of the food-web structure (biomass spectra).

Methods

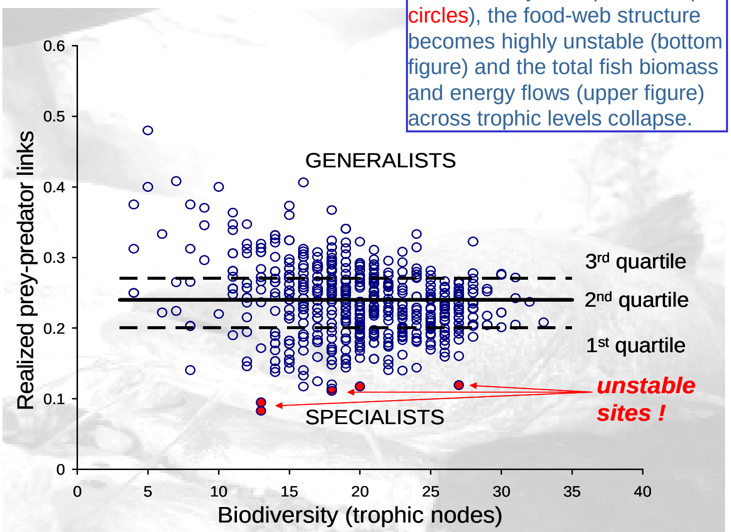
The extent to what piscivorous fishes will feed on other species is quantified by metrical computations. Rather than computing the link density as the number of realized trophic interactions per local-occurring fish species, a new measure was derived from the Shannon-Wiener entropy index of the links of individual species. Based on our empirical knowledge of fish traits –like body size– and consequently the fish guilds, the proportion of all possible trophic links (L) that are realized in one food web of S species (connectance C, where $C = L/S^2$, as derived from the matrix shown below) is suggested to reflect either a dominance of fish generalists (high C values: omnivory dominates) or a skew towards specialists and immature life stages (low C values: high sensitivity to environmental stress). Such methodologies are supposed to reduce the influence of empirical differences in long-term sampling efforts as in the US-EPA Monitoring Programme.







The number of trophic links L is a power function of fish diversity S. As soon a community becomes dominated by fish specialists (red circles), the food-web structure becomes highly unstable (bottom figure) and the total fish biomass and energy flows (upper figure) across trophic levels collapse.



Conclusions so far

We thus quantified the trophic structure ("who eats whom") for the native fish species occurring at each location in relation to different chemical elements. This step is crucial, because large data sets are rarely homogeneous enough to justify the computation of variances from coefficients of variations across data sets. In this way we can compare efficiently the trophic sustainability for the fishes occurring at each location. From an overall assessment, it can be concluded that the fish communities which can be regarded as *sustainable* and *stable* are **more widespread and common** than preliminarily thought. Such a structural approach strongly contributes to re-assess Red-Lists for legal conservation status of native key specialists. We illustrate the utility of the trophic exploration using trait-based approaches and we show how it can be a useful, ecology-based fundament in researching contaminant-stress in exposed fish communities in Ohio.

References on methodology

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