Master thesis proposal

Establishing robust relationships between size and trophic level in fishes globally

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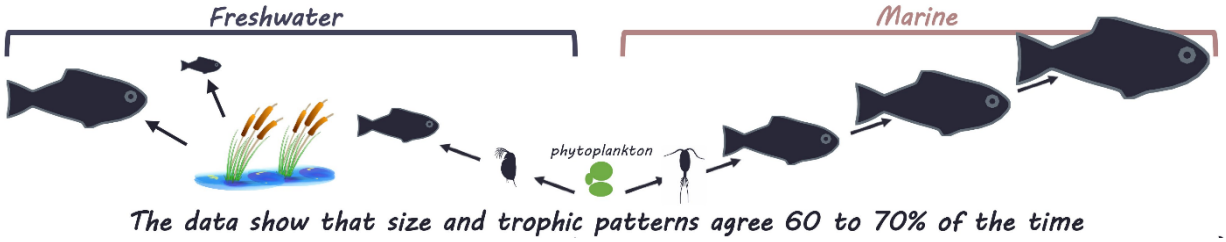

The growing availability of data and large phylogenies for thousands of species means we are now in a position to more rigorously explore the relationships between different characters, and map these on a global scale to better understand what processes drive global patterns of biodiversity. For example, researchers are mapping the body sizes of species globally in order to determine what environmental and evolutionary factors best predict size. Such efforts will also help researchers to determine how a changing climate may influence these patterns in the decades and centuries ahead. In this vein, a supervisor on this study documented how fish sizes vary systematically between the major salinity environments in aquatic settings, such as between marine and freshwater fishes (Clarke 2021). This study also found some evidence that the trophic level of fishes (i.e. whether they are high or low down in the food chain) appeared to correlate well with these size differences between environments. The observed variation raised the question 'exactly how tight is the relationship between size and trophic level in fishes, and are their other widely available traits that may better predict size or trophic level?'. Although this has been explored broadly without a phylogeny, or in more detail using smaller datasets, a dedicated, broadscale phylogenetic evaluation would more clearly establish the relationship, and enable broader predictions to be made.

The student would therefore seek to:

- use phylogenetic information to rigorously establish relationships between size and trophic level in at least 7000 species of fishes. The student may also choose to utilise the R package mvSLOUCH developed in house by Krzysztof Bartoszek (Bartoszek et al. 2012) to test for more sophisticated relationships between these two traits.

- establish if any other anatomical traits act as a better predictor of trophic level. For instance, it has been suggested that jaw size is superior predictor relative to body size, but this has only been demonstrated in relatively small numbers of taxa.

- establish how this relationship changes by taxonomic group, size class, and dietary category. For instance, there is evidence this relationship is relatively weak in small taxa, but strengthens above a certain threshold size, above which the relationship grows stronger. Similarly, the relationship may be absent in fishes with specific diets (e.g. herbivores) but strong in some predatory taxa.

- use these newly established relationships to predict the size or trophic level for taxa where we only possess one of these traits.

Bartoszek, K. and Pienaar, J. and Mostad. P. and Andersson, S. and Hansen, T. F. (2012) A phylogenetic comparative method for studying multivariate adaptation. Journal of Theoretical Biology

Clarke, J.T (2021). Evidence for general size-by-habitat rules in actinopterygian fishes across nine scales of observation. Ecology Letters.