
Coral reef fish communities are not size-structured: implications on the prevalence of inverted trophic pyramids

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Abstract

Unravelling the dynamics of food webs is a major goal for ecology. In this context, the analysis of the distribution of biomass across body-size classes (i.e. the size spectrum) allows for the description of the shape of the trophic pyramid and for the indirect inference of energy fluxes in size-structured ecosystems. On coral reefs, an apparent inversion of the regular bottom-heavy trophic pyramid has been documented and extensively debated. Potential explanations for this phenomenon range from methodological biases in quantifying large mobile fish density, to spatial subsidies feeding higher trophic levels. Here, we show evidence that inverted size-spectra are due to a substantial lack of relationship between fish body size and trophic position. Using an extensive stable isotope dataset (d15N) on fish trophic position, body mass and biomass for 240 species across 58 sites spanning four Indo-Pacific archipelagos, we explored the distribution of biomass across body-size trophic-position classes. Consistent with previous studies, our analyses revealed a positive correlation between biomass and body mass classes (i.e. which has been interpreted as evidence for inverted pyramids). However, when we used d15N from stable isotopes as a proxy of species trophic position instead of body mass, the observed trophic pyramid exhibited a bottom-heavy shape, with higher biomass in primary consumers compared to higher trophic positions. This study challenges previous findings and suggests that coral reef fish community data cannot be described by simple size spectrum models.

Keywords: trophic structure, pyramid, biomass, reef fishes, size spectra, stable isotopes

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