

Community size structure varies with predator-prey size relationships and temperature across Australian reefs

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March 11, 2022

Abstract

Climate change and fisheries exploitation are dramatically changing the species composition, abundances, and size spectra of fish communities. We explore whether variation in abundance-size spectra, a widely studied ecosystem feature, is influenced by a critical parameter thought to govern the shape of size-structured ecosystems—the relationship between the sizes of predators and their prey (predator-prey mass ratios, or PPMRs). PPMR estimates are lacking for vast numbers of fish species, including at the broader trophic guild scale. Using measurements of 8,128 prey items in gut contents of 97 reef fish species, we established PPMRs for four major trophic guilds (piscivores, invertivores, planktivores and herbivores) using linear mixed effects models. To assess theoretical predictions that higher mean community-level PPMR leads to shallower size spectrum slopes, we compared observations of mean community-level PPMR with size spectrum slopes for coastal reef sites distributed around Australia. PPMRs of individual fishes were remarkably high (median ~71,000), with significant variation between different trophic guilds (~890 for piscivores; ~83,000 for planktivores), and ~8,700 for whole communities. Community-level PPMRs were positively related to size spectrum slopes, broadly consistent with theory, however, this pattern was also influenced by the latitudinal temperature gradient. Tropical reefs showed a stronger relationship between community-level PPMRs and community size spectrum slopes than temperate reefs. The extent that these patterns apply outside Australia, and consequences for community structure and dynamics, are key areas for future investigation.

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