Phylogenetic conservatism drives nutrient dynamics of coral reef fishes

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March 30, 2022

Abstract

A predictive understanding of ecological processes requires identifying the factors that explain variation in the organismal traits that drive these processes. Integrating evolutionary history and ecology has been shown to be essential to understand variation in traits that determine species interactions in community ecology. However, the extent to which these factors determine traits relevant for ecosystem dynamics (and thus ecosystem ecology) is poorly understood. Nutrient cycling is essential for reef ecosystem dynamics, and consumers are critical drivers of this process. We use a dataset of nine consumer "chemical traits" (e.g., body nutrient content and nutrient excretion rates) associated with nutrient cycling, collected from 1,572 individual coral reef fish (178 species spanning 41 families) in two biogeographic regions, the Caribbean and Polynesia, to quantify the relative importance of phylogenetic history and ecological context as a driver of chemical trait variation on coral reefs. We find: (1) phylogenetic history is a better predictor of variation in all chemical traits, overwhelming the influence of ecological factors, (2) phylogenetic conservatism in chemical traits is greater in the Caribbean than Polynesia, where our data suggests that ecological forces may have a greater influence on chemical trait variation, and (3) differences in chemical traits between regions can be explained by differences in nutrient limitation associated with our study locations. Our study provides multiple lines of evidence that phylogenetic conservatism is a critical determinant of contemporary nutrient dynamics on coral reefs. More broadly our findings highlight the utility of evolutionary history to improve prediction in ecosystem ecology.

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