

Parrotfish abundance and selective corallivory on a Belizean coral reef

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Abstract

Parrotfish are important members of coral reef communities because they consume macroalgae that would otherwise outcompete reef-building corals for space. However, some Caribbean parrotfish species also feed directly on live corals, and thus have the potential to negatively impact coral fitness and survival. This study investigates selective grazing by parrotfish on particular coral species, differences in grazing incidence among reef habitats and intraspecific discrimination among colonies of several coral species. We also investigate spatial and temporal patterns of parrotfish species abundance across habitats on the Belize barrier reef, and examine correlations between parrotfish abundance and grazing intensity across reef habitats. We found that members of the *Montastraea annularis* species complex, major builders of Caribbean reefs, were preferred targets of parrotfish grazing across all reef habitats, while *M. cavernosa*, *Agaricia agaricites*, *Diploria strigosa*, *Porites astreoides* and *Porites porites* were not preferred; *Siderastrea siderea* was preferentially grazed only in the spur and groove habitats. Parrotfish grazing preferences varied across habitats; *M. annularis* was grazed most often in shallow habitats, whereas *M. franksi* was consumed more at depth. Although it was not possible to directly observe parrotfish grazing on corals, we did find a positive correlation between *Sparisoma aurofrenatum* abundance and *M. franksi* grazing incidence across habitats. Finally, when we compared our results to parrotfish abundances measured by a previous study, we found that *Sparisoma viride* and *Sp. aurofrenatum*, two species known to be corallivorous, had increased abundances between 1982 and 2004. In light of escalating threats on Caribbean reef corals, it would be important for future studies to evaluate the impact of parrotfish corallivory on coral survival.

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1. Introduction

Scleractinian corals are ecosystem engineers (sensu Jones et al., 1994) of tropical reefs, providing a structural base for one of the most diverse ecosystems world-

wide. Parrotfish play an important role in the maintenance of coral reefs; as herbivores, they consume macroalgae that otherwise outcompetes reef-building corals for space (Lewis, 1986; Hughes, 1994; Bellwood et al., 2004). Parrotfish are known to feed selectively on different types of algae (Lewis, 1985; Bellwood and Choat, 1990; Bruggemann et al., 1994a). In addition, some Caribbean parrotfish species, including *Sparisoma viride*, *Scarus vetula*, *Sc. guacamaia* and *Sparisoma aurofrenatum*, have been reported to feed

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directly on living corals (Gygi, 1975; Frydl, 1979; Littler et al., 1989; Bruggemann et al., 1994b; Miller and Hay, 1998; Bruckner et al., 2000; Garzon-Ferreira and Reyes-Nivia, 2001; Sanchez et al., 2004; Rotjan and Lewis, 2005). Because of the potential negative effects such parrotfish corallivory may have on coral fitness (Van Veghel and Bak, 1994; Meesters et al., 1996; Rotjan and Lewis, 2005), it is important to understand whether parrotfish feed selectively on coral, as might be predicted by their algal diet selectivity. However, little is known about parrotfish feeding selectivity among coral species and only a few studies have quantified spatial patterns of parrotfish corallivory (Littler et al., 1989; Bruggemann et al., 1994b; Garzon-Ferreira and Reyes-Nivia, 2001).

In this study, we investigated whether parrotfish discriminate among coral species, and whether coral grazing intensity changes across different habitats on the Belizean barrier reef. We also explored whether or not grazing is uniform or varies across colonies of particular coral species, as well as the spatial and temporal patterns of parrotfish species abundance across reef habitats. Finally, we correlated parrotfish abundance with grazing intensity across reef habitats to provide insight into which parrotfish species might be responsible for observed patterns of corallivory.

2. Methods

2.1. Study and transect locations

This study was conducted in February 2004 at Carrie Bow Cay (16°48'N and 88°05'W) on the Belizean barrier reef. Six major habitats were examined for parrotfish species abundances, as well as the incidence and extent of coral grazing: the backreef (1–2 m depth), lagoon (2–4 m), upper spur and groove (3–8 m), lower spur and groove (8–20 m), inner reef slope (20–30 m) and the crest of the outer ridge (15–25 m) (described in detail by Ruetzler and Macintyre, 1982). Within each reef habitat, we measured parrotfish and coral abundances, grazing incidence and extent within the same five 30 m × 2 m belt transects. Transect locations were chosen haphazardly (wherever the anchor landed), but were oriented towards areas with the greatest live coral cover (as opposed to sand or rubble substrate).

2.2. Parrotfish species abundances

There are 14 species of Caribbean reef parrotfish (Humann and Deloach, 2002). We measured abundance of all parrotfish species encountered by conducting four

consecutive passes over each 30 m × 2 m transect ($n=5$ per reef habitat), then summing counts to yield individuals per 240 m², following the methods of Lewis and Wainwright (1985). We summed four consecutive passes in order to increase the probability of including highly mobile parrotfishes; it is possible, but not likely, that some individuals could have been counted more than once. We separately counted adults and juveniles for each species, distinguished by body size and coloration as described in Humann and Deloach (2002). Because only adult parrotfish are known to consume live coral (Bruggemann et al., 1994c,b), we present data here only for adults (both initial and terminal phase). Caribbean parrotfish are mainly considered to be herbivorous, yet *Sp. viride*, *Sp. aurofrenatum* and *Sc. vetula* also consume some live coral as part of their diet. In particular, *Sp. viride* adults allocate 1–1.3% of their bites to live corals in shallow reef zones in Bonaire, Netherlands Antilles (Bruggemann et al., 1994a,b), and we have observed that about 2% of all *Sp. viride* bites are taken on live *Porites astreoides* corals on the back-reef habitat of Carrie Bow Cay, Belize (S. Lewis, unpublished data). We compared the abundance of each parrotfish species across habitats using Kruskal–Wallis non-parametric comparisons.

2.3. Relative coral abundance

In assessing coral species abundance across reef habitats, we focused on nine scleractinian corals that have been identified as the main targets of parrotfish grazing in the Caribbean (Garzon-Ferreira and Reyes-Nivia, 2001): *Agaricia agaricites*, *Diploria strigosa*, *Montastraea annularis*, *M. cavernosa*, *M. faveolata*, *M. franksi*, *Porites porites*, *P. astreoides* and *Siderastrea siderea*. Although other coral species have been reported as grazed (Frydl, 1979; Bruckner and Bruckner, 2000), we did not observe any additional coral species with grazing scars in our transects in Belize. *M. annularis*, *M. faveolata* and *M. franksi* are very closely related, and are commonly grouped together as the *M. annularis* species complex (Weil and Knowlton, 1994); this complex has been reported to be grazed throughout the tropical Atlantic (Bythell et al., 1993; Bruggemann et al., 1994b; Bruckner and Bruckner, 1998; Bruckner et al., 2000; Sanchez et al., 2004). Caribbean *Porites* spp. have also been reported as grazed in Barbados, Belize, Florida and the Virgin Islands (Frydl, 1979; Littler et al., 1989; Bythell et al., 1993; Miller and Hay, 1998; Rotjan and Lewis, 2005). For each of these individual coral species, we quantified coral abundance along five 30 m × 2 m transects in each habitat (the same transects

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