Fish abundance and diversity: Do they differ between macroalgae and barren zones in Discovery Bay, Jamaica?

INGRID S. BIEDRON AND JENNIFER P. CASLER

Abstract: Over the past two decades, coral reefs at Discovery Bay have been highly degraded, resulting in two distinct habitats on the reef: a macroalgal zone and a barren zone. We hypothesized that macroalgal zones would contain a greater richness, abundance, and diversity of fish because they provide more food resources. Alternatively, macroalgal zones could contain a lower richness, abundance and diversity of fish because they provide fewer spatial refugia. Although we found that the distribution of fish species differs between the macroalgal and barren habitats, we did not find any differences in richness, abundance, or diversity between the two zones. These results suggest that the transition from barren to macroalgal dominance over the last two decades has not significantly impacted fish community assemblages.

Key Words: coral reef, habitat, species diversity

INTRODUCTION

Over the past two decades the coral reefs of Discovery Bay, Jamaica, W. I. have been significantly degraded by a variety of factors including overfishing, severe hurricanes and the mass *Diadema antillarum* die-off in 1983. This combination of events led to an explosion of algal biomass, with non-crustose algae cover increasing from 30.7% to 72.3% (Liddel and Ohlhorst 1986). However, in recent years *D. antillarum* has begun to recover, thereby facilitating the gradual restoration of the barren zone in the shallow forereef. As a result, there are now two distinct habitats in the Discovery Bay forereef: a macroalgal zone at depths greater than 7 m that is distinguished by high macroalgal cover, often over corals, and above this, a barren zone characterized by clean corals and an abundance of *D. antillarum.*

Macroalgal growth could influence the richness, abundance and diversity of reef fish according to two alternative hypotheses. First, it is possible that increased macroalgal cover would decrease these parameters by covering hiding places within the corals. However, macroalgal cover could increase these parameters by providing a food source for herbivores and a suitable habitat for invertebrates eaten by predatory fish. Thus, we conducted a study to determine if macroalgal zones contain a greater richness, abundance and diversity of fish due to increased food supply, or, alternatively, if they have a lower species richness, abundance and diversity due to lack of refuge space.

METHODS

We surveyed fish populations in the barren and macroalgal zones of the Dancing Lady and Caricomp dive sites in Discovery Bay, Jamaica from 6 -11 March 2003. With the aid of SCUBA, we ran 10 swimming transects in each zone at Dancing Lady and 3 in each zone at Caricomp. Each transect was 10 m long and sampling effort was consistent for all transects. Sample sizes were unequal between sites because diving at Caricomp was discouraged. To avoid scaring fish, we unrolled the transect tape as we swam and counted all fish within one meter on each side of the transect. We recorded fish species (if possible), and whether or not they were schooling.

We used the equation: $H^1 = (n \log n - \Sigma^k_{Ii=1} f_I \log f_I)/n$ (n = sample size, k = number of species, i = species) to calculate diversity (Zar 1984).

RESULTS

We found no significant difference in abundance between barren and macroalgal zones in Discovery Bay (Table 1; F = 0.69, df = 1,1, P = 0.41). Additionally, neither species richness (Table 1; F = 0.41, df = 1,1, P = 0.53) nor diversity differed significantly between zones (Table 1; F = 0.54, df = 1,1, P = 0.47). The distribution of species differed between zones (G = 765.68, df = 3595, P < 0.0001) and sites (G = 562, df = 3595, P < 0.0001).

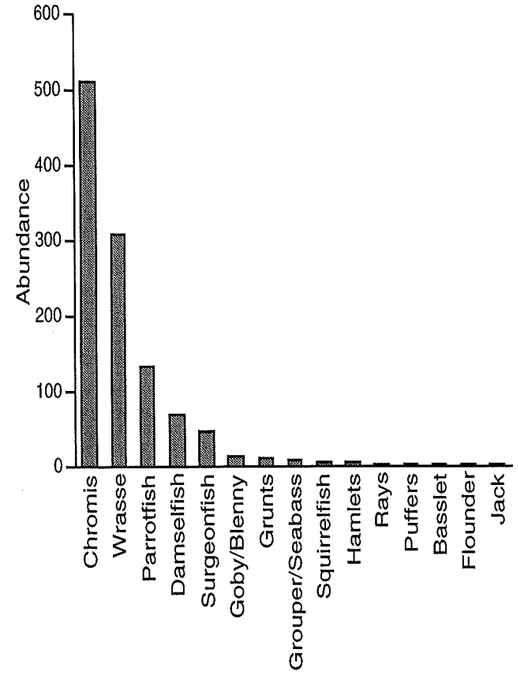

FIG. 1. Rank abundance of major fish groups by site and zone in Discovery Bay, Jamaica, W. I.

Qualitatively, we noticed that in the barren zone fish tended to be more cryptic and were often found under rocks, and we observed many fish grazing in the macroalgal zone. We also found high numbers of small herbivorous fish and low numbers of cryptic fish across sites and zones (Fig. 1).

DISCUSSION

Our results indicate that there is no significant difference in fish abundance, richness, or diversity between the macroalgal and barren zones in the forereef of Discovery Bay, Jamaica. This may be because many fish in our census were transient species that could migrate between zones to exploit both the increased refugia in the barren zone and the increased food supply of the macroalgal zone. It is also possible that we found no difference in abundance, richness, or diversity between zones because the large herbivorous fish that are most likely to benefit from increased algal cover are severely overfished on Jamaican reefs. Thus, their influence on fish assemblages in these sites may be greatly reduced. However, although species richness, abundance and diversity are similar across zones, we found a difference in the distribution of species across zones. Therefore, although relatively the same number and species of fish were present in both the barren and macroalgal zones, species occurred at different proportions in each habitat.

Furthermore, many herbivorous fish are generalists in their feeding habits (Sale 1977), and many of the fish in our census, such as parrotfishes, damselfishes and surgeonfishes, feed on both plants and detritus (Randall 1967). Therefore, these fish may not rely entirely on the macroalgal zone for their food supply. However, we found high numbers of small herbivorous fish and invertebrate-feeders, such as parrotfish, wrasse, damselfish, grunts and surgeonfish, in both zones, suggesting that this group may gain some benefit from the increased macroalgal food source. Additionally, our census included many zooplanktivorous fishes, such as fairy basslets, soldierfish and bigeyes. Since zooplankton may be proportionately common in both the barren and macroalgal habitats, these fish may inhabit both zones. We also found a low proportion of species such as groupers, seabass, hamlets, squirrelfish, and pufferfish across both zones. This could be due to lack of refugia in the macroalgal zone, which dominated

TABLE 1. Fish abundance, richness, and diversity in barren and macroalgal zones at two sites on the forereef of Discovery Bay, Jamaica,W. I. Data represent means ± SE.

Site	Zone	N	Abundance	Richness	Diversity
Caricomp	Barren	4	87.25 ± 23.24	13.00 ± 1.68	0.83 ± 0.05
Caricomp	Macroalgal	3	107.33 ± 28.39	17.67 ± 2.40	0.88 ± 0.05
Dancing Lady	Barren	10	187.60 ±24.92	14.30 ± 1.20	0.79 ± 0.04
Dancing Lady	Macroalgal	10	99.00 ± 39.67	11.90 ± 1.39	0.87 ± 0.06

the reef habitat after the 1983 *D. antillarum* die off. However, we may have disproportionately surveyed these species due to their cryptic behavior.

Finally, our methods may not have accurately portrayed the true species richness, abundance and diversity of fish species. Although the swimming transect method is commonly used in fish censusing, it has several drawbacks. Furthermore, we were not always able to accurately distinguish fish species. Our results suggest that the increase in macroalgal cover after the 1983 *D. antillarum* die off will not strongly influence fish species assemblages in Discovery Bay, Jamaica.

LITERATURE CITED

Liddell, W. D., and S. L. Ohlhorst. 1986. Changes in benthic community composition following the mass mortality of *Diadema* at Jamaica. J. Exp. Mar. Biol. Ecol. 95. Pp. 271 – 278.

Randall, J. E. 1967. *Food habits of reef fishes of the West Indies*. Studies in Tropical Oceanography. Pp. 669 – 845.

Sale, P. F. 1977. Maintenance of high diversity in coral reef fish communities. Amer. Nature. 3. Pp. 337-359.

Zar, J. H. 1984. Biostatistical Analysis. Prentice-Hall, Inc. Englewood Cliffs, Jersey.