Effects of habitat degradation on the aggressive response of the territorial threespot damselfish

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Abstract: Threespot damselfish (*Stegastes planifrons*) defend territories that contain thick algal mats, and provide refuge, food, and a nesting site. Previous studies have shown that damselfish with large amounts of algae in their territories respond more aggressively to invading fish than those whose territories have little algae. We predicted that after degrading territories through the removal of algae, threespot damselfish would respond less aggressively to an invading herbivorous fish. Although aggressive (≈ 10 attacks / min), we found no change in damselfish aggressive response after territory degradation. The one day that we allowed for damselfish to respond to territory degradation may not have been sufficient to change aggressive behaviors. Alternatively, the amount of algae removed may have been insufficient to appreciably decrease algal availability.

Key Words: territorial aggression, algal tufts, habitat quality

INTRODUCTION

Territoriality by damselfish plays a major role in structuring the benthic and fish communities found in shallow waters of coral reefs. The threespot damsel, *Stegastes planifrons*, is commonly found in Discovery Bay, Jamaica, and defends territories with distinct mats of thickly packed algae. Threespot damselfish territories are approximately 70 cm^2 and provide shelter from predators, food from the algal mat, and a nesting site, all of which are defended by the males (Robertson et al. 1981). *S. planifrons* chases away all fishes, as well as sea urchins, that invade its territory.

Threespot damselfish are comparable to beaugregory damselfish (*S. leucostictus*), a congeneric species with similar behavior and reproductive ecology. Itzkowitz et al. (1995) found that estimates of reproductive success were significantly correlated with the total amount of algae within a beaugregory territory. Since the amount of algae within a territory affects fitness, algal biomass partially determines territory quality for damselfish. Additionally, Itzkowitz (1995) found that the intensity of beaugregory territorial defense against the herbivorous striped parrotfish, *Scarus croicensis*, was positively correlated with algal biomass. We predict similar behavior for the threespot damsels: a decrease in territory quality (removal of algal biomass) should result in a decline in defense intensity.

METHODS

On 27 February to 1 March, 1999, we surveyed the territorial behavior of 14 randomly encountered threespot damselfish in the back reef mangrove area of Discovery Bay, Jamaica. We observed each damselfish for several minutes to determine the center of its territory. We simulated the intrusion of a foraging herbivore into the damselfish territory by placing a striped parrotfish (*Scarus croicensis*) in a clear plexiglass container in the center of the territory. We quantified the aggressive response of the damselfish as the number of charges at the container in a five minute period ("Day 1" sampling). Next, we created seven "degraded" territories by removing 1.25 L of algae (approximately 10-20% of algae in the territory), and left seven "unaltered" territories. After 18 - 24 hours, we measured aggressive response to the parrotfish intruder a second time in both treatments ("Day 2" sampling).

RESULTS

As expected for unaltered territories, the mean number of charges was similar between days (Day 1: 47.0 ± 8.3 hits / 5 min (mean ± SE); Day 2: 55.1 ± 13.2 hits / 5 min). Contrary to our hypothesis, we found no change in the aggressive response of damselfish after their

territories had been degraded (Day 1: 53.7 ± 15.8; Day 2: 60.6 ± 14.0). Additionally, the change in aggressive response from Day 1 to Day 2 was not significantly different between the degraded and unaltered territories (Fig. 1; Kruskal-Wallis: $X^2 = 0.0656$, df = 1, P = 0.80).

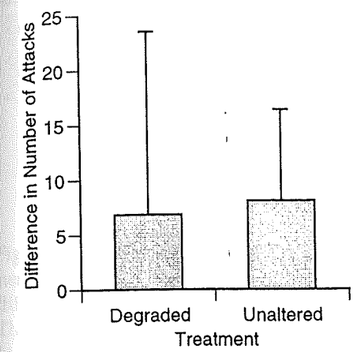

Fig. 1. The mean difference in attack frequency (+ SE) of the threespot damselfish between Day 1 and 2 trials for both degraded and unaltered territories in Discovery Bay, Jamaica (P = 0.80).

For the degraded territories, three damselfish increased their attack frequency, three decreased, and one had no change in its aggressive behaviors. Similarly, two damselfish in the unaltered territories increased their attack frequency, two decreased, and three had equal aggressive responses for both Day 1 and Day 2.

DISCUSSION

Damselfish do not appear to alter their level of aggression a day after the degradation of their territories. If territories are limiting in Discovery Bay, damselfish may defend their existing territory with the same level of aggression regardless of the degraded quality because the cost of searching for a new territory is too high. However, Itzkowitz et al. (1995) found that the availability of territories for beaugregory damselfish is not limiting in Discovery Bay. By conducting multiple surveys of natural and artificial nesting sites, Itzkowitz determined that vacancies and reoccupations were the result of an overabundance of breeding sites, with males shifting among the many equally suitable sites.

The 1.25 L of algae we removed may not have sufficiently degraded territory quality to generate a change in aggressive response. Depressed populations of the urchin *Diadema* and herbivorous fish have resulted in low herbivory levels, and have caused unusually high algal cover throughout the back reef of Discovery Bay. It is also highly probable that the 24 hour period in which the damselfish were allowed to become accustomed to the changed territory was not long enough to effect a change in damselfish behavior. As mentioned above, Itzkowitz et al. (1995) found decreased defense intensity in low algal biomass territories. If this decreased defense intensity is due to diet induced physiological stress, then a single day in a degraded environment is unlikely to produce a change in behavior.

LITERATURE CITED

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