

# Aggressive response of three-spot damselfish to two urchin species

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**Abstract:** Territorial three-spot damselfish (*Stegastes planifrons*) feed upon and defend algal turfs on the Caribbean back-reef. Aggression toward territory invaders varies with trespasser movement and activity level. The distributions of two species of herbivorous sea urchins, *Diadema antillarum* and *Tripneustes ventricosus*, frequently overlap with the territories of three-spot damselfish. We found that damselfish attacked the more active *D. antillarum* at a higher rate than the slower-moving *T. ventricosus*. Our findings suggest that three-spot damselfish may influence the distribution of these two urchin species, restricting *D. antillarum* to sites further from damselfish territories.

**Key Words:** *Diadema antillarum*, *Stegastes planifrons*, territoriality, *Tripneustes ventricosus*

## INTRODUCTION

In the shallow reefs of the Caribbean, organisms in highly diverse communities reside in close proximity to one another and compete intensely for resources such as food and space. The three-spot damselfish (*Stegastes planifrons*) is an abundant reef fish that is fiercely territorial and defends an algal turf by biting and chasing away intruders (Humann 1997). Three-spot damselfish feed on these dense algal mats and in defending them prevent grazing by sea urchins and herbivorous fish. Previous studies have shown that the level of damselfish aggression varies with the color, form, and activity level of the invader. Williams (1979) found a higher frequency and rate of attacks on the highly active urchin, *Diadema antillarum*, compared to the slower moving urchin, *Echinometra viridis*. Williams speculated that greater three-spot damselfish aggression towards *D. antillarum* restricted the urchin's distribution to the outer edges of damselfish territories.

In Discovery Bay, Jamaica, *D. antillarum*, *Tripneustes ventricosus* (another urchin species) and the three-spot damselfish coexist in shallow reef habitats. During the day *D. antillarum* inhabits protected crevices and rapidly moves to cover if exposed. In contrast, *T. ventricosus* inhabits open sea grass beds inshore of the reef and moves slowly. We hypothesized that three-

spot damselfish attacks on territory intruders would depend on intruder activity level. Specifically, we predicted that attack rates would be higher on *D. antillarum* than on *T. ventricosus* because *D. antillarum* is more active, waving its spines and travelling quickly.

## METHODS

We conducted experimental territory invasions on the backreef at Discovery Bay Marine Laboratory, Jamaica on 25 and 26 February 2003. We haphazardly selected three-spot damselfish ( $n = 20$ ) and observed each fish to determine the boundaries and center of its territory. We placed either one *D. antillarum* or one *T. ventricosus* in the center of each territory and counted the number of attacks within a two-minute period. Damselfish attacks consisted of nipping at the urchin's spines and often breaking off spine tips. If the urchin left the territory, we noted the time when the urchin left. We repeated this manipulation with the other urchin species, alternating which species we placed first. Using these data, we calculated the number of attacks per minute on each urchin. We used a paired  $t$ -test to determine whether attack rates differed between the two urchin species.

To see whether three-spot damselfish respond preferentially to one urchin species,

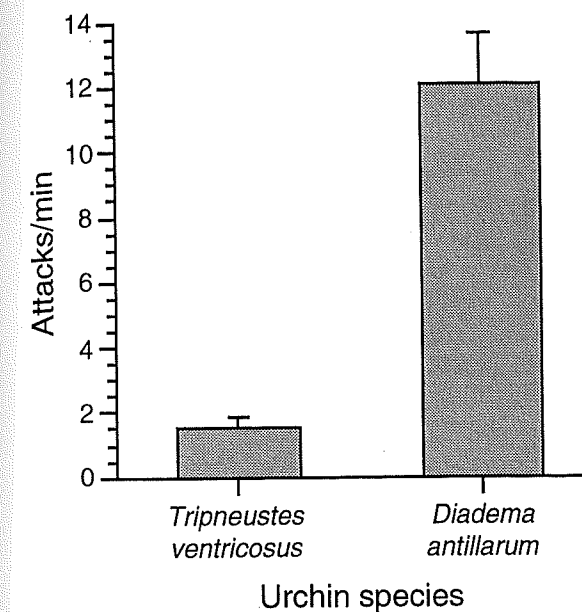


FIG. 1. Attack rates (mean  $\pm$  SE) of three-spot damselfish (*Stegastes planifrons*) on two species of sea urchins ( $n = 20$ ), on the western back reef of Discovery Bay, Jamaica.

we placed one urchin of each species adjacent to the other in the center of the territory and recorded which urchin was attacked first. We used a chi-squared test to determine whether there were differences in primary attacks for each urchin.

## RESULTS

Three-spot damselfish attack rates during single-species trials were significantly higher on *D. antillarum* than on *T. ventricosus*, with mean values ( $\pm$  SE) of  $12.10 \pm 1.55$  bites/min and  $1.58 \pm 0.29$  bites/min, respectively (Fig. 1; paired- $t = -6.50$ ,  $df = 19$ ,  $P < 0.001$ ). With both urchin species present, 70% of initial strikes were against *D. antillarum* and 30% were against *T. ventricosus*, but the difference was not significant ( $X^2 = 3.2$ ,  $df = 1$ ,  $P > 0.05$ ).

## DISCUSSION

As predicted, damselfish attack rates were higher on *D. antillarum* than on *T. ventricosus*, possibly due to the higher activity level of *D. antillarum*, which rapidly waved its spines and often vacated the

territory before the observation time had elapsed. *Diadema antillarum* possibly provoked more attacks by increasing its spine-waving in response to damselfish aggression. However, we did not assess the movement of urchins placed on areas without damselfish, and our study would have benefited from a comparison of movement between urchin species without provocation by attacking damselfish. With a few exceptions, damselfish always attacked urchins placed in their territories but would cease to attack an urchin in order to chase away an invading fish. This suggests that fish invaders present a greater threat to damselfish territories than urchins.

Our findings suggest that differential territorial defense by damselfish may influence the distribution of these two urchin species, restricting the more active *D. antillarum* to sites further from damselfish territories. We observed *D. antillarum* outside damselfish territories on rocky outcrops and within crevices. In contrast, we observed *T. ventricosus* much closer to damselfish territories, at times even bordering the defended algal turf. Algal turf was noticeably thicker where damselfish territories were concentrated, and thus represents a rich potential resource for grazing urchins. The low profile of the less active *T. ventricosus* may permit it to encroach on damselfish territory and exploit this resource. Further studies could investigate whether interactions between urchins influence their distributions.

## LITERATURE CITED

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