Diel migration and behavior of juvenile balloonfish (*Didon holocanthus*)

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Abstract: Balloonfish (*Didon holocanthus*) are slow-swimming, nocturnal, benthic foragers found in and around coral reefs. Earlier studies conducted at Discovery Bay Marine Laboratory, Jamaica, reported that juvenile balloonfish clustered in a nearby mangrove lagoon. We found that juveniles schooled high in the water column among the mangrove roots in low salinity water during the day and descended into the algal beds within the lagoon at night. Freshwater inputs (lowering salinity), shallow depths, schooling behavior and daytime inactivity may reduce balloonfish vulnerability to daytime visual predators. This behavior demonstrates how one life stage of a coral reef fish could be closely linked to another nearby habitat.

Key Words: mangroves, salinity, vertical migration

Introduction

Little is known about the behavioral ecology and spatial distribution of balloonfish (*Didon holocanthus*). These slow swimming, round-bodied fish are nocturnal, benthic foragers that feed primarily in shallow water on sea urchins, mollusks and crustaceans (Randall 1983). A survey of the day and night behavior of balloonfish at Discovery Bay Marine Laboratory, Jamaica found that the majority of balloonfish were active at night and that smaller individuals (< 10 cm) were clustered in nearby mangroves during the day (LaPlante et al. 2000).

They speculated that mangrove roots serve as a refuge habitat for the smaller balloonfish. Freshwater inputs flowing into the lagoon could lower the surface salinity, deterring some fish predators and providing a refuge for the juvenile balloon fish (Cowen 2002). We hypothesized that schooling behavior and location of juvenile balloonfish would vary with time of day. We predicted that juvenile balloonfish would return to the same schooling areas in the low salinity, shallow water of the mangroves during the day and then descend to the higher salinity waters along the bottom at night to feed.

Methods

On 25 and 26 February 2003, we observed balloonfish activity in the mangrove lagoon and the adjacent turtle grass bed within 50 m of the entrance to the lagoon at Discovery Bay Marine Laboratory, Jamaica. Each day we observed daytime activity from 14:00 to 16:00 and nighttime activity from 19:30 to 21:30.

During each survey, we swam back and forth across the turtle grass bed and lagoon in 2 m wide belt transects looking for balloonfish in the water column and crevices. For each balloonfish that we encountered, we noted the substrate on which it was found, its depth and approximate size (< 10 cm, 10 – 17 cm, > 17 cm). We also noted its behavior, and whether or not it was schooling (a school was defined as a group of four or more fish within 50 cm of each other). We recorded the location of each school. On the first day and night of observation, we took 30 ml water samples at the depth of 11 haphazardly selected balloonfish. We also took samples at the surface, 1 m, and the bottom of both the lagoon and 50 m out into the bay. We tested these samples with a conductivity meter to determine the salinity of the water occupied by the fish.

Results

During the day we found several schools of 4 to 25 juvenile balloonfish among the mangrove roots (63 and 74 fish on days one and two, respectively). We found schools of balloonfish at the same locations each day, but the numbers of

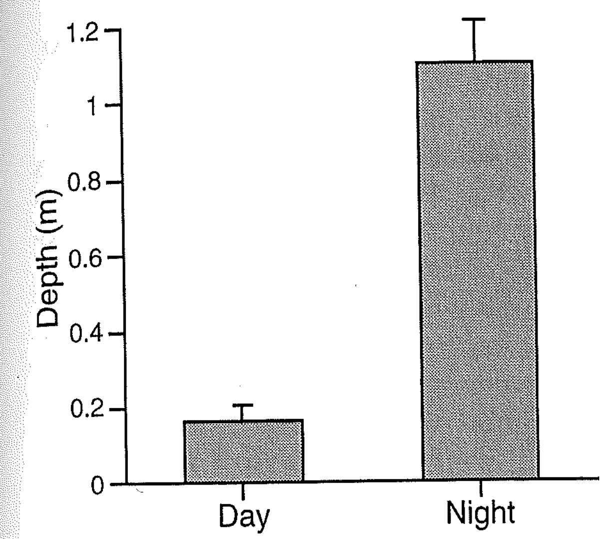

FIG. 1. Mean (± 1SE) depth of juvenile balloonfish during day and night surveys in a mangrove lagoon and the 50 m outside the lagoon at Discovery Bay Marine Laboratory, Jamaica. Data pooled from both day (n = 137) and night (n = 108) surveys.

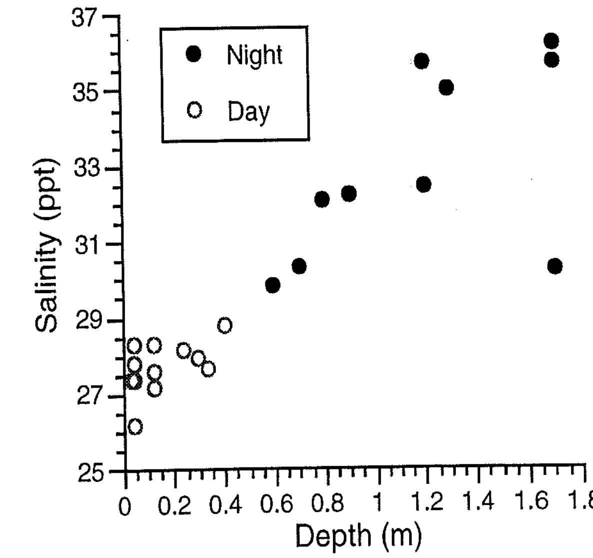

FIG. 3. Salinity at the depth of the water column of observed juvenile balloonfish during day and night surveys of the back reef and mangrove lagoon at Discovery Bay Marine Laboratory, Jamaica.

individuals in each school changed slightly. At each site, balloonfish aligned themselves in tight, vertical lines, facing the mangrove root. They rarely moved, except to maintain their position along the root. However, we did observe two juveniles migrating between schools across the lagoon. We did not observe any juveniles outside of the mangrove lagoon during the day.

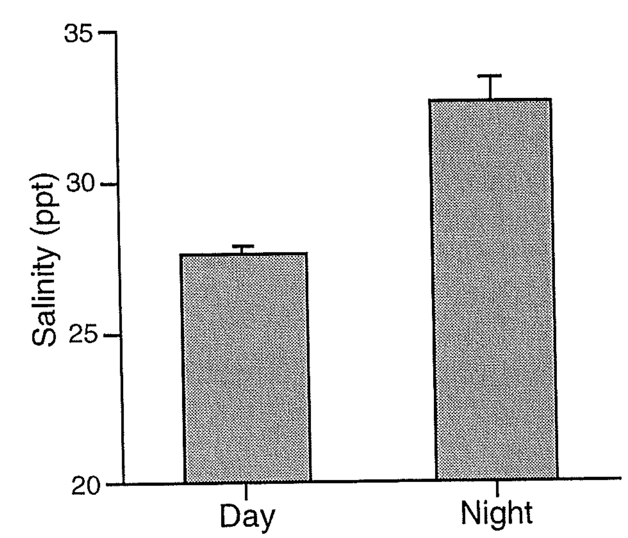

FIG. 2. Average salinity of water occupied by juvenile balloonfish during day and night surveys of the back reef and mangrove lagoon at Discovery Bay Marine Lab, Jamaica (n = 11).

In the lagoon at night, we observed juveniles foraging along the sandy bottom and on macro-algal beds (55 and 63 fish on nights one and two, respectively). No juvenile balloonfish were found in the mangrove roots. Of all the fish we located at night, we found only two fish outside of the lagoon in the back reef. We did not observe schooling behavior at night, but the juvenile balloonfish were often only one meter from their nearest conspecific.

During the day, juvenile balloonfish (7-10 cm in length) schooled at the top of the water column at a depth of 0.17 ± 0.04 m (Fig. 1; mean ± 1 SE). At night, we found juvenile balloonfish in the benthos at an average depth of 1.10 ± 0.11 m. Salinity in locations where we found balloonfish during the day was significantly lower than salinity where we found balloonfish at night (Fig. 2). Salinity increased with depth (Fig. 3; $r^2 = 0.80$, df = 14 , $P < 0.001$).

Discussion

During the day, juvenile balloonfish schooled in the shallow, low salinity water around the mangroves. Their configuration parallel to the roots and their relative inactivity may make them less conspicuous and help to camouflage them from passing predatory fish that enter the mangroves during the day. Their schooling behavior could also serve to confuse predators and reduce the risk of any one individual to predation. Additionally, schooling could indicate that there are certain microclimates within the mangroves that juvenile balloon fish prefer.

The low salinity of the shallow water may also help to protect the fish from predation. Lower salt concentrations negatively effect most marine fish by increasing the osmotic gradient between their gills and the water. Many reef fish avoid areas with lower salinity to prevent this physiological stress (Cowen 2002). Additionally, the fierce defense of benthic macro-algal lawns by three-spot damselfish during the day could also influence balloonfish juveniles to move up into the shallow mangrove roots.

At night when predation pressure and damselfish aggression may be reduced, the juvenile balloonfish descend into the macro-algal beds to feed. The relative similarity between night and day census numbers suggests that most of the balloonfish forage within the lagoon at night. They are slow swimmers, and this may prevent them from traveling far from their daytime schooling locations. Additionally, we sampled early in the evening (19:30-21:30), and it is possible that they moved further from the mangroves and into the surrounding water later that night. Future studies that investigate other refuges of juvenile balloonfish in the backreef closer to the reef crest, the fidelity of juvenile balloonfish to their daytime schools, and the movements of balloonfish at other life stages would improve our understanding of balloonfish behaviors.

The behavior of juvenile balloonfish is one example of the important link between coral reefs and other surrounding habitats. Almost all of the balloonfish we found in the mangroves were approximately 7-10 cm in length. This suggests that the mangroves may play an important role in this stage in balloonfish development. Habitats surrounding coral reefs may play a critical role in the early life stages of reef fish and should be included in plans for coral reef preservation.

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