DIEL CHANGES IN THE FISH POPULATIONS OF THE BACK REEF OF DISCOVERY BAY

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Abstract. We examined diel changes in fish abundance and community composition between coral reef and turtle grass (*Thalassia testudinum*) habitats in the marine reserve in Discovery Bay, Jamaica. During the day, we found more fish in the coral reef habitat than in the turtle grass habitat, presumably because the coral reef is a more structurally complex substrate offering fish a broad range of vegetation and possible refuges. The coral reef is also covered with macroalgae fed upon by the territorial damselfish (*Pomacentridae*), which were the most abudant fish in the study. During the day, herbivorous fish were most common in both habitats, due to their better ability to locate food and avoid predators during daylight. During the night, more planktivorous and invertebrate feeding fish were found than during the day. This feeding group was found in both habitats, although there were significantly more of these fish over the turtle grass than over the coral. These data are consistent with results from a concurrent study on the diel distribution of zooplankton in the same habitats, which found zooplankton to be most abundant in the turtle grass habitat during the night.

Key Words: need some

INTRODUCTION

At the back reef of the Discovery Bay Marine Laboratory, we examined diel differences in fish abundance and community composition between the coral reef and turtle grass habitats. The coral reefs are a more heterogenous habitat than the turtle grass beds, offering fish a wider variety of food resources (e.g. a more diverse community of macroalgae) and a larger number of refuges due to the substrate's structural complexity. We therefore expected to find a higher abundance of fish in the coral habitat than in the open turtle grass habitat.

The foraging patterns of fish follow patterns of prey availability and light, two resources which change over the course of a day. We predicted that we would find more herbivorous fish during the day than during the night in both habitat types because most herbivorous fish are visual feeders and defenders. We also predicted that we would find more planktivorous fish at night than during the day in both coral reefs and turtle grass beds as previous studies have shown that zooplankton are more abundant in the water column during night-time (Bell et al. 1984). In a concurrent study of diel distribution of zooplankton in the same habitats in Discovery Bay, Dums et al. (1997) found eight times more zooplankton in the turtle grass habitat than in the coral reef habitat during the night; therefore, we expected to census more planktivorous fish in the turtle grass habitat than in the coral habitat during the night. Finally, we expected to see a greater number of piscivorous fish during the day and over the turtlegrass, because piscivorous fish are known to be visual predators (James et al. 1994), and the turtle grass bed offers a more open hunting ground.

METHODS

We used transect sampling to compared fish abundance and community composition between turtle grass and coral reef habitats in the west back reef of Discovery Bay on 28 February, 1997. Eight pairs of observers (four pairs in each habitat) swam for ten minutes along an approximate 50 m transect, counting and identifying all fish observed within a 2 m width. Day sampling was conducted at approximately 0900 and night sampling at approximately 2100. Each pair of observers swam and counted at night in the same habitat they had sampled in the morning.

Fish were identified to family and classified in one of three functional feeding groups: herbivores, planktivores/invertebrate feeders, or piscivores. Several species of fish such as squirrelfish (*Holocentridae*) are planktivorous as juveniles but invertebrate feeders as adults. Since no distinction was made between fish age in sampling, we grouped planktivores and invertebrate feeders into the same guild.

The transects sampled by each pair were not counted as replicates due to the difficulties in standardizing swimming speeds and transect length between the pairs. Chi-square tests were run to analyze the numbers counted. We compared the fish counted between night and morning for each habitat and compared the fish numbers between habitats at each of the sampling times. To examine community composition, we compared the percentages of fish representing each of the feeding guilds between night and day for the two habitats.

RESULTS

We observed a total of 1280 fish representing 21 different fish families during day and night censuses (Table 1). Common fish observed during the day were damselfish (*Pomacentridae*), parrotfish (*Scaridae*), wrasses (*Labridae*), grunts (*Lutjanidae*), and surgeonfish (*Acanthuridae*). Squirrelfish (*Holocentridae*), cardinalfish (*Apogonidae*), and balloonfish (*Diodonitdae*) were most commonly seen at night (Table 1). Many unidentified small (< 5 cm) silvery-blue fish were also seen in the turtle grass habitat at night.

Fish abundance changed with time of day and with habitat (Pearson's chi-square test, $X2=300.72$, $df=1279$, $P<0.01$; Fig. 1). In the turtle grass, fish were approximately 1.5x more abundant during the night than during the day. However, in the coral, there were approximately 6x more fish during the day than during the night. Comparing between habitats, we observed 3x more fish in the coral habitat than in the turtle grass habitat during the day. At night, the trend was reversed; we observed three times more fish in the turtle grass habitat than in the coral habitat.

Within both the turtle grass and coral habitats, representation of different feeding guilds changed with time of day (turtle grass: G-test, $X2=135.45$; $df=314$, $P<0.01$; coral: G-test, $X2=157.88$, $df=693$, $P<0.01$). During the day, most of the fish observed in both habitats were herbivores, compared to the night when less than five percent of the fish were herbivorous (Fig. 2). During the night, most of the fish observed in both habitat were planktivores/invertebrate feeders (Fig. 2). Piscivorous fish made up the lowest percentage of fish during both times of day in both habitats (Fig. 2).

DISCUSSION

The greater number of fish found over the coral during the day can be explained by the large number of potential niches available in the heterogeneous environment. Coral structures (e.g. coral rubble remaining from recent hurricanes) create a structurally complex habitat that can inhibit the movement of predators and reduce the visibility of prey. Such structures can serve as protective refuges for many fish (James et al. 1994). The high amount of algal cover over the coral substrate and the complexity of the habitat also offer a wide range of food resources. Damselfish were the most commonly observed fish in the study, and fleshy algae, the main food resource of damselfish, is abundant on the coral. The turtle grass beds represent a more homogeneous environment; turtle grass blades and their epibionts are the primary food source and grass clumps offer only a single type of refuge.

Most fish observed in coral and turtle grass habitats during the day were herbivores. As visual feeders, the light available during the day allows fish to find food and remain vigilant against predation. At night, many of these fish sleep hidden in refuges, so although they may still remain in the habitat, they were not seen and censused. However, the number of planktivores/invertebrate feeders observed in both habitats was greater during the night than during the day, presumably because their food resources are more abundant during the night. Dums et al. (1997) found a 10-fold increase in zooplankton abundance in the coral habitat and a 40-fold higher zooplankton abundance in the turtle grass habitat at night. Our finding that there were more planktivores/invertebrate feeders in the turtle grass habitat than in the coral habitat during the night suggest that these fish were tracking the greater abundance of zooplankton. The open turtlegrass habitat is also likely to offer increased visibility and reduced hunting obstacles.

Like herbivores, the piscivores are visual feeders, and day offers better hunting conditions as well as a greater number of potential prey. Piscivores were extremely rare in our study. Discovery Bay and surrounding waters hav a long history of overfishing, which may be responsible for such low numbers of predatory fish censused in this study.

Future fish census studies should distinguish between juvenile and adult fish because many familes make an ontogenetic shift into a different feeding guild as adults. Making the distinction between juveniles and adults would allow greater accuracy in examining differences in community composition betweeen adults and times of day. Because fish feeding strategies within a single family can be quite diverse, identification of fish to genus or even species would also make the guild assignments more accurate.

LITERATURE CITED

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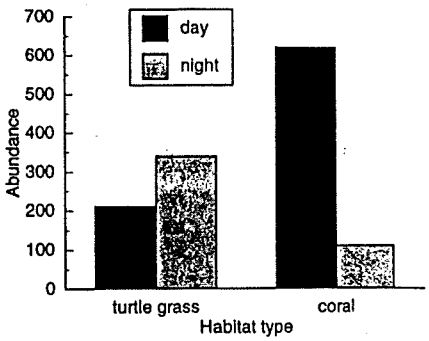

Fig. 1. Fish abundance in coral reef and turtlegrass habitats at Discovery Bay, Jamaica, during day and night. Values represent total fish that were counted during 4 ten minute swims along ~50 m transects in each habitat.

Table 1. Fish observed during four ten-minute swims along 50 m transects in two different habitats in Discovery Bay, Jamaica, during day and night.

Fish type	Feeding group	Turtle grass day	Turtle grass night	Coral day	Coral night	Totals
damselfish	herb	85	0	206	2	293
surgeonfish	herb	8	2	52	2	64
parrotfish	herb	14	0	169	0	183
angelfish	herb	0	0	1	0	1
butterflyfish	pl/inv	0	0	29	0	29
wrasse	pl/inv	20	1	96	0	117
trunkfish	pl/inv	0	0	2	0	2
balloonfish	pl/inv	6	9	2	16	33
soldierfish	pl/inv	10	41	5	64	120
squirrelfish						
grunt	pl/inv	34	0	36	0	70
hamlet	pl/inv	0	0	1	0	1
goatfish	pl/inv	0	0	1	0	1
goby	pl/inv	0	0	2	1	3
cardinalfish	pl/inv	0	51	0	4	55
trumpetfish	pl/inv	0	0	1	0	1
scorpionfish	pisc	0	0	1	0	1
sanddiver	pisc	2	0	0	0	2
jack	pisc	31	0	0	0	31
snapper	pisc	0	2	0	1	3
moray eel	pisc	0	0	1	0	1
unidentified	?	0	234	15	20	269
TOTALS		210	340	620	110	1280

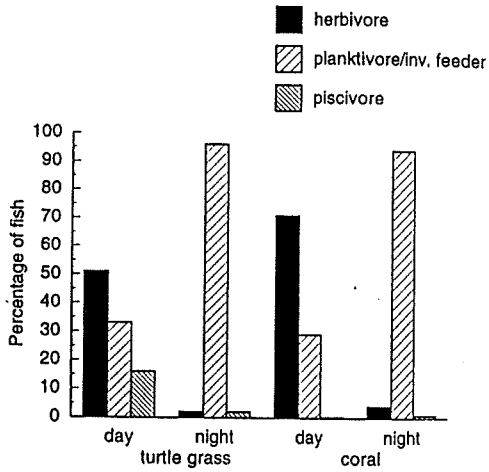

Fig. 2. Shifts in community composition as defined by guild. Percentages represent fish found in each habitat in Discovery Bay, Jamaica, during day and night. Turtle grass day N=210; Turtle grass night N=106; Coral day N=605; Coral night N=90.