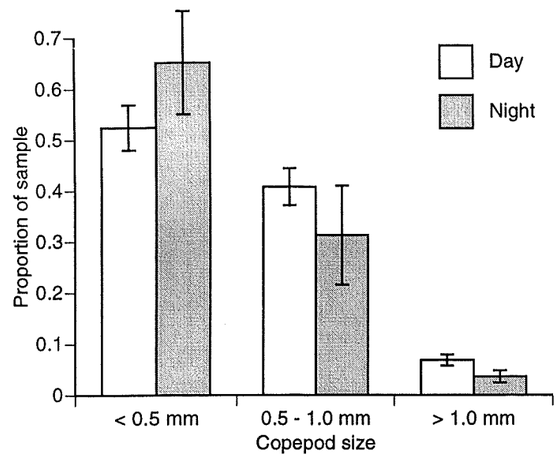

Fig. 1. A comparison of the size distribution (length; mm) of copepods (mean (± 1 s.e.)) between day (n = 5 tows) and night (n = 5 tows) on the back reef of Discovery Bay, Jamaica. No contrasts were significant by a t-test.

DISCUSSION

As predicted, zooplankton on the back reef of Discovery Bay were both larger and more abundant during the night than the day. It is likely that the night zooplankton community was also more diverse and species rich. Presumably the changes in community composition reflect predator avoidance behavior. By day zooplankton move deeper into the water column or seek refuge among corals and other substrate on the reef. At night fishes and other predators that use visual cues to capture prey are less common, or at least less efficient, and the predation risk decreases for the zooplankton. The absence or low occurrence of large zooplankton such as mysids, cumaceans, and fish larvae in the night samples compared to previous studies (Chiavelli et al. 1998) could be due to the entirely full moon and bright conditions during the night sampling. It is suggested that succeeding studies make note of light conditions during sampling as moonlight (Alldredge and King 1980; Jerling and Wooldridge 1992) affects movement into the water column for particular zooplankton taxa.

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A comparison between the day and night fish communities on the back reef of Discovery Bay, Jamaica

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Abstract. The FSP class surveyed the day and night fish communities on the back reef of Discovery Bay, Jamaica. Significantly more fish species were observed during the day than night; although most species were observed by fewer than 20% of observers, the class identified a total of 79 spp. during the day, 61 spp. at night, with 42 spp. in common. Of the active fish, herbivores were relatively more common during the day, whereas carnivores dominated at night. In addition, schooling was significantly more common during the day than at night. It appears that the fish community changes substantially over the course of a day, and such temporal partitioning may contribute to the maintenance of the remarkable diversity of tropical coral reefs.

Key words: coral reef fishes, niche differentiation, feeding guilds

INTRODUCTION

Tropical coral reefs are amongst the most diverse habitats on earth. One mechanism proposed to explain the coexistence of so many coral reef fishes is species differences in resource use. In this paper we examined differences in the fish community over the course of a day.

More specifically, we asked:

1. How does the composition of the fish community change between day and night on the back reef of Discovery Bay, Jamaica?
2. Which fish species are most often encountered?
3. Which species are active by day and by night?
4. Which species are solitary by day and by night?
5. What are the similarities and differences in the relative abundance of fishes among feeding guilds day and night?

METHODS

On February 28, 1999, nine pairs of observers identified the coral reef fish, their activity (resting or active), and grouping behavior (solitary or schooling) in the back reef immediately north of the Discovery Bay Marine Lab, Jamaica. Observations were made by skin-diving along nine parallel transects in the western back reef, starting to the north of the boat channel and running out to the reef crest. All pairs conducted two surveys: one hour in the morning (0900-1000 h; slightly overcast) and one at night (2000-2100 h; full moon, clear).

The first time each pair of observers encountered a species, the species identification was recorded. No attempt was made to quantify the abundance of any fish species. Rather, an index of encounter rate for each species was calculated as the number pairs (out of the possible nine pairs) that identified each species. For example, there would be a greater probability of encountering a fish seen by all nine pairs than a species seen by only one pair.

RESULTS AND DISCUSSION

On February 28, 1999, nine pairs of observers identified a total of 99 species of coral reef fish in the western back reef of Discover Bay, Jamaica. During the one-hour day census, each pair of observers encountered an average of 30.0 ± 1.2 species (Mean ± SE), for a combined total of 79 species (Fig. 1). At night fewer species were identified (18.7 ± 1.7 spp. per pair), 62 species in all. The day and night samples had 42 species of fish in common (Fig. 1). Although fish are more difficult to observe at night, the significant decrease in the number of species seen at night (t-test: $t = 5.48$, $df = 16$, $P < 0.0001$) also represents changes in the fish community over the course of the day; 44% of the fish species active during the day were inactive or missing from the night sample (Table 1).

The majority of the inactive fish species during the day were active at night (75%; G-test: $X^2 = 5.022$, $P = 0.025$; Table 1). The remainder (4 spp.)

were considered inactive both day and night. However, all is not what it seems. Most of these species, such as the blue-striped lizardfish, are ambush predators, and would appear inactive unless disturbed or pouncing on prey.

The probability of encountering most of the fish species during a one-hour survey would be small; during our surveys, most species were recorded by only one or two groups of observers (Table 1). Only the balloonfish was seen by everyone both day and at night. On average, a fish species was seen by 3.4 ± 0.31 pairs of observers (out of a possible nine) during the day, and at night by 2.8 ± 0.27 (Table 1).

There was no significant difference in the proportion of herbivores, carnivores, or omnivores in the day and night fish communities (X^2 = 3.26, P = 0.52). However, when inactive species are excluded, there was a highly significant difference between the relative abundance of fishes in the different feeding guilds (G-test: X^2 = 12.763, P = 0.0017). Herbivores were abundant during the day (34.7%) but decreased at night (3.5%), while the opposite was true for carnivores, which made up the vast majority of active fish at night (49% vs. 79%, day vs. night).

The increase in carnivores at night may be a response to prey availability. Plankton and macro-invertebrate abundance increase at night in Discovery Bay (Dums et al., 1997; Pickhardt et al. this volume). The relatively large eyes of most nocturnal carnivorous (and planktivorous) fishes allows them to ambush prey at night.

In contrast, herbivores were more abundant in the day. Parrotfish, among other species, feed upon the blades of turtlegrass, *Thalassia testudinium*. Berry et al. (1995) found that foraging parrotfish depend heavily upon sight to select blades with high epibiotic loads. High daytime light levels are therefore, probably necessary for parrotfish, and perhaps other herbivores, to forage efficiently.

Relatively more fish were solitary at night (95.1%) than during the day (79.9%; G-test: X^2 = 15.161, P= 0.0001). Most fish that were solitary during the day remained solitary at night, whereas most fish that schooled during the day became solitary at night (G-test: X^2 = 6.605, P= 0.01). Many of the smaller fish that school during the day are presumably reducing their chance of being eaten by a visual predator because schooling makes it difficult for predators to focus upon a single prey. Furthermore, actively foraging nocturnal species may stop schooling to decrease competition for food. Eaton et al. (1998) also suggest that schooling relies upon visual cues, thus, cohesion in a school would be more difficult to maintain in the darkness of night.

Differences in light and prey availability appear to drive diel changes in the composition, activity and schooling behavior of the fish community in the back reef of Discovery Bay. This temporal partitioning by the fish community may help maintain the coexistence of the highly diverse coral reef fishes.

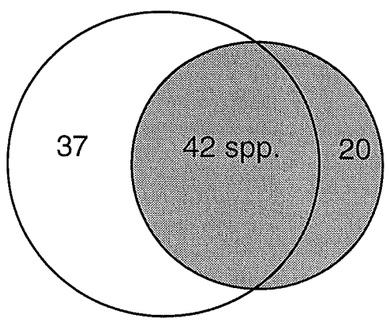

Fig. 1. Number of species of fish in the back reef of Discovery Bay, Jamaica. Open circle describes the number of species identified during the day census, the grey circle decsribes the number of species identified during the night census, and overlap of the circles indicates the number of species in common between day and night.

Table 1. Activity (Active or Resting) and number of transects each fish species was observed on during day and night censuses in the back reef of Discovery Bay, Jamaica.

Day		Taxon	Night	
Activity	No. transects		No. transects	Activity
R	2	BASS, HARLEQUIN		
R	4	BASSLET, FAIRY		
R	1	CARDINAL SOLDIERFISH		
R	1	DAMSELFISH, COCOA		
R	1	EEL, GOLDENTAIL MORAY		
R	1	EEL, PURPLEMOUTH MORAY		
R	1	FILEFISH, ORANGE-SPOTTED		
R	2	FLOUNDER, PEACOCK		
R	1	PIPEFISH		
R	1	PUFFER, SHARPNOSE		
R	1	SCORPIONFISH, PLUMED		
R	1	WRASSE, DWARF		
A	1	ANGELFISH, QUEEN		
A	3	BARRACUDA		
A	2	BUTTERFLYFISH, BANDED		
A	4	BUTTERFLYFISH, FOUREYE		
A	1	BUTTERFLYFISH, SPOTFIN		
A	1	CREOLE FISH		
A	6	DAMSELFISH, BICOLOR		
A	7	DAMSELFISH, SERGEANT MAJOR		
A	1	GOATFISH, YELLOW		
A	1	HAMLET, BLUE		
A	2	PARROTFISH, BUCKTOOTH		
A	5	PARROTFISH, PRINCESS		
A	2	PARROTFISH, REDBAND		
A	1	PARROTFISH, REDTAILED		
A	3	PARROTFISH, YELLOWTAILED		
A	1	SCHOOL MASTER		
A	1	SNAPPER, SCHOOLMASTER		
A	1	TANG, BLUE		
A	9	WRASSE, BLUEHEAD		
A	6	WRASSE, CLOWN		
A	1	WRASSE, CREOLE		
A	1	WRASSE, PUDDINGWIFE		
A	1	WRASSE, SLIPPERY DICK		
A	1	WRASSE, SPANISH HOGFISH		
A	2	WRASSE, YELLOWHEAD		

Day		Taxon	Night	
Activity	No. transects		No. transects	Activity
A	3	ANGELFISH, FRENCH	2	A
A	2	EEL, SPOTTED MORAY	1	A
A	1	FLAMEFISH	1	A
A	4	GRUNT, BLUESTRIPED	3	A
A	1	GRUNT, TOMTATE	1	A
A	1	HERRING, DWARF	1	A
A	2	HERRING, SCALED SARDINE	2	A
A	3	JACK, BAR	2	A
A	2	MOJARRA, UNKNOWN SP.	3	A
A	7	MOJARRA, YELLOWFIN	6	A
A	3	PUFFER, BANDTAIL	1	A
A	1	SAILORS CHOICE	1	A
A	1	SOLDIERFISH, BLACKBAR	2	A
A	9	SURGEON, DOCTORFISH	3	A
A	2	TRUMPET FISH	3	A
A	9	DAMSELFISH, BEAUGREGORY	3	R
A	9	DAMSELFISH, DUSKY	6	R
A	7	DAMSELFISH, YELLOWTAIL	2	R
A	9	GOATFISH, SPOTTED	1	R
A	8	GOBIES	3	R
A	5	HAMLET, INDIGO	2	R
A	8	PARROTFISH, STOPLIGHT	1	R
A	8	PARROTFISH, STRIPED	1	R
A	7	SURGEON, BLUE TANG	1	R
A	6	SURGEON, OCEAN	5	R
R	5	GOBY, BRIDLED	1	A
R	7	GRUNT, FRENCH	6	A
R	2	HAMLET, BARRED	1	A
R	6	NEEDLEFISH, HOUNDFISH	1	A
R	9	PUFFER, BALLOONFISH	9	A
R	2	RAY, LESSER ELECTRIC	1	A
R	7	SILVERSIDE, HARDHEAD	5	A
R	6	SQUIRRELFISH	7	A
R	1	SQUIRRELFISH, DUSKY	6	A
R	1	SQUIRRELFISH, LONGJAW	4	A
R	5	SQUIRRELFISH, LONGSPINE	8	A
R	2	SQUIRRELFISH, REEF	8	A
R	2	SWEEPER, GLASSY	4	A
R	2	BLENNIES	3	R
R	9	DAMSELFISH, THREESPOT	3	R
R	3	LIZARDFISH, BLUESTRIPED	1	R
R	2	SAND DIVER	2	R

Day		Taxon	Night	
Activity	No. transects		No. transects	Activity
		DAMSELFISH, BROWN CHROMIS	1	R
		DAMSELFISH, NIGHT SERGEANT	2	R
		FILEFISH, SCRAWLED	1	R
		FILEFISH, SLENDER	1	R
		FLOUNDER, EYED	1	R
		PARROTFISH, MIDNIGHT	1	R
		SOAPFISH, GREATER	3	R
		CARDINALFISH, BARRED	5	A
		CARDINALFISH, BELTED	3	A
		CARDINALFISH, BRIDLED	1	A
		CARDINALFISH, DUSKY	4	A
		CARDINALFISH, FLAMEFISH	3	A
		CARDINALFISH, PALE	1	A
		EEL, SHARPTAIL	1	A
		PUFFER, PORCUPINE FISH	2	A
		PUFFER, WEB-BURR	1	A
		RAY, YELLOW STING-	5	A
		REEF CROAKER	2	A
		ROCK HIND	1	A
		SNAPPER, GLASSEYE	1	A