FISH COMMUNITIES IN CONTINUOUS AND PATCH MANGROVE HABITATS ON LITTLE CAYMAN ISLAND

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Abstract. Mangroves, highly productive ecosystems that provide habitat for fish, are being fragmented by coastal development in the South Hole Sound, Little Cayman Island. We evaluated fish communities between continuous mangrove habitats and mangrove patches, by comparing total abundance, species richness, and community composition, and found that the two communities did not differ. Because docks and other man-made structures have replaced mangrove habitats, we also observed fish communities under the docks to see if they were comparable to those in mangrove habitats. The fish communities under the docks had lower abundance and lower species richness than continuous and patch mangrove habitats.

Keywords. Habitat fragmentation, docks, fish species richness, fish abundance

INTRODUCTION

Mangroves are highly productive ecosystems that provide habitat for fish (Laegdsgaard and Johnson 2001). The complex root structures and high turbidity of mangrove habitats provide protection from predators (Robertson and Blabber 1992). In recent years, mangroves have been heavily fragmented by coastal development. Mangrove fragmentation increases light penetration, visibility and proximity to open water, reducing protection from predators (Clynick and Chapman 2002). Thus, mangrove fragmentation is responsible for decreases in abundance and diversity of fish (Pittman et al. 2004).

The coastal development on South Hole Sound of Little Cayman Island has fragmented the formerly continuous stretches of mangroves (T. Collins, *personal communication*). We compared fish communities between the two habitats in terms of total abundance, species richness, and community composition. We predicted that the continuous mangrove habitat would have higher abundance and higher species richness than patch habitats. We also observed sandy shore habitats between mangrove patches to compare areas with and without mangroves. We predicted that sandy shore habitats would have different community structure than mangrove habitats. Because docks and other man-made structures have replaced mangrove habitats, we also observed

fish communities under the docks to see if they were comparable to those in mangrove habitats.

METHODS

We studied fish communities in red mangrove (*Rhizophora mangle*) stands along the coast of South Hole Sound on Little Cayman Island from 3-6 March 2007. We observed fish in three habitat types: continuous mangrove (coastline with > 100 m stretches of unbroken mangroves), fragmented mangrove (coastline with mangrove patches *c.* 5-35 m long), and stretches of sandy shore (*c.* 5-20 m long) between mangrove patches. In each habitat type, we haphazardly chose 1 m x 2 m quadrats and counted the abundances of all fish species in each quadrat during 15 minute observations (n=18 quadrats for continuous, n=14 for patches, n=14 for sandy shore). We used the same methods to observe fish communities under boat docks at a distance from shore and depth comparable to that around mangrove roots (n=14).

Statistical Analyses. To test if both fish abundance (square-root transformed) and species richness differed among habitat types, we used a MANOVA. To test if mean fish abundance (square-root transformed) and species richness differed among habitat types, we used two one-way ANOVAs. Because we had different numbers of samples across habitats, we generated species-sample accumulation curves using EcoSim 7.0 (iterations = 5000, random seed = 10) (Gotelli and Entsminger 2001) for all four habitat types (Figure 2). Using the fish species that we observed in both continuous and patch mangrove habitats, we performed a matched pairs t-test to determine whether there was a difference in fish abundance between continuous and patch mangrove habitats.

RESULTS

Abundance and species richness differed among the four habitats (MANOVA, Wilks' Lambda =0.38, $F_{6,100}$=11.27, P<0.0001). Total fish abundances were similar for continuous mangroves, patch mangroves, and sandy shore habitats, but lower for dock habitats (ANOVA, $F_{3,54}$=12.62, P<0.0001) (Figure 1a). Species richness was higher for continuous and patch mangrove habitats than for open water and dock habitats (ANOVA, $F_{3,54}$=16.08, P<0.0001) (Figure 1b). The 95% confidence intervals on the species accumulation curves are more informative: species richness of continuous habitats was higher than that of sandy shore and dock habitats, and species richness of patch habitats was similar to that of the other three habitats (Figure 2).

Continuous and patch mangrove habitats shared 14 species in common, 10 of which were the most abundant species in all habitats (Table 1, Figure 3). We observed more schoolmaster, French grunts, and Caesar grunts in patch than continuous mangroves and more striped parrotfish in continuous than patch mangroves (Table 1). Abundances of those species occurring in both continuous and patch mangrove habitats did not differ significantly between the two habitats (matched paired t-test, t_{13}=1.01, P=0.16**).**

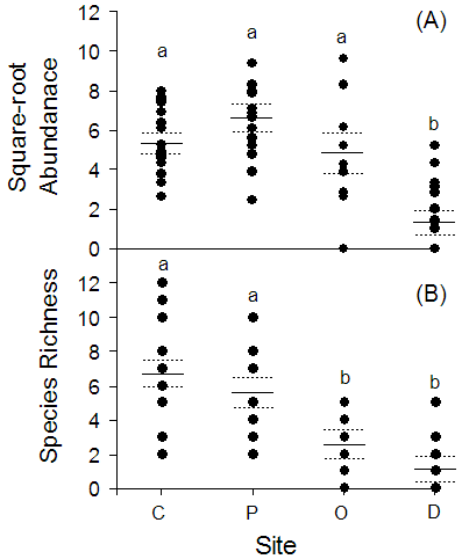

Figure 1. Number of fish (square-root transformed) (A) and species richness of fish (B) that were present in or passed through 1 m x 2 m quadrats during 15 minute observations at continuous mangrove (C, n=18), patch mangrove (P, n=14), sandy shore habitats (S, n=14) and dock habitats (D, n=14) along South Hole Sound, Little Cayman Island. Bars represent mean ± SE.

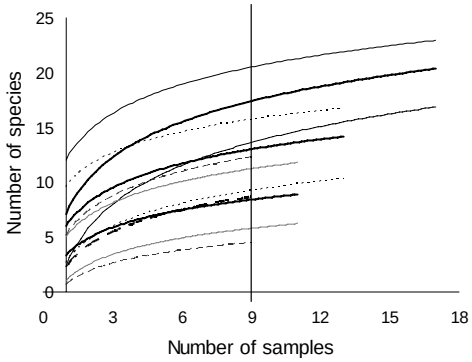

Figure 2. Species-sample accumulation curves for fish present in 1 m x 2 m quadrats over 15 minutes observation periods in South Sound, Little Cayman Island. The four bold lines represent four habitats: continuous mangrove (C), patch mangrove (P), sandy shore habitat (S), and docks habitat (D; dashed line). Thin grey lines are 95% confidence intervals: solid dark lines for C, dark dotted lines for P, solid light lines for S, and dark dashed lines for D. The vertical line aids comparison of the four habitats at the highest common number of samples (9).

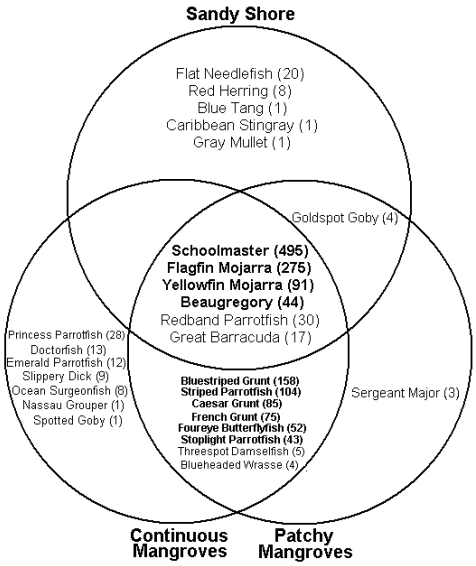

Figure 3. Venn diagram of fish species that were present in or passed through 1 m x 2 m quadrats during 15 minute observations in three habitats in South Hole Sound, Little Cayman Island. The total abundances (counts) are in parentheses; the 10 most abundant species are in bold.

Table 1. Abundance and percent abundance of fish species that were present in or passed through 1 m x 2 m quadrats during 15 minute observations in continuous and patchy mangrove habitats in South Hole Sound, Little Cayman Island. Abundance of species in bold are significantly different between the two habitats (matched pairs t-test).

Fish Species	Continuous		Patch	
	Abundance	% Abundance	Abundance	% Abundance
Beaugregory	18	3.23	17	2.94
Blueheaded Wrasse	2	0.36	2	0.35
Bluestriped Grunt	91	16.31	64	11.07
Caesar Grunt	**13**	**2.33**	**71**	**12.28**
Doctorfish	2	0.36	0	0.00
Emerald Parrotfish	12	2.15	0	0.00
Flagfin Mojarra	5	0.90	14	2.42
Foureye Butterflyfish	39	6.99	11	1.90
French Grunt	**9**	**1.61**	**66**	**11.42**
Goldspot Goby	0	0.00	1	0.17
Great Barracuda	6	1.08	6	1.04
Nassau Grouper	1	0.18	0	0.00
Ocean Surgeonfish	8	1.43	0	0.00
Princess Parrotfish	25	4.48	0	0.00
Redband Parrotfish	12	2.15	6	1.04
Red Herring	0	0.00	0	0.00
Sargeant Major	0	0.00	1	0.17
Schoolmaster	**154**	**27.60**	**269**	**46.54**
Slippery Dick	9	1.61	0	0.00
Spotted Goby	1	0.18	0	0.00
Stoplight Parrotfish	33	5.91	10	1.73
Striped Parrotfish	**93**	**16.67**	**11**	**1.90**
Threespot Damselfish	3	0.54	2	0.35
Yellowfin Mojarra	22	3.94	3	4.67

DISCUSSION

Although continuous and patch mangrove habitats differed in the spatial scale of their mangrove root coverage (*personal observation*), we found no difference in fish abundance and species richness between these two habitats. However, species richness was lower in sandy shore habitats than in both mangrove habitats, suggesting that fish communities in mangrove habitats have more in common with each other than those in sandy shore habitats (see Figure 3). The degree of fragmentation in our study area did not alter fish communities in mangrove patches.

Fish community composition also did not differ greatly between continuous and patch mangrove habitats. However, there were strong differences associated with fragmentation when we considered particular fish species. Because some species were more common in one habitat than the other, there may be species-specific responses to

mangrove fragmentation. Anecdotally, we also observed large fish individuals in continuous mangroves, but not in patch mangroves.

Fish abundance and species richness of both dock and sandy shore habitats were lower than in mangrove habitats. While docks provide structure for fish communities, they are inadequate substitutes for mangroves. Fish communities were apparently not affected by the current degree of fragmentation of mangrove habitats, but they were strongly and negatively affected by mangrove removal.

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