SPECIES RICHNESS IN THREE OCEANFLOOR HABITATS IN BERMUDA BAYS

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Abstract

Species richness of fish was compared between sand, sea grass, and coral habitats. Video and visual transects were conducted in these three habitats. Habitat, fish, and number of different families were recorded per transect. There were a significantly greater number of fish taxa in coral habitats than in sand or sea grass, and as expected, fish taxa diversity was greatest in coral habitats with 13 families of fish present. This species richness data forms a baseline that could help conservation biologists quantify growth or destruction of these communities.

Key Words: Species richness, sand, sea grass, coral, Bermuda

Introduction

Species Richness is a term that refers to the number of species in a community, and is associated with measuring the species diversity in a habitat. One species diversity hypothesis, the heterogeneity hypothesis, states that the more structurally complex the community, the greater the species richness and diversity (Tews et al. 2003). This is because more complex habitats have greater resources. Extensive research has been conducted on coral reef species richness and diversity (Friedlander et al. 2003; Grober-Dunsmore et al. 2007), but limited work has been conducted comparing species richness between marine habitats. In accordance with the heterogeneity hypothesis, Gratwicke and Speight (2004) found that more complex marine habitats support a greater number of fish species than the less complex habitats. Therefore, because reef habitats are more complex than sea grass beds, which are more complex than sandy areas, reef habitats were predicted to have the most species diversity. Alternatively, Yoklavich et al. (2002) found no significant difference in fish densities from four distinct habitats. More research is needed to understand habitat effects on fish assemblages. The current study compares species richness in three shallow, ocean floor habitats – sand, sea grass, and coral – in Tobacco and Shelly Bay, Bermuda. I hypothesize that coral areas will have the greatest species richness, due to greater habitat complexity, followed by sea grass then sand.

Materials and Methods

Study Sites: Three ocean floor habitats were studied – sand, sea grass, and coral – in two shallow, Bermudan bays. The first location, Tobacco Bay, is located just outside St. Georges. Sand and coral video and visual transects were conducted here. The second location, Shelly Bay, is located in Hamilton Parish. Sand, sea grass, and coral video transects were taken here.

Sampling: Before sampling, swimming rate was standardized by swimming along a transect line multiple times to see the average distance traveled in 30 second intervals. The standard measure was 15m in 30s with approximately 1m of distance propelled by 2 kicks. At Shelly Bay, ten 30s video transects were taken over sand; ten 30s video transects were taken over sea grass; and four, 30s videos were taken over coral before the camera froze, ending sampling for the day. In Tobacco Bay, the number and common name of fish observed were recorded on underwater tablets. The researcher swam in straight lines for 30s, recording any fish that swam by. Ten of these visual transects were taken over sand; ten were recorded over sea grass; and ten were recorded over coral.

In total, twenty 30s transects were taken over sand (10 video, 10 written); twenty 30s transects were taken over sea grass (10 video, 10 written); and fourteen 30s transects were taken over coral (4 video, 10 written). Video transects were reviewed to identify species of fish and the results from visual transects were compiled into a single document after sampling. Fish were accounted for by location (sand, sea grass, and/or coral) and number of transects they appeared in (Table 1). Number of fish taxa per transect was also recorded for each habitat (Table 2)

Table 1: Fish taxa present in different sampling locations

			Habitat			
Number	**Common Name**	**Family**	**Sand**	**Seagrass**	**Coral**	**# of Transects Present**
1	Bermuda Bream	Cyprinidae	x	x	x	30
2	Bermuda Chub	Kyphosidae			x	5
3	Butterflyfish	Chaetodontidae			x	9
4	Damselfish	Pomacentridae		x	x	3
5	Grunt	Haemulidae	x	x	x	24
6	Houndfish	Belonidae			x	2
7	Jack	Carangidae			x	6
8	Mojarra	Gerreidae			x	4
9	Needlefish	Belonidae	x			3
10	Parrotfish	Scaridae			x	10
11	Sand Diver	Creediidae	x	x		8
12	Sergeant Major	Pomacentridae			x	6
13	Silversides	Atherinopsidae	x	x		23
14	Slippery Dick	Labridae	x	x	x	31
15	Snapper	Lutjanidae			x	6
16	Squirrelfish	Holocentridae		x	x	8
17	Surgeonfish	Acanthuridae			x	2
18	Wrasse	Labridae		x	x	5

Table 2: Number of fish taxa present in each of the transects

Transect	Habitat	# of Taxa	Transect	Habitat	# of Taxa	Transecta	Habitat	# of Taxa
1	Sand	1	21	Seagrass	0	41	Coral	5
2	Sand	1	22	Seagrass	0	42	Coral	8
3	Sand	2	23	Seagrass	2	43	Coral	9
4	Sand	1	24	Seagrass	3	44	Coral	7
5	Sand	1	25	Seagrass	3	45	Coral	6
6	Sand	1	26	Seagrass	4	46	Coral	5
7	Sand	2	27	Seagrass	1	47	Coral	9
8	Sand	1	28	Seagrass	1	48	Coral	6
9	Sand	1	29	Seagrass	1	49	Coral	5
10	Sand	1	30	Seagrass	0	50	Coral	7
11	Sand	2	31	Seagrass	4	51	Coral	6
12	Sand	4	32	Seagrass	2	52	Coral	11
13	Sand	3	33	Seagrass	4	53	Coral	8
14	Sand	4	34	Seagrass	3	54	Coral	6
15	Sand	2	35	Seagrass	3			
16	Sand	5	36	Seagrass	2			
17	Sand	4	37	Seagrass	1			
18	Sand	6	38	Seagrass	4			
19	Sand	3	49	Seagrass	1			
20	Sand	4	40	Seagrass	2			

Results and Discussion

Sixteen families of fish were identified. Six different families were present over sand, eight different families were present over sea grass and thirteen were present in the coral habitat (Table 1 and Fig. 1). Of the seventeen families identified at the three sample sites, coral had 76% of the identified fish families, while sea grass had 47% and sand had 35%. Therefore coral was the most diverse with 29% more diversity than sea grass and 41% more than sand. Sea grass had 12% more diversity than sand and sand was the least diverse of the sampling sites.

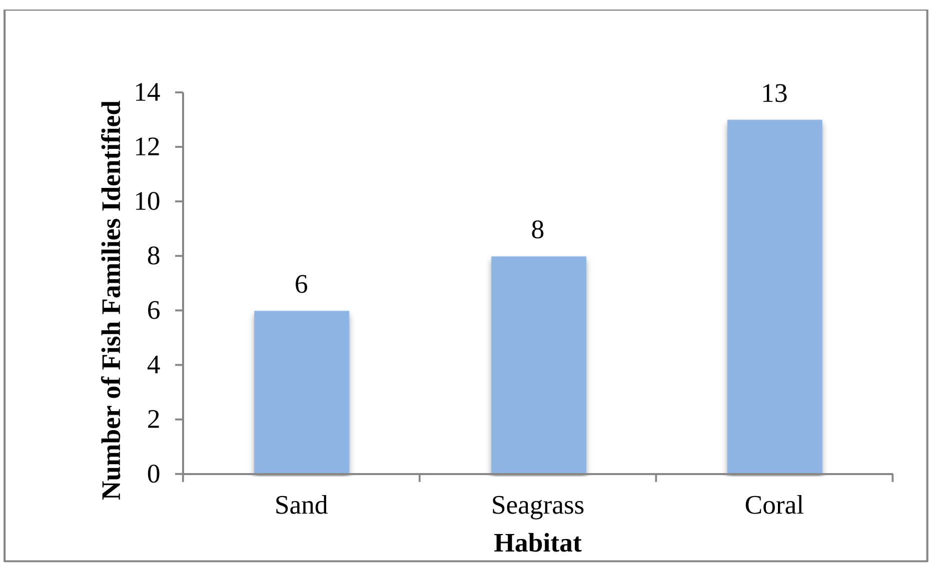

Fig. 1: Number of Fish taxa identified in three habitats

Fish occurrences were also recorded. *Halichoeres* bivittatus (Slippery Dick) present in all three habitats occurred most frequently appearing in 31 transects. Similarly, *Diplodus bermudensis* (Bermuda Bream), present in all three habitats, appeared in 30 transects. *Menidia menidia* (Silversides) and Haemulidae (Grunt) were also quite abundant, occurring in 23 and 24 transects respectively, with Grunt present in all three habitats, but Silversides only in sand and sea grass. *Tylosurus crocodilus* (Houndfish) and Acanthuridae (Surgeonfish) had the least occurrences, only appearing in 2 transects, both in coral habitats.

Results were analyzed in JMP by means of a oneway ANOVA test comparing number of taxa by habitat. Comparisons between pairs were made using a Tukey-Kramer test. There were significant interactions between coral and sea grass ($p < .0001$) and coral and sand ($p < .0001$) such that coral has significantly more taxa than both sea grass and sand (Fig. 2). Sea grass and Sand were not significantly different.

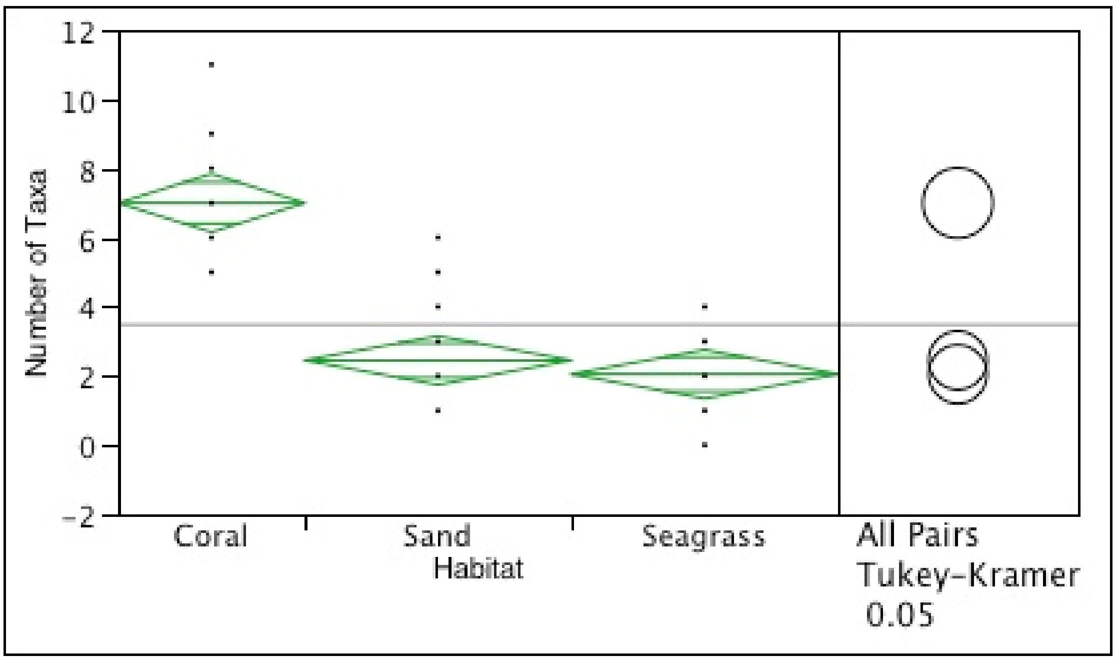

Fig. 2: Oneway ANOVA analysis of number of taxa by habitat

As hypothesized, coral habitats were found to be more diverse than sea grass or sand. These results support the Friedlander et al. (2003) hypothesis that habitat complexity is an important factor in explaining fish assemblage characteristics such that the more complex the habitat, the more heterogeneous the assemblages. There are many reasons why a more complex habitat like coral could support greater fish diversity. Gratwicke and Speight (2004) identify the six components of habitat complexity that make it able to support more fish. These components include: 1) topographic complexity, 2) substratum diversity, 3) variety of refuge hole sizes, 4) vertical relief, 5) percentage live cover, and 6) percentage hard substratum. Refuge holes, for instance, are a key difference between coral habitats and sea grass or sand. In the latter two, it is far more difficult for fish to conceal themselves from predators, making survivorship more difficult in these two areas. Percentage live cover is another key factor such that coral habitats have more food available than sea grass or sand. Resource availability is a crucial determinant of habitat.

Though coral has significantly more fish taxa, there are potential confounding variables that could account for the statistical non-significance for sea grass and sand. Schooling behavior and mobility, for instance, are fish defense mechanisms exhibited by many of the sand dwelling fish. These behaviors may have caused the same fish to appear in numerous transects, moving across ocean floor locations. Sea grass, though containing slightly more taxa than sand, may have had less diversity than coral because species here were less likely to school and more likely to just be passing through to more complex regions. Coral contained both the highest diversity and significant fish occurrences, supporting the heterogeneity hypothesis of species richness and diversity.

There are some limitations of the current study. Parker et al. (1994) point out the importance of the researcher’s ability to recognize and identify species during sampling. The current study could be improved with greater knowledge and experience identifying Bermudian fish before sampling takes place. Though species richness was studied, the researcher’s inexperience at fish identification made it only possible to identify fish genus or fish family in some cases. Therefore fish family is used here for consistency. Grober-Dunsmore et al. (2007) address fish migration. The proximity of the three sampling sites to each other could make it difficult to determine whether certain fish families mainly reside in the area they were identified in, or whether they were merely passing through, potentially confounding the data. Lastly, issues surrounding technology, specifically unavailability and dysfunction of video cameras forced fish identification to rely heavily on memory, making the written method of sampling less reliable.

The current study contributes to our knowledge of fish habitats. This study forms a baseline of knowledge that could be monitored to distinguish growth or destruction of the three habitats. Using this baseline, marine conservation groups could better understand how to protect these fish communities.

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