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COMPARISON OF FISHES OCCURRING IN ALGA AND SEAGRASS HABITATS ON THE EAST COAST OF FLORIDA

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ABSTRACT: I compare the distribution and abundance of fishes between macroalga and seagrass habitats in Indian River lagoon, Florida. I sampled fishes monthly (Oct. 1986 - Sept. 1987) for a year by placing seines 10 m apart and pulling them together. I used a 1 m^2 throw net to sample during March, May, June, August and September 1987. There was no significant difference in temperature, salinity, dissolved oxygen, and pH between habitats. Water depth was significantly different between alga (mean = 0.80 m) and seagrass (mean = 0.52 m). Dominate species (*Lucania parva, Menidia peninsulae, Gobiosoma robustum, Syngnathus scovelli, Microgobius gulosus, Eucinostomus lefroyi, Floridichthys carpio,* and *Strongylura notata*) were similar between the two habitats. Mean abundance, biomass, juvenile abundance and richness per seine tow; and abundance and biomass per throw net throw were significantly greater for seagrass habitat ($p < 0.05$). Multiple regression analysis indicated that habitat type accounted for the majority of the variation in abundance (37%) and biomass of fishes (31%) collected. Vegetation biomass, dissolved oxygen, pH, salinity, temperature, and water depth accounted for smaller amounts (<10%) of variation in abundance and biomass of fishes.

Many studies of fishes associated with macrophyte habitats have concentrated on describing and quantifying fishes associated with seagrass habitat (Hoese and Jones 1963, Briggs and O'Connor 1971, Gilmore 1977, Schooley 1977, Orth and Heck 1980, Martin and Cooper 1981, Livingston 1982, Stoner 1983, Sogard *et al.* 1987, Heck *et al.* 1989, Sogard *et al.* 1989a, 1989b). Briggs and O'Connor (1971) and Heck *et al.* (1889) compared fishes occurring over naturally vegetated and sand/mud bottoms and Martin and Cooper (1981) and Stoner (1983) compared fishes found in pure stand of different seagrass species. These descriptive and comparative studies reveal the abundance and diversity of fishes occurring in seagrass habitats.

In contrast to seagrasses, the macroalgae habitats of shallow water estuaries have received little attention. These habitats often account for large portions of the submerged aquatic vegetation in lagoon systems of Florida (Thompson 1978, Benz *et al.* 1979, White and Snodgrass 1990).

Macroalgae habitats have both an attached and a drifting component (Dawes 1985). Both attached and drifting macroalgae are found interspersed among seagrasses or as large aggregations removed from or adjacent to seagrasses (Thompson 1978, White and Snodgrass 1990).

Kulczycki *et al.* (1981) studied fish abundance in relationship to drift algae in a seagrass-drift algae community. Their study found a positive relationship between drift algae abundance and abundance of two fishes, *Gobiosoma robustum* and *Syngnathus scovelli*. However, studies of macrophyte habitats have not investigated the relationship of fishes to attached macroalgae.

In this paper I describe the distribution and abundance of fishes in at-

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tached macroalgal habitat and compare them with nearby seagrass habitat in the Indian River lagoon, Florida. The wide distribution of the macroalgae, *Caulerpa prolifera* in Indian River lagoon during 1986 and 1987 allowed fishes occurring in near monospecific stands of the alga and the seagrass, *Halodule wrightii* to be collected and compared.

METHODS

Study Site Selection

This study was conducted in the Indian River lagoon near central Merritt Island (Figure 1). The lagoon is described in detail by Schneider *et al.* (1974), Gilmore (1977), Schooley (1977, 1980), Mulligan and Snelson (1983) and Snodgrass (1990).

I selected two study sites based on proximity of monospecific stands of the alga, *Caulerpa prolifera* and the seagrass, *Halodule wrightii* (Figure 1). The sites were located in Banana River (Site 1) and Indian River (Site 2). Site 1 was subdivided into 99, 33 × 150 m plots. This size plot allowed three seine samples to be collected in each macrophyte habitat (six in each plot) on a single day without overlap or disturbance of subsequent sampling areas. One plot was randomly selected for sampling each month. The size of Site 2 did not allow randomization of sampling and the same area was sampled each month.

Collection Methods

I collected fishes monthly from October 1986 to September 1987 using seines at both sites and during March, May, June, August and September 1987 using a 1 m² throw net at Site 1. I conducted all sampling on the same day

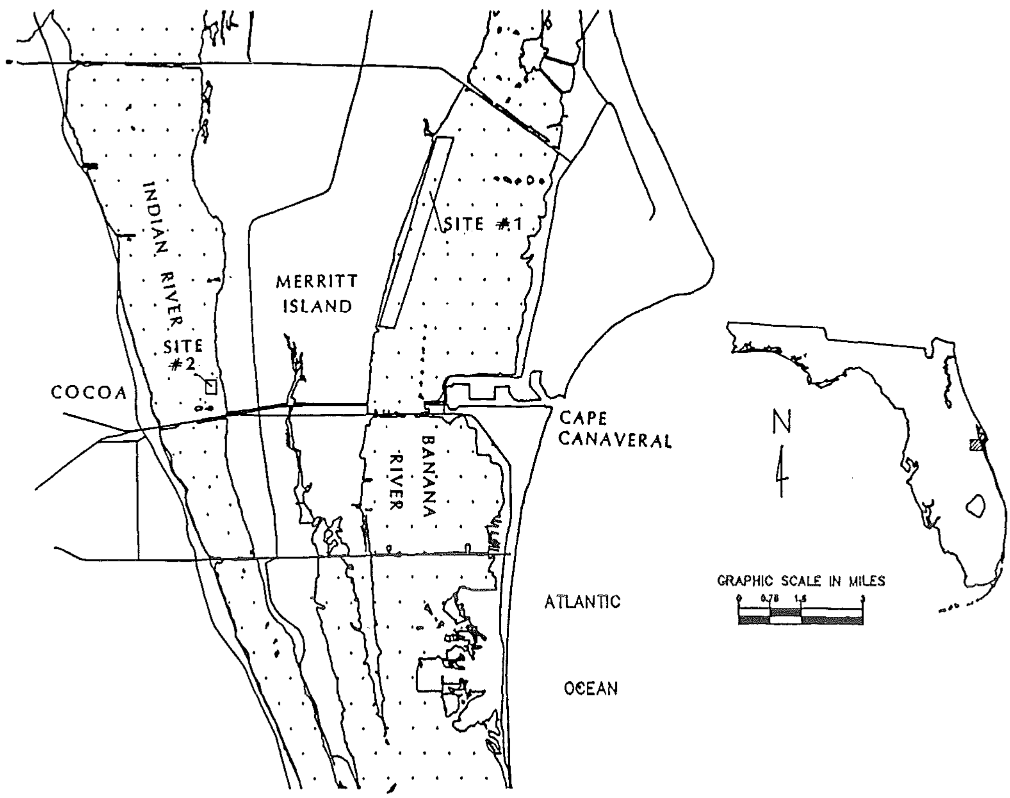

Figure 1. Location map of study sites in Indian River lagoon.

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when possible. When condition did not allow completion of sampling on the same day, I completed sampling in a week. Site 1 was sampled in the morning and Site 2 in the afternoon throughout the study.

Between May and June 1987 the alga habitat at Site 2 disappeared, resulting in a sand/mud bottom. I continued sampling Site 2 throughout the study. However, samples collected over the sand/mud bottom are not used for analysis in this paper.

To investigate effects of physical parameters on fishes I measured dissolved oxygen, pH, salinity, temperature and water depth in each habitat at the time of sampling. Depth was measured at four randomly selected sites within each area seined or entrapped by throw net. One measure of the other parameters was taken at each sampling site in each habitat at the time of sampling.

I used a 6.1 m straight seine with 3.2 mm mesh as a barrier net and a 10.0 m bag seine with 1.6 mm mesh to sample fishes. The seines were setup 10.0m apart and the bag seine pulled to the straight seine then lifted from the water. This method sampled an estimated 61 m^2.

During September of 1986, I collected six seine samples in each macrophyte habitat at Site 1. Species accumulation curves constructed from these samples indicated that no further species were collected after three seine collections in either habitat. Based on this, I collected three seine samples a month in each habitat at each site.

To obtain more quantitative data on fish abundance and biomass I used a 1 m^2 throw net. The throw net construction followed Kushlan (1981), with some modifications and used 3.2 mm mesh netting. The net was thrown from the front of a boat that was allowed to drift slowly onto the macrophyte bed being sampled. I removed fishes with a square front dip net (3.2 mm mesh). Sampling method are described in detail by Snodgrass (1990).

I processed all fish samples as follows: Fishes were preserved in 10% solution of formaldehyde and estuarine water in the field on warm days or on return to the laboratory on cooler days. Samples were transferred to denatured ethyl alcohol after two weeks for storage. Fishes were identified as to species, counted, and measured. Fishes were then dried at 100°C for 24 hours and weighed to the nearest 0.1 g.

I measured macrophyte biomass by removing all above ground vegetation in three randomly selected 0.03 m^2 areas in each area sampled. The vegetation was dried at 100°C for 24 hours and then weighed to the nearest 0.1 g.

Table 1. Means and 95% confidence intervals of physical parameters from October 1986 to September 1987 in alga and seagrass habitats of the Indian River lagoon and results of paired t-test and t-statistics. Minus indicates no significant difference and plus indicates a significant difference ($p \leq 0.05$).

Parameters	Habitat	$\bar{x} \pm 95\%$CI	t-statistic
Study Site 1			
Salinity (‰) (n = 12)	seagrass algae	23 ± 13 23 ± 3	– 0.70(–)
pH (n = 12)	seagrass algae	8.08 ± 0.07 8.24 ± 0.04	1.19(–)
DO (mg/L) (n = 12)	seagrass algae	8.21 ± 2.62 8.89 ± 5.20	0.82(–)
Temperature (°C) (n = 12)	seagrass algae	23 ± 11 23 ± 16	– 0.89(–)
Depth (m) (n = 36)	seagrass algae	0.50 ± 0.02 0.69 ± 0.01	2.98(+)
Study Site 2			
Salinity (‰) (n = 12)	seagrass algae	24 ± 13 25 ± 12	0.56(–)
pH (n = 12)	seagrass algae	8.05 ± 0.08 7.93 ± 0.11	– 0.36(–)
DO (mg/L) (n = 12)	seagrass algae	9.82 ± 6.93 8.74 ± 12.06	– 1.57(–)
Temperature (°C) (n = 12)	seagrass algae	24 ± 6 23 ± 8	– 1.39(–)
Depth (m) (n = 36)	seagrass algae	0.53 ± 0.02 0.91 ± 0.01	6.73(+)

Data Analysis

I used a minimum adult length to calculate the number of juvenile fishes occurring in a sample (lengths and references are given by Snodgrass [1990]). To provide a measure of diversity I calculated Shannon Diversity Index using the following formula:

$$H' = -\Sigma p_i \log p_i',$$

where $p_i = n_i/N$ for each seine sample.

For mean comparisons I used paired t-test for physical parameters and t-test for abundance, biomass, juvenile abundance, richness, and Shannon Diversity Index per seine tow. To investigate the relationship between fish abundance and biomass and physical parameters and macrophyte characteristics I used regression analysis. I included Site and habitat type in the regression analysis as binomial variables. Abundance and biomass data were normalized using a natural log transformation. I considered the results of all statistical tests significant at the $p = 0.05$ level.

RESULTS

There were no significant differences in dissolved oxygen, pH, salinity, or temperature between the two macrophyte habitats at Site 1 or Site 2 (Table 1). The difference in mean depth at Site 1, 0.19 m was less than Site 2, 0.38 m, and was significant in both cases.

Alga biomass was consistently higher than seagrass biomass at both sites (Figure 2). Biomass of the alga averaged 104.4 g m^{-2} at Site 1 and

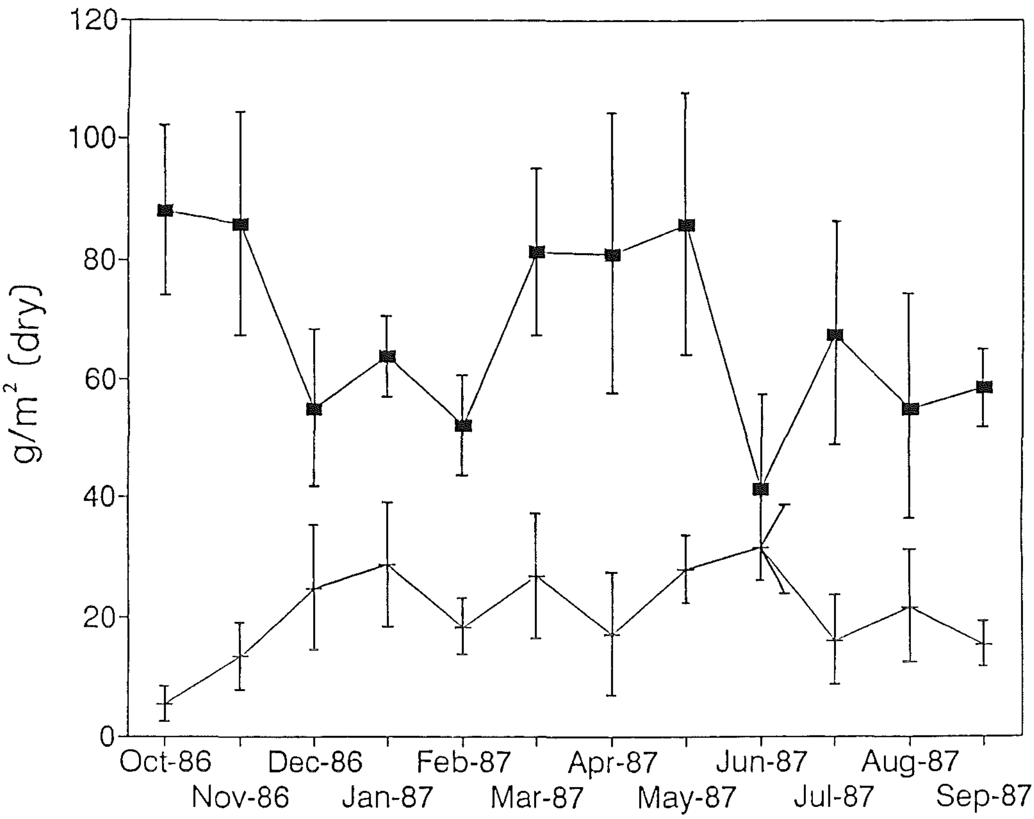

Figure 2. Mean biomass of *Caulerpa prolifera* (squares) and *Halodule wrightii* (lines) between October 1986 and September 1987 in Indian River lagoon. *C. prolitera*means for June, July, August and September 1987 are based on collections from Site 1 only. Error bars represent 95% confidence intervals.

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82.5 g m^{-2} at Site 2 before algal loss. Seagrass biomass averaged 30.6 g m^{-2} and 24.1 g m^{-2} at Site 1 and Site 2, respectively.

A total of 132 seine samples resulted in the collection of 89,427 fishes during the study period. The alga habitat produced 8,187 fishes representing 27 species in 14 families, while the seagrass habitat produced 81,240 fishes representing 26 species in 13 families. Five species representing 5 families and 6 species representing 6 families were collected exclusively in alga and seagrass habitats, respectively.

Lucania parva was the most abundant species collected at both sites in both macrophyte habitats (Table 2). The second most abundant species was *Menidia peninsulae* at Site 1 in both macrophyte habitats and *Gobiosoma robustum* at Site 2 in both macrophyte habitats. The three most abundant species accounted for 95% and 94% of the fishes collected at Site 1 from alga and seagrass habitats, respectively. Comparable values for Site 2 were 91% and 92%.

Some shifts in the dominant species occur when biomass is considered and

Table 2. Relative abundance and occurrence (n_p) of the 10 most abundant fish species collected between October 1986 and September 1987 using seines in alga and seagrass habitats of the Indian River lagoon. Occurrence is defined as the number of samples that the species occurred in divided by the total number of samples collected in each macrophyte type at each study site. Numbers in parenthesis are absolute ranks.

	Relative Abundance		n_p	
	Alga	Seagrass	Alga	Seagrass
Site 1[1]				
Lucania parva	0.83 (1)	0.77 (1)	0.94	1.00
Menidia peninsulae	0.10 (2)	0.12 (2)	0.44	0.92
Microgobius gulosus	0.02 (3)	0.02 (4)	0.44	0.75
Lagodon rhomboides	0.01 (4)	<0.01 (14)	0.36	0.14
Floridichthys carpio	0.01 (5)	<0.01 (7)	0.36	0.69
Gobiosoma robustum	0.01 (6)	<0.01 (10)	0.42	0.22
Eucinostomus lefroyi	0.01 (7)	0.01 (6)	0.11	0.31
Syngnathus scovelli	0.01 (8)	0.01 (5)	0.44	0.78
Strongylura notata	<0.01 (9)	<0.01 (8)	0.14	0.31
Eucinostomus harengulus	<0.01 (10)	<0.01 (23)	0.06	0.03
Poecilia latipinna	<0.01 (13)	0.05 (3)	0.08	0.47
Gambusia affinis		<0.01 (9)		0.25
Site 2[2]				
Lucania parva	0.49 (1)	0.85 (1)	0.92	1.00
Gobiosoma robustum	0.33 (2)	0.04 (2)	0.96	1.00
Syngnathus scovelli	0.09 (3)	0.02 (6)	0.92	0.89
Anchoa mitchilli	0.02 (4)		0.04	
Hippocampus zosterae	0.02 (5)	<0.01 (12)	0.46	0.19
Menidia peninsulae	0.01 (6)	0.03 (4)	0.17	0.89
Microgobius gulosus	0.01 (7)	0.03 (3)	0.25	0.83
Lagodon rhomboides	0.01 (8)	<0.01 (7)	0.21	0.28
Chasmodes saburrae	<0.01 (9)	<0.01 (15)	0.29	0.06
Bairdiella chrysoura	<0.01 (10)	<0.01 (10)	0.13	0.17
Poecilia latipinna		0.02 (5)		0.28
Floridichthys carpio		<0.01 (8)		0.44
Strongylara notata	<0.01 (13)	0.01 (9)	0.17	0.31

[1]Relative abundance at Site 1 is based on data from 36 collections in each macrophyte type.
[2]Relative abundance at Site 2 is based on 24 collection in alga beds and 36 collection in seagrass beds.

Table 3. Relative biomass of the 10 most abundant fish species collected between October 1986 and September 1987 using seines in alga and seagrass habitats of the Indian River lagoon. Numbers in parenthesis are absolute ranks.

Species	Relative Biomass Alga	Relative Biomass Seagrass
Site 1[1]		
Lagodon rhomboides	0.31 (1)	0.03 (4)
Lucania parva	0.31 (2)	0.47 (1)
Menidia peninsulae	0.16 (3)	0.35 (2)
Sphoeroides nephelus	0.09 (4)	
Floridichthys carpio	0.05 (5)	0.02 (6)
Arius felis	0.01 (6)	
Bairdiella chrysoura	0.01 (7)	<0.01 (10)
Opsanus tau	0.01 (8)	<0.01 (24)
Microgobius gulosus	0.01 (9)	0.01 (8)
Syngnathus scovelli	0.01 (10)	0.01 (7)
Poecilia latipinna	<0.01 (17)	0.08 (3)
Eucinostomus lefroyi	<0.01 (16)	0.02 (5)
Strongylura notata	<0.01 (14)	0.01 (9)
Site 2[2]		
Lucania parva	0.31 (1)	0.77 (1)
Gobiosoma robustum	0.15 (2)	0.02 (3)
Anchoa mitchilli	0.14 (3)	
Bairdiella chrysoura	0.11 (4)	0.02 (4)
Lagodon rhomboides	0.10 (5)	<0.01 (12)
Syngnathus scovelli	0.07 (6)	0.02 (5)
Opsanus tau	0.03 (7)	<0.01 (11)
Chasmodes saburrae	0.03 (8)	<0.01 (15)
Menidia peninsulae	0.01 (9)	0.11 (2)
Hippocampus zosterae	0.01 (10)	0.01 (19)
Microgobius gulosus	0.01 (12)	0.02 (5)
Poecilia latipinna		0.01 (8)
Sphroides nephelus		0.01 (8)
Strongylara notata	<0.01 (18)	0.01 (9)
Floridichthys carpio		<0.01 (10)

[1]Relative biomass of fishes is based on data from 36 collection in each habitat at Site 1.

[2]Relative biomass is based on data 24 collection in the alga beds and 36 collection in seagrass beds at Site 2.

the degree of dominance of the most abundant species decreases (Table 3). The three most abundant species in terms of biomass at Site 1 made up 78% of the fish collected in alga and 90% of the fish collected in seagrass. At Site 2 they made up 60% of the fish collected in alga and 89% of the fish collected in seagrass.

Juveniles of 26 species were collected during the study period (Table 4). *Lucania parva, Poecilia latipinna, Menidia peninsulae, Gobiosoma robustum,* and *Microgobius gulosus* accounted for the majority of juveniles collected and occurred throughout the study period.

Mean abundance, biomass, richness, and juvenile abundance per seine tow were significantly greater for the seagrass habitat at both sites (Table 5). Mean

Table 4. List of juvenile fish species collected between October 1986 and September 1987 using seines in alga and seagrass habitats of Indian River lagoon and the months of their occurrence.

	1987									1986		
Seagrass	J	F	M	A	M	J	J	A	S	O	N	D
Menidia peninsulae	*	*	*	*	*	*	*	*	*	*	*	*
Poecilia latipinna	*		*		*	*	*	*	*			*
Microgobius gulosus	*	*	*	*	*	*	*			*	*	*
Lucania parva	*	*		*	*	*	*	*	*	*	*	*
Syngnathus scovelli	*		*	*	*	*	*	*	*	*	*	*
Floridichthys carpio		*	*	*		*	*	*		*	*	*
Eucinostomus lefroyi	*	*	*			*			*			*
Strongylura notata					*	*	*	*	*			
Gobiosoma robustum	*	*	*					*		*	*	*
Syngnathus louisianae	*	*	*								*	*
Lagodon rhomboides	*	*	*	*	*							*
Cyprinodon variegatus							*	*		*	*	
Gambusia affinis	*			*	*		*					
Eucinostomus gula												*
Diapterus olithostomus	*											
Mugil cephalus	*	*									*	*
Fundulus similis							*					
Strongylura marina			*	*								
Eucinostomus harengus					*							*
Achirus lineatus			*									
Opsanus tau							*		*			
Algae	J	F	M	A	M	J	J	A	S	O	N	D
Gobiosoma robustum		*	*						*	*	*	*
Lucania parva	*		*		*	*		*	*	*	*	*
Menidia peninsulae		*	*	*	*	*					*	
Microgobius gulosus	*					*			*	*	*	*
Lagodon rhomboides	*	*		*	*	*						
Chasmodes saburrae	*	*	*	*								*
Syngnathus scovelli	*	*									*	*
Bairdiella chrysoura	*							*			*	*
Cyprinodon variegatus			*							*		*
Eucinostomus gula						*			*			*
Eucinostomus lefroyi	*	*							*			
Cynoscion nebulosus					*			*				
Eucinostomus harengus		*				*						
Opsanus tau											*	*
Strongylura notata					*	*						
Floridichthys carpio						*						
Megalops atlanticus								*				
Mugil cephalus		*										
Poecilia latipinna								*				
Strongylura marina						*						
Syngnathus louisianae												*
	J	F	M	A	M	J	J	A	S	O	N	D

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Table 5. Means, 95% confidence intervals, and minimum and maximum values of number of fishes, biomass, juveniles, species, and Shannon Diversity Index per seine tow and results of t-tests. Statistic for the habitats at Site 1 and seagrass habitats at Site 2 are based on 36 samples and statistics for the alga habitats at Site 2 are based on 24 samples.

	$\bar{x}$ ±95%CI	Max.	Min.	t-statistic (df=70)
Site 1				
Total Fishes				
Seagrass	1017.1±270.4	3124	39	5.01
Algae	264.6±128.5	1646	9	
Biomass (g)				
Seagrass	56.4± 16.2	238.9	1.4	5.43
Algae	11.9± 6.0	81.3	0.3	
Juveniles				
Seagrass	111.5± 36.7	498	2	3.75
Algae	27.2±21.2	379	0	
Species				
Seagrass	6.7± 0.7	11	3	5.19
Algae	4.3± 0.6	8	1	
Shannon Diversity				
Seagrass	0.30± 0.04	0.56	0.04	1.77
Algae	0.23± 0.05	0.62	0.00	
Site 2*				
Total Fishes				
Seagrass	1318.2±284.9	3535	149	8.47
Algae	112.4± 36.5	281	1	
Biomass (g)				
Seagrass	53.7± 10.4	130.7	8.8	9.95
Algae	11.9± 6.0	81.3	0.3	
Juveniles				
Seagrass	124.5± 35.7	488	3	6.59
Algae	8.3± 4.4	44	0	
Species				
Seagrass	6.9± 0.6	10	2	5.76
Algae	5.0± 0.7	10	1	
Shannon Diversity				
Seagrass	0.26± 0.05	0.55	0.01	-1.47
Algae	0.37± 0.06	0.56	0.00	

Shannon Diversity was higher in seagrass at both sites, although this difference was not significant at either site.

Thirty throw net collections were made in the alga habitat and 21 in the seagrass habitat at Site 1. *L. parva* was the most abundant species in all throw net collections. Mean fish abundance (66.0 fish/throw, SD=15.8) and biomass (2.2 g/throw, SD=0.5) collected in seagrass was significantly greater than mean fish abundance (19.7 fish/throw, SD=3.2) and biomass (0.7 g/throw, SD=0.1) collected in alga.

The binomial variables, "alga" and "Site 2" were assigned values of zero (0) and "seagrass" and "Site 1" values of one (1) for inclusion in the regression analysis. The analysis was significant using both abundance and biomass per seine tow (F-test, $p<0.05$, Table 6). The independent variables, habitat, vegetation biomass, dissolved oxygen, pH, salinity, and depth were significant when abundance per seine tow was used as the dependent variable. When fish biomass was used, site and temperature became significant in addition to the above mentioned variable. Habitat accounted for the majority of the variability with the effects of other variables being relatively minor (Table 6).

DISCUSSION

Most of the species collected in this study can be classified as resident

Table 6. Results of regression analysis using total number of fishes and biomass per seine tow as dependent variables.

Independent Variable	Estimated Parcial Slope	t-statistic	Contribution to R^2
Dependent variable = total number of fishes per seine tow			
Intercept	-7.73	-2.31	----
Habitat	3.48	11.28	0.37
Veg. Biomass*	0.12	3.51	0.04
DO	0.09	3.07	0.03
pH	1.25	3.16	0.03
Salinity	-0.06	-2.26	0.02
Depth	1.98	3.59	0.04
$R^2=0.59$	F-statistic=34.77	se of regression=1.07	
Dependent variable = biomass of fishes per seine tow			
Intercept	-5.33	-1.59	----
River	0.28	1.20	<0.01
Habitat	3.05	9.88	0.31
Veg. Biomass*	0.09	2.42	0.02
DO	0.07	2.09	0.01
pH	0.57	1.41	0.01
Temperature	0.03	1.15	<0.01
Salinity	-0.04	-1.55	0.01
Depth	1.31	2.10	0.01
$R^2=0.55$	F-statistic=22.50	se of regression=1.07	

*dry weight of vegetation (seagrass or algae) per meter squared.

macrophyte habitat species, species that breed and carry out their life in the macrophyte habitat (Kikuchi 1980). This is supported by the collection of juveniles of the more abundant species during most months of the study and the reported association of these species with seagrasses by other authors (Hoese and Jones 1963, Weinstein *et al.* 1977, Schooley 1977, 1980, Orth and Heck 1980, Martin and Cooper 1981, Livingston 1982, Stoner 1983).

Because of the resident status of the species collected dial variations in abundance are probably minimal. Dial variation in abundance is more likely to occur among transient species, species that are active in the macrophyte habitat for a predictable portion of the day (Kikuchi 1980). These species tend to be large motile predators often of sports or commercial interest. Because seines and throw nets are inefficient in sampling more motile fishes the abundance of transient species could not be compared.

While the seine and throw net methods I used do not provide absolute densities they do allow comparisons between alga and seagrass habitats. The relatively abundant species were much the same between macrophyte habitats with the exception of *Poecilia latipinna* and *Anchoa mitchelli*. Large numbers of *P. latipinna* were collected in the seagrass habitat while few were collected in the alga habitats. *P. latipinna* prefers protected habitats and may be more abundant in seagrass habitats as a result of their protected nature. Water depths were significantly less in the seagrass habitats and seagrass habitats were located closer to shore at both sites.

At Site 2, two large collections of the epibenthic schooling species, *A. mitchelli*, accounted for its relatively high abundance and biomass. This species is reported to be abundant in the open waters of the lagoon (Mulligan and Snelson 1983) and therefore is not considered to be associated with the alga habitat.

Comparison of relative biomass reveals differences between sites and between macrophyte habitats. However, these differences are limited to the relative biomass of *Lagodon rhomboides*. This species accounted for a substantial portion (31%) of the fish biomass collected from the alga habitat at Site 1 while accounting for a small portion ($\leqslant$10) of the fish biomass collected from the macrophyte habitats at Site 2 and seagrass habitat at Site 1. This may be a result of sampling bias. The use of trawls or other more effective methods of sampling larger more motile species may reveal the occurrence of large *L. rhomboides* in both macrophyte habitats at both study sites.

The most striking difference between alga habitat and seagrass habitat was the significantly greater abundance and biomass of fish collected from the seagrass habitat. I found fish abundance to be five times greater in *Halodule* when compared with *Caulerpa*. This ratio is slightly higher than the ratios of 2.5 to 1 reported by Stoner (1983) and 4.8 to 1 reported by Martin and Cooper (1981) when they compared *Halodule* with other seagrasses and less than the ratio of 8 to 1 reported by Heck *et al.* (1989) when comparing seagrass with sand/mud bottom. This suggests an intermediate abundance of fishes occurring in macroalgae habitats when compared with seagrass and sand/mud bottom habitats. Mean fish abundance during July, August and September 1987 was significantly greater (t-test, $p \leqslant 0.5$) in the alga habitat at Site 1 when compared with sand/mud bottom habitat resulting from algal loss at Site 2. Because this study was not designed to compare alga and sand/mud bottom habitats and the reason for algal loss remains unknown few conclusions can be drawn from this comparison. How-

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ever, a more controlled comparison of attached macroalgae habitat with sand/mud bottom habitat may help to define this relationship.

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