The Abundance of Fishes in Shallow, Algal/Seagrass Habitats in the Waters Surrounding Parque Nacional del Este, Dominican Republic

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ABSTRACT

No information exisits on the fish fauna in the shallow, algal/seagrass habitat surrounding Parque Nacional del Este, Dominican Republic. In order to assess the current status of fish populations near the park, 63 two-minutes otter trawls were conducted among nine stations. The number, size, and weight of each fish collected was recorded at each station. The percent converage of algae and seagrass species was collected at each station using belt quadrats. The most dominant species numerically in the catch was the balloonfish (*Diodon holocanthus*). Only three snapper individuals and three grouper species were collected. All three grouper individuals were mutton hamlet (*Epinephelus afer*). There were significant differences in the mean biomass of fish per trawl among stations. Stations at the opening of the channel between the mainland and Saona Island had higher biomass than other stations. Length-weight relationships were calculated for four speies: *D. holocanthus, Scarus criocensis, Sparsimona aurofrenatum*, and *Sparsimona rubripinne*. There appears to be very little relationship between algae or seagrass abundance and the biomass of fish collected. There is a lack of recruitment of snappers and groupers to these habitats which is one of the causes of low densities of these fishes on offshore coral reefs.

INTRODUCTION

Parque Nacional del Este (PNE) is located in the southeast corner of the Dominican Republic. It was established as a park in 1975. The marine portion of the park has only recently been legally recognized as part of the park. The majority of scientific studies completed in PNE have concentrated on the flora and fauna of the land portion of the park. A Rapid Ecological Assessment (REA) was carried out in March of 1994 in PNE (Vega, 1994). The objectives of the fish portion of that study were to describe the marine fish communities and to identify the potential or realized threats to fishes in the area. Qualitative surveys were completed in order to evaluate the status of the marine ecosystem and to provide the basis for the development of monitoring studies. The REA results suggested: 1) Reef fish assemblages are characterized by high species richness, but relatively low numbers of larger, predatory species and 2) The only recognizable human impact in the park was overfishing.

The abundance of fish is influenced by biological and physical factors affecting the recruitment of larval fish as well as those influencing post-settlement survival (Victor, 1991). Recruitment is affected by the physical oceanography of the region, larval behaviour, and of larval stage, predation, and starvation. Post-settlement survival is affected by factors such as resource limitation, habitat, competition, predation, disease and exploitation.

Coral reef systems are connected to other habitats through the flow of water and resources. Most fish eggs and larvae are planktonic and may travel great distances before settling (Leis, 1991). Larvae of many species settle in seagrass beds before moving to other habitats. Juveniles of many types of organisms inhabit seagrass beds for a period of time, and as these organisms grow, many of them move to coral reefs (Ross and Moser, 1995). Seagrass beds also function as a feeding area for some fish such as grunts, which move off the reef and into the seagrass at night to feed (Shulman and Ogden, 1987). Quantitative characteristics of these habitats have been shown to influence the species abundances of fish.

The goal of this study is to examine the abundance of juvenile fishes in algal/seagrass dominated habitats in PNE in order to determine if there is significant recruitment to these habitats. Two objectives will be completed to meet this goal: 1) the species composition and biomass will be reported and 2) the biomass of fish will be compared among stations with quantitatively different types of algal/seagrass habitat. Lenght-weight relationships will be reported for those species for which there was a large enough sample size to have a statistically valid relationship.

METHODS

Quantitative Sampling of Juvenile Fish

Sampling was conducted from March 7-15, 1995, between 0900 and 1700 hours. Nine stations were selected: four located in between Isla Saona and the mainland, three on the western edge of the park, and two on the western edge of Isla Saona (Figure 1). A three-meter wide otter trawl was used to collect quantitative information on the species composition and biomass of fish.

A point was selected in shallow-water with algae or seagrass covering the

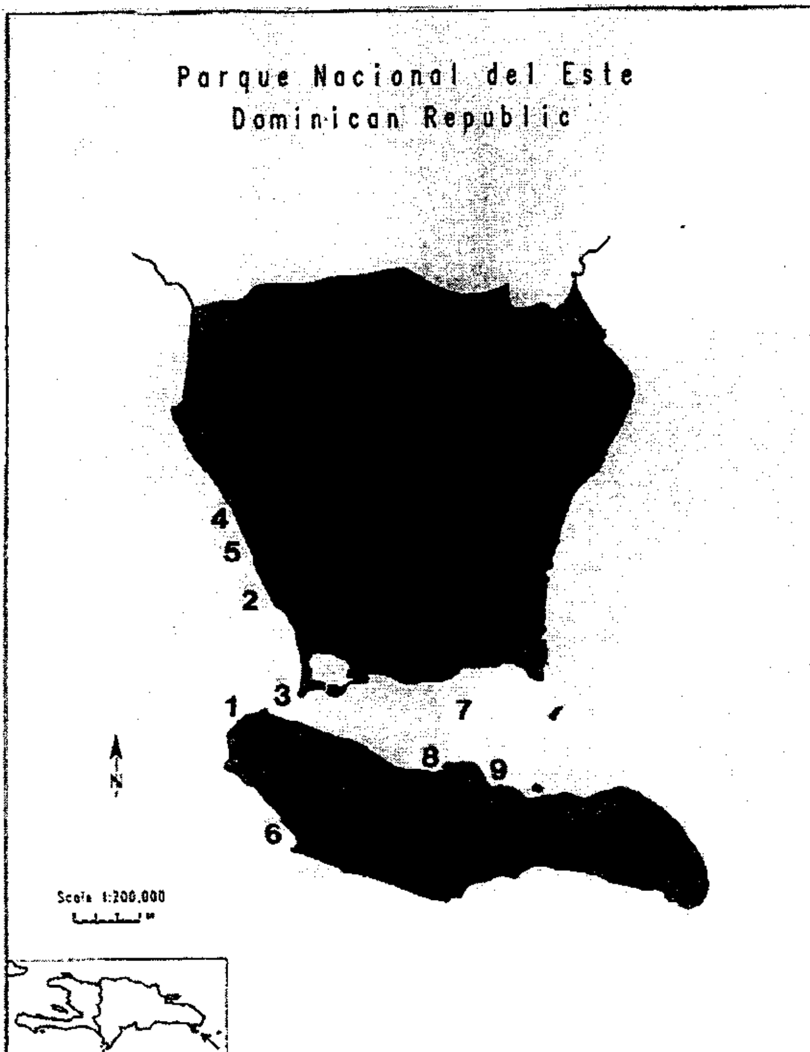

Figure 1. Map of study area. The numbers show the location of trawling stations.

Table 1. Fish Trawling Stations at Parque Nacional del Este, Dominican Republic. The asterisk represents a station whose position could not be recorded. Standard deviation is shown in paranthesis.

Station	General Location	No. of Trawls	Mean Dist./Trawl (m)	Mean Biomass/Trawl (g)
1	Western edge of Saona	12	245 (335.708)	230.43 (216.37)
2	Western edge of Mainland	6	258 (360.09)	211.46 (184.90)
3	Western Mouth of Saona Channel	3	*	682.70 (786.50)
4	Western edge of Mainland	4	103.3 (35.12)	65.40 (41.06)
5	Western edge of Mainland	6	105 (65.95)	169.00 (100.57)
6	Western edge of Saona	4	270 (197.99)	30.23 (36.35)
7	Saona Channel	12	176 (303.58)	66.83 (96.70)
8	Saona Channel	8	130 (90.11)	166.06 (216.49)
9	Saona Channel	10	235 (527.11)	93.50 (112.13)

Table 2. Estimated bottom component coverage of trawling stations. All values are in cm^2/m^2. Standard deviation is shown in parenthesis. Stations with an asterik (*) could not be surveyed.

Station	*T. Testudinum*	*S. filiforme*	*H. wrightii*	Algae	Fine Sediment	Coarse Sediment	Halimeda carbonates
1	4500(1175)	3312.5(1208.2)	75(335.4)	2175(1057.9)	0	0	5500(1175.4)
2	0	0	0	2690(1473.3)	8625(559)	437(1956.5)	15(67.1)
3	1602.5(1628.9)	0	0	6215(3000.4)	0	4815(2854.2)	4690(2724.6)
4	2180(3237)	42.5(89.6)	0	375(494.2)	7076.2(3256.1)	131.3(632.9)	0
5	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*
7	1325(1118.9)	91.85(109.5)	45.3(66)	5682.5(1678.8)	8734.4(139.75)	0	1.88(16.8)
8	2698.8(2405.1)	0	0	3056.9(2338.1)	8125(1089.4)	1562.5(2723.4)	1858.1(1857.2)

bottom. The site was inspected for obstructions, such as corals and rocks, in order to avoid damage to the environment or equipment. Each transect was standardized at 2 minutes duration and approximate speed of 2 to 3 knots. The position at the beginning and end of the trawl was recorded using a Global Positioning System receiver (GPS) in order to calculate the distance trawled. After the trawl was completed, the fish collected were measured to the nearest 0.1 cm and weighted to the nearest 0.1 gram. Species which could not be readily identified were retained for later identification. Three to twelve trawls were conducted per station (Table 1). The mean biomass per trawl was compared between stations using Kruskal-Wallis ANOVA (Zar, 1984).

Algal/Seagrass Quantitative Surveys

Quantitative surveys in order to characterize the coverage of algal and seagrass species as well as sediments was conducted at seven of the nine trawling sites (Table 2). Belt-quadrats were used to collect the cm^2 per m^2 of algae, seagrass (*Thalassia testudinum, Syringodium filiforme* and *Halodule wrightii*), and sediments (fine grain silt or mud and coarse grain sediment). Within each 1-m^2 quadrat the percent coverage of each of the seven categories was visually scored into one of the following categories: 0) absent, 1) 1%, 2) 1-5%,3) 6-25%, 4) 26-5-%, 5) 51-75%, and 6) >75%. The mid-point of each category was used to transform percent coverage into cm^2/m^2. The relationship between algae, seagrass and sediment coverage and fish biomass was tested with Spearman rank correlation (Zar, 1984).

Length-weight Relationship

The length-weight relationships of fish species was studied using linear regression between the logarithms of weight (g) and length (cm) of each individual encountered. This yielded relationships between length and weight described by the equation $W=aL^b$ for the four species with more than 30 individuals collected.

RESULTS

Species Composition and Biomass of Fishes

There were significant differences in the mean biomass per trawl among the stations sampled ($H=18.677$, $df=8$, $p<0.05$). The stations with the highest biomass were 3 and 1. The biomass by species is presented in Table 3.

The most frequently encountered species was the baloonfish, *Diodon holocanthus* (n=110), which was found in all 9 trawling stations. This species was followed in frequency by the scarids *Sparisoma aurofrenatum* (n=47), *Scarus croicensis* (n=45) and *Sparisoma rubripinne* (n=42). A total of three

Table 3. Mean Biomass of Species per Trawl Station in Parque Nacional del Este. Standard deviation is shown in paranthesis.

Family/Species	1	2	3	4	5	6	7	8	9
ACANTHURIDAE									
Acanthurus bahianus	0.13(0.46)	-	12(10.39)	0.42(0.49)	-	-	-	-	-
Acanthurus chirurgus	-	0.53(0.92)	-	-	24.67(40.5)	-	-	-	4.1(4.38)
Acanthurus coeruleus	-	-	-	-	-	-	-	-	0.9(2.60)
ATHERINIDAE									
"Silverside"	-	0.51(0.88)	-	-	-	-	-	-	-
AULOSTOMIDAE									
Aulostomus maculatus	0.25(0.87)	0.27(0.46)	-	0.9(1.04)	-	0.3(0.35)	-	-	-
BALISTIDAE									
Aluterus scriptus	-	-	-	-	-	-	-	-	0.1(0.29)
Monacanthus ciliatus	0.83(2.89)	3.53(4.53)	-	-	-	-	0.01(0.03)	0.44(1.01)	-
Cantherhines pullus	-	0.42(0.72)	3.5(3.03)	0.9(1.04)	0.53(0.92)	-	-	-	-
BOTHIDAE									
Bothus ocellatus	1.82(3.98)	0.18(0.32)	2.6(1.53)	-	0.67(1.16)	-	0.08(0.6)	-	-
CHAETODONTIDAE									
Chaetodon striatus	-	-	-	0.07(0.12)	-	-	-	-	-
CLINIDAE									
Malacoctenus versicolor	-	0.13(0.23)	-	-	-	-	-	-	-
Paraclinus nigripinnis	-	-	-	0.03(0.03)	-	-	-	-	-
GOBIDAE									
Coryphopterus glaucofraenum	-	-	-	-	-	-	-	-	-

Table 3. (cont.) Mean Biomass of Species per Trawl Station.

Family/Species	1	2	3	4	5	6	7	8	9
HOLOCENTRIDAE									
Holocentrus rufus	-	3.17(5.49)	-	-	-	-	-	-	-
LABRIDAE									
Doradonotus megalepsis	0.08(0.29)	-	0.27(0.23)	0.23(0.19)	0.85(0.71)	-	-	-	-
Halichoeres bivittatus	0.54(1.73)	1.13(1.46)	2.17(1.30)	0.25(0.29)	1.35(1.43)	2.98(3.44)	-	-	-
Halichoeres poeyi	0.51(1.76)	3.33(5.77)	-	3.45(3.10)	3.57(3.86)	-	-	-	-
LUTJANIDAE									
Lutjanus apodus	-	-	-	-	-	-	-	12.5(28.9)	-
Ocyurus chrysurus	-	-	0.13(0.12)	-	-	-	-	1(2.31)	-
MULLIDAE									
Pseudupeneus maculatus	1.18(3.17)	1.4(2.43)	6.9(5.98)	5.78(5.41)	3.48(4.00)	-	-	-	-
OGCOCEPHALIDAE									
Ogcocephalus parvus	-	-	-	-	-	-	-	12.5(28.9)	-
OSTRACIIDAE									
Lactophrys bicaudalis	-	0.45(0.78)	-	-	-	-	-	-	-
Lactophrys quadricornis	-	0.28(0.98)	-	-	-	-	-	-	-
Lactophrys spp.	-	-	-	-	-	-	-	-	0.73(1.42)
POMADASYDAE									
Haemulon aurolineatum	-	0.1(0.17)	-	-	-	-	-	-	-

Table 3. (Cont.) Mean Biomass of Species per Trawl Station.

Family/Species	1	2	3	4	5	6	7	8	9
Haemulon chrysargyreum	-	0.03(0.06)	-	-	-	-	-	-	-
Haemulon flavolineatum	-	-	1.27(0.88)	-	-	-	-	-	1.5(4.33)
Haemulon plumieri	-	-	-	-	-	-	-	3.93(6.24)	9.33(4.62)
Haemulon sciurus	-	-	69.96(60)	0.05(0.6)	-	-	-	-	0.27(0.78)
Haemulon spp.	-	-	0.1(0.9)	-	-	-	-	0.88(2.02)	-
SCARIDAE									
Scarus iserti	-	0.73(0.86)	8.97(4.48)	-	-	-	-	7.23(6.49)	1.4(4.04)
Scarus spp.	-	-	0.27(0.23)	-	-	-	-	-	-
Sparisoma aurofrenatum	-	-	-	-	-	-	4.2(7.98)	33.4(35.0)	23.73(42.3)
Sparisoma chrysopterum	18.8(60.6)	5.1(8.83)	-	-	-	-	0.5(1.73)	-	-
Sparisoma radians	2.92(5.68)	0.9(1.56)	4.33(3.75)	-	-	-	-	-	-
Sparisoma rubripinne	25.4(71.9)	9.63(7.62)	24.33(18)	6.95(6.56)	11.23(9.5)	-	-	-	-
SCORPAENIDAE									
Scorpaena grandicornis	9.5(28.78)	-	-	1.4(1.62)	1.3(2.25)	-	-	-	-
Scorpaena plumieri	0.36(1.24)	13.2(22.8)	-	1.9(2.19)	-	-	-	-	-
SERRANIDAE									
Alphestes afer	31.3(108)	-	333.3(288)	-	-	-	-	-	-

Table 3. (cont.) Mean Biomass of Species per Trawl Station.

Family/Species	1	2	3	4	5	6	7	8	9
Hyppoplectrus puella	-	-	3.86(3.32)	-	-	-	-	-	-
SYNGNATHIDAE									
Cosmocampus bachycephalus	-	0.15(0.17)	-	-	-	-	-	-	-
"Pipefish"	-	-	-	-	-	-	2.2	-	-
SYNODONTIDAE									
Synodus foetens	4.5(15.59)	-	-	-	-	-	-	-	-
Synodus intermedius	2.92(7.72)	-	9(7.79)	-	1.67(2.89)	-	-	-	-
Synodus synodus	-	-	-	2(2.31)	-	-	-	-	-
TETRAODONTIDAE									
Canthigaster rostrata	-	-	-	-	-	-	-	*	-
Chilomycterus antennatus	-	-	-	-	-	-	-	25(57.74)	-
Diodon holocanthus	129(115)	139.5(140)	89(46.39)	41(32.93)	115.5(72)	27.3(21.4)	61.8(91.0)	93.5(94.9)	31.1(57.04)
Sphoeroides spengleri	-	-	4.33(3.75)	-	4.33(7.51)	-	-	-	-
POMACENTRIDAE									
Stegastes leucostatus	-	-	9.07(7.16)	-	-	-	-	0.5(1.15)	-
Stegastes variabilis	-	-	-	-	-	-	-	-	0.15(0.43)

grouper (all mutton hamlet *Alphestes afer*) and three snapper (two yellowtail snapper *Ocyurus chrysurus* and one schoolmaster *Lutjanus apodus*) were collected in all 63 trawls.

Relationship between bottom type and fish biomass

The composition of algae, seagrass, and sediments is shown in Table 2. There was a significant correlation between the area coverage of coarse-grain sediments and the mean fish biomass per trawl (r_s=0.893, n=7, P<0.05). There was no significant relationship between any other habitat variable and fish biomass, nor any significant intercorrelations among habitat variables.

Length-weight relationships

Length-weight relationships were calculated for three species of parrotfish and one species of puffer. The lenght-weight relationship for the ballonfish (*Diodon holocanthus*) was $W=5.73x10^{-2} L^{2.26}$ (n=110, R^2=0.76). The equation calculated for the striped parrotfish (*Scarus croicensis*) was $W=5.16x10^{-3} L^{3.24}$ (n=45, R^2=0.77). The relationship calculated for the redfin parrotfish (*Sparisoma rubripinne*) was $W=1.16x10^{-2} L^{2.84}$ (n=42, R^2=0.96). The relationship for redband parrotfish (*S. aurofrenatum*) was $W=6.11x10^{-3} L^{3.17}$ (n=47, R^2=0.89).

DISCUSSION

Most reef fishes have a bipartite life-history with pelagic larvae that travel with the currents until a suitable habitat is found in which to settle (Leis, 1991). Adults are relatively sedentary, spending most of their whole life in the same reef (Bardach, 1958). Factors which affect the distribution of coral reef fish can be divided into those which affect the larval pelagic stage and those which influence the sedentary adult stage (Jones, 1991).

The trawl data provided information on the distribution of juvenile fish species. The most biomass was found near the mouth of the channel between the mainland and isla Saona, indicating that this area had suitable habitat for juveniles. At this site the mutton hamlet, a permanent resident of seagrass beds, dominated in biomass. Several studies have shown that there are significant differences in the biomass and species composition among different types of seagrass assemblages. In Biscayne Bay, Florida, Roessler (1965) showed that the numbers of species and individuals varied between dense turtle grass (*Thalassia testudinum*), patchy turtle grass, and bare sand and mud bottom. Martin and Cooper (1981) also found that the biomass of fish in pure stands of *Thalassia testudinum* were significantly higher than in pure stands of *Syringodium filiforme*. The location of the seagrass bed relative to other ecological features such as mangroves and coral reefs is also important (Baelde, 1990) We did not observe a significant difference in the fish assemblages between different types of seagrass/algal habitats. The most important influence appeared to be related to water flow out of the channel between Isla Saona and the mainland. In PNE, future research must concentrate on determining the coverage of seagrass beds nearshore as possible settlement habitat for juvenile fish.

There are clearly very few recruits residing in these seagrass beds, specially commecially important predators such as groupers and snappers. The low numbers of these fish are influenced by the physical oceanography of the region. Recruitment of juveniles can be either local (from the offshore reefs), regional (from other areas in the Caribbean), or a combination of the two. Fishing pressure can also influence the amount of recruitment in an area since it targets the larger fish which have the biggest reproductive output , due to the exponential increase in fecundity with length (PDT, 1990). In PNE, future research should concentrate on small scale circulation patterns within the park to determine whether recruitment is probably the greatest influence on the number of juveniles. For predatory species in PNE, the number of mature, reproductively active fish in shallow water was clearly not enough to support future generations.

This paper represents the first information on the populations of juvenile fish in shallow-water habitats in Parque Nacional del Este. The surveys showed that there is a lack of recruits which could move to offshore coral reef habitats. The physical oceanography of the region will need to be better understood so that it can be determined whether this is a result of local or regional fishing efforts reducing spawning stock biomass.

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