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# A Comparison of Fish Faunas Found in Pure Stands of Two Tropical Atlantic Seagrasses, *Thalassia testudiunum* and *Syringodium filiforme*

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## Recommended Citation

# A COMPARISON OF FISH FAUNAS FOUND IN PURE STANDS OF TWO TROPICAL ATLANTIC SEAGRASSES, *Thalassia festudinum* AND *Syringodium filiforme*[1]

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**ABSTRACT: Quantitative samples of fish faunas found in pure stands of *Thalassia testudinum* and *Syringodium filiforme* were taken using ®Pronoxfish. The fish faunas of the two habitats were compared for similarity of species, species diversity, and biomass to assess habitat equivalency of the two seagrass communities. Peter's (1971) method of analysing biogeographic data was used. The resulting cluster analysis using minimum distance showed all within habitat comparisons to cluster within a scalar distance of 99 while between habitat comparisons clustered at a scalar distance of 6.1 indicating that the associated faunas of the two seagrasses are highly dissimilar. Mean fish biomass of samples from *Thalassia* was 3.15 g/m$_2$ while that of samples from *Syringodium* was 0.65 g/m$_2$. These values were significantly different (df = 20, t = 5.33, p<.001). Mean diversity ($\bar{H}'$) of samples from *Thalassia* was 2.38 and that of samples from *Syringodium* was 2.11. These values are not significantly different (df = 20, t = 1.26, p>.05). Differences between seagrass fish faunas were obvious both at family and species levels. From these data it seems that the two seagrass types are not equivalent as fish habitats. The reasons for this lack of equivalency probably related to substrate, relatively higher patchiness in the *Thalassia* habitats, and environmental sturcture imposed by blade morphology.**

"Because of their uniform appearance and small number of angiosperm species, seagrass communities are generally regarded as having a very simple structure. Such a generalization is unjustified . . . A general classification of the seagrass communities, based on a wide variety of characters, has to be developed." (International Seagrass Workshop 1973 : 18). The proposals made by this workshop include comparisons with adjacent nongrass communities and comparisons between localities for a particular seagrass. There were no recommendations for studies comparing associated communities with seagrass species in the same area. In our estimation this is an oversight as the comparative synecology of these different species of grasses may give new and important insights into habitat selection of associated faunas.

Within the western Atlantic there are few published comparative studies of seagrass associated species. Weinstein and Heck (1979) have compared *Thalassia* bed ichthyofaunas between Panama and the Gulf of Mexico. Randall (1965) published some largely anecdotal comparisons of utilization of *Thalassia* and *Syringodium* by grazing species. Phillips (1960) compared the physical parameters influencing the four most common genera of seagrasses in Florida

but did not compare associated com-munities. One of the few studies compar-ing associated communities of sea-grasses is that of O'Gower and Wacasey (1967) who compared infaunal com-munities of *Thalassia, Diplanthera* and sand beds and found that the infaunas were different between the two sea-grass species.

### STUDY AREAS

All samples were taken from the southwestern coast of Puerto Rico (Figure 1). Sample sites were selected on the bases of having only one species of seagrass, a high density of visible leaves, a depth between 0.5 and 1.0 m, most of the leaves reaching lengths in ex-cess of 20 cm, and with a subtrate firm enough so that sampling was possible.

A total of 12 samples was taken from *Thalassia testudinum* beds. These beds were located about 1.2 km East of Bahia Sucia (two samples) and within 2 km either direction from the mouth of Bahia Fosferscente (ten samples). A total of 10



**Figure 1.** Collecting sites in southwestern Puerto Rico. *Thalassia* samples were taken near Bahia Sucia and Bahia Fosforescente. *Syringodium* samples were taken between Punta Molino and Punta Pitahaya.

samples was taken from *Syringodium filiforme* beds. These beds were located between Punta Molino and Punta Pitahaya. All samples were taken during March, 1974.

### METHODS AND MATERIALS

The method of collecting was stand-ardized among samples and is highly re-peatable if sufficient time for removing specimens is allowed. When an ap-propriate sampling area was identified, 2-m aluminum poles were quickly driven into the substrate about 6 m apart in position marking off the corners of a square. A beach seine was attached to the last pole anchored. The seine was then pulled around the square to fench in the area and the leadline was fixed firmly on-to the substrate. The seine measured 1.2 m x 24.5 m and had 4 mm stretched mesh. Plastic floats maintained the top of the net at the water surface and the second end of the net was attached to a fifth pole which was pulled past the fourth pole and anchored to eliminate any gaps which would allow fish to escape. The entire procedure was completed in five to ten minutes. After the net was deployed and if it was judged that the deployment had met both time standards and sixe and shape criteria, an ichthyocide (®Pronox-fish) was introduced into the area.

The usual dosage of the ichthyocide was about 475 ml and it was introduced using polyethylene bottles. The toxicant was as evenly distributed within the en-closure as currents would allow. If cur-rent conditions were such that the toxi-cant dispersed too rapidly a second 250 ml dose was put into the enclosure after about ten minutes. All fish which sur-faced within the enclosure were dipped up with dipnets having 3 mm mesh size. Eels were caught with nets having mesh sizes of approximately 0.5 mm. When no more fish came to the surface within a five

minute period, another dose of 250 ml of toxicant was added and the remaining more resistant species were taken. The water was clear and most of the fish which died and did not surface could be seen and were picked up by hand or were dipped up. When no more fish surfaced the poles were removed and the seine was slowly pulled into a boat with the leadline pursed in order to remove the last few specimens. All fish were placed in labeled plastic bags and stored on ice. As soon as possible they were frozen.

In the laboratory the samples were thawed, identified to species and the numbers of individuals and cumulative wet weight of each species was recorded. Specimens were stored frozen in plastic bags for no more than two weeks.

Comparisons among sites and between habitats were done using the biographic technique of Peters (1971). This technique involves first calculating similarity indices between each pair of samples. These indices are then ranked for each sample and the ranked indices are compared in a pairwise fashion for discrepancies in rankings. These discrepancies are used to generate a second order similarity index which is $S$ Peters = $1 - 2D/N_2$ where D is the number of discrepancies and N is the number of samples compared. These values then were examined using the BMDP cluster analysis program and a dendrogram was generated. For these data minimum distance was used to define linkages.

The similarity index used was that of Sørenson (1948) which is about the same as the Burt coefficient of Peters (1968). This index is $S = 2C/A+B$ where A is the number of species at the first site, B is the number of species at the second site and C is the number of species in common between the two sites. This index was chosen because it makes no assumptions about the quantification of our data.

Shannon's (1948) diversity index was calculated using log base 2 and numbers of individuals. Mean diversity and mean total fish biomass was compared between seagrass beds using Student's "t" test. Prior to use of the "t" test data, variances were compared using the "F" test.

## RESULTS

The total number of species collected was 43 with 26 of these occurring exclusively in samples from *Thalassia* beds, 9 occurring exclusively in samples from *Syringodium* beds and 8 occurring in samples from both habitats (Table 1). Of the species which occurred in 50% or more of samples from *Thalassia*, 5 were restricted to that habitat while of the species which occurred in 50% or more of samples from *Syringodium*, 6 were restricted to that habitat. Four species occurred in more than half of the samples from *Thalassia* and were much less frequent in samples from *Syringodium*.

Figure 2. is a dendrogram showing similarity of samples using Peter's (1971) biogeographic technique. Scalar values are 0 for complete dissimilarity, 50 for a correlation value of 0 and 100 for a complete similarity. As can be seen, clustering within habitat type is very close while between habitat clustering occurs in the negative correlation area (scalar distance 6.1).

Mean fish biomass values for samples from *Thalassia* was 3.15 g/m$_2$ while that of samples from *Syringodium* was 0.65 g/m$_2$. These means are significantly different (df = 20, t = 5.33, p<0.001). Mean numbers of specimens in samples from *Thalassia* was 68.5 and the mean of samples from *Syringodium* was 42.3, however these means do not differ significantly (df = 20, t = 1.88, p>0.05). Mean numbers of species in samples from *Thalassia* was 11.1 while the mean for samples from *Syringodium* was 7.5. These means were significantly different

**TABLE 1.** Fish species captured in stands of different tropical seagrasses. Fractional numbers following the species name indicates the proportion of samples in which the species occurred.

| A. Exclusively in samples from *Thalassia* bed. | | |
|---|---|---|
| Clupeidae | *Harengula humeralis* | 1/12 |
| | *Jenkinsia lamprotaenia* | 9/12 |
| Muraenidae | *Echidna catenata* | 1/12 |
| | *Lycodontis funebris* | 2/12 |
| | *Lycodontis vicinus* | 5/12 |
| Ophichthidae | *Ahlia egmontis* | 8/12 |
| Syngnathidae | *Syngnathus dunckeri* | 1/12 |
| Holocentridae | *Holocentrus ascensionis* | 1/12 |
| | *Adioryx vexillarius* | 1/12 |
| Antherinidae | *Atherinomorus stripes* | 10/12 |
| Pomadasyidae | *Haemulon flavolineatum* | 5/12 |
| | *Haemulon sciurus* | 1/12 |
| Chaetodontidae | *Chaetodon capistratus* | 2/12 |
| | *Chaetodon striatus* | 1/12 |
| Scaridae | *Scarus* sp. (juvenile) | 112 |
| | *Sparisoma radians* | 11/12 |
| | *Sparisoma rubripinne* | 7/12 |
| | *Sparisoma aurofrenatum* | 3/12 |
| | *Sparisoma viride* | 1/12 |
| Dactyloscopidae | *Dactyloscopus tridigitatus* | 1/12 |
| Clinidae | *Labrisomus bucciferus* | 1/12 |
| | *Malacoctenus gilli* | 4/12 |
| | *Paraclinus nigripinnis* | 1/12 |
| Acanthuridae | *Acanthurus chirugus* | 1/12 |
| Scorpaenidae | *Scorpaena plumieri* | 1/12 |
| Ostraciidae | *Rhinosomus triqueter* | 1/12 |

| B. Exclusively in samples from *Syringodium* beds | | |
|---|---|---|
| Opthichthidae | *Myrophis punctatus* | 10/10 |
| Sphyraenidae | *Sphyraena barracuda* | 2/10 |
| Serranidae | *Epinephelus striatus* | 5/10 |
| Lutjanidae | *Lutjanus apodus* | 7/10 |
| Gobiidae | *Bathygobius soporator* | 8/10 |
| | *Gobionellus boleosoma* | 10/10 |
| | *Gobionellus saepepallens* | 8/10 |
| Bothidae | *Bothus ocellatus* | 3/10 |
| Tetraodontidae | *Sphoeroides testudineus* | 3/10 |

| C. Occurring in samples from both *Thalassia* and *Syringodium* | | |
|---|---|---|
| Xenocongridae | *Chilorhinus suensoni* | 4/12T, 2/10S |
| Syngnathidae | *Cosmocampus brachycephalus* | 3/12T, 3/10S |
| Gerriidae | *Eucinostomus jonesii* | 1/12T, 3/10S |
| Pomacentridae | *Eupomacentrus leucostictus* | 2/12T, 1/10S |
| Scaridae | *Sparisoma chrysopterum* | 12/12T, 2/10S |
| Clinidae | *Labrisomus nuchipinnis* | 9/12T, 1/10S |
| Gobiidae | *Bathygobius curacao* | 10/12T, 3/10S |
| Acanthuridae | *Acanthurus bahianus* | 6/12T, 1/10S |

(df = 20, t = 3.40, p<0.01). Mean species diversity (H') for samples from *Thalassia* was 2.38 and the mean for samples from *Syringodium* was 2.11. These means are not significantly different (df = 20, t = 1.26, p>0.05).

## DISCUSSION

There are a number of possible reasons for the differences in the associated fish communities noted in these studies. One possible explanation is related to
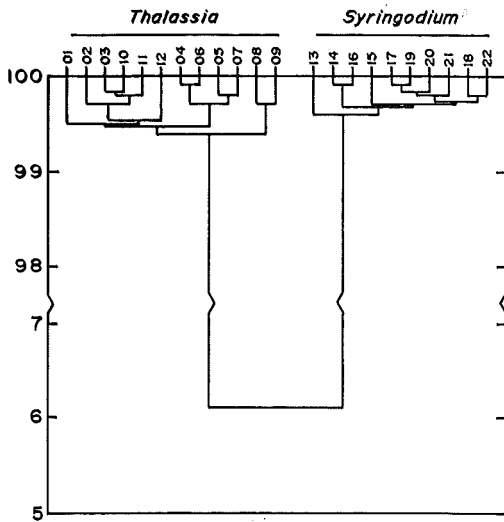
**Figure 2.** Cluster diagram using nearest neighbor procedure showing relationship between ichthyofauna of *Thalassia* and *Syringodium*.

substrate type (Table 2). *Thalassia* is usually reported from fairly dense sediments dominated by sand, though it is found occasionally on quite soft mud (Phillips 1960). Our *Thalassia* stations were on mud-sand mixture where sand was usually dominant. *Syringodium* is reported from a variety of substrates but densest growth is on very soft bottoms (Phillips 1960). Our *Syringodium* stations were on substrates which were more silty than the subtrates of the *Thalassia* stations. A number of fishes taken during these studies are demersal. The moray

species which we encountered usually live on hard substrate among rocks and corals. The presence of *Echidna catenata* in one of the *Thalassia* stations is an indicator that there were rocks or coral at the station. Of 89 individuals of *E. catenata* from 13 collections from Puerto Rico all were taken from rocks or coral rubble (Martin and Patus, unpublished data). Snake and worm eels, Ophichthidae, normally live in the substrate. Within our samples *Ahlia egmontis* is confined to *Thalassia* while *Myrophis punctatus* is confined to *Syringodium*. Cervigon M. (1966) reported that the preferred habitat for *Ahlia egmontis* was sand while Hoese and Moore (1977) reported that *Myrophis punctatus* is common on mud bottoms. These two species do co-occur commonly although this is less often than their separate occurrences (Martin and Patus, unpublished data).

Other common demersal fishes which are exclusive to one seagrass or the other are the clinids, except for *Labrisomus nuchipinnis*, and the gobies except for *Bathygobius curacao*. Tropical clinids are found mostly on rock or coral substrates though many are reported to occur occasionally on turtlegrass (Böhlke and Chaplin 1968). Despite the fact that most gobies occur on hard substrates such as coral, rock or hard sand, the species which were captured in these

**Table 2.** Comparison of Parameters of Sample Sites of stands of different tropical seagrasses.

|  | *Thalassia* | *Syringodium* |
|---|---|---|
| Substrate | Mud-sand, dominated by sand or seemingly an equal mixture, frequently coral rubble and *Halimeda* fragments present. | Mud-sand, dominated by mud, uniform texture. |
| Current | Present, variable. | Present, variable. |
| Depth | 0.5-1.0 m | 0.5-1.0 m |
| Plant Cover | Dense, numerous small open patches, especially around coral rubble. | Dense, uniform |
| Blade Morphology | Most more than 20 cm long, flat, about 7 to 10 mm wide, patches of shorter blades around 15 cm in length. | Most more than 25 cm long, round, about 3-4 mm diameter, leaf length uniform. |
| Water | Clear, marine, little wave action. | Clear, marine, little wave action. |

studies prefer softer bottoms (*Gobionellus* spp.) or have a broad tolerance for bottom types (*Bathygobius* spp.). Based on published information from Böhlke and Chaplin (1968) and Cervigon M. (1966), we fail to comprehend why *Bathygobius soporator* was restricted to *Syringodium* samples as this species is usually found on hard substrates in the areas reported on.

Given large reservoirs of individuals available to colonize an area and high migration rates as opposed to extinction rates there is no formal limit to the number of species that can be fitted into a given patchy environment (Horn and MacArthur 1972). The *Thalassia* stations were visually more heterogenous having patches of sand or coral rubble while the *Syringodium* stations were almost completely homogeneous. The presence of *Dactyloscopus tridigitatus* which normally only occurs in sand patches or open sandy areas and *Echidna catenata* which normally occurs around rocks or coral also indicates such heterogenity in the *Thalassia* stations. Heterogenous environments present a mixture of habitats and therefore should have more species. This is concordant with our observations on mean numbers of species. Since species diversity is related to species evenness and species richness there is no *a priori* reason why it should reflect patchiness of an environment if scale evens out the distribution of patches. Since patches were less than 0.25 $m_2$ and the sample area was 36 $m_2$ this objection seems to have been met. Neither is there an *a priori* reason why a heterogenous environment should have more individuals. Our data do not allow us to reject the hypothesis that environmental patchiness of these *Thalassia* beds may play some role in producing the differences between the two ichthyofaunas.

An additional cause for these community differences may life in the different environmental structures imposed by the blade morphologies of the two grasses. Sale and Dybdahl (1978) using models of three different-shaped corals found that fish which colonized the substrate models did discriminate among the types of models but to a lesser extent than would be expected considering the differences in form of the corals modeled. They found that differences in communities associated with particular models were more pronounced on the reef slope than on the reef flat, which in turn were more distinctive than those in the lagoon. On the whole, their data suggested that habitat preference by species among habitats of roughly similar type acted together with chance events related to migration and extinction rates to determine associated communities. These probably apply to our seagrass habitats also as the two seagrasses are roughly similar and there are large numbers of species available for recruitment into these habitats.

Luckhurst and Luckhurst (1978) when examining the effects of substrate variables on coral reef fish communities found that species richness was correlated with "substrate rugosity" and that stratification of the fishes by body size showed that the correlation with "Substrate rugosity" was scale-dependent. In particular, sand dwelling gobies were affected by scale, probably because of territorial behavior. They noted that there appeared to be a complex of factors determining the responses of species to the substrate with which they were associated.

In summary, we believe that the very large community differences noted in these studies are due to several factors. These factors are substrate differences for those species which are demersal, habitat patchiness with the *Thalassia* stations and random events related to emigration and extinction rates.

## ACKNOWLEDGMENT

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