12-1979

Community Structure and Abundance of Fishes Inhabiting Oceanic Oyster Reefs and Spoil Islands in the Northeastern Gulf of Mexico

Gray Bass

Florida Game and Freshwater Fish Commission

Vincent Guillory

Florida Game and Freshwater Fish Commission

DOI: 10.18785/negs.0302.09

Follow this and additional works at: <https://aquila.usm.edu/goms>

Recommended Citation

Bass, G. and V. Guillory. 1979. Community Structure and Abundance of Fishes Inhabiting Oceanic Oyster Reefs and Spoil Islands in the Northeastern Gulf of Mexico. *Northeast Gulf Science* 3 (2).
Retrieved from <https://aquila.usm.edu/goms/vol3/iss2/9>

This Article is brought to you for free and open access by The Aquila Digital Community. It has been accepted for inclusion in Gulf of Mexico Science by an authorized editor of The Aquila Digital Community. For more information, please contact Joshua.Cromwell@usm.edu.

COMMUNITY STRUCTURE AND ABUNDANCE OF FISHES INHABITING OCEANIC OYSTER REEFS AND SPOIL ISLANDS IN THE NORTHEASTERN GULF OF MEXICO.

This paper is a quantitative comparison of the community structure of the fishes associated with oceanic oyster reefs and spoil islands of the Gulf of Mexico. These oyster reefs (Figure 1) along the northeastern Gulf coast are the only living oyster reefs known in oceanic waters of North America (Price 1954). Although oceanic by exposure to the open sea, this coastal zone is estuarine in character, receiving freshwater discharges from the Withlacoochee and Crystal Rivers (Grimes 1971; Grimes and Mountain 1971; Carr and Adams 1973).

Portions of the oyster reef system have been replaced by spoil islands created by construction of a navigation channel for the proposed Cross-Florida barge canal. Other channels have also been cut through the reefs north and south of the study area.

Destruction of oyster reefs has been viewed with concern for several reasons. Reef removal adversely affects sport and commercial oyster harvests. Secondly, the oyster reef may be valuable to the nearshore ecosystem through production of food and habitat for other marine organisms. In addition, oyster reefs may also improve the potential angler harvest of an estuary (Arve 1960; Sieling 1960; Dahlberg 1972).

Quantitative measurements of the fishes associated with oyster reefs are lacking although the ichthyofauna of oyster reefs have been qualitatively evaluated (Pearse and Wharton 1938; Gunter 1945; Arve 1960; Runyan 1961; Wells 1961; and Dahlberg 1972). Many studies have reviewed environmental effects of turbidity and siltation associated with dredge and fill operations.

However, little data, with the exception of Ritchie (1970) and Briggs and O'Connor (1971), exist concerning fishes associated with spoil islands.

MATERIALS AND METHODS

The extremely rough substrate of oyster reefs prevent adequate sampling with conventional techniques such as trawls and seines. In addition, the cryptic habits of many benthic fishes makes them difficult to collect. Although large areas of the spoil islands are sand-bottomed, there are also areas of rough substrate on the islands. In an effort to overcome sampling difficulties and to obtain quantitative results we employed a Wegener Ring sampler in both habitats.

Originally designed by Wegener *et al.* (1974) for quantitative sampling of shallow lake margins, the sampler consists of a floating ring with a fine mesh net suspended between the surface float and a steel ring which acts as a bottom weight. The area enclosed by the sampler is 0.004 ha. our sampler differed from the standard design only in having deeper net sides (100 cm) to allow use in deeper water. The sampler is thrown over the area to be sampled and emulsified rotenone immediately applied inside the ring. Fishes killed or stunned by the toxicant are then collected with dip nets.

During August and September 1975 we obtained fifteen random samples each from oyster reefs and from spoil islands. Sampling was conducted during daytime at slack low tide as water depths over the reefs were too great during high tide to employ the sampler. Sampling could not be accomplished during rising or falling tides because the rotenone did not remain within the enclosure long enough to kill all fishes and also killed fishes outside the net. All

fishes collected were immediately preserved in 10% formalin and later transferred to 45% isopropanol in the laboratory. Specimens were later identified and weighed. Scientific nomenclature follows Bailey *et al.* (1970).

Species associations were determined by a modification of Cole's (1949) index of affinity. The first, or primary, species group was defined as the largest group in which all species exhibit, as determined by this index, affinity for one another. The species of this primary group were excluded in determination of the second largest species group, and this procedure was repeated until all possible groups were identified.

RESULTS

Fourteen species were taken from the oyster reefs (Table 1). Number and bio-

mass per sample ranged from eight to 63 individuals ($\bar{x}$ = 35.5) and 2.1 to 39.0 g ($\bar{x}$ = 22.4 g). Expanded, these figures provided an estimate of 86,779 fish per ha, and a biomass of 55.5 kg per ha. The most abundant oyster reef fish was *Gobiosoma bosci*, followed by *Bathygobius soporator*, *Chasmodes saburrae*, *Eucinostomus gula*, *Gobiesox strumosus* and *Opsanus beta*. These six species comprised 90.7% of the total by number and 92.8% of the biomass.

Six species dominated the oyster reef collections. *Eucinostomus gula* occurred in every sample, while *Gobiosoma bosci* appeared in 14 of 15 samples. *Chasmodes saburrae*, *Bathygobius soporator* and *Opsanus beta* were taken in twelve samples while *Gobiesox strumosus* was taken in nine. The remaining eight species occurred less than

Figure 1. Location of the study area.

three times, except *Lucania parva*, which appeared in five collections.

Spoil island samples yielded a total of fifteen species (Table 2). Number and biomass per sample ranged from 0 to 251 individuals ($\bar{x}$ =24.1) and 0 to 42.6 g ($\bar{x}$ =8.4 g). The estimated standing crop consisted of 59,610 fish per ha, with a biomass of 20.7 kg per ha. *Anchoa mitchilli* was the most abundant species of the spoil islands, followed by *Eucinostomus gula*, *Syngnathus floridae* and *Lucania parva*. *Eucinostomus gula* appeared in 11 of 15 samples while no other species appeared more than four times.

Eight species (see Tables 1 and 2) were taken from both habitats, although most exhibited differences in abundance. Fish observed on the oyster reefs alone were *Myrophis punctatus*, *Gobiesox strumosus*, *Micrognathus crinigerus*, *Gobiosoma boscii*, and *Citharichthys spilopterus*. Species taken only from the spoil islands were *Menidia beryllina*, *Orthopristis chrysoptera*, *Cynoscion nebulosus*, *Prionotus scitulus*, *Prionotus tribulus*, and *Paralichthys lethostigma*.

Species associations differed between the two habitats. Species of the primary species group of both habitats were

mutually exclusive: *Paralichthys lethostigma*, *Symphurus plagiusa*, *Cynoscion nebulosus*, *Lucania parva*, and *Syngnathus floridae* from the spoil islands; *Opsanus beta*, *Gobiesox strumosus*, *Eucinostomus gula*, *Chasmodes saburrae*, *Bathygobius soporator*, and *Gobiosoma boscii* on the oyster reefs.

Spoil island species groups two and three, characterized by *Opsanus beta*, *Prionotus scitulus* and *Gobiosoma robustum*-*Prionotus tribulus* were also mutually exclusive from the corresponding secondary species groups of the oyster reefs. Species groups two and three of the oyster reefs were composed of *Myrophis punctatus*-*Micrognathus crinigerus* and *Syngnathus floridae*-*Citharichthys spilopterus*.

DISCUSSION

Fish communities of the spoil islands and oyster reefs differ both quantitatively and qualitatively. Although the Wegener Ring cannot be expected to adequately sample truly pelagic fishes or large transient species, the characteristic species, especially the cryptic or burrowing forms, of both habitats were adequately collected.

TABLE 1. Composition, standing crop and frequency of occurrence of fishes collected from oyster reefs.

	Total				Standing Crop/ Hectare		Frequency of Occurrence	
	No.	%	wt.(g)	%	No.	Wt.(kg)	No.	%
<i>Myrophis punctatus</i>	2	0.4	18.7	5.6	329.2	3.08	2	13.33
<i>Anchoa mitchilli</i>	14	2.6	2.2	0.6	2305.2	0.37	3	20.00
<i>Opsanus beta</i>	22	4.2	37.3	11.1	3622.7	6.16	12	80.00
<i>Gobiesox strumosus</i>	37	7.0	36.2	10.7	6043.3	5.95	9	60.00
<i>Lucania parva</i>	8	0.3	0.7	0.2	1317.2	0.12	5	33.33
<i>Micrognathus crinigerus</i>	3	0.6	0.3	0.1	494.0	0.04	1	6.67
<i>Syngnathus floridae</i>	1	0.2	0.2	0.1	164.7	0.02	1	6.67
<i>Eucinostomus gula</i>	48	9.0	39.6	11.8	1904.0	6.52	15	100.00
<i>Chasmodes saburrae</i>	69	13.1	50.9	15.1	11362.9	8.37	12	80.00
<i>Bathygobius soporator</i>	119	22.6	119.1	35.4	19595.3	19.61	12	80.00
<i>Gobiosoma boscii</i>	183	34.7	29.4	8.7	30134.0	48.41	14	93.33
<i>Gobiosoma robustum</i>	19	3.6	1.5	0.4	3128.7	0.25	1	6.67
<i>Citharichthys spilopterus</i>	1	0.2	0.6	0.2	164.7	0.10	1	6.67
<i>Symphurus plagiusa</i>	1	0.2	0.2	1.1	164.7	0.02	1	6.67
TOTAL	527		336.8		86779.3	55.57		

TABLE 2. Composition, standing crop and frequency of occurrence of fishes collected from spoil islands.

	Total				Standing Crop/ Hectare		Frequency of Occurrence	
	No.	%	wt.(g)	%	No.	Wt.(kg)	No.	%
<i>Anchoa mitchilli</i>	252	69.61	15.6	12.41	16796.0	2.57	2	13.33
<i>Opsanus beta</i>	1	0.28	2.3	1.83	164.7	0.53	1	6.67
<i>Lucania parva</i>	9	2.49	1.6	1.27	1482.0	0.27	3	13.73
<i>Menidia beryllina</i>	4	1.10	7.7	6.12	658.7	1.26	3	13.33
<i>Syngnathus floridae</i>	21	5.80	6.3	5.01	3458.0	1.02	3	13.33
<i>Eucinostomus gula</i>	49	13.53	30.7	24.42	8068.7	5.06	11	73.33
<i>Orthopristis chrysoptera</i>	1	0.28	11.3	8.99	164.7	1.85	1	6.67
<i>Cynoscion nebulosus</i>	5	1.38	16.8	13.36	823.3	2.76	1	6.67
<i>Chasmodes saburrae</i>	8	2.21	5.2	4.41	1317.3	0.86	4	26.67
<i>Bathygobius soporator</i>	2	0.83	4.9	3.90	329.3	0.82	1	6.67
<i>Gobiosoma robustum</i>	4	1.10	0.5	0.40	658.4	0.08	1	6.67
<i>Prionotus scitulus</i>	1	0.28	3.2	2.55	164.7	0.52	1	6.67
<i>Prionotus tribulus</i>	1	0.28	0.2	0.16	164.7	0.02	1	6.67
<i>Paralichthys lethostigma</i>	1	0.28	18.2	14.48	164.7	2.99	1	6.67
<i>Symphurus plagiusa</i>	3	0.83	1.2	9.55	494.0	0.20	1	6.67
TOTAL	362		125.7		59610.5	20.7		

Biomass and numerical abundance were greater on the oyster reefs than on the spoil islands. The numerical differential between the habitats is probably greater than our samples suggest because 70% of the total number of fish collected on the spoil islands was taken in one sample dominated by a large school of juvenile *Anchoa mitchilli*.

The larger standing crop associated with the oyster reefs may be attributed to the dominance of productive oyster bottoms which provide an abundance of cover and food for the associated ichthyofauna. While the spoil islands offer greater habitat variety (sand, rock, and mud substrates, oysters, submergent vegetation and emergent plants), an estimated 80% of the submerged area consisted of barren sand where few fishes were collected. On the spoil islands greatest density of fishes was observed on those areas recolonized by oysters or covered by submergent vegetation. Age differential between the two habitats may also contribute to the difference in fish production. The spoil islands, constructed between 1960 and 1970, are much younger than the reefs. Over a longer period of time the spoil islands may develop greater capacity for

production. However, it is unlikely that barren sand areas will approach the production of the living oyster reefs.

Nine spoil fish species were restricted to collections over oyster shell or submergent vegetation and were collected only once. The presence of these species in relatively minor spoil island habitats may account for the slightly higher numbers of species found there.

Despite inferences drawn from the species assemblages derived from mathematical analysis of our data, a characteristic ecological community apparently does not exist on the islands. The five species in the primary group of the spoil islands were not encountered more than three times. All three species groups were not encountered as a unit more than once. Thus, the species assemblages of the spoil islands were quite uncommon, and apparently represent fortuitous associations rather than an ecological community. The presence of many spoil island species only once or twice in samples may be simply an indication of transience or ubiquitousness.

On the other hand, a distinctive assemblage was observed on the oyster reefs. All six species in the primary

species group were collected at least nine times and were the most common fishes taken. As a unit this group was observed together in seven samples. Five of these (*Gobiosoma bosci*, *Bathygobius soporator*, *Chasmodes saburrae*, *Gobiesox strumosus*, *Opsanus beta*) are cryptic benthic forms which apparently exhibit preference for the oyster reefs. *Eucinostomus gula*, one of the most common fish of the reefs, was not considered a characteristic element of the reef ichthyofauna despite its constant appearance there because it is ubiquitous and abundant almost everywhere else in the nearshore zone (Grimes 1971; Grimes and Mountain 1971; Carr and Adams 1973).

Destruction of oceanic oyster reefs in the northeastern Gulf eliminates an ecologically distinctive community. Further studies to better describe this system of oyster reefs are needed. We hope that this study will provide a stimulus to other workers to quantitatively investigate community structures in the coastal zone.

LITERATURE CITED

- Arve, J. 1960. Shell plantings in Chincoteague Bay, Maryland. *Ches. Sci.*, 1(1-2): 58-63.
- Bailey, R., I. Fitch, E. Herald, E. Lachner, C. Lindsey, C. Robins, and W. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada. *Amer. Fish. Soc., Spec. Publ. No. 6*, 150 pp.
- Briggs, P. and J. O'Connor. 1971. Comparison of shore-zone fishes over naturally vegetated and sand-filled bottoms in Great South Bay. *New York Fish Game. Jour.*, 18(1):15-40.
- Carr, W. and C. Adams. 1973. Food habits of juvenile marine fishes occupying seagrass beds in the estuarine area near Crystal River, Florida. *Trans. Amer. Fish. Soc.*, 102(3):511-540.
- Cole, L. 1949. Measurement of interspecific association. *Ecol.*, 30:411-424.
- Dahlberg, M. 1972. An ecological study of Georgia coastal fishes. *Fish. Bull.* 70(2):323-353.
- Grimes, C. 1971. Thermal addition studies of the Crystal River steam electric station. *Fl. Dept. Nat. Resour., Mar. Res. Lab. Prof. Pap. Ser. No. 17*, 54 pp.
- _____, and J. Mountain. 1971. Effects of thermal effluent upon marine fishes near the Crystal River steam electric station. *Fl. Dept. Nat. Resour., Mar. Res. Lab. Prof. Pap. Ser. No. 18*, 64 pp.
- Gunter, G. 1945. Studies on marine fishes of Texas. *Publ. Inst. Mar. Sci., Univ. Tex.*, 1(1):1-190.
- Pearse, A. and C. Wharton. 1938. The oyster "leech" *Stylochus inimicus* Palomli associated with oysters on the coast of Florida. *Ecol. Monogr.*, 8:605-665.
- Price, W. 1954. Oyster reefs in the Gulf of Mexico. In: *Gulf of Mexico, its origin, waters, and marine life*, *Fish. Bull.*, 55(89):491.
- Ritchie, D. 1970. Fish. In: *Gross physical and biological effects of overboard spoil disposal in upper Chesapeake Bay*, *Univ. Md. Nat. Res. Inst., Spec. Rept. No. 3*, pp. 50-63.
- Runyan, S. 1961. Early development of the clingfish, *Gobiesox strumosus* Cope. *Ches. Sci.*, 2(3-4):113-141.
- Sieling, F. 1960. The resources of Worcester County Coastal waters. *Md. Dept. Res. Educ., Ref. No. 601-10*, 17 pp.
- Wegener, W., D. Holcomb, and V. Williams. 1974. Sampling shallow water fish populations using the Wegener Ring. *Proc. Southeast. Assoc. Game Fish Comm.*, 27:663-674.
- Wells, H. 1961. The fauna of oyster beds, with special reference to the salinity factor. *Ecol. Monogr.*, 31(3):239-266.

Gray Bass, *Florida Game and Fresh Water Fish Commission*, 926 Michigan Ave., Pensacola, FL 32505 and Vincent Guillory¹, *Florida Game and Fresh Water Fish Commission*.

¹ Present address: Louisiana department of Wildlife and Fisheries, P.O. Box 37, Grande Isle, LA 70358.

Reviews:

L.O. Sorensen, **A Guide to the Seaweeds of South Padre Island, Texas**. 123 pp. ISBN 0-89787-101-4, Gorsuch Scarisbrick, Publishers, Dubuque, Iowa, 1979. \$6.95.

Various aspects of the morphology, distribution and ecology of marine algae are given in this nontechnical, illustrated guide for the identification of the algae of South Padre Island, Texas. The spiral bound text, which is small enough to be used as a pocket field guide, contains information on the collection and preservation of marine algae; a map of the study area; systematic lists of green, brown and red algae; keys for identification; figures and descriptions of the most abundant taxa; a glossary; and a bibliography.

It is unfortunate that the shortcomings of this informative manual detract from its intended use. Several common rules have been violated in the construction of the keys which make them unsatisfactory. For example, the key to the identification of the brown algae does not begin with a dichotomous couplet — a fact that resulted in the exclusion of *Giffordia* from the key. The phrase "not as described above" is used four times in a key of seven brown algae and 17 times in a key of 29 red algae. Taxonomic names in the keys should have been followed by page numbers to the appropriate description and figure. While most errors in the text are not serious, several such as the listing of *Rosenvingeia* as *R. sanctae crucis* in the key and as *R. orientalis* in the text and the omission of *Penicillus capitatus* and *Giffordia mitchelliae* from the keys are disconcerting to the reader. I am puzzled by the author's use of the words algae, alga and algal. Although the line