

Northeast Gulf Science

Volume 10
Number 1 *Number 1*

Article 4

12-1988

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S.A. Bortone
University of West Florida

R.L. Shipp
University of South Alabama

W.P. Davis
U.S. Environmental Protection Agency

R.D. Nester
U.S. Army Corps of Engineers

DOI: 10.18785/negs.1001.04

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Recommended Citation

Bortone, S., R. Shipp, W. Davis and R. Nester. 1988. Artificial Reef Development Along the Atlantic Coast of Guatemala. *Northeast Gulf Science* 10 (1).

Retrieved from <https://aquila.usm.edu/goms/vol10/iss1/4>

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ARTIFICIAL REEF DEVELOPMENT ALONG THE ATLANTIC COAST OF GUATEMALA

S.A. Bortone, R.L. Shipp, W.P. Davis, and R.D. Nester

(SAB) Biology Department

University of West Florida, Pensacola, FL 32514 (USA)

(RLS) Department of Biological Science

University of South Alabama, Mobile, AL 36608 (USA)

(WPD) U.S. Environmental Protection Agency

Sabine Island, Gulf Breeze, FL 32561 (USA)

(RDN) U.S. Army corp of Engineers

P.O. Box 2288, Mobile, AL 36628 (USA)

ABSTRACT: A visual census of a four year old artificial reef in the Bahía de Amatique off Guatemala's Atlantic coast indicates a substantial standing number of fishes. The fish fauna is comprised chiefly of juvenile grunts (*Haemulon aurolineatum*; 7.39/m²) accounting for the reef's low species diversity ($H' = 0.68$). A considerable portion of the assemblage is composed of commercially exploitable adults of *Lutjanus griseus* (0.38/m²) and *Haemulon plumieri* (0.03/m²). The proximate grassbeds have large populations of juveniles and small adults of all the commercially exploitable species. Further development of the reef is indicated providing the grassbed biotope remains "healthy" and fishing pressure does not become excessive.

EXTRACTO: Un censo visual de un arrecife artificial que tiene cuatro años en la Bahía de Amatique frente a la costa Atlántica de Guatemala indica un número cuantioso de peces establecidos. La ictiofauna está comprendida principalmente de Hemulones juveniles (*Haemulon aurolineatum*; 7.39/m²) justificando la poca diversidad de especies en el arrecife ($H' = 0.68$). Una porción considerable del grupo está compuesta de adultos de *Lutjanus griseus* (0.38/m²) y *Haemulon plumieri* (0.03/m²), los cuales sirven en explotación comercial. Las praderas de grama cercanas tienen poblaciones grandes de juveniles y adultos pequeños representando todas las especies de uso comercial. No podemos rechazar la hipótesis de que desarrollo adicional o explotación del arrecife debería continuar. Desarrollo adicional del arrecife podría ser aconsejable siempre que el biotopo de las praderas permanezca "sano" y que la presión debida a la explotación pesquera no se vuelva excesiva.

Naturally occurring nearshore coral-reef and hard-bottom biotopes are sparse along Guatemala's Atlantic coast. To improve nearshore fishing for reef and hard-bottom-associated fish species, an artificial reef was established in 1982 in the Bahía de Amatique, about 15 km NW of Puerto Barrios, Guatemala. In their review of artificial reef research and recommendations for future research priorities, Bohnsack and Sutherland (1985) indicated that future artificial reef research should emphasize small, nearshore artificial reefs and identify the economic and social impact of

these structures. Currently there are few studies examining the impact and effectiveness of artificial reefs in tropical, inshore estuarine areas (cf, Stanton, Wilber, and Murray, 1985) and none off Guatemala. Fast (1974) and Fast and Pagan (1976) presented some insight into the efficacy of artificial reef construction in these areas off Puerto Rico but much work remains regarding: accurate determinations of their standing biomass; their utility in improving local fisheries; their impact on community productivity in proximate biotopes, etc.

In 1986, four years after deployment

of an extensive artificial reef off Guatemala's Atlantic coast, the opportunity became available to assess the reef-associated fish assemblage and to observe its impact on the local economy. During an assessment of the artificial reef, trawl surveys were conducted in a proximate grass bed community where juveniles of the adult fishes, which usually inhabit reefs and hard-bottom biotopes, often occur (Bortone and Williams, 1986). This report constitutes the first of a regular, continuing series of assessments of this artificial reef and its potential impact on the local economy.

METHODS

Description of the Study Area

The reef is located in the Bahía de Amatique, 15 km NW of Puerto Barrios, Guatemala, C.A. (Fig. 1). The bay receives freshwater from the Lago de Izabal-Río Dulce drainage. The reef, composed chiefly of discarded automobile and

truck bodies, heavy construction beams, large appliances, and other large metal refuse objects, is located at 7.5-8.5 m depth. The total area encompassed by the reef is approximately 2000 m² and reef height varies from 1 to 3 m. Other parameters associated with the reef at the time of this survey were: visibility = 7-8 m; temperature = 29-30 °C; distance from shore = 4-5 km; bottom type = sand; salinity was variable due to local rain and runoff. Nearby (5 km E) is the Bahía de Graciosa, an extensive grass bed community comprised chiefly of *Thalassia testudinata*, only 1 to 2 m deep.

Sampling Techniques

Visual assessments of the fish fauna were conducted on the reef from 8 to 11 September 1986 using a modification of the Stationary Visual Census (or "Point Count") method of Bohnsack and Bannerot (1986). Divers using SCUBA, identified fish species and counted the number of individuals from the center position of a circle with a radius of 4.6 m (total area observed per sample = 65.7 m²) for five minutes. Divers positioned themselves on or near the reef and slowly turned at the center of the imaginary circle, listing fish species and the number of individuals on a sheet of roughened white plastic. A total of 48, five-minute visual "point counts" were conducted during daylight hours (10:30 to 16:00, local time). Standard Length (*i.e.*, SL) of captured specimens was measured from the anterior tip of the upper jaw to the middle of the hypural plate.

To evaluate the possibility of the Bahía de Graciosa serving as a recruitment area for the reef, 10 five-minute samples of the fish fauna were made using a 4-m otter trawl.

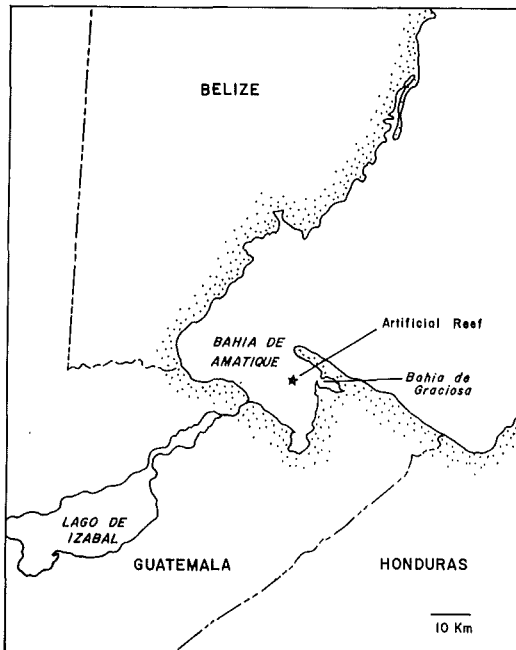


Figure 1. Location of the artificial reef and the grass beds (Bahía de Graciosa) in the Bahía de Amatique off Guatemala's Atlantic coast.

RESULTS

Visual Census

Twenty-eight species were recorded during the 48 visual censuses (Table 1). The species diversity (*i.e.*, Shannon-Wiener H') of the fish community was relatively low (0.68) due to the predominance of juvenile grunts comprised primarily of *Haemulon aurolineatum* (7.39/m²). Other species abundant on the reef were: *Odontoscion dentex*, *Lutjanus griseus*, and *Decapterus* sp. Of the commercially important species, *Lutjanus griseus* (0.38/m²) and *Haemulon plumieri* (0.03/m²) were of sufficient size and number to contribute substantially to the local fishery with other lutjanid species

also contributing to the fishery. A non-random sample of 10 *L. griseus* speared from the reef by a local fisherman had a mean length (SL) of 209 mm (minimum SL = 160, maximum SL = 250; standard deviation = 26.4). While the total number of species observed during the assessment surveys was low, four additional species were observed on the reef: *Ginglymostoma cirratum*, *Epinephelus cruentatum*, *Rypticus saponaceus*, and *Echeneis neucratoides*.

Trawl Survey

Trawl samples from the Bahia de Graciosa indicated that most species constituting the fauna of the reef also occurred in the grass beds as juveniles

Table 1. Summary of reef census data from 48 visual, 5-min. point counts (mean = average number of fish observed per visual census; sd = standard deviation; min-max = minimum and maximum number of individuals of species observed; No./m² = estimated number of individuals per square meter).

Species	mean	sd	min-max	No./m ²
<i>Haemulon aurolineatum</i> *	485.21	455.89	50-2000	7.39
<i>Odontoscion dentex</i>	43.69	81.90	0-500	0.67
<i>Lutjanus griseus</i>	24.73	26.12	0-150	0.38
<i>Decapterus</i> sp.	12.02	34.27	0-200	0.19
<i>Haemulon plumieri</i>	1.65	2.22	0-10	0.03
<i>Caranx chrysos</i>	1.65	5.98	0-30	0.03
<i>Scarus croicensis</i>	1.60	1.99	0-11	0.02
<i>Haemulon parrai</i>	1.19	1.68	0-8	0.02
<i>Abudefduf saxatilis</i>	1.17	1.52	0-6	0.02
<i>Selene vomer</i>	1.13	4.72	0-31	0.01
<i>Hypoplectrus puella</i>	0.54	0.68	0-2	0.01
<i>Haemulon bonariense</i>	0.46	0.99	0-5	0.01
<i>Scombermoros regalis</i>	0.42	1.83	0-12	0.01
<i>Serranus flaviventrus</i>	0.42	1.13	0-6	0.01
<i>Gerres cineereus</i>	0.23	0.72	0-4	<0.01
<i>Anisotremus virginicus</i>	0.10	0.37	0-2	<0.01
<i>Coryphopterus</i> sp.	0.15	0.62	0-4	<0.01
<i>Chaetodon capistratus</i>	0.08	0.28	0-1	<0.01
<i>Sphyræna barracuda</i>	0.06	0.24	0-1	<0.01
<i>Pomacentrus fuscus</i>	0.04	0.20	0-1	<0.01
<i>Lutjanus synagris</i>	0.04	0.20	0-1	<0.01
<i>Equetus acuminatus</i>	0.04	0.20	0-1	<0.01
unident. blenniid	0.02	0.14	0-1	<0.01
<i>Seriola</i> sp.	0.02	0.14	0-1	<0.01
<i>Lutjanus jocu</i>	0.02	0.14	0-1	<0.01
<i>Chaetodipterus faber</i>	0.02	0.14	0-1	<0.01
<i>Lutjanus apodus</i>	0.02	0.14	0-1	<0.01
<i>Pomacanthus paru</i>	0.02	0.14	0-1	<0.01

**H. aurolineatum* may include juveniles of other *Haemulon* species

or small adults. This was especially true for lutjanids. Several species common to the grassbeds, however, were not observed on the reef (e.g., *Syngnathus* sp., *Archosargus rhomboidalis*, *Ocyurus chrysurus*, *Nicholsina usta*, and *Sphoeroides testudineus*). Most of these species have strong affinities to a grassbed biocenosis but the absence of *O. chrysurus* from the reef is perplexing as adults of this species are often associated with such structures (Bortone and Williams, 1986).

DISCUSSION

Local fishermen, using hand spears (without the use of SCUBA), "Bahamian"-style fishtraps and hook-and-line, fish the reef daily from Puerto Barrios. Conversations with these fishermen indicate that fishing pressure has been nearly constant since deployment of the reef in 1982. Discussions with local officials indicate that future restrictions regarding fishing effort are being considered to protect fishery resources on the reef. Our data indicate that under relatively heavy fishing pressure a reasonable standing community of commercially useful species persists. This is perhaps due to the readily available, proximate source of juvenile and small adult lutjanid and haemulid species associated with the grassbeds. It should be noted, however, that more data are needed to determine the exact relationship between these grass bed and artificial reef communities with regard to recruitment. Studies monitoring movement of fishes between the grass bed and the reef would provide information essential to determining the relationship of these biotopes. Present observations, however, indicate that future expansion and utilization of the reef is in order, providing the grass bed biotope is protected and fishing pressure on the reef does not become excessive.

ACKNOWLEDGEMENTS

We thank Gene Wilson, David Dean, Ken Heck, Pam James and especially Gina Cazali for assistance in conducting the surveys. We also thank Señor Federico Caracamo and the people of Puerto Barrios for facilitating this project. Funding was provided by the Sister City program from the City of Mobile, Alabama and the University of South Alabama.

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