Proceedings, Third International Coral Reef Symposium
Rosenstiel School of Marine and Atmospheric Science
University of Miami
Miami, Florida 33149, U.S.A.
May 1977

REEF FISHES OVER SPONGE BOTTOMS OFF THE MOUTH OF THE AMAZON RIVER

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ABSTRACT

A typical West Indian reef-fish fauna (45 species) was found associated with a diverse West Indian sponge fauna (35 species) at 14 stations 48-73 m deep off French Guiana and northern Brazil between 5° and 0° N. These records greatly narrow the supposed discontinuity in reef faunas between the Caribbean and Brazil and indicate that endemism in the tropical marine reef fauna of northeastern Brazil is probably limited to species occurring shallower than 50 m.

KEY WORDS: Reef Fishes, Sponges, Zoogeography.

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Introduction

The distribution of reef fish communities in the tropical western Atlantic has been considered to be disjunct (1-3), like that of reef-building corals (4), with a 2700 km gap between the mouths of the Orinoco River in Venezuela and the Amazon in Brazil. The large volume of silt-laden fresh water coming from the Orinoco, Pará, and Amazon rivers has been considered as forming a barrier to the continuous distribution of corals and coral-reef fishes, isolating populations north and south of the barrier, thereby leading to speciation (2, 3). Therefore, it is of great zoogeographic interest to report that populations of typical West Indian reef fishes are present over sponges on hard bottoms with oceanic salinity from Cayenne, French Guiana, south to the equator.

Methods and Materials

Collections were made with a 40-foot flat shrimp trawl fished on the bottom at 57 of a planned 68 stations within the 40-80 m depth range from approximately 5°N to 0° on cruise 58 of the National Oceanographic and Atmospheric Administration R/V Oregon II in May 1975. A typical reef fish fauna was found at 14 of these 57 stations (Fig. 1). This fauna was probably also present at 11 additional stations at the southern end of the survey area but these stations could not be sampled due to the very rough bottom. Temperature profiles were made with bathythermograph probes and surface and bottom water samples were collected for salinity analysis at the beginning and end of each trawl Surface and bottom salinities and temperatures for the 14 reef fish stations are summarized in Table 1. Detailed station data is available from the National Marine Fisheries Service, Pascagoula, Mississippi.

Fishes were sorted and identified in the field by the first author. Representative specimens were sent to specialists on the list of the Smithsonian Oceanographic Sorting Center to verify identifications. A diverse sponge fauna was present at 12 of these 14 stations, with an estimated 800 kg taken at sta. 17702 and 200 kg at sta. 17721. Two large samples of sponges and one small sample were frozen in the field and subsequently identified by the second author. Voucher specimens of fishes, sponges, and some other invertebrates have been deposited in the National Museum of Natural History.

Results

The most common species of reef-fishes taken at the 14 reef fish stations are listed in Table 2. Reef fishes that were taken at only a few stations include the following species (number of stations in parentheses): *Gymnothorax vicinus* (1); *Aulostomus maculatus* (2); *Apogon pseudomaculatus* (2); *Cephalopholis fulva* (2); *Diplectrum bivittatum* (1); *Epinephelus morio* (3); *Paranthias furcifer* (1); *Serranus phoebe* (2); *Pristipomoides aquilinaris* (3); *Ocyurus chrysurus* (1); *Haemulon boschmae* (2); *H. plumieri* (1); *H. steindachneri* (1); *Mulloidichthys martinicus* (1); *Equetus lanceolatus* (1); *Holacanthus ciliaris* (2); *Chromis multilineata* (1); *Eupomacentrus* sp. (1); *Bothus lunatus* (1); *B. ocellatus* (3); *Alutera monoceros* (2); *Cantherhines pullus* (1); *Stephanolepis hispidus* (1); *Chilomycterus antennatus* (2); *C. antillarum* (1); *C. atinga* (1). A number of additional species of fishes, benthic and midwater species not particularly associated with reefs, was also collected but are omitted as not relevant to this paper.

Thirty-five species of sponges from 20 families were identified from the three stations (Table 3). A 3-cm pebble attached to the base of one sponge (sta. 17718) proved to be well cemented quartz-rich (22%) calcarenite, containing many mollusk shell fragments and encrusted by a coralline alga, by a bryozoan and by several specimens of *Homotrema* sp. (Foraminifera). Other representatives of the benthic population (sta. 17702 and 17698) preserved were one species each of Hydroidea, Zoantharia, Octocorallia (*Telesto* sp.), two species of Bryozoa, one species of Ophiuroidea (basket star) and four species of Ascidiacea.

Surface salinities ranged from 25.1°/oo at sta. 17720 to 35.7°/oo at sta. 17716 except for the northernmost two of the 14 reef fish stations (17638, 17640) which had water of much lower salinity, 17.0 and 22.3°/oo. Bottom salinities showed much less variation, 34.5-36.4°/oo, and were not influenced by freshwater drainage from the Amazon. Thus, no inhibitory effect of freshwater was noted at the bottom where the sponges and reef fishes were found.

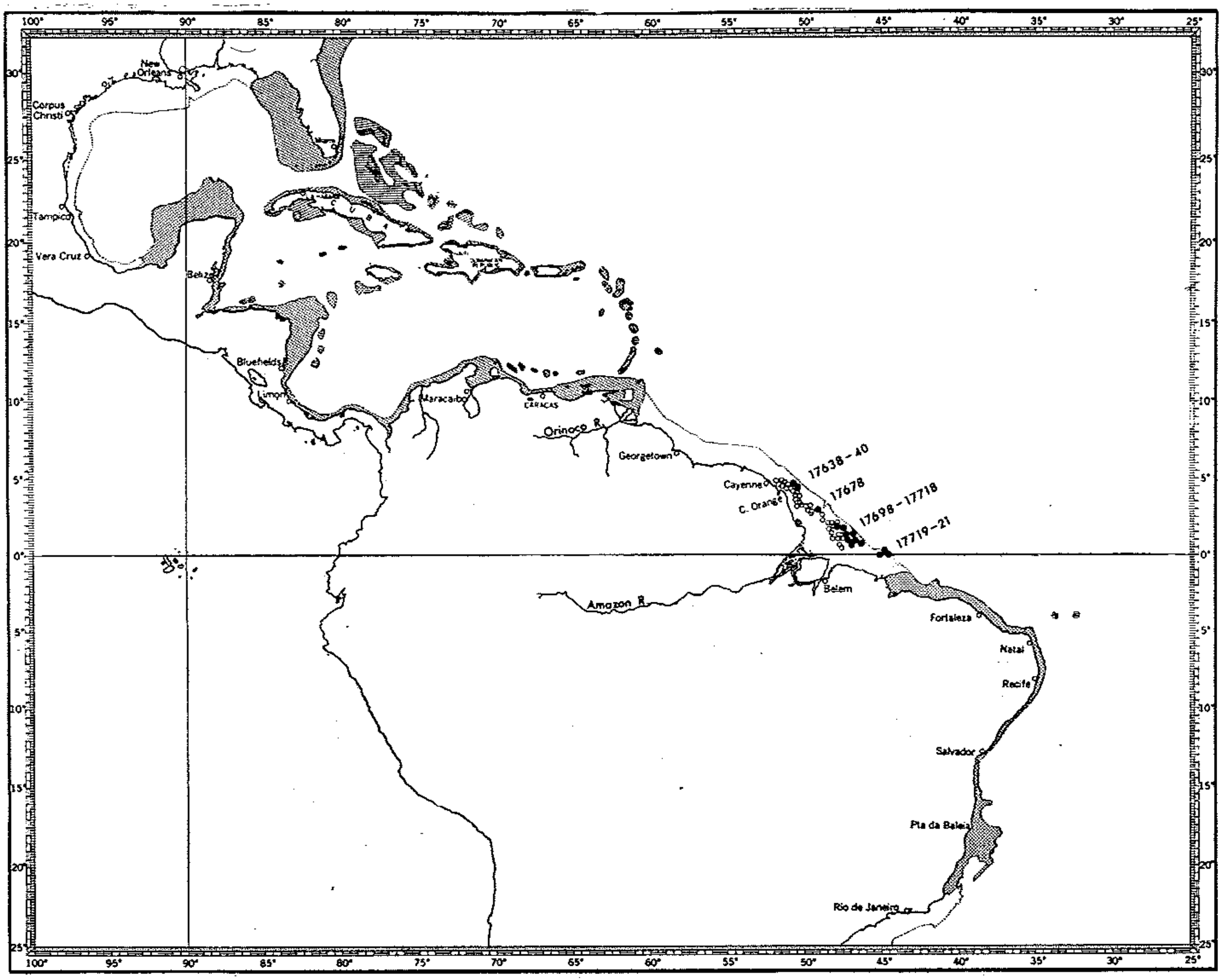

Fig. 1. Distribution of coral reef fishes (shaded area) in the tropical western Atlantic (based on 1, 2). Large dots indicate the 14 stations with sponges and reef fishes collected on R/V Oregon II Cruise 58; open circles indicate the stations without a reef fish fauna.

Discussion

Hermatypic representatives of milleporid and scleractinian corals generate massive limestone build-ups in many tropical coastal regions. Their flourishing depends on a narrow spectrum of suitable environmental conditions which are equally advantageous to a great variety of benthic algae, invertebrates and fishes. Together they form a complex community that can only survive because the coral skeletons provide a highly structured habitat with ample solid substrates and hiding places. Similar configurations with comparable, although less diverse, associated flora and fauna are also known as "reefs." They can be created by sessile organisms (coralline algae, gorgonians, polychaete worms, vermetid mollusks, bryozoans), by eroded rock, by boulder fields and even by man's activity (breakwaters, artificial reefs composed of automobiles, tires, or concrete blocks). Reef fishes are known to associate with many kinds of substrates that provide hiding places (5), as long as their other ecological requirements are met.

Sponges, together with certain algae and gorgonians, are among the dominant organisms of Atlantic coral reef communities. They gain considerable quantitative importance below the depth of 30 m where the abundance of reef corals begins to decline due to reduced light conditions. Many coral reef sponges are ramose or are shaped like tubes or vases and give shelter to many species of reef fishes (6).

Little evidence has been available previously that "stepping stones" in the form of habitats suitable for reef fishes exist between the West Indies and Brazil. Freshwater outflow, fine sediments and a strong northwesterly current in the

Table 1. Depth (m), temperature (°C), and salinity (o/oo), for 14 reef fish stations of the Oregon II off the coast of French Guiana and northern Brazil.

	17638	17640	17678	17698	17702	17704	17705	17715	17716	17717	17718	17719	17720	17721
depth	71	73	73	62	64	66	59	48	53	68	69	66	64	55
surface salinity	17.0	22.3	30.3	29.7	32.8	30.7	33.2	32.2	35.7	34.3	33.8	25.6	25.1	29.4
bottom salinity	36.2	36.3	36.4	35.6	36.1	35.8	34.9	34.5	35.7	35.9	36.1	36.0	36.1	35.9
surface temp.	27.8	28.3	27.8	27.8	28.3	27.8	27.8	27.8	28.3	27.8	28.9	29.4	28.3	28.3
bottom temp.	26.1	26.1	24.5	27.8	27.8	27.2	27.8	27.8	28.3	27.2	27.8	27.8	26.1	27.8
reef fish spp.	14	6	10	16	13	6	8	9	14	20	9	10	8	6
total fish spp.	31	9	24	27	17	9	8	10	14	25	9	11	10	6
sponges present?	fire sponge	?	yes	yes	800 kg	yes	yes	yes	yes	yes	yes	yes	yes	200 kg
(no. spp.)	-	-	-	14	22	-	-	-	-	-	6	-	-	-

coastal zone of the Guianas make the Orinoco-Amazon area an effective barrier for the dispersal of West Indian reef corals. Ten of 18 hermatypic species (56%) known from Brazil are endemics (7). In comparison, only 5 of 17 species of gorgonians (30%) are exclusively Brazilian (8). Similar estimates for sponges are more difficult because of dubious identifications in the older literature and the scarcity of reliably identified collections from the West Indian and other regions. Hechtel (9), in a detailed zoogeographical analysis, estimated that 64 of 156 Brazilian sponge species (42%) are endemics. Our present sponge material is incompletely identified because some species are either new or require more study and comparison with types. Names and diagnoses of 16 new species listed by Hechtel (9) are not yet available. Of our identified species, all but one are of West Indian origin (*Homoeodictya grandis* has hitherto only been known from South Africa). On the generic level, the other species all have strong West Indian affinities.

Bayer (8) recorded 7 species of gorgonians from waters off the Guianas, all with West Indian distribution. Ottmann (10) mentioned the occurrence of several benthic organisms (bryozoans, sponges, echinoderms and octocorals) from more than 100 km off the mouth of the Amazon. None of these, however, were identified.

From presently available data, it appears that taxonomic problems, lack of ecological information and insufficient sampling are the main causes for conflicting zoogeographical concepts. Light, water movement and availability of solid substrates are the major factors governing the depth distribution of sessile organisms, like sponges, corals and gorgonians. Most sponges, like gorgonians, are less light dependent than hermatypic corals. In shallow water, large

Table 2. Common reef fishes taken at 14 Oregon II stations off the coast of French Guiana and northern Brazil. Numbers indicate number of specimens taken at station.

	17638	17640	17678	17698	17702	17704	17705	17715	17716	17717	17718	17719	17720	17721
Gymnothorax ocellatus	2	1	-	2	-	-	-	-	-	-	-	-	-	-
Holocentrus ascensionis	1	-	-	2	67	3	2	2	6	11	2	-	-	-
Myripristis jacobus	1	-	-	20	3	3	-	-	16	10	-	-	-	-
Serranus atrobranchius	2	-	-	2	-	-	-	-	-	1	-	-	-	-
Priacanthus arenatus	3	-	10	2	3	-	1	3	1	2	-	8	-	-
Lutjanus purpureus	4	12	3	17	1	5	-	-	-	8	-	-	-	-
Lutjanus synagris	1	-	-	2	-	-	-	-	-	4	-	11	-	-
Rhomboplites aurorubens	1	2	3	1	-	-	-	-	-	8	-	9	-	-
Haemulon aurolineatum	-	-	-	5	1	-	-	-	7	187	1	10	-	-
Pseudupeneus maculatus	-	-	-	-	15	2	1	-	-	7	-	1	-	-
Chaetodon ocellatus	3	-	-	-	12	-	-	-	-	-	-	2	1	-
Chaetodon sedentarius	2	-	20	-	-	5	-	-	-	10	-	-	-	-
Pomacanthus paru	-	-	-	-	31	-	3	7	5	3	-	2	1	-
Pomacanthus arcuatus	-	-	-	1	-	-	-	1	1	-	-	-	-	-
Acanthurus chirurgus	-	-	-	1	3	-	-	2	-	3	-	-	1	4
Sparisoma chrysopterum	-	-	-	-	28	1	3	-	2	-	3	-	3	4
Balistes vetula	-	-	120	-	-	-	31	8	19	8	2	2	2	2
Acanthostracion polygonius	-	-	-	-	20	-	-	2	5	1	1	-	5	4
Acanthostracion quadricornis	6	25	3	4	-	-	-	-	1	-	-	1	-	-

Table 3. Sponges (Demospongea) from three Oregon II stations off the coast of northern Brazil (number of stations shown; asterisk indicates new record for Brazil).

- Order Dictyoceratida
  - Spongiidae
    - *Ircinia strobilina* (Lamarck)-2
  - Verongiidae
    - *Fasciospongia* sp., cf. *turgida* (Lamarck)-1
    - *Verongia cauliformis* (Carter)-2
    - *Verongia fistularis* (Pallas) f. *fistularis*-1
    - *Verongia fistularis* (Pallas) f. *fulva*-1
    - *Pseudoceratina crassa* (Hyatt)-1
- Order Haplosclerida
  - Haliclonidae
    - *Haliclona* sp.-1
    - *Xestospongia muta* (Schmidt)-1
    - *Xestospongia* sp.-1
  - Callyspongiidae
    - *Callyspongia pergamentacea* (Ridley)-1
    - *Callyspongia villosa* (Pallas)-1
- Order Poecilosclerida
  - Adociidae
    - *Petrosia* sp.-1
  - Agelasidae
    - *Agelas clathrodes* (Schmidt)-1
  - Esperiopsidae
    - *Homoeodictya grandis* Ridley & Dendy-2*
  - Coelosphaeridae
    - *Coelosphaera biclavata* (Priest)-1*
    - *Inflatella bartschi* Laubenfels-1*
    - *Inflatella* sp.-1*
  - Mycalidae
    - *Echinostylinos* (?) *unguiferus* Laubenfels-2
    - *Mycale* sp.-1
  - Myxillidae
    - *Iotrochota* sp.-1
  - Clathriidae
    - cf. *Clathria* sp.-1
- Order Halichondrida
  - Halichondriidae
    - genus and species unidentified-1
- Order Axinellida
  - Axinellidae
    - *Perissinella* sp., cf. *madeirensis* Topsent-2
    - *Pseudaxinella lunaecharta* (Ridley & Dendy)-2
    - cf. *Teichaxinella* sp.-2
    - *Thrinacophora funiformis* Ridley & Dendy-2
  - Raspailiidae
    - *Echinodictyum* sp.-1
    - *Raspailia* sp.-1
  - Euryponidae
    - cf. *Eurypon* sp.-1
- Order Hadromerida
  - Chondrosiidae
    - *Chondrilla nucula* Schmidt-1
- Order Choristida
  - Geodiidae
    - *Geodia neptuni* (Sollas)-1
  - Stellettidae
    - cf. *Stelletta* sp.-2
    - *Penares* sp., cf. *S. mastoidea* Schmidt-1
- Order Spirophorida
  - Tetillidae
    - *Cinachyra kuekenthali* Uliczka-2
- Order Homosclerophorida
  - Plakinidae
    - *Plakortis halichondrioides* (Wilson)-1

sponges are more affected by wave action because they are readily dislodged. All three groups need solid substrates to attach themselves. Many sponges may have an advantage because they can anchor on coarse sand substrates as long as there are only steady currents (boundary layer effect) and no oscillating water movement (below the reach of waves). Some can stabilize their substrate by rooting, others by attaching to, and thus connecting many small pieces of shell or rubble (11).

Ottmann (10) indicated that a belt of shelly sand arches around the fluviatile quartz sands and clay-rich sediments beyond 100 km from Marajo Island in the mouth of the Amazon, at a depth of 30-100 m. The majority of our stations extend from about this location to the edge of the continental shelf and range from 48 to 73 m in depth. Due to the nature of the sampling gear used we do not have much information on substrate conditions but, from the behavior of the trawl and from fathometer readings, we conclude that hard bottoms are abundant in this region.

Conclusions

The composition, diversity and biomass of benthic fauna obtained on Oregon cruise 58 show that excellent conditions for the survival of a West Indian reef fauna exist on the continental shelf off the Guianas and the Amazon. A very similar reef fish fauna has been reported over sponge and dead coral bottom at 55-73 m off Guyana (12). Additional sampling is likely to produce more evidence for zoogeographical "stepping stones" between the West Indies and Brazil. Collecting with scuba and ichthyocides will doubtless increase the number of small species of reef fishes known from these stepping stones. More and better identified collections should show that the fresh silt-laden water of the Amazon and Orinoco acts as a filter barrier to interrupt gene flow between populations of species directly associated with corals or occurring in reef habitats shallower than 50 m. Endemism in the tropical marine fauna of Brazil is probably confined to species with a bathymetric distribution limit of approximately 50 m.

Acknowledgments

We thank the crew and scientific staff of the Oregon, the chief scientist of cruise 58, Alexander Dragovich, and Elmer Guthertz, for their cooperation and assistance during the cruise. Voucher fish specimens were identified by William D. Anderson, Jr., Eugenia B. and James E. Böhlke, Margaret G. Bradbury, Leonard J. V. Compagno, C. E. Dawson, Carter R. Gilbert, and C. Richard Robins. Joseph Russo assisted in preparing Table 2 and Fig. 1 and Keiko Hiratsuka Moore completed the map. Useful comments on drafts of the ms were contributed by John C. Briggs, Daniel M. Cohen, Alexander Dragovich, Carter R. Gilbert, George C. Miller, and C. Richard Robins.

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