A COMPARISON OF FISH FAUNAS IN A HIGHLY STRESSED AND A LESS STRESSED TROPICAL BAY - GUAYANILLA AND JOBOS BAY, PUERTO RICO

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ABSTRACT

Jobos and Guayanilla Bays are semi-enclosed bays on the south coast of Puerto Rico. Jobos Bay receives some small amounts of raw sewage from two small villages and some wastes from a sugar central. Guayanilla Bay receives some sewage from a town on one shore, hydrocarbon, heavy metals, and carbohydrate addition from a petrochemical complex, and heat from an electrical power generating plant. Species diversity as indicated by the Shannon-Weaver index is higher in Jobos but the lowest values found in either bay are higher than these reported for normal temperate aquatic systems. Numbers of fish species are high (198 for Jobos and 93 for Guayanilla). The greatest similarity between the two bays is between Jobos Inner Bay which is turbid and receives some raw sewage and Guayanilla Thermal Cove which receives heated effluents up to 40°C (s=.526).

INTRODUCTION

The island of Puerto Rico is highly industrialized and is becoming more so quite rapidly. In order to furnish more power for the growing industrial segment, the Puerto Rico Water Resources Authority is constructing a series of power plants on Jobos Bay. The studies presented here are part of the base line studies, these parts of which have been going on since September 1971. For comparative purposes studies of Guayanilla Bay, a bay which has had a power plant for 16 years, were begun in December of 1971.

At this time we would like to acknowledge the assistance of Lynn Blickenstaff, John Kovarna and Peter Schroeder for their help in producing computer programs for data analysis. This work was supported by contract AT-(40-1)-4079 from the Puerto Rico Water Resources Authority.

METHODS AND MATERIALS

Jobos Bay is a semi-enclosed bay on the south coast of Puerto Rico about 45 km. east of Ponce between the towns of Salinas and Guayama (See Figure 1). Two villages, Puerto de Jobos and Aguirre are located on the bay and dump raw sewage into the adjacent waters. The Inner Bay (See Figure 2), besides receiving the sewage of Puerto de Jobos, is shallow enough so that wave surge keeps the water turbid. Most of the shoreline of the Inner Bay is densely covered with mangroves, dominated by the red mangrove, *Rhizophora mangle,* (Westinghouse Electric Corp, 1972). The cays of the reef and cay area are fringed with or completely covered with red mangrove and from Punta Colchones westward the entire Bahia de Cayo Puerco complex and ship channel shoreline represent the largest extant stands of mangroves on the south coast of Puerto Rico, the second largest on the entire island. For the entire Jobos Bay area there are 542.3 hectares of mangrove swamp, (Westinghouse, 1972). For a comparison of Jobos and Guayanilla bays see Table 1.

In addition to the sewage from these two villages, Central Aguirre, a large sugar cane processing plant, until two years ago allowed sugar cane wastes, primarily bagasse, to enter the Bahia de Cayo Puerco complex; lesser but significant quantities were dumped into the central bay. This has been a stress from which the bay has not fully recovered.

Guayanilla Bay is also a semi-enclosed bay and is locat4d about 15 km. west of Ponce. The town of Playa de Guayanilla is located on the north shore of the bay. Also located on this bay are the Costa Sur electrical power plants and a petrochemical complex. As at Jobos, mangroves cover much of the shoreline of

Guayanilla Bay is also a semi-enclosed bay and is located about 15 km. west of destroyed to the extent that only about 20 hectares of that shore are presently under mangrove cover. Guayanilla Bay receives raw sewage from Playa de Guayanilla, hydrocarbon, carbohydrate, and heavy metals from the petrochemical complex, and heat from the Costa Sur power generating plants (Kolehmainen *et al.* 1972). Within Guayanilla Bay there is a semi-enclosed cove, Thermal Cove, into which the heated effluent of the Costa Sur plants is pumped (labeled T. C. in Figure 3). The present discharge rate is 1510 m^3/min. with a t of about 10° C resulting in summer discharge temperatures of about 40° C and winter discharge temperatures of about 37° C (Kolehmainen *et al.* 1972). The intake water of the Costa Sur plants is the already chemically polluted bay water; this compounds the effects of the increased heat content of the thermal cove. Associated reefs outside the mouth of Guayanilla Bay are included in the study since Jobos Bay has reef areas within, and forming some of the boundary of Jobos Bay.

Both bays contain several distinct environments; therefore, they have been divided into areas on the basis of naturally occurring geographic features, water temperature and depth, and common sessile organisms (see Figure 2 and 3).

Methods of capture include the use of fish toxin (®Pronoxfish), nylon monofilament gill nets (1.3 cm, 1.9 cm, 2.5 cm, 3.8 cm, 5.1 cm, 6.4 cm, and 8.9 cm square mesh), and seine. Seine data have been disregarded except in preparing species lists. Poison stations have been made semiquantitative by surrounding areas either 8 m. or 10 m. square with a 0.6 cm mesh seine before introduction of the toxin. Fish are placed on ice immediately and then frozen as soon as possible. After bringing them to the laboratory they are thawed, identified, counted, and weighed.

Shannon-Weaver species diversity indices have been estimated using the calculation methods of Lloyd, Zar, and Karr (1968); similarity indices have been calculated according to the method of Sorenson (1948).

RESULTS

Table 2 is a list of species of fish taken by all methods in the two bays. Table 3 shows numbers of species for these two bays in relationship to the major subareas. No real conclusion can be drawn on species number alone as the collecting effort in Jobos Bay has been considerably more intense than in Guayanilla. Within each bay the collecting effort has been nearly equal in each subarea except for Jobos Inner Bay which has had less collecting effort than the rest of Jobos Bay. Collecting effort there is more on the order of that given the subareas of Guayanilla Bay.

Table 4 shows species diversity indices based on the Shannon-Weaver index. The two lowest values are for Guayanilla Thermal Cove and Jobos Inner Bay (3.661 and 3.852 respecitvely). On the average Jobos Bay is more diverse than Guayanilla, but only slightly more so.

Table 5 shows similarity index values for the subareas of Jobos and Guayanilla Bays. The greatest similarity shown is between Jobos Inner Bay and

Guayanilla Thermal Cove. The lowest values are in comparing the two reef areas with Guayanilla Thermal Cove and Jobos Inner Bay.

DISCUSSION

There are occasional small fish kills in Guayanilla Bay which seem to be related to hydrocarbon pollution but there has been no catastrophic reduction in fish population. Local fishermen, however, state that they have quit fishing in the bay as no one will buy their fish because they smell bad. No fish kills have been reported from Jobos Bay.

Copeland (1970) reported that the number of reef associated species in Bahia de Tallaboa, the next bay east of Guayanilla Bay and which receives wastes from the same petrochemical complex, dropped from 160 to 30. Szmant-Froelich (personal communication) reports that the Tallaboa reefs and those around Punta Verraco (Guayanilla Bay area) are reduced to less than 20% of the number of coral species which were formerly there or are currently present at Jobos Bay. However, the fish species diversity which we have found is still fairly high.

Copeland and Birkhead (1972) and Bechtel and Copeland (1970) report H′ values of around 2.9 bits/individual for lower Cape Fear River Estuary, North Carolina, and for unstressed Texas bays respectively. Margalef (1968) reported values ranging from 1.4 to 3.5 bits/individual for demersal fishes on the Spanish Mediterranean coast. Margalef states that there is an upper limit near 4.5 which aquatic communities do not surpass. Wilhm and Dorris (1968) as cited by Bechtel and Copeland (1970) believe that species diversity can be an indicator of stress on aquatic systems. They state that values below 1.0 represent highly polluted areas, values below 2.0 indicate stress, and values 2.0 and above indicate relatively unstressed ecosystems. We would like to modify their statements to in all cases include the phrase "temperate and subtropical fish species diversity".

The latitudinal effect on species diversity is well documented (Pianka, 1966; Paine, 1966; MacArthur and MacArthur, 1961 and others). Puerto Rico is at latitude 18°N while Cape Fear River is at about 35°N and the Texas bays lie between 26° and 29°N. Latitudinal differences and the accompanying increase in numbers of species available necessitate a modification of the H′ ranges which would be accepted as indicating stress. We feel that Guayanilla Thermal Cove is in fact a highly stressed system and that the H′ value which we have calculated probably represents a level which indicates stress in Puerto Rico. Normative data are not available to tell us where to draw lines between stressed and unstressed systems.

Also a further cautionary word: H′ values calculated for taxa other than fish will not necessarily be in the same range. Porter (1972) reports H′ values for corals in Panamanian waters ranging from slightly below 1.0 to over 3.0 while Janzen and Schoener (1968) report values between 4.8 and 6.4 for tropical forest insects. Seiglie (1973a), working with foraminiferans, reported H′ values in the range 0.14 to 1.39 (converted from bels to bits) for Guayanilla Bay, Jobos Bay, and Mayaguez Harbor. Seiglie (1973b) also reported lower H′ values (0.86-1.00) for Thermal Cove than for Guayanilla Inner Bay (0.94-1.43). Normative data could probably be prepared for any ecological group one wished to investigate and then be used as suggested by Copeland, Bechtel *et al.*

The similarity indices which indicate a fairly high similarity between Jobos Inner Bay and Guayanilla Thermal Cove would indicate that there are opportunistic species (weeds) which are tolerant of heat, chemicals, organic load and high turbidity. The mojarras (Gerridae) and the sea bream (*Archosargus rhomboidalis*, family Sparidae) are the dominant species both by numbers caught and biomass in the disturbed areas. Erdman (personal communication)

reports the sea bream to be a scatophage which concentrates around sewage outfalls and which may increase in numbers in the presence of man's disturbance due to decreased interspecific competition. We predict an increase in these species when Jobos Bay begins receiving effluents from the Aguirre power complex.

SUMMARY

1) The Shannon diversity index (H') was used to measure stress effects on a highly polluted and a mildly polluted bay. As predicted by various authors, H' values were lower in the more stressed areas.

2) Latitudinal differences, with accompanying larger numbers of species from which to draw, cause even the lowest values from the most stressed area to be higher than Bechtel and Copeland (1970) consider to be signs of healthy temperate communities.

3) Faunal similarities between an area stressed by sewage and high turbidity and an area stressed by heat, heavy metals, hydrocarbons, and carbohydrates indicate that there is a common weed fauna which benefits from man's disturbances.

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Table 1. Comparison of Jobos and Guayanilla Bays*.

	Jobos Bay	*Guayanilla Bay*
Open Water Surface Area	1542 hectares	911 hectares
Mangrove	542 hectares	190 hectares
Shore line	59.3 km.	17.7 km.

*All data from Westinghouse Electric Corporation, 1972.

Table 2. Fish species taken during these studies.

Species	Guayanilla	Jobos
Orectolobidae		
Ginglymostoma cirratum-Nurse Shark		X
Carcharhinidae		
Carcharhinus acronotus-Blacknose Shark		X
**Galeocerdo cuvieri*-Tiger Shark		X
Negaprion brevirostris-Lemon Shark	X	X
Rhizoprionodon porosus-Atlantic Sharpnose Shark		X
Sphyrnidae		
Sphyrna lewini-Scalloped Hammerhead		X
Dasyatidae		
Dasyatis americana-Southern Stingray		X
Myliobatidae		
Aetobatis narinari-Spotted Eagle Ray	X	X
Elopidae		
Elops saurus-Tenpounder	X	X
Megalopidae		
Megalops atlanticus-Tarpon	X	X
Albulidae		
Albula vulpes-Bonefish	X	X
Moringuidae		
Moringua edwardsi-Spaghetti Eel	X	X
Muraenidae		
Echidna catenata-Chain Moray	X	X
Gymnothorax funebris-Green Moray	X	X
Gymnothorax moringa-Spotted Moray		X
Gymnothorax vicinus-Purplemouth Moray	X	X
Muraena miliaris-Goldentail Moray		X

Table 2. Continued

Species	Guayanilla	Jobos
Ophichthidae		
Ahlia egmontis-Key Worm Eel	X	X
Myrichthys acuminatus-Sharptail Eel		X
Myrophis punctatus-Speckled Worm Eel	X	X
Clupeidae		
Harengula clupeola-False Pilchard		X
Harengula humeralis-Redeared Sardine	X	X
***Jenkinsia lamprotaenia*-Dwarf Herring		X
Opisthonema oglinum-Thread Herring	X	X
Sardinella aurita-Spanish Sardine		X
Cheirocentridae		
Cheirocentrodon taeniatus	X	
Engraulidae		
Anchoa cubana-Cuban Anchovy		X
***Anchoa hepsetus*-Striped Anchovy		X
Anchoa lamprotaenia-Longnose Anchovy	X	X
Anchoa parva-Small Anchovy		X
Anchoviella perfasciata-Flat Anchovy		X
Cetengraulis edentulis-Whalebone Anchovy	X	X
Synodontidae		
Synodus foetans-Inshore Lizardfish		X
Synodus intermedius-Sand Diver		X
Gobiesocidae		
Acyrtops amplicirrhus-Southern Emerald Clingfish	X	X
Arcos rubrigenosus-Red Clingfish		X
Gobiesox sp.-Clingfish	X	
Tomicodon fasciatus-Banded Clingfish	X	
Antennaridae		
Histrio histrio-Sargassumfish		X
Ophidiidae		
Ogilbia sp.	X	X
Carapidae		
Carapus bermudensis-Pearlfish		X
Exocoetidae		
Hemirhamphus brasiliensis-Ballyhoo	X	X
Hyporhamphus unifasciatus-Halfbeak		X
Belonidae		
Strongylura marina-Atlantic Needlefish	X	X
Tylosurus raphidoma-Houndfish		X
Cyprinodontidae		
Rivulus marmoratus-Rivulus		X
Poeciliidae		
Poecilia vivipara-One-Spot Livebearer		X
Atherinidae		
Atherinomorus stipes-Hardhead Silverside	X	X
Holocentridae		
Adioryx vexillarius-Dusky Squirrelfish		X
Holocentrus ascensionis-Longjaw Squirrelfish	X	X
Holocentrus rufus-Squirrelfish		X

Table 2. Continued

Species	Guayanilla	Jobos
Myripristes jacobus-Blackbar Soldierfish		X
Aulostomidae		
Aulostomus maculatus-Trumpetfish		X
Serranidae		
Alphestes after-Mutton Hamlet	X	
Epinephelus adscensionis-Rockhind		X
**Epinephelus itajara*-Jewfish		X
**Epinephelus striatus*-Nassau Grouper		X
Grammistidae		
Rypticus saponaceus-Soapfish		X
Rypticus subbifrenatus-Spotted Soapfish		X
Rypticus sp.-Soapfish		X
Apogonidae		
Apogon maculatus-Flamefish		X
Apogon pigmentarius-Dusky Cardinalfish		X
Apogon quadrisquamatus-Sawcheek Cardinalfish		X
Astrapogon puncticulatus-Punctate Cardinalfish		X
Echeneidae		
Echeneis naucrates-Sharksucker		X
Carangidae		
Caranx bartholomei-Yellow Jack	X	
Caranx fuscus-Blue Runner		X
Caranx hippos-Crevalle Jack	X	X
Caranx latus-Horse-Eye Jack	X	X
Chloroscombrus chrysurus-Bumper	X	X
Oligoplites saurus-Leatherjacket	X	X
Selene vomer-Lookdown		X
Trachynotus carolinus-Pompano		X
Trachynotus falcatus-Permit	X	X
Trachynotus goodei-Palometa	X	X
Vomer setapinnis-Moonfish		X
Lutjanidae		
Lutjanus analis-Mutton Snapper	X	X
Lutjanus apodus-Schoolmaster		X
Lutjanus griseus-Gray Snapper	X	X
Lutjanus mahogani-Mahogany Snapper		X
Lutjanus jocu-Dog Snapper	X	X
Lutjanus synagris-Lane Snapper	X	X
Ocyurus chrysurus-Yellowtail Snapper	X	X
Lobotidae		
Lobotes suranamensis-Tripletail		X
Gerridae		
Diapterus olisthostomus-Irish Pompano	X	X
Diapterus rhombeus-Rhomboid Mojarra	X	X
Eucinostomus argenteus-Spotfin Mojarra	X	X
Eucinostomus gula-Silver Jenny	X	X
Eucinostomus jonesii-Slender Mojarra	X	X
Eucinostomus lefroyi-Mottled Mojarra		X
Eucinostomus melanopterus-Espanola	X	X
Eugerres brasiliensis-Streaked Mojarra	X	

Table 2. Continued

Species	Guayanilla	Jobos
Eugerres plumieri-Striped Mojarra		X
Gerres cinereus-Yellowfin Mojarra	X	X
Pomadasyidae		
Anisotremus surinamensis-Black Margate	X	
Anisotremus virginicus-Porkfish		X
Haemulon aurolineatum-Tomtate	X	X
Haemulon chrysargyreum-Smallmouth Grunt		X
Haemulon flavolineatum-French Grunt	X	X
Haemulon macrostomum-Spanish Grunt		X
Haemulon melanurum-Cottonwick		X
Haemulon parrai-Sailor's Choice		X
Haemulon plumieri-White Grunt	X	X
Haemulon sciurus-Bluestriped Grunt	X	X
Pomadasys corvaenifomis-Burro Grunt	X	X
Sparidae		
Archosargus rhomboidalis-Sea Bream	X	X
Calamus bajonado-Jolthead Porgy		X
Calamus calamus-Saucereye Porgy		X
Calamus penna-Sheepshead Porgy		X
Scianidae		
Bairdiella ronchus-Ground Drummer	X	X
Corvula sanctaluciae-St. Lucian Corvina	X	X
Cynoscion jamaicensis-Mongolar Drummer		X
Larimus breviceps-Cabezon		X
Menticirrhus martinicensis-Jewsharp Drummer	X	X
Micropogon furnieri-West Indian Drummer	X	X
Odontoscion dentex-Reef Croaker	X	
Ophioscion adustus-Snake Croaker	X	X
Stellifer stellifer-Star Drum		X
Mullidae		
Pseudupeneus maculatus-Spotted Goatfish		X
Ephipiidae		
Chaetodipterus faber-Spadefish	X	X
Chaetodontidae		
Chaetodon capistratus-Foureye Butterflyfish	X	X
Chaetodon striatus-Banded Butterflyfish	X	X
**Holocanthus ciliaris*-Queen Angelfish		X
Pomacanthus arcuatus-Gray Angelfish		X
**Pomacanthus paru*-French Angelfish		X
Pomacentridae		
Abudefduf saxatilis-Sergeantmajor	X	X
Chromis multilineatus-Brown Chromis		X
Eupomacentrus fuscus-Dusky Damselfish		X
Eupomacentrus leucostictus-Beaugregory	X	X
Eupomacentrus partitus-Bicolor Damselfish		X
Eupomacentrus planifrons-Yellow Damselfish		X
Eupomacentrus variabilis-Cocoa Damselfish		X
Mugilidae		
Mugil curema-White mullet	X	X
Mugil trichodon-Fantail Mullet		X

Table 2. Continued

Species	Guayanilla	Jobos
Sphyraenidae		
Sphyraena barracuda-Barracuda	X	X
Sphyraena guachancho-Guaguanche		X
Polynemidae		
Polydactylus virginicus-Barbudo	X	X
Labridae		
**Bodianus rufus*-Spanish Hogfish		X
Doratonotus megalepis-Dwarf Wrasse		X
Halichoeres bivittatus-Slippery Dick		X
Halichoeres poeyi-Blackear Wrasse		X
Lachnolaimus maximus-Hogfish		X
Thalassoma bifasciatum-Bluehead Wrasse		X
Scaridae		
Scarus coeruleus-Blue Parrotfish	X	X
Scarus croicensis-Striped Parrotfish	X	X
Scarus guacamaia-Rainbow Parrotfish		X
Sparisoma chrysopterum-Redtail Parrotfish	X	X
Sparisoma radians-Bucktooth Parrotfish	X	X
Sparisoma rubripinne-Yellowtail Parrotfish	X	X
Sparisoma viride-Stoplight Parrotfish	X	X
Opisthognathidae		
Opisthognathus maxillosus-Mottled Jawfish		X
Dactyloscopidae		
Dactyloscopus tridigitatus-Sand Stargazer		X
Blenniidae		
Blennius sp.	X	
Entomacrodus nigricans-Pearl Blenny		X
Hypleurochilus aequipinnis-Oyster Blenny	X	X
Hypleurochilus springeri-Orangespotted Blenny		X
Ophioblennius atlanticus-Redlip Blenny		X
Tripterygidae		
Enneanectes boehlkei-Roughhead Triplefin		X
Clinidae		
Acanthemblemaria aspera-Roughhead Blenny		X
Acanthemblemaria spinosa-Spinyhead Blenny		X
Coralliozetus cardonae-Twinhorn Blenny		X
Labrisomus bucciferus-Puffcheek Blenny	X	X
Labrisomus gobio-Goggleeye Blenny		X
Labrisomus guppyi-Mimic Blenny		X
Labrisomus hatiensis-Reef Blenny		X
Labrisomus nuchipinnis-Hairy Blenny	X	X
Malacoctenus aurolineatus-Goldline Blenny		X
Malacoctenus delalandei-Brazilian Blenny	X	X
Malacoctenus erdmani-Imitator Blenny		X
Malacoctenus gilli-Dusky Blenny	X	X
Malacoctenus macropus-Rosy Blenny		X
Malacoctenus triangulatus-Saddle Blenny		X
Paraclinus cingulatus-Coral Blenny		X
Paraclinus fasciatus-Banded Blenny		X
Paraclinus nigripinnis-Blackfin Blenny	X	X

Table 2. Continued

Species	Guayanilla	Jobos
Stathmonotus stahli-Eelgrass Blenny		X
Gobiidae		
Bathygobius curacao-Notchtongue Goby		X
Bathygobius mystacium-Island Frillfin		X
Bathygobius soporator-Frillfin Goby	X	X
Coryphopterus glaucofraenum-Bridley Goby	X	X
Erotelus smaragdus-Emerald Sleeper	X	X
Ginsburgellus novemlineatus-Ninelined Goby		X
Gobionellus boleosoma-Darter Goby	X	X
Gobionellus saepepallens-Dash Goby	X	
Gobiosoma dilepis-Orangeside Goby		X
Quisquilius hipoliti-Rusty Goby		X
Acanthuridae		
Acanthurus bahianus-Ocean Surgeon	X	X
Acanthurus chirurgus-Doctorfish	X	X
Acanthurus coeruleus-Blue Tang	X	X
Trichiuridae		
Trichiurus leptutus-Cutlassfish	X	X
Scombridae		
Scomberomous cavalla-King Mackerel		X
Scomberomorus maculatus-Spanish Mackerel		X
Scomberomorus regalis-Cero	X	X
Nomeidae		
Nomeus gronovii-Man-O'-War-Fish		X
Stromateidae		
Hyperoglyphe sp.-Driftfish		X
Peprillus paru-Harvestfish	X	X
Bothidae		
Bothus lunatus-Peacock Flounder		X
Syacium micrurum-Channel Flounder	X	X
Soleidae		
Achirus lineatus-Lined Sole		X
Gymnachirus nudus-Naked Sole		X
Balistidae		
**Balistes vetula*-Queen Triggerfish		X
Monacanthus ciliatus-Fringed Filefish		X
Stephanolepis setifer-Pygmy Filefish		X
Ostraciontidae		
**Acanthostracion* sp.-Cowfish		X
Lactophrys trigonus-Chapin	X	X
Tetraodontidae		
Canthogaster rostrata-Sharpnosed Puffer		X
Sphaeroides spengleri-Bandtailed Puffer		X
Sphaeroides testudineus-Checkered Puffer	X	X

*Sight identification; not captured.
**Reported from stomachs of other fishes only; none captured or seen.

Table 3. Numbers of Species by Subareas.

Jobos	No.	Guayanilla	No.
Reef and Cay	148	Reef	53
Inner Bay	26	Inner Bay	53
Central Bay	70	Thermal Cove	28
Ship Channel	85		

Table 4. Shannon-Weaver Species diverisyt values (bits/individual).

Jobos	H'	Guayanilla	H'
Reef and Cay	5.309	Reef	4.788
Inner Bay	3.852	Inner Bay	4.863
Central Bay	5.122	Thermal Cove	3.661
Ship Channel	4.813		

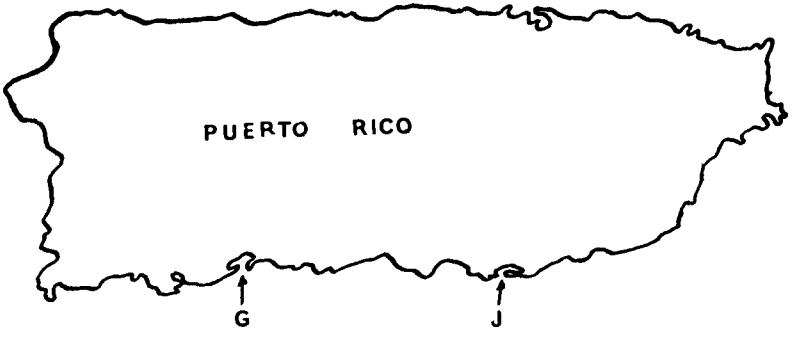

Figure 1. Puerto Rico showing the locations of Jobos Bay (J) and Guayanilla Bay (G).

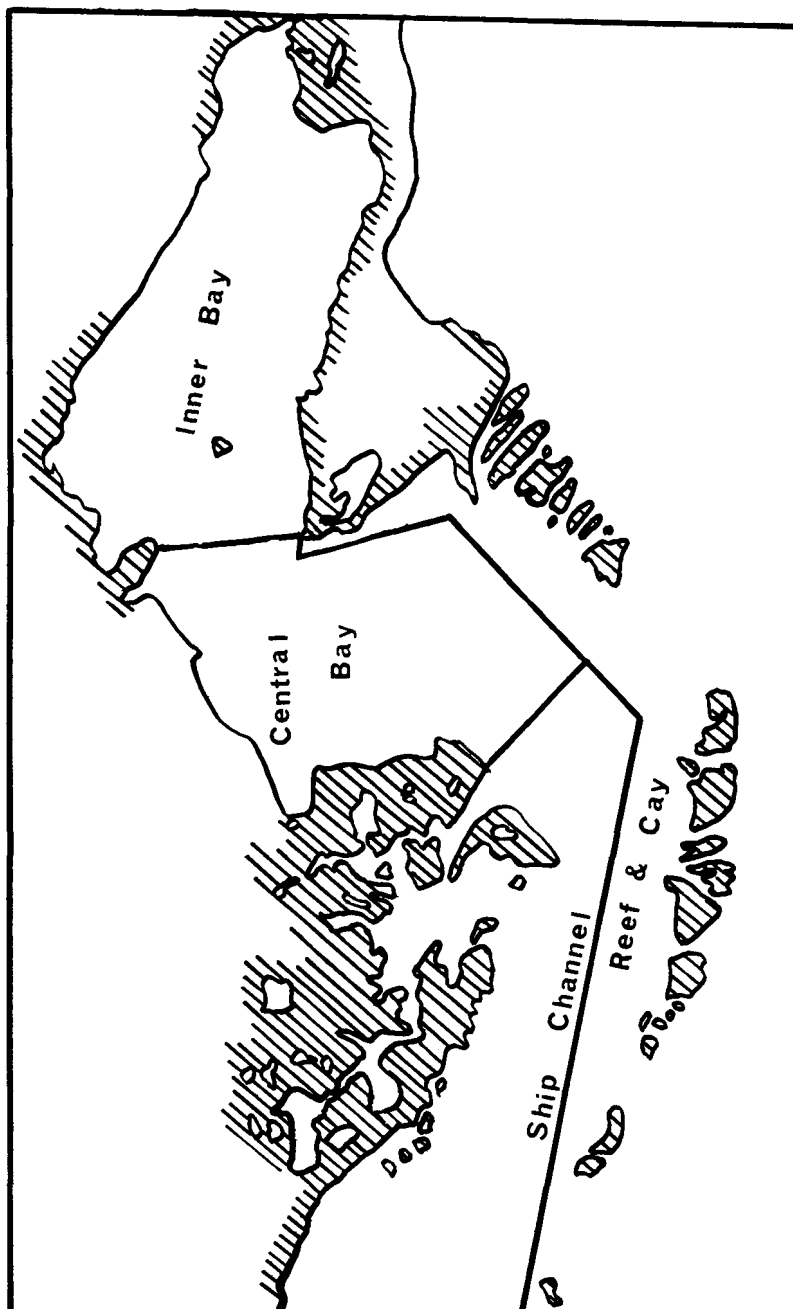

Figure 2. Jobos Bay Puerto Rico showing the major divisions of the bay discussed in the text. Mangrove areas are represented by cross hatching.

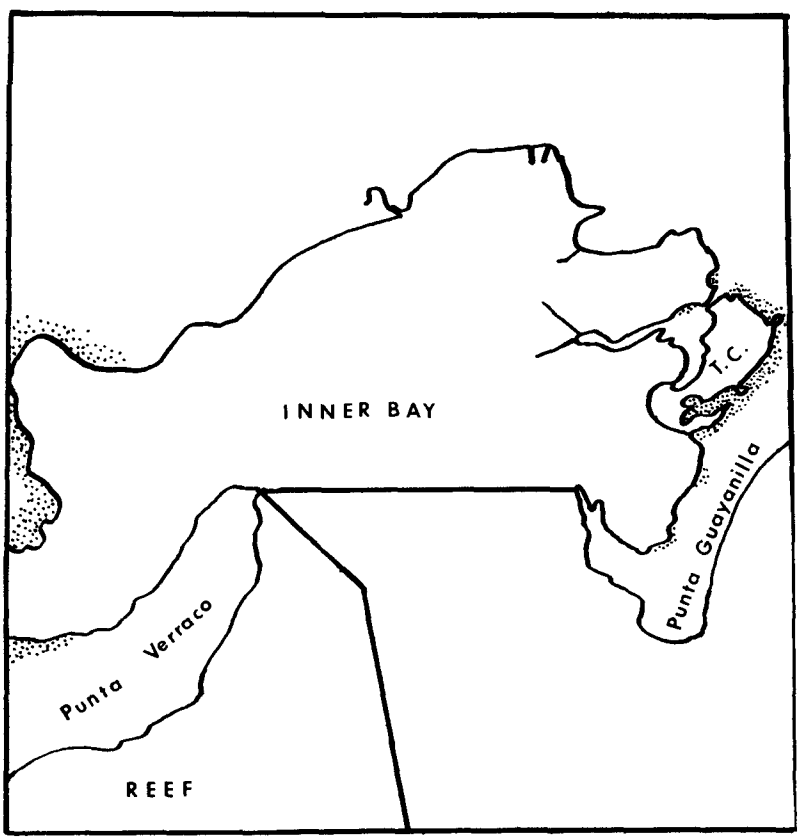

Figure 3. Guayanilla Bay, Puerto Rico showing the major divisions of the bay discussed in the text. Mangrove areas are shown as stippled areas.

Table 5. Similarity indices calculated according to Sorenson, 1948.

	Jobos Inner Bay	Jobos Central Bay	Jobos Ship Channel	Jobos Reef & Cay	Guayanilla Inner Bay	Guayanilla Thermal cove
Guayanilla Reef	.317	.267	.454	.406	.321	.247
Guayanilla Thermal	.526	.257	.362	.113	.444	
Guayanilla Inner Bay	.390	.428	.440	.446		
Jobos Reef and Cay	.227	.489	.455			
Jobos Ship Channel	.389	.247				
Jobos Central Bay	.376					