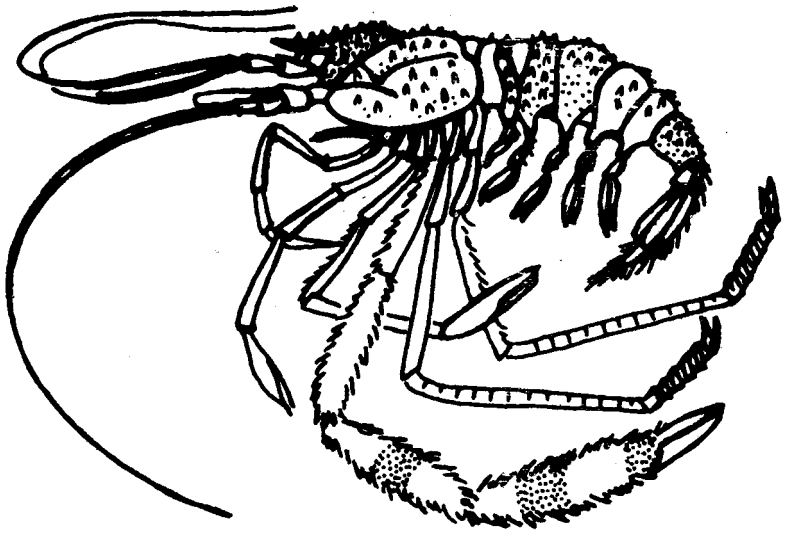
Ray Waldner

ASSOCIATION OF ISLAND MARINE LABORATORIES

OF

THE CARIBBEAN

Eighth Meeting



University of the West Indies

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INTRODUCTION

Board of Directors (newly elected).

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The eighth meeting of the Association of Island Marine Laboratories of the Caribbean was held August 31 to September 4, 1969 at the University of the West Indies, Kingston, Jamaica. Dr. T. F. Goreau, as president, and Dr. Ivan Goodbody, as convener, organized the meeting with much appreciated assistance of Miss Eileen Graham.

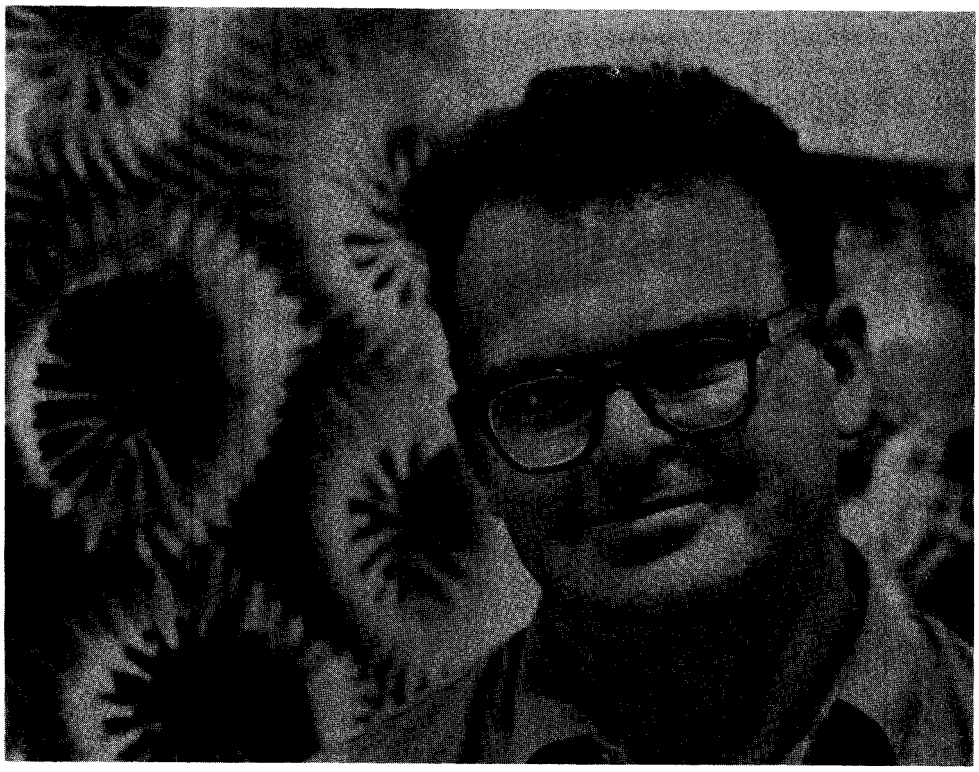
The board of directors' meeting was held Sunday evening, August 31. Welcoming addresses by Prof. O. R. Marshall, Vice Chancellor of the University of the West Indies, and Dr. T. F. Goreau, President of AIMLC, opened the meetings Monday morning, September 1. The period, Monday to Wednesday, was largely devoted to the presentation of 22 papers, the abstracts of which are published herein.

An adjunct to the meeting was a lively general discussion on the problems related to a proposed Central American sea-level canal led by Dr. Ivan Goodbody, member of the National Academy of Sciences advisory committee on the sea-level canal. Later, at the general meeting of the Association, it was proposed that an Extraordinary Meeting of the Association be held in Panama to further discuss the sea-level canal and make evident the concern of the Association members.

Wednesday evening, September 3, a joint meeting of the Association and the Jamaican Association of Scientists was held. Dr. Donald F. Squires, State University of New York, was guest speaker.

Memorable diversions were a hydrofoil tour of Kingston Harbor, a visit to the Marine Laboratory at Port Royal, and an informative tour of the archaeological excavations at Port Royal. The last day of the meetings was devoted to an all day excursion to the Discovery Bay Marine Laboratory.

DEDICATION



Thomas F. Goreau - 1924-1970

This volume of the Proceedings of the Association of Island Marine Laboratories of the Caribbean is dedicated to Dr. Thomas Goreau who was a charter member of the Association and served as President from 1966 to 1969.

The following memorial was written by Miss Eileen Graham and Dr. Judy Lang, associates of Dr. Goreau at the Discovery Bay Marine Laboratory in Jamaica, in consultation with Mrs. Nora Goreau.

Thomas F. Goreau: In memoriam

It was once said of Tom Goreau that he "knew more about living corals than any other man has ever known." This reputation was founded on his studies of coral calcification, where he proved that the skeletogenesis of reef corals is related to the photosynthetic activity of their symbiotic algae, and on his ecological investigations of Jamaican reefs. He will also be remembered for his astonishing perception which led to exciting discoveries such as the Sclerospongiae, cryptic coralline sponges which have affinities with the important but poorly understood fossil stromatoporoids and chaetetid tabulates, and Fungiacava eilatensis, a mytilid bivalve having a unique symbiotic association with some fungid corals and their zooxanthellae.

While most of his research was carried out in Jamaica (whose reefs he considered "probably among the world's best"), Goreau also worked at Bikini, Eniwetok, Guam and Saipan in the Central Pacific; on the Australian Barrier Reef; in the Southern Red Sea; in the Sinai and at Eilat, Israel; in the Bahamas, Tobago, Barbados and Puerto Rico in the West Indies.

When we first knew him, on the Mona Campus of the University of the West Indies, a field trip was usually a strenuous, eighteen-hour week-end luxury, involving many hours of driving with a boat in tow and carrying all diving gear. It was obvious that some kind of base on the north coast, whose reefs he found particularly interesting, would save much time and energy, and in 1965 the Kaiser Bauxite Company provided the site and buildings which for five years became a "temporary" marine laboratory at Discovery Bay.

Goreau's growing scientific reputation and capacity for making friends attracted many visiting scientists and students who came to the laboratory to work on the nearby modern and fossil reefs. In 1967 Goreau became Professor of Marine Sciences at the Mona Campus of the University of the West Indies and Professor of Biology at the State University of New York, Stony Brook; both these institutions and the Wolfson Foundation of Great Britain provided funds for the construction of a new, much larger laboratory at Discovery Bay which was officially opened a few weeks before his death.

Those who knew Tom Goreau remember his zestful discussion of all topics connected even remotely with reefs when he shared freely his wide range of knowledge and ideas. His own overwhelming energy and dedication, whether driving the Landrover or photographing corals at 200 feet, drew extra effort from the group who worked with him, and his warmth and delight in new discoveries made that effort worthwhile.

In May 1970, in a letter to Nora Goreau, Heinz Lowenstam expressed our feelings when he wrote: "I always admired Tom for his pioneering spirit, his native curiosity and keen sense of observation, and their translation into basic studies resulting in most thought provoking data and interpretation. His death is a real loss to the small community of true scholars."

Eileen Graham
Judy Lang

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NEW CLASSES OF REEF-BUILDING PORIFERA IN THE TROPICAL ATLANTIC AND INDO-PACIFIC OCEANS

Ten new species of hermatypic sponges have recently been found in the tropical Atlantic, Indian and Pacific Oceans. These differ so fundamentally from existing classes in the phylum, and from each other in their tissue and skeletal organization that they appear to require the erection of at least three major new taxa having the status of classes. Of these only one, the Sclerospongiae, has recently been characterized and named by Hartman and Goreau, the other two are still undescribed.

The one common morphological feature of these taxa is a massive calcareous skeleton, by virtue of which some of the species play a significant role in the process of reef-building. The skeletal characteristics of each of the groups have close resemblances to a number of supposedly extinct orders. Thus the aragonitic Sclerospongiae appear most closely related to some of the Stromatoporoidea, and perhaps to Palaeozoic incertae sedis such as Stromatactis and Pulchrilamina. A second class, still unnamed, possesses a skeleton of magnesium calcite so similar in its organization to the extinct chaetetid schizocorals (Order Tabulata) that it can only be considered a living representative of one group of tabulate "corals." The third major new group of sponges possesses an internally chambered skeleton similar in all essential morphological characteristics to the genus Barroisia in the order Sphinctozoa, an extinct group that has been provisionally put into the poriferan class Calcarea. However, since the Calcarea are all calcitic and the new form is aragonitic, it is likely that the latter belongs to an independent major taxon.

This sponge assemblage is widespread throughout the tropical oceans and is closely associated with coral reefs. Seven species of sclerosponges have been found in Jamaica alone and three more in the Marianas. Others are found throughout the central Pacific and Indian Oceans. Without exception, these forms are found in shallow water caves, crevices, sub-reef tunnels and other shaded localities where they are often so abundant that they dominate the fauna.

It is of considerable interest that the communities of hermatypic sponges are invariably associated with a number of other geologically ancient taxa that have many more fossil than living representatives. Chief among these are the thecidioid brachiopods and, in the Indo-Pacific, pharetronid sponges (Porifera, Calcarea) of the genera Murrayona and Plectroninia. Their occurrence together with living representatives of three supposedly extinct groups of reef builders now shown to be Porifera points to the great antiquity of the entire fauna.

This work is being supported by the Office of Naval Research (T.F.G.) and the National Science Foundation (W.D.H.).

T. F. GOREAU
Discovery Bay Marine Laboratory
Discovery Bay, Jamaica

W. D. HARTMAN
Peabody Museum
Yale University
New Haven, Connecticut

Proc AIMLC 8: 8 March 1973

KINGSTON HARBOUR, JAMAICA - A PROBLEM IN CONSERVATION AND DEVELOPMENT

Kingston Harbour is a natural lagoon of about 20 sq. miles in area with a narrow entrance at its south-western corner. It is divided into three major areas, an inner harbour with a depth of 60 feet at its deepest point and an outer harbour with a depth of 40 feet. These two are separated by a shallow sill through which runs a narrow channel of maximum depth 36 feet. The third area, Hunts Bay in the north-west, has a depth of 10 feet and has recently been isolated by a causeway and narrow bridge. The mean tidal range is 0.77 feet and hence water exchange in the harbour is slow although partly assisted by a wind driven circulation. Salinity measurements suggest tha high density water may accumulate in the bottom of the inner harbour and renewal of water in this basin may be slow.

Levels of primary production in the harbour are high and in the inner harbour amount to as much as forty times that found in the adjacent open oceans. As well as phytoplankton, Thalassia and mangrove contribute substantially to overall productivity. Zooplankton populations are correspondingly high and parts of the harbour serve as nursery grounds for fish and shrimp.

Until recently the system appears to have been stable and balanced but in the past fifteen years the rapid development of Kingston City has begun to have significant effects on the harbour regime. Industrial and domestic effluents contribute about 12 million gallons of primary treated sewage per day with a B.O.D. load of 600,000 lbs. Physical development is also seriously affecting the natural balance of the ecosystem and already two-thirds of the original mangrove areas have been destroyed while the remainder is threatened. The building of a causeway across the entrance to Hunt's Bay will alter the pattern of water exchange in the harbour but at the same time may enhance the area as a nursery ground for shrimp and fish. A long term plan to span the entrance to the harbour with a causeway needs to be examined carefully in the light of its effects on both the hydrological and biological regimes in the harbour.

IVAN GOODBODY
Department of Zoology
University of the West Indies
Mona, St. Andrew
Kingston 7, Jamaica

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A STUDY OF BENTHIC COMMUNITIES IN KINGSTON HARBOUR, JAMAICA

As knowledge of level-bottom communities grows world-wide, it is becoming increasingly clear that the most diverse communities are to be found in the tropics while the least diverse occur in polar regions and in other areas of severe environmental conditions. However, there have been relatively few studies conducted in truly tropical situations with the result that little is known about the composition and structure of benthic communities in these areas. The present study, therefore, aims at filling this gap in our knowledge through an investigation of the communities in Kingston Harbour.

Kingston Harbour is a bar-built lagoon situated on the south coast of Jamaica at latitude 17° 58' N and longitude 76° 48' W. It covers an area of about 20 square miles and has a maximum depth of 11 fathoms. Two rivers empty into a shallow basin at the northwestern arm of the harbour and reduces the salinity there during the rainy seasons to as low as 5‰. Otherwise, the salinity is greater than 25‰ in this basin and about 35‰ in the rest of the harbour. The mean tidal range is only 0.77 ft. and currents are weak, being all less than 1 knot. Sediments range from clays and silts in the deep basins to sands and gravel on the shallow flats.

Four distinct benthic communities are found in the sediments where clay and silt predominate, while a fifth occurs in the sandy sediments. These are:

(1) A Spiochaetopterus community confined to the extreme eastern end of the harbour and parts of the northern shore wherever anaerobic conditions exist. This consists of very few species with the dominant comprising more than 95% of the numbers. McNulty (1961) has shown that Spiochaetopterus is a precise indicator of high pollution in Biscayne Bay, Florida, and the same seems to be true in Kingston Harbour.

(2) A Chaetopterus community, occuring over the inner basin of the harbour at depths of 20 to 60 ft. The dominant species accounts for 47% of the numbers and over 90% of the biomass.

(3) An Armandia-Alpheus community of the low salinity basin. This is of extremely low density (10 individuals per m^2 in certain places) and is dominated by 3 species which together comprise 52% of the numbers. The animals in this community are not truly estuarine and probably die off during the rainy seasons.

(4) A Lumbrineris-Diplodonta community of the deep outer basin. This is a highly diverse community comprising more than 100 species. Dominance is greatly reduced and the 2 characterizing species together comprise only 21.3% of the numbers. Polychaetes, bivalves and shrimps predominate, but most other burrowing forms are represented.

(5) A Branchiostoma community of the shallow sand flats. This is a highly variable community as a result of the wide range of sediment grades with which it is associated. Of all the communities, this is the only one in which suspension feeders predominate.

The diversity of Kingston Harbour communities may be illustrated by Sander's (1968) rarefaction curve which is especially suitable because of the low densities of animals. When curves are drawn for all the communities, they show that the diversity increases steeply from inside to outside the harbour along pollution and salinity gradients. The low diversity communities are similar to some in higher latitudes where stress conditions exist; but the high diversity community is similar only to others in certain tropical regions where the most favourable conditions exist.

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BARRY A. WADE
Department of Zoology
University of the West Indies
Mona, St. Andrew
Kingston 7, Jamaica

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BEHAVIOURAL STUDIES ON THE SPINY LOBSTER PANULIRUS ARGUS

Data is presented indicating that the spiny lobster (Panulirus argus) is a social animal in that it forms a hierarchy within the group that shares a sheltering cave. The hierarchy appears to be linear, sex-independent and its order based primarily upon size. Dominance is not absolute since occasional aggression is directed by individuals against those higher in the hierarchy than themselves.

This hierarchy, possibly together with the "individual distance" phenomenon, allows for, or leads to, a reasonably ordered distribution of "roosting" sites within a cave in which selection of apparently preferred sites occurs in the order of dominance. Whilst the sites are defended against intra-specific intrusion, they do not appear to bestow upon their possessors that "divine right" so typical of territorialism from which a distinction is therefore emphasized.

Possibly of greatest interest is the occurrence of a "periodic shift" phenomenon within the hierarchy. Either before or immediately after each moult, the individual concerned loses its position in the hierarchy (and its roosting site) and falls to the bottom of the social ladder from where it gradually - over the succeeding two or more days - climbs again to its original position.

J. STRANGWAYS-DIXON
Zoology Department
University of the West Indies
Mona, St. Andrew
Kingston 7, Jamaica

Proc AIMLC 8: 11 March 1973

NOVEL CHARACTERS IN CORAL TAXONOMY

Aggressive interactions have been found to be invoked by some corals in competition for space on West Indian reefs. They can also be provoked experimentally by putting corals in close contact. Characteristic of different species is the intensity of their aggressiveness towards other corals, which has been used to differentiate species in several genera of the family Mussidae. Dominance relationships are not altered by starvation or overfeeding, nor by removing a coral's zooxanthellae. Underwater transplantation experiments have shown that when aggressive corals which are found on the lower fore-reef slope are brought into very shallow water and left without shade, they lose their zooxanthellae, extrude their filaments and die within a few days. During this time they can be killed by other corals from the upper fore-reef slope which normally are less aggressive.

With the exception of the genus Mycetophyllia, corals studied in Curacao exhibited identical behaviour towards other corals as do the Jamaican populations. Other genera of mussid corals found in the Pacific and presently under investigation show greater aggressivity than any West Indian species.

The response of mussids and other corals to transplantation from a uniform depth into shallow water is a species characteristic which corresponds to their natural distributions with respect to depth and position.

When closely related taxa do not respond to each other, and behave similarly when they are made to interact with other corals, aggressive criteria cannot solve problems of systematics. For the separation of such taxa an immunological approach is being developed.

JUDY LANG
Discovery Bay Marine Laboratory
Discovery Bay, Jamaica

Proc AIMLC 8:12 March 1973

ZOOXANTHELLAE - A PROBLEM IN TAXONOMY

Endosymbiotic brown unicellular algae, vernacularly termed zooxanthellae have been known for some time to belong to the group of algae called the Dinophyceae. The observation that these algae possessed a motile gymnodinioid phase in their life cycle established that they were related to the free-living "Gymnodinium type" dinoflagellates. The studies of Freudenthal established taxonomically one type of zooxanthellae, that from Cassiopeia frondosa as Symbiodinium microadriaticum.

Differences in behaviour of isolated zooxanthellae in axenic culture and ultrastructure have in the past been used as tools to investigate possible differences between zooxanthellae from different hosts. I have drawn on the dogma of molecular biology, i.e. the "one cystron one polypeptide chain" concept, and the techniques of protein biochemistry to study the incorporation of ^{14}C- and ^{3}H-leucine into protein by zooxanthellae from Anthopleura elegantissima Brandt (Coelenterata: Actiniaria) and Palythoa sp. (Coelenterata: Zoanthidea), and I conclude, tentatively, that zooxanthellae from the two animals appear to be at least physiologically distinct strains.

ROBERT K. TRENCH
Department of Agricultural Science
Oxford University
Parks Road
Oxford, England

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BIOLOGICAL STUDIES IN A JAMAICAN COASTAL LAGOON

The Great Salt Pond, a mangrove lagoon, on the south coast of Jamaica is environmentally unstable; mainly with reference to salinity. This instability is related to rainfall and the presence of a sandbar across the mouth of the pond. The period of study included an occasion when the pond became hypersaline (75‰), this condition resulting in death of most of the fauna. When salinities decreased as a result of heavy rains and subsequent breaching of the sandbar, repopulation of the pond occurred. Capitella capitata was the only member of the benthic infauna to have remained throughout the period of study. Macoma constricta and Nereis sp. have returned but not to their original abundance. Penaeus duorarium and Callinectes danae are again the dominant epibenthic forms and the mangrove host epifauna has been re-established. Tilapia mossambica was the only commercially important fish to escape the hypersaline period and Eugerres plumieri, Tarpon atlanticus and Mugil brasiliensis have since become abundant. The environmental instability has resulted in low faunal diversity and a few species are very abundant.

PETER REESON
Zoology Department
University of the West Indies
Kingston 7, Jamaica

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GAS EXCHANGE DURING ALGAL PHOTOSYNTHESIS

One of the longstanding doubts confronting students of photosynthesis has concerned the validity of the assumption, still widely adopted, that dark respiration continues without alteration during exposure of chlorophyllous tissues to light. Brown and Weis (1959) were the first to show that this is not necessarily the case when, using mass spectrometry, they demonstrated a depression of CO_2 production in the light by the green alga Ankistrodesmus. Probably because other published data by the same authors indicated little or no effect of light on respiration, the findings noted tend to have been ignored.

With a less complicated mass spectrometer technique, Hoch, Owens and Kok (1963), working with the green alga Scenedesmus and the blue green Anacystis, showed clearly that light can exert two effects on O_2 consumption. A depression in O_2 consumption was noted at low intensities with a marked increase as the intensity was raised to levels adequate to saturate photosynthesis. Hoch et al. (1963) suggested that the increased O_2 consumption, assumed not to be associated with release of CO_2, may have been a mechanism for ATP production. Generally similar data were obtained with mass spectrometry by Ozbun, Volk and Jackson (1964) working with bean leaves. Bunt, Owens and Hoch (1966) extended the data of Hoch et al. (1963) to a marine diatom.

Over the period during which the above data had been collected, other reports appeared indicating that, in the light, many higher plants replace respiration with photorespiration. Photorespiration occurs at an appreciably more rapid rate than dark respiration and is said to be favored by low CO_2 concentrations, high light intensities and elevated partial pressures of O_2. A depression of net photosynthesis with increasing level of O_2 was first noted by Warburg (1920). Criteria for photorespiration include a post-illumination burst of CO_2 and a finite CO_2 concentration at the CO_2 compensation point, both of which increase with O_2 concentration (e.g. Forrester, Krotkov and Nelson, 1966).

Evidence for a photorespiration on one hand and, on the other, for increased O_2 consumption in the light without an associated release of CO_2 is in obvious conflict. This study was undertaken in an attempt to reconcile these differences, using for convenience the two fresh water algae Chlorella pyrenoidosa and Scenedesmus sp.

The mass spectrometer technique used was essentially identical with that of Hoch et al. (1963). Particular attention was paid to measuring gas exchange rates at known and varied concentrations of dissolved O_2 and CO_2 approaching the CO_2 compensation point.

In both algae, the CO_2 compensation point increased with O_2 concentration and, at compensation, measurable O_2 exchange continued. There was a general tendency for rate of O_2 consumption to increase with rates of O_2 production. In Scenedesmus but not in Chlorella, O_2 exchange was greater at the CO_2 compensation point at high than at low O_2 concentrations.

In chloroplasts it is known that Hill activity ceases in absence of CO_2. A similar interpretation is suggested to explain

the data from the current experiments with whole cells which indicate also some form of competition between O_2 and CO_2 so that the CO_2 requirement for Hill activity increased with O_2 concentration. Under these circumstances, and without any form of O_2 consumption, CO_2 would be expected to decline through photosynthesis to a compensation point in no way dependent upon photorespiration. With normal respiration continuing in the light at any proportion of the dark rate, CO_2 fixation should decline until its rate was controlled by the supply of CO_2 regulating Hill activity, thus shifting CO_2 compensation points upwards by a constant increment. Were photorespiration operating, one would expect the upward shift in the compensation point to be more and more pronounced the higher the O_2 concentration. These suggestions would accommodate the simultaneous existence of respiration, photorespiration, and increased O_2 consumption not linked with CO_2 release.

These possibilities are now under test with marine algae, screening first for glycolate oxidase and for an O_2 effect on net photosynthesis in terms of O_2 exchange and carbon fixation before seeking more detailed information with the mass spectrometer.

J. S. BUNT
Institute of Marine Sciences
1 Rickenbacker Causeway
Miami, Florida

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CURRENTS OF THE CARIBBEAN AND ADJACENT REGIONS AS DEDUCED FROM DRIFT BOTTLE RECOVERIES

Since 1967, scientists from the Tropical Atlantic Biological Laboratory in Miami have been releasing drift bottles in the Caribbean Sea and adjacent tropical Atlantic. Charts are presented that delineate all release/recovery data through 1968. An analysis of drift bottle tracks supplemented by horizontal sections of thermocline depth and dynamic height, reveals variations in the current regime which are not evident in atlases of average conditions: (1) A divergence was found adjacent to the Grenadine Banks northeast of Grenada. (2) A predominantly north current was evident along the island chain north of St. Vincent. (3) A "backward" S current pattern was located in the Gulf of Honduras. (4) A westward current was found along the central coast of Panama in association with an anticyclonic gyre.

JOHN T. BRUCKS
Bureau of Commercial Fisheries
Tropical Atlantic Laboratory
Miami, Florida 33149

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THE DEVELOPMENT OF COMMERCIAL FISHERIES STATISTICAL SYSTEMS IN THE CARIBBEAN

A commercial fisheries statistical project was commenced for Puerto Rico in July 1967 by the Institute of Marine and Atmospheric Sciences, University of Miami. This first attempt at establishing an island-wide collecting and reporting system for the marine products of the island has been successful. After 2 years of direction and supervision by the Institute of Marine and Atmospheric Sciences the project is now operated solely by the Puerto Rican Department of Agriculture.

We believe the problems encountered and the principles developed for this project could be useful in other areas because the Puerto Rican inshore fisheries and the marketing structure have many parallels in other Caribbean countries. The philosophy of statistical programs is explained in this paper. Statistical procedures used in Puerto Rico are discussed and some initial production in terms of value and quantities of fish is given.

The statistics currently being obtained in Puerto Rico have considerable economic importance. They may be of value to the Government in making policy, or the industry in planning expansion. Potential investors also require such data.

In contrast to economic statistics biological statistics are of a more precise and detailed nature than are used in the conservation of fisheries. A practical example of the use of biological statistics in the management of the shrimp fishery in El Salvadore is cited and the principles involved in its application are explained.

CHARLES W. CAILLOUET, JR.
and
JAMES B. HIGMAN
Institute of Marine Sciences
1 Rickenbacker Causeway
Miami, Florida 33149

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BIOLOGY OF THE WEST INDIAN CHITONS ACANTHOPLEURA GRANULATA GMELIN AND CHITON TUBERCULATUS LINNE: DENSITY FEEDING, REPRODUCTION AND GROWTH

Acanthopleura granulata and Chiton tuberculatus are the most abundant chiton species on wave-swept, rubble shores of coral reefs in Southwestern Puerto Rico. Acanthopleura and Chiton reach maximum densities of 17 and 62 individuals per M^2, respectively. Dry weight biomass ranged from 59.1 to 72.2 gm/M^2 for Acanthopleura and from 40.8 to 63.4 gm/M^2 for Chiton. A marked reduction in the overall density of animals on one reef occurred between 1962 and 1968, probably a result of destruction of suitable habitat by hurricanes.

Feeding occurs mainly at night; however, Acanthopleura also feeds during the day. The diet consists of blue-green, green and red algae, which appear to be ingested indiscriminately. Ingestion of inorganic materials is considerable, often amounting to 40% of the total material consumed. Acanthopleura ingests its own weight (on a dry weight basis) about every 34 days; Chiton in 18 days. The assimilation efficiency in both species is relatively low, of the order of 20-25%. Defecation of inorganic materials, equal to the respective biomass of each population, occurs in 55 days in Acanthopleura and in 38 days in Chiton.

Reproduction is seasonal in both species, and spawning is largely confined to the late summer and autumn when sea water temperatures are high. At this time of year the standing crop of planktonic diatoms is often at a maximum. Acanthopleura demonstrates a marked bimonthly spawning periodicity, in phase with the new and full moon. Frequency of spawning indicates that some individuals spawn at least twice during the breeding season. Chiton seems to spawn irregularly over the breeding season. Major recruitment in both species occurs from about September through November.

Growth of the chitons is relatively rapid. Both species can reach a size of around 34 mm in 12-14 months, when sexual maturity is attained. The bulk of the chiton populations seems to be made up of one and two year old individuals.

Similar studies are being continued on the Atlantic seaboard of Panama, where fringing reefs support high population densities of Acanthopleura and Acanthochitona hemphilii Pilsbry. Further measurements will be made on feeding rates, mortality, and respiratory activities.

PETER W. GLYNN
Smithsonian Tropical Research Institute
P.O. Box 2072
Balboa, Canal Zone

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SOME ASPECTS OF THE PHYSIOLOGY OF SPONGES: BACTERIAL UPTAKE AND PATTERNS OF PUMPING ACTIVITY

Bacterial uptake was studied in the marine demosponge Haliclona permollis at Puget Sound, Washington, U.S.A. Exhalent and ambient water samples were collected from sponge held in running seawater aquaria. The samples and controls were compared for numbers of bacteria present by three methods: a) settling on glass slides, b) plating and culturing on nutrient agar, c) membrane filtration followed by staining and direct counting under oil immersion. The mean efficiency of bacteria removal by H. permollis was, respectively, a) 53% from 15 samples, b) 65.4% from 13 samples, c) 76% from 4 samples. Close inspection of the data indicates normal bacterial removal efficiency at 83% over a bacterial concentration range of 2.7×10^5 to 2.2×10^7 cells/ml. This data furthermore indicates that bacterial uptake is sufficient to meet the requirements of H. permollis.

Constant levels of pumping activity by sponges can no longer be assumed as normal behavior. Data from in situ monitoring of pumping activity of two Jamaican sponges show great variation of activity. Verongia fistularis (sp. ?), found in 90 to 160 feet of water, exhibits 1 to 2 hour periods of cessation of water pumping. These periods are irregularly distributed in time and are not correlated with recognized environmental events. Mycale sp.? exhibits diurnal patterns of daytime high and nighttime low levels of water pumping. Varying levels of activity may be assumed to be a normal phenomenon of most demosponges and must be taken into account in attempting to quantify material exchanges between sponges and their environments.

HENRY M. REISWIG
Biology Department
Yale University
New Haven, Connecticut 06520

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THE PRESENT STATUS OF KNOWLEDGE OF GNATHOSTOMULIDA (SCOLECIDA)

Gnathostomulida, microscopic marine worms, represent the most recently discovered class of the animal kingdom. First described in 1956 by P. Ax, this group now comprises over 80 species and 18 genera. On the basis of the present material, a total species number of over 1,000 can be predicted. Morphologically the most interesting features are the monociliated skin epithelium (which is unique in Scolecida, and very rare in adults of other taxa), and the pharyngeal apparatus. In striking contrast to the otherwise rather simple internal anatomy, the pharynx is highly specialized and - with its jaws and basal plate - represents one of the most important taxonomic characters. Other features of higher systematic value are the sensory organs, the female bursa system, the testes and the sperm structure. In a first systematic classification Sterrer (in press) proposed two orders, according to the absence (Filospermoidea) or presence (Bursovaginoidea) of a female bursa-vagina system and paired sensory organs. The Filospermoidea comprise two, the Bursovaginoidea six families. The closest relationship of the class seems to be with the Turbellarian order Catenulida, and affinities with the enigmatic fossil Conodontophorida are probable. Distribution of Gnathostomulida is world-wide, whereas their occurrence is confined to sand rich in organic detritus, ranging from the upper tidal to 130 meters depth. The aspect of the typical biotope (in which they reach high population densities) as well as their deep vertical distribution in an H_2S-rich substratum suggest anaerobic metabolism. Initial data on development (spiral cleavage), feeding (grazing of surface film on sand grains), behavior (gregariousness) and biology (encystment) are already available.

WOLFGANG STERRER
Bermuda Biological Station
St. George's West, Bermuda

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MORPHOLOGICAL ASPECTS OF THE SKIN FROM TOXIC CARIBBEAN PUFFERFISHES (TETRAODONTIFORMES)

Four species of Caribbean pufferfishes, Sphaeroides spengleri (Tetraodontidae), S. testudineus, S. greeleyi and Canthigaster rostrata (Canthigasteridae) are reported as producing highly toxic secretions from their skin. The gross morphology and micro-anatomy of the skin from three of these, Sphaeroides spengleri, S. testudineus, and Canthigaster rostrata, are discussed from the standpoint of elucidating probable structures associated with the concentration or elaboration of the toxins. This study forms part of a comparative biotoxicological investigation being conducted on several species of the order Tetraodontiformes (Plectognathi).

A conspicuous feature of the gross integumentary anatomy of these pufferfishes is the presence of small spines or bristles which are especially numerous on the ventrum. Being modified scale plates, they arise from the dermis, and with development, are seen to extend into the epidermis although rarely breaking through that layer. When these fishes are in the deflated condition the spines are rooted deep into the collagenous dermal fibers with their tips oriented posteriorly. From its dermal base the longitudinal axis of the spine curves gently upward toward the epidermis so that its distal third lies parallel to the surface epithelium. From gross inspection, the spine can be seen to lie in a pocket or groove formed by the invagination of dermis and epidermis. The entire distal third of the spine is surrounded by dermal and epidermal tissue which increases in thickness at the spine apex. With inflation of the underlying air sac, pressure is exerted upon the subcutaneous tissue and the dermis. This compression results in the spine being extended to a position approximately perpendicular to the surface epithelium and the associated surrounding tissue mass is forced into an exposed position.

The epidermal micro-anatomy of non-spinous regions of the three species reveals a structural stratification of supportive, undifferentiated basal cells interspaced by numerous mucous cells especially near the surface. The mucous cells generally are somewhat ovoid when mature and have an average maximum diameter of 15-17 microns.

The epidermis in the region of the spines is decidedly different than elsewhere. Typically, it invaginates around the spine shaft forming a pocket or depression and is seen to be only 40-50 percent as developed as the non-spinous epidermal regions. Few epidermal basal cells are found here and the mucous cells are large, having an average size of 30 x 25 microns in Sphaeroides testudineus, 25 x 20 microns in S. spengleri and 15 x 10 microns in Canthigaster rostrata. As the epidermis continues around the distal region of the spine it increases in thickness, due to the formation of a layer of glandular cells. These specialized secretory cells are most numerous near the apex of the spine, where they form an extensive multicellular complex.

In Sphaeroides testudineus, dermal septa invade the main glandular cell mass producing several villi formations of cell groups which open into narrow channels within the cell complex. The entire secretory cell complex is most extensive in this species and measures 600-650 microns in diameter. The individual gland cells are generally columnar to polyhedral in shape and show a range in size from 50 x 27 microns to 22 x 12 microns.

In Sphaeroides spengleri, the entire secretory cell complex has a maximum diameter of 130 microns. Although there is a lack of complex villi and channel formation, the ventral glandular surface does present some secondary infolding. The individual cells of the glandular complex present a size range of 25 x 17 microns to 17 x 10 microns. The thin epidermal region which lines the depression around the spine in this species is considerably infolded and shows a high proliferation of mucous cells in contrast to the other species studied.

In Canthigaster rostrata, a basic tissue pattern similar to Sphaeroides spengleri is seen with regard to the spine and associated glandular complex. A striking exception however, is that situated at the apex of the glandular mass are 8-10 very These large cells are in direct contact with the smaller (20 x 10 microns to 10 x 7 microns) underlying cells forming the bulk of the glandular complex.

The glandular cell complex associated with the spine apparatus appears to be acidophilic while the mucous cells are generally basophilic in all species studied. Preliminary histochemical studies on the secretory products of the various gland cell types have revealed that the mucins in Sphaeroides spengleri are acid mucopolysaccharide in nature while the exact chemical nature of secretory products from other cell types has not yet been confirmed. The specialized glandular cells associated with the spines of these species are, nevertheless thought to represent the probable site of toxin secretion.

The defensive mechanism of inflation most likely contributes to the effectiveness of the toxin against potential predators, by not only exposing the gland cell complex to the immediate environment but also by causing the compression of that tissue, thereby facilitating the secretion of the toxin.

WILLIAM H. EGER
and
JOHN G. STARKUS
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

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PERIODIC SEA LEVEL FLUCTUATIONS AT LA PARGUERA, PUERTO RICO

Four major modes of periodic fluctuation of sea level observed at La Parguera, Puerto Rico, are those associated with wind waves and swell, seiching, astronomical tides, and seasonal variations of the characteristics of the Caribbean surface water.

Due to the sheltering effects of the shelf and fringing reefs, wind waves and swell seldom exceed 50 cm. in height.

Oscillations with periods of approximately 50 minutes are frequently observed on the tide records, sometimes with heights up to 10 cm.. Comparison with the calculated fundamental period of free oscillation of the shelf suggests that these oscillations are shelf seiches. Harmonics of the fundamental oscillation have been observed, and at times appear to become the dominant mode of oscillation for certain coastal bays.

The astronomical tides are diurnal with a maximum range seldom greater than 45 cm.. The ratio of the principal diurnal harmonic constituents to their semidiurnal counterparts is 8.5, making these tides more purely diurnal than elsewhere in the Caribbean Sea. As always in the case of diurnal tides, high ranges (tropic tides) occur semimonthly with a mean period of 13.7 days, and annual maximum ranges are associated with the solstices and minimum ranges with the equinoxes.

The seasonal variation of sea level has a mean annual range of 15 cm., generally reaching a maximum in late summer or fall and a minimum in late winter or spring. Although, these variations are primarily due to seasonal changes of the density of the surface water, they are also affected by changes in the wind stress on the surface of the Caribbean Sea.

GRAHAM S. GIESE
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

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MANGROVE ROOT FAUNAS IN TRINIDAD SWAMPS

In Trinidad, as in most other Caribbean islands, the Red Mangrove, Rhizophora mangle, is the pioneer species in coastal swamps. The prop roots or 'rhizophores' which support the plants on soft, unconsolidated sediments are of great importance in the ecology of mangrove swamps as they provide the only firm substrate for the attachment of sessile benthic animals. Rhizophore faunas were studied in the Caroni Swamp which consists of about 30 sq. kms. of mangrove swamp forest built on the estuaries of a number of rivers which flow into the Gulf of Paria on the west coast of Trinidad. The principal estuary, that of the Blue River, is 5.3 kms long, averages 30 to 40 m wide and 6 m deep and experiences an annual salinity range of from 5 to 30 ‰.

Three faunal zones were found on the rhizophores, each with a characteristic species whose distribution was related to the salinity, the amount of exposure and the degree of interspecific competition. The lowest region was dominated by Eudistoma olivaceum and keratose sponges in association with Symplegma viride, Perophora bermudensis, Branchioma nigromaculata, Eudendrium carneum, Tubularia solitaria and Obelia bicuspidata. Because a vertical salinity stratification was present in the estuary with fresh water flowing seawards at the surface and sea water moving landwards deeper down, the lower part of the rhizophores was bathed in higher salinity water which permitted the development of this typically marine fauna. With the general reduction in salinity which occurred in the wet season these animals were greatly reduced in numbers. Furthermore, only the upper portion of the Eudistoma zone was ever exposed to the air during the spring tides, but for no more than six hours twice a day for four to five days. The major part of this zone was continuously submerged, and it was found experimentally that the animals rarely survived exposure for longer than 24 hours.

The mid tidal zone was dominated by the typically estuarine species Crassostrea rhizophorae in association with Balanus eburneus, B. amphitrite, Aiptasia tagetes and Modiolus americanus, all euryhaline species with wide salinity tolerance. Crassostrea and its associates are limited in their downward extension by competition with the faster growing tunicates, sponges and hydroids.

An abrupt change in the faunal distribution occurs at the level of Highest high water of neap tides. From MHHW to EHWS the rhizophores are covered by Chthamalus fragilis, which is the only species found at this level. The presence of Chthamalus was related to its tolerance of dessication while exposed to the atmosphere, for this level remains uncovered by the tides for periods of 10 or more days twice a month during neap tides. Under experimental conditions Crassostrea could not survive for more than three days out of water and B. eburneus showed 50% mortality after five days with a few individuals surviving exposure for as long as eight days. These two species could not survive above the MHHW level. Chthamalus, however, appeared unaffected by exposure for up to 23 days.

PETER BACON
Department of Biological Sciences
University of the West Indies
St. Augustine, Trinidad

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COMPARATIVE GROWTH RATES OF SOME TROPICAL, INTERTIDAL GASTROPODS IN BARBADOS AND JAMAICA

The growth rates of six species of intertidal marine molluscs were observed in Barbados and Jamaica over a three year period. Growth of individual animals was observed by means of attached numbered plastic tags. Growth of three species of the genus Nerita was slower in Jamaica than in Barbados while other species showed no marked differences. There was considerable variation in growth rates observed between different sites in Barbados. It was concluded that local microclimate differences were equally as important as latitudinal climatic differences in determining comparative growth rates.

JOHN B. LEWIS
Redpath Museum
Mc Gill University
P.O. Box 6070
Montreal 101, P.Q. Canada

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THE EFFECT OF DIET ON GROWTH OF THE SEA URCHIN, Tripneustes ventricosus.

Growth of the tropical sea urchin, Tripneustes ventricosus, was measured at ambient sea temperatures (27-29° C) in the laboratory for six months. Animals feeding on the phaeophyte, Sargassum sp., increased in live weight from 51 to 167 g and, of this, the gonads represented 11.6 g. In contrast, animals feeding on the tracheophyte, Thalassia testudinum, grew from 40 to 77 g and their gonads increased only 0.3 g. The slower test and gonadal growth of animals feeding on Thalassia may be attributed to a lower feeding rate (about 2/3 that on Sargassum) and to a lower food absorption efficiency (15-20%, as compared with 35-40% for animals feeding on Sargassum).

GEORGE LILLY
Bellairs Research Institute
of Mc Gill University
St. James, Barbados

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COOPERATION BETWEEN SCIENTIFIC INSTITUTIONS AND THE UNDP/FAO CARIBBEAN FISHERIES DEVELOPMENT PROJECT

"The purpose of the Project is to provide through exploratory fishing, market study and demonstration and training, a basis for the future growth of the fisheries of the Caribbean region, by indicating the most promising ways in which the productivity of the fisheries can be increased, by setting up a nucleus of trained fishermen and fishery officers, by indicating the most economic ways of developing domestic and export markets and by defining those fields in which future capital investment can most fruitfully be applied" (excerpt from Project Plan of Operations).

The Caribbean Fisheries Development Project became operational on 27th August, 1965. The first two vessels Alcyon and Calamar arrived to the project in the end of 1966 while a third vessel Fregata arrived in the middle of 1967. To July 1969, 80 cruises have been conducted, for a total of 1406 operational seadays and 1737 completed stations.

The area covered by the project extends from the edge of the Central American continental shelf in the west eastward along the islands of the Greater Antilles in the north. The Lesser Antilles and the Guianas to the border of Brasil in the east and the Netherlands Antilles in the southern Caribbean.

Exploratory and Experimental fishing effort was distributed over the following approaches.

Demersal: Trawl 20 cruises; Bottom longline + Snapper reels + fish pots 22 cruises; Shark bottom set line + modified bottom longline 5 cruises.

Pelagic: Tuna longline 9 cruises; Live bait + pole and line fishing 19 cruises.

Mixed: 5 cruises which had a mixed effort.

Cooperation with Scientific Institutions up to July 1969 consisted of:

1. Collecting specimens for a number of institutions. This material has included plankton samples, fish specimens for taxonomic and physiological and other research.

2. Providing space for observers from institutions aboard project vessels to obtain data for personal research.

3. Making observations requested by institutions examples of these are bird, mammal and reptiles occurance, when possible tagging has been carried out.

4. Conducting services for institutions such as releasing drift bottles, making BT casts, taking water samples and making other observations.

5. Scientists from outside the Project acting as cruise leaders on the vessels.

The present objective is to continue and escalate this cooperation for the next two years this project will be operational.

Up to July 1969 the Project has been in cooperative contact with over 25 institutions.

KAREL KLEIJN
UNDP/FAO Fisheries Development Project
Bridgetown, Barbados

Proc AIMLC 8: 25 March 1973

THE DISTRIBUTION OF STONY CORALS IN THE GULF OF CARIACO, AN AREA OF EXTREME ENVIRONMENTAL CONDITIONS

The Gulf of Cariaco was selected as an object of ecologic research because of its practical importance (productivity) and scientific significance (unique water conditions). The results were obtained with skin-diving method. About 80 different sites were surveyed and sampled. An interesting complication is a body of cold, oxygenpoor and turbid water, that fills the entire depth of the Gulf below 20-30 m. Slight upwelling causes a steep temperature gradient in coastal water. Extreme upwelling in the center of the Gulf causes a restriction of coral growth there. The horizontal coral distribution is therefore divided into two main parts. Another area of restriction is the eastern end of the Gulf, where shallow, muddy flats with little water exchange are located. Those water conditions also cause a strict vertical zonation of corals and the occurrance of back-reef and deep-water species. Although, the lowest line of coral distribution nowhere exceeds a depth of 15 m in the Gulf of Cariaco.

DR. ARNFRIED ANTONIUS
Division of Echinoderms
U.S. National Museum
Washington, D. C. 20560

Proc AIMLC 8: 26 March 1973

ESTRUCTURA MORFOLOGICA E HISTOQUIMICA DE LA MEMBRANA BASAL EN LOS POLICLADIDOS DE LA REPUBLICA DOMINICANA

En la actualidad la membrana basal está siendo objeto de estudios comparados tanto en los vertebrados como en los invertebrados. En el presente trabajo se analiza la estructura de esta membrana en varios géneros de policladidos del Mar Caribe, de la costa de la República Dominicana. Estos animales son muy adecuados para tal estudio en razón de que poseen una membrana muy desarrollada. El estudio comprende los elementos que la constituyen, la distribución en el cuerpo del animal, el grosor en relación con el epitelio, así como el método de fijación con respecto a las células epiteliales en cortes transversales, longitudinales y tangenciales. Además de los estudios morfológicos, se hace un análisis histoquímico con métodos adaptados a los policladidos.

IDELISA BONNELLY DE CALVENTI
Instituto de Biología Marina
Universidad Autónoma de Santo Domingo
República Dominicana

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THE POLYCHAETE FAUNA OF MANGROVE SWAMPS IN THE DOMINICAN REPUBLIC

In mangrove areas, very interesting relationships, mainly ecological can be found.

In one such area, the brackish waters of the Cumayasa River on the southwest coast of the Dominican Republic, a study was made of polychaete worms. Twelve samples were taken and observations were made during most of one year.

Two species, Eupomatus manglicola and Mercierellopsis riojai n. sp. belonging to Family Serpulidae, were predominant. Eupomatus manglicola is distinguished by a distal circlet of ten spines. Each spine is geniculated and has a spine-like protuberance at its dorsal middle region. Mercierellopsis riojai n. sp. is easily separated from the only other known species by the following characteristics: a thoracic uncini almost triangular in shape, provided with 4 or 5 teeth and a large basal tooth; an operculum with calcified plate; and abdominal setae gently sigmoid and with fine dentition on the outer margin.

Some specimens of Nereis pelagica lunulata also were found but not in significant numbers.

As is well known, mangrove roots are used for implantation by other animals such as Crassiostrea rhizophorae, Isognomon alatus, Cirripedia, Porifera, Pyura (Tunicata), Bryozoa and Hydrozoa. After such colonization, Porcellanidae, some free-living Nematoda and some Polychaeta Errantia arrive. The distribution of the animals suggests a type of zonation such as is observed on rocky shores. In the upper zone is found genus Littorina, but I think this is a premature explanation.

Our observations using artificial collectors showed that polychaete worms in an early stage had a settling advantage over other animals. We think this preliminary observation can be used in any future program in which exploitation of Crassostrea rhizophorae is involved. It will be necessary to eliminate such competitors by periodic cleaning of the artificial collectors and to provide by law protection of the research area.

FIDEL JELDES
Instituto de Biología Marina
Universidad Autónoma de Santo Domingo
Santo Domingo, República Dominicana

Proc AIMLC 8: 27 March 1973

ASSOCIATION OF ISLAND MARINE LABORATORIES OF THE CARIBBEAN

Extraordinary Meeting

Canal Zone - October 12-15, 1970

An extraordinary meeting of the Association was held October 12-15, 1970, at the Smithsonian Tropical Research Institute, Canal Zone, to consider the role which AIMLC might play in dealing with ecological consequences of the proposed sea-level canal, as well as to familiarize participating members with the Pacific and Atlantic littoral fauna and flora.

A highly organized and pertinent program was planned by STRI. Registered participants numbered 38, and 5 AIMLC member institutions were represented. Fifteen scientific papers were presented at the meeting, the titles of which follow. Two resolutions were passed, one pertaining to concern over the proposed sea-level canal, the other with pumping salt water into Gatun Lake. Copies of these two resolutions were distributed to appropriate agencies and/or released to the news media.

Opportunity was unstintingly provided by STRI for participants of the meeting to familiarize themselves with research endeavors at STRI, at Laboratorio de Biologia Marina en la Universidad de Panama, and at Barro Colorado Island. Trips to Miraflores Locks and the STRI laboratories at Naos and Galeta Islands accentuated the purpose of the meeting.

Resolution I

The Association of Island Marine Laboratories of the Caribbean, which includes thirteen laboratories located in the Bahamas, Barbados, Bermuda, Colombia, Curacao, Jamaica, Panama Canal Zone, Puerto Rico, Republica Dominicana, and Venezuela (see attached list) wishes to express its concern about the possible ecological consequences that the construction of a new sea-level canal across the American Isthmus may bring upon the Caribbean Sea and upon the tropical Atlantic and Pacific Oceans. The Association asserts that the final decision regarding the details of construction of the new sea-level canal should not be made unless and until sufficient information is made available to insure that adequate measures will be taken to guard against potential undesirable environmental alteration and against the risk that the transmigration of organisms from one ocean to the other may bring deleterious effects upon the existing natural marine communities.

A special meeting of the Association of Island Marine Laboratories of the Caribbean was held in Panama City, Republic of Panama, on October 12th - 15th, 1970 to discuss the ecological problems of the new canal with representatives from the Universidad de Panama and the University of Miami participating. The Association wishes to be consulted in ecological planning for the canal and stands ready to assist in the planning, development, coordination and execution of pertinent studies and endeavours.

The professional resources, facilities and locations of the member laboratories in the Caribbean, together with other concerned institutions and programs, present a unique capacity for determining the present biological and physical environmental characteristics of the adjacent seas. This knowledge will be essential to insure the effectiveness of measures to limit the unpredictability of the environmental alterations.

Resolution II

At a meeting in Panama City, Republic of Panama on October 12-15, 1970, the Association of Island Marine Laboratories of the Caribbean (members listed below) learned of the proposed plan by the Panama Canal Company to add sea water to Gatun Lake to increase water volume during the dry season. The Association views such a step with great concern, for the addition of salt water to Gatun Lake could destroy the effectiveness of the lake as a biological barrier to the interchange of Marine Organisms between the Caribbean Sea and the Gulf of Panama. The addition of salt water from either ocean into Gatun Lake should be considered as a complex ecological rather than a simple hydrological problem. The Association urges the Canal Company to seek a solution to the problem of maintaining the water level of Gatun Lake during the dry season that will not break down or destroy the existing barrier to marine organisms, Gatun Lake.

ASSOCIATION OF ISLAND MARINE LABORATORIES OF THE CARIBBEAN
EXTRAORDINARY MEETING SMITHSONIAN TROPICAL RESEARCH INSTITUTE, CANAL ZONE

TITLES OF PAPERS PRESENTED

C. Birkeland (Smithsonian Tropical Research Institute). Patterns of change in temperate and tropical tunicate communities.

Eric S. Todd (STRI). Terrestriality in Gobionellus sagitulla.

R. W. Rubinoff (STRI). Geographic and reproductive isolation in Atlantic and Pacific populations of Panamanian Bathygobius.

W. Hazen (STRI). Population ecology of a west coast fiddler crab.

A. Reimer (STRI). Role of glycine in the nutrition of zooanthids.

Máximo Cerame-Vivas (Univ. of Puerto Rico). The effect of oil spills on tropical marine communities.

Peter Glynn and Carmen Glynn (STRI). Isopods and color polymorphism: the role of visual predators.

J. Young Redemske (STRI). Ecological studies on coral reef algae of Atlantic Panama.

I. Rubinoff (STRI). Antipredator adaptations of the Eastern Pacific sea-snake Pelamis platurus.

C. Arellano (University of Panama). Biomasa zooplanktonica del Golfo de Panama.

D. West (University of Puerto Rico). Character variation in two closely related species of the genus Eucinostomus (Gerredae) from the West Indies.

J. Graham (STRI). Aspects of temperature sensitivity in some tropical marine inshore fishes.

L. Howell Rivero (University of Panama). Trabajo que desarrolla el Laboratorio de Biología marina en la Universidad de Panama.

J. Ogden (STRI). Some aspects of the behavior of the striped parrotfish (Scarus croicensis) - a coral reef herbivore.

A. Antonius (Universidad de Oriente). Upwelling effects on coral communities in Eastern Venezuela.