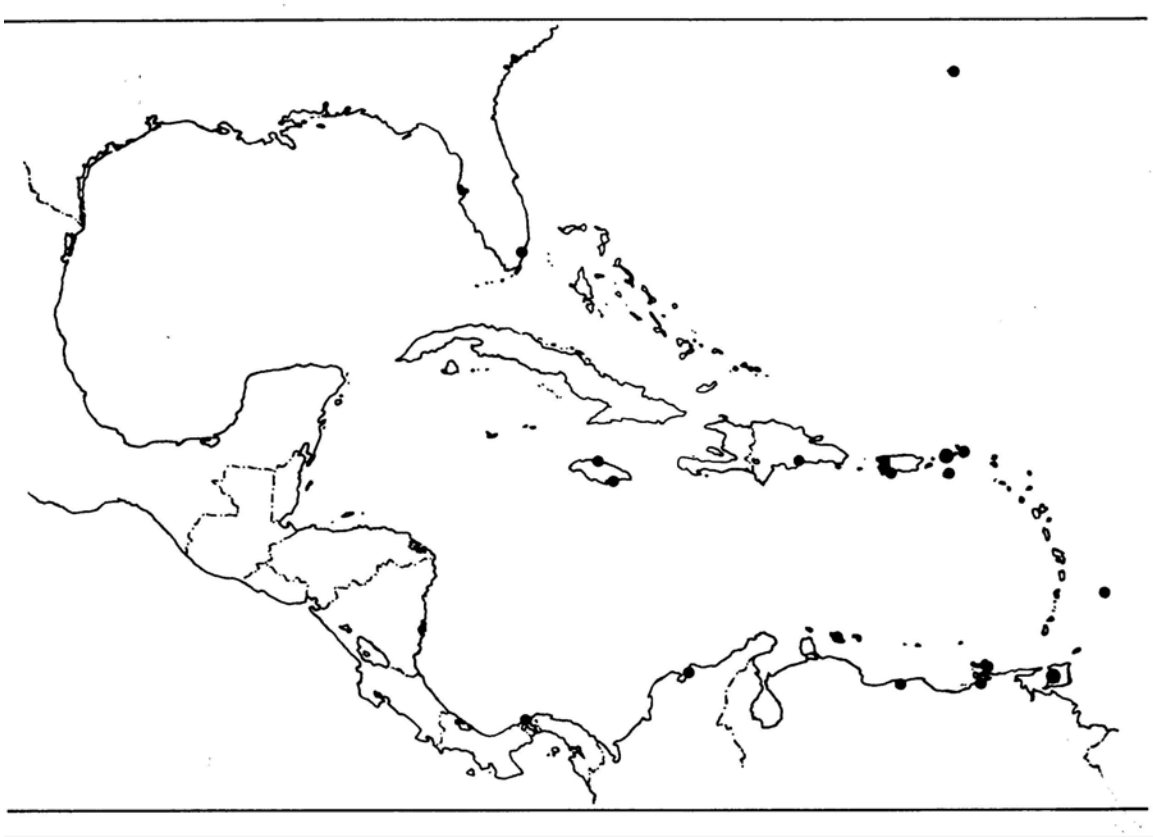
ASSOCIATION OF ISLAND MARINE LABORATORIES OF THE CARIBBEAN

NINETEENTH MEETING



WEST INDIES LABORATORY
FAIRLEIGH DICKINSON UNIVERSITY

St. Croix, U.S. Virgin Islands May 20-23, 1986

Ernest H. Williams, Jr. and Lucy Bunkley Williams – Editors

Session E – Late Submissions[6]

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[1]Sessions were only lettered, not named. Arrangement or interrelationships of the papers in each session was not explained.
[2]Paper was presented, but no abstract was submitted
[3]Paper title was not listed (to be announced) in the meeting program
[4]Paper was not presented, and no abstract was submitted
[5]Eric Jordan presented a summary of the proposed program and goals, but no abstract was submitted
[6]Paper was not listed in the meeting program
[7]Presented by Bert Williams for Juan Gonzalez

INTRODUCTION

Unlike most of our meetings held in hotels, the nineteenth scientific meeting of the Association of Island Marine Laboratories of the Caribbean was hosted by West Indies Laboratory of Fairleigh Dickson University, St. Croix, U.S. Virgin Islands, at the actual marine facilities from 20 to 23 May 1986. Most of our laboratories lack the dormitory, dining, and meeting facilities to accommodate our members in the functioning marine laboratory. We all appreciated the experience. The participants were greeted at West Indies Laboratory (WIL) with a Crucian cocktail party in the WIL dinning hall on the evening of 20 May. The next morning the scientific sessions were opened by President John Ogden, closely assisted by the person who supervised all the arrangements for the meeting, Betsy Gladfelter. A total of 31 papers were presented in four sessions over a three-day period. In the evening of the first day, a PBS film "Cities of Coral" was shown in the WIL auditorium. Following the morning scientific session the next day, field trips were conducted in the afternoon to enjoy diving, snorkeling, beaches, and other attractions of St. Croix. That evening the Executive Board Meeting was held with the following officers:

John Ogden – President
Meredith Jones – 1st Vice President
Bert Williams – Secretary-Treasurer
Charlene Long – 2nd Member-at-Large
Jim Parrish – 3rd Member-at-Large
Arturo Acero – Colombia
Jorge Corredor – Puerto Rico (DMS)
Joe Kimmel – Puerto Rico (FRL)
Meter Lutz – Florida (RSMAS)
Rick Phleger – Jamaica (PRML)
Eugene Ramcharan – Trinidad
Carlos Ramos – Puerto Rico (CEER)
Jeff Sybesma – Curaçao
Teresa Turner – St. Thomas
Jeremy Woodley – Jamaica (DBML)
Sheila Wyers – Bermuda
Phil Taylor (observer)

Charlene Long reported on the progress of the History Committee. Doon Ramsaroop sent a letter read to the Board as the Communications Committee report. He had to resign as Newsletter Editor, but continues with the Logo Committee, and asked for more submissions for the Logo Contest. John Ogden deferred the UNESCO Committee report until the General Meeting. Jose Lopez filled no report for the Modem Committee.

New lab applications for membership included Mote Marine Laboratory, USA by the Director, Kumar Mahadevan; Centro de Investigaciones de Estudios Avanzados del IPN Unidad Merida, Mexico by Jorge Corredor; Centre Universitaire Antilles-Guyane, Guadeloupe by John Ogden; Caribbean Marine Research Center, Bahamas; and the Bahamian Field Station, College Center of the Finger Lakes, Bahamas. The discussions were more acrimonious than usual with our two top officers opposing different laboratory admissions and, more unfortunately, each other. The Secretary-Treasure had to quickly obtain additional information on two labs and sooth a few ruffled feathers before each lab was approved. Only a compromise to tentatively accept the last lab, with formal reconsideration during the next meeting, resolved the problems. Once the labs were approved, their representatives were invited to join the Executive Board meeting. The status of one

of our older member laboratories has changed slightly, but Jeff Sybesma explained that they wish to continue their membership. The Board had no objections.

Future meeting sites were scrambled a bit by Bellairs Research Institute reneging on their planned meeting for the second time. However, they quickly reformed into a four-year schedule:

Instituto de Investigaciones Marinas de Punta de Betin	Colombia	11-14 August 1987
Mote Marine Laboratory	Sarasota, Florida, USA	24-27 May 1988
Department of Marine Sciences	Mayagüez, Puerto Rico	15-18 May 1989
Smithsonian Tropical Research Institute	Panama	1990

Bert requested that a local representative of each lab be appointed by each Director to conduct AIMLC business. The Board agreed. Bert requested that the Board fund the reprinting of the early Proceedings. Very few copies of most of the Proceedings remain. Oddly, the Board was not very receptive to the request.

Tom Goreau addressed the Board concerning the National Academy of Science "Scientific Plan for Caribbean Marine Research in Support of Marine Resource Development." He suggested that the present plan would not benefit the Caribbean and that it excludes the involvement of Caribbean laboratories and Caribbean scientists. Tom wanted the AIMLC to protest. The Board thought friendly persuasion should be attempted first. President Ogden asked Tom to draft a statement and submit it to the Board. He asked Bert to make the necessary revision, return it to him, and he would send it to all our laboratory directors for approval. The final version would be sent to the National Academy of Science. The Executive Board approved the following statement:

ASSOCIATION OF ISLAND MARINE LABORATORIES OF THE CARIBBEAN COMMENTS ON THE U.S. NATIONAL ACADEMY OF SCIENCE "SCIENTIFIC PLAN FOR CARIBBEAN MARINE RESEARCH IN SUPPORT OF MARINE RESOURCE DEVELOPMENT"

The Association of Island Marine Laboratories of the Caribbean notes with enthusiasm the initiation of the National Academy of Science "Scientific Plan for Caribbean Marine Research in Support of Marine Resource Development," a program intended to "capture the essence of Caribbean needs and interests." It is the view of the Association that any proposed plan place highest priority upon:

[1] active participation of Caribbean marine laboratories and scientists in the formation and execution of the plan,
[2] enhancement of Caribbean marine research facilities and instrumentation in order to ensure the retention of significant numbers of already trained Caribbean marine scientists and development of sustained marine resource development programs,
[3] inclusion of the following previously identified primary research needs:
[a] a focus on shallow water and shelf ecosystems in which the overwhelming bulk of

currently and potentially harvestable resources occur,
[b] conservation of existing stocks,
[c] development of intensive mariculture production in small areas as an economic alternative to the present devasting overharvesting of the entire area,
[d] understanding the sources of nutrients that support new production, especially from terrestrial sources,
[e] elucidation of mechanisms involved in continuing and unexplained catastrophic mortalities of corals, echinoids, and other critical components of the fauna and flora.

The Association of Island Marine Laboratories of the Caribbean (AIMLC), representing 25 laboratories and 300 individual members, has for 30 years been the consistent representative of professional Caribbean marine scientists and a significant forum for the area-wide dissemination of research results (a listing of the member laboratories is attached). The AIMLC stands ready to offer our collective experience with Caribbean marine resources and intimate knowledge of local environments towards the development of a comprehensive and effective Caribbean Marine Science Plan.

Association of Island Marine Laboratories of the Caribbean Laboratory Members

Bahamian Field Station, College Center of the Finger Lakes, Bahamas
Bellairs Research Institute, Barbados
Bermuda Biological Station, Bermuda
Caribbean Marine Biological Institute, Curaçao, Netherlands Antilles
Caribbean Marine Research Center, Bahamas
Centre Universitaire Antilles-Guyane, Guadeloupe
Center for Energy and Environmental Research, Puerto Rico
Centro de Investigaciones de Biologia Marina, Dominican Republic
Centro de Investigaciones de Estudios Avanzados del IPN Unidad Merida, Mexico
College Center of the Finger Lakes Bahamian Field Station, Virgin Gorda
Department of Marine Sciences, University of Puerto Rico, Puerto Rico
Discovery Bay Marine Laboratory, Jamaica
Division of Science and Math, University of the Virgin Islands, St. Thomas, USVI
Estacion de Investigaciones Marinas de Margarita, Venezuela
Fisheries Resaerch Laboratory, CODREMAR, Puerto Rico
Fundacion Cientifica Los Roques, Venezuela
Institute of Marine Affairs, Trinidad
Instituto Oceanografico, Universidad del Oesta???, Venezuela
Instituto de Investigaciones Marinas de Punta de Betin, Colombia
Mote Marine Laboratory, USA
Natural Resources laboratory, Cayman Islands
Port Royal Marine Laboratory, Jamaica
Rosentiel School of marine and Atmospheric Sciences, USA
Smithsonian tropical Research Institute, Panama

West Indies Laboratory, St. Croix, USVI

Ernest H. Williams, Jr., Executive Director, and the Executive Board of the AIMLC

The morning of the 23rd of May began with the last scientific papers session and concluded with the closing of the meeting by Betsy Gladfelter and the General Business Meeting by President John Ogden. A total of 52 members were present. Bert explained that the Executive Board has chosen a functional approach for the selection of all officer candidates. The President is the host for our next meeting. The Second Vice president is the host for the 1988 meeting. The First Vice president is now in charge of new Institutional Member Laboratory applications. The Secretary-Treasurer has the normal responsibilities of any organization. The list of Members-at-Large candidates below have been selected for the following reasons:

Arturo Acero – Local Representative of AIMLC in Colombia
Helping to organize and prepare the 1987 meeting
Mel Carriker – Active in Caribbean policy and science
Eric Jordan – Exploring the possibility of his laboratory in Mexico joining the AIMLC
Harris Lessios – Local Representative of the AIMLC in Panama
Helping to organize and prepare the 1990 meeting
Prudencio Martinez – Encouraging more physical science participation in AIMLC
Alida Ortiz – Starting a new marine Lab in eastern Puerto Rico
Interested in AIMLC Institutional Membership in the future
Pablo Penchaszadeh – Seeking AIMLC Membership for his lab in Venezuela

The following officers were nominated and elected:

PRESIDENT: Hernando Sanchez
1ST VICE PRESIDENT: Meredith Jones
2ND VICE PRESIDENT: Kumar Mahadevan
SECRETARY-TREASURER: Bert Williams
1ST MEMBER-AT-LARGE: Arturo Acero
2ND MEMBER-AT-LARGE: Eric Jordan
3RD MEMBER-AT-LARGE: Harris lessios

The committee reports and new meeting sites decided by the Executive Board were announced. The President appointed the following committees (Chairperson listed first):

HISTORY – Charlene Long, Bert Williams
COMMUNICATION – Lucy Williams, Jeremy Woodley, Ray Hayes, Bert Williams
UNESCO – John Ogden, Gerardo Gonzalez
BYLAWS – Meredith Jones, Bert Williams, Charlene Long
MODEM – Jose Lopez, Doon Ramsaroop, Bert Williams
LISTS FOR MEETING PARTICIPANTS – Charlene Long

New business included a request by Ray Hayes to appoint Bert as Executive Director and Lucy Williams as Secretary-Treasurer to complete and send the statement to the Natioanal Academy of Sciences. Arturo Acero asked Bert to act for the new President in sending the statement. Edgardo Ortiz objected to the sending of the Statement; however, it was approved. Jeremy Woodley asked about the student travel funds. Bert explained the process. President Ogden closed the meeting. Meredith Jones and Jim Parrish expressed the appreciation of the Association to John Ogden, Betsy Gladfelter, and the faculty and staff of West Indies laboratory for hosting the meeting.

In the afternoon the field trips were continued. That evening the meeting banquet was held at the St. Croix Yacht Club.

Ordinarily I would end by thanking our President for hosting the meeting. But this year our President is almost as much of a visitor as the rest of us. The Association would like to thank Betsy Gladfelter and the rest of the WIL staff for the excellent preparation, organization, and conduct of our 19th AIMLC Meeting.

Normally we thank University, government or business leaders and organizations for entertainment, education, or cultural activities provided for our participants; however, WIL chose a more in-house and businesslike approach. The essence from our meeting seems to portray a serious, commercial professional laboratory that deserves our appreciation and respect.

Ernest H. Williams, Jr., Executive Director

CLOSING REMARKS – Elizabeth H. Gladfelter

Thanks to participants for traveling to WIL for the meeting. Our laboratory enjoyed the opportunity to host you and hope that you enjoyed your visit. Special thanks to the speakers. I enjoyed listening to all the papers, both to learn new information and to have the chance to share enthusiasm about the natural world. We may not be wealthy in a monetary sense, but all share an invaluable resource, a curiosity about the natural world.

Thanks are also due to the WIL staff that cheerfully joined forces and cooperated in many ways to make this meeting a success. I want to acknowledge the entire maintenance staff and the kitchen staff for keeping things running smoothly. I especially wish to acknowledge two people, whom most of you have interacted with during the past few days, and who have provided extensive help in organizing this meeting with me for the past couple of months: Dorothy Rowe and Joan Runge. Together they carried the bulk of the pre-meeting organization as well as helping extensively during the course of the meeting. I would also like to thank my faculty colleagues, Bill Gladfelter, Dennis Hubbard, and Susan Williams for moderating sessions and for suggesting and leading your field trips. Doug Kesling, our dive supervisor, has done all the logistical organization for the SCUBA trips and has relieved me entirely of any worry on that aspect. Helmut Gieben, our lab supervisor, deserves special recognition for his efforts over the past year in maintaining and improving our research facilities and for all his help

during the last few days. Finally, I want to thank our "gradual,"whoops, I mean graduate students, Eric Telemaque, John Bythell, Gudrun Gaudian and Dan Cook, who not only completed their assigned jobs with cheerful cooperation, but also could be counted on to perform numerous errands at last minute notice.

The last topic I wish to mention are two thoughts that occurred to me after a few conversations with individuals and small groups during the quite period yesterday afternoon. First, this meeting has given me the opportunity to recharge batteries, as it were, by sharing enthusiasm and information about our marine systems. Second, I feel we share a common concern about our environment, not merely the natural environment about which we heard in the talks, but also the social and political environment in which we at marine laboratories find ourselves today. Some of you from government laboratories are finding a heavy emphasis on applied research with short-term goals even to the extent of being told you must be a money-making venture. Those of us at privately funded institutions also face the problem of justifying our existence in terms of the Almighty Dollar, while the many other benefits that we bring to society are not taken into consideration. I guess the final point I would like to make is in agreement with the one made by Bill Gladfelter in the opening address [no copy provided], we share an interest in the Caribbean, a wonderful area with a rich diversity of history, culture and natural systems. These AIMLC meetings are a fine opportunity to share again and perhaps rekindle these interests. When one returns again to our isolated situations and becomes overburdened with day-to-day details of our "normal" lives, it is often easy to become frustrated and wonder about the worth of ones efforts. Try to remember that there are a number of other people who share your interests and values about the Caribbean marine environment and your efforts are appreciated by us all. I hope to meet you again at a future meeting and share new ideas. Best of luck to you, both as individuals and institutions. Thank you.

RECENT OBSERVATIONS OF SPAWNING PHENOMENA IN BERMUDA: DOES SYNCHRONOUS MULTI-SPECIES SPAWNING OCCUR IN WESTERN ATLANTIC COMMUNITIES?

Sheila C. Wyers, Bermuda Biological Station for Research, Ferry Reach 1-15, Bermuda

The periodic occurrence of pigmented eggs and larvae in extensive aggregations on the water surface, or in dense concentrations in the water column over the reef, presents a striking spectacle off Bermuda. This paper collates reports of these events over a five year period, and presents evidence that the spawning of scleractinian corals contribute to the phenomenon. From 1981 to 1985, masses of spawn were detected on one or several days every year. Observed events occurred between mid-July and mid-September, 6-15 days after the full moon. These observations were casual. Sea state and currents can affect the concentration and visibility of spawn. Spawning activity was not detected during simultansous day time field observations of reef benthos. Morphologically, field samples were typical of spawned coelenterate eggs and planulae in the earliest stages of development. Some specimens were reared to the primary polyp scleractinian stage. However, other coelenterate groups could also have been represented. The sizes (200-1000 μm) and colors (beige, pink, red, brown) of freshly collected eggs and planulae suggest a number of species occurred in the spawn. The spawning periodicity of the scleractinian coral *Montastrea annularis* in outdoor aquaria was found to approximate observed field events in 1985. Colonies released pink eggs (300-350 μm) during the 5^{th} to 10^{th} nights after the full moon in August, and on the 8^{th} night after the full moon in September. Studies of *Diploria strigosa* indicate that this species also spawns during the summer producing pink-red 440 μm (mean) eggs. My study suggests that synchronous, multi-species mass spawnings occur in Bermuda and are caused, at least in part, by the periodic spawning of corals.

A NITROGEN BUDGET FOR THE SHALLOW-WATER ELKHORN CORAL *ACROPORA PALMATA*

John C. Bythell
West Indies Laboratory, St. Croix, U.S. Virgin Islands

Using exclusively *in situ* techniques, an attempt is being made to assess the total production and losses of the essential element nitrogen from the Elkhorn Coral *Acropora palmata*. Results to date suggest that the exchange of dissolved inorganic nutrients may be an order of magnitude less than the annual allocation of nitrogen into production of gametes and tissue growth. Autotrophic assimilation of dissolved inorganic materials may thus provide less than a quarter of the requirements for nitrogen due also to a substantial loss of dissolved organics, possibly the dissolved fraction of the mucus. It is hoped that this research will provide a clearer view of how materials are fluxed between coral environments and also among adjacent ecosystems.

INITIATION OF A LONG-TERM MONITORING PROGRAM FOR CORAL REEFS IN THE VIRGIN ISLANDS NATIONAL PARK, ST. JOHN, USVI

Caroline S. Rogers and Evonne S. Zullo
Virgin Islands National Park, St. Thomas, U.S. Virgin Islands

A long-term monitoring program was initiated for the coral reefs of Virgin Islands National Park and Biosphere Reserve in recognition of the need for quantitative baseline data to provide information for resource assessment and effective management. Major stresses to the reefs in the park include terrigenous runoff following watershed development, storm damage, and damage associated with boating activities. Transects were established on coral reefs in Reef, Fish, and Hawksnest Bays. Tropical Storm Klaus (November 1984) resulted in a statistically significant decrease in the mean percent cover of live coral (26% down to 21%), an increase in diversity and evenness, and a slight decrease in spatial index at the Fish Bay site. The percent cover by the dominant coral *Agaricia agaricites* decreased significantly (17% down to 11%). At Reef and Hawksnest Bays, post-storm cover was 20% and 26%, respectively (no pre-storm data). These quantitative data will serve as a basis for documentation of deterioration or recovery of coral reefs in these three bays. Monitoring and management guidelines for Caribbean coral reefs are presented.

AN INDICATION OF SEASONALITY ON THE ALGAL PLAIN AT COKI BAY, ST. THOMAS, USVI

LaVerne E. Ragster and Rudnell O'Neal
Division of Science and Mathematics, College of the Virgin Islands, St. Thomas, USVI

Preliminary observations of macroalgae growing on a deep-water plain off the northeastern coast of St. Thomas, USVI, indicate a diverse flora thriving in a dynamic environment. The members of the Rhodophyta dominate the algal plain community by numbers of genera and in their diversity of form. Siphonous chlorophytes are also well represented in the more than 50 species that have been identified. Initial studies point to the presence of both seasonal and aseasonal species being able to survive in this habitat. Studies to elucidate the role of environmental parameters on community structure and the types of seasonality exhibited by the more abundant genera are indicated by these early observations.

PLANT DEFENSE ASSOCIATIONS IN THE BELIZE BARRIER REEF

Phillip R. Taylor[1,2], Mark M. Littler[2] and Diane S. Littler[2]
[1]Biological Oceanography Program, NSF; [2]Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, District of Columbia, USA

Studies on the Belize barrier reef provide the first documentation of herbivore escapes for combinations of palatable and unpalatable marine plants. A highly signify-cant association of several macrophyte taxa (*Laurencia poetei*, *Dictyota* sp., *Amphiroa fragilissima*, *Cladophoropsis macromeres*, *Galaxaura cylindrica*, rhodophycean turf) exists within a 2.0-cm radius of the herbivore-resistant brown alga *Stypopodium zonale*. Almost twice as many taxa occurred within 10 cm of *S. zonale* as within 10 cm of an equal number of random *Stypopodium*-free points. There were no algal species negative-ly associated with *S. zonale*. The association of *Amphiroa tribulus*, *L. poetei*, *Digenia simplex*, rhodophycean turf, and *Jania adherens* with *S. zonale* provided them a fourfold greater survivorship per 48 hours in the presence of grazing activity by fishes (mainly acanthurids and scarids). Reduced herbivory on macroalgae associated with *S. zonale* was not solely a consequence of its structural aspect. Losses of the palatable alga, *Acanthophora spicifera*, were significantly greater for thalli spatially-removed (30-60 cm) from either a real or simulated *Stypopodium*; however, losses of *A. spicifera* adjacent to actual *Stypopodium* plants were significantly less than the losses next to models. These interrelationships, where an abundant and well-defended plant provides a signifi-cant refuge habitat for at least five relatively edible macroalgae, facilitate the survival of certain taxa in the reef system and concomitantly enhance the within-habitat diversity.

EFFECTS OF THE COOLING WATERS FROM A THERMOELECTRICAL POWER PLANT ON THE SURVIVORSHIP OF *ACARTIA TONSA* AND *ACARTIA LILLJEBORGII* IN GUAYANILLA BAY, PUERTO RICO

R. A. Olivieri
Department of Marine Sciences, University of Puerto Rico, Mayagüez, Puerto Rico

Zooplankton samples were collected from the waters adjacent to the Costa Sur power plant, Guayanilla, Puerto Rico on 14 different occasions from March to October 1985. Five different stations were studied with three replicate tows collected per station per day of sampling. Temperature was measured at each station. Population density and percentage of survival of *Acartia tonsa* and *A. lilljeborgii* were computed based on the neutral red vital stain technique. An average increase in temperature of 10.2˚C was documented in the water pumped through the power plant that resulted in an average increase of 8.5˚C in the thermal cove. This decreased significantly the survival of plankton during the warmer months of the year when the water temperatures in the natural environment almost reaches 30˚C and the thermal cove waters 40+˚C.

OBSERVATIONS ON BENTHIC MARINE DIATOMS OF PUERTO RICO

J. Nelson Navarro
Biology Department, Catholic University, Ponce, Puerto Rico

The diatoms from two areas of the southwestern coast of Puerto Rico were studied. The first study site was submerged mangrove prop roots at La Parguera. The diatom communities had different ways of associating and co-existing with the organisms that live on these roots (e.g., algae and invertebrates): forming gelatinous capsules; attaching directly by pads or stalks; epiphytically moving or entangling among microalgae; or tube dwelling. The second study area was in Cabo Rojo and had hypersaline waters, up to 90 ppt, where microbial mats existed. Some interesting species occur in this extremely inhospitable habitat. This is the first taxonomic report of diatoms living on microbial mats.

THE INFLUENCE OF THE MARINE ENVIRONMENT IN THE PRECIPITATION CHEMISTRY OF A TROPICAL RAIN FOREST

Carlos R. Ramos-Perez, Cindy Gines-Sanchez and William H. MacDowell
Center for Energy and Environmental Research,
University of Puerto Rico, San Juan, Puerto Rico

Weekly precipitation samples were collected from February 1985 to January 1986 in the El Verde area of the Luquillo Rain Forest as part of a nationwide monitoring being conducted by the National Atmospheric Deposition Program (NADP), and funded by the National Oceanic and Atmospheric Administration (NOAA). Elevation at the sample site was 400 m. Seasalt contributed an average 3.7 ueg/l (SD=2.4), or 34% of the total calcium, and 10.1 ueg/l (SD=6.6) or 48% of the total sulfate. For the elements magnesium, chloride, and potassium, the seasalt fraction represents 95% (18.9 ueg/l, SD=6.6). 97% (96.5 ueg/l, SD=63.3), and 75% (1.8 eug/l, SD=1.19), respectively. The mean ratios for magnesium and chloride (using sodium as a seawater tracer) are 9% and 2% higher than those of the seawater ratio, respectively. For sulfate, calcium, and potassium the ratios are significantly greater than the seawater value. This means that while sea water is the primary source of magnesium and chloride, there are other sources of sodium, calcium, and potassium.

PRELIMINARY NOTES ON THE DISTRIBUTION OF *RUPPIA MARITIMA* AS A POSSIBLE FACTOR CONTROLLING THE PRESENCE OF MIGRATORY BIRDS AT THE SOUTHWESTERN COAST OF PUERTO RICO

Yasmín Detrés C.
Department of Marine Sciences, University of Puerto Rico, Mayagüez, Puerto Rico

Studies concerning the ecological importance of the seagrass *Ruppia maritima* were conducted in southwestern Puerto Rico. The importance of this marine phanerogam as a food source for migratory water birds was evaluated through an analysis of stomach and guizzard contents of *Anas discors*. *Ruppia maritima* distribution and transplant studies were done to determine if its presence is related to the presence of migratory water birds in southwestern Puerto Rico. Its distribution was mapped. This plant occurs in salinities between 1 and 87 ppt in protected, shallow waters with mud bottoms. The seagrass was transplanted into the Marimbo Lagoon (stations 1-2) and the Guayacan Island Lagoon (station 3) near La Parguera, which are suitable habitats for the seagrass and for migratory birds. The seagrass is growing in sites 2 and 3.

CLIMATIC INFLUENCES ON SEABIRD POPULATIONS OF THE TROPICAL WESTERN ATLANTIC

Robert L. Norton
Division of Fish and Wildlife, Department of Conservation and Cultural Affairs,
St. Thomas, U. S. Virgin Islands

Climate variation is known to affect seabird population dynamics in the Pacific Ocean through reduced food resources forced by ocean and atmosphere interactions coincident with El Niño. Seabirds of the Virgin Islands archipelago show a subtle, yet measurable, annual difference in mean egg sizes and mean clutch size that appear to be linked to periodic or cyclic dry and wet spells. The response to local and global climatic change by inshore and offshore feeding seabirds is detected when measuring egg sizes and their volume. A procellarid, two solids, and six sternids showed annual variation in either clutch size, egg volume, nesting attempts and success during and following the 1982-1983 El Niño. Nesting recovery appears to be annual for migratory species, but the fish resource and resident seabird species recovery is not well known.

CURRENT EFFORTS TO MONITOR THE ARTISANAL FISHING INDUSTRY OF PUERTO RICO

Joseph J. Kimmel
Fisheries Research laboratory, CODREMAR, Mayagüez, Puerto Rico

The fisheries Research laboratory of CODREMAR has undertaken a project with the objective of monitoring the commercially exploited fisheries resources around Puerto Rico. A cooperative effort among laboratory staff and local fishermen will be made to sample trap catches for biostatistical data, including length-weight, sex ratios, reproductive condition, and aging of hard parts (otoliths or spines), on 15 shallow-water reef fishes and Spiny Lobsters. Field agents will also collect landings and biostatistical data on the same species from selected fishing centers around the island. A census of comercial fishermen and the gears they use will be compiled from information obtained through the licensing program and other sources. The proper monitoring of Puerto Rico's coastal marine fisheries resources will aid managers and existing and/or potential users in making the appropriate management decisions for optimal utilization of these resources.

FISH-CRUSTACEAN FEEDING RELATIONSHIPS IN PRISTINE REEF COMMUNITIES

James D. Parrish
Hawaii Cooperative Research Unit, University of Hawaii, Honolulu, Hawaii

The larger crustaceans are a conspicuous component of the benthic invertebrate fauna and of the diet of the fish community on undisturbed coral reefs in the Northwestern Hawaiian Islands. Crustacean communities were quantified by collecting representative samples of reef substrate and removing their invertebrates. Fish communities were quantified by visual census and by complete chemical collections of patch reefs. Fish consumption of crustaceans was assessed by examination of gut contents of all important reef-fish species. Large crustaceans comprised 7.5% (all percentages by weight) of the entire benthos (plants and animals) and 40% of all food in the diet of the entire fish community. Eighty-six fish species, of the 108 examined for diet, consumed crustaceans. The major diet groups were crabs (26.0% of diet), shrimp (11.3%), and stomatopods (2.4%). Crabs were also 3-4 times as important as shrimp in the benthos, and stomatopods were negligible in substrate collections. Brachyuran crabs dominated the diet, with 11 families, led by Xanthidae, Majidae, and Portunidae. Hermit crabs and Galatheidae were also important prey. The same groups were important in the benthic community. Shrimp in nine families were consumed, mostly in Caridea (7 families), led by Rhynchocinetidae, Palaemonidae, and Thalassocarididae. Alpheidae were the dominant shrimp in the benthos, followed distantly by Palaemonidae and Hippolytidae. Stomatopods, mostly Squillidae, accounted for about 6% by weight of all large crustaceans in the diet. Two types of palinurid lobsters and penaeid shrimps were minor prey. The trophic interaction between the larger benthic crustaceans and a major segment of the fish community produces significant ecological effects on both groups.

ATTACHMENT, MOVEMENT, AND SURVIVAL OF MICROMALE *ANILOCRA CHROMIS* (ISOPODA: CYMOTHOIDAE) ON ADULT AND JUVENILE BROWN CHROMIS

Lucy Bunkley Williams and Ernest H. Williams, Jr.
Department of Marine Sciences, University of Puerto Rico, Mayagüez, Puerto Rico

Anilocra chromis Williams and Williams selectively parasitizes the Brown Chromis, *Chromis multilineatus* (Guichenot) in the central and eastern West Indies and the Blue Chromis, *C. cyaneus* (Poey), in the northern West Indies, never both in any locality, although these fishes occur sympatrically throughout the region. The present work is part of a series of experiments examining the host-parasite relationships of these organisms. Data were obtained using saturation, scuba diving techniques from the NOAA, National Undersea Laboratory System Hydrolab Undersea Habitat, located at Salt River Submarine Canyon, St. Croix, USVI. In this area, *A. chromis* naturally parasitizes Brown Chromis. Female *A. chromis*, gravid with developmentally advanced broods, were collected in the field and isopods that were released from these females (called micromales in this paper) were confined in plastic aquarium bags until exposures to hosts were made. Experimentally exposed micromales were host specific to adult Brown Chromis, attaching only at night, and subsequently migrating across the body of the host toward the attachment position of the female isopod. Forty percent of the 45 Brown Chromis were infected with one or more micromales and of those, 28% were infected with two isopods. No more than two isopods settled on a host. Attachment of each isopod is an independent event. Host with experimentally attached micromales were released in the field. Most isopods on these hosts survived only 24-48 hours. Cleaning organisms probably removed these isopods. Isopods infected 40% of the 112 juvenile Brown Chromis, settling near the eyes, and 6% of the 94 Blue Chromis juveniles, attaching near the fins. Attachment occurred only at night. Two isopods infected 13.3% of the infected juvenile Brown Chromis and none of the juvenile Blue Chromis had multiple infections. Host specificity may be more important than predisposition of the host in determining which host will be infected. Experimentally infected juvenile Brown Chromis were not released in the field, but held in plastic bags. Most isopods attached to these fish survived longer than two days probably due to protection from cleaners. Subsequent movement on the host was not observed.

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EFFECTS OF SEWAGE DISCHARGES ON THE INORGANIC NITROGEN CONTENT IN A SEAGRASS-MANGROVE ECOSYSTEM

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Incubation chambers (one light, one dark) were used to quantify rates of inorganic nitrogen exchange between the sediments and the overlying water in order to characterize nitrogen sedimentary cycling processes at reference stations and those directly receiving discharges at La Parguera, Puerto Rico. Sampling of the water was preformed at each station before, during, and after the week-end recreational activity of the area, which included a marked increase in boat activity inside the channels and occupancy of the houses. It was of interest to determine if the increase in recreational activity, experienced during week-ends, could be traced to a change in the inorganic nitrogen in the water. The integration of all objectives was to extrapolate on the system response to small, but periodic, inputs of new inorganic nitrogen. A significantly lower ammonium concentration was found during and after the week-end recreational activity compared to samples taken before the week-end. No difference was found in ammonium concentration during and after, suggesting the week-end effect influences for more than 24 hours. Significant differences were found between stations. No significant difference in nitrate concentration could be attributed to the week-end activity. For data gathered during the afternoon, a significant difference between stations was found both for ammonium and nitrate.

LITTERFALL AND RESIDUAL TRANSPORT IN THE SOUTH OROPOUCHE SWAMP, TRINIDAD

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The south of Oropouche Swamp is a major wetland of 1500 hectares occurring along the southern part of the gulf coast of Trinidad. The mangroves are well developed and mature and, although previously more extensive, now cover 700 hectares. The forest comprises, mainly *Rhizophora mangle*, which attains heights of 15-20 m, and lesser occurrences of *Avicennia germinans, A. schauerana*, and *Laguncularia racemosa*. Littler was collected for 12 months from the *R. mangle* zone, and values ranged from 1.05 $gm^{-2}d^{-1}$ to 5.05 $gm^{-2}d^{-1}$, with an average of 2.51 $gm^{-2}d^{-1}$. A marked seasonality was expressed, with an increase in litterfall during the wet season. Residual discharge varied with rainfall, and ranged from 180 000 m^3d^{-1} in February to 16 million m^3d^{-1} in June. In addition, the movement of suspended material across the mangrove/coastal area boundary ranged from an import of 450 mtd^{-1} in January to an export of 3500 mtd^{-1} in June. The movement of particulate organic matter followed a similar trend, with an import of 74 mtd^{-1} in January to an export of 720 mtd^{-1} in June. This data indicated that more organic matter is being exported from the wetland than is currently being produced by litterfall, and leads to the suggestion that the area may be losing substrate from the forest floor.

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DIPHOSPHONATE (EHDP) INHIBITS SKELETOGENESIS, BUT NOT CALCIFICATION, IN LARVAL SCLERACTINIAN CORAL

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Crystal-bearing intracellular vesicles identified in calicoblastic epidermal cells of the scleractinian corals, *Astrangia danae* and *Porites porites*, by Hayes and Goreau (Biol. Bull. 152: 26-40, 1977) suggest a mechanism for cellular control of coral calcification and skeletogenesis. Accordingly, these seed crystals of $CaCO_3$ would be transported to the apical cell surface, would be released by exocytosis, and once deposited extracellularly, would serve as sites for epitactic growth of the coral skeleton. In experiments to test this hypothesis, we exposed coral planulae of *Favia fragum* to the synthetic diphosphonate, Didronel, or EHDP (Proctor and Gamble Co., Inc.). This compound inhibits vertebrate mineralization by complexing to the (110) axis of hydroxyapatite thereby preventing further crystal growth. Both pelagic and decumbent planulae were maintained in filtered sea water containing 0.1% EHDP (4.0 mM). The free-swimming larvae became progressively sluggish in movement, assumed an elongated shape, and lost the characteristic pigmented zone around the stomodeum. Light microscopy of specimens fixed after 6 hr exposures to EHDP revealed the disruption of apical epidermal cell integrity. The microvillous (brush) border of the epidermis was irregular in height and microvilli were swollen. Although junctional complexes among epithelial cells appeared intact, the apical cell membrane was severely disorganized. Ultrastructural examination of this surface indicated a loss of core structure in microvilli, disruption of the glycocalyx and a dissociation of the terminal web region of the cell. Ciliary assembly is also uncoupled. Settled and attached planulae revealed similar structural alterations. Electron microscopic examination of the calicoblast showed accumulation of crystal-bearing vesicles in the cytoplasm, but not in the apical cell region. These vesicles were distributed in the basal and juxta-nuclear zones and were frequently enlarged with multiple crystal profiles. Our data imply that EHDP exerted its effects upon the apical cell surface, interfering with transport and release of the vesicles, but that it does not enter the cell directly. The EHDP prevented the accumulation of extracellular $CaCO_3$ crystals (skeletogenesis), but did not inhibit seed crystal formation intracellularly (calcification). We interpret the primary effect of EHDP to be complex formation with ionic and protein-bound calcium resulting in disruption of the integrity of the apical cell glycocalyx, plasmalemma, and cytoplasm. The transport and exocytosis of seed crystals within membrane-bound vesicles, dependant upon the integrity of that apical cell region, are thus terminated.

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BONE OIL STORAGE IN MARINE FISHES OF JAMAICA

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Bone lipid in fishes appears to be used for major marine metabolic energy reserves as well as maintenance of neutral buoyancy and posture. Fifteen species of fishes from 13 families were analyzed. Three species, *Priacanthus arenatus*, *Acanthurus chirurgus*, and *A. bahianus*, had oil-filled bones (15.7-29.7% skull lipid as percent of dry weight). Six species, *Acanthurus coerulus*, *Haemulon flavolineatum*, *Eupomacentrus planifrons*, *Malacanthus plumeri*, *Pempheris schomburgki*, and *Equetus acuminatus*, had intermediate amounts of bone oil (7.4-13.6%). Six other species, including an elasmobranch, *Urolophus jamaicensis*, had low bone oil (0.1-4.0%). Fewer lipids are stored in the spine than in the skull. Triglyceride comprised 84.9-93.7% of the lipid in the fishes with oil-filled bones. Phospholipid and cholesterol were minor components comprising 2.2-13.2% and 1.7-5.9%, respectively. The metabolic significance of skull triglyceride was assessed in *A. bahianus* by feeding palmitic acid C^{14} (1.6×10^7 dpm per fish), a fatty acid known to be incorporated into triglyceride from food. Carbon-14 was rapidly incorporated into starved *A. bahianus* skull triglyceride (8.7×10^4 dpm/mg lipid) after 12 hr. After 48 hr, the specific activity of the skull lipid was much lower (4.1×10^3 dpm/mg lipid) with an order-of-magnitude more radio-label in the flesh lipid than after 12 hr. These fishes rapidly depleted their total body lipid from 3.3% (dry weight) after 12 hrs to 1.0% after 48 hrs, and died after 48 hrs. Oil-filled bones in tropical marine fishes, such as *A. bahianus*, may function as very short term energy reserves, since these fish die rapidly during starvation stress (2 days) as compared to temperate fishes of similar size (>7 days). Since food is available year round to these herbivores, bone triglyceride may be effectively utilized during short periods of storms and high surf (3-24 hrs) when foul weather prevents feeding.

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RECENT OBSERVATIONS OF THE VESTIMENTIFERA, INCLUDING THOSE OF THE GULF OF MEXICO

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Phylum Vestimentifera consists of nine species in six genera. Two new species have been collected in the Gulf of Mexico in *Lamellibrachia* and in a new genus, at least. These, along with *Escarpia laminata* form the base of the Florida Escarpment in the Gulf, *L. luymesi* off Guyana, and a second new species of *Lamellibrachia* off Uruguay. Five species are known in the Atlantic and adjacent areas. All vestimentiferans examined contain sulfide-oxidizing, chemoautotrophic, endosymbiotic bacteria necessary to sustain these mouthless, gutless worms. A transitory structure in juveniles may uptake free-living bacteria into the worms where the microbes are isolated in a so-called trophosome. The intricate pattern of vascularization of both the branchial plume and the trophosome is a special adaptation to insure a supply of sulfide to the symbionts.

DISTAPLIA COROLLA: A LITTLE KNOWN WEST INDIAN ASCIDIAN

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Distaplia corolla F. Monniot, 1974 was described from the Azores and has recently been found in the West Indies in Guadeluope (Monniot) and Jamaica (pers. observ.). In parts of the Belize Barrier reef it is abundant primarily on the prop roots of offshore Red Mangrove, *Rhizophora mangle*. Unlike *Distaplia bermudensis*, which forms cushion-shaped colonies, *D. corolla* is formed of numerous small rosettes of zooids linked to one another by stolonic processes. These are of ecological importance in permitting the growth of a colony through, around, or under other sessile organisms to provide new rosettes beyond the obstruction. Rosettes can occasionally close up to form 'lump-heads' in which the zooids cease to be functionally active. After a period of reorganization, the rosette opens and becomes functional again. Stolons may sometimes be replaced by a broad advancing sheet of tissue that permits rapid expansion of the colony over unobstructed surfaces. In sexual reproduction, the egg is not released into an oviducal brood pouch, but descends posteriorly into the test matrix where the embryo becomes encapsulated. The capsules migrate toward the surface of the colony where the larvae are released through rupture of the capsule. Larvae are released in the first hour after dawn and in the last hour before dusk and settle within about 15 minutes. Further work on the biology of this interesting species is progressing. This work was supported by the Smithsonian Reef and Mangrove Study, partly funded by a grant from the Exxon Corporation and UNESCO.

SUBMERSIBLE AND LABORATORY OBSERVATIONS ON DEEPWATER BRITTLESTARS AT DISCOVERY BAY, JAMAICA

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Deep water is found very close to shore off the north coast of Jamaica. The island, or insular, shelf is only a few hundred meters wide, and the island, or insular, slope is steep. Small submersibles can be operated directly from the shore without the need for a mother ship. Deep water organisms can be observed *in situ* and then transported alive to a controlled environment in the laboratory. Simple-armed euryaline brittlestars are mostly deepwater species about which little is known. In early 1985, observations were made from the Perry PC-8 on *Asteroporpa annulata* and *Asteroschema tenue*, on the insular slope off Discovery Bay. They occurred from about 160 m to the limit of observations at 245 m. Prevailing currents were very light or non-existent. Both species are suspension-feeders, epizoic on large, stalked invertebrates. *Asteroschema tenue* was found only on the gorgonian whip *Ellisella barbadensis*. *Asteroporpa annulata* was most commonly seen on an antipatharian whip, Cirrhipathes sp., but also occurred on *Ellisella barbadensis*, and on the stems of stalked crinoids. *Asteroschema tenue*, which has very long, thin arms, was coiled closely about its host during the day. At night, it was much more loosely applied and further extended along the gorgonian. Bights of the arms lay alongside, clear of the polyps, or hung in D-loops, while arm-tips trailed for a few centimeters into the water column. *Asteroporpa annulata*, in contrast, trailed its arms by day and night. These differences in diel behavior seem to be correlated with differing susceptibility to predation. Individuals of *Asteroschema tenue* were maintained for several weeks in a chilled flow-tank. Feeding experiments showed that they were microphagous, using aerosol filtration onto extended tube-feet. In this, and in the absence of arm-loop feeding, they resemble ophiurine brittlestars and differ from other known euryalous forms. *Asteroschema tenue* arms are sheathed by a thick layer of longitudinal collagen fibers. These are probably a "multiple contractive tissue" (Wilkie, I. C. 1984. Mar. Behav. Physiol.) able to alternate between flexible and rigid states. When rigid, they would confer more resistance to bending, free of metabolic cost, than would the actively contracted inter-vertebral muscles. This might be a general characteristic of the euryaline brittlestars all of which are probably suspension-feeders.

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THE DISTRIBUTION OF THE SPINY LOBSTER (*PANULIRUS ARGUS*) ON THE SOUTH COAST OF CURAÇAO, NETHERLANDS ANTILLES

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The south coast of Curaçao, Netherlands Antilles has a healthy, well-developed fringing reef, and inner bays and lagoons that act as nursery grounds for coral-reef organisms. In the old literature, Curaçao was noted to have high populations of Spiny Lobster, *Panulirus argus*, but today, this animal is only found with difficulty. We examined the Spiny Lobster population from February-Octotober 1985 with scuba and a count-per-unit-of-effort method: 15 min at 25 and 21 m, and 15 min at 15 and 11 m, covering 225 m x 4 m x $\sqrt{2}$ each or 5090 m^2 per dive. The inner bays were mapped by echography and lobsters were counted with scuba. On the reef, mean day abundance was 1.12/ha and night 2.23/ha. Values in the literature, taken on similar reefs, were 3.9 and 7.7 per ha, respectively. Mean carapace length was 90 mm for both sexes. In the inner bays, young lobsters were found on slopes of channels with small rocks and holes. The muddy bottom was avoided. Carapace length was 40-70 mm, significantly smaller that those on the reef. Only two bays had lobsters, and their yearly output would be no more than 115. These results suggest the reefs are overfished. Pollution may also be involved.

AN ORDINATION OF SHALLOW WATER GORGONIANS OF PUERTO RICO

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Gorgonian samples collected from 26 sites around Puerto Rico were analyzed by reciprocal averaging ordination. Six sites were sampled before and after Hurricane David, and two sites before and after the mass mortality of *Diadema antillarum*. Only one environmental gradient was identified. One extreme of this gradient was represented by north coast stations (Tortuguero, Desecheo Island, Punta Higuero) and species such as *Muriceopsis sulphurea*, *Pterogorgia anceps*, and *Gorgonia mariae*. These stations occur in high wave energy environments with low topographic relief. South and west coast stations (lee of Caja de Muertos Island, Tallaboa, Cabo Rojo) with species such as *Pseudopterogorgia albatrossae*, *P. bipinnata*, and *Briareum asbestinum* occurred at the other extreme of the gradient. These stations are characterized by low wave action and/or moderate topographical relief. Colony mortalities from Hurricane David were 0-100%. Populations increased about tenfold after the *D. antillarum* disappearance. Changes in community structure were highly variable with respect to this environmental gradient. The most closely related environmental factor to this gradient is horizontal sediment transport. It increases with wave energy and is confined to local depressions with increasing relief. Changes following the hurricane and mass mortality were consistent with their variable effect on sediment transport.

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REEF FISHES OF THE SANTA MARTA REGION (COLOMBIA): 11 NEW RECORDS FOR THE SOUTHERN CARIBBEAN

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The Santa Marta Region (Colombia)(11.1-11.4˚N, 74.0-74.3˚W) includes many bays, islets, points, and rocky shores, with a diverse fauna typical of Caribbean reefs and others restricted to the southern Caribbean. We have been studying the fishes in this region, including 340 species in 71 families, for the last five years. *Gymnothorax* hubbsi and Muraena *robusta* (Muraenidae), *Synodus saurus* (Synodontidae), *Ogcocephalus radiatus* (Ogcocephalidae), *Amphelikturus dendriticus* (Syngnathidae), *Serranus annularis* (Serranidae), *Seriola fasciata* (Carangidae), *Enneanectes altivelis* (Tripterygiidae), *Chaenopsis ocellata* (Clinidae), and *Acyrtus rubiginosus* and *Arcos macrophthalmus* (Gobiesocidae) represent new locality records for the southern Caribbean.

PATTERNS OF NITROGEN DEPOSITION IN A NEARSHORE TROPICAL SEDIMENTARY ENVIRONMENT

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The direct discharge of untreated sewage to nearshore waters at La Parguera, Puerto Rico, has caused localized eutrophication in this mangrove/seagrass environment. The bulk of the released nitrogen is rapidly remineralized and subsequently utilized by the primary producers; notably *Microcoleus lyngbyaceous*, a ubiquitous filamentous cyanophyte. Mats of *M. lyngbyaceous* accumulate on the sediment and release soluble ammonium upon decomposition. Patterns of deposition of *M. lyngbyaceous* are determineed by physical factors such as wind and currents, coupled with local bathymetry and scouring die to boating activity. Thus, the greatest accumulations of decomposing *M. lyngbyaceous* can be found in the deeper, more protected basins and along the mangrove fringes. Concentrations of dissolved nitrogenous salts, principally ammonium, in the interstitial sediment waters reflect the patterns of deposition of *M. lyngbyaceous* with concentrations of up to 2 mM in the deeper, organic-rich basins and low concentrations (50-100 uM) in the shallow carbonate sediments where scouring, currents, and boating activity inhibit organic deposition.

LIGHT SCATTERING IN THE PHOSPHORESCENT BAY AT LA PARGUERA, PUERTO RICO

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Light scattering measurements made at the Phosphorescent Bay at La Parguera in southwestern Puerto Rico produced unexpected and unusual results as compared to similar measurements made at a station outside the Bay. The scattering spectrum of the Bay waters showed a dip at 600 nm, whereas the transmission spectrum showed a large amplitude at that wavelength. The scattering spectrum for the station outside the Bay conformed to the transmission spectrum. It was deduced that a yellow-orange gelationous material could produce such results. Further investigation revealed that high concentrations of *Gonyaulax tamarensis*, dinoflagellate, found at the Phosphorescent Bay, may be responsible for the scattering phenomenum.

CARBONATE CYCLING IN A DEEP SHELF-EDGE REEF, ST. CROIX, USVI

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The relative importance of constructive and destructive processes was quantified along a 5-km shelf-edge reef in northwestern St. Croix. Along two transects between shore and a depth of 40 m, the standing cover of calcifying organisms was censused. The major corals of the area (90% of the calcification) were sampled along each gradient, and their growth rates were determined by x-radiography. Seven cores taken along the transects recorded the accretionary history of the area. On average, the reef produces carbonate at a rate of 3.67 $kg/m^2/yr$. The cores indicate that the reef has accreted at corresponding to net production of 1.27 $kg/m^2/yr$. The difference between the gross production on the present reef surface and the net production, reflected in the cores, is related to bioerosion of the reef and removal of the resulting sediment by physical processes, primarily during major storms. Physical processes are the dominant transport mechanism, even during fair weather, and are responsible for 80% of the sediment transport on a long-term basis. The highest rate of carbonate production now occurs at the shelf edge in 10-20 m, away from the more stressful nearshore environment. Accretion rate increases with water depth, related to the incorporation of slumped material from the upper reef face. This demonstrates potential problems with using a simple depth-related model to predict patterns of accretion in modern and probably ancient reefs. Sediment production is twice that available from the recognizable framework. This suggests that detritus is important in the accretion of modern reefs, and that sediment is a potentially limiting factor in reef development.

JAMAICAN BACK REEF SPRINGS: SOME ASPECTS OF THEIR ECOLOGY AND MARICULTURE POTENTIAL

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The clear, warm waters of coral back-reef habitats have tremendous potential for highly productive mariculture when adequate and balanced nutrient supplies are available. We have observed the ecological changes in back reef communities fed by high nitrate groundwater springs along the limestone coasts of north Jamaica for more than 25 years. Spring waters, though unusually high in dissolved nitrates, are exceedingly low in phosphorus (an element whose excess via pollution helps stimulate massive filamentous algal growth that smothers corals) and in particulates and dissolved humic materials that absorb light and retard coral growth. Springs near Discovery Bay were formerly sites of unusually lush algal biomass despite large schools of herbivorous fishes, perhaps because moray eels were abundant in crevices around springs. Algal biomass declined markedly after late 1980, when intensified fish and urchin grazing followed near complete destruction of reef crest habitats by Hurricane Allen (L. Kaufman, pers. comm.). Nevertheless, spring communities remain oases of harvestable fish production in Jamaican reefs. Located along a fine-scale network of faults, all are known and intensively utilized by local fishermen, who obtain a major fraction of their fish catch near the springs. Excessive over harvesting of juveniles by fish traps (Munro, 1983, Caribbean Coral Reef Resources) and destruction of mangroves for tourist development (Gleaner, 1986, Fish Shortage) have increased utilization of spring-supported food chains by fishermen. Although the fishermen have always been aware that unsustainable over harvesting is systematically reducing future yields, they have no choice but to continue doing so until a more profitable alternative use of the area becomes available. Many species of algae and fishes in spring communities would have considerable economic value if they could be brought into intensive mariculture. We have identified: (1) commonly marketed fish species currently harvested in springs that might be amenable to intensive culturing, and (2) algal species with commercial value as industrial hydrocolloid sources and with potential for cultivation in seawater-springwater mixtures. Algae include clones selected for high growth rates and vegetative propagation at the Harbor Branch Institute, and wild Jamaican clones with high structural polysaccharide quality selected at the University of the West Indies. We are currently adapting the Harbor Branch phosphate pulse fertilization technique to optimize growth rates under culture conditions representative of spring environments. If pilot field trials are promising, shallow, back-reef lagoon areas next to high-nitrate springs could be used for intensive production of selected species of algae and fish in adjacent enclosures, using only a small fraction of the natural nitrogen input. Mariculture could: (a) permit fishermen to considerably improve their income, (b)

generate additional jobs in processing and utilization of algae products such as agar in the food and biotechnology industries, and (c) by promoting intensive production in a small part of the reef as an alternative to over fishing the entire area, it would ease pressures on the reef community, allowing recovery towards levels of harvestable biological production more like those of the past. [D.B.M.L. Contribution]

MARINE EDUCATION WORKSHOP BY THE UNIVERSITY OF PUERTO RICO AND THE UNIVERSITY OF NORTH CAROLINA

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The University of Puerto Rico and the University of North Carolina Sea Grant Programs are planning a joint marine education workshop for the southeastern Sea Grant states during the summer of 1987. The activity will be held at the marine station of the Department of Marine Sciences of the University of Puerto Rico. The Caribbean countries interested in this important academic venture are welcome to participate. Those interested please give your name and address to Dr. Ernest H. Williams so that I can send you additional information. Telephone for information: (809) 832-3432.

MARINE DEBRIS IMPACTS IN THE CARIBBEAN AND GULF OF MEXICO: A PROJECT OF THE U.S. MARINE MAMMAL COMMISSION AND THE NATIONAL MARINE POLLUTION PROGRAM OFFICE

Burr Heneman
Bolinas, California, USA

"For the past decade, concern has been growing among scientists, fishermen, conservationists, and others over the markedly increased volume of marine debris apparent in the world's oceans" That sentence introduces the "Proceedings of the Workshop on the Fate and Impact of Marine Debris," an international meeting in November 1984, which sought to summarize what was known, recommend research needs, and recommend steps to mitigate the problems (mostly in the North Pacific). Sources included lost and discarded fishing gear (mostly large-net fisheries), plastic pellets (manufacturing raw materials), and solid wastes from vessels or land. Impacts on wildlife included entanglement of marine mammals and sea turtles, ingestion of plastic pellets and other debris by sea birds, and "ghost fishing" by nets and traps Vessel entanglements and tourism impacts also occurred. The U.S. Fish and Wildlife Service has begun a program to investigate and mitigate these problems. I am requesting information concerning this problem in this region with the questionnaire I am distributing.

SHARK ATTACK

Electa Pace
RSMAS, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida, USA

The Florida Shark Attack File is seeking information for a documented file on shark attack in Florida and Caribbean waters. Please complete the form I am distributing and returned it to the address indicated. The data form includes the physical characters of the site, victim, wounds, and shark; possible cause; medical treat and results.

UNESCO-NSF WORKSHOP: FACTORS INFLUENCING ORGANIC PRODUCTIVITY IN THE CARIBBEAN COASTAL ZONE

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In November 1985, 35 scientists from 11 Caribbean nations met for a workshop, at the Discovery Bay Laboratory in Jamaica, sponsored by UNESCO and NSF. There a research project was defined and the infrastructure established to carry it forward. The focal points of the project are the three major coastal interface ecosystems in the Caribbean: mangroves, seagrass beds, and coral reefs. A major hypothesis of the project is that the magnitude of terrestrial input is a major factor in determining the structure and productivity of the coastal zone. In order to develop the central program as rapidly as possible, several projects have been authorized by the steering committee and funded by UNESCO: (1) development of a modern reference list and bibliography of the Caribbean literature pertaining to these three ecosystems, including computer reference sources, input from specialists, and laboratory reference lists. Citations will be collected and edited at the University of Virginia and printed by UNESCO. (2) the most critical and important 20-40 papers concerning each of the three ecosystems in the Caribbean will be assembled and printed as above. I would like to solicit your support, and the support of your institution, to make this effort as comprehensive as possible. I need your lists of journal articles, book chapters, and reviews and, if possible, reprints of each article. I also would like to obtain and grey-literature materials. Frequently these contain important distribution and abundance information, but escape indexing and summarization services.