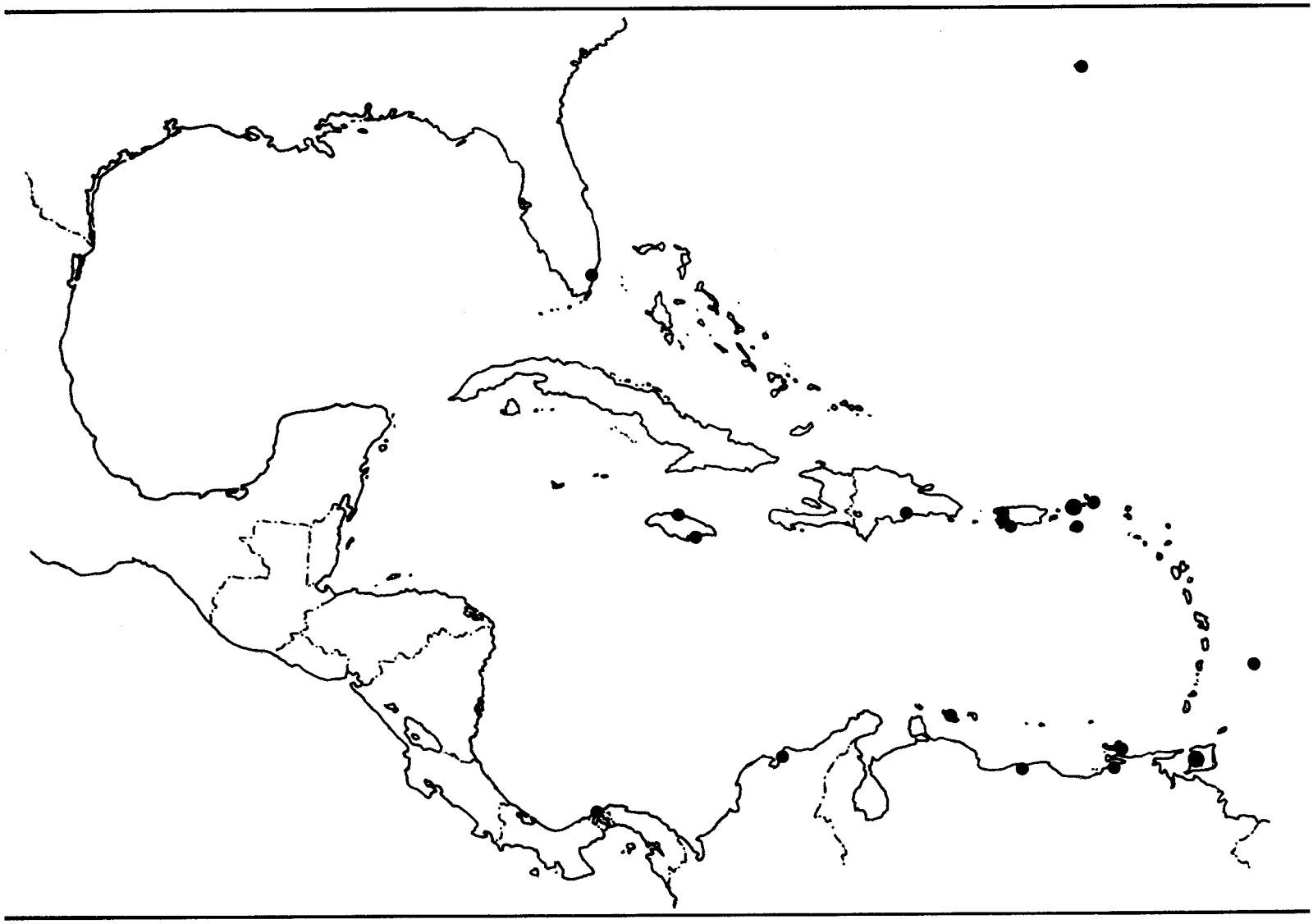
ASSOCIATION OF ISLAND MARINE LABORATORIES OF THE CARIBBEAN

SIXTEENTH MEETING



BERMUDA BIOLOGICAL STATION

ST. GEORGES WEST, BERMUDA

4-8 SEPT. 1981

ERNEST H. WILLIAMS — EDITOR

TABLE OF CONTENTS

OCEANOGRAPHY/OCEANOGRAFIA
W. Sterrer, Chairman

ECOLOGY/ECOLOGIA
W. Sterrer, Chairman

CORALS/CORALES
M. Jones, Chairman

REPORT

INTRODUCTION

The sixteenth meeting of the Association of Island Marine Laboratories of the Caribbean was hosted by the Bermuda Biological Station, with assistance from the Department of Agriculture and Fisheries of Bermuda, 4 to 8 September, 1981. Members were welcomed to the meeting with a tour of the Biological Station by the President of the Association and Director of the Station, Wolfgang Sterrer, in the afternoon, and an informal swizzle party in the evening of 3 September. The next morning the meetings began with welcoming addresses by Drs. Sterrer and James Burnett-Herkes, Assistant Director of the Department of Agriculture and Fisheries, in charge of Fisheries. Meredith Jones opened the scientific sessions, which extended over 3 days in 4 sessions with 28 presentations. Participants were treated to a boat trip with skin or SCUBA diving on the "boiler reefs" and a wreck off St. David's, 5 September; a boat trip and SCUBA dives on North Rock, or a tour of terrestrial caverns, during the day and a "bar-b-q" on the evening of 6 September; Tours of the Aquarium and Museum and of the Fish Processing Plant and Fisheries Headquarters, including an excellent buffet dinner served at the plant, 7 September; a planned tour of Nonsuch Island, cancelled by Hurricane Floyd, was replaced by a film concerning Nonsuch Island and a slide show of photographs from "The Fauna and Flora of Bermuda", a book being prepared by Dr. Sterrer, 8 September. The meetings were concluded with a coctail party and farewell dinner with many board members and patrons of the biological station. The Executive Board meeting was conducted 6 September by:

Wolfgang Sterrer	President	John Ogden	St. Croix
Meridith Jones	1st Vice Pres.	Peter Lutz	Miami
Ernest Williams	Sec./Treasurer	Helen Gjessing	St. Thomas*
Ray Hayes	2nd Mem.-at-Large	Ronald Linsky	Trinidad*
Ana Bardales	Puerto Rico	Doon Ramsaroop	Trinidad*
John Cubit	Panama	(*new members)	

The Institute of Marine Affairs of Trinidad and The Marine Science Center, College of the Virgin Islands, St. Thomas were invited to Association membership. The following offers to host Association meetings were accepted by the board: 1) Miami, 1983; 2) Trinidad, 1984; and 3) St. Croix, 1986. An Invitation by Dr. Manuel Hernandez to host an Executive Board Meeting in Puerto Rico for 1982 was accepted by the Board.

The Business meeting was held on the evening of 7 September. Committees continued or appointed by the President included: HISTORY: Charlene Long*, Ernest Williams; ADVERTISEMENT: Paul Yoshioka; COMMUNICATION: Doon Ramsaroop*, Jeremy Woodly, Ray Hays; SCHEDULE: John Ogden*, Manuel Hernandez (*Chairman). New officers were elected:

President:	Alan Berman	Secretary-Treasurer:	Ernest Williams
1st Vice President:	Meridith Jones	Members-at-Large:	Charlene Long, Ray
2nd Vice President:	Doon Ramsaroop		Hayes, Jim Parrish

Despite the effects of Hurricane "Emily" and the direct threat of Hurricane "Floyd", the Bermuda Biological Station produced an excellent meeting. The Association is very grateful to Wolfgang Sterrer, Jim Burnett-Herkes, Brian Luckhurst, Margaret Emmot, Harry Barnes, and all the staff and students of the Bermuda Biological Station for making the sixteenth Meeting enjoyable and successful.

Ernest H. Williams - Editor.

ADDRESS BY THE PRESIDENT - Wolfgang E. Sterrer

As director of your host institution and current President of the AIMLC, I have the pleasure of welcoming you to Bermuda and its Biological Station. Of the 2 main goals of our Association, the first, to facilitate the exchange of information on marine research in the Caribbean, will be served by the presentations and discussions over the next 5 days; it is the second goal, to promote the well-being of island marine laboratories, that may deserve a few words.

Judging from my own experience, island laboratories are every bit as fragile as the ecosystems they are designed to explore - they are truely an endangered species. On the surface, the danger invariably expresses itself in financial terms; at the root, however, are misconceptions persistant among the decision makers in science politics. The image of marine stations as holiday resorts for "biologists recuperating from a seige of instructional duty", and "the proposition that one cannot continuously persue intellectual work in a warm climate", as listed by W. J. Crozier in 1923 in a letter to SCIENCE (vol. 57, no. 1478), are myths which are very much alive today, and so is the belief that it is more economical to have marine organisms shipped to the scientist's home lab. All those of us who have experienced the bliss of doing research at a marine lab, uninterrupted, and in close proximity to organisms in their natural environment, will agree that there is simply no substitute. Crozier (who during his 5 years as resident naturalist in Bermuda published 70 papers) continues to extol the virtues of an island marine laboratory: "Within less than an hour's run in a small boat from the Bermuda laboratory and in most cases closer than this, one could reach exposed or sheltered shores of sandy, muddy, or rocky type, caves, mangrove creeks, lagoons, and the locations of four or more distinct types of coral associations, each with its characteristic fauna, and all of them free of pollution; and this at all periods of the year. I doubt very much if those who have not tested the experience of continuous biological work (not merely collecting of specimens) under such conditions have a proper realization of its possibilities. The abundance of this fauna can be appreciated only by living with it. It seems to me stupid that the opportunity to further the advancement of biology in locations of this sort has not been seized."

As shown by the many island laboratories which have been founded since and are represented here today, this opportunity has been seized. The challenge to all of us is to ensure that island marine laboratories move away from the status of endangered species, and toward a stable and secure future.

THE AIR-BREATHING INTERTIDAL FAUNA OF BERMUDA

Reinhart Schuster
Inst. Zoologie, Univ. Graz, A-8010 Graz, Austria

The air-breathing intertidal fauna of Bermuda was examined in 1977 and 1981. More than 25 species of centipedes, pseudoscorpions, mites, apterygote and pterygote insects were collected. Mites are the dominant group both in number of species and individuals. Two orders (Pseudoscorpiones and Diplura), several families, and all species (except the centipede) collected from rocky shores are new records for the Bermudan fauna. The mite family Fortuyniidae, known from the tropical Pacific, is recorded for the first time from the Atlantic. Some taxa are new for science (Mahnert and Schuster 1981, Revue Susse Zool. vol. 88; Nosek, loc. cit.). Studies of the ecology and zoogeography of these groups are continuing.

THE DISTRIBUTION PATTERN OF GASTROPODS AND BIVALVES (MOLLUSCA) IN HARRINGTON SOUND, BERMUDA

Michael Schweimanns
Zoolog. Inst., D-23 Kiel, West Germany

The carbonate producers were identified to determine their abundances, dominance, substrate preferences and their biophysical factors influencing distribution, project SFB 95, Kiel University. Samples (140) were taken on 17 stations in 2 transects with an airlift (1000 mu mesh size) and SCUBA. The environment at each station was characterized by grain size analysis of surface sediment samples. Samples from 1977 were compared to the 1978 samples. Characteristic elements of the habitats were determined by statistical analysis. The abundances of every bivalve species with corresponding substratum preference helped to subdivide the bivalves into certain habitats. Less competitive species (feeding habits) occupying shallow water areas because of their better physiological adaptation complicated these patterns. A group of hard substratum inhabitants mainly occupy the rocky zone. Most bivalves in shallow water live within the sediment as suspension and detritus feeders. Species adapted physiologically to diurnal oxygen changes are mainly found in seagrass beds. Bivalves without respiratory pigments are usually found in open sandy areas. Bivalve communities of deeper sandy areas where water exposure is reduced became more stable. Dominant bivalves of the muddy zone are secondary hard substratum inhabitants. The distribution of gastropods showed the opposite trend. They were highly diverse and dominant towards shells in shallow waters. Few species penetrate the muddy area. Most snail species did not show a substratum preference. Their distribution is regulated by their specific feeding habits. Shallow water species penetrate deeper sediments differently from year to year. This may be due to different hydrographic conditions influencing the feeding range of benthos grazing fishes. So changes in abundances of bivalves and snails in the 2 years and the differences in numbers of shallow water species in deeper water layers can be a result of different grazing pressures. The green alga Cladophora showed a special faunal composition consisting out of 5 dominant species mainly detritus and diatom feeders. The spatial distribution within the mat had higher abundances than those in sandy areas. The decreasing abundances within the mat correspond to increasing oxygen deficiency. Bivalves played a minor part with a dominance less than 1%.

INTERACTIONS BETWEEN SPONGES AND HERMATYPIC CORALS IN CORAL REEF ENVIRNOMENTS OF PUERTO RICO

Vance P. Vicente
Center for Energy & Environmental Research, Univ. Puerto Rico, Mayaguez, PR

Sponges in coral reefs may never be seen directly interacting with corals. Such is the case of many tubular and ramose sponge species which project most of their growth vertically in the water column. In addition, many sponges are adapted to live in crevices or cryptic habitats which generally are not suitable environments for hermatypic corals. However, sponges strongly interact with corals and sometimes displace them through 1) Boring into their skeleton with or without harming live polyps (Cliona, Siphonodictyon), 2) Sprawling over live coral surfaces (Agelas conifera), and 3) Encrusting whole coral colonies without boring (Chondrilla nucula) or with boring the upper coral skeleton (Anthosigmella varians f. incrustans). A field study on A. varians f. incrustans indicates it grows at a rate of 0-7.3 cm/year and can cover live coral heads at the rate of 37.3-189 cm^2/year. The population dynamics of this species is presented and a theoretical model is proposed that attempts to evaluate its effect on the community.

INDIVIDUAL VARIATION IN THE CAVITY-DEFENSE BEHAVIORS OF THE STOMATOPOD, GONODACTYLUS BREDINI

Rick Steger and Roy L. Caldwell
Dept. Zoology, Univ. California, Berkeley, CA

The behavioral tactics employed by an individual during a contest generally correlate with its fighting ability. More specifically, any change in fighting ability should cause the animal's tactics to change in an appropriate manner. Few studies have been able to document this relationship due to the inseparable complications arising from experimental and environmental changes likewise associated with growth and/or age. Stomatopods, however, provide an opportunity to examine individual variation in aggression as a function of fighting ability without these complications. At the time of molting a stomatopod's fighting ability drops to zero. The fighting ability or Resource Holding Power (RHP), begins to increase within hours after the molt as the cuticle hardens. A few days later, RHP equals or surpasses its previous value. To quantify the effects on behavioral tactics, we conducted experiments in Panama at the Galeta Marine Laboratory. Newly molted stomatopods were allowed to take up residence in coral rubble cavities before being placed in contest situations against inter-molt opponents. The New-molts were tested on the day of molting (day 1), and also on subsequent days through day 10 in order to monitor individual variation. Control tests used randomly chosen Inter-molts for residents as well as intruders. Individuals did adjust their cavity-defense behaviors as a direct function of changes in RHP. However, possibly the most interesting data we obtained unambiguously documented the use of bluff tactics to defend a cavity. A comparable study has shown that injured stomatopods also change their behaviors in response to RHP. These studies demonstrate that stomatopods will adjust the expression of aggression as a function of fighting ability, independent of other considerations.

NEW ISOPODS FROM WEST INDIAN FISHES

Ernest H. Williams, Jr. and Lucy Bunkley Williams
Dept. Marine Sciences, Univ. Puerto Rico, Mayaguez, PR

Since our note (Williams and Williams 1977, Proc. Assoc. Is. Mar. Labs. Carib. 13:14) listing the parasitic isopods we had collected from West Indian fishes, we have described 14 additional species and have 2 more descriptions in review. Renocila colini was described from Apogon maculatus (Poey) and A. townsendi (Breder) from Mona Island; R. waldneri from Serranus tigrinus (Bloch) from La Caleta, Dominican Republic; and R. bowmani from the same host at Saona Island, Dominican Republic (Williams and Williams 1980, Proc. Biol. Soc. Wash. 93:573-592). Anilocra haemuli was described from Haemulon flavolineatum (Desmarest) and other grunts and groupers in Puerto Rico; A. holocentri from Holocentrus ascensionis (Osbeck) from Puerto Rico; A. myripristis from Myripristis jacobus Cuvier from Mona Island; A. acanthuri from Acanthurus chirurgus (Bloch) from Puerto Rico and Acanthurus bahianus Castelnau; A. chromis from Chromis multilineatus (Guichenot) from Puerto Rico and C. cyaneus (Poey); A. abudefdufi from Abudefduf saxatilis (Linnaeus) from Panama; A. holacanthi from Holacanthus tricolor (Bloch) from Puerto Rico; A. chaetodontis from Chaetodon capistratus Linnaeus and other butterfly fishes in Puerto Rico; and A. partiti from Pomacentrus partitus from Jamaica (Williams and Williams 1981, Proc. Biol. Soc. Wash. 94:1005-1047). A new species of Mothocya is being described from cardinalfishes, and a new Glossobius from halfbeaks in Puerto Rico.

EXPERIMENTAL TRANSFERS OF FEMALE *ANILOCRA CHROMIS* (ISOPODA: CYMOTHOIDAE) ON BROWN AND BLUE CHROMIS AT HYDROLAB HABITAT, ST. CROIX

Lucy Bunkley Williams and Ernest H. Williams, Jr.
Dept. Marine Sciences, Univ. Puerto Rico, Mayaguez, PR

Anilocra chromis Williams and Williams selectively parasitizes the brown chromis, *Chromis multilineatus* (Guichenot), in the northeastern West Indies and the blue chromis, *C. cyaneus* (Poey), in the northwestern West Indies, never both at the same location, although these fishes occur sympatrically throughout the West Indies. To test host suitability, *A. chromis* naturally infecting brown chromis were transferred to 42 previously uninfected brown and 42 previously uninfected blue chromis that were tagged and then released at their original site of capture at Salt River Submarine Canyon, St. Criox, U. S. Virgin Islands. *Anilocra chromis* were better able to survive on brown chromis than on blue chromis. Blue chromis reacted violently to the presence of this isopod whereas brown chromis did not. Brown chromis seemed to be behaviorly predisposed to infection by this parasite. This predisposition may determine which species of chromis is parasitized in a geographic area. This work was supported by 2 grants and 2 service contracts from NOAA, and conducted at the Hydrolab Habitat site.

DONDICE N. SP. (FAVORINIDAE: OPISTHOBRANCHIA) AND ITS ASSOCIATION WITH *CASSIOPEA* IN PUERTO RICO

Marielle Brandon
Dept. Marine Sciences, Univ. Puerto Rico, Mayaguez, PR

An undescribed species of *Dondice* occurs in association with *Cassiopea xamachana* on back reefs at La Parguera, Puerto Rico and is here reported as the first instance of an eolid nudibranch preying on an adult scyphozoan. As many as 5 (average 2) eolids per medusa feed upon the tentacular fringe bordering the mouths and also deposite their eggs on the oral surface of the medusa. The eolid has not been found apart from the medusa. The smallest specimens observed (7 mm) appear between late September and mid-October and none could be found after mid-July. The nudibranchs begin to spawn at 24 mm length. The spherical eggs (averaging 125 um) are layed in randomly folded, gelatinuous strings that are 0.6 mm in diameter and up to 200 mm long. A single egg mass is estimated to contain 30,000 ova. In 6 days, eggs hatch into veligers ranging in size from 150 to 200 um. Veligers are of the typical long-lived, planktotrophic type and begin to feed on micro-algae soon after hatching. Although the veligers readily feed on cultured micro-algae, none have lived in the laboratory for more than 19 days. *Dondice* veligers, of any age, have not been found on *Cassiopea* or in plankton samples. *Dondice* n. sp. averages 40 mm in length, is largely translucent ocher and has white rhinophores, tips of cerata and dorsal stripe. Up to 9 crescentric clusters of cerata occur on each side of the body, and there are up to 11 annulations per rhinophore. *Dondice* n. sp. differs from the most similar members of the genus in respect to prey, number of rhinophore annulations, groups of cerata and number of radular teeth.

A STUDY OF FISHERY ECOLOGY OF AN ISLAND REEF TRACT

James D. Parrish
Hawaii Cooperative Fisheries Research Unit, Honolulu, HI

The coral reef tract at Puako, on the leeward coast of the Island of Hawaii, contains a rich fauna of fish and invertebrates and supports a diverse, small-scale fishery. A two-year ecological study is aimed at characterizing the system by quantitative description of its major habitat and resource components and analyzing the fishery catch and effort. Substrate survey and mapping revealed widespread, rich coral growth and the occurrence of 6 major benthic habitat zones. Visual fish censuses taken at all seasons indicate an abundant and diverse fish fauna, dominated by herbivores and omnivores, particularly acanthurids and pomacentrids. Small, carnivorous wrasses are also abundant. There was little indication of seasonal variability except in the shallowest habitat zones, but fish communities in the same habitat zone at Puako showed a higher diversity evenness (J) value than at a nearby comparison site with low fishing pressure. Food studies of common, abundant wrasses indicated a diverse diet of mobile, cryptic benthic invertebrates headed by gastropods, pelecypods, crabs and echinoids. There was considerable evidence of piscivory, even among small-to-medium sized fishes. The small-scale, mostly recreational fishery employs primarily gill nets, throw nets, pole-and-line and spears. Intensity of the latter 2 methods varies considerably with the season. All methods catch and retain quite small fish. Current work based on an intensive fisherman census will estimate size-specific fishing mortality of important species. Combined with results of concurrent studies on age at reproductive maturity, thus indicate the extent of prereproductive fishing mortality. The results will allow management of this small-scale, low technology fishery without benefit of conventional catch records.

ICHTHYOPLANKTON OF THE CENTRAL VENEZUELAN COAST: COMPOSITION, ABUNDANCE AND SEASONALITY

Brian E. Luckhurst and Howard Powles
Division of Fisheries, Southampton, Bermuda

Monthly nocturnal samples of fish eggs and larvae were collected at 5 inshore stations (10 m depth) at Punta Moron, over a 13 month period. A total of 31,041 larvae were collected representing 41 kinds of larvae in 31 families. The Engraulidae dominated the samples comprising 89% of the total larval catch; the Gobiidae and Clupeidae ranked second (4.2%) and third (2.7%) respectively. There were no major differences in the taxonomic composition of the larval catches from the 5 stations. The 10 most abundant families were represented at all stations; identification and ecological notes as well as larval size ranges are presented for these families. The density of fish eggs and larvae was consistently higher in nocturnal samples than in 3 sets of diurnal samples taken from the same stations. No significant correlations were detected between water temperature and 3 biological variables. Fish egg density exhibited peaks in abundance in November, May and August. The larvae of the most abundant families had irregular pulses in abundance with a major peak in July. Other families (e.g. Carangidae, Gerreidae, Elopidae) were markedly seasonal in occurrence.

Proc. Assoc. Is. Mar. Labs. Carib. (1981) 16: 6

ANISOTREMUS MORICANDI (RANZANI) (PISCES: PERCIFORMES: HAEMULIDAE): THE THIRD CARIBBEAN SPECIES OF ITS GENUS

Arturo Acero P. and Jaime Garzon F.
INVEMAR, Santa Marta, Colombia

The third western Atlantic species of Anisotremus, last reported in 1925 in Panama, was rediscovered on the Caribbean coast of Colombia. New information has led us to its rediscription as A. moricandi (Ranzani). Ecology and distribution of the species are discussed. It differs from its 2 western Atlantic congeners mainly in the presence of 6 narrow white stripes on the brown background of its body and a dark blotch on the sides of the caudal peduncle; furthermore it has more pored lateral line scales (56-58). A. moricandi seems to have rather restricted ecological preferences, as so far it has only been observed in turbid waters around shallow rocky reefs. The species is now known from Panama, Colombia and Brasil. A. moricandi is the smallest species of its genus, and its distinctive color pattern results form the retention of the juvenile pattern.

HOMING BEHAVIOR OF IMMATURE GREEN TURTLES (CHELONIA MYDAS)

Leonard C. Ireland
Marine Biology Laboratory, Woods Hole, MA

Fifty immature green turtles were netted in the inshore waters about Bermuda, equipped with ultrasonic transmitters, and released at locations 1.5-11.0 km distant from their capture sites. Each turtle was tracked by investigators in a small boat fitted with an acoustic receiver and a directional hydrophone. Forty-eight of the turtles returned to points near the sites of their captures. The directions of waves, winds, or surface currents did not appear to affect the direction of travel chosen by the turtles in any predictable way. Once they arrived near their capture sites, the turtles displayed remarkable tenacity. The study showed that acoustic telemetry is a practical technique for studying the movements of immature green turtles in inshore waters. Studies of the sensory cues which guide the homing behavior of immature C. mydas may shed light on the sensory mechanisms which guide the long distance, reproductive migration of adult green turtles.

FORAGING BEHAVIOR OF JUVENILE GREEN TURTLES (CHELONIA MYDAS) ON ST. CROIX

John C. Ogden, Stacey Tighe, and S. Miller
West Indies Laboratory, Christiansted, St. Croix, USVI

Graze sites persisting for at least 2 years and composed of 1 to 4 scars (10 - >100 m^2 in area) of closely cropped seagrasses, mainly Thalassia testudinum, have been monitored by time lapse photography and attributed to foraging green turtles (Chelonia mydas). The scars are recropped an average of every 4 to 10 days. This strategy assures the turtle new growth relatively free from epiphytes and with certain potential chemical advantages such as low lignin content. Repeated grazing sets up a stress response in Thalassia over time resulting in narrow, often flaccid blades and lower productivity on an area basis. Scars slowly shift position within the site over time and new scars appear suddenly on occasion. Acoustical tracking of juvenile (40 cm) green turtles showed that individual animals have particular feeding areas and resting areas about 0.5 km apart. The turtles feed from early to mid-morning and again in mid- to late afternoon. Non-feeding periods are spent in the resting areas.

DIEL MIGRATIONS OF TWO PARROTFISHES

Ileana E. Clavijo and Ana T. Bardales
Dept. Marine Sciences, Univ. Puerto Rico, Mayaguez, PR

Daily migrations of 2 parrotfishes, Scarus guacamaia and S. coelestinus were documented at dawn and dusk at Salt River Submarine Canyon, St. Croix, U. S. Virgin Islands. Previous work in the area had established that these 2 species were not daytime residents in the canyon, but utilized caves on the walls as night shelter. The present study showed that both species enter the canyon approximately 1 hr before sunset at 2 sites, 1 on the east and 1 on the west wall. A greater number of fish entered the canyon at the east wall site. Fish became inactive and swam into caves as late as 25 minutes after sunset when ambient light intensity was lower than 0.016 foot candles. A limited number of observations indicate that individuals are capable of returning to the same shelter each night. Fish became active approximately 20 min before the time of sunrise also at ambient light intensities lower than 0.016 foot candles. The direction and time of departure from the canyon could not be determined precisely due to social interactions and milling behavior which continued as late as 2.5 hours after the time of sunrise. Scarus guacamaia were more numerous than S. coelestinus.

THE STRUCTURE OF THE OCEAN OFF PUNTA TUNA, PUERTO RICO

Jose M. Lopez
Center for Energy and Environment Research, Univ. Puerto Rico, Mayaguez, PR

The sea, south of Puerto Rico, shows variability in the upper 200 m, surface salinity varying from 34.2 to 36.7 ppt and temperatures from 26 to 29.5 C. The maximum salinity and minimum temperatures occur during winter and minimum salinity and maximum temperature during summer. Below 200 m the variability due to internal waves increases and is the most significant factor at 1000 m. Long-term variations in the temperature fields have a frequency on the order of 4 months. The current system is predominantly a westward drift with occurrence of occasional eddies and meanders. Ecological processes in this ocean appear to occur on small spatial scales as no large scale patterns were observed.

THE BERMUDA PLATFORM: A TRUE ATOLL IN THE ATLANTIC OCEAN

Dieter Meischner, Horst Torunski, and Gerhard Kuhn
Geol. Pal. Inst., George August Univ., West Germany

There has long been a controversy as to whether the apparent atoll morphology of the Bermuda platform is merely a thin veneer of algal and coral growth on older rocks formed by other processes, or true reef and lagoon structure. Shallow seismic reflection profiles (UNIBOOM) and deep vibration coring now reveal a clear picture. During inter-glacial periods, at high sea levels, reefs grew on older reefal elevations, former lagoon bottoms covered with newly generated calcareous mud, sand and shell. Susceptible grain sizes blown out from beaches formed dunes that prograded inland and amalgamated to the existing island core. During glacial periods, at low sea levels, recently formed and older carbonates underwent subaerial diagenesis, solution, and karst formation. Silicaceous soils accumulated in depressions of the surface. During periods of rising sea levels, semi-enclosed inshore basins filled with peat-marsh, pond, and finally marine deposits. By repeated rises and falls of the sea level, the atoll structure gradually became enhanced, and the calcarenite island grew to its present shape, the recent configuration of the Bermuda atoll being the most advanced one ever reached during this process. Bermuda looks like an atoll, was built up, and functions like an atoll. It is the only true oceanic atoll in the Atlantic Ocean.

BIOACCUMULATION OF RADIOCALCIUM BY SELECTED MARINE ORGANISMS

Raymond L. Hayes
Morehouse School of Medicine, Atlanta, GA

As a compliment to feasibility studies concerning oceanic disposal of low-level nuclear waste, we have examined the accumulation of radio-nuclides by marine organisms under controlled aquarium conditions. Our initial studies have evaluated the Atlantic oyster (Ostrea virginica), the killifish (Fundulus heteroclitus), and the crab (Panopeus herbstii) as biological monitors of radioactive pollution. We have also investigated water temperature as an experimental variable. ^{45}Ca was selected because of that element's ubiquity in biological tissues and because of its role in mineralization. Organisms were exposed for 8-12 hours to ^{45}Ca at 1.0 uC/ml of natural filtered sea water. Following transfer of non-radioactive water, 2-3 animals were sacrificed per time interval through 24 hours. Data were expressed as average cpm/mg protein or dry shell weight. Pulse accumulation and clearance rate were computed for each organism. For oysters, both inter- and subtidal regimes were conducted. Temperatures tested were 7 and 12 C (winter season), 17 C (spring or fall) and 25 and 30 C (summer). Preliminary results indicate that irrespective of temperature, total radioactive loading is greatest in the killifish, least in the crab and intermediate in the oyster. In fish, visceral levels are highest following the pulse loading, but decline progressively during chase. Skeletal levels increase gradually with time. The oyster tissue retaining the greatest radioactivity is the mantle, with muscle and gills slightly lower. Intertdal oysters are slower to lose radioactivity because of shell closure and sea water retention during exposure to air. The crab tissue showing the highest accumulation during pulse are viscera and muscle. However, during the chase these soft tissues lose radioactivity and the ^{45}Ca accumulates within the exoskeleton. Generally, radionuclide incorporation increases directly with an increase in temperature. Our data strongly suggest that marine species accumulate radioactivity from the sea water column differentially. Also, tisue constituents of these organisms accumulate radioactivity differently and, more significantly, clear of such radioactivity at specific rates. These differences reflect unique metabolic treatment of the radionuclide by the animal. Data analysis is in progress to determine the suitability of these species as biological monitors of radioactive contamination of the marine environment. We are able to conclude at this point, however, that other factors such as the season of the year, the tidal phase, the location of a nuclear spill and the delay in time prior to a monitoring effort are all important considerations as to the selection of an appropriate monitoring organism.

CHEMICAL AND PHARMACOLOGICAL INVESTIGATIONS ON BERMUDIAN FAUNA AND FLORA

John H. Cardellina II
Dept. Chemistry, Montana State Univ., Bozeman, MT

In the autumn of 1979, samples of 51 sponges, 15 algae, 7 tunicates, and 2 coelenterates were collected for pharmacological screening (anti-microbial and anti-cancer activities) and chemical study (isolations of novel chemical constituents). The status of the pharmacological evaluations will be discussed and the results of chemical investigations of 4 of the organisms will be presented.

Proc. Assoc. Is. Mar. Labs. Carib. (1981) 16: 9

NUTRIENTS AND TRACE METALS IN THE INSHORE WATERS OF BERMUDA

Timothy Jickells
Bermuda Biological Station, Ferry Reach, Bermuda

The Bermuda inshore waters divide into 2 distinct groups on the basis of the nutrient chemistry. In the more open bodies of water, nutrient levels are very low and there is evidence that benthic uptake, notably by the coral community, reduces levels to below those of the Sargasso Sea. In the more enclosed inshore waters, restricted water exchange and increasing relative amounts of terrestrial inputs result in elevated dissolved inorganic nitrogen concentrations. Interactions of sewage seepage with the local calcium carbonate rock remove phosphorus leading to a phosphorus-limited ecosystem in the enclosed inshore waters. While nutrients and primary productivity are elevated in the inshore waters relative to offshore and the open waters, the only body of water to show even the earliest stages of eutrophication is Hamilton Harbor. Trace metal distributions in the inshore waters follow a similar distribution pattern to nutrients, with the biggest increases in the inshore waters over offshore levels for copper, iron, and zinc. This similarity of distribution pattern does not, however, prove that the sources of these metals are the same as those of nutrients; boat traffic and dumping may be important sources of these metals.

SUBMARINE CAVE STUDIES IN BERMUDA

Thomas M. Iliffe
Bermuda Biological Station, Ferry Reach, Bermuda

The numerous terrestrial and marine caves of Bermuda present unique opportunities for geological, biological, and paleontological research. Bermuda is a mid-ocean volcanic seamount that is completely capped with Pleistocene and Recent, eolian and marine limestones. Caves have been formed within these limestones during glacial low stands of sea level when the land surface of Bermuda was approximately 13 times as large as today and consequently large bodies of fresh ground water necessary for cave formation were present. As post glacial sea levels rose, extensive portions of the caves were drowned by seawater. Recently, diving explorations into these underwater caves have produced a number of significant findings. Most interesting has been the discovery of a rich marine fauna inhabiting inland caves and cave pools. Plankton carried into caves by tidal currents provides an excellent food resource in a lightless and otherwise food poor environment. To date, 18 new species representing Polychaeta, Copepoda, Ostracoda, Tanaidacea, Isopoda, Amphipoda and Decapoda have been identified from the caves. Some of these animals lack eyes and pigment as evidence of their adaptation to the cave environment. Zoogeographic connections have been found between cave fauna of Bermuda and those of the Caribbean region and North America as well as Europe. A variety of marine algae including at least 1 new species has been found in inland, collapse cave pools open to daylight. Cave diving explorations have resulted in the discovery of Bermuda's longest cave, the totally underwater, 1.8 km long Green Bay Cave System. This essentially horizontal cave, developed at a depth of 17 m below sea level, served to carry water between Harrington Sound and the North Lagoon during periods of lowered sea level. Dating of speleothems, which only form in air, from this and other underwater caves has helped to produce a sea level curve showing fluctuations during the Pleistocene. Deposits of avian fossils within the caves, both above and below the water, are producing data on the Pleistocene fauna of Bermuda.

ENVIRONMENTAL SENSITIVITY MAPPING OF THE BERMUDA COASTAL ZONE

Thomas M. Sleeter
Bermuda Biological Station, Ferry Reach, Bermuda

A system was developed which ranks 15 coastal environments on a sensitivity scale 1-10 with respect to expected persistance of hazardous material spills (e.g. oil) within or along the coast. The index of coastal types is based on the geomorphology of the area, the dominant coastal processes and the amount of physical energy to which the coastline is subject. In general, areas exposed to high levels of physical energy (rocky headlands) rank low on the scale; whereas sheltered areas such as mangroves have the highest sensitivity ranking. The maps also identify pertinent political and socioeconomic resources as well as areas of biological significance. Water depths, current velocities, and distances across inlets are indicated for deployment of containment booms. This system of coastline sensitivity ranking provides a useful first step in the design of contingency plans for major spill disasters of for intelligent coastal zone management, as it identifies priority areas that require maximum effort for protection, clean-up and conservation. Therefore, strike teams, government and contractors charged with environmental protection or spill responce are provided a focus for their activities. This is particularly useful during the first few hours and days of a spill when resources are stressed and sound organization and consentration of effort are essential.

THE ROLE OF BIOLOGICAL RESEARCH FIELD STATIONS AS A CATALYST FOR LOCAL CONSERVATION

David Wingate
Flatts, Bermuda

In situations where large national or intenational research institutes or universities have established field research stations on small remote islands or in smaller undeveloped countries, there is a potentially enormous benefit to the islands or countries concerned in the form of detailed scientific information and expert advise which can be applied to the design of sound economic developments or conservation measures. The key to realizing this potential is a close working relationship between the local government or conservation groups and the research stations. In Bermuda, there has been increasingly close cooperation between the Biological Station, government and the Bermuda National Trust on matters of environmental concern with benefits on all sides. Examples are the Bermuda Inshore Waters Investigations program funded largely by the Bermuda Government; the collaboration of preparation of a book (on man's environmental impact and future options on Bermuda) entitled "Bermuda's Delicate Balance"; and most recently, a collaboration between the Station and Bermuda conservation groups inventorying and conservation of Bermuda's caves. Scientists from the Station have also frequently volunteered with restoration and maintanence work on Bermuda's nature reserves.

THE ENVIRONMENT OF A FRINGING REEF IN THE SOUTHERN CARIBBEAN

John Cubit
Smithsonian Tropical Research Inst., Cristobal, Panama

The Smithsonian Institution maintains an environmental monitoring program at the Galeta Point Marine Laboratory of the Smithsonian Tropical Research Institute on the Caribbean coast of Panama. This site is in the southernmost Caribbean (9^{o} 28'N), on a post-climax fringing reef. The hydrometerological factors being monitored are the following: wind speed and direction; air temperature; solar radiation; rainfall; salinity; water temperature; and water level. Concomitantly the following aspect of the biota are also being monitored: abundances of sessil organisms (algae, seagrasses, sponges, cnidarians) on the reef platform (as spacial coverage or biomass-density); population densities of sea urchins (predominantly Echinometra lucunter, E. viridis, Lytechinus variegatus and Eucidaris tribuloides); and growth rates and size-frequency distributions of the high intertidal littorinid snails (Littorina ziczac, L. angustior, L. lineolata, L. angulifera, L. nebulosa, Nodolittorina tuberculata, and Tectarius muricatus). The most important variation of the physical environment which affects the biota appears to be changes in water level. Extreme low tides periodically generate large-scale reductions in the abundances of the organisms of the reef platform. However, long-term monitoring data show that populations regularly recover. Experiments are now underway in which portions of the reef platform are irrigated during low tides. This has prevented the periodic reduction in the abundances of algae and seagrasses. These experiments will be continued over the long term to see how the periodic cycles of mortality and recovery affect the comminity composition of the reef platform.

TERRESTRIAL BODIES OF WATER ON BERMUDA

Martin S. Brewer and Timothy D. Jickells
Bermuda College, Prospect, Bermuda

Bermuda's ponds may be divided into 2 broad groups. One (unsealed) group contains those bodies of water which are connected to the groundwater of the island; the other (sealed) group comprised those sealed in some way from groundwater flushing. The groups of unsealed are brackish or saline and include open air cave pools all of which are open to flushing by the groundwater (which is polluted in Bermuda by sewage seepages) and by seawater. They range from relatively small deep pools connected to underground cave systems and containing relatively high concentrations of nitrate and low chlorophyll concentrations, to shallow well-lit lakes where phytoplankton activity reduces nitrate concentrations to low levels and gives high chlorophyll concentrations. The sealed groups comprised clay-sealed marshes as well as artificial ponds and one clay-sealed cave pool. The water sources for these pools are rainwater and runoff. All have low salinities and nitrate concentrations except where they are polluted. Of the other parameters measured, beside nitrate and chlorophyll, nitrite and ammonia were at very low levels except in 2 seriously polluted ponds; phosphate and silicate correlate with one another and negatively with salinity indicating a surface (or rainwater) source brought in by runoff or vadose percolation.

CORAL SURVEY OF BERMUDA'S REEFS

S. Robbie Smith and Katherine M. Muzik
Bermuda Biological Station, Ferry Reach, Bermuda

The schleractinian and octocorallian populations on the reefs of the Bermuda platform were surveyed in 1980 at 21 sites with ten 10 m line transects. Hard corals were identified and measured after Loya (1972). Any soft coral intersecting the vertical plane of the transect line was measured in width and height. Reef habitats surveyed were seaward and shoreward of the "boiler" reefs on the south shore, ledge flats on the northern perimeter of the platform, reef-front terrace seaward of the ledge flats, and some lagoonal patch reefs. The highest mean percent coverage by hard corals, per site, was found outside of the "boilers" and on the reef-front terrace, with values ranging from 36-60%. Inside he "boilers", on the ledge flats and on the patch reefs, hard coral coverage varied from 12-39%. The dominant coral at 15 sites was the brain coral, Diploria strigosa, mainly on the reef-front terrace, inside and outside of the "boilers" and on the ledge flats. D. labyrinthiformes, Porites asteroides, Montastrea annularis, M. cavernosa and Stephanocoenia michelini were the next most abundant hard corals. Montastrea annularis dominated the lagoonal reefs, along with Madracis decactis, Madracis mirabilis, Oculina diffusa and the hydrizoan, Millepora alcicornis. The distribution of the hard coral species around the island's reefs appeared to be fairly even, though the branching species, Madracis spp. and Oculina spp. were found only on the lagoonal patch reefs. The greatest density of soft corals was found at the southwest edge of the platform, at Chaddock Bar, with a mean value of 24.5 colonies per transect. Values at other sites ranged down to 6.9. No consistant pattern in their density distribution could be determined though some higher densities were recorded outside of the "boilers", on the ledge flats and on some patch reefs. Pseudoplexaura spp. dominated the soft coral populations at 16 sites. Other species that dominated surveyed reefs were Plexaura flexosa, P. homomalla, Gorgonia ventalina and Eunicia spp. The distribution of the different species was also fairly even around the platform. However, Gorgonia ventalina was very abundant only in the patch reefs and sparce on other areas. Pseudopterogorgia spp. were common on all sites except the lagoonal patch reefs.

OCTOCORALS IN AN ESTURINE ENVIRONMENT WITH SPECIAL REFERENCE TO TRINIDAD

Doon Ramsaroop
Institute of Marine Affairs, St. James, Trinidad

The coastal waters of Trinidad are significantly affected by Orinoco River discharge. Surface salinity is sub-oceanic throughout the year and fluctuates seasonally. Turbidity levels are high, and light penetration is severely inhibited. Sharp thermoclines and haloclines occur. Hermatypic corals are generally restricted to depths shallower that 10 m while ahermatypic species are common below 10 m. There is species impoverishment of the hermatypic fauna, whereas there is species enrichment of the ahermatypic. Population densities are high in both groups. Several species found only at depths in excess of 200 m in other areas, are common at depths as shallow as 25 m. Fluctuating salinities cause all hermatypic and the few ahermatypic forms occurring at depths shallower than 10 m to be necessarily euryhaline.

REPRODUCTIVE CYCLES OF THREE SPECIES OF OCTOCORALS IN LA PARGUERA, PUERTO RICO

Ana Teresa Bardales
Dept. Marine Sciences, Univ. Puerto Rico, Mayaguez, PR

Telesto riisei (Telestidae), Briareum asbestinum (Briareidae) and Muriceopsis flavida (Plexauridae), each having a different growth form, were collected semimonthly during the course of 1 year and examined for sex, number and size of gonads. All 3 species were dioecious and only 1% were hermaphrodites. M. flavida and B. asbestinum have an annual reproductive cycle, spawning activity lasting from January through March and from April through July, respectively. T. riisei was found to reproduce throughout the year. Sexes are synchronized in colonies of T. riisei and M. flavida, a mechanism that ensures a greater fertilization rate. B. asbestinum has the largest spermary and ova diameters and largests number of mature ova per polyp. M. flavida spawns earlier in the year in deep water populations than in shallow ones. In B. asbestinum shallow populations spawn earlier in the year than deep water ones. Tmperature and moon phase are important factors regulating reproduction in these West Indian octocorals.

THE DISTRIBUTION OF BLACK CORALS ALONG BONAIRE

E. C. Newton and T. van't Hof
Netherland Antilles National Park Foundation, Bonaire

A survey of black coral around Bonaire was conducted for resource management. In 49 vertical transects 10 m wide, from the surface to 60 m, the number of colonies belonging to 2 species has been counted per 5 m depth interval, distinguishing 6 size classes. The 2 species are a possibly undescribed bushy species with resemblance to Antipathes dichotoma Pallas as redescribed by Brook and A. pennacea Pallas as redescribed by Opresko, a flabellate species. The former species is most used in jewelry manufacture. The total number of A. cf dichotoma is considerably lower than tha of A. pennacea, but generally they have similar fluctuations in the horizontal distribution. The windward side of the island has far less numbers of these species and A. cf dichotoma is often absent. The optimal depth for A. pennacea is deeper (40-45 m) than for A. cf dichotoma (25-30 m), with a maximum depth of 60 m for A. cf dichotoma. The size distribution of A. pennacea is much steeper than tha of A. cf dichotoma, the last species having relatively less smaller specimens and relatively more large ones, suggesting a larger turn-over of A. pennacea (IUCN/WWF Project 1496).

TRINIDAD AND TOBAGO'S INSTITUTE OF MARINE AFFAIRS: A BREIF OVERVIEW

Ronald B. Linsky
Institute of Marine Affairs, St. James, Trinidad

The institute was established by the Trinidad and Tobago Parliament in 1976: To promote and encourage a deeper and broader understanding and appreciation of all aspects of the marine environment; to make available to the nation and the wider Caribbean region knowledge of this environment as developed by various disciplines; to increase the capabilities of the government in the formulation of consistant and informed policies of marine affairs. The Institute has 2 divisions based upon the functional activities. Research and Development is composed of: Coastal Area Planning and management; Environmental quality; Socio-Economic and Legal; Natural Resources; and Ocean Technology: Advisory Services Division of Information Services; Public Education; and Extension Services. The Institute has 80 staff. The 7000 sq. ft. Marine Analytical and Biological and Physical Oceanographic Labs are being completed. Phase 2 will be 11,000 sq. ft. of support and advisory services facilities and Phase 3 an Ocean Technology facility of 5000 sq. ft. in 1982.