

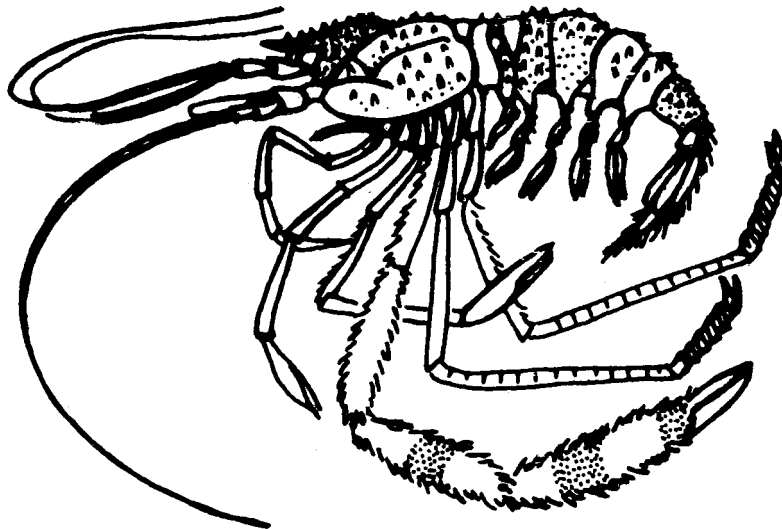
Kay Waldner

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INTRODUCTION

The 12th Meeting of the Association of Island Marine Laboratories of the Caribbean was hosted by the Caribbean Marine Biological Institute in Curacao, Netherlands Antilles from 22 to 26 September 1976. The Island Government of Curacao represented by the Lieutenant Governor Mr. Ornelio Martina and others welcomed the Association with a cocktail party at the Frommer Hotel on the evening of 22 September. The following morning Mr. Martina and AIMLC 1st Vice President Meredith Jones officially opened the meeting with brief addresses prior to the first of ten sessions of scientific paper presentations. The sessions extended for two days in facilities of the Frommer Hotel adjacent to the Caribbean Marine Biological Institute, as 39 papers were presented and 66 registrants from 7 countries representing more than 24 laboratories and universities exchanged information.

The regular meeting was concluded Friday night with a splendid exhibition of folkloric dancing and a cocktail party offered by Mr. Wilson Godett, Minister of Sport, Culture and Recreation and organized and hosted by Mr. E. A. V. Jesurun, Head of the Bureau of Culture and Education and Mr. Johan van Walbeeckplein of Curacao. This festive event was held at the Landhuis Brakkeput Mei-Mei.

At the business meeting of the Association held on Thursday evening an institutional membership invitation was extended to the St. Croix Marine Station of the University of Texas.

Following the regular sessions a large contingent was accompanied to Bonaire, Netherlands Antilles, by Ingvar Kristensen, Director of CARMABI, for a variety of excursions. Throughout the 12th Meeting Ingvar and the staff and students of the Caribbean Marine Biological Institute provided tireless help of all sorts. Their able organization and cordial hosting of this meeting brings thanks from all the participants.

INFLUENCE OF FREE AMMONIA AND INSOLUBLES
ON THE APPLICATION OF SEAWATER
FOR INDUSTRIAL REFRIGERATION

Ali H. Baha Al-Deen
Departamento de Química
Universidad de Oriente
Cumaná, Venezuela
and
Biserka Krog de Baha Al-Deen
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

In a Venezuelan salt work, where seawater is used as coolant, excessive corrosion and abnormal equipment wear were observed, although the equipment was designed to work under such conditions. Those two phenomena were attributed to the presence of free ammonia and suspended insolubles which apparently act as abrasives. To ascertain whether this is true, the content of insolubles in seawater and its distribution with depth in the suction area were studied. We found a maximum of 28.6 ppm and a minimum of 1.3 ppm of insolubles with a mean value of 25.0 ppm of insolubles in the surface water (0 to 20 cm) and 28.6 ppm of insolubles at a depth of about 180 cm. The lowest values were observed at the intermediate layers (60 to 140 cm) with a range of traces of insolubles (not appreciable quantitatively) up to 10 ppm of insolubles, except for one case. These values are influenced by the type of tides. The contents of ammonium-N and free ammonia in seawater were 0.2240 ppm and 0.2340 ppm and 0.2724 ppm and 0.2845 ppm, respectively, while these values were 0.080 ppm and 0.0973 ppm, respectively, in the waste water. It was also determined that the ammonium-N and free ammonia content of the water, in a well initially proposed to be used for the equipment refrigeration, was about 500 times higher than that in seawater. From the results obtained above, it was suggested that the use of the well should be eliminated and that the refrigeration should be made by suction of seawater from the study area and at intermediate depths.

DISTRIBUCION DE NITROGENO ORGANICO PARTICULADO
EN COSTAS DEL ESTADO SUCRE--VENEZUELA

José Benítez A.
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

En base a las observaciones realizadas en los Golfos de Paria, Cariaco y Santa Fé a bordo de la M/N "La Salle" y M/N Dios Te Salve durante los años de 1973 y 1974, se determinó la distribución y concentración del nitrógeno orgánico particulado en las diferentes épocas del año (sequía y lluvia). Se encontraron concentraciones mayores en la época de sequía y en determinadas zonas de cada golfo. Al comparar la distribución del nitrógeno orgánico particulado con otros parámetros hidroquímicos se observamos que la distribución del nitrógeno orgánico particulado en costas del Estado Sucre está influenciado por el aporte del agua de los ríos, por el flujo de agua oceánica y por la actividad fotosintética. También al comparar el valor promedio del nitrógeno orgánico particulado entre los golfos mencionados, así como con el de otras áreas, se nota que hay variaciones en las concentraciones.

HYDROCHEMICAL ASPECTS OF THE DEEP WATERS IN THE GULF OF CARIACO, VENEZUELA

Taizo Okuda
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

The hydrochemical conditions in the southeastern area of the Caribbean Sea are influenced mainly by seasonal variations in upwelling directly related to the Trade Winds regime. The Gulf of Cariaco is located in the eastern part of the Cariaco Trench. The entrance to the Gulf is very narrow and its depth (60-70 m) is less than that of the central part of the Gulf (90 m approximately). The geographical situation of the Gulf of Cariaco and the variation in intensity of the upwelling process, dominates the hydrographical and chemical conditions of the Gulf. Based on data obtained during our observations, in the years between 1972 and 1975, some hydrographic and chemical aspects of the deep waters of the Gulf of Cariaco have been analyzed. In the season of less upwelling intensity, anoxic conditions develop in the deep layers; this occurs during the period from June to December and is accompanied by various biochemical processes, such as denitrification and reduction of sulphate. Hydrochemical characteristics in the process of development of the anoxic condition in the deep layers of the Gulf of Cariaco have been observed.

Holocene Reef Accretion on the Leeward Side of Curacao, Netherlands Antilles

Jaap W. Focke

Geological Institute
Leiden University
The Netherlands

Caribbean Marine
Biological Institute
Curacao, Netherlands Antilles

Along the leeward side of Curacao a flourishing coral fringing reef is found with a shallow (6-12 m) reef platform, a drop-off and a fore reef slope. In spite of active coral growth the possibility could not be denied that this reef consisted of only a relatively thin veneer of Holocene accretion on top of some older basement, presumably a submarine Pleistocene terrace.

A deep submarine section, blown through the reef platform with explosives, demonstrated the presence however of at least 12 meter vertical Holocene accretion. No older basement or other discontinuities could be found. The internal structure shows a vertically and laterally continuous reef facies in which the corals Montastrea annularis, Colpophyllia natans, Acropora cervicornis and Diploria labyrinthiformis predominate. The framework is interlocking with unsorted sediment filling the interspaces. No significant difference could be found between the coral assemblages of internal structure and living platform reef. Coral species and growth forms associated with deeper parts of the reef are lacking. These data suggest a gradual upward growth following post-Wisconsin sea level rise. Furthermore the recent platform reef is regarded as the living equivalent of the fossil reef.

The gross carbonate production on the living reef will be compared with the net accumulation rate of the internal structure (radiocarbon datings, from which relations with known sea level movements will possibly emerge, as well as accurate data on net accumulation rates, will be available in the near future).

The gross carbonate production on the living reef is being approximated using recent data (Bak, in press) on carbonate production per unit area living coral tissue. Tentative calculations yield production rates of approximately $5 \cdot 10^3$ g/m²/year, permitting maximum upward growth rates of 5 mm/year. This is probably sufficient to match sea level rise relative to Curacao in the last 8000 years.

Marine diagenetic features are strikingly absent: marine biodegradation only slightly affected the coral framework, marine cements are completely lacking. As a result the original framework has been preserved without much alteration. Encrusting coralline algae are insignificant both by volume and as framebinders.

In a similar setting on Bonaire a Pleistocene basement was found underneath some 12 meter Holocene reef deposits, at depths of 20-25 m below mean sea level. This reef successfully masked a preexisting karst topography on a 1-5 m scale.

QUATERNARY MARINE TERRACES OF LA BLANQUILLA (VENEZUELA) AND CURACAO (NETHERLANDS ANTILLES): PROGRESS REPORT

Carlos Schubert
I. V. I. C., Apartado 1827
Caracas 101, Venezuela

Three limestone terraces crop out on La Blanquilla (northeastern Venezuelan continental platform), at 7-10, 11-15, and 25 to over 30 m above sea level, respectively (Limestone Terraces 1, 2, and 3). The terraces consist of a flat top surface and an external cliff, in reef limestone with subordinate calcarenite and beach rock. This limestone is called Blanquilla Formation and overlies unconformably the Paleocene granitic basement of the island. All three limestone terraces contain varying amounts of fossils (mostly coral). These show progressive diagenetic alteration with age. Limestone Terrace 1 (youngest) contains relatively fresh coral, and numerous examples of former sea level (or island) stands, such as wave-cut notches and emerged submarine caves. Limestone Terraces 2 and 3 (middle and oldest) show significant diagenesis in terms of recrystallization of original aragonite to calcite, and secondary calcite deposition. In the highest terrace, almost total recrystallization was observed.

The well known sequence of five marine terraces on Curacao (Lower, Middle I, Middle II, Higher, and Highest Terraces; de Buissonje, 1974) was studied and sampled for geochronological purposes. A similar progressive diagenesis with age was observed. The Lower Terrace (youngest) contains fresh coral, frequently in growth position. From the Middle Terrace upward, the limestone shows significant recrystallization of original aragonite to calcite, and in the Highest Terrace almost all coral structure has disappeared.

Carefully collected suitable samples of coral in growth position of all terraces are being Th/U dated in collaboration with the U.S. Geological Survey (Denver). Preliminary correlation of the Lower Terrace of Curacao and Limestone Terrace 1 of La Blanquilla can be made with Terrace III of Barbados and the main limestone terrace of La Urchile.

PHYTOPLANKTON OF THE GULF OF SANTA FE
AND ADJACENT AREAS (1973-1974)

Jeanette Breeuwer de Ramírez
Universidad Simón Rodríguez
Caracas, Venezuela

The analysis of 538 samples, collected monthly at 11 stations, at depths of 0, 5, 10 and 20 meters, during the period April 1973-March 1974, is given.

In general, it was observed that the phytoplankton shows marked differences, both quantitative and qualitative, throughout the year. The composition and density of phytoplankton varies slightly between stations, owed mainly to the differences of upwelling intensity at each station. Station 1 shows stronger upwelling events, which are also observed approximately one month earlier than at the others.

The densities found were between 10 and 10^4 cells/ml, with lowest values of 10.14 cells/ml and highest values of 5443.23 cells/ml.

The phytoplankton maxima were found during the months of May, June, December, 1973, January and March, 1974, while the minima were found from September through November 1973.

The periods of highest densities are characterized by a great variety and abundance of diatoms, among which Thalassiosira excentrica, Nitzschia pungens, Cylindrotheca closterium, Chaetoceros spp., Rhizosolenia delicatula, Rh. stolterforthii, Leptocylindrus danicus and Skeletonema costatum are the most abundant. Equally, a great variety of dinoflagellates was observed, although in lower concentrations, among which are found Dinophysis caudata, D. recurva, Gonyaulax polygramma, G. catenata, G. tammarensis excavata, Prorocentrum micans, Ceratium furca hircus, Polykrikos sp., Peridinium trochoideum.

During the months of intermediate densities there is predominance of C. closterium and N. pungens in addition to spores of Gimnodinium and small species of Peridinium. These last two are practically the only ones present during the periods of low densities.

Also, silicoflagellates were found, in small quantities during September, December, 1973, and March, 1974, especially in deeper samples. Two species were found, Distephanus octonarius and Dictyocha fibula.

PRODUCTIVIDAD PRIMARIA EN LAGUNA GRANDE DEL OBISPO,
GOLFO DE CARIACO, VENEZUELA, DURANTE EL PERIODO
ENERO-JULIO DE 1974

Elvira Ferraz de Reyes
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

Se estimó la productividad primaria en Laguna Grande del Obispo, Golfo de Cariaco, Venezuela, mediante el método de incorporación de ^{14}C (Steeman Nielsen, 1952), durante el período enero-julio de 1974, el cual correspondió a la época de mayor surgencia en el área, para el año señalado.

Se observaron dos períodos de máxima productividad primaria, uno en febrero y otro en mayo, presentándose incrementos en los valores de clorofila *a* y en el número de células por unidad de volúmen. Los organismos dominantes en el fitoplancton, fueron las diatomeas. Los valores más bajos de productividad se encontraron a fines de junio y en julio.

ESTUDIO BACTERIOLOGICO DEL GOLFO DE
SANTA FE Y AREAS ADYACENTES

Esther Fernández Alvarez
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

La distribución cuantitativa de bacterias heterotrófas en el Golfo de Santa Fe (Estado Sucre, Venezuela) está influenciada principalmente por la penetración de masas de agua provenientes de la Fosa de Cariaco y la surgencia local en la zona. El estudio se realizó filtrando 20 ml de agua de mar, por el sistema de filtros de membrana y agar marino 2216E (Difco) con 75% de agua de mar añeja y filtrada. Se midieron algunos parámetros físico-químicos como temperatura, salinidad, oxígeno disuelto, transparencia y transmisibilidad del agua, durante los meses de abril a julio los valores se presentan algo bajos, relativamente altos durante septiembre, diciembre, enero, febrero y marzo. La concentración promedio en la zona de estudio es de 4.5×10^3 colonias/20 ml.

La relación entre la densidad de bacterias heterotrófas y los parámetros físico-químico estudiados no es muy notable a excepción de la correspondencia bastante marcada con el oxígeno disuelto, la transparencia y transmisibilidad del agua.

En general la región presenta una población bacteriana cuantitativamente muy abundante.

SOME ASPECTS RELATED TO THE POPULATION DYNAMICS OF THE
SEATROUT Cynoscion virescens ALONG THE NORTHEASTERN
COAST OF SOUTH AMERICA FROM VENEZUELA TO
FRENCH GUYANA

Alfonso Lozano, Rigoberto Cáceres and Hno. Ginés
Fundación La Salle de Ciencias Naturales
Estación de Investigaciones Marinas de Margarita
Punta de Piedras, Isla de Margarita, Venezuela

Biological data on Cynoscion virescens were collected during 10 exploratory fishing expeditions along the northeast coast of South America in 1967, 1968, 1969 and 1971. Growth was calculated and several values of natural mortality, fishing mortality and age at entry to exploited phase were taken to calculate, for the exploited phase, annual mean numbers per recruit, annual yield in numbers per recruit, annual mean biomass per recruit, annual yield in weight per recruit. Recommendations are advanced for the management of the fishery.

THE DISTRIBUTION OF ALGAL EPIPHYTES ON MACROPHYTE
HOSTS, OFFSHORE FROM LA PARGUERA, PUERTO RICO

David L. Ballantine and Luis R. Almodóvar
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

During a three year study period, 180 species of algae were identified from an algal plain located two miles off the southwest coast of Puerto Rico. One hundred nine species comprising 61% of the total flora were observed growing either as epiphytes or endophytes. Red algae were the most common epiphytes, and in this group the order Ceramiales was best represented.

Host plants varied considerably in their suitability to support epiphytes; however, the suitability of both good and poor hosts increased with age. A definite zonation pattern of epiphytes was observed on many host plants. Epiphytism was heaviest on the older portions of plant hosts and both numbers and abundance of epiphytic species decreased with proximity to meristematic regions. Composition of epiphytic species also commonly differed between young and old portions of algal hosts.

INFORME PRELIMINAR DE LAS ALGAS MARINAS BENTONICAS MACROSCOPICAS DE LA REPUBLICA DOMINICANA

Luis R. Almodóvar
Departamento de Ciencias Marinas
Universidad de Puerto Rico
Mayaguez, Puerto Rico
y
Idelissa Bonnelly de Calventi
Centro de Investigaciones de Biología Marina
Universidad Autónoma de Santo Domingo
Santo Domingo, República Dominicana

El conocimiento de las algas marinas bentónicas macroscópicas de la República Dominicana es limitado. Gran parte de los estudios en la Isla de Española comprenden aquellos que se han realizado en la costa oeste de Haití. El primer y único informe de recolecciones en Santo Domingo es el de Børgesen (1924) quien presenta 63 especies.

No fue hasta 1972 que el primer autor de este trabajo visitó la República Dominicana por siete días como participante del Torneo Anual del Club Náutico de Santo Domingo de Pesca Deportiva en Boca de Yuma realizando recolectas en el poblado de Yuma, la Ría de Yuma y Playa Borinquen, encontrando 63 especies de algas marinas bentónicas macroscópicas, de las cuales 16 fueron colectadas por primera para la zona.

Como parte del programa docente y de investigación de la Universidad Autónoma de Santo Domingo y bajo la responsabilidad del Centro de Investigaciones de Biología Marina, ha empezado un programa de amplias proyecciones en las ciencias marinas. El segundo autor tomó la iniciativa estimulando a los estudiantes para realizar recolecciones de plantas marinas en el curso de Métodos de Investigación durante el año 1976. Las áreas estudiadas comprenden la Bahía de Puerto Viejo en Azúa, Guayacanes en San Pedro de Macoris, Guibia y Boca Chica en el Distrito Nacional. Un total de 200 especímenes fueron examinados y 9 especies resultaron nuevos informes de recolección.

Tomando los informes de Børgesen y Almodóvar encontramos que hay un total aproximado de 132 especies de algas marinas informadas para la República Dominicana.

Con el deseo de ampliar el catálogo presente, se procedió a realizar una serie de visitas a varios puntos en la costa norte, a saber Playa Escocesa, Cabo Francés Viejo, Playa Preciosa, Sosua, y Puerto Plata; costa sur Playa Montero, Soco y Marota en San Pedro de Macoris; Boca Chica, D.N. y Puerto Viejo en Azúa. Estas recolecciones están pendientes para ser estudiadas en el Departamento de Ciencias Marinas de la Universidad de Puerto Rico, Recinto de Mayaguez.

DETERMINACION TAXONOMICA DE UNA MICROALGA MARINA EN BASE A SUS PIGMENTOS

Gilberto Cedeño F. y Elvira F. de Reyes
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

Se aisló una microalga marina en aguas del Golfo de Cariaco y se cultivó bajo condiciones controladas, usando los enriquecimientos nutritivos sugeridos por Guillard y Ryther (1962). De la biomasa recolectada a los 7 días se extrajeron los pigmentos con metanol, los cuales fueron separados por cromatografía en capa fina, usando silicagel AG y una mezcla de éter de petróleo, acetato de etilo y dietilamina en la proporción 58:30:12. En las bandas principales se identificaron clorofila "a", clorofila "b", caroteno "a" y violaxantin.

De acuerdo a los resultados obtenidos y según la table de distribución de pigmentos propuesta por Chapman (1973) la microalga aislada, la cual fué difícil ubicarla taxonómicamente, se clasificó dentro del grupo de las Chlorophyceae.

USE OF THE SEAWEED Hypnea Musciformis (RHODOPHYTA) IN TREATING OIL REFINERY WASTES

Kenneth C. Haines and Rosemary K. Monahan
University of Texas Marine Science Institute
St. Croix Marine Station
St. Croix, U.S. Virgin Islands

The carrageenan-producing red seaweed Hypnea musciformis (Wulfen) Lamaroux was tested in batch cultures for its ability to grow in various mixtures of surface seawater and two oil refinery waste effluents entering oxidation ponds. The refinery effluents are rich in ammonia-nitrogen; removal of this nutrient by micro-algae in oxidation ponds is not desirable because this results in a high suspended solids content, and harvesting the micro-algae is not practical. Seaweeds, being macroscopic, can be easily harvested.

Single growing tips (1.2-1.9 mg fresh weight) were incubated ten days in 300 ml seawater/effluent mixtures under ca 1,000 ft-candles fluorescent light on a 12 hr light/12 hr dark cycle at 23.5-29.5° C. Growth rates (doublings per day) were calculated from the increase in fresh weight during the incubation period.

The effluent from the west refinery was more toxic to Hypnea than was the effluent from the east refinery: 60% dilution of the west refinery effluent with seawater was required before growth occurred, while only 20% dilution of the east refinery effluent was required for growth to occur. Growth rates generally increased with increased dilution, indicating reduction of toxicity due to some factor(s). Growth rates equal to 49% and 76% of that observed in an optimal culture medium were observed in 5% refinery effluent/95% seawater mixtures.

Comparison of salinities and concentrations of ammonia-nitrogen and sulfides in the various dilutions of the two refinery effluents indicates that something other than salinity, ammonia-nitrogen or sulfides is the toxic factor(s). Petroleum residues are suspected to be the toxic substances; these were detected (by smell) in refinery effluents diluted as much as 90-95% with seawater.

Although the experiment indicated that the refinery waste effluents can support growth of Hypnea only after considerable dilution with seawater, it may also be possible to use the oxidation ponds as a primary treatment process to reduce the toxicity of the effluents to Hypnea. Additional studies in long-term outdoor continuous-flow culture systems would be necessary to test the effects of fluctuations in effluent properties on growth of Hypnea during the course of refinery operations.

ANTIBIOLOGICAL ACTIVITY OF SOME CARIBBEAN SPONGES
AGAINST THE SEA ANEMONE, Aiptasia tagetes

Lin L. Craft and Rick Kellner
College of the Virgin Islands
St. Thomas, U.S. Virgin Islands

The mangrove sea anemone, Aiptasia tagetes was used to assay some Caribbean sponges for antibiological activity. Standardized crude alcohol extracts were prepared by adding 5 ml of 95% ethanol per gram of wet sponge (sponges were "drip-dried" to remove excess water before being weighed and placed in ethanol). Assay tests were carried out in dishes containing pairs of attached, relaxed anemones in seawater to which sponge extract preparations consisting of the residue from 8 ml of evaporated alcohol crude extract dissolved in 25 ml of seawater were added.

In preliminary testing, effects of sponge extracts on anemones ranged from no detectable response through a wide spectrum of physical reactions which, in several cases, resulted in death of the sea anemones. Of 42 species of sponges tested, the following 9 were strongly antibiotic causing death of the anemones within 60 minutes, some in less than 15 minutes: Haliclona rubens, Haliclona subtriangularis, Haliclona erina, Haliclona manus, Xestospongia longleyi, Dysidea etherea, Merriamium tortugasensis, Agelas dispar, and an unidentified sponge, CVI Unknown #10. Five other sponges produced debilitation to the extent that anemones failed to recover within one hour: Verongia lacunosa, Verongia longissima, lanthella ardis, CVI Unknown #2 and CVI Unknown #9.

The effects produced in Aiptasia by the above sponges indicates the presence of strong antibiological compounds. Most of these sponges also exhibit antimicrobial and in some cases, ichthyotoxic activity. To our knowledge this work constitutes the first use of a sizeable marine invertebrate in screening for biologically active substances in marine sponges. The nature of the physiological stresses being imposed on the anemone through exposure to these sponge extracts is not yet known, and work is in progress to isolate and identify the active compounds in the sponges listed above.

ANTIBIOTIC ACTIVITY OF BACTERIA ISOLATED FROM SOME CARIBBEAN SPONGES

Helen W. Gjessing and Robert Ruskin
College of the Virgin Islands
St. Thomas, U.S. Virgin Islands

Bacteria showing antibiotic activity against several species of terrestrial bacteria and the yeast Candida albicans have been isolated from the Caribbean sponges Haliclona rubens, Haliclona sp. ("brown"), Verrucaria longissima and Gellioides sp. 1. Terrestrial bacteria routinely used in the antibiotic assay included Staphylococcus aureus, Bacillus subtilis, Escherichia coli and Mycobacterium smegmatis. Nutrient broth cultures of these were spread on nutrient agar plates. Filter paper disks soaked in marine broth cultures of the marine bacteria were dried and planted on the seeded plates. Of 16 marine isolates tested, seven have inhibited growth of the assay bacteria, two inhibited Candida. These are all short, gram negative motile rods. Taxonomic studies have not been completed. One species appears to be a true symbiont of sponges, since repeated efforts to isolate it from sediment and seawater surrounding the sponges have been unsuccessful. Cell-free broth filtrates of two of the antibiotic sponge bacteria were also antibiotic, whereas equal amounts of uninoculated marine broth absorbed on disks did not inhibit growth. Further studies will include mouse protection tests and the chromatographic separation of active fractions in an attempt to elucidate the chemical structures of the active components.

THE INTRASPONGE FAUNA OF THE LOGGERHEAD OR MANJACK
SPONGE (PORIFERA: Sphaciospongia vesparia (LAMARCK) MARSHALL)

Paul Hoetjes, Eddy Westinga and Hans de Kruijf
Caribbean Marine Biological Institute
Curacao, Netherland Antilles

We have investigated the intrasponge fauna of the loggerhead sponge, Sphaciospongia vesparia (Lamarck) Marshall.

These sponges usually occur at depths of 30-65 m (100-200 ft), though at St. Michiels Bay we could collect many of them at a depth of about 3 m (10 ft). Thirty sponges of various sizes from 0.025 litre to 14 l were cut in slices (± 1 cm) and kept in alcohol (5%) for a period of several hours in order to remove and collect all inquilines (lodgers) larger than about one millimeter. Next the slices were thoroughly searched for remaining animals.

In all sponges we sampled, the same taxonomic groups of animals were collected. Two species of snapping shrimp (mostly parasitized by bopyrid isopods), and worms of the family Syllidae were most abundant in number and weight. A porcellanid crab and a gobiid fish were important with respect to weight only. The other taxonomical groups occur in much smaller quantities and include a gammarid, and some other worms and shrimps. Furthermore, the composition of the intrasponge fauna with regard to presence and abundance of taxonomical groups, did not significantly differ with depth nor with geographical location.

These data suggest that the composition of the inhabiting fauna of Sphaciospongia vesparia is highly constant.

Plotting the net weight of all inquilines in a sponge (expressed as g/l) versus sponge volume revealed a fairly constant inquiline biomass of about 6 g/l regardless of sponge size, but with greater variability in small sponges. Increase in sponge volume does correspond with a highly significant increase in the number of taxonomic groups found in the sponge ($p \leq .001$).

We conclude that colonization of sponges is achieved at a relatively early period in the life of the sponge and that the intrasponge community becomes more and more stable in time with respect to biomass relative to volume, as well as taxonomic composition.

SURVIVAL AND GROWTH OF RED MANGROVE SEEDLINGS
AND SMALL TREES IN A THERMALLY STRESSED
AREA IN PUERTO RICO

Mario D. Banus
Puerto Rico Center for Energy and Environmental Research
Mayaguez, Puerto Rico

The survival and growth of large batches of seedlings from trees in a thermally altered lagoon and from control trees were compared at three sites adjacent to the trees. Sub-batches of 100 seedlings were floated in 1 m net cages from mid June to mid September. At the thermally altered sites, with mean monthly maximum water temperatures of 37.0–39.0°C and 35.5–37.5°C, respectively, more of the local seedlings rooted and they survived better than the control seedlings. At the control site with ambient water of 29–32°C, all seedlings survived and rooted with 1/3 to 1/2 forming the first pair of leaves.

When these seedlings were transplanted into local sediments, all seedlings died within four months, although water temperatures decreased during this period; 16 seedlings from control trees planted at the cooler control site survived. Therefore, temperatures of 37–39°C inhibit rooting severely and eventually cause complete mortality to red mangrove seedlings. Temperatures of 35–37°C inhibit rooting and growth and are generally lethal except to a few hardy individuals.

Small trees grown in the laboratory were transplanted at the three sites in December and June. In the thermal lagoon, trees in water with mean monthly maximum temperatures of 31–33°C, 100% survived at 7 months with new growth observed after 3 weeks. In water of 32–35°C, 94% survived at 7 months with growth after 2 months. In water 34–36°C, 75% survived at 2 months all with new growth. In water 36–38°C, 70% survived 2 months with 20% showing new growth. At 31–33°C the growth was substantially more vigorous than at the control site (25–28°C). Elevated temperatures increase the time for recovery from transplanting shock.

THE EFFECT OF AN INDUSTRIALLY DISTURBED ENVIRONMENT
ON THE ECOLOGY OF THALASSIA BEDS IN THE
SOUTH COAST OF PUERTO RICO

Vance P. Vicente

Puerto Rico Center for Energy and Environmental Research
Mayaguez, Puerto Rico

Eight Thalassia beds have been studied under different environmental regimes. Four beds are located in an industrially disturbed bay. Two of these beds are continuously exposed to higher than ambient temperatures due to thermal effluents from power plants, while two beds are occurring under ambient temperatures but not necessarily under natural conditions due to the industrial character of Guayanilla Bay. On the other hand, four beds were studied in Jobos Bay under natural environmental conditions.

It has been determined that Thalassia beds in Guayanilla Bay subjected to higher than ambient temperatures have been deleteriously affected by the thermal effluents. These beds have very low standing crop (S.C.) values (1.7 ± 1.2 and 3.9 ± 2.9 gr. d.w./ $.02 \text{ m}^2$) while undisturbed beds occurring under natural conditions have high standing crop values (27.1 ± 6 and 25.9 ± 6.1 gr. d.w./ $.02 \text{ m}^2$). The S.C. values include the weight of the roots, rhizomes and shoots. These low S.C. values have serious implications since the amount of Thalassia largely determines the physical and biological stability of a Thalassia bed ecosystem. The roots and rhizomes provide physical stability by preventing soil erosion while the amount of leaf material largely determines the amount of energy that is going to support upper trophic levels.

Thalassia have been affected in Guayanilla Bay in many other ways. Both Thalassia beds exposed to thermal effluents do not form sexual reproductive bodies, and the other two beds in Guayanilla Bay under ambient temperature are practically inhibited from formation of buds, flowers, or seeds probably due to chemical pollution. On the other hand, the four Thalassia beds occurring under natural conditions in Jobos Bay were prolific in the formation of reproductive bodies where the percentage of shoots with reproductive bodies ranged from 14 to 54%. Other beds around the island of Puerto Rico were very prolific also. In addition, Thalassia exposed to the effluents have thinner leaves and rhizomes, which are also indicative that this plant is under stress.

Besides the damage done to the vegetation of seagrass beds, the thermal effluents have killed a significant portion of the Thalassia faunal assemblage. The urchin Lytechinus, the gastropod Tegula fasciata, many bivalves like Chione cancellata, and Codakia, corals like Manicina areolata and many other species have been killed and only fossils of these species can be found.

Diadema antillarum (PHILIPPI): ENHANCEMENT OF
CORAL SPECIES DIVERSITY IN THALASSIA BEDS

José A. Rivera
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico
and
Vance P. Vicente
Puerto Rico Center for Energy and Environmental Research
Marine Ecology Division
Mayaguez, Puerto Rico

During an extensive marine fauna and flora survey at Jobos Bay, on the southeast coast of Puerto Rico during the summer of 1974, observations on the role of Diadema antillarum in the Thalassia meadows were investigated. These observations give evidence on the possible role Diadema plays in the regulation of coral species composition in the Thalassia ecosystem.

In Thalassia meadows where Diadema antillarum is present in densities of $2.6 \pm 1.3/m^2$ (the highest density found for Diadema in the meadows sampled) coral species composition is the most abundant. The average number of corals recorded was $12.9/m^2$. In meadows where Diadema's densities are lower than the above or where it did not occur at all, the average number of corals varied from $1.25/m^2$ to $0/m^2$.

Diadema's intense grazing pressure makes substrate space available for corals to settle and develop. When this grazing pressure is intensified as in clumps of urchins ($17-19/m^2$) the substrate available for other organisms to establish is proportionately larger.

Both Thalassia and corals need available substrate and light for existence. Regulation of Thalassia by Diadema's grazing enhances the coral species to establish and develop successfully, by reducing shadow and substrate occupation by Thalassia.

SEAGRASS PRODUCTIVITY: THE RELATIONSHIP TO LIGHT FOR SOME TROPICAL SPECIES

Susan L. Williams and C. Peter McRoy
Institute of Marine Science
University of Alaska
Fairbanks, Alaska

The disparity in the many reports of the productivity of seagrasses has led to little predictive understanding. Yet the several species of seagrasses are taxonomically closely related and indeed many of the most common are morphologically similar. These facts suggest that the plants have a basically similar photosystem and that the differences in productivity measurements are due to technique and ecological conditions. To test this hypothesis we performed a series of controlled experiments on the effect of light on net productivity.

Net productivity of three species (Thalassia testudinum, Syringodium filiforme and Halodule wrightii) collected from the shores of Puerto Rico was measured by ^{14}C uptake of plants enclosed in bottles. The response of productivity to light for all species showed the same general pattern of initial exponential phase of light-limited growth followed by light saturation at an intensity corresponding to approximately 50% (or $0.6 \text{ ly} \cdot \text{min}^{-1}$) of the surface irradiance. The average maximum productivity ($\text{mgC} \cdot \text{g dry}^{-1} \cdot \text{hr}^{-1}$) was 2.96 for Thalassia, 3.33 for Syringodium, and 11.42 for Halodule. For all species the irradiance yielding half the maximum rate (K_{L_t}) was $0.36 \cdot \text{ly} \cdot \text{min}^{-1}$ (or 31 to 36% surface irradiance). The slope or light affinity of the initial linear uptake was the same for Thalassia and Syringodium but was four times greater for Halodule. In addition all species were photoinhibited by very high irradiance.

We conclude that the identical K_{L_t} values for all species are an indication of a common photosystem despite the differences in maximum productivities; furthermore this kinetic similarity in their response to light suggests that the maximum productivities are the result of ecological rather than species-specific factors. The high productivity of Halodule confirms its role as a seagrass colonizer.

GAMMARIDEAN AMPHIPOD FEEDING STRATEGIES IN A FLORIDA SEAGRASS BED

R. J. Zimmerman
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

R. A. Gibson
Harbor Branch Foundation, Inc.
Ft. Pierce, Florida

and

J. B. Harrington
(Summer Intern, Harbor Branch)
Biology Department
Texas A & M University
College Station, Texas

Four common gammaridean amphipods from seagrass beds in the Indian River lagoon of Florida feed on different marine plant material reflecting an apparent resource partitioning. The pattern which emerges, based on 200 laboratory tests measuring ingestion rates and food preferences as well as direct field observation, involves macrophagy and microphagy of benthic algae and seagrass detritus. Two amphipod species, Cymadusa compta and Gammarus mucronatus, are macrophagous on drift algae and larger fragments of detrital seagrasses. Cymadusa compta ingests macroalgae at a rate of 1 to 2 mg/mg amphipod/day (wet weights), while G. mucronatus consumes large particle plant detritus at a rate of 0.7 to 1.5 mg/mg amphipod/day. In contrast, Melita nitida and Grandidierella bonnieroides are microphagous plant consumers. Melita nitida feeds upon algae epiphytic on seagrasses, ingesting 0.7 to 1.5 mg/mg amphipod/day. Grandidierella bonnieroides eats small particle detritus at a rate of 0.5 to 1 mg/mg amphipod/day.

Assimilation efficiencies are similar for each of the four amphipods. Seagrass epiphytes appear most useful, with 40-75% ¹⁴C uptake from ingesta, while mean assimilation of drift algae and seagrass detritus is lower, varying between 10 and 25%.

Overlap occurs between feeding categories, thus indicating a dynamic condition with competitive interaction and a potential for major shifts in feeding or switching of food types. Despite the overlap and also an apparently unlimited food supply, the following pattern of partitioning food by size and kind is evident.

<u>Feeding Method</u>	<u>Food</u>	<u>Amphipod</u>
macrophagy	drift macroalgae	<u>C. compta</u>
	large detritus	<u>G. mucronatus</u>
microphagy	epiphytic algae	<u>M. nitida</u>
	small detritus	<u>G. bonnieroides</u>

COMPETITIVE INTERACTIONS BETWEEN CORALS AND OTHER BENTHIC REEF ORGANISMS

R. P. M. Bak, J. J. W. M. Brouns and F. M. L. Heys
Caribbean Marine Biological Institute
Curacao, Netherlands Antilles

Studies on the ecology of coral reefs often stress the importance of the competition for space on the available hard substratum. Because Scleractinian corals are the main structural component of most reef zones in Curacao, the result of interactions between corals and other benthic organisms is of importance in the maintenance of the reef habitat.

In order to assess the occurrence of spacially competitive organisms we recorded all organisms bordering on living corals under line transects on the reef terrace at a depth of 8-12 m. Two transects, at a distance of 150 m parallel to the coast, with lengths of 160 and 446 m, respectively, were studied. The same kinds of organisms are of importance in both areas.

It appears that the occurrence of bordering organisms on coral species is not random. Certain organisms tend to occur with certain coral species. This may be due to the micro habitat, the habitus or the behavior of the coral species.

To check the competitive ability of the bordering organisms and the corals we studied the advance or retreat of three of the most abundant bordering organisms in relation to the position of the living coral tissue. We chose the common coral Agaricia agaricites and Montastrea annularis and followed their reaction to thin algal turf, Gypsina spec. and Didemnum spec. It appears that the algal turf either advanced or retreated a few mm and that Gypsina slowly progressed over the living coral at a rate of 1-2 mm/month. Didemnum showed a very erratic behavior, sometimes growing very fast over the corals at a rate of 17 mm/month, sometimes completely disappearing.

To assess the relative competitive ability of corals and other benthic organisms in a more direct way small lesions (1 cm²) were made on colonies of Montastrea annularis and Agaricia agaricites. In nearly all cases the bare spot (coral skeleton devoid of living tissue) was colonized by algae resulting in the formation of a thin algal turf. This algal turf was subsequently overgrown by the regenerating corals. More extensive studies are in progress.

ECOLOGICAL STRUCTURE OF VENEZUELAN CORAL COMMUNITIES: DESCRIPTION AND COMPARISON

Freddy J. Losada
Centro de Ecología
Caracas, Venezuela
and

Juan F. Urich
Escuela de Biología
U. C. V.
Caracas, Venezuela

The structure of coral communities at some Venezuelan islands (La Orchila, La Blanquilla and Los Roques) and at the Morrocoy National Park are described and compared in terms of hermatypic species composition, zonation and diversity patterns.

The study was carried out by line transects laid underwater using a 50 m measuring tape with the aid of SCUBA diving. The following information was recorded for each transect: frequency of hermatypic corals, dead and living coverage of colonies, coverage and nature of bottom substrate, macroscopic algae and gorgonians coverage (including canopy) and abundance of other conspicuous invertebrates such as Diadema antillarum.

The mainland coral communities are patchy, less developed in seaward extension, more species packed but less diverse (overall diversity) than island communities. There is more living coverage per unit area at Morrocoy than on any of the island communities. Biological zonation is more difficult to detect on mainland but more obvious on the islands, particularly at a locality southwest of La Orchila.

The species composition distribution and the patterns of diversity are described and compared within and between communities. They are discussed as a function of some probable biological and physical parameters operating in each locality.

A STUDY ON THE RELATION BETWEEN A STONY CORAL,
Meandrina meandrites, AND ITS ENDOPARASITIC
COPEPOD, Corallonoxia longicauda

Maureen Butter
Caribbean Marine Biological Institute
Curacao, Netherlands Antilles

Recently endoparasitic copepods (Corallovexiidae) were discovered to be abundantly present in some Caribbean corals (Stock, 1975). In Curacao Meandrina meandrites is the most heavily infested species. However, the numbers of the parasite, Corallonoxia longicauda vary greatly in different colonies of this coral species.

The rate of infestation, the relation between biomass of the parasites and the biomass of the host, the distribution of the parasites in the colony, as well as the food requirements of the parasites are investigated. These facets will be related to depth, direction of the current, amount of zooxanthellae and other factors.

The rate of infection appears to be correlated with depth, the shallower colonies (10 m) being more heavily infested than colonies from the deeper reef (30 m). In most samples the amount of males surpassed that of the females by a factor of two or more. Juvenile individuals tend to be rare. Young colonies of Meandrina meandrites (1-4 polyps) usually do not contain parasites, which suggests that the first infection occurs through a free swimming stage.

An interesting observation is that the spacial distribution of the parasites within the colony appears to correspond to a distinct pattern: the greatest density is found downstream and at the seaside.

A method has been developed to determine ash free dry weight of both host and parasite and the relationship between biomass of host and parasites as well as the food requirements of the parasites, are currently under investigation.

INDIVIDUAL AND COORDINATED POLYP BEHAVIOR IN THE
HYDROCORALS Millepora complanata (MILLEPORINA)
AND Stylaster roseus (STYLASTERINA)

H. A. M. de Kruijf
Caribbean Marine Biological Institute
Curacao, Netherlands Antilles

Both Millepora and Stylaster, each belonging to a different order, have three different types of individuals: gastrozooids, dactylozooids, and medusae which are free living in Millepora and not so in Stylaster. Gastrozooids and dactylozooids of the Caribbean Millepora species are not arranged in any distinct pattern, and they occur in a ratio of one gastrozooid to four to eight dactylozooids. The polyps in Stylaster roseus are arranged in a cycloid system of 10 to 15 dactylozooids each with one dactylozooid around a gastropore with one gastrozooid. In Millepora the gastrozooids are up to 2.5 mm long, in Stylaster they are at most 2 mm from inside the gastropore and do not extend more than 0.5 mm above the skeleton. The hypostomes are surrounded by 4-8 small tentacles, capitate in Millepora, nearly filiform in Stylaster. Dactylozooids are mouthless polyps in both orders. They have numerous small capitate tentacles in Millepora. The dactylozooids are filiform in Stylaster. The dactylozooids in Millepora can expand up to 2.5 mm that is as long as the gastrozooids, and usually many polyps are extended to the same height and at the same time. Dactylozooids of Stylaster can stretch to a size of up to 3 mm thus projecting out of the skeleton 4-10 times the size of the gastrozooids. However, in some cycloid systems one (occasionally two) dactylozooids are enormously stretched to 15 mm or perhaps even more; they have a hair-like appearance with a spindle-like tip.

Behavior of Millepora complanata gastrozooids consists of slow swaying, fast swaying (search behavior), retraction, and feeding; dactylozooids show slow swaying and retraction only, though they may catch some prey. Dactylozooids serve a defensive function; the gastrozooids are the actual searchers for food which they ingest. With regard to catching of food there is virtually no coordination between the two types of polyps. Retraction into the pores is coordinated through a conducting system for the dactylozooids and through a different conducting system for gastrozooids. These two systems are interconnected. There seems to be no other type of colonial coordination nor conduction in Millepora.

Behavior of Stylaster polyps is certainly more complex than in Millepora. Gastrozooids show small jerk-like movements and can contract upon a strong mechanical stimulus with jerks and rather slowly. Strong stimulation of one gastrozooid may cause retraction of neighboring gastrozooids as well as but not necessarily of dactylozooids, even in the same

cycloid system, thus indicating a specific gastrozoid conducting system. Gastrozooids open their mouths (the initial movement of feeding behavior) when touched by a dactylozoid, but also when the upper rim of the mouth is touched by a glass rod or needle. Thus in addition to chemical activation of feeding behavior mechanical stimulation also elicits this type of behavior. Normally expanded dactylozooids are rather quiet though once in a while they sweep individually to the gastrozoid, very much like the filiform tentacles in Tubularia species and other Hydroids. The extremely elongated dactylozooids are much more active and are swaying constantly but slowly over a large area. This may be considered as searching behavior. The dactylozooids react to mechanical stimulation in two different ways depending on the place where the stimulus is applied. Touching gently the dactylozoid with a needle causes bending over the gastrozoid by that particular dactylozoid alone or by all dactylozooids of that cycloid system. Dactylozooids in other cycloid systems may immediately react to the same stimulus and then they perform the same movement. Touching the skeleton or the edge of the dactylopore causes withdrawal into the pore in one or more jerks of one or more polyps in that system suggesting the presence of a conduction system for retraction similar to that of Millepora. Thus two systems seem to be present in dactylozooids. Gastrozooids may retract upon skeleton stimuli but they usually need at least two and often more stimuli before they actually retract into the pore, and always quite slowly.

In conclusion, the cycloid system in Stylaster roseus acts very much like a complete single hydroid. The dactylozooids seem to serve a real tentacle function, i.e. defense and prey-catching. In addition to the two conducting systems governing colonial retraction and very similar if not homologous to the two known conducting systems in Millepora, in Stylaster there must at least be a third conducting system for dactylozooids in each cycloid system which coordinates sweeping towards the gastrozoid and at once inhibits retraction of the dactylozooids into their pores. Furthermore the sweeping system in each cycloid system is connected with the other cycloid systems. Due to the fact that dactylozooids in different cycloid systems react extremely fast we suppose that the conducting systems are neuronal.

ON THE GROWTH FORMS OF MILLEPORA

Wallie de Weerd and Hans de Kruijff
Caribbean Marine Biological Institute
Curacao, Netherlands Antilles

The genus Millepora (Hydrozoa) is divided into ten species, three of which are recognized at the reefs of Curacao: Millepora alcicornis, M. complanata and M. squarrosa.

The identification of the species is based on the growth form of the corallum. M. alcicornis is probably the most variable species of the genus in the Caribbean. At the growing edge the colony is divided into branches, which may be fingerlike or laterally compressed. In older parts the branches are generally united.

M. complanata consists of thin vertical plates growing from a common base. M. squarrosa consists of upstanding plates with numerous lateral expansions which among each other are united to form a more or less honeycombed complex with a frilled surface.

This investigation is concerned with the question: are these species really distinct or just growth forms of one highly variable species. Environmental factors influence the growth form of Millepora, but to what extent is not known. The sturdiest growth form, e.g. M. squarrosa, occurred in the surf zone; the platelike form, M. complanata was found over the entire shelf below the surf zone. The most delicate growth form, M. alcicornis, was found from a depth of about 3 m down to at least 25 m. Many intermediate forms were found, as well as completely different forms and many purely incrusting forms. In some areas up to 80% of all Millepora colonies could not be identified. Therefore, separation of the three species, based on the growth form of the corallum, is doubtful.

Several specimens of the three "species" were transplanted to different depths (76 specimens), and monitored by periodically photographing the colonies. Their growth was expressed in square mm per length of growing edge. Only results for the complanata-form have been analyzed.

In the surf zone mean growth of five specimens was 14 mm² per cm growing edge per month (range 11-11 mm²), whereas at a depth of 5 m, two control specimens showed growth of 6 mm² per cm growing edge per month.

The second part of the project will be to investigate by scanning electron microscopy the growing edges of the transplanted colonies, as well as specimens of all growth forms, collected at different geographical locations. The fine skeletal structure of the colonies may prove to be of specific value.

THE EPIDERMAL FLAGELLARY APPARATUS IN THE
LARVAE OF Porites porites (SCLERACTINIA)

Raymond L. Hayes and Nora I. Goreau
Departments of Anatomy and Zoology
University of Pittsburg
Pittsburg, Pennsylvania
and
Discovery Bay Marine Laboratory
University of the West Indies
Mona, Jamaica

Locomotion of Scleractinian planulae conduces to both establishment and continued colonial expansion of the species within the coral reef. The ultrastructural basis for larval motility in the tropical reef builder Porites porites (Pallas) consists of extensive specialization of the free cell membranes and subjacent cytoplasm of the epidermal epithelium in association with a single flagellum per cell extending from a circular indentation in the apical cell surface.

The flagellary apparatus includes a conical collar of 10-15 microvilli bound together by an organized fibrous meshwork continuous with the outer leaflet of the plasmalemma and homologous to the glycocalyx of enteric cells. The membrane of the flagellum is structurally integrated with the microvillous membrane by the glycocalyx. The proximal glycocalyx is organized while the distal portion is amorphous. The proximal glycocalyx extends from the surface indentation as is composed of septae radiating from the flagellum to the microvilli. Horizontal shelf-like connections are irregularly distributed between the septae. Hence, the basal flagellum is supported by an elaborate three dimensional network unifying the motile apparatus and the apical cell. Further constituents of the flagellary support mechanism lie in the apical cell cytoplasm. A filamentous cytoskeleton conjoins the terminal web, root filaments of the flagellum and desmosomal tonofibrils. This cytoskeleton prevents cell disruption by forces generated during flagellar movement, while the root filaments serve as ballasts, anchoring the axoneme of the flagellum.

The surface membrane of the flagellum and the flagellar core structures are both tethered with respect to the apical cell by a complex of extracellular and cytoplasmic shrouds or guys which create a stable foundation from which the whip-like action of the flagellum is generated. The integrity of the epithelium is maintained because of mechanical reinforcement provided by this system. Moreover, through the establishment of this flagellary apparatus cellular and tissue functions unrelated to locomotion are preserved.

ENZYMES ASSOCIATED WITH CARBOHYDRATE METABOLISM
OF SCYPHISTOMAE OF SCYPHOZOAN JELLYFISH

Alan L. Lin

Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

and

Paul L. Zubkoff

Department of Environment Physiology
Virginia Institute of Marine Science
Gloucester Point, Virginia

The presence of malate dehydrogenase (MDH), succinate dehydrogenase (SDH), pyruvate kinase (PK), phosphoenol carboxykinase (PEPCK), malic enzyme, and NADP -linked isocitrate dehydrogenase (ICD) in the scyphistomae of two scyphozoan jellyfish, Aurelia aurita and Chrysaora quinquecirrha, has been demonstrated by spectrophotometric methods.

In Aurelia and Chrysaora, the presence of a functional tricarboxylic acid cycle is indicated by the activities of NADP -linked ICD, MDH and SDH. The presence of MDH, SDH, PK, PEPCK and malic enzyme indicates that the scyphistomae are potentially capable of surviving under a low oxygen condition. The Michaelis constants (K_m) and energies of activation (E_a) of MDH, PK, PEPCK and SDH of scyphistomae have been determined. The dependence on pH of MDH, PK, and PEPCK has been investigated and the possible role of pH control at the branch point of phosphoenolpyruvate is discussed.

Although scyphistomae of Chrysaora cultured under different temperatures do not differ in MDH isozyme patterns, they differ with respect to K_m . The energy of activation of MDH, PK, and PEPCK in these two kinds of scyphistomae is also different. The scyphistomae cultured in the cold always have a higher substrate-enzyme affinity (low K_m) than the scyphistomae maintained at room temperature. Scyphistomae maintained in the cold have a lower energy of activation than those maintained at room temperature. These results are consistent with the suggestion of Somero and Hochachka (1969) that substrate enzyme affinity varies reciprocally with temperature over a large portion of the temperature of the poikilothermic animal's habitat. The reduction of velocity of enzymatic reactions with decrease temperature may be partially and sometimes fully offset by the decrease of K_m and the energy of activation.

ROCKY SHORE ZONATION ON CURACAO, NETHERLANDS ANTILLES

P. J. van Loenhoud, J. C. P. M. van de Sande and J. W. Focke
Caribbean Marine Biological Institute
Curacao, Netherlands Antilles

The zonation of rocky shores was investigated at four stations, ranging from slightly to severely exposed to the effects of the trade winds.

Two cliff profiles are distinguished: a "notch profile," occurring on slightly to moderately exposed parts of the southeast coast, and a "surf platform," on exposed parts of the (leeward) southeast coast and the (windward) northwest coast.

Two stations show the notch profile. The slightly protruding sublittoral margin is characterized by an algal turf of Dictyopteris delicatula, Jania adherens and Ceramium sp.

The eulittoral region, comprising the gentle lower slope of the notch, is colored pink by Porolithon sp., Neogoniolithon sp., and Hydrolithon sp. along with Pocockiella variegata and Peyssonnelia rubra. Keyhole limpets, Chiton marmoratus, Lithotrya corsalis, Spiroglyphus irregularis and Spirobranchus polycerus var. augeneri occur here.

The back of the notch has few algae.

The supralittoral region consists of the upper parts of the notch roof where a conspicuous zonation is found: from the back of the notch outwards a green zone, with blue-green algae; a black zone; and a yellow zone, where chroococcoid blue-green algae dominate.

The two other stations have surf platforms. In the sublittoral margin Spirobranchus polycerus var. augeneri, Neogoniolithon sp. and Lithophyllum sp. form porous outgrowths. In between porcelanid crabs, Chiton marmoratus and Echinometra lucuntur occur.

The surf platform is eulittoral with an edge formed by dense growths of Spiroglyphus irregularis, Porolithon sp. and Neogoniolithon sp., overgrown by Laurencia papillosa and Vallonia ocellata. Vegetation on the platform includes Padina gymnospora, Polysiphonia ferulacae and Jania adherens.

The eulittoral margin is characterized by Fosliella sp., Ectocarpus breviarticulatus and Cladophoropsis membranacae, with chitons and limpets.

The upper half of the slope is supralittoral with zones of Littorina mespilum and L. ziczac. Higher is a zone with Nodolittorina tuberculata, followed by one with Tectarius muricatus land vegetation.

Zonation is related to surf action, rather than to tidal levels.

COMMUNITY ANALYSIS AND BIOLOGY OF POLYCHAETA OFF THE NORTH COAST OF PUERTO RICO

Charlene D. Long
69 Windsor Street
Arlington, Massachusetts

Prior to the development of an industrial sewage system, there were 3 cruises off Barceloneta, Puerto Rico, in 1974. Eight thousand organisms were collected in waters 11-200 m deep. Compared with other temperate and tropical particulate benthic habitats, which yield 40-80% polychaetes compared to other infauna, the study area had only 14% polychaetes.

A measure of similarity called the normalized expected species shared was used to cluster 39 samples. The largest cluster consisted of samples from cruises 1 and 2 and was characterized by Myriochele heeri and Lumbrineris tenuis and/or Glycera oxycephala, with 191, 65, and 32 individuals, respectively, from stations 11-28 m deep. Seventy-nine per cent of the specimens in Cluster 1 came from sand substrates, 13% from mud, and 8% from sandy-mud. Cluster 1 was dominated by filter feeders.

The second largest cluster was characterized by L. tenuis and G. oxycephala, with 25 and 21 individuals, respectively, from stations 11-33 m deep. Seventy-six per cent of the specimens in Cluster 2 came from sand substrates and 24% from sandy-mud. Thus, Cluster 2 occupied the same type of substrate as Cluster 1 but included samples lacking M. heeri and therefore had a high percentage of cruise 3 samples, from which M. heeri was missing. Cluster 2 was dominated by deposit feeders.

Sanders found filter feeders and deposit feeders from temperate waters to be numerically dominant in sand and mud sediments, respectively. Bloom et al. corroborated earlier work to indicate that deposit feeders from warmer waters can dominate sediments with far less mud fractions than in temperate waters. The study reported here substantiated both workers, for the sand sediments were dominated by a filter feeder, M. heeri, when it was present, but also had a smaller, apparently more stable population of deposit feeders, L. tenuis and G. oxycephala. Based on this, we would expect deposit feeding communities to be much less well defined than filter feeding communities in tropical as compared to temperate waters.

CONTRIBUCION AL CONOCIMIENTO DE LA FAUNA DE POLIQUETOS
ERRANTES DE BAHIA DE MOCHIMA, EDO. SUCRE, VENEZUELA

Mirella Cadena
Universidad de Guayaquil

y
Gregorio Reyes-Vásquez
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

Se presentan los resultados de un estudio de la fauna de poliquetos errantes, provenientes de sedimentos, comunidades de algas y esponjas, de 6 localidades situadas en la Bahía de Mochima, Edo. Sucre, Venezuela.

Se enumeran las 17 especies encontradas indicandose la familia a la cual pertenecen.

Familia Polynoidae	<u>Eunice vittata</u> (delle Chiaje)
<u>Halosydna glabra</u> Hartman	<u>Lysidice ninetta</u> Audouin & Edwards
Familia Amphinomidae	<u>Marphysa sanguinea</u> (Montagu)
<u>Hermodice carunculata</u> (Pallas)	* <u>Palola siciliensis</u> (Grube)
<u>Notopygos crinita</u> (McIntosh)	Familia Chrysopetalidae
Familia Nereidae	* <u>Bahawania goodei</u> (Webster)
<u>Neanthes succinea</u> (Frey & Leukart)	Familia Syllidae
<u>Nereis falsa</u> (Quatrefages)	<u>Typosyllis variegata</u> Grube
* <u>Nereis pelagica</u> (Linnaeus)	* <u>Trypanosyllis taeniaformis</u> (Haswell)
* <u>Perinereis cultrifera</u> (Grube)	Familia Lysaretidae
* <u>Perinereis oliveirae</u> (Horst)	* <u>Oenone fulgida</u> (Savigny)
Familia Eunicidae	
* <u>Eunice aphroditois</u> (Pallas)	

Las especies marcadas con * se señalan por primera vez para Venezuela. Es de hacer notar que Halosydna glabra Hartman, conocida hasta ahora sólo de California, Mexico y Panamá, ha sido encontrada en el Golfo de Cariaco (Amaral, en prensa) y en esta colección de Bahía de Mochima. La mayor parte de las especies señaladas son de amplia distribución en mares tropicales.

ETHOLOGICAL AND ECOLOGICAL ASPECTS OF FISH CLEANING
SHRIMP (CRUSTACEA: STENOPODIDAE, PALAEMONIDAE,
HIPPOLYTIDAE) IN THE BAY OF SANTA MARTA, COLOMBIA,
AND YOUNG ISLAND CHANNEL, ST. VINCENT, W.I.

Lilliane Corredor and María Mercedes Criales
Instituto de Investigaciones Marinas de
Punta de Betín, Santa Marta, Colombia

Field observations by means of diurnal and nocturnal SCUBA diving were made on the ethology and distribution in space and time of the fish cleaning shrimp of Santa Marta (Colombia) and Young Island Channel, St. Vincent) from January to September of 1976.

The cleaning behavior of the shrimp species was recorded, along with data on the frequency of cleaning particular fish species. In addition data on the habitat and population fluctuations of each shrimp species were maintained.

In Santa Marta the dives ranged from 10 to 35 mts and were usually diurnal (some nocturnal dives were made for comparison). At Young Island Channel most dives were nocturnal and covered depths 6 to 20 mts.

The following results are of particular interest:

1. In Santa Marta the most active cleaner Lysmata grabhami (Gordon), was usually found associated with the anemone Telmatactis rufa (Verrill). Second in amount of cleaning activity was Periclimenes peder-soni Chace, showing a special preference to clean the gills and mouth of the fish. Periclimenes yucatanicus Ives was only found at irregular intervals and was not observed cleaning.

2. The shrimp of family Pandalidae, Parapandulus longicauda Rathbun reported from 53-112 mts deep (Pequegnat, 1970) was found at 35 mts in the bay of Santa Marta, forming aggregations of up to 100 individuals. Cleaning behavior has not been confirmed in this species, but it has morphological features similar to other cleaning shrimp; their occurrence at Santa Marta seems to be seasonal.

3. Stenopus hispidus (Olivier)(St. Vincent) is a facultative cleaner and feeds mostly on zooplankton. The other species of the genus, S. scutellatus Rankin is more dependent upon the cleaning, but it also has other food sources.

4. Brachycarpus biunquiculatus (Lucas), a probable seasonal visitor to Young Island Channel, is a new fish cleaning shrimp and shows more species specific preferences than Stenopus spp.

ASPECTS OF THE BIOLOGY AND ECOLOGY OF Cassidulus
caribbeorum (ECHINOIDEA: CASSIDULOIDA):
PRELIMINARY RESULTS

William Gladfelter and Elisabeth Gladfelter
West Indies Laboratory
Fairleigh Parkinson University
St. Croix, U.S. Virgin Islands

Dense but local populations of the cassiduloid urchin C. caribbeorum have recently been found in shallow water off Virgin Gorda and Anegada in the Virgin Islands. Preliminary scanning of the literature reveals that nearly nothing is known of the biology of members of this order. In areas of shallow water and coarse, well-sorted sand, adults (greater than 16 mm) achieve average densities of more than 100/m² over many square meters. The urchins are effective diggers in coarse sand, and maximum digging rates were achieved in sieved sand which most closely approximated that of the natural habitat. The urchins ingest sand and their guts are always packed full. Sand is moved completely through the gut in about 4 hours. Preliminary growth rates of marked individuals averaged about 0.5 mm during the month of July. C. caribbeorum broods its young, producing successive broods (at least 8 in some individuals) of 100 to 200 young per brood. At ambient water temperature (28°C in July) the developmental schedule was 9 to 10 days from release of the uncleaved eggs till young urchins left the parent. The principal agent of mortality on these urchins appears to be helmet snails (identity as yet unknown): about 95% of the tests washed onto the beach adjacent the study area at Anegada reveal bore holes characteristic of these snails. Other sources of mortality are discussed, including mass mortality caused by storm waves.

SEASONALITY OF ECHINOID MORTALITY AT GALETA, PANAMA

Gordon Hendler
Smithsonian Tropical Research Institute
Galeta Marine Laboratory
Balboa, Canal Zone

The population fluctuations of several species of reef-flat echinoids are portrayed using long-term population density data and daily collections of dead echinoids from permanent quadrats. The cause of death is determined by examining each test for damage characteristic of specific predators.

Preliminary analyses reveal that the most serious decline in numbers of Lytechinus variegatus, Tripneustes ventricosus, and Diadema antillarum occur during extended periods of subaerial exposure of the reef-flat. A careful examination of Echinometra lucunter reveals that 30% of annual mortality is due to predators and the remainder die from physical stress or other causes.

The two major predators on Echinometra are the Ruddy Turnstone (Arenaria interpres) and a boring gastropod (Cypræacassis testiculus). The Turnstones are a serious factor only during their peak period of migration, while the gastropod exerts continuous pressure on the echinoid population. Death from agents other than predation peaks during periods when the reef-flat is exposed, and this tends to occur during March-May and August-October.

BEHAVIOR OF TWO SNAILS: ESCAPE BY Turbo castanea
FROM PREDATORY ATTACKS OF Fasciolaria tulipa

Norman A. Engstrom
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

Turbo castanea exhibit a vigorous escape reaction when contacted by Fasciolaria tulipa or by water from the mantle cavity of F. tulipa. During escape, T. castanea locomotion rate is trebled (average 78 mm/min, normal; 233 mm/min, escape), the shell is rotated violently two or three times and the antennae and caudal cirri are extended maximally. The rate of locomotion by T. castanea is related to their size and specimens too small to attain a maximum speed of 230 mm/min tend to turn 180° and attempt to crawl onto the shell of F. tulipa upon contact. Contact with a fleeing T. castanea or with water in which escaping T. castanea were held does not elicit the escape reaction from other T. castanea, so a pheromone is not involved.

DISTRIBUTION AND ECOLOGY OF THE HERMIT CRABS
(CRUSTACEA, DECAPODA, PAGURIDEA) FROM
THE REGION OF SANTA MARTA

Hernando Sánchez Moreno
Instituto de Investigaciones Marinas de
Punta de Betín, Santa Marta, Colombia

The hermit crabs of the Santa Marta region were studied with special attention to their distribution and certain ecological factors.

In the shallow waters are found a series of communities that are tightly bound to abiotic factors; salinity, temperature, and type of substrate.

The hermit crabs, through their abundance, their clear separation by species into determinable bands and regions, and their dependence on specific abiotic factors make them one of the important communities of this zone.

The purpose of this study was to establish a general model of species distribution along a vertical gradient.

To that end, as much information as possible was recorded along 3 vertical transects from 0 to about 30 meters (precise depth varied from site to site). Then in order to test certain hypotheses formulated in the field, laboratory experiments were performed to determine the maximum temperature tolerance of the crabs at various salinities.

THE STRUCTURE OF A SHALLOW OCEANIC BENTHIC COMMUNITY OFF PUERTO RICO AND ITS FISH PREDATORS

James D. Parrish
U.S. Fish & Wildlife Service
University of Massachusetts
Amherst, Massachusetts
and

Roger J. Zimmerman
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

The benthic community of the unconsolidated carbonate sediments just seaward of a coral reef 9 1/2 km west of the coast of Puerto Rico was studied by making quantitative collections from a saturation diving habitat. The invertebrate community consisted of about 6800 animals/m² with a dry biomass of 18 g/m², composed of at least 242 species from 11 phyla. Ascidians provided 67% of the total biomass, with both solitary (mostly Microcosmos helleri) and colonial forms well represented and providing ecologically important substrate/habitat. Low, sediment-consolidating sponges were abundant and played an important role in substrate modification and habitat formation. Polychaetes were the most numerous group, systematically and trophically diverse, and accounted for 8% of the total invertebrate biomass. Pelecypods were numerous and diverse; the mytilid, Musculus lateralis, was strongly dominant numerically. Gastropods were insignificant. Reptantia were numerous (2% of total invertebrates) and significant in biomass (5.4% of the total). The xanthid crab, Micropapilio lobifrons, dominated; majids, anomurans and macrurans all provided substantial contributions. The Natantia were diverse, fairly numerous (1.5%) and significant in weight (1.6%). Stomatopods and holothurians were few but large, providing significant biomass. Ophiuroids were more numerous and comprised an important biomass component (7.5%). Amphipods were the second most numerous group, but minor in biomass. The small corophiid, Chevalia aviculae, was strongly dominant. Isopods were large, diverse, and not numerous. The results of early analyses permit some tentative conclusions on trophic and habitat effects upon the community structure. Random concurrent collection of the local fish community and examination of guts from 27 demersal species allowed evaluation of an additional trophic level. Quantitative comparison of the occurrence of invertebrates in guts with occurrence in the benthos indicates (1) avoidance of polychaetes and amphipods, (2) an indifferent consumption of ascidians, pelecypods, ophiuroids and tanaidaceans, and (3) a strong positive selection for isopods, gastropods, Reptantia, Natantia and stomatopods. The latter three groups provide the bulk of the fishes' diets, with ophiuroids also important.

ALIMENTACION, PREDACION Y CANIBALISMO EN ASTEROIDEOS BAJO CONDICIONES EXPERIMENTALES

Aída Martínez de Rodríguez
Instituto Oceanográfico
Universidad de Oriente
Cumaná, Venezuela

El objetivo de este trabajo, fue el de observar alimentación, depredación y canibalismo, en cuatro especies de asteroideos comunes en nuestras aguas costeras, bajo condiciones experimentales.

El experimento fue realizado con Luidia senegalensis, Oreaster reticulatus, Tethyaster vestitus y Astropecten brasiliensis brasiliensis. Se utilizaron tres acuarios, con agua de mar circulante, en la ensenada de Turpialito (Cumaná, Venezuela) donde se encuentra ubicada la estación hidrobiológica del Instituto Oceanográfico (U.D.O.). El agua de mar fue tomada aproximadamente a una distancia de 25 metros del nivel de marca.

Las especies fueron distribuidas en acuarios diferentes, a excepción de Tethyaster vestitus que fue colocada junto con Astropecten brasiliensis brasiliensis. Se les suministró la misma cantidad y calidad de alimento, el cual estaba basado en bivalvos y equinoideos comunes en las zonas donde se capturaron los asteroideos. Entre ellos podemos señalar: Perna perna, Trachycardium isocardia, Anadara notabilis, Arca zebra, Pinctada imbricata y Pecten ziczac entre los bivalvos; Echinometra lucunter y Lytechinus variegatus entre los equinoideos.

Los resultados obtenidos en este experimento fueron los siguientes:

1. Hubo diferencias en cuanto a la adaptación de estos organismos a las condiciones experimentales, con respecto al inicio de su actividad alimentaria.

2. Oreaster reticulatus comenzó a alimentarse justo a los 8 días de haber sido colocada en el acuario, comenzando por depredar dos ejemplares de Arca zebra y 3 de Echinometra lucunter en un período de 24 horas. En término de tres meses había depredado 28 ejemplares de Perna perna, 5 de Anadara notabilis, 3 de Pinctada imbricata, 3 de Pecten ziczac y 6 de Lytechinus variegatus.

3. Luidia senegalensis permaneció indiferente a la presencia del alimento durante 25 días, luego comenzó a alimentarse, depredando 2 ejemplares de Trachycardium isocardia y 2 de Anadara notabilis en un período de 72 horas.

4. Tethyaster vestitus pasó 45 días sin ingerir alimento. Cuarenta días después había depredado 19 ejemplares de Astropecten brasiliensis brasiliensis. Permaneció inactiva ante presencia de los bivalvos.

REPRODUCTION, GROWTH, AND LONGEVITY OF THREE
SPECIES OF WEST INDIAN COLONIAL ASCIDIANS

T. O. Morgan
Department of Marine Sciences
University of Puerto Rico
Mayaguez, Puerto Rico

Reproduction, growth, and longevity of the colonial ascidians Botrylloides nigrum Herdman, Ecteinascidia turbinata Herdman, and Aplidium lobatum Savigny are being studied in a mangrove lagoon at the east end of Magueyes Island near La Parguera, Puerto Rico. Life histories of all three species follow a similar pattern. Upon metamorphosis, colony growth proceeds exponentially through asexual budding. As the colonies reach sexual maturity, growth slows, and ultimately, they begin necrosis.

Botrylloides nigrum doubles in size every three days for 45 days, at which time it becomes sexually mature. Necrosis begins in older portions of the colony before long, and after 90 days the entire colony is dead.

Ecteinascidia turbinata doubles in size every six days for 50 days, whereupon it reaches sexual maturity. Older zooids begin dying shortly thereafter. At an age of 120 days, the remaining zooids die, leaving a network of stolons. The stolons remain viable and give rise to subsequent generations of zooids which become sexually mature after 20 days and die within 50 days. This process of regression and regeneration continues until the colony is overrun by a competitor or killed by predation.

Aplidium lobatum doubles in size every 10 days before spawning commences after 120 days. Necrosis begins by the 170th day. In some cases, necrosis spreads rapidly and the colony dies within 30 days. However, if necrosis spreads slowly, the colony may survive and continue sexual activity considerably longer.