BULLETIN OF MARINE SCIENCE, 54(3): 1072–1088, 1994

ABSTRACTS

THE AFFECTS OF WIND, RAIN, AND WATER RELEASES ON THE WATER DEPTH AND SALINITY OF NORTHEAST FLORIDA BAY.—This study is an exploratory examination of factors affecting salinity levels and water depths in the northeast estuaries of Everglades National Park, Florida. Wind speed and direction, water releases through the C-111 canal system, and upland stage data were correlated with local rainfall, salinity, conductivity, depth, and water temperature measurements recorded at five stations located in the northeast Florida Bay estuaries. The statistical analysis of this data for the study year 1989, as well as individual events during that year, were used to formulate models of the C-111 system. These models indicated that water depth varies directly and conductivity varies inversely with major C-111 water releases through gate structure 18-C. During other periods, regression results indicated that ground water stage, not C-111 releases, was the major independent variable influencing estuary depth and salinity. Wind was found to increase estuary water depth when coming from the southern quadrants, and decrease water depth when coming from the north. With the exception of isolated events, local rainfall events during the year were not of the magnitude to have a significant influence on bay depth or conductivity.—*Alan M. Baratta and Robert J. Fennema, Everglades National Park, P.O. Box 279, Homestead, Florida 33030.*

FOREST FRAGMENTATION AND MINIMUM AREA REQUIREMENTS FOR BREEDING FOREST BIRDS IN THE UPPER FLORIDA KEYS.—Since colonization by Europeans, the Florida Keys have undergone two periods of widespread deforestation. The first, in the late 1800's was primarily a result of conversion of forested land to agriculture. Following the demise of the agricultural industry in the early 1900's, the forests went through a recovery phase. The second period of deforestation occurred from the mid 1900's to the present as a result of forest clearing for human settlement and development of a tourist industry. We digitized all remaining upland forests in the upper Keys >24 m × 24 m from 1991 aerial photographs. Keys not accessible by road (in Biscayne National Park and state-owned areas) had lost <1% of their upland forest acreage. In northern Key Largo, where much of the land is either state- or federally-owned, 29% of the upland forest acreage had been lost. In contrast, 65% of the historic acreage of upland forest had been lost from central Key Largo south through Long Key. We investigated the minimum size requirements of breeding birds that use upland forests in the Keys and found that four species of forest-breeding birds were sensitive to size of forest tracts. The minimum area requirements were 2.3 ha for White-eyed Vireo, 3.5 ha for Northern Flicker, 7.5 ha for Yellow-billed Cuckoo, and 12.8 ha for Mangrove Cuckoo. In 1991, in the upper Keys, upland forests >12.5 ha comprised only 3% of the number of forests and 67% of the forested area compared to 30% of the forests and 97% of the forested area in the historic condition. Habitat fragmentation has probably had immense impacts on the population and distribution of these four species in the upper Florida Keys.—*G. Thomas Bancroft, Allan M. Strong, Mary E. Carrington, Richard J. Sawicki, and Wayne Hoffman, National Audubon Society, 115 Indian Mound Trail, Tavernier, Florida 33070.*

EFFECTS OF HURRICANE ANDREW ON REEF FISHES IN BISCAYNE NATIONAL PARK.—Reef fish populations have been monitored over the past several years at 10 reef sites in Biscayne National Park under support from the Reef Assessment Program of the National Park Service. Hurricane Andrew passed directly over study sites on August 23, 1992. Study sites were sampled as soon as practical after water visibility cleared. Most reef fishes showed no obvious injuries or effects of the hurricane. Large numbers of newly settled ocean sturgeon, *Acanthurus bahianus,* were observed at some disturbed sites following the hurricane. We have documented similar observations following small-scale disturbances to reef substrate. Unusually strong recruitment of these herbivorous fishes to damaged sites following disturbance may facilitate ciguatera outbreaks when appropriate toxin producing algae also colonize the disturbed substrate.—*James A. Bohnsack, David B. McClellan, Douglas E. Harper, Stephania K. Bolden, Anne-Marie Eklund, and Scott Sandorf, Miami Laboratory, Southeast Fisheries Science Center, National Marine Fisheries Service, 75 Virginia Beach Dr., Miami, Florida 33149.*

HIGH RESOLUTION OPTICAL SIGNATURES IN HAWK CHANNEL AND CORALS—OPTICAL SIGNATURES AND ECOSYSTEM STUDIES.—High resolution optical reflectance signatures of water in Hawk Channel are compared to reflectance signatures of different coral species, submerged aquatic vegetation and bottom types. Mathematical techniques are applied to the reflectance signatures in order to determine bands or channels that may be used to discriminate these ecosystem components. Techniques are demonstrated for modeling the reflectance signatures based upon optical data and in-situ data. Based upon optical algorithms and model results, shallow water physical/optical buoys designed for reef systems may provide a future approach for scientifically based monitoring of tropical coral ecosystems. Bands are presented which may be used from aircraft based high resolution imaging spectrometers for discrimination of live corals, sand bottom, submerged aquatic vegetation and optically deep waters.—*Charles R. Bostater, Assistant Professor, Florida Institute of Technology, Melbourne, Florida 32901.*

SPONGE MASS MORTALITY AND HURRICANE ANDREW: CATASTROPHE FOR JUVENILE SPINY LOBSTERS IN SOUTH FLORIDA?—The hardbottom communities of Florida Bay and Biscayne Bay are dominated by sponges, macroalgae, and octocorals, and are prime settlement and juvenile nursery habitat for south Florida's spiny lobster (*Panulirus argus*) population. We have been studying spiny lobster recruitment in south Florida for nearly a decade and, in 1991–1992, our ongoing field investigations provided us the opportunity to quantitatively assess the impact of two large-scale disturbances on hardbottom community structure and, consequently, juvenile spiny lobster population dynamics. From November 1991–January 1992, a massive sponge die-off occurred in south-central Florida Bay following an episodic phytoplankton bloom thought to have resulted from the nutrient flux emanating from a seagrass die-off event. Nearly every species of sponge was impacted and over 90% of the sponges were dead or damaged in many areas. Sponges are the primary shelter for juvenile spiny lobsters and their loss precipitated dramatic shifts in lobster shelter use and abundance. Hurricane Andrew slammed into south Florida the following September and passed directly over Biscayne Bay, where we had completed surveys of juvenile spiny lobster abundance and hardbottom habitat structure only a month before. We are resurveying those sites to determine the effect of the storm on hardbottom community structure and the juvenile spiny lobster abundance and distribution. These two massive, but dissimilar disturbances have potentially important consequences for south Florida's hardbottom habitat and the juvenile spiny lobsters that reside there.—*Mark J. Butler, IV, Department of Biological Sciences, Old Dominion University; William F. Herrnkind, Department of Biological Science, Florida State University; John H. Hunt, Florida Marine Research Institute, Florida Department of Natural Resources.*

A COORDINATED RESEARCH PROGRAM FOR THE FLORIDA KEYS NATIONAL MARINE SANCTUARY.—The passage of the Florida Keys National Marine Sanctuary and Protection Act has made it possible to consider the development of management strategies that are ecosystem-wide in scope. The 2800 square nautical mile Sanctuary encompasses the entire marine environment of the Florida Keys. It includes all of the major communities that help to comprise and support the diverse coral reef ecosystem that Congress has declared significant. Equally diverse are the various uses of the marine resources of the Keys that experience enormous levels of direct and indirect human impact. Comprehensive, holistic management is a relatively new concept in the management of marine protected areas in the United States. The success of this innovative, ecosystem approach to marine management is largely dependent upon the degree of coordination and cooperation that is established between Sanctuary management and the scientific community. At the October 1991 Research Planning Workshop, which was jointly sponsored by NOAA and RSMAS, there was a strong consensus that managers and researchers must drive each other's agenda in the Florida Keys National Marine Sanctuary (FKNMS). It was suggested that management decisions should be based on a scientific understanding of the functioning of the ecosystem, as determined through existing and planned research. An objective of this paper is to review the policy recommendations that were generated at the 1991 Workshop and to suggest a protocol for establishing a working partnership between Sanctuary management and the scientific community. The merits of a scientific advisory board and Memoranda of Agreements between various agencies will be discussed. Other mechanisms for establishing a solid partnership between Sanctuary management and the scientific community, including various government agencies, academia, nongovernmental organizations, and the private sector will be explored. Hopefully, this paper will serve to rally scientific interest toward ecosystem-based research. Such an approach will require that researchers coordinate with one another at unprecedented levels. Some dogmatic approaches to research problems may have to be stripped away to allow for increased coordination and cooperation within the scientific community. The various federal, state, and local agencies affected by the development of the management plan for the FKNMS have shown an enormous amount of inter/intra-agency cooperation and coordination during the planning process. These efforts should serve to exemplify for the scientific community, the significance of the task at hand in South Florida.—*Billy D. Causey, Sanctuary Project Manager, Florida Keys National Marine Sanctuary.*

GLOBAL CLIMATE CHANGE AND THE IMPORTANCE OF TIDAL FLAT ECOSYSTEMS IN THE CARIBBEAN AND GULF OF MEXICO.—Algae, corals, seagrasses and other living organisms actively construct and maintain extensive tidal flat structures in the Gulf of Mexico and Caribbean. The various types of tidal flats, including reef flats, algal flats, and seagrass flats, are important economically and ecologically. They rank among the world's most productive ecosystems and export much of their organic material to adjacent ecosystems. These biogenic structures of carbonate rock and consolidated sediment, covered by meadows of plants and sessile animals, function as forgaging grounds, nursery areas, natural breakwaters and shoreline reinforcements. Models of global climate change predict considerable changes for the coastal environments of the Gulf and Caribbean, including rises in sea level, increases of water temperature, and more frequent hurricanes. Physical and geographic features of the Florida Bay and the Keys, such as the narrow tidal range and location in the "hurricane belt," would make this region particularly sensitive to the effects of global climate change. Long-term, integrated moni-

toring of natural variations of the physical environment and populations of algae, seagrasses, corals, and other reef flat biota on the Caribbean coast of Panamá demonstrate that changes in sea level and sea temperature can affect the distribution and abundance of these organisms, but the tidal flat communities as a whole should be able to maintain vertical rates of habitat accretion in pace with predicted rises in sea level until the middle of the next century. However, studies of the effects of a major oil spill at this site illustrate that such pollution can cause longer-term damage of the groups of biota essential for building tidal flat structures. Proper management to maintain the tidal flat ecosystems in the Gulf and Caribbean, including the diverse tidal flats of Florida Bay and the Keys, could mitigate much of the potential damage expected from global climate change, including erosion of shorelines, loss of endangered species habitats, destruction of developed property and reduction of fisheries.—*John D. Cubit, Coastal Zone Research, P.O. Box 97, Sopchoppy, Florida 32358.*

THE INFLUENCE OF TEMPERATURE, SALINITY, AND LARVAL TRANSPORT ON THE DISTRIBUTION OF JUVENILE SPINY LOBSTERS, *PANULIRUS ARGUS*, in Florida Bay.—Florida Bay is the major nursery area for Florida's spiny lobster, *Panulirus argus*. It is characterized by a series of shallow hardbottom or seagrass covered basins separated by seagrass covered mud banks less than one meter in depth. Because these mud banks serve as barriers to circulation, the basins formed between the banks may experience extreme fluctuations in temperature and salinity due to reduced tidal influx and high rates of evaporation. Larval transport to areas of Florida Bay that experience these temperature/salinity fluctuations were monitored monthly (March 1992–July 1992) using artificial benthic collectors. Diver surveys to monitor new recruits and characterize lobster habitat were also conducted at eight sites along two transects (four sites per transect) leading from the cuts between the Florida Keys and extending north and northwest to Twin Key Bank and the subsequent basin. Concurrently, postlarval *P. argus* were reared in the laboratory, in a completely crossed design, at four temperatures (18°C, 22°C, 29°C, and 33°C) and four salinities (25, 35, 45, and 50 ppt). Survival, time to metamorphosis, and growth to first stage juvenile were measured. Results from monthly benthic collector censuses suggest that postlarvae are not regularly transported beyond Twin Key Bank, however, diver surveys indicate that some recruitment does occur in the western and central position of Twin Key basin, but not in the eastern portion of the same basin. During this study, temperature and salinity readings in this basin ranged from 21°C to 32°C and 35 ppt to 45 ppt, respectively. Laboratory results indicate that this range of temperatures and salinities could be tolerated, however, mortality is greatest at high temperatures in conjunction with high salinities.—*Jennifer M. Field, and Mark J. Butler, IV, Department of Biological Sciences, Old Dominion University.*

A SIMULATION MODEL TO PREDICT FINE SCALE CHANGES IN HABITAT DISTRIBUTION ON SUGARLOAF KEY RESULTING FROM CHANGES IN SEA LEVEL.—Sugarloaf Key is undergoing changes in the size and distributions of its ecological communities. The most likely cause of these habitat changes is the ongoing increase in sea level, which is rising at a rate of approximately 40 cm per century. In this study, we developed a simulation model, SeaChange, that could project these changes over time in order to visualize the future spatial distribution of habitats on the key. SeaChange works by dividing Sugarloaf Key into 40,000 25 m pixels, each assumed to be homogeneous relative to elevation and habitat type. At each model timestep, each pixel has opportunities to "give birth" to an adjacent pixel of the same habitat type, or to change itself to the habitat type of an adjacent pixel. These changes are governed by rules that guarantee the maintenance of known elevation/vegetation relationships, the complex spatial relationships of the communities, and the fractile index of the landscape. The use of 25 m pixels permits a very fine grain description of changes in habitat distribution. The model was used to hindcast changes in the distribution of habitats on Sugarloaf Key that have occurred since 1935. We then used it to project changes until the year 2150. The aerial extent of the key actually increased as mangrove banks increased, but upland habitats were sequentially replaced by transitional habitats that were in turn replaced by mangroves. The model predicted that the key would eventually become an intertidal mangrove habitat.—*R. Glenn Ford, Ecological Consulting Inc., Portland, Oregon; Michael S. Ross, National Audubon Society, Tavernier, Florida; John F. Meeder, National Audubon Society, Tavernier, Florida; Joseph J. O'Brien, National Audubon Society, Tavernier, Florida.*

HISTORICAL EVOLUTION OF THE SOUTHWEST FLORIDA COASTLINE AND ITS EFFECT ON ADJACENT MARINE ENVIRONMENTS.—An examination of historical aerial photography (1928–present) reveals three significant types of change in the coastal/wetland environment on the southwest coast of Florida between Cape Sable and Chatham River: coastal erosion, erosion of shorelines and islands in larger interior bays, and landward expansion of mangrove communities. There are two types of coastal erosion. Progressive erosion from winter storms has affected significant portions of this west-facing coastline. Hurricane surges penetrating tidal creek complexes have created local patches of catastrophic erosion within the wetland environment. Coastlines and islands within larger interior bays are eroding, especially along the north and east shores. This erosion has resulted from both recurrent winter storm

waves and episodic hurricane scour. Eroded sediment is largely organic and is oxidized, dissolved or transported out of the system. Shore erosion within bays has resulted in the expansion of tidal prisms and in the enlargement of channels connecting to the offshore marine environment. During the past 52 years of historical records, some mangrove community boundaries have remained relatively stable while others have dramatically expanded across adjacent transitional and freshwater marshes. As much as 86 meters of landward expansion is recognized. Mangrove community expansion occurs by both episodic, storm-generated seedling introduction and progressive expansion. Gently sloping coastlines provide a setting to record the temporary advance of infringing mangrove communities in this wetland coastal landscape. Erosion of these coastlines is providing a significant volume of dissolved and particulate organics and nutrients into adjacent mangrove, transitional, and freshwater wetlands and into the adjacent marine environments. Organics and nutrients discharged into coastal marine waters are pulsed southward by winter storms into Florida Bay and the Florida Keys. Future global warming, with increased rates of sea-level rise and increased frequency of hurricanes, should dramatically increase rates of erosion of this wetland coastline and increase the importance of this area as a source for organic and nutrient discharge.—*Bruce C. Frederick, Sarah Gelsanliter, and J. Andrew Risi, Geology and Geophysics, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Causeway, Miami, Florida 33149; Harold R. Wanless, Dept. Geological Sciences, Univ. of Miami, P.O. Box 249176, Coral Gables, Florida 33124.*

THE ETIOLOGY OF SEABATHER'S ERUPTION.—Scientific, medical, public health and tourism personnel have sought to understand Seabather's Eruption (SBE), since this annoying, sometimes severe pruritic dermatitis was first described as a clinical manifestation by Sams in 1949. First mentioned by Thomas, more than 60 years ago, in 1931, the causative agent(s) is still unknown in the tropical Florida and Caribbean waters where the itchy rash is most prevalent and often referred to as "sea lice." Investigations during an epidemic in the summer of 1980 along the Atlantic ocean beaches of the south shore of Long Island, New York, finally provided the first SBE incident in which a marine etiological agent was identified. Additionally, this was the first documentation of SBE in northern waters, and the first larval sea anemone implicated in human illness. A monitoring program was established and a dozen years of field and laboratory studies suggest ecological and epidemiological similarities with the traditional southern affliction. These observations should help solve some of the mysteries of this typically tropical malady.—*Anita R. Freudenthal, Ph.D., C.W. Post College of Long Island University, Brookville, New York 11548.*

THE DISTRIBUTION OF ORGANIC MATTER IN A DYNAMIC CARBONATE SEDIMENTARY SYSTEM, FLORIDA BAY.—Sedimentary organic matter (OM) has been recovered from a Recent carbonate mudmound environment. Input sources have been identified via chemical characterisation of the soluble OM fractions. Use of these chemical markers as tracers has provided confirmation of sedimentary process model previously based on facies distribution. Twenty-two cores were taken from the windward-leeward aspects of mudmounds in Florida Bay, southeast USA. Solvent soluble OM fractions have been analysed using Gas Chromatography/Mass Spectroscopy (GC/MS) and solvent resistant OM fractions using Pyrolysis GC/MS. This study has resulted in the recognition of distinctive chemotypes (chemical markers thought to have been derived from a particular OM source), revealing clear variations on a centimetre to kilometre scale. Changes are primarily caused by proximity to source, sedimentary facies variation and sediment reworking through bioturbation or storm processes. In particular, the preservation potential of higher plant (i.e. seagrass and mangrove) cuticular material within the sediments is clarified through the chemical characteristion of the external membrane. The Holocene submergence curve was formulated from Florida Bay stratigraphy by Scholl et al. (1969). This study highlighted the importance of backstepping vegetation types during a transgression where there is a shift from freshwater to transitional to marine organo-facies. The relatively simple vegetational succession of Florida Bay makes it particularly sensitive to sea level interpretation. The selective use of organic chemical markers enables us to "fingerprint" organo-facies change, even when the recognisable particulate fraction has been removed through taphonomic processes.—*Neil L. Frewin, Royal Holloway and Bedford New College, University of London.*

SOUTH FLORIDA'S ENVIRONMENTS ARE GEOLOGICAL INHERITANCES: THE PAST IS THE KEY TO THE PRESENT.—The geography and bathymetry of South Florida's marine and terrestrial environments are inherited from geologic events extending back millions of years. The interactions of these physiographic subdivisions with marine communities and hydrography during the past several hundred thousand years has produced today's characteristic biotas, sediments, and local topography of reefs and shoals. The template for all of South Florida began to form as a platform of shallow-water calcareous deposits nearly 600 m thick dating back some 200 million years to the Jurassic Period. Some tens of millions of years ago, a dramatic change in deposition began that transformed the regime of the calcareous platform into one of siliceous sands and clays. This geologic revolution was the result of the southward

spread of siliceous deposits derived from the Appalachian Mountains and distributed by rivers and movement along shorelines. The template, fully formed when the Gulf Stream-Florida Current system developed some 10 to 15 Ma, had shaped the southeast margin of the siliceous deposits into the gentle curve that is now surmounted by the Florida Keys and offshore reefs. The return of the calcareous-deposit regime that would form the Florida Keys, the mainland, and surrounding shallow sea floors came with the onset of glaciation in the Northern Hemisphere. During a highstand of sea level about 125 ka, coral reefs and their associated calcareous deposits that are now the Upper and Middle Florida Keys accumulated preferentially along the southeast edge of the previously deposited siliceous sediments. At about the same time, an arc of calcareous sand banks and tidal channels grew from Ft. Lauderdale to Homestead and Flamingo and formed the present southernmost Atlantic Coastal Ridge. Farther south, similar sand banks accumulated and now form the low-relief limestone islands from Big Pine Key to Key West and the Marquesas. The topography of reefs and sand shoals was fossilized by cementation that occurred when they were above sea level for some 110,000 years. Then, a rising sea progressively began to flood the limestone landscape at about 8 ka. A new rim of reefs and shoals formed seaward of the Keys, and on the western, protected side of the Upper Keys, shallow Florida Bay and Barnes and Card Sounds were born. The major physiographic and hydrographic environments—the Florida reef tract, Biscayne Bay, and Florida Bay—are the large-scale template inheritances, but there are smaller scale ones as well. For example, two of the major subdivisions of the modern reef tract, the areas seaward of the Upper and Middle Keys, are determined by the degree of continuity of the islands formed 125 ka. Where an island is linear such as Key Largo, the offshore reef tract is shielded from the inhospitable waters of Florida Bay, and reef communities flourish. Where islands are discontinuous as in the Middle Keys, tidal exchange between the Gulf of Mexico and Atlantic Ocean produces a mobile sand substrate unfavorable for the establishment of corals and associated reef builders. In addition, the interisland channels allow discharges of inhospitable waters from shallow, restricted Florida Bay to reach the reef tract, which further deter development of reefs offshore. These factors, the mobile sand substrate from cross-shelf tidal currents and the inimical waters from Biscayne Bay, may explain the absence of significant reef development seaward of the Safety Valve south of Key Biscayne.—*Robert N. Ginsburg[1] and Eugene A. Shinn,[2] [1]Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149; [2]U.S. Geological Survey, Center for Coastal Studies, 600 4th St. South, St. Petersburg, Florida 33701.*

CORAL MASS SPAWNING ON THE FLOWER GARDEN BANKS, NW GULF OF MEXICO.—Between 1990 and 1992, several coral species on the reefs in the Flower Garden Banks National Marine Sanctuary (FGBNMS) were observed to participate in annual mass spawning (massive, synchronous gamete release by multiple species). In 1992, reports from Looe Key (lower Florida Keys) indicated substantial activity by two of the four species seen spawning at the Flower Gardens. Observers reported no activity on Carysfort Reef (upper Keys). During each year, colonies in the FGBNMS released enormous amounts of eggs, sperm, or egg/sperm bundles after dark, eight evenings after the August full moon. Mass spawning of four species (*Diploria strigosa, Montastrea annularis, M. cavernosa,* and *Stephanocoenia michelini*) has been documented. Peak activity occurred after 2100 hours, but gamete release was seen between 1830 and 0030 hours. Minor spawning activity has occurred on the evening prior to the major event, prior to sunset on the most active dates, and on the evening following mass spawning, as well as seven days following the July full moon in 1991. Future research in the FGBNMS, as well as the Florida Keys and other western Atlantic reefs should include evaluations of the extent to which various coral species spawn, the timing of gamete release by various corals, the reproductive behaviors of different species, the dispersal patterns and fate of output, and fertilization success. It is important that researchers and resource managers evaluate and consider the implications of coral reproductive viability on reef ecosystem condition and health.—*S. R. Gittings,[1] W. A. Inglehart, G. S. Rinn[2], and Q. R. Dokken,[3] [1]NOAA, Flower Garden Banks National Marine Sanctuary, [2]Rinn Boats, Inc., [3]Center for Coastal Studies, Corpus Christi State University.*

HISTORY OF MARINE RESEARCH IN THE FLORIDA KEYS.—The earliest description of the upper Florida Keys occurs on maps surveyed by DeBrahm in 1765 and 1770 and by Romans in 1775. The first scientific studies of the Florida Reef Tract by Agassiz in the 1880s led to the establishment of the Tortugas Laboratory which issued an extensive list of publications from 1908 to 1941. Between the 1920s and 1940s, sewage pollution and public health concerns prompted a series of studies on the health of Biscayne Bay. In 1957, extensive spearfishing and coral dynamiting aroused conservationists, resulting in the establishment of the first aquatic preserve in the U.S., John Pennekamp Coral Reef State Park off Key Largo. Several important ecological studies were carried out in the 1950s on Soldier Key, off Miami. In 1961, when Seadade Realty Company announced its plans to build a giant oil refueling and petrochemical plant in south Biscayne Bay, Dade County scientists and conservationists exposed the ecological effects of oil/petrochemicals. The Company withdrew its application. In the

late 1960s, a nuclear power plant, constructed by Florida Power and Light, eventually led to a series of scientific studies on Biscayne Bay and Card Sound. In 1968, the Biscayne National Monument was established, expanding into a National Park in 1980. With several notable exceptions, such as the Florida and U.S. Geological Surveys, the Florida Department of Natural Resources, and the National Park Service, few comprehensive studies have been carried out on the Keys. In the 1970s, no Washington agencies included coral reefs in their purview. Only in the 1980s, when the condition of the corals changed for the worse, did federal agencies begin to support outside research. Dade and Monroe Counties have carried out little research in the Keys. Even today, little long-term study is planned. This is why this conference has been organized.—*Kay K. Hale and Donald P. De Sylva, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida 33149.*

MONITORING THE HEALTH OF THE FLORIDA KEYS NATIONAL MARINE SANCTUARY: RESEARCH NEEDS.—The Florida Keys National Marine Sanctuary is the first sanctuary in the Nation to encompass an entire ecosystem. It is composed of several productive and biologically diverse communities such as the coral reefs, seagrasses, and mangroves, some of which are showing signs of severe stress. Recognizing the threats to these unique resources, the President signed the Florida Keys National Marine Sanctuary and Protection Act (Keys Act) on November 16, 1990. The Keys Act calls for the protection of resources and requires NOAA to develop a comprehensive management plan. The sanctuary will be managed to allow continued, compatible multiple uses while achieving the resource protection goals of the Keys Act. This will be accomplished through coordinated inter/intra agency resource protection efforts, education which promotes wise-use of resources, zoning to minimize conflicts and protect biodiversity, and research designed to better understand the ecosystem. In addition to identifying research needs, the Keys Act requires that NOAA establish a long-term ecological monitoring program. To successfully protect this ecosystem, NOAA must understand and monitor its health. This will require considerable input from researcher. This paper will review research needs and will propose a framework for a long-term monitoring program for the sanctuary.—*Benjamin D. Haskell, Edward Lindelof, Billy D. Causey, National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management, Sanctuaries and Reserves Division, Washington, D.C. 20235.*

DISTRIBUTION OF LOGGERHEAD TURTLES AND BOTTLENOSE DOLPHINS OFFSHORE OF THE FLORIDA KEYS.—Analyses of spatial and seasonal distributions of loggerhead turtles and bottlenose dolphins and their relationship with environmental variables offshore of the Florida Keys will be conducted. Data to be analyzed include (1) an aerial survey for sea turtles and marine mammals on the southeastern U.S. seaboard; (2) concurrent sea surface temperatures (SST) from satellite remote sensing; (3) reef locations, and (4) bathymetry data. Seasonal densities of the study animals in the Florida Keys area will be estimated and spatially characterized. Relationships of the estimated densities of the animals with SST, distributions of reefs, and other coastal oceanographic features will be examined. GIS analysis will be applied to the study.—*Haolan Huang[1], Joan A. Browder[2], Guillermo P. Podesta[3], Nancy B. Thompson[2], Larry J. Hansen[2], and Anthony Martinez[2], [1]Cooperative Institute for Marine and Atmospheric Studies, University of Miami; [2]Southeast Fisheries Center, National Marine Fisheries Service; [3]Rosenstiel School of Marine and Atmospheric Science, University of Miami.*

A THREE-YEAR EVALUATION OF COMMUNITY DYNAMICS OF CORAL REEFS AT FT. JEFFERSON NATIONAL MONUMENT, DRY TORTUGAS, FLORIDA, USA.—A long-term ecological research program and a study of the research methods used were initiated in May, 1989, at five reef sites at Ft. Jefferson. Benthos was mapped and photographed within five quadrats (2.56 m^2) per site. Attached biota and substrates were measured along 20- to 25-m chain transects (3 per site). Recruitment arrays were constructed of PVC pipe, flat stock, and ceramic tiles (10.8 × 10.8 cm) and were secured to reference stakes. A carriage-mounted video camera, suspended on cables between two "T" poles secured to the stakes, was pushed the length of a transect. Results implied relative stability of the reef communities over three years. Dominant biota as determined by abundance and cover remained similar. Classification analyses of stations over time also corroborated relative stability. Recruitment of *Millepora,* Octocorallia, and Scleractinia was variable; most recruits were found in cryptic refuge.—*W. C. Jaap, J. L. Wheaton, K. B. Donnelly, B. L. Kojis, J. E. McKenna, Jr., L. J. Miller, and M. L. Kub, Fla. Mar. Res. Inst., 100 8th Ave. SE, St. Petersburg, Florida 33701-5095.*

MICROBIAL COMMUNITY DYNAMICS IN THE MUCUS OF HEALTHY AND STRESSED CORALS HOSTS.—Increased coral mucus secretion can be stimulated in corals by exposure to stress and often leads to elevated numbers of bacteria in the mucus. We hypothesized that increased stress to coral hosts, such as infection by black band disease, tissue damage by fish grazing, and other obvious tissue abnormalities, would result in a change of the microbial community structure and productivity associated with coral mucus. The microbial community associated with the coral *Colpophyllia natans* was studied on French, Grecian, and Horseshoe Reefs at Key Largo, Florida during July 1992. Changes in micro-

bial community productivity in coral mucus and the overlying sea water were measured using microbiological, biochemical, and molecular methods, to determine their variability at different locations and physiological states of the host. All microbial parameters analyzed were at least one order of magnitude greater in the coral mucus as compared to those of the overlying seawater at all locations. The microbial indicators for productivity indicative of DNA, RNA, and protein synthesis rates were significantly higher, the number of eukaryotic nuclei and ug DNA/m^2 were significantly higher and alkaline phosphatase activity was significantly faster for all hosts infected with black band disease as compared to healthy and other compromised states studied. Some measures varied significantly between different locations, most notably the number of bacteria, ug DNA, and primary production rates per unit area of coral. The results may eventually be used to generate a predictive model for coral health based on the microbial population inhabiting the coral mucus, to determine the corals' response to stresses for defining in situ sublethal impacts that may lead to long term ecological damage.—*Deborah L. Santavy[1], Wade H. Jeffrey[2], Richard A. Snyder[2], Jedidiah Campbell[3], Penny Malouin[1], and Leslie Cole[2], Gulf Breeze Environmental Research Laboratory, U.S. EPA, Gulf Breeze, Florida[1]; Center for Environmental Diagnostics and Bioremediation, Univ. of West Florida, Pensacola, Florida[2]; Technical Resources, Inc., Gulf Breeze, Florida[3].*

CONTROLS ON SALINITY IN FLORIDA BAY ISLANDS.—Holocene mud islands found within Florida Bay often contain ephemeral ponds in their interior which are periodically flooded by either bay water during high tides and storms, or by meteoric water during seasonal rainfall. The salinity within these ponds, and the island sediments underlying the ponds, is thought to be controlled by the frequency and intensity of flooding, type of flooding, and intensity of evaporation. To better understand these controls, salinity was measured in ponds and in pore fluids taken from 15 islands across much of Florida Bay in February, 1992. In addition, one island, Cluett Key, was instrumented with pressure transducers to determine the frequency of tidal flooding. Although large variations in salinity exist between different islands (38–130 g/kg), the shape of the salinity profiles within each island was similar, often reaching a maximum between 60 and 80 cm depth from the surface. There appears to be no trend in the magnitude of an island's salinity with it's geographic location within Florida Bay, suggesting that rainfall gradients and salinity gradients within Bay waters are having little effect on an island's salinity. Based on this survey, we hypothesize that it is the flooding frequency of Bay waters over an island and thus the elevation of an island relative to Bay waters that controls the magnitude of it's salinity. Transducer data from Cluett Key support this scenario, and in fact show that the island is flooded daily by Bay waters during the highest tides of a month.—*P. A. Kramer and P. K. Swart, Marine Geology and Geophysics, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida 33149; H. L. Vacher and T. Juster, Department of Geology, University of South Florida, Tampa, Florida 33620.*

DISTRIBUTION AND FREQUENCY PATTERNS OF BLACK BAND DISEASE IN THE NORTHERN FLORIDA KEYS.—Black band disease is present throughout the coral reefs of the Florida Keys. The disease consists of a population of the cyanobacterium *Phormidium corallyticum* and associated microbial community, and is characterized by an active season which occurs during the warmer months when water temperature is at or above 25 C. A field investigation was carried out during the 1992 active season to determine the distribution and frequency patterns of infected scleractinian coral colonies, and to support a statistical analysis of coral species which became infected. Three reefs were chosen for an in depth study—Algae Reef, Grecian Rocks, and Key Largo Dry Rocks. The reefs are patch and fringing reefs, and all are offshore from Key Largo in the Florida Keys National Marine Sanctuary. The study was carried out using both photo transects and 10 m radius quadrats (10 per site). Dispersion indices were used to determine the distribution pattern of the disease on each of the reefs. Distribution of black band occurrence was clumped. In areas of high incidence of the disease, colonies which had been infected in 1991 were observed to become reinfected in 1992. There were distinct differences in the coral species infected between the three study reefs. Most notably, on Algae Reef black band disease was absent from all *Montastrea annularis,* the coral reported to be most susceptible to black band. Infected *M. annularis* was found at both Grecian Rocks and Key Largo Dry Rocks. Also infected were colonies of *M. cavernosa, Diploria strigosa, Colpophyllia natans* and *Colpophyllia breviserialis.*—*Kevin G. Kuta and Laurie L. Richardson, Department of Biological Sciences and Drinking Water Research Center, Florida International University, Miami, Florida 33199.*

ECOLOGY OF EPIBENTHIC CRUSTACEANS IN HARDBOTTOM MARINE COMMUNITIES OF THE FLORIDA KEYS.—Three distinct, image-definable, shallow-water, hardbottom communities in the Florida Keys were sampled qualitatively and quantitatively for their crustacean species assemblages, by targeting crustacean refuges within each community. Three crustacean refuge parameters common to these communities were targeted: (1) algal biomass, (2) sponge presence and abundance, and (3) benthic complexity (relief, substrate, corals and octacorals). A total of 67 species from 27 families, 10 orders, and

3 classes of Subphylum Crustacea were sampled at all sites. The crustacean assemblage of each of the refuge components was obtained and inter and intra-site comparisons were made. In addition, the ecology of each crustacean refuge is discussed. The sites were considered in a gradient of depth, area, and structural complexity. Emphasis was placed on habitat characteristics that caused changes in faunal compositions between sites. The results indicated that an increase in heterogeneity and complexity was accompanied by an increase in diversity. The refuge parameters, algal biomass and sponge presence and abundance, were the best indicators of crustacean abundance, while the refuge parameters of benthic complexity were the best indicators of crustacean diversity and species richness.—*J. M. Levy[1] and K. M. Sullivan,[1,2] [1]University of Miami, Department of Biology, P.O. Box 249118, Coral Gables, Florida 33124; and [2]The Nature Conservancy, South Florida and Caribbean National Parks Data Center, Everglades National Park, Homestead, Florida 33030.*

LATE QUATERNARY SEQUENCE STRATIGRAPHY OFF MARQUESAS KEYS, SOUTH FLORIDA PLATFORM MARGIN.—Seismic reflection profiles seaward of the Marquesas Keys reveal at least eight late Quaternary sequences which downlap onto the Miocene (?) age Pourtales Terrace at 250 m water depth. The setting is unusual in that the present reef-rimmed, shallow inner shelf supplies minimal sediment to the adjacent margin where over 40 m of Holocene sediment has accumulated on portions of the outer shelf and slope. The principal source of sediment appears to include a combination of entrained offbank sediment transport from the west Florida shelf and redistribution of eroded sediment, transported alongslope by the eastward flowing Florida Current. Seaward of the inner-shelf "reef" barrier, an outer-shelf terrace in 50–60 m water depth forms the upper boundary of the prograding late Quaternary sequences. These sequences exhibit both current-controlled internal geometries (e.g., sediment drifts) and sea-level controlled features such as lowstand slope erosion, transgressive unconformities, and paleoshorelines or reefs formed during lower stands of sea level. Bottom currents also severely eroded the slope at times, creating prominent unconformities. Rock samples collected by submersible from the "paleoshorelines" were submarine-cemented grain-stones containing a mixture of shallow-water components such as *Halimeda*, molluscs, benthic forams, and ooids. Other bottom types include smooth submarine-cemented hardgrounds, modern muds, and winnowed coarse sediments. This study provides new insight into the importance of both geostrophic boundary currents and sea-level change in controlling stratigraphic development of the South Florida platform margin. Locally-thick accumulations off the Marquesas Keys may demonstrate sedimentation in response to a persistent cold cyclonic gyre in this area which causes weak counter-currents in an otherwise strong geostrophic current area.—*S. D. Locker, A. C. Hine, Univ. of South Florida, St. Petersburg, Florida; and E. A. Shinn, U.S. Geological Survey, St. Petersburg, Florida.*

GEOCHEMISTRY OF NEAR-SHORE GROUNDWATERS, FIESTA KEY, FL.—In June 1992 five piezometers were installed along a 75 meter shallow water transect offshore of a mangrove patch on Fiesta Key. At each well site a 5 cm dia. core was extracted using a rotary hydraulic drill, and a 2.5 cm dia. PVC piezometer installed. Four wells were cased to bedrock depths ranging from 75 cm to 140 cm with 50 cm of screened interval. One shallow well was cased to 20 cm with 2.5 cm of screen. Wells were developed and sampled 24 hours after installation; well recovery was instantaneous. It is important to emphasize that the following results are preliminary and associated with initial well development. The majority of sampling will take place in mid-August 1992. Temperatures of sampled groundwaters were consistently 27.0 ± 0.2°C (1–3°C cooler than Florida Bay waters) with salinity values of 35–36‰ (38‰ for Bay water). All groundwater samples contained a strong sulfidic odor. Groundwater samples were also analyzed for alkalinity, pH, and Soluble Reactive Phosphate (SRP). Groundwater alkalinity increased from 4.0 ± 0.1 meq/l at 13 meters away from the mangroves to 5.1 ± 0.1 meq/l at 72 meters out. pH also increased from 7.3 ± 0.1 to 7.5 ± 0.1 at 13 and 72 meters respectively. SRP followed a decreasing trend outward from the mangrove patch. At 13 meters SRP measured 0.75 μM and decreased to 0.45 ± 0.12 μM at 72 meters out. The highest value for SRP, 0.88 μM, was measured in the shallow well located at 20 meters out. Groundwater samples collected in August will also be analyzed for sulfide, N-species, F^-, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, and Na^+. Cored materials represent Pleistocene patch reef deposits of coral and cemented shell hash and carbonate mud. In each of the four longer cores there are 1–5 cm thick highly porous zones (presumably of secondary origin) that contain light-colored coatings of carbonate precipitates. Other high porosity zones appear 'grungy' with coatings of darker material that may be associated with organic/inorganic processes. Cores will be examined using SEM, XRF and Microprobe techniques for comparison with aqueous determinations. At present there are insufficient data to suggest any definite conclusions, but it does appear that groundwaters closest to the mangroves differ in measured alkalinity, pH, and SRP from those groundwaters located at greater distances offshore. Continued study will elucidated these preliminary findings and it is hoped that inferences can be made about potential anthropogenic and/or natural groundwater effects.—*Donald D. Machusak, and Lee R. Kump, Department of Geosciences, The Pennsylvania State University, University Park, Pennsylvania 16802.*

THE DENSITY EFFECTS OF THE ECHINODERM *ECHINOMETRA LUCUNTER* ON BENTHIC ALGAL COMMUNITY, INDIAN KEY.—Herbivory is an intense selective pressure in the evolution of marine and terrestrial plants and is a significant factor in the composition and development of macroalgae communities. It has been shown in studies conducted on *Diadema antillarum* that areas of high urchin density are dominated by algal turfs and crustose algae and in areas of reduced urchin density, the algal community is characterized by opportunistic macroalgae, in the form of sheets and/or filaments. The maintenance of algal turf, by the grazing of urchins, is a significant component of coral reef dynamics because algal turf areas are highly productive and are often responsible for the majority of reef primary production. The sea urchin *Echinometra lucunter* is a major inhabitant of tropical coral reefs and can exist in very high densities within the Florida Keys. Little research has been conducted however on the feeding activity and diet of *E. lucunter*. This study investigated the relationship among algal community composition, algal biomass and the density of the sea urchin *E. lucunter*, at Indian Key, Florida Keys. *E. lucunter* was tagged and tethered to maintain experimental densities, from June to October 1992. During this period, data was collected on algal percent cover and biomass. In order to provide additional baseline data for future studies, body measurements and population counts of the conch *Strombus gigas* were also taken and the fish and coral populations were identified and quantified at Indian Key.—*Deborah A. McArdle, Florida Institute of Technology, Department of Biology, 150 W. University Blvd., Melbourne, Florida 32901.*

EXTERNAL VS. LOCAL ENVIRONMENTAL CONTROL OF SOUTH FLORIDA ECOSYSTEMS.—South Florida is at the periphery of the Caribbean biogeographical region. Tropical marine and coastal species here are at or near the ecological limits of their ranges. Many of these species depend on external sources of larval recruitment as documented for lobsters by the SEFCAR project. The upstream source populations are nearer to the optimum centers of their ranges. Extreme environmental shocks such as hurricanes and cold fronts affect local population dynamics as do the pervasive chronic impacts of human overdevelopment. However, these local forces for change must be considered in the larger context. For example, the theories of dynamic biogeography and basin models of population dynamics encompass the issue of local habitat suitability as well as larger scale temporal and spatial phenomena. Recovery from extreme or longterm perturbations depends upon local and external processes and both should be incorporated into expectations for successful management of the South Florida ecosystem.—*Michael F. McGowan, Division of Marine Biology and Fisheries, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149.*

EFFECTS OF HURRICANE ANDREW ON *THALASSIA* ECOSYSTEM DYNAMICS AND THE STRATIGRAPHIC RECORD.—Abnormally high bottom currents associated with Hurricane Andrew had significant, varied and localized impacts on *Thalassia*-dominated marine meadows. Extensive areas of *Thalassia* beds along the west side of Totten Key lost up to 80% of their cover. Most grass bed loss was by the removal of D-shaped divots of grass. These divots are up to 8 m wide and considerably longer, often coalescing. The *Thalassia* root system may be: 1) attached at the flat side of the "D" (and overturned or frequently rolled up like a carpet), 2) detached and transported out of the system, or 3) redeposited in either its upright growth position or upside down. Preservation of such erosional remnants should make future chronostratigraphic interpretations of similar settings very difficult. Several ecosystem processes are documented: 1) *Thalassia* detritus and fine-grained sediments were winnowed from grass beds, 2) previously continuous *Thalassia* beds are broken up and eroded, increasing water depth up to 45%, 3) previously buried sediments and nutrients are made available at the water-sediment interface, 4) bottom habitat diversity is increased, 5) *Thalassia* edge is increased, and 6) mass export or turnover of stored organic carbon and nutrients occurred. Greatest *Thalassia* loss was closest to shore. Since bottom deepening is associated with cover loss, perhaps island leeward channel origin and maintenance is also associated with scouring storm bottom currents.—*John F. Meeder[1], Ronald Jones[2], Joseph J. O'Brien[1], Michael S. Ross[1], Richard J. Sawicki[1], and Allan M. Strong[1], [1]National Audubon Society Tavernier Science Center, [2]Florida International University.*

LONG-TERM MONITORING OF FLORIDIAN CORAL REEFS: CHANGES BEFORE AND AFTER HURRICANE ANDREW.—Six coral reef locations in the Florida Keys were permanently marked and have been photographed periodically between 1984 and 1992. Our photostations consist of two locations on Looe Reef in the Looe Key National Marine Sanctuary (monitored since 1984), two locations on Carysfort Reef in the Key Largo National Marine Sanctuary (monitored since 1984), and two locations in Biscayne National Park: Ball Buoy Reef and Triumph Reef (monitored since 1989). During each monitoring episode we determined species number, species diversity, and percent cover of living coral. Between the initial sampling year and 1991, all photostations lost between 13% and 29% of their initial species number, and five of the six photostations declined in percent cover of living coral. Losses ranged from 7.3% to 43.9% of initial projected surface area. Coral cover increased in only one photostation during this period, but that station was on one of the reefs hardest hit by Hurricane Andrew. It is remarkable,

however, that the amount of damage to reefs in the path of this Class 4 hurricane was still less than the losses incurred by reefs elsewhere in the Florida Keys from other impacts. This presentation will focus on a comparison of pre-hurricane and post-hurricane patterns among corals in terms of sources of mortality, species-specific patterns of coral loss, and geographic trends among reefs in mortality rates and patterns. For example, while Triumph and Ball Buoy Reefs were located approximately equidistant from the epicenter of the hurricane, the force released at Triumph Reef was greater than that released at Ball Buoy Reef. Hypotheses explaining the differences in damage will be presented.—*Ouida W. Meier and James W. Porter, University of Georgia.*

THE POLITICS OF CONSERVATION IN THE FLORIDA KEYS.—The paper focuses on the politics of conservation in land use planning in the tropical, marine environment of the Florida Keys. It takes the case of the development of the Monroe County Land Use Plan (LUP), developing the following analysis. The creation of a land use plan broaches the problem of "density" which is, itself, a surrogate for the trajectory of the community's future development. It raises the question of what the community should become and therefore what will be the lifestyle and "quality of life" in that community. To pose the political opposition of conservation and development in terms of density, and thus the fate of the community itself, reveals a complex set of social relations between the different interest groups as well as their different types of interests (e.g., economic, social, environmental); the coordination between class interests and community interests; and the relationship between county and city, and the state. Within this context, the immediate short-term political solution in favor of increasing density appears more expedient, less costly, precisely because it ignores the underlying social characteristics of the community at large. Accordingly, the opposition arises between developers' short-term, self-interested economic solution and conservationists' long-term, community-oriented social solution. The community-based groups, retirees and fishermen share a common need for the long-term solution. Yet, because they comprise groups with distinct ethnic, occupational, and class backgrounds, it is difficult for them to ally despite the shared desire to maintain water quality and their allocation of community real estate. Everyone from developers to fishermen and retirees, share a dislike for the LUP. Their differences in occupation, ethnicity, and class give rise to divergent concepts of "pollution" and "freedom" and "quality of life." The result is that the two major community groups, fishermen and retirees, form shifting and unstable alliances with development and conservation interests during the land use planning process.—*Sarah Keene Meltzoff, Division of Marine Affairs, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Causeway, Miami, Florida 33149.*

NUMERICAL SIMULATION OF THE FLORIDA CURRENT: A COMPARISON OF TWO MODELS.—Two state-of-the-art numerical ocean circulation models are applied to the same model domain, grid and bathymetry. Similarly, the same initial and boundary conditions and forcing functions are applied to the models. Results are compared from the Bleck (Miami) isopycnal-coordinate and the Mellor (Princeton) sigma-coordinate models, which have the same basic model physics (primitive equations) but a quite different scientific strategy for dealing with density stratification and bottom topography. The model domain covers the entire Florida Straits; thus, the results provide an idea of the level of realism for the Florida Current (and its behavior near the Florida Keys) which can be expected of a contemporary numerical simulation model.—*Rainer Bleck, Dong-Shan Ko, Thomas N. Lee, Craig Mattocks and Christopher N. K. Mooers, Ocean Pollution Research Center, Rosenstiel School of Marine & Atmospheric Science, University of Miami.*

HURRICANE ANDREW IN NORTH KEY LARGO: CHARACTERISTICS OF THE STRUCTURAL DAMAGE TO FORESTS.—In April 1990 we conducted architectural analyses which intersected most of the important terrestrial vegetation types of the Florida Keys, including two permanently marked transects in North Key Largo (Oosterhuis and Ross 1991). Both of these areas were affected by winds estimated at more than 100 mph associated with the hurricane's southern flank, but upland sites were not affected by the storm surge which inundated islands further north. Two weeks after the storm we utilized the same architectural technique to assess structural damage to the 188 trees rooted in the transects. We also repeated light measurements by which we had estimated pre-hurricane leaf area along one transect, and continued to monitor nitrogen and phosphorus levels in the ground water underlying the area. Based on the direction of tree and limb fall, the strongest winds in the study area were from the west. The upland hammock absorbed the greatest structural injury and the highest degree of defoliation, with 62% of the trees severely impacted. Damage was less complete in the mangrove forest, and was further reduced in the transitional and supratidal communities. Leaf area response followed the same trend, with reductions from pre-hurricane levels of 3.8×, 3.4×, and 1.8× in the hammock, mangrove, and supratidal zones, respectively. Structural damage in the hammock consisted of the breakage of most major branches of the dominant canopy individuals, but in the mangrove forest a majority of the severely injured trees were uprooted or bent over. Overall, about ⅓ of major impacts were attributable to indirect effects from neighboring trees. Monitoring of recovery processes along these tran-

sects should provide insights regarding the structural and compositional effects of periodic hurricane events on Florida Keys ecosystems.—*Joseph J. O'Brien, Michael S. Ross, and Lenora Oosterhuis, National Audubon Society, Tavernier Science Center.*

COMPARATIVE UTILIZATION OF FLORIDA BAY AS A NURSERY AREA BY JUVENILE GRUNTS.—Seven trawl surveys of Florida Bay, Everglades National Park, were conducted between June 1990 and October 1991, in order to describe spawning times, size at recruitment to the bay, relative abundance, and distribution and growth rate of juvenile grunts. Species present in decreasing order of abundance, were white grunt, blue striped grunt, pigfish, sailors choice and French grunt. The northern and western regions of the bay, with high turbidity and dense grassbeds, were the only regions used by pigfish and contained the highest density of white grunt. Sailors choice and blue striped grunt were present in all areas though more common in the east. Pigfish (as small as 15 mm and 50 days old) recruited to the nursery area in March, grew more rapidly than other species (.76 mm/day) and by winter were either gone or no longer available to our gear. Blue striped grunt were spawned throughout the year with a peak from February through April, recruited to the bay at approximately 30 mm SL and 70 days old, grew 0.46 mm SL/day and remained in the bay up to a year. White grunt, the product of spring (May–June) and fall (September–November) spawnings, recruited to the western bay at about 20 mm SL and 50 days old and central bay at about 50 mm SL and 130 days old. They remained in the bay up to a year, growing on average 0.23 mm/day, however, those in the turbid west grew much faster than those in the clearer central region.—*David S. Peters, Lawrence Settle, John Burke and Elisabeth Laban, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Beaufort Laboratory, Beaufort, South Carolina 28516.*

ASSESSING CHANGE IN FLORIDIAN CORAL REEFS.—Our widely reported studies on coral loss in the Florida Keys demonstrate that (1) all six stations showed a reduction of biotic diversity, (2) five of six stations showed a loss of living coral cover, and (3) no station showed any recruitment of juvenile corals of any major reef building species during the seven years of the survey. These alarming results raise three questions: (1) Are these trends statistically significant? (2) Are the areas chosen representative of surrounding reef areas? and (3) Are the sample sizes sufficient to extrapolate to the entire Florida reef tract? In answer to these questions: (1) yes, (2) yes, and (3) no. To address the third question, we report on a whole-reef survey initiated by the Great Barrier Reef Marine Park Authority. Their survey utilizes 216 video belt transects, each 50 m long and 2 m wide, arranged in the following manner: 6 bands perpendicular to the shore line (stretching out to the reef from Cairns to Heron Island); 3 reefs/band (a near shore reef, a mid-shelf reef, and an off-shore reef); and 12 video transects/per reef (three "key reefs," photographed annually; plus 9 "cycle reefs," photographed once every three years). The video camera moves along permanent transects. Videos are analyzed either by fixed points on randomly grabbed frames or random points on regularly grabbed frames. Power analyses predict that this technique will detect 20% change among common biota. This system could be adapted for Florida Keys coral reefs.—*James W. Porter and Ouida W. Meier, Zoology Department, University of Georgia, Athens, Georgia 30602.*

PIGMENT AND SPECTRAL ANALYSIS OF SEAGRASS AND ALGAL BLOOMS IN FLORIDA BAY.—The relationship between pigments and reflectance spectra of seagrasses and phytoplankton from numerous basins in Florida Bay is being studied. Both filtered and concentrated samples have been collected for organism identification, enumeration, and chlorophyll fluorescence. Measurement of total absorbance, chlorophylls, carotenoids and phaeo-pigments from whole cell extractions are made on a Shimadzu spectrophotometer. Separation and identification of specific pigments are performed with a Hewlett Packard 1090 HPLC run in reverse-phase. Surface reflectance (368 to 1,160 nm in 2 nm increments) is measured with a Spectron Model SE590 spectroradiometer. Second and fourth derivative spectra of the total absorbancy from the extracted pigment samples have been compared with derivatives of surface reflectance spectra of the sampled basin. Although total absorbancy and reflectance spectra derivatives are similar for the predominent seagrass *Thalassia testudinum,* and a vast (11 km dia.) algal bloom composed principally of planktonic diatoms, the data suggest regions of the visible spectrum which may be useful in satellite interpretation of Florida Bay algal and seagrass dynamics.—*C. J. Reese, and L. L. Richardson, Florida International University, Dept. of Biological Sciences and The Drinking Water Research Center, University Park, Miami, Florida 33199.*

NITROGEN AND PHOSPHORUS IN THE FLORIDA KEYS: GROUNDWATER-VEGETATION RELATIONSHIPS.—As in low limestone islands elsewhere, Florida Keys vegetation is arranged in distinct assemblages along an hydrologic gradient from shoreline to interior. Although hydroperiod and salinity may be the primary influences on community structure, our studies indicate that groundwater nutrients also vary predictably along the hydrologic gradient. We monitored dissolved inorganic nitrogen and soluble reactive phosphorus near the surface of the saturated zone over a 24 month period. The 27 sampling locations

represent the major terrestrial vegetation types present in the Keys. Despite dramatic temporal variation, the rankings of locations within islands remained quite stable, as did the rankings of islands relative to each other. Within-island variation was associated with vegetation type; both nutrients were highest in groundwater beneath paralic mangrove forests and lowest beneath certain upland communities. Most significantly, groundwater nutrient concentration was positively correlated with annual litterfall, litter nutrient concentration, and decomposition rate. The stable patterns of variation observed here suggest a strong influence of biological processes on the character of Florida Keys groundwater.—*M. S. Ross, R. D. Jones, J. J. O'Brien, and L. J. Flynn, National Audubon Society, Tavernier, Florida, and Florida International University, Miami, Florida.*

CAUSES OF FISH KILLS IN THE FLAMINGO AREA OF EVERGLADES NATIONAL PARK.—During the summer-fall period of 1990, three large fish kills occurred in the Snake Bight area, east of Flamingo in north-central Florida Bay. These events caused public concern which prompted the park to initiate a study to determine if fish kills occurred as a result of stressful environmental conditions or in response to anthropogenic contaminants. In December funding was obtained to begin a study. The objectives of the study were to: 1) gather and summarize historical data on fish kills in park coastal waters; 2) establish a continuous water quality monitoring platform in Snake Bight; and 3) survey fish associated with a fish kill for potential anthropogenic contaminants. Based on summaries of historical park fish kill events, it was found that 38 kills have occurred since 1944; seven took place during the passage of south Florida cold fronts while the remaining 31 occurred between March and November and appear to have resulted from hypoxic conditions due to local environmental extremes. Nearly half of the kills took place in the waters of either Florida or Whitewater Bays; 24% occurred east of Flamingo in Snake Bight. Over half of the Snake Bight kills were considered severe (1,000 to 100,000 fish reported as dead); most took place over the past 15 years. Snake Bight is an area characterized by extreme environmental conditions (i.e., severe seagrass die-off, poor water quality, elevated salinities, and hypoxia due to restricted tidal circulation and very shallow water), and relatively frequent fish kills. Presumably, fish kills result from significant drops in water temperature or by stress related hypoxia associated with these extreme environmental conditions. To date no substantive information is available to suggest that fish kills are caused by the disposal of pollutants in ENP. It is possible that the effects of severe seagrass die-off east of Flamingo contributed to the three fish kills reported in Snake Bight during the summer-fall period of 1990. However, the causal factors involved in seasonal fish kills are unknown. To answer these questions, we need to continue collecting fish kill information, improve this documentation, monitor water quality data in relation to environmental conditions associated with a fish kill and, when necessary, analyze fish for potential contaminants.—*Thomas W. Schmidt and Michael B. Robblee, Everglades National Park, South Florida Research Center, P.O. Box 279, Homestead, Florida 33030.*

CROSS-SHELF TRANSPORT OF SETTLEMENT-STAGE NASSAU GROUPER AND OTHER FISHES IN EXUMA SOUND, BAHAMAS.—The onshore movement of settlement-stage Nassau groupers and other fishes was examined on the western side of Exuma Sound by suspending large nets in tidal channels between islands on the edge of Exuma Bank. Nets were fished continuously for 2.5 months during winters, 1990–1 and 1991–2. Moored current meters and a meteorological station provided data on oceanographic and weather conditions associated with onshore movement. Most taxa exhibited a distinct tendency for movement across the 2-km wide shelf when night flood tides occurred under moonless conditions. This transport was enhanced during stormy periods characterized by northeast winds driving surface water across the shelf, and minimized when prevailing southeast winds induced along-shore water movement. Catches in both years were dominated by leptocephali, which accounted for 25–40% of the fishes collected. Tremendous interannual variability in Nassau grouper settlement was observed. Ninety percent of the 1,309 post-larval Nassau grouper collected the first winter moved onshore during a single 4-day storm; only 55 grouper were taken during the second winter.—*J. M. Shenker, S. R. Thorrold, E. Maddox, and R. Mojica, Caribbean Marine Research Center, and Department of Biological Sciences, Florida Institute of Technology, Melbourne, Florida 32901.*

COMMUNITY RESPONSE TO SEAGRASS DIE-OFF IN FLORIDA BAY I. SHALLOW BANKS.—Drop sampling in 1990–92 compared fishes and decapods in healthy *Thalassia*, open water caused by die-off, and algal and *Halodule* regrowth. In waters ≤ 1 m depth, fishes were dominated by *Lucania* in *Thalassia* and by *Floridichthys* elsewhere. Decapods were dominated by *Thor* in *Thalassia* and by a mixture of *Thor*, *Penaeus* and *Pagurus* elsewhere. Fish and decapod densities were usually highest in *Thalassia*, lowest in open water, and intermediate in *Halodule* and algae. Fish and decapod species diversities were usually higher in disturbed habitats. These distributions may be affected by behavior, feeding or predation. Laboratory experiments with *Lucania* and *Cyprinodon* (a congener of *Floridichthys*) indicated that single species distributions may be altered when schools of different species interact. Infaunal communities were altered as well. Predatory *Opsanus* consumed more *Lucania* in disturbed

habitats than in healthy *Thalassia.—Peter F. Sheridan, National Marine Fisheries Service, 4700 Avenue U, Galveston, Texas 77551.*

FACTORS CONTROLLING DISTRIBUTION OF FLORIDA KEYS REEFS.—Regional and area-specific high-resolution seismic profiling, combined with core drilling and analysis of aerial photography, indicates that the distribution of Florida's reefs is regulated by two factors. The primary control is Pleistocene topography, created before Holocene sea-level rise (conversion of landscape to seascape). The secondary influence is water quality, which has progressively changed with rising sea level and changing seascape. A regional sequence of flooding, patterns resulting from sea-level rise, is shown by converting contoured structural maps of the under-lying Pleistocene limestone into paleoshoreline maps. The maps show that (1) the area of the reef tract off the Lower Florida Keys flooded sooner than that off the Upper Keys, suggesting that Holocene reef growth began first off the Lower Keys; (2) the major offshore reefs formed around offshore islands, probably as fringing reefs, and became bank reefs as sea level arose; and (3) rising sea level created wide passes through the Lower and Middle Keys, allowing influx of inimical Florida Bay and Gulf of Mexico waters onto the reef tract 3 to 4 ka and causing senility in major Holocene reefs opposite the passes. Detailed seismic mapping of the reef tract in a portion of the Key Largo National Marine Sanctuary off north Key Largo shows that about 6 to 7 ka a linear chain of barrier islands (Pleistocene outlier reefs) extended along the edge of the platform margin from The Elbow to French Reef. Rising sea level caused flooding of the platform through prominent bedrock depressions south of The Elbow and between French and Molasses Reefs, creating a linear, protected embayment. Corals recruited to a bedrock terrace within the embayment and flourished, forming 14-m-thick linear Holocene reefs, such as Grecian Rocks and Key Largo Dry Rocks. With further rise in sea level, coral patches became established at Mosquito Bank in a bedrock depression within Hawk Channel. At about the same time, marine sediments began to fill a 600-m-diameter sinkhole near Key Largo Dry Rocks. Surprisingly, coral growth along the outlier-reef islands did not lead to major Holocene accumulations at the edge of the platform margin, and reefs such as The Elbow, French, and Molasses are thin (~1 m thick) and are considered geologically senile. These observations are consistent with new data from the Great Barrier Reef of Australia, which also show that older and thicker reef accumulations occur on lagoonal topographic highs rather than on the offshore barrier.—*Eugene A. Shinn,[1] Barbara H. Lidz,[1] and Michael W. Harris,[2] [1]U.S. Geological Survey, Center for Coastal Studies, 600 4th St. South, St. Petersburg, Florida 33701; [2]University of South Florida, Marine Science Center, 140 7th Ave. South, St. Petersburg, Florida 33701.*

POPULATION GENETICS OF THE SPINY LOBSTER, *PANULIRUS ARGUS.*—Mitochondrial DNA sequence polymorphisms were assayed in 258 adult spiny lobsters (*Panulirus argus*) from locales throughout the Caribbean in order to test the null hypothesis of no genetic population subdivision. The *P. argus* mtDNA was found to be extremely polymorphic, with a large number of unique mtDNA haplotypes. The mean amount of mtDNA nucleotide diversity within and between locales was not statistically significant, with mean values of 1.46% and 1.45% respectively. Cluster analysis of distance measures and parsimony failed to detect genetic subdivision between lobsters from widely separated regions. These data are consistent with high levels of gene flow among populations. Although the proportion of local and foreign recruits cannot be estimated from these data, high levels of gene flow suggest long range larval dispersal and recruitment of lobsters from Caribbean sources. This work does not preclude the presence of genetic subdivision that may be cryptic to mtDNA analysis. Future research with other genetic markers and actual recruits may reveal patterns of local recruitment and specific settlement patterns of spiny lobster larvae. Thus, the contribution of new recruits to the Florida spiny lobster population by local adult breeding populations should continue to be protected by management regulations, and management of the spiny lobster on a pan-Caribbean scale should be considered.—*Jeffrey D. Silberman and Patrick J. Walsh, University of Miami, Rosenstiel School of Marine and Atmopheric Science, Miami, Florida.*

RELATIONSHIPS OF SPORT FISHERIES CATCHES IN FLORIDA BAY TO FRESHWATER INFLOW FROM THE EVERGLADES.—Principal components analysis was used to characterize inflow to Florida Bay from Shark River Slough and Taylor Slough. Four components described >71% of the variation in inflow. The components clearly separated summer-fall inflow from winter-spring inflow. Additionally the pattern of variation in inflow was more complex in Taylor Slough than in Shark River Slough. Regression analysis was used to relate individual species catch rates for gray snapper, spotted seatrout, red drum and common snook to the principal components of inflow. Highly significant ($P \leq .05$) regression models were developed and verified for all species. Increased runoff in the winter led to decreased catches of snapper, seatrout and snook. Above average summer and fall runoff led to increased catches of red drum, seatrout, and snook but decreased catch of snapper. Management practices need to consider not only the volume of water but the timing of delivery to the estuary to ensure fishery yields

in the future.—*Thomas J. Smith III, Rookery Bay National Estuarine Research Reserve; and Michael B. Robblee, Everglades National Park.*

EXTENSION OF THE WILDERNESS ACT TO MARINE AREAS: APPLICATION TO THE FLORIDA KEYS.—The Wilderness Act of 1964 establishes a National Wilderness Preservation System of *lands* where human influence is unnoticeable, thus, providing outstanding opportunities for solitude and unconfined types of recreation. Today over 546 separate areas covering about 95 million acres have wilderness designation and are managed by four federal agencies. My paper analyzes the language of the Wilderness Act, its legislative history, and wilderness ethics, and argues for expansion of the Act to cover marine areas under jurisdiction of the National Park Service, the National Marine Sanctuary Program of NOAA, and the US Fish & Wildlife Service. The Florida Keys provide the case studies for my analysis. Several current federal management regimes approximate wilderness designation. These regimes cover areas of Biscayne National Park, proposed zones of the Florida Keys National Marine Sanctuary, and "backcountry" portions of the National Wildlife Refuges in the Florida Keys. My analysis distinguishes these management regimes from wilderness areas and argues that, nevertheless, there remains a need for marine wilderness areas. I propose regulations for different marine wilderness areas in the Florida Keys and describe some possible user group conflicts that might arise were rules to be promulgated.—*Daniel O. Suman, Division of Marine Affairs, Rosenstiel School of Marine and Atmospheric Science, 4600 Rickenbacker Causeway, Miami, Florida 33149.*

A 120 YEAR RECORD OF NATURAL AND ANTHROPOGENIC VARIATIONS IN FLORIDA BAY BASED ON OXYGEN AND CARBON ISOTOPIC VARIATIONS IN A CORAL *SOLENASTREA BORNONI*.—The unusual occurrence of a specimen of *Solenastrea bornoni* within Lignumvitae basin in Florida Bay has allowed us to use stable O and C isotopes to investigate the effect of anthropogenic activities and natural phenomenon (Hurricanes) upon the water circulation in the area. This coral shows a marked increase in the $\delta^{18}O$ and a decrease in the $\delta^{13}C$ around 1908–1910 coincident with the infilling of passages between adjacent keys during the construction of the railway from Miami to Key West. The addition of fill between the Keys allowed increased evaporation (higher $\delta^{18}O$) and limited the exchange of $\delta^{13}C$ depleted waters with the Florida Reef tract. Since 1910 major hurricanes have had the effect of breaking down this isolation and causing the basin to return temporarily to more marine conditions producing an enrichment of $\delta^{13}C$ and a depletion in $\delta^{18}O$. From 1946 to 1964 the carbon isotopic composition of the coral became increasingly negative reflecting the lack of hurricanes during this period. After three hurricanes in 1964, 65 and 66, during which the $\delta^{13}C$ became heavier, this trend continued to the present day. The increase is not seen in the $\delta^{18}O$ as the water in the bay is already at equilibrium with the atmosphere and increasing evaporation does not act to increase the isotopic composition of the water. Although there are only limited salinity measurements available for the Bay over this period, those that do not exist appear to correlate extremely well with the oxygen isotopic record and support our interpretation that the $\delta^{18}O$ of the coral records previous salinity levels in Florida Bay.—*P. K. Swart, P. Kramer, and J. J. Leder, Stable Isotope Laboratory, MGG/RSMAS 4600 Rickenbacker Causeway, Miami, Florida 33149; R. B. Halley, USGS Center for Coastal Geology, Coastal Center, 600 4th St. S., St. Petersburg, Florida 33701; J. H. Hudson, NOAA, Florida Keys National Marine Sanctuary, P.O. Box 1083, Key Largo, Florida 33037.*

SEDIMENT AND WATER COLUMN NITROGEN AND PHOSPHORUS DISTRIBUTION PATTERNS IN THE FLORIDA KEYS: SEAKEYS.—Nutrient studies were initiated under SEAKEYS because of the concern that anthropogenic nutrients may be impacting Florida coral reefs. Both water column and sediment nutrients are being studied, with the latter emphasized because they integrate the longer-term nutrient dynamics of each area. Samples were collected along 8 transects from passes or canals to offshore of the reef-line. The 4 transects off Key Largo are in an area with the best present-day reef development; the 2 off Long Key are in an area with minimal patch reefs and where major passes allow Florida Bay water to flow onto the Florida reef platform. Two patterns of nutrient distribution emerged. Off Key Largo, and from Ohio to Looe Key, concentrations of N and Chla were elevated near marinas and canals, but returned to oligotrophic levels within ca. 0.5 Km of shore (e.g., Chla $\leq$ 0.25 μg/l; $NO_3 \leq 0.25$ μM; $NH_4 \leq 0.10$ μM). P concentrations, however, were often higher offshore. Sediment N and P were low and comparable to those of pristine reef areas. Sediment N was higher nearshore and decreased offshore; P concentrations varied little or exhibited the reverse pattern. Sediment N:P ratios were consistently lower offshore (1–10 vs. 20–40 nearshore) indicating that N may be limiting to offshore algae. Low sediment nutrient content suggests that either supply of detrital material to reef tract sediments is low, or that remineralization rates are high. Higher offshore PO_4 concentrations are attributed to periodic upwelling along the shelf edge. The second distribution pattern was found in the "middle keys": Water column nutrients and Chla were 2× those in areas north and west of there. Sediment nutrients were higher also but nearshore and offshore areas did not differ. The middle keys are largely devoid of patch reefs and the offshore reefs are drowned ca. 5 m or more in depth. The

higher sediment and nutrient efflux through the wide passes in this area (i.e. Shinn's inimical waters) are likely responsible for the lack of Holocene reef growth in this part of the Florida Keys.—*Alina M. Szmant and Amy Forrester, RSMAS, U of M, 4600 Rickenbacker Cswy., Miami, Florida 33149.*

VERTICAL FLUXES RESULTING FROM BIOIRRIGATION: THE SIGNIFICANT EFFECT OF DEEP BURROWING ARTHROPODS.—Deep burrowing arthropods (*Callianassa, Alpheus,* and *Upogebia*) are prevalent vertical advectors of sediment throughout the shallow marine bays, lagoons and the reef-tract of South Florida. Their thumb-sized open burrow complexes commonly extend more than a meter into the subsurface. During burrow excavation and feeding, these crustaceans expel suspension-sized sediment to the depositional interface. Expelled sediment is overwhelmingly less than 175 μm in settling diameter and represents grains swept up and out of the burrow by currents generated by the shrimp. Expelled sediment may be the finer-grained sediment from the original substrate in the case of deposit feeders or waste from suspension trapping during filter feeding. Large storms and hurricanes erode, resuspend and transport surficial sediments that infill open burrow complexes. Storm infilling from the surface is with a mixture of traction-bedload-sized grains and mud. Burrow excavation and feeding effectively transports deeply buried (>1 meter) sediments, including particulate and surface adsorbed pollutants, to the depositional interface while storm infilling transports surficial sediment deep into the subsurface. Initial calibration of rates of burrow excavation and infilling using ^{210}Pb geochronologies in Biscayne Bay, demonstrate vertical particle advection rates sufficiently fast to recycle 15–25% of the upper 1 to 1.5 m of deposit over 100 year time scales. Deep burrowing arthropods are present throughout Biscayne Bay, the reef tract and the more normal marine portions of Florida Bay. Vertical advection of particles by their burrowing and feeding behavior coupled with storm infilling of their burrows represents a major pathway for large-scale particle and pollutant transport.—*Lenore P. Tedesco, Department of Geology, Indiana/Purdue University at Indianapolis, 723 W. Michigan St., Indianapolis, Indiana 46202-5132.*

AN ALTERNATIVE HYPOTHESIS FOR THE FLORIDA BAY SEAGRASS DIE-OFF.—A large die-off of the subtropical seagrass *Thalassia testudinum* has recently occurred in Florida Bay. Currently, it is the belief of many researchers that human activities other than freshwater divergence had little role in the initiation of this die-off. Elevated salinities (>50 ppt) and water temperatures are thought to be involved with die-off. Previous work indicates that *T. testudinum* has an optimum salinity of about 30 ppt, with reductions in productivity above and below this level. However, when the die-off areas are overlain on salinity isopleths it is apparent that die-off areas are not centered around areas of highest salinities. In Laguna Madre, a negative estuary similar to Florida Bay, *Thalassia testudinum* is found in areas with salinities above 40–45 ppt, well above values found in most (not all) areas of die-off in Florida Bay. It is the belief of the authors that there is little evidence that suggests high salinities were important in bringing about the die-off of *T. testudinum* in Florida Bay, as has been previously suggested. Therefore, not only would re-establishment of historical freshwater flows into northeast Florida Bay increase nutrient loads into that area (due to anthropogenic nutrient enrichment of discharged water), there is not much promise that this activity would lessen the chance of later seagrass die-offs. However, high temperatures (perhaps related to high water column chlorophyll levels) might be an important component to die-off. What seems more clear is that areas of Florida Bay that experienced later die-off are characterized by higher biomass than areas where die-off did not occur. In addition, these areas of already high biomass had experienced recent large increases in aboveground biomass prior to die-off. This leaves the question of how did such an increase in biomass occur? A review of the literature suggests two ways to bring about an increase in seagrass biomass: increase the available light, and increase the sediment nutrient supply. This paper will address the *potential* role of both increased light levels and increased sediment nutrient levels in triggering the die-off of *Thalassia testudinum* in Florida Bay.—*D. A. Tomasko*, and B. E. LaPointe**, *Sarasota Bay National Estuary Program, 1550 Thompson Parkway, Sarasota, Florida 34236; **Harbor Branch Oceanographic Inst., Route 3, Box 297A, Big Pine Key, Florida 33043.*

QUATERNARY SEA-LEVEL LOWSTAND FEATURES ON THE SOUTHERN FLORIDA KEYS UPPER CONTINENTAL SLOPE: SEISMIC, SUBMERSIBLE, AND OUTCROP DATA.—Newly-discovered features along the continental slope of the south Florida platform have been interpreted via seismic-reflection data as Quaternary sea-level lowstand deposits (shoreline and nearshore features). The low-gradient slope, seaward of the Holocene reef tract and latest Pleistocene outlier reefs, is superimposed by mounds or bumps. These range in depth from 60 to 100 m MSL, and resemble reefal or dune deposits, or shoreline nickpoints. Seismic data were recently augmented by a series of 2-man submersible dives (DELTA) in and around these features, providing invaluable first-hand dimensional perspective on the undersea outcrops, as well as extensive video, still photography, and in situ outcrop samples. The outcropping grainstones contain abundant subtropical and tropical skeletal components useful for paleoclimatic and age analyses, paleoenvironmental and diagenetic studies, and interpretation of the deposits in terms of sea

level position and relationship to climate. Quaternary sea-level lowstand deposits have not previously been sampled from the south Florida platform, a current-dominated windward carbonate margin. Because this platform is tectonically stable, it should preserve a relatively pure signal of the amplitudes of sea-level fluctuations. High-frequency sea-level changes recorded by slope features provide data on modes of platform evolution and contribute to the refinement of sequence stratigraphic models for long-term platform development. Florida lowstand deposits should additionally corroborate lowstand data from Bahama Blue Hole studies. These lowstand amplitudes in combination with available highstand data can be used to establish a maximum range for Quaternary sea level fluctuations.—*Marguerite A. Toscano and Albert C. Hine, Department of Marine Science, University of South Florida, 140 7th Ave. South, St. Petersburg, Florida 33701.*

IMPLICATIONS OF POPULATION GENETICS AND LIFE HISTORY EVOLUTION FOR THE MANAGEMENT OF FLORIDA KEYS FISHES.—The management of fish populations in the Florida Keys should consider the consequences of man's activities for genetic variation of fish life histories. Population-genetic structure yields information about the scale over which population processes are carried out, but spatial patterns of genetic variation assessed by molecular techniques may not correspond to spatial patterns of genetic variation for life-history traits. The consequences of activities such as size-selective fishing for fish stocks, therefore, cannot be predicted from population structure alone. Sailfin mollies from the Florida Keys, where this species is ubiquitous, illustrate this point. Life-history patterns, physiological adaptations to salinity variation, and allozymes vary on different spatial scales in Keys populations. Should morphologically distinct local populations in the Florida Keys ever be extirpated, efforts to reestablish them should consider all types of genetic variation. The implications of these observations for reef-fish management and the design of marine reserves will be discussed.—*Joel C. Trexler, Department of Biological Sciences, Florida International University, Miami, Florida 33199; and Joseph Travis, Department of Biological Science B-142, Florida State University, Tallahassee, Florida 32306-2043.*

HOLOCENE ENVIRONMENTAL HISTORY OF CARBONATE BANKS IN FLORIDA BAY AND BISCAYNE BAY, SOUTH FLORIDA.—Florida Bay is underlain by a gently westward sloping limestone surface which rising sea level transgressed between 4,500 and 3,000 years ago. Subtle irregularities in the limestone topography defined landward-penetrating peat-filled sloughs and temporary shore buildups (coastal levees). These peat and levee deposits, though now transgressed and dissected, served as a defining control on the patterns of subsequent growth of carbonate sand and mud banks. Portions of many islands are remnants. Skeletal sand and mud banks in Biscayne Bay either extend from gaps in the seaward limestone ridge (Featherbed Banks and Caesar's Creek Bank) or are positioned bayward of the protection of a shallowly submerged limestone ridge (Safety Valve). The carbonate mud banks in central Florida Bay and Biscayne Bay are either transgressed coastal deposits or marine carbonate banks built by the physical bank growth, extension and migration. The internal stratigraphy of the marine carbonate banks record pulses of physical growth followed by seagrass recolonization. Each physical growth pulse contains a basal erosion or smothering surface, covered by 1–10 cm of coarse skeletal sand and gravel (if available) and mud clasts. This is overlain by 1–10 cm of layered skeletal to peloidal sand which normally fines upwards. A 10–120 cm unit of layered mud (to fine sand in more exposed settings) forms the bulk of each physical growth pulse. Banks are extending/migrating southward and westward by repetitive pulses of physical banks growth. Banks tend not to form in the lee of emergent islands. We interpret these physical pulses of sedimentation to record a hurricane-level storm initiation (scour, smothering, gravel and layered sand) followed by years of layered mud sedimentation by winter storms. Gradual sea grass recolonization helps to stabilize the banks but appears to play little role in bank growth. The broad carbonate banks in western Florida Bay have resulted from the coalescenec of smaller banks as interbank bays filled with sediment. Bay infillings are commonly associated with persistent seagrass cover and community. Both the narrow and broad banks tend to build towards and into the intertidal zone. This is accompanied by a coarsening of the substrate and elimination of the stabilizing seagrass and algal communities. Carbonate banks are dynamic features that are highly responsive to sea level changes, storm processes and sediment supply.—*Harold R. Wanless, Department of Geological Sciences, University of Miami, P.O. Box 219476, Coral Gables, Florida 33124; Lenore P. Tedesco, Department of Geological Sciences, Indiana/Purdue University at Indianapolis, 723 W. Michigan St., Indianapolis, Indiana 46202; Daniel Cottrell, EGG, 2666 Tigertail Ave, Miami, Florida 33133; and Matthew G. Tagett, 8825 S.E. 16th Place, Portland, Oregon 97202.*

TRANSPLANTING ORGANISMS ON A DAMAGED REEF AT PULASKI SHOAL, FT. JEFFERSON NATIONAL MONUMENT, DRY TORTUGAS, FLORIDA.—Grounding of the 475-ft freighter, MAVRO VETRANIC, at Pulaski Shoal Reef, Dry Tortugas, on 30 Oct. 1989, damaged 3,465 m^2 or reef surface. After one year, minimal recruitment of macrobenthos, principally the alga *Dictyota,* had occurred. An experiment was designed to test the effects of adding relief and of transplanting sponges, octocorals, and scleractinian corals on recruitment of biota to the damaged area. In Sept. 1991, one control and two experimental plots,

each 9 m^2, were selected, marked, mapped, and photographed. Large reef rocks were placed in one experimental plot to provide relief and refuge. More than 185 organisms (73 species of algae, Porifera, and Cnidaria) were transplanted and cemented into five of the nine one-m^2 subunits in the other experimental plot. Sites were photographed and mapped and will be monitored to determine if recruitment of macrobenthic organisms is enhanced.—*J. L. Wheaton[1], W. C. Jaap[1], B. L. Kojis[1], G. P. Schmahl[2], D. L. Ballantine[3], and J. E. McKenna, Jr[1], [1]Fla. Mar. Res. Inst., 100 8th Ave SE, St. Petersburg, Florida 33701; [2]Looe Key Natl. Mar. Sanctuary, P.O. Box 782, Big Pine Key, Florida 30433; [3]Univ. Puerto Rico, P.O. Box 5000, Mayaguez, Puerto Rico 00709.*

CAN ISOLUME DEPTHS GENERATED BY A COMPUTER MODEL PREDICT THE VERTICAL DISTRIBUTION OF SPINY LOBSTER PHYLLOSOMA LARVAE (CRUSTACEA: PALINURIDAE)?—During a Southeastern Florida and Caribbean Recruitment (SEFCAR) zooplankton survey, May 22–29, 1990, in the Florida Keys, 1,330 *Panulirus* spp. phyllosomata (80% stages I–II) were collected with a 1-m^2 MOCNESS of 0.333 mm mesh. They were almost entirely caught above 60 m, and were found to migrate vertically from 20–40 m in the day to 0–20 m at night. We examined whether a simple relationship exists between light and the diel vertical distribution pattern of phyllosomata using submarine irradiance generated by a computer model. In general, phyllosomata occurred between 40–400 $\mu Em^{-2}s^{-1}$ during the day. There was some correspondence between depths of isolumes and vertical distribution, but statistically the correlation was insignificant. Spatial and physical heterogeneity could confound correlation. Control mechanisms for diel vertical migration could also involve more complex responses to light, or a combination of other biological, chemical, and physical factors.—*Cynthia Yeung, J. Theodore Couillard, IV, and Michael F. McGowan, Division of Marine Biology and Fisheries, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149-1098.*

THE ROLE OF CLIMATE IN THE FLORIDA BAY SEAGRASS DIEOFF.—Since the fall of 1987, Florida Bay has experienced a major die-off of seagrasses and benthic macrophytes totaling tens of thousands of hectares. After several years, dieoff of *Thalassia* continued at a reduced rate, while colonization and growth of the colonizer *Halodule* became widespread. Anomalies in the recent climate record may have played a significant part in the dieoff initiation. Retrospective analysis of earlier data coupled with current studies show a large increase in seagrass biomass prior to the dieoff and a decline in turnover rate or specific plant productivity during the dieoff. External stress in the form of hypersaline conditions (maximum salinities >70, max. yearly station averages >50 ppt), which are partly anthropogenically derived, were prevalent during much of the dieoff. Climatic stresses are 1) excessively warm waters in the late summer and fall of 1986–1988, and 90, and 2) a reduction of historic tropical storm frequency and intensity. Increased temperatures and decreased day length in the fall negatively impact seagrass P/R. Historical and anecdotal evidence suggests a continuing shift over the past decades from a mixed habitat to an increasingly monospecific *Thalassia* community. While recolonization processes are establishing a more diverse mixture of habitats with the potential of enhanced secondary productivity, in some areas, in 1992, major dieoff expansion has occurred in western Florida Bay.—*J. C. Zieman[1], R. Davis[1], J. W. Fourqurean[2], and M. B. Robblee[3], [1]Environmental Sciences, University of Virginia, Charlottesville, Virginia 22903; [2]San Francisco State University, Tiburon, California; [3]Everglades National Park, Homestead, Florida.*