ABSTRACTS

DISTINGUISHING THE EFFECTS OF ANTHROPOGENIC AND NATURAL (HURRICANE) DISTURBANCES ON MANGROVE CREEK FISHES *by Aaron J. Adams and R. Kirby Wolfe.*—Disturbances are considered important factors influencing biological organization. Hurricanes are disturbances of particular importance in warm latitude coastal ecosystems. However, disturbance effects are often modified by interactions with anthropogenic disturbances, which tend to have different ecological effects than, and often alter the ecological response to, natural disturbances. Four creeks (two "natural", two "degraded") had been sampled for 22 mo prior to, and 14 mo after hurricane Charley. Prior to the hurricane, fish assemblages were different between creek types, with more species and higher densities in natural creeks. Species richness and density in natural creeks declined precipitously post-hurricane, and species generation times and isolation from likely source populations has resulted in a delayed recovery in abundance, but species richness is similar to pre-hurricane levels. Fish assemblages in degraded creeks appeared less impacted by the hurricane, likely because they had already experienced a phase shift.— *Mote Marine Lab., Charlotte Harbor Field Station, Pineland, Florida, U.S.A.*

PIT-TAGS AND REMOTE ANTENNAE: EFFECTIVE TOOLS FOR STUDYING JUVENILE FISH USE OF MANGROVE CREEKS *by Aaron J. Adams and R. Kirby Wolfe.*—Mangroves are purported nurseries for many marine and estuarine fishes, but information on density, growth, and survival is necessary to define nursery habitats. Recent technological advances have made large-scale tagging efforts a viable approach to studying juvenile fishes by increasing recapture rates and enabling the use of individual-identification tags. Passive Integrated Transponder (PIT) tags and autonomous antennae, used extensively in freshwater environments, have been successfully adapted to estuarine mangrove creeks to study juvenile snook, *Centropomus undecimalis.* Tag retention rate in juveniles > 120 mm standard length was 100%, with no mortality. The antenna detected approximately 67% of tagged fish that swam through, and the overall "recapture" rate by the antenna was > 40%. The high recapture rate allowed population model estimates of survival and population size, and physical recaptures allowed direct measures of growth. This is a viable approach to examining the nursery function of difficult-to-sample mangrove creek habitats.— *Mote Marine Lab., Charlotte Harbor Field Station, Pineland, Florida, U.S.A.*

SHRIMP INGRESS INTO MANGROVE FORESTS OF DIFFERENT AGE STANDS, MATANG MANGROVE FOREST RESERVE, MALAYSIA *by N. Affendy and V. C. Chong* .—Although the importance of mangrove forests as nursery areas for shrimps has been well documented, why shrimps are associated with mangroves is not fully understood. This study investigates the relationship between shrimp abundance and mangroves of different age stands. Shrimp abundance in a cleared area and four different age stands of mangroves (5, 17, 24 and > 30 yrs) were compared. These forest stands are silvicultured, varying in tree densities as well as structural complexity of the root system. Shrimps were sampled using baited shrimp pots. A total of 3609 penaeid, caridean, and alpheid shrimps belonging to 10 species were sampled over a 12-mo period. The majority of prawns moved at least 56.4 m into the mangrove forest at high tide. The highest mean catch of prawns recorded in the 24-yr-old age stand was 51.08 prawns per hour and the lowest was 2.52 prawns per hour in the clear-felled mangrove site. Prawn catch increased with increasing distance from the mangrove river fringe into the forest. More prawns were caught among prop roots than in the open spaces between trees. The role of mangroves as nursery areas and implications for forestry management are discussed.— *Institute of Biological Sciences, University of Malaya, Kuala Lumpur, Malaysia.*

VARIATIONS IN JUVENILE FISH DENSITY ALONG THE MANGROVE–SEAGRASS–CORAL REEF CONTINUUM IN SOUTHWESTERN PUERTO RICO.—*by Alfonso Aguilar-Perera and Richard S. Appeldoorn.*—Despite extensive study of the fish community off southwestern Puerto Rico, little information is available on the relative importance of mangroves, seagrass beds, and shallow-water coral reefs as nursery areas. We investigated the extent to which 20 selected, reef-associated fish species use the mangrove and seagrass as nurseries in contrast to the use of shallow-water coral reefs. Stratified sampling was applied to quantify the variability of juvenile fish densities along the mangrove–seagrass–coral reef continuum following an inshore-offshore gradient. We recorded 28,758 individuals (in 7 families), with juveniles accounting for 80%. Significant variations in juvenile densities were evident. The importance of mangroves and seagrass for harboring juveniles was found to be relative and species-specific. In the majority of cases, shallow-water coral reefs showed higher densities than mangroves and seagrass. Ontogenetic migration of juveniles through the continuum was evident. Results highlight the importance of including this continuum within coastal management through marine reserves.—*University of Puerto Rico, Mayagüez, Puerto Rico.*

THE INTERNATIONAL MARINE SHRIMP ENVIRONMENTAL GENOMICS INITIATIVE (IMSEGI): MONITORING ECOSYSTEM, ANIMAL, AND PUBLIC HEALTH — CURRENT STATUS AND PERSPECTIVES FOR THE FUTURE *by Acacia Alcivar-Warren [1,2,3,5], John Keating [1,6], Louise Maranda [1,3,4,5], Martha Delaney [1,2,5], Dawn Meehan-Meola [1,2,5], William Moomaw [1,7], Caleb McClennen [1,7], Jorge Echevarria [1,8], Adan Alvarado [1,9], Cecilia Serrano [1,10], Cesar Valarezo [1,10], Luis Mejia [1,11], Marco Saavedra [1,11], Luis A. Alcivar [1,11], Miriam Alcivar [1,11], Margarita Palmieri [1,12], Suwanna Panutrakul [1,13], Wansuk Senanan [1,13], Praparsiri Barnette [1,13], Nongnud Tangrock-Olan [1,13], Jim Enright [14], Benjamin Brown [15], and Jianghai Xiang [1,16].*—Marine shrimp populations in their natural habitat are threatened by a variety of pressures including habitat destruction, pollution (i.e., pathogens, heavy metals, PCBs, antibiotics) and gene pool depletion. To conserve penaeid shrimp species and develop a sustainable shrimp aquaculture industry, the IMSEGI was initiated with the purpose of yearly monitoring (1) the structure of the meta-population of wild penaeid shrimp species, (2) the levels of genetic differentiation of selected species, and (3) pollutant load (pathogens, heavy metals, PCBs, etc.) in penaeid shrimp populations along their natural range. We invite academic and industry groups as well as governmental and non-govermental organizations to join IMSEGI.—*[1] IMSEGI. [2] Environmental & Comparative Genomics Section. [3] Center for Conservation Medicine. [4] International Program. [5] Department of Environmental and Population Health. [6] Pathology Laboratory, Department of Biomedical Sciences, Cummings School of Veterinary Medicine at Tufts University, N. Grafton, Massachusetts, U.S.A. [7] The Fletcher School of Law and Diplomacy, Tufts University, Medford, Massachusetts, U.S.A. [8] Departamento de Biología y Bioquímica, Facultad de Ciencias de la Salud, Universidad Nacional de Tumbes, Peru. [9] Departamento de Acuacultura, Facultad de Ingeniería Pesquera, Universidad Nacional de Tumbes, Peru. [10] Escuela de Acuacultura, Universidad Técnica de Machala, Ecuador. [11] Clinica de Especialidades Médicas, Santo Domingo, Ecuador. [12] Universidad del Valle de Guatemala, Guatemala. [13] Department of Aquatic Science, Faculty of Sciences, Burapha University, Chonburi. [14] Mangrove Action Project, Amphur Muang, Trang, Thailand. [15] Mangrove Action Project, Yayasan Akar Rumput Laut, Yogyakarta, Indonesia. [16] Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China.*

DECLINING MANGROVES AND FISHERIES IN THE BATAN ESTUARY, PANAY ISLAND, CENTRAL PHILIPPINES *by Jon P. Altamirano.*—In the Philippines, being an archipelago of 7100 islands with a vast 184,000 km^2 continental shelf area, fishing is a major means of livelihood. With recent trends, coastal fishing grounds that were once abundant with fishery resources and vast coral reefs, seagrasses and mangrove belts, have been becoming increasingly depleted. Mangrove cover has dramatically declined and these important ecosystems were converted to other uses. About 279,000 ha were lost from 1951 to 1988 in

the Philippines, 50% of which were attributed to aquaculture. Population increase that led to a more intense fishing pressure and alongside the loss of these important mangrove ecosystems is the noticeable decline in municipal capture fisheries in coastal fishing grounds. One important fishing ground in central Philippines is the Batan Estuary in Panay Island where about 10,000 households are dependent upon its fisheries, especially on shrimps. Shrimp catch in the Batan Estuary showed that especially the high-priced tiger shrimp *Penaeus monodon* composition declined from 61.9% of the total shrimp landings in 1976–80 to only 6.22% in 1990–91. It is important to note that mangrove cover along the estuary decreased from 4800 ha in 1953 to only less than 300 ha of scattered patches in the 1990s. There are also extensive (4596.81 ha) culture ponds in the area. In recent interview and sampling data, fishers who used to catch 10–25 kg d^{-1} of shrimps and fish in the 1970s only catch an average of 1.5 kg d^{-1} at present. These trends and status of mangroves and fisheries of the Batan Estuary in central Philippines are presented in this paper.—*Global Fisheries Development Science Laboratory, University of Tokyo, Tokyo, Japan.*

LARVAL, JUVENILE, AND ADULT FISHES IN MANGROVE TIDAL CREEK HABITATS: SPATIOTEMPORAL CHANGES IN A BRAZILIAN TROPICAL ESTUARY *by Mário Barletta [1], Audrey Barletta-Bergan [2], and Ulrich Saint-Paul [2].*—Mangroves, open water channels, and adjacent marine areas are considered important spawning grounds and nursery areas for riverine, estuarine, and marine fishes. This study describes the seasonal changes of fish species composition in relation to biomass, density, and biodiversity in the mangrove tidal creeks and in different reaches of the main channel of the estuary. The fish fauna of each habitat was different in density, biomass, and species composition. Seasonal salinity fluctuation is the main factor which structures the fish assemblages in the different habitats of the estuary. The results are also discussed in relation to the different levels of estuarine dependence from the most important species captured in Caeté Estuary. At least 85% of the species captured by the artisanal and subsistence fisheries in the coastal areas of this region require estuarine conditions to complete their life cycle.—*[1] Laboratório de Ecologia de Ecossistemas Aquáticos, Departamento de Oceanografía, Universidade Federal do Pernambuco, Recife, Pernambuco, Brazil. [2] Zentrun für Marine Tropenökologie, Bremen, Germany.*

GRACKLES FORAGING MAY ENHANCE FEEDING SUCCESS OF MANGROVE FISHES *by Laura E. Bavaro, Lizeth M. Szelistowski, and William A. Szelistowski.*—Positive interactions (mutualism, commensalism) are widespread in tropical environments such as coral reefs, but are not well known in mangroves. This study presents evidence that in the Gulf of Nicoya, Costa Rica, mangrove fishes use disturbances made by foraging grackles to locate and consume tree crabs. Historically, artisanal fishermen in the gulf were known to mimic grackle disturbances to attract snappers and catfish. We found that: (1) four common snappers, *Lutjanus colorado, L. aratus, L. jordani,* and *L. argentiventris,* and the catfish *Hexanematichthys seemanni* feed on the grapsid crabs *Aratus pisonii* and *Goniopsis pulchra;* (2) fishes frequently prey on tree crabs which enter the water to escape grackles; and (3) snapper and catfish attack rates on submerged crabs are increased following experimentally-produced disturbances resembling those of grackles. The difficulty of making visual observations in mangroves may contribute to the paucity of positive interactions known to occur there.—*Eckerd College, St. Petersburg, Florida, U.S.A.*

SPOIL DREDGE MANGROVE FORESTATION AS A POTENTIAL SUPPORT FOR FISHERIES IN A MEXICAN COASTAL LAGOON *by D. Benitez-Pardo [1], F. J. Flores-Verdugo [2], and M. Casas-Valdéz [3].*—The main problem in most coastal lagoons in Mexico is the silting of tidal channels. In the Bay of Navachiste (northwest coast of Mexico) a dredging program was developed by the Federal Fisheries Ministry with the purpose to restore the natural tidal hydrodynamics. The spoils were used for the construction of islands and forested with mangroves from a nursery with 25,000 seedlings of *Rhizophora mangle* and *Avicennia germinans*.

Mangrove plantation was carried out considering flooding period for each species, according to their tidal ranges and soil salinities. After a year the survival rate was from 68% to 59% for *R. mangle* and from 80% to 85% for *A. germinans*. The growing rate for *R. mangle* was 1.4 cm mo^{-1} compared to 0.8 cm mo^{-1} for seedlings in the natural forest. For *A. germinans* growing rate was 3.2 cm mo^{-1} vs 1.5 cm mo^{-1} in the natural forest.—*[1] Facultad de Ciencias del Mar de la Universidad Autónoma de Sinaloa, Mazatlán, Sinaloa, Mexico. [2] Unidad Académica Mazatlán del Instituto de Ciencias del Mar y Limnología de la UNAM, Mazatlán, Sinaloa, Mexico. [3] Centro de Investigaciones de Ciencias Marinas del IPN, La Paz, Baja California Sur, Mexico.*

HURRICANE IMPACTS ON FISH COMMUNITIES ASSOCIATED WITH MANGROVES *by Stephen A. Bortone , A. J. Martignette, Brad Klement, Jon Guinn, and Eric Milbrandt*.—Hurricane Charley (Category 4) hit the southwest Florida coast in August 2004 and had a significant impact on mangrove structure. Ongoing surveys on fishes and mangroves presented the opportunity to investigate changes in the mangrove-associated fish community relative to the impact of the hurricane. Presumably, waters and substrates proximate to the mangrove shoreline were altered relative to increased exposure to sunlight with concomitant increases in temperature and decreases in oxygen. Consequently, a scenario was provided to examine the effects that these physical features of the mangrove community had on the associated fish community. Three replicate seine hauls, using a 21.3-m × 1.8-m (3.2-mm mesh) net, were deployed to sample the mangrove-adjacent fish community at numerous locations before and after the hurricane. Analyses of community structure (Bray-Curtis dissimilarity index) in simultaneous comparisons with associated environmental variables using CCA (Canonical Correspondence Analysis) indicated changes in the basic community structure were detectable but short lived, and were overwhelmed by other "catastrophic" events, such as red tide. Mangrove re-vegetation continues with concomitant evaluation of the fish community.— *Marine Laboratory, Sanibel-Captiva Conservation Foundation, Sanibel, Florida, U.S.A.*

MANGROVE MYTHS AND REALITY: THEIR CONNECTIVITY TO FISHERIES PRODUCTION *by Dawn Couchman , John Beumer, and John Kirkwood*.—Mangrove protection in Queensland, Australia, has a long history (ongoing for 100 yrs) and is unique in the developed world. Considerable resources have been invested in recent years to map and identify the extent, diversity, structure, and function of mangrove communities and their productivity, based on leaf-fall and nutrient export to coastal food webs. However, the linkages between fish and fisheries production and mangroves remains poorly understood. This presentation explores the current evidence for and against the reliance of fisheries productivity on mangrove communities and highlights the challenges resource managers face in an era of high development pressure in Queensland's coastal cities. New legislation supporting development threatens to erode the protection afforded to Queensland's mangroves. The pressure is on to provide hard evidence to support the continuing conservation of these marine plants.— *Queensland Depertment of Primary Industries and Fisheries, Brisbane, QLD, Australia.*

VARIABILITY IN CARIBBEAN MANGROVE CREEK FISH POPULATIONS AND COMMUNITIES: IMPACTS OF HUMAN THREATS AND ENVIRONMENTAL FACTORS *by C. P. Dahlgren [1], P. Kramer [2], Craig A. Layman [3], D. Albrey Arrington [4], L. Burke, and Lori M. Valentine [4]*.—Mangrove fringes of tidal creeks serve as important habitats for juvenile and adults of numerous fish species in the Caribbean. Fish using these habitats include those of importance to marine resource managers due to their economic value, ecological function or their threatened status. Thus, understanding factors that influence mangrove fish communities and populations of key species residing in mangroves is essential for effective management of mangrove systems and species that depend on them. Here we combine GIS analyses of human threats to mangrove systems, in situ measurements of environmental parameters,

and surveys of fish from mangrove creek systems from the Bahamas and Virgin Islands. Using these datasets, we examine the relationship that human threats and environmental factors have with mangrove creek fish population and community structure. Preliminary analyses show that environmental variables such as water depth have the greatest influence on fish community structure, but several human threats also contribute to fish community structure and populations of fishery species.—*[1] Perry Institute for Marine Science, Jupiter, Florida, U.S.A. [2] National Science Foundation, Washington, DC, U.S.A. [3] Department of Ecology and Evolutionary Biology, Yale University, New Haven, Connecticut, U.S.A. [4] Loxahatchee River District, Jupiter, Florida, U.S.A. [3] University of Alabama, Tuscaloosa, Alabama, U.S.A.*

CATCH-AND-RELEASE ANGLING IN MANGROVE CREEKS: SURVIVAL AND BEHAVIOR OF BONEFISH (*ALBULA* SPP.) IN ELEUTHERA, BAHAMAS *by Sascha A. Danylchuk [1,3,4], Andy J. Danylchuk [1,3], Steve J. Cooke [1,2,3], Tony L. Goldberg [1,4], Jeff Koppelman [1,5], and David P. Philipp [1,3,4].*—Bonefish (*Albula* spp.) inhabit shallow tropical and subtropical mangrove environments worldwide and are economically important due to their popularity among recreational anglers. Despite their importance, little is known about the biology and ecology of bonefish. The purpose of this study was to examine how different angling, handling, and release techniques affect the short-term post-release survival of bonefish inhabiting mangrove creeks in Eleuthera, Bahamas. A total of 87 fish were angled, released, and visually tracked using small surface floats. A total of 15 (17%) bonefish were preyed upon. Fish released near protective mangrove cover did not experience decreased predation risk. However, all but one of the predation events occurred over 10 m distance from mangrove cover. These results indicate that handling practices and release strategies can significantly affect the short-term survival of bonefish in mangrove creeks. Angler education and management plans that encourage conservative handling can help to sustain this important fishery.—*[1] Cape Eleuthera Institute, Eleuthera, The Bahamas. [2] Institute of Environmental Science and Department of Biology, Carleton University, Ottawa, Canada. [3] Illinois Natural History Survey, Center for Aquatic Ecology and Conservation, Champaign, Illinois, U.S.A. [4] Department of Natural Resources and Environmental Sciences, University of Illinois, Urbana, Illinois, U.S.A. [5] Missouri Department of Conservation, Columbia, Missouri, U.S.A.*

DIFFERENT FISH COMPOSITION IN SEAGRASS BEDS ADJACENT TO EXTENSIVE MANGROVE AREAS AS OPPOSED TO CORAL REEFS *by M. Dorenbosch, M. G. G. Grol , I. Nagelkerken, B. R. Lugendo, and G. van der Velde.*—Little is known about fish assemblages on seagrass beds located adjacent to different habitats. Visual census surveys were used to study the fish composition of two types of seagrass habitats in Zanzibar (Tanzania): seagrass beds adjacent to extensive mangrove areas in an embayment (bay seagrasses) and seagrass beds situated on the continental shelf adjacent to coral reefs (reef seagrasses). At species level, 39 fish species were common in the seagrass habitats, of which nine showed significantly higher densities in bay seagrasses, and four species were exclusively observed in bay seagrasses. Seine net data supported these data and showed that five species occurring only or in higher densities in bay seagrasses were species typically associated with the mangroves as juveniles (*Lethrinus harak, Lutjanus argentimaculatus, L. ehrenbergii, L. fulviflamma* and *Scarus ghobban*). This suggests that for some species, the occurrence of fishes on seagrass beds is related to the connectivity with mangroves.—*Radboud University, Department of Animal Ecology and Ecophysiology, Nijmegen, The Netherlands.*

LOCAL JUVENILE FISH DENSITIES IN FLORIDA KEYS MANGROVES CORRELATE WITH REGIONAL LANDSCAPE CHARACTERISTICS *by C. Ashton Drew and David B. Eggleston* .—Juvenile fish density and diversity vary greatly among mangrove prop root habitat in the Great White Heron National Wildlife Refuge, Florida Keys, USA. We tested relationships between juvenile fish density and diversity and patch- (100s m) and landscape-scale (1 km) habitat characteristics by using backwards elimination, multiple regression models,

and Akaike's Information Criterion and adjusted R^2 values to evaluate model fit. We observed that: (1) variability in juvenile fish density was better explained by landscape- than patch-scale habitat characteristics; (2) each species' density responded uniquely to patch and landscape characteristics; and (3) juvenile fish diversity was not strongly related to either patch- or landscape-scale habitat characteristics. Contour maps of predicted relative juvenile species density and diversity in mangrove habitat (based on landscape-scale regression models) provided a good fit to field data. Our conclusions urge caution where experimental design or conservation strategies generalize the importance of mangrove habitat to juvenile fish.— *[1] North Carolina State University, Department of Marine, Earth, and Atmospheric Sciences, Raleigh, North Caroliona, U.S.A.*

INTEGRATED APPROACHES FOR MANGROVE CONSERVATION AND FISHERIES RESOURCES DEVELOPMENT *by P. Eganathan , H. M. S. R Subramanian, and M. S. Swaminathan.*—The past few years have been marked by the exploitation of the mangrove ecosystem for coastal development. Indiscriminate felling of mangrove trees has been going on for timber, charcoal, etc. Aquatic faunas are depleted for commercial gains without any awareness toward ecological harm that it might lead to. Of late there is an increasing awareness at various levels of governments as well as the society in general with regards to the crucial ecological functions that the mangrove ecosystem plays. One good example is the strategy of Joint Mangrove Management (JMM) that involves coastal community along with government bodies in the conservation of mangrove ecosystem. This method has received some success in Tamilnadu wherein the JMM involved people who live along the coasts near the mangroves and linked them to the Forest Department. The presentation will explain in detail the methods of implementing JMM and thereby achieving sustainable management of mangrove and fishery resources.— *M. S. Swaminathan Research Foundation, Chennai, India.*

SPINY LOBSTER AND FISH IN MULTIPLE BACKREEF HABITATS IN THE LOWER FLORIDA KEYS, USA *by David B. Eggleston [1], Geoff W. Bell, Eric G. Johnson, and G. Todd Kellison [2].*—Aerial photographs and ground-truthing were used to map putative backreef nursery habitats in the lower Florida Keys, followed by diver-surveys of spiny lobster and juvenile fish. Back reef habitats appear to serve as an integrated mosaic of nursery habitats for reef fish and spiny lobster. Channels connecting the Atlantic Ocean and Gulf of Mexico provide conduits for larval ingress into back reef nursery habitats, as well as for ontogenetic migrations of animals from back reef to offshore reef habitats. Expansive seagrass meadows contained the smallest stages of fish and spiny lobster, whereas mangroves contained the highest densities of fish. Isolated patch coral heads contained the highest diversity of fish and density of spiny lobster. The relatively high densities of fish observed in the lower Keys compared to other Florida and Caribbean backreef systems highlight the important nursery role of this tropical system, and the need for strict conservation.—*[1] North Carolina State University, Raleigh, North Carolina, U.S.A. [2] National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, Florida, U.S.A.*

A META-ANALYSIS OF SNAPPER AND GRUNT DATA FROM MANGROVE SHORELINE HABITATS IN THE GREATER CARIBBEAN *by Craig H. Faunce.*—Worldwide field studies (109) were examined for size (mean, range, and maturation) and utilization (standardized abundance, density, or biomass) of mangrove habitats by snappers and grunts. The majority of comparable data are derived from visual surveys conducted in the Netherland Antilles (NA) and Florida (FL). The average size of each species examined was roughly half its respective size-at-maturity, though adult-sized fish were recorded for most species. Average sizes of six species were comparatively larger in FL, though differences were significant in only two cases. The mean density of snappers and grunts were significantly greater than either seagrass or reef habitats in three of four comparisons. Agglomerative cluster-analysis and Indicator Species Analysis of data from 21 studies identified three distinct groupings;

Lutjanus apodus and *Haemulon flavolineatum* indicated most island countries, *Lutjanus griseus* indicated continental western margins, and *Lutjanus jocu, Haemulon aurolineatum,* and *Haemulon bonairi* indicated Guadeloupe.—*Florida Fish and Wildlife Research Institute, Tequesta Field laboratory, Tequesta, Florida, U.S.A.*

UTILIZATION OF MANGROVES BY JUVENILE LEMON SHARKS (*NEGAPRION BREVIROSTRIS*) IN THEIR PRIMARY NURSERY AREAS *by Bryan R. Franks [1,3] and Samuel H. Gruber [2,3]*.—Lemon sharks and other coastal shark species utilize shallow, protected waters during their early stages of life. Many of these highly productive, shallow nurseries in tropical and subtropical areas tend to be mangrove-fringed coastlines and estuaries. Sharks are thought to use these areas to reduce predation risk and maximize prey availability. An ongoing, multi-year telemetry study of juvenile lemon sharks in two primary nursery areas demonstrated that these sharks are disproportionately found near the mangrove roots. During the first two years of this study, we found that 55% of all tracking locations from 26 individuals in two separate nurseries were within 50 m of the mangroves and over 88% within 200 m of the mangroves. Prey sampling showed that prey density significantly decreases beyond 100 m from the mangroves suggesting that more prey are available close to shore. Additionally, predator presence increases proportionately with increasing distance from the mangroves suggesting that it is safer close to shore. These results stress the importance of mangroves for a properly functioning coastal shark nursery.—*[1] Drexel University, Philadelphia, Pennsylvania, U.S.A. [2] University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A. [3] Bimini Biological Field Station, Bimini, Bahamas.*

SPECIAL MANAGEMENT NEEDS OF THE GOLIATH GROUPER, *EPINEPHELUS ITAJARA,* IN THE WESTERN ATLANTIC OCEAN *by Sarah Frias-Torres.*—Groupers are extremely vulnerable to commercial extinction, due to their late maturity, longevity, site fidelity, and formation of spawning aggregations. The Goliath grouper, *Epinephelus itajara,* is the largest reef fish in the Atlantic Ocean. It is found in tropical and subtropical waters. The species has been protected in U.S. waters since 1992. *Epinephelus itajara* is mangrove-dependent, with juveniles restricted to mangrove habitats and adults found in coral reefs and artificial structures. The status of *E. itajara* populations in the western Atlantic Ocean is evaluated. Lack of no-take mangrove reserves in the region might affect juvenile survival if fishing bans are lifted. Since existing marine protected areas (MPAs) rarely link nursery and adult habitats, I propose that, for *E. itajara* conservation, future MPA design should aim to link coral reefs with adjacent nursery habitats. Such strategy will also be useful to protect other coral reef fish species.—*University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A.*

BIOLOGICAL, FISHING, AND SOCIOECONOMIC STUDIES WITHIN THE CAYAPAS-MATAJE MANGROVE ECOLOGICAL RESERVE IN THE PROVINCE OF ESMERALDAS, ECUADOR *by Nikita Gaibor, Leonor de Cajas, Mónica Prado, Dialhy Coello, Jacqueline Cajas, Rosa García, and Juan Moreno.*—The Cayapas-Mataje Mangrove Ecological Reserve (REMACAM) is one of the most important ecological areas of the Ecuadorian coastal zone. It is located on the northwestern part of Ecuador. The reserve has extensive mangroves forests, which are very important for its high productivity, and where hundreds of aquatic species inhabit. The REMACAM has ecological and economic value, which serve as food for the local communities. The main objective was to obtain biological, fishing, and social information, such as the structure of phytoplankton and zooplankton within the reserve, the current biodiversity, and to have a baseline of biological and socioeconomic information, to help the knowledge and sustainable management of the reserve. Fourteen classes, with a wide variety of species, represent the zooplankton in which *Acartia lilljeborg* and *A. tonsa* predominated during the rainy and dry season, respectively. The northern area of the reserve is very productive and it showed the highest plankton biomass, with a diversity that varied between 3

and 5 bits, which means clean waters and low presence of human activities. In the central area of the reserve, the zooplankton increased and the phytoplankton decreased in relation to the northern area. It means that in this central area there are more human activities. The diversity oscillated between 3 and 4.3 bits, which is still an indication of clean water. In the southern area, the diversity decreases (1.4 and 2.8 bits). This means that these waters might be lightly polluted due to the physical and chemical conditions, especially due to the increase organic matter that is good for those species from inner waters, such as *Pseudodiaptomus* cf. *marshi* and *Pseudodiaptomus* sp., and also due to the anthropogenic activities within the REMACAM. There was more abundance of zoea and megalopa of brachyuran (70%), especially along the central zone. In addition, we have identified *Macrobrachium* larvae and larvae of *Litopenaeus* shrimp, which are of commercial importance, and local consumption (18%), but also species of ecological value such as mysidaceae, caridea, anomura, fish larvae, chaetognata, among others (12%). Concerning cockles' landings, the highest were registered in the Tambillo community with an annual average of 392,109 cockles in 2000 and 497,591 cockles in 2001. The capture per unit of effort was 151 cockles of *A. tuberculosa* and 45 of *A. similis* in 2000, while the CPUE in the 2001 was 169 cockles of *A. tuberculosa* and 51 of *A. similis*. The average income was of US$1757 for the community of Santa Rosa, US$7787.5 for Tambillo, and US$3127 for the community of El Viento.—*Instituto Nacional de Pesca – Fondo Ecuatoriano Populorum Progressio, Guayaquil, Ecuador.*

ADULT SURVIVAL, PROBABILITY OF CAPTURE, AND ABUNDANCE ESTIMATES FOR MANGROVE DIAMONDBACK TERRAPINS (*MALACLEMYS TERRAPIN*) IN EVERGLADES NATIONAL PARK, FLORIDA *by Kristen M. Hart [1], Catherine A. Langtimm [2], and Carole C. McIvor [1].*—Diamondback terrapins are distributed along the US east coast from Massachusetts to Texas in brackish water, but little is known about terrapins living in mangrove habitats. To estimate adult survival rate, capture probability, and abundance for mangrove terrapins, we conducted a capture-recapture study in the Big Sable Creek (BSC) complex of the Florida Everglades (November 2001–December 2003), and analyzed individual turtle encounter histories over five sampling occasions. We determined the first adult survival rate ($\phi = 0.79$) and population estimate (mean n = 1545 individuals) for mangrove terrapins. We also determined that terrapin distribution within BSC lies largely in small headwater creeks. Moreover, terrapins in BSC showed a higher than expected injury rate (16%) compared to other populations surveyed in more northern salt marsh habitats. This high rate of injury may be due to a high proportion of unfished predators in the protected waters of BSC.—*[1] U.S. Geological Survey, Center for Coastal and Watershed Studies, St. Petersburg, Florida, U.S.A. [2] U.S. Geological Survey, Florida Integrated Science Center, Gainesville, Florida, U.S.A.*

FISH ASSEMBLAGES IN THE CAUSEWAY MARGINS *by Joán Irán Hernández-Albernas.*—In 2003, 80 visual censuses were performed along the Caibarién-Santa María causeway to know the environmental impact on fish communities. The families better represented were Haemulidae, Lutjanidae, and Scaridae. The abundance and biomass showed significant differences ($P < 0.05$) for the interaction of factors strata and margins. The sizes most seen varied between 10–20 cm fork length. The dominant trophic guild was the benthivore. The composition per species showed high similarities to the ones registered at the mangroves of the region, even though the community structure based on the density, differed to those reported in the nearest biotopes. The biomass estimates in some areas were similar to those obtained in the productive reef patches at the Sabana-Camagüey archipelago. The results suggest that the spatial heterogeneity (increase of refuges) contributed by the rocky margins of the causeway has created favorable conditions for the development of fish assemblages exported from the adjacent mangroves areas.— *Centro de Estudios y Servicios Ambientales de Villa Clara, Santa Clara, Villa Clara, Cuba.*

ECOLOGICAL EFFECTS OF THE EXTENSIVE BIMINI BAY RESORT DEVELOPMENT ON THE JUVENILE LEMON SHARK (*NEGAPRION BREVIROSTRIS*) POPULATIONS OF BIMINI, BAHAMAS: A BACI ANALYSIS *by D. E. Jennings, S. H. Gruber [1], S. T. Kessel, B. R. Franks [2,3], and A. L. Robertson*.—The shallow waters around Bimini (25°43.70´N, 79°18.00´W) provide an ideal nurseries for lemon sharks (*Negaprion brevirostris*), but this habitat is under threat from an extensive resort development. Using BACI analysis, effects of the development were investigated by studying three aspects; comparing growth rates of juvenile lemon sharks in the North Sound, Sharkland, and South Bimini nurseries; comparing first-year survival rates of neonate lemon sharks in the North Sound and Sharkland between 1995–2005; and a comparing of habitat structures in the North Sound and South Bimini between 2003 and 2005. BACI analysis did not identify statistically significant differences between growth rates of sharks before and after March 2001. However there was a highly significant statistical difference between first-year survival rates of both North Sound and Sharkland neonates before and after March 2001. Significant changes were also identified between 2003 and 2005 in the North Sound nursery.—*[1] University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A. [2] Drexel University, Philadelphia, Pennsylvania, U.S.A. [3] Bimini Biological Field Station, Bimini, Bahamas.*

VARIATION OF OTOLITH ELEMENTAL SIGNATURES AMONG THREE SPECIES OF JUVENILE SNAPPERS INHABITING NURSERY REGIONS WITHIN SOUTH FLORIDA *by David L. Jones [1], Monica R. Lara [1], and John T. Lamkin [2]*.—The snappers inhabiting south Florida's marine ecosystems are a commercially, recreationally, and ecologically important group of fishes that use mangrove and seagrass nursery habitats before migrating to the reef tract as young adults. Trace elements permanently incorporated into the otoliths of a fish during growth will vary in composition and proportion depending on the environmental conditions to which the fish was previously exposed. ICP-MS was used to determine the microchemical constituents of fish otoliths defining a distinct "elemental signature". These signatures can differ among fishes exposed to different water masses and environmental conditions allowing them to serve as natural tags for tracking fishes. The trace elemental composition of otoliths extracted from 227 individuals of four species of snapper (*Lutjanus apodus, L. chrysurus, L. griseus,* and *L. synagris*) collected from 14 sites within and around Florida Bay were examined in order to assess the extent of spatial, temporal, and taxonomic variability.—*[1] University of Miami, Rosenstiel School of Marine and Atmospheric Science, Cooperative Institute for Marine and Atmospheric Studies (CIMAS), Miami, Florida, U.S.A. 2 NOAA Fisheries Service, Miami, Florida, U.S.A.*

AN EVALUATION AND COMPARISON OF DUAL-FREQUENCY SONAR AND STEREOSCOPIC VIDEO FOR ESTIMATING FISH ABUNDANCE AND SIZE STRUCTURE IN MANGROVE HABITATS *by G. Todd Kellison [1], Jiangang Luo [2], Jack Javech [1], Peter S. Rand [3], Peter Johnson [4], and Joseph E. Serafy [1]*.—Underwater visual fish surveys have become the most commonly used method for estimating fish abundance and diversity in coral reef environments, and more recently in adjacent environments such as mangroves, which provide habitat for a wide range of ecologically and economically important species. Limitations associated with visual surveys (e.g., restricted to daylight hours and relatively clear-water conditions) have resulted in a potentially incomplete assessment and understanding of fish community composition, structure and dynamics. In the present study, we examine the utility of three techniques for underwater fish community assessment. In mangrove and coral reef habitats, under varying conditions of light and water clarity, we compare and contrast: (1) a newly-developed, dual-frequency sonar system (DIDSON); (2) a stereo-video system; and (3) a standard visual survey. We discuss the benefits and limitations of each method for assessing fish community structure, and recommend combined survey approaches to maximize our knowledge of fish utilization of reef and mangrove habitats.— *[1] National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Miami, Florida, U.S.A. [2] Univer-*

sity of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A. [3] *Wild Salmon Center, Jean Vollum Natural Capital Center, Portland, Oregon, U.S.A.* [4] *LGL Northwest, North Bonneville, Washington, U.S.A.*

SPATIAL VARIATIONS IN MANGROVE NURSERY BOUND JUVENILE LEMON SHARK (*NEGAPRION BREVIROSTRIS*) PREY ITEMS, BIMINI, BAHAMAS *by S. T. Kessel, S. H. Gruber* [1]*, and S. P. Newman.*—The North Sound and South Bimini study sites, Bimini Bahamas, are important nurseries for lemon sharks *Negaprion brevirostris* and a variety of finfish and invertebrates. Both sites are fringed by *Rhizophora mangle,* but *Laguncularia racemosa* and *Avicennia germinans* also occur. Following ground truthing of a false-color Landsat image, 17 habitats were recognized and overlain in GIS software with teleost catches comprising 574 daytime seine and block nets hauls. Positive relationships were identified between prey communities and specific habitats. The mangrove prop-roots showed highest prey densities, which decreased steadily with increasing distance from shore. These relationships suggest mangroves and near-shore habitats are essential for the survival of juvenile lemon sharks at Bimini. Uncontrolled development has already resulted in extirpation of approximately 30% of the North Sound fringing mangroves and sedimentation of much of the near-shore fringing habitat. Site plans which call for complete destruction of the fringing habitat have been approved. This would likely result in complete sterilization of this irreplaceable nursery ground.—[1] *University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A.*

PATTERNS IN TIDAL MIGRATION OF MANGROVE FISH: A HYDROACOUSTIC APPROACH *by Uwe Krumme and Ulrich Saint-Paul.*—A 200-kHz split-beam echosounder with a 6° circular-beam transducer was applied in a macrotidal mangrove channel in north Brazil to study the migratory patterns of intertidal fish. Each tidal cycle, the first flood rise caused a clear response in the upstream movements of the entire fish population. Riding the first flood rise likely enables fish to early access the productive intertidal zone and to avoid significant expenditure of energy for movement, thereby gaining capacity for faster growth. Together with a net upstream longitudinal current in the study area, it is likely sufficient for the fish to achieve retention in the tidal tributaries from one tidal cycle to the next, emphasizing the importance of these habitats in providing a significant nursery function. When sampling the spatiotemporal distribution of fish in intertidal environments, the 3D spatial heterogeneity versus time should be considered. Hydroacoustics provides a valuable non-intrusive, high-resolution method, even in a turbid mangrove environment.—*Center for Tropical Marine Ecology (ZMT), Bremen, Germany.*

ECOLOGICAL CHARACTERIZATION OF MANGROVE ECOSYSTEM AS A FISH HABITAT IN TERMINOS LAGOON, IN THE SOUTHERN GULF OF MEXICO *by Ana Laura Lara Dominguez* [1]*, David Zarate Lomeli* [2]*, Guillermo Villalobos Zapata* [3]*, and Alejandro Yañez-Arancibia* [1].—During seasonal sampling in 1991 and 1992, 909 individuals of 25 different fish species were collected with a trap net along the fringe red mangrove in Estero Pargo. Juvenile and pre-adults stages predominanted in the community. With more than 70% of the catch species having commercial importance; we conlcude that the mangrove ecosystem is an important critical habitat.—[1] *Instituto de Ecología, Xalapa, Veracruz, Mexico.* [2] *Consultores en Gestión Política y Planificación Ambiental, Cancún, Quintana Roo, Mexico.* [3] *Centro EPOMEX, Campeche, Campeche, Mexico.*

THE CHRONIC ABSENCE OF CUMULATIVE IMPACT ANALYSES IN COASTAL CONSTRUCTION PERMITTING *by Ken Lindeman.*—Sustainable fishery management is contradicted when juvenile growth and mortality rates are compromised by long-term degradation of key habitats. However, construction projects that modify habitats continue at high rates in many areas. Primary permitting agencies have been consistently reluctant to

say no or to seek significant reductions in project impacts. Many problems, well known in permitting, yet absent from most workshops, require attention. Cumulative impacts and associated habitat and trophic cascades are still rarely considered, even in massive documents regarding areas that have already undergone many anthropogenic disturbance events. Too often, environmental impact assessments only represent large project justification exercises. Expensive monitoring projects often do not meet minimum standards of peer-review (e.g., no replication, an absence of BACI designs). Euphemistic assumptions about project impacts gain administrative momentum and are continuously repeated in subsequent assessments. Tractable, but underutilized, analytic and administrative alternatives exist and are summarized using examples from coastal areas of the northern Caribbean.— *Environmental Defense, Miami, Florida, U.S.A.*

PUBLICATION OF A 2ND EDITION OF THE *WORLD MANGROVE ATLAS by M. Loyche Wilkie [1], S. Baba [2], M. Kainuma [2], S. Johnson [3], M. Clusener-Godt [4], E. Corcoran [5], and Z. Adeel [6].*—Mangrove ecosystems are unique and highly productive. They support the livelihoods of millions living along tropical and subtropical coasts, providing diverse services including supporting fisheries. Drastic losses of mangrove forest are being experienced. Accurate information on of the status of mangroves is essential to achieve conservation and sustainable use of these services. The publication of a 2nd edition of the *World Mangrove Atlas,* first produced in 1997, is intended to inform not only scientists but also managers and conservation experts, and provide a reliable and consistent baseline. The *World Mangrove Atlas* will include national and local-level case studies and thematic case studies that cut across national boundaries. Also country data will include profile, map, threat data where available and updated information on the current extent and changes in mangrove areas. This publication is being prepared as a joint initiative of FAO, ISME, ITTO, UNESCO-MAB, the UNEP-WCMC and UNU-INWEH.—*[1] Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. [2] International Society for Mangrove Ecosystems (ISME), Okinawa, Japan. [3] International Tropical Timber Organization (ITTO), Yokohama, Japan. [4] United Nations Educational, Scientific and Cultural Organization, Man and the Biosphere Programme (UNESCO-MAB). [5] United Nations Environment Programme World Conservation Monitoring Center (UNEP-WCMC), Cambridge, U.K. [6] United Nations University, International Network on Water, Environment and Health (UNU-INWEH), Hamilton, ON, Canada.*

SPATIAL AND TEMPORAL VARIATION IN FISH COMMUNITY STRUCTURE OF A MARINE EMBAYMENT IN ZANZIBAR, TANZANIA *by Blandina R. Lugendo [1,2], Arjan de Groene [1], Ilse Cornelissen [1], Annelies Pronker [1], Ivan Nagelkerken [1], Gerard van der Velde [1,3], and Yunus D. Mgaya [2].*—Spatial-temporal variations in the fish community structure were studied from a tropical non-estuarine embayment in Chwaka Bay, Zanzibar. Fish samples were collected bimonthly for 1 yr from mangroves, mud/sand flats and seagrass beds. Environmental variables were examined to determine their relationship with fish the community structure. The fish community structure together with the environmental variables in mangroves and mud/sand flats remained constant for most part of the year; however, a marked decline in fish densities, biomass, and species richness and in environmental variables was observed during the rainy period. A significant relationship was found between density and species richness of fish, and temperature, salinity, and water clarity. Salinity was the most conspicuously changing environmental variable with seasons; we therefore propose that, salinity alone or in combination with the other environmental variables, was probably the most important environmental factor structuring the fish assemblage in the mangroves and mud/sand flats habitats.—*[1] Department of Animal Ecology and Ecophysiology, Institute for Water and Wetland Research, Faculty of Science, Radboud University, Nijmegen, The Netherlands. [2] Faculty of Aquatic Sciences and Technology, University of Dar es Salaam, Dar es Salaam, Tanzania. [3] Naturalis National Natural History Museum, Leiden, The Netherlands.*

CONNECTIONS BETWEEN ROOT EPIBIONTS AND FISH COMMUNITIES IN MANGROVE HABITATS *by James A. MacDonald and Judith S. Weis.*—Many fish and epibiont species utilize red mangrove (*Rhizophora mangle*) prop roots as habitat. There is often great variation between mangrove areas; fish communities and populations may vary significantly between nearby, similar mangrove areas. This study examined the relationship between fish and prop-root epibiont communities. Fish communities at 15 sites in Bocas del Toro, Panama, were examined by visual census and trapping. Artificial mangroves consisting of stakes driven into seagrass, adorned with artificial epifauna (combinations of blocks and dowels) were also established. Prop-root organisms were censused using a random sample of roots per site. There was significant correlation between epibiont diversity and fish diversity, and a correlation between percent coverage of epibionts and fish diversity. The artificial mangroves with the most artificial epifauna attracted the most diverse fish community. Data will also be presented on community composition between sites, and on results of epibiont manipulation experiments.—*Rutgers University, Biological Sciences, Newark, New Jersey, U.S.A.*

THE IMPACTS OF NATURAL DISTURBANCE ON THE NEKTON COMMUNITY STRUCTURE IN MICRONESIAN MANGROVE FORESTS *by Richard A. MacKenzie and Nicole Cormier.*—Six and 18 mo after a category 3–4 typhoon devastated the island of Yap, we surveyed nekton communities from mangroves hypothesized to be more impacted and less impacted from the typhoon using lift and float nets. Fish densities were not significantly different among any sites in either year. Densities were generally higher in disturbed sites compared to undisturbed sites in 2004, and were dominated by Gobiidae. In 2005, fish densities were higher in undisturbed sites compared to disturbed sites, and were dominated by Apogonidae. Shrimp densities were higher in disturbed sites compared to undisturbed sites in 2004, but were similar between all sites in 2005. Results suggest that demersal fish may be better adapted at recovering from typhoons compared to other species. Elevated shrimp densities may have resulted from increased deposition of mangrove leaves after the typhoon, which may provide an important mechanism to help fish species recover after typhoons.—*U.S. Department of Agriculture Forest Service, Institute of Pacific Islands Forestry, Hilo, Hawaii, U.S.A.*

ECONOMIC VALUE AND SOCIAL DIMENSIONS OF MANGROVE FISHERIES IN VILLAGES AFFECTED BY THE 2004 TSUNAMI *by Rusyan Jill E. Mamiit.*—On December 26, 2004, mangrove fisheries in coastal villages in Sri Lanka were subject to severe damage caused by the tsunami. The impacts of the disaster on the mangrove ecosystem magnified the significance of the resource as important source of fish, which supports the livelihood of the village residents. A socioeconomic assessment of the value of mangrove fisheries in Kapuhenwala and Waduruppa, villages characterized by functioning and degraded mangrove ecosystems, respectively, was carried out following the tsunami. Results indicate that intact mangroves generate an average annual fishing economic value of approximately SLR641,148 (US$6411) per fishing household; whereas, a degraded mangrove ecosystem has a value of SLR243,662 (US$2437). The economic values suggest that areas with degraded mangroves generate lower fishing benefits to the community. The findings further provide a sound basis for the inclusion of mangrove rehabilitation efforts in the post-tsunami reconstruction and rebuilding programs.—*Joint Institute for Marine and Atmospheric Research, University of Hawai'i at Manoa, Manoa, Hawaii, U.S.A.*

EVALUATING TROPHIC LINKAGES IN MANGROVE-BASED FOOD WEBS USING STABLE ISOTOPES OF CARBON AND NITROGEN *by Debashish Mazumder [1], Ron Szymczak [1], Neil Saintilan [2], and Robert J. Williams [3].*—An understanding of the energy flow pathways and trophic linkages in estuarine food webs is essential for managing estuaries and their ecosystems sustainably. These pathways are complex, given the dynamics in physico-chemical processes, variety and area of habitats. Carbon and nitrogen stable isotope ratios ($\delta^{13}C$ and

$\delta^{15}N$) were measured for a variety of fish, invertebrate, and crustacean species collected from saltmarsh and mangrove habitats in Botany Bay and Homebush Bay, NSW, Australia. The work is on-going, however, initial observations indicate specific prey-predator linkages evident within a complex trophic structure. Results also advocate the role of certain non-commercial estuarine species as important conduits of energy and nutrition to higher trophic-order commercially valuable species, linking these with specific estuarine habitats. This work seeks to model the source of energy and nutrition in mangrove and saltmarsh-based food webs and to determine the chemical linkages between high trophic order species and different habitat resources.—*[1] Australian Nuclear Science and Technology Organisation, Menai, NSW, Australia. [2] River and Wetlands Unit, Department of Environment and Conservation, Sydney, NSW, Australia. [3] Department of Primary Industry, Cronulla, NSW, Australia.*

VARIABILITY OF STABLE ISOTOPE RATIOS OF MANGROVE GLASSFISH (*AMBASSIS JACKSONIENSIS*) FROM SOUTHEAST AUSTRALIA AND THE IMPLICATIONS FOR ECOSYSTEM STUDIES *by Debashish Mazumder [1], Robert J. Williams [2], Ron Szymczak [1], Dennis Reid [2], and Neil Saintilan [3].*—Scientists concerned with organic matter flow and food web structures in aquatic ecosystems are increasingly realizing the potential of stable isotope ratios as natural tracers. Stable isotopes offer an accurate and cost effective way to understanding critical pathways of energy and pollutant transfer. Further, many aquatic habitats have been degraded and isotope ratios offer insights into appropriate conservation and rehabilitation techniques to manage these valuable resources. So far, the literature shows little attention has been paid to spatial and temporal variations in isotope signatures of samples taken from saltmarsh and mangrove environments. This study reports on investigations into the differences in isotopic signatures within a single species, *Ambassis jacksoniensis*, surveyed from two locations at two different times. The results suggest significant variation in $\delta^{13}C$ between different season and location for glassfish, but not for $\delta^{15}N$. The results also suggest that care is needed in interpreting previously published results.—*[1] Australian Nuclear Science and Technology Organisation, Menai, NSW, Australia. [2] Department of Primary Industry, Cronulla, NSW, Australia. [3] River and Wetlands Unit, Department of Environment and Conservation, Sydney, NSW, Australia.*

EPSCOR PHASE II: FUTURE DIRECTIONS — LAND-SEA INTERACTIONS *by Amber McCammon, Richard Nemeth, Meri Whitaker, and Nasseer Idrisi.*—The Experimental Program to Stimulate Competitive Research (EPSCoR) is a program of NSF to strengthen research, development and competitiveness in participating states and territories. The Virgin Islands EPSCoR is a partnership between NSF and the higher education, government, and business communities of the Virgin Islands to promote the development of the territory's science and technology resources through targeted research, education, and outreach activities. The current VI-EPSCoR research thrust is the study of the Biocomplexity of Caribbean Coral Reefs (BCCR). BCCR research covers areas of oceanography, biodiversity, and ecology of Caribbean coral reef ecosystems. In accordance with the environmental mission of VI-EPSCoR, phase II will cover the land-sea interface, including mangroves, an important component to the island ecosystem. Mangroves act as nursery grounds for many coral reef fishes. Mangroves also act as a buffer to filter nutrient and sediment run-off that would potentially upset the fragile balance of coral reef ecosystems.—*University of the Virgin Islands, U.S.V.I.*

USE OF CARBON AND NITROGEN STABLE ISOTOPIC TO INFER FOOD SOURCES IN BELIZE OFFSHORE MANGROVES *by C.C. McIvor [1], M.L. Fogel [2], D. S. Taylor [3], W. Davis [4], and E. Reyier [5].*—As part of an ichthyological survey of Twin Cays, Belize, we sampled fish and crustaceans for carbon and nitrogen stable isotopes from multiple habitats (fringe forests, dwarf *Rhizophora mangle* forests, ponds, internal channels, sinkholes). Of 12 species with at least three individuals in a given habitat (individuals analyzed separately), eight species differed significantly in their C isotopic values and five species differed in N isotopic values

in different habitats. Species using multiple habitats, therefore, are likely to derive both carbon and nitrogen from different within-habitat sources. Animals from hydrologically isolated sinkholes had carbon isotopic values significantly more negative than in other habitats, indicating either greater dependence on a carbon source from mangroves or from highly-respired, microbial carbon. Comparison of frequency histograms of carbon isotopic values from Twin Cays' consumers with those from other mangrove studies indicates a greater incorporation of a variety of carbon sources than previously reported.— *[1] U.S. Geological Service, Florida Integrated Science Center, Center for Coastal & Watershed Studies, St. Petersburg, Florida, U.S.A. [2] Carnegie Institution of Washington, Geophysical Laboratory, Washington, D.C., U.S.A. [3] Brevard County Environmentally Endangered Lands Program, Melbourne, Florida, U.S.A. [4] PO Box 607, Quincy, Florida, U.S.A. [5] Dynamac Corporation, Kennedy Space Center, Florida, U.S.A.*

CONNECTIVITY CONTROLS MANGROVE-FISH ASSEMBLAGE STRUCTURE: EVIDENCE FROM 12 MANGROVE-LINED WETLAND PONDS IN TAMPA BAY, FLORIDA *by C. C. McIvor [1], J. M. Krebs [1,2], and A. B. Brame [1,2].*—We collected seasonal nekton samples (fish and decapod crustaceans) from 12, mangrove-lined tidal ponds as part of a larger study to characterize the coastal wetlands of Tampa Bay. We captured 43,493 individuals of 63 species using a center-bag seine. Pond assemblages differed between regions of the bay and were distinct from tidal-creek assemblages from which they are likely derived (PRIMER, ANOSIM, Global r = 0.619, P = 0.004). The differences between pond and creek assemblages indicate predictable macrohabitat associations for some species. When averaged over the 2004 sampling year, mean nekton density in ponds ranged from 79 to 1160 per 100 m^2. Species composition of ponds can be explained by degree of connectivity with nearby estuarine waters (PRIMER, P = 0.001). Three ponds with only intermittent connection to bay waters were depauperate, whereas ponds with moderate or good connectivity supported estuarine transient as well as estuarine resident species.— *[1] U.S. Geological Service, Florida Integrated Science Center, Center for Coastal & Watershed Studies, St. Petersburg, Florida, U.S.A. [2] ETI Professionals, Tampa, Florida, U.S.A.*

THE INSULAR ECOLOGY OF THE DIAMONDBACK TERRAPIN, *MALACLEMYS TERRAPIN,* ON THE MANGROVE KEYS OF SOUTH FLORIDA *by Brian K. Mealey [1,3], Greta B. Mealey [2], John D. Baldwin [3], Gregory D. Bossart [4], and Michael R. J. Forstner [5].*— The insular ecology and population dynamics of *Malaclemys terrapin macrospilota* and *M. t. rhizophorarum* on mangrove keys permeating Florida Bay and the Florida Keys are under investigation by collaborative investigators from many management, research, and educational institutions in south Florida. Results indicate extreme site fidelity over this time period for terrapins. Survival of individual terrapins over a 20-yr span has been documented using data from previous researchers in the region. Many are currently residing in the same highly localized black mangrove system, *Avicennia germinans,* in which they were first captured in the early 1980s. *Malaclemys* have a varied diet consisting of fish, crustaceans, and molluscs. The analyses of mitochondrial DNA (mtDNA) and nuclear DNA (nDNA) microsatellite markers support the physical evidence of limited dispersal. Florida terrapin populations represent localized assemblies with strong tendencies for long-term site fidelity. This has significant implications for management of these populations.—*[1] Institute of Wildlife Sciences, Palmetto Bay, Florida, U.S.A. [2] Miami Museum of Science, Miami, Florida, U.S.A. [3] Department of Biology, Florida Atlantic University, Davie, Florida, U.S.A. [4] Harbor Branch Oceanographic Institute, Ft. Pierce, Florida, U.S.A. [5] Department of Biology, Texas State University, San Marcos, Texas, U.S.A.*

RESTORING ESSENTIAL FISH HABITAT IN SOUTHEAST FLORIDA: MANGROVE AND SEAGRASS HABITAT DESIGN COMPONENTS AND SUCCESS MONITORING *by Gary R. Milano [1], Neil Hammerschlag [2], John Barimo [2], and Joseph E. Serafy [3].*—Rapid urban-

ization of the south Florida area has resulted in a loss of vital fisheries habitat for many commercially and recreationally important fish and invertebrate species. Large-scale wetlands restoration efforts are being designed and implemented regionally to maximize habitat heterogeneity, and provide critical fish habitat. To provide diverse seagrass and mangrove habitats for larval and juvenile fish development, the designs include a network of tidal flushing channels inter-connecting low energy tidal pools, and shallow open-water areas with specific hydrological criteria. To document the efficacy of the restored habitat, fish assemblages are being monitored at a 30-ha mangrove wetlands restoration site on Key Biscayne, Florida. To date, a total of 29 fish taxa have been identified in the restored tidal pools, and the diversity of fish species has increased from five to ten species per tidal pool over the five year monitoring effort. Fish species richness has increased by four species since the baseline was established in 2000/2001, and the fisheries inventory has documented the restored areas functioning to support important fisheries species.—*[1] Miami-Dade County, Department of Environmental Resource Management, Miami, Florida, U.S.A. [2] University of Miami, Rosenstiel School of Marine and Atmospheric Science, Miami, Florida, U.S.A. [3] NOAA Fisheries, Miami, Florida, U.S.A.*

SEASONAL VARIATION IN FISH ABUNDANCE IN MANGROVE ECOSYSTEMS: COMPARING FORESTED AND UN-FORESTED HABITATS *by H.O.D. Mirera [1], J. G. Kairo [2], N. E. Kimani [2], and K. F. Waweru [1].*—The research investigated fish abundance in forested and unforested sites at Ungwana Bay, Kenya. Four forested sites having paired unforested sites were studied for comparison. Samples were collected with nets for 8 mo over two years (2003 and 2004). Mean fish abundance ranged from 6.11 fish 36 m^{-2} to 80.08 fish 36 m^{-2} in forested sites and 3.08 fish 36 m^{-2} to 125.89 fish 36 m^{-2} in unforested sites while biomass varied from 37.87 to 326.75 in forested sites and 7.88 to 303.92 in unforested ones. The results indicate a high abundance of fish in forested sites compared to unforested ones a part from site 4 where the unforested area had more fish abundance due to one big sample of *Pellona ditchella* that accounted for 73.1% of the fish in the site. A total of 35 fish species were sampled from both forested and unforested sites with 11 being exclusively forested and five unforested. There were significant differences in fish abundance and biomass with respect to substratum type indicating that the fish community preferred muddy bottom forested sites to sandy bottom forested sites. Fish abundance was significantly higher in all sites (forested and unforested) during northeastern monsoon compared to southeastern monsoon, however, the gap between the seasons was more pronounced in muddy substratum sites compared to sandy ones. The unforested sites showed significantly lower density of meiofauna in the sediments compared to forested sites, while muddy substratum sites also had significantly higher meiofauna density. The results support the hypothesis that fish visit mangrove habitats to feed and to avoid predators. They also raise the idea of substrate type as an influencing factor in fish habitat preference.—*[1] Egerton University, Department of Natural Resources, Njoro, Nakuru, Kenya. [2] Kenya Marine and Fisheries Research Institute, Mombasa, Kenya.*

NUTRIENT DYNAMICS IN A CLOSED SYSTEM WITH MANGROVE SEEDLINGS AND POECILID FISHES *by Leonardo Moroyoqui-Rojo [1], Francisco J. Flores-Verdugo [2], Diana Escobedo-Urías [1], and Maria Nancy Herrera-Moreno [1].*—Six closed recirculation systems (1000 L each) with poecilid fishes and mangrove seedlings were designed to estimate the nutrient uptake by mangroves and the survival and growth rate of poecilid fishes. Each system has a biological filter of gravel and sand, 34 mangrove seedlings (*Rhizophora mangle* and *Laguncularia racemosa*) and 200 poecilid fishes. The results show that mangroves removed 71%–94% of the dissolved inorganic nitrogen (DIN) and 36%–47% of the orto-PO_4. The systems without mangroves removed 35%–52% of DIN and 21%–25% during a cycle of 10 d. The poecilid fish survival was 100% with a good growth rate in all the systems (1 cm mo^{-1}). Even though growth rate and survival of the poecillid fishes were similar in all the systems, we consider that in a long term, the mangroves play an important role in keeping good water

quality conditions for fish communities.—[1] *Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional, Guasave, Sinaloa, Mexico.* [2] *Unidad Mazatlán del Instituto de Ciencias del Mar y Tecnología (UNAM), Mazatlán, Sinaloa, Mexico.*

ADOPTION RATES OF SILVOFISHERIES INNOVATIONS AS AN OPTION FOR MANGROVE CONSERVATION; CHALLENGES AND RESEARCH OPPORTUNITIES ALONG THE EAST AFRICA COASTLINE *by D. O. Obura [1], H. O. D. Mirera [2], and E. M. Arriesgado [2].*—Mangrove wetlands offer refuge and nursery ground for juvenile fish, crabs, shrimps, and molluscs. Apart from being nutrient rich ecosystems they also act as buffers protecting the coastline from erosion, storm damage, wave action inclusive the recent traumatic tsunamis. This vital ecosystem has been jeopardised along the East African coast due to poor realisation of its diversified importance. Though efforts have been made by mangrove experts and conservationists, the big problem has been convincing the people on the immediate use of this resource to attain their daily food requirement while maintaining sustainability. Getting a new idea adopted, even when it has obvious advantages is difficult; hence a common problem for many individuals and organisations is how to speed up the rate of diffusion of an innovation. In trying to empower the local people to own and conserve their resource, intense awareness campaigns on silvofisheries and mangrove eco-tourism are prioritized along the East African coastline. Presently, ten communities along the Kenyan coast and five along Tanzania's Tanga regions are covered in silvofisheries on farm trials to assess technology adoption rate. Social changes and social problems facing the East African coastal communities affect the diffusion of the innovations. The main challenge lies in the extreme poverty of the people and lack of dedication in culturing crabs and fish to market size coupled with mangrove conservation. The diffusion of innovations and consequent adoption is essentially important in silvofisheries technology in East Africa so as to ascertain meaningful mangrove conservation. Despite the success of a few communities, the researchers are challenged on how their day to day findings can reach the custodians and beneficiaries of our vital mangrove wetland. In due respect, the question still remains of whether there is enough silvofisheries research along East Africa coastline.[1] *Kenya Marine and Fisheries Research Institute, Mombasa, Kenya.* [2] *Egerton University, Department of Natural Resources, Njoro, Nakuru, Kenya.*

FOOD HABITS OF FISH ASSOCIATED TO COASTAL HABITATS IN SAN ANDRÉS ISLAND, COLOMBIAN CARIBBEAN *by Vivian Ochoa , Arturo Acero, Adriana Santos, and Jaime Polanía*.—Feeding habits of fish captured at Hooker-Honda and Sea Horse Bays in San Andrés Island (Colombian Caribbean) were characterized. Four hundred and twenty-one individuals distributed in 18 families and 37 species were caught and purchased from local fishermen in the area. Three species of some commercial importance, formed 60% of the abundance; *Opisthonema oglinum* (32%), *Gerres cinereus* (15%), and *Harengula humeralis* (13%). Other species, for instance *Oligoplites palometa* and *Caranx hippos* demonstrated very low numerical abundances, with only one individual caught each. In stomach content analysis, 91 nutritional categories of different taxa, including seaweeds, seagrass, mollusks, annelids, crustaceans, fish, among others, were identified. In addition, each species was trophically categorized yielding the following proportion: 76% carnivores, 19% omnivores, 5% herbivores; planktivores were absent. This proportion has been widely observed in a variety of tropical systems. The dominant group was the carnivores, which exercise a strong predatory activity over crustaceans, mollusks, and fishes.—*Universidad Nacional de Colombia Sede Medellín, Medellín, Colombia.*

EXPLAINING PATTERNS OF ABUNDANCE FOR FISH USING MANGROVES: A MULTI-SCALE SEASCAPE APPROACH *by S. J. Pittman, C. Caldow, S. Davidson Hile , and M. E. Monaco.*—Mangroves are often considered an important resource for many species of fish, supporting high densities of juveniles including many commercially important species. Typically, these species use mangroves as part of a chain of interlinked resources through

daily home ranges and to support developmental shifts ("ontogenetic stepping stones"). Considerable spatial variability is found in the patterns of abundance from one area to another. This study applies a landscape ecology approach to explore the influence of seascape composition on the abundance of fish using mangroves in southwestern Puerto Rico. We quantified within-patch structure (1 m^2 quadrat) and seascape structure (50, 100, 300, 500 m) using landscape metrics applied to NOAA's benthic habitat map. Results indicate that the amount of seagrass surrounding mangroves explains more of the variability in fish abundance than fine-scale mangrove structure. Fish community composition is significantly different in mangroves with high adjacent seagrass cover than mangroves with little or no seagrass cover. This has important implications for resource protection, restoration efforts, and water quality management.—*National Oceanic and Atmospheric Administration, NOS, CCMA Biogeography Team, Silver Spring, Maryland, U.S.A.*

INTEGRATION OF AQUACULTURE AND MANGROVES *by J. H. Primavera*.—Southeast Asia has the highest concentration of mangroves and brackish water aquaculture ponds. This paper describes studies that integrate mangroves as biofilters, and as pen culture sites for mud crab farming. In one study, passing shrimp pond effluents through a natural mangrove stand reduced levels of TSS, sulfide, NH_3-N and NO_3-N by 18.7%–64.2%. Estimates show that 1.4–6.5 ha of mangroves are needed to assimilate nitrogen wastes from one hectare of shrimp pond. Mangrove biomass increase was 2.5 times greater with effluents compared to a control mangrove, although plant numbers remained similar. Present mud crab *Scylla* spp. farming still depends on raw ("trash") fish and wild seed. To lessen such dependence, another study compared the stocking of hatchery vs wild juveniles, and feeding of pellet + raw fish ("trash fish") vs fish alone. Preliminary results show that low-cost pellets can reduce raw fish requirement, and that hatchery crab juveniles need immediate feeding whereas wild crabs can subsist on natural mangrove productivity for one month. Mud crab pen culture is commercially viable but technological refinements and land tenure issues remain.—*Aquaculture Department, Southeast Asian Fisheries Development Center, Tigbauan, Iloilo, Philippines.*

THE MANGROVE ACTION PROJECT: ITS GENESIS, MISSION AND CHALLENGES *by Alfredo Quarto*.—Founded in 1992, the Mangrove Action Project (MAP) is an environmental, non-governmental organization dedicated to reversing the degradation and destruction of mangrove forest ecosystems worldwide. Early work focusing on mangrove conservation and restoration in Latin America and Asia has expanded to include science, education and outreach projects around the globe. Its mission is to promote the rights of local coastal peoples, including fishers and farmers, in the sustainable management of their coastal environment. MAP provides five essential functions for grassroots associations and other proponents of mangrove conservation: (1) serving as an information clearinghouse on the status of, and future threats to, mangrove systems around the world; (2) coordinating an international network of over 450 NGOs on issues relevant to mangrove protection; (3) promoting public education and awareness of mangrove forest issues; (4) developing of technical and financial support for relevant NGO projects; and (5) communicating, both within and outside impoverished coastal fishing and farming communities, how consumer demand affects coastal livelihoods and environments. MAP is addressing the challenges of conserving diverse and productive mangrove systems in the face of poverty, shrimp aquaculture and development for tourism through participatory resource management, promoting responsible consumer choices and implementing sound environmental and socio-economic impact studies.— *Mangrove Action Project,Port Angeles, Washington,. U.S.A.*

MANGROVE COVER, FISHERIES, AND ENVIRONMENTAL PERTURBATIONS IN THE CIÉNAGA GRANDE DE SANTA MARTA (CGSM), COLOMBIAN CARIBBEAN *by Jorge Restrepo, Jacobo Blanco, Carlos Villamil , Efraín Viloria, Juan Carlos Narváez, and Mario Rueda*.—Hydrological manipulations in the Ciénaga Grande de Santa Marta (CGSM)

since 1956, mostly due to road and channel building, as well as historically-low precipitation in the 1990s, caused high rise in salinity in soil and water. In 1995, 56% of the mangrove cover disappeared, and fish catch declined by 49%. Channel dredging supplying freshwater from the Magdalena River in 1996 and 1998, and high rainfall in 1999 (2509 mm) caused the reduction of salinity in soil and water, which fostered a 10% increment in mangrove cover and 40% in fish catches. Nile tilapia (*Oreochromis niloticus*), an exotic freshwater species favored by environmental changes, represented 62% of the catch in 1999–2000. After 2000, draught and channel sedimentation affected mangrove cover, fish catches, and species composition. Climatic variation associated with ENSO seemed to account for these changes, involving hydrological and community perturbations, which in turn affected vegetation and fish resource availability in the CGSM system.— *Instituto de Investigaciones Marinas y Costeras José Benito Vives de Andréis (INVEMAR), Santa Marta, Colombia.*

ICHTHYOLOGIC DYNAMICS IN THE MANGROVE OF TÉRRABA, PACIFIC COSTA RICA: TOOLS FOR MANGROVE MANAGEMENT *by José Rodrigo Rojas Morales.*—Abundance and diversity of the estuarine fish of the mangroves in the south of the Pacific Coast of Costa Rica were determined between June 2001 and June 2004. Eighty-five species distributed in 34 families and 48 genera were found. The total number of individuals captured was 4200 and the total biomass was 547.6 kg. We found 31 families of osteichthyes and three species of chondrichthyes (*C. limbatus, Dasyatis longus* and *Urotrygon nana*). The families with more species were Carangidae (10), Haemulidae (7), Centropomidae (6), Lutjanidae (6), Scianenidae (6), Ariidae (5), Gerridae (5). Seventeen families were represented only with one species. The main community component in the site ware occasional visitors, representing 43% of species. *Anchoa spinifer* (876), *Centropomus armatus* (610) and *Bairdiella ensifera* (479) accounted 46.7% of the total number of individuals. Based on these results, we proposed the establishment of an integral management plan for the area.—*Instituto Costarricense de Electricidad, San José, Costa Rica.*

PREDATION RATES VARY WITH WATER DEPTH AND OTHER BIOLOGICAL FACTORS IN MANGROVE-LINED TIDAL CREEKS *by Andrew L. Rypel [1], Craig A. Layman [2], D. Albrey Arrington [3], and Lori M. Valentine [1].*—Changing water depths are thought to drive many ecological processes in estuarine intertidal zones. We examined how predation rates varied as a function of water depth in mangrove-lined tidal creeks of the Bahamas by tethering an abundant prey fish, mojarra (*Eucinostomus* spp.). Results revealed a significant exponential relationship between predation rate and water depth. Tethered mojarra in shallow water mangroves had significantly longer survival times than did fish tethered in deeper water, and we were able to identify a "critical depth" of predation, i.e., a water depth threshold at which predation rates increased abruptly. Subsequently, we explored three additional factors (local predator density, prey fish size, and creek flooding regime) which contributed to variation in time until predation along the water depth gradient. Predation rates are influenced by all of the above mentioned variables, and we suggest that water depth especially should be incorporated into studies linking mangroves and fisheries ecology.— *[1] University of Alabama, Tuscaloosa, Alabama, U.S.A. [2] Department of Ecology and Evolutionary Biology, Yale University, New Haven, Connecticut, U.S.A. [3] Loxahatchee River District, Jupiter, Florida, U.S.A.*

INTERRELATIONS BETWEEN MANGROVES, LOCAL ECONOMY, AND SOCIAL SUSTAINABILITY: AN EXAMPLE FROM A CASE STUDY IN NORTH BRAZIL *by Ulrich Saint-Paul.*—The littoral region of coastal Pará in NE Brazil is part of the world's second-largest continuous mangrove region. The Bragança peninsula is the specific study area of the interdisciplinary still ongoing joint German Brazilian project on "Mangrove Dynamics and Management" (MADAM), which started in 1995. Human use in this mangrove ecosystem is characterized by about 15 products, which have either subsistence value or generate monetary income for the local rural population. The importance of these functions for the rural

households increases with the distance from the urban center. In the primary production sector, agriculture and artisanal fisheries are the main source of income in the wider Bragantinian region. Both industries are characterized by many small operators. The industrial sector is very underrepresented throughout the region. Presently the control of the allocation of resources within this region rests predominantly in the hands of local individuals. This paper examines the conditions for the successful co-management of diverse species, resource use patterns and household income portfolios in a mangrove environment. Therefore stakeholders have been incorporated directly e.g., by participation in workshops. This is part of the support of the formation of the local RESEX (reserves extrativistas) movement, a Brazilian model of natural resources co-management.— *Center for Tropical Marine Ecology, Bremen, Germany.*

CHANGES TO FISH ASSEMBLAGES VISITING ESTUARINE WETLANDS FOLLOWING THE CLOSURE OF COMMERCIAL FISHING IN BOTANY BAY, AUSTRALIA *by Neil Saintilan [1], Debashish Mazumder [2], and Karen Cranney [1].*—Data on commercial landings of fish and crustaceans are available for 52 estuaries in New South Wales. These same estuaries have been mapped with regards to the distribution of fish habitat, including mangrove, saltmarsh, and seagrass, along with a suite of geomorphic units. A multiple regression analysis demonstrated strong relationships between the area of mangrove and the catch of a number of commercially important species, including long-finned eel, and the mud crab *Scylla serrata*.— *[1] Centre for Environmental Restoration and Stewardship, ACU National, North Sydney, NSW, Australia. [2] Australian Nuclear Science and Technology Organisation, Menai, NSW, Australia.*

HURRICANE-INDUCED CONVERSION OF MANGROVE FOREST TO MUDFLAT: IMPACTS ON NEKTON, BIG SABLE CREEK, FLORIDA *by Noah L. Silverman [1,2], Carole C. McIvor [1], Justin M. Krebs [1,2] and Victor A. Levesque [1].*—The passage of two Category 4-5 hurricanes across SW Florida (Labor Day Hurricane of 1935, Hurricane Donna 1960) resulted in patchy conversion of mangrove forest to mudflat habitat within Big Sable Creek, Everglades National Park, Florida. Our goal was to determine the consequence of this habitat conversion on nekton (i.e., fish and decapod crustaceans) inhabiting the intertidal zone. We used block nets across intertidal rivulets to compare nekton leaving replicate forest and mudflat sites. Overall nekton density (individuals m^{-3}) was significantly greater for forested habitats than non-vegetated mudflats (RM ANOVA, $P < 0.001$). Species composition also differed between habitat types (PRIMER, ANOSIM). Benthic forage species dominated forested sites, whereas schooling species dominated mudflats. Results are consistent with previous studies regarding the influence of vegetation structure on density of fish. These results can assist managers in assessing the long-term impact that strong hurricanes can have on mangrove-associated nekton.— *[1] U.S. Geological Survey, Florida Integrated Science Center, Center for Coastal & Watershed, St. Petersburg, Florida, U.S.A. [2] ETI Professionals, Tampa, Florida, U.S.A.*

THE IMPORTANCE OF MANGROVES AS NURSERY HABITAT FOR SMALLTOOTH SAWFISH (*PRISTIS PECTINATA*) IN SOUTH FLORIDA *by Colin A. Simpfendorfer.*—The use of mangrove habitats by smalltooth sawfish (*Pristis pectinata*) was investigated using surveys, acoustic telemetry, a public encounter database and habitat suitability models. Neonates (70–99 cm) occur on shallow mud banks, normally associated with mangrove coves or shorelines. Movements of these animals are strongly affected by the tide, with individuals electing to use very shallow parts of the bank (< 30 cm), presumably to avoid predation by sharks that occur in adjacent deeper water. When depths on banks become too deep to avoid predators, sawfish refuge within mangrove prop root habitats, either on the edges of banks or in drainage channels running out of mangrove stands. Acoustic tracks of juveniles 100–199 cm in length show that they inhabit slightly deeper water (< 100 cm) and their movements are strongly associated with mangrove shorelines. Analysis of sawfish encounter data indicated

that juvenile sawfish < 200 cm are positively associated with mangroves, and that there is a positive relationship between size and distance from mangroves. To identify priority conservation areas for the endangered smalltooth sawfish habitat suitability models including mangrove distribution were constructed.— *Mote Marine Laboratory, Sarasota, Florida, U.S.A.*

SPATIAL-TEMPORAL PATTERNS OF ISLAND MANGROVE CREEK HABITATS: A CHARACTERIZATION AS RELATED TO SIZE, ENERGETICS, AND FEEDING MODE OF FISHES *by Kathleen Sullivan Sealey , Vanessa L. Nero, and Sherry Constantine.*—We examine the benthic and oceanographic characteristics of small mangrove creek systems with adjacent soft-bottom embayments in the northern and central Bahamas to understand differences in the diversity and biomass of fishes. Fish assemblages were evaluated by standard beach seines, visual surveys and traps. Key species such as bonefish (*Albula vulpes*), snappers (Lutjanidae) and mojarras (Gerridae) vary in their abundance, size-frequency distribution and abundance based on season, tidal state and habitat (site). Benthic characteristics focused on floral (e.g., algae and seagrass) species composition, density and canopy height. Habitat maps of three different islands are used to first characterize mangrove systems by size, variability in temperature and salinity, geomorphology as well as proximity to platform margin reefs. Associations of fishes with particular habitat and oceanographic features can be crucial to monitoring population dynamics of commercially important species. The use of more detailed mangrove creek habitat-complex characterization can improve Marine Protected Area (MPA) planning.— [1] *University of Miami, Department of Biology, Miami, Florida, U.S.A.*

A HYBRID MAXIMUM-LIKELIHOOD METHOD FOR DERIVING LARGE-SCALE MANGROVE DISTRIBUTIONS IN FLORIDA FROM THEMATIC MAPPER DATA *by Jeff Ueland.*—The mangrove habitats of Florida have experienced significant change in recent years due to both anthropogenic and natural forces. Understanding regional-scale changes of mangroves, so as to be utilized in conjunction with large-scale datasets on marine fisheries, requires a systematically derived and comparable spatial inventory of these important habitats. This paper offers a method for this purpose by examining the spatial extent and change of mangrove habitat in a 14 county area of south Florida between 1987 and 2000. To this end, remotely sensed, Thematic Mapper satellite data were classified by coupling posterior probabilities from a maximum-likelihood, supervised classification process with spatially explicit ancillary data sources. The results showed a decline in mangrove habitat over the 13 yr period, but the changes were uneven and varied across space.— *Ohio Univeristy, Athens, Ohio, U.S.A.*

MANGROVES AND SEAGRASS BEDS AS DIURNAL FEEDING HABITATS FOR JUVENILE *HAEMULON FLAVOLINEATUM by Marieke C. Verweij [1], Ivan Nagelkerken [1], Susanne L. J. Wartenbergh [1], Ido R. Pen [2], and Gerard van der Velde [1].*—Caribbean seagrass beds supposedly are important feeding habitats for so-called nocturnally active zoobenthivorous fish, but the extent to which these fishes use mangroves and seagrass beds as feeding habitats during daytime remains unclear. Therefore, we studied daytime behavior of large juvenile (5–10 cm) and sub-adult (10–15 cm) *Haemulon flavolineatum* in mangroves and seagrass beds in Curaçao. Sub-adults occurred in mangroves only, spent most time on resting, and showed rare opportunistic feeding events, regardless of their social mode (solitary or schooling). They probably feed predominantly during the night in seagrass beds. Large juveniles were present in both habitat types and solitary fishes mainly foraged, while schooling fishes mainly rested. Large juveniles showed more feeding activity in seagrass beds than in mangroves. The study shows that both mangroves and seagrass beds provide daytime feeding habitats for some life-stages of *H. flavolineatum,* which is generally considered a nocturnal feeder.— [1] *Department of Animal Ecology and Ecophysiology, Institute for Water and Wetland Research, Radboud University, Nijmegen, The Netherlands.* [2] *Theoretical Biology Group, Centre for Ecological and Evolutionary Studies, University of Groningen, Haren, The Netherlands.*

DEVELOPING SHALLOW-WATER ACOUSTIC TELEMETRY METHODS FOR JUVENILE SNAPPER HABITAT STUDIES IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY *by Samantha R. Whitcraft [1], Bill Richards [2], John Lamkin [2], Trika Gerard [2], Tom Carlson [3], Geoff McMichael [4], Jessica Vucelick [4], Greg Williams [5], and Lisa Pytka [6]*.—The recent availability of customized coded micro-transmitters for juvenile fish tagging may provide useful tools in determining the early life history habitat requirements of commercially valuable snapper species within and outside marine protected areas. This pilot study utilizes micro-acoustic tags (dry wt = 0.65 g; excess mass = 0.39 g; 417 kHz) and standard acoustic telemetry methodologies developed by Battelle and NOAA Fisheries to investigate questions of habitat-use patterns of juvenile snappers in Florida Keys National Marine Sanctuary's reserve areas. We apply these methodologies to examine specific physical, environmental, and biological factors with the goal of optimizing telemetry instrumentation and field techniques for this application. Optimization requires trade-offs between limitations imposed by biological constraints and factors influencing the propagation/detection of signals in estuarine/marine environments. Important physical factors are operating frequency, encoded pulse length, and vegetation density in mangrove and seagrass habitats in 1.5–6 m depths. Environmental factors include determining baseline configuration within the geometry of distinct habitat patches and effects of dense mangrove prop roots on acoustic signal propagation and reception. Biological factors include tag-effects on survivorship of juvenile snappers. We present initial data from shallow-water testing of acoustic reception in obstruction-rich environments, compare juvenile salmon and snapper survivorship, and range-testing strategies.— *[1] Cooperative Institute for Marine and Atmospheric Studies (CIMAS), Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, Florida, U.S.A. [2] Early Life History Lab, NOAA Southeast Fisheries Science Center, Miami, Florida, U.S.A. [3] Pacific Northwest National Lab/Battelle, Portland, Oreon, U.S.A. [4] Ecology Group, Pacific Northwest National Lab/Battelle, Richland, Washington, U.S.A. [5] Sequim Marine Sciences Lab, Pacific Northwest National Lab/Batelle, Sequim, Washington, U.S.A. [6] New College of Florida, Sarasota, Florida, U.S.A.*