

Fall 2001

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NSU Oceanographic Center

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Currents



Fall 2001 • Volume XV, Number 4

Observing the NECC in the Eastern Tropical Pacific

by Sean Kennan

In the eastern tropical Pacific, south of Mexico, some of the warmest waters in the world are found, and further to the south, the coldest equatorial waters anywhere. This contrast of warm and cold sea surface temperatures (SST) drives a large-scale branch of the global atmospheric circulation. The seasonal cycle is dominated by monsoons that affect weather across Central America. In addition, the ocean, coupled with the atmosphere there, plays a dominant role in the dynamics of the El Niño Southern Oscillation (ENSO). Consequently, oceanographers, meteorologists, and climatologists are striving to better understand the various dynamics of this region.

While most research in this region has focused on the distribution of SST and the atmospheric response, an oceanographer from NSU (**Sean Kennan**, Ph.D.), and Scripps Institution of Oceanography—UCSD (J. Sprintall, Ph.D. and P. Niiler, Ph.D.) have identified the North Equatorial Countercurrent (NECC) as a potentially important component of the coupled system. The NECC flows across the tropical Pacific Ocean in response to the large-scale wind stress curl of the Intertropical Convergence Zone, where the northeast and southeast trade winds meet north of the equator. The seminal theory, which explains these dynamics, was first formulated and tested using hydrographic observations of the NECC in the eastern Pacific by one of the fathers of modern oceanography—Harald Sverdrup. His theory states that the transport of ocean currents is



The R/V Roger Revelle is a 274 ft. oceanographic research vessel owned by the U.S. Navy and operated by Scripps Inst. of Oceanography for the University-National Oceanographic Laboratory System (UNOLS). (photo S. Kennan)

determined solely by the curl, or twisting, of the winds. The primary breakthrough of Sverdrup's theory was that oceanographers could finally explain why a current like the NECC was observed to flow opposite to the surface winds. Today, Sverdrup dynamics lie at the root of all large-scale theories and models of the major ocean currents.

However, modern observations of the surface wind stress using satellite sensors, and of the surface currents using satellite tracked drifting buoys, indicate that the dynamics of the NECC may be more complex than

previously thought. In the far eastern Pacific, the Sverdrup dynamics may break down, and the current may actually flow downwind of the seasonal monsoon winds. To check these ideas, an ambitious project was mounted to make modern observations of the NECC for testing Sverdrup's theory. The R/V Roger Revelle departed San Diego, California on July 14, 2001, for a 42-day expedition to the NECC (see photo). After a week in transit, the next 36 days were devoted to surveying the currents and thermal structure of the upper ocean

(Continued on page 2)

(Continued from page 1)



The SeaSoar, ready for deployment from the *Revelle*. (photo S. Kennan)

from 2–8N, 105–85W. The survey pattern was designed to obtain data on the downstream evolution of the NECC while resolving the inertial currents, which are constantly excited by wind events. To achieve this, a variety of instruments were used.

A CTD (conductivity, temperature, depth) package was towed behind the ship inside a submarine-like housing called a SeaSoar (see photo), which measured temperature, salinity, and pressure along several meridional sections from the surface to 200–300 meters depth. From these data, density, and consequently the geostrophic component of the flow, can be calculated. Direct measurements of the current speed

were made from four acoustic Doppler sonars. The first—standard equipment on all UNOLS' vessels—operated at 150kHz measuring velocity from about 20–300 meters depth. Two others were recently installed on the *Revelle* by R. Pinkel, Ph.D. at Scripps; they operate at 45 and 140kHz, and have improved resolution for studying velocity shear. The low frequency unit penetrates beyond a thousand meters depth. Finally, a fourth ADCP at 600kHz was specially mounted on the *Revelle* for measuring velocities below the ship's hull, but above the 20m first bin of the shipboard ADCP. There were also over 100 drifting buoys deployed during the experiment. The drifters flowed with the NECC during

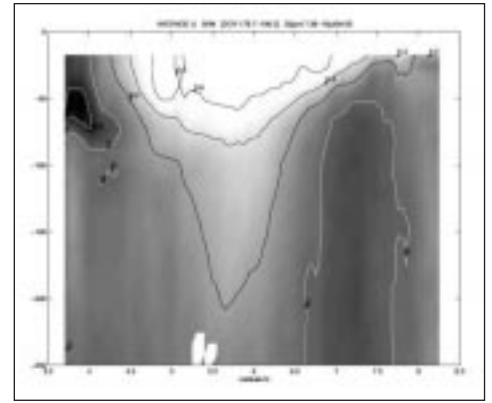


Figure 1: Eastward current at 95W in the eastern tropical Pacific Ocean, contoured as a function of latitude (degrees north of the equator) and depth (meters). White is eastward, black is westward.

the expedition, and will continue to follow the path of the NECC and other tropical currents for several years. Also, meteorological observations of the winds, air temperature, humidity, rainfall, and radiation were made from the shipboard sensors.

The observations from the shipboard ADCP indicated that while the surface flow is quite shallow, and likely to be wind driven, the deeper flow was geostrophic in appearance (see Figure 1). Therefore, a preliminary conclusion would be that the NECC does have complex dynamics in the eastern Pacific, and is likely influenced by the monsoon winds. The next three years of the project will be devoted to calculating the wind-driven and geostrophic components, and testing Sverdrup's theory of the NECC. It will also be interesting to see if the NECC has an important impact on the fluxes of heat and freshwater for the region. 🌊

People on the Move

Alexander (Sasha) Yankovsky, Ph.D., attended the Mid-Atlantic Bight Physical Oceanography and Meteorology (MABPOM) meeting on October 18–19. This year, the MABPOM meeting was hosted by Dept. Marine Sciences, Univ. Connecticut, in Groton, Connecticut. Yankovsky gave a talk titled “Pathways for the cold water during an upwelling event on the New Jersey shelf in summer 1996.” Yankovsky also gave a seminar at RSMAS (coastal studies series) on August 30. The title was “Impact of variable inflow on the dynamics of a coastal buoyant plume.”

Joshua Feingold recently returned from the Galapagos Islands where he performed studies on the recovery of corals following

impacts associated with the El Niño Southern Oscillation (ENSO).

Robin Sherman presented a paper titled “Examination of structural differences in gill vasculature among some batoid elasmobranchs using corrosion casting and SEM,” at M&M 2001, Microscopy & Microanalysis in Long Beach California.

Masters student, **Heather Ann Halter**, participated in a one and a half week research cruise this July with a chemical oceanography group from the University of Washington. Halter had lived in Washington and had previously volunteered for chief scientist, Steven R. Emerson, Ph.D., so when this cruise

was being planned, he asked her if she would like to participate. They sailed from UW in Seattle and returned to Newport, Oregon, aboard the *RV Thomas G. Thompson*. Halter was Emerson's main research assistant throughout the cruise and worked with him in a 4° C cold room slicing cores, centrifuging mud, and filtering trace metals.

The cruise followed a transect from the mouth of the Columbia River outward toward the Pacific Ocean. Eight stations were sampled with a multicore, hydrocasts, and gravity core. The goal of the study was to extract trace metals from the sediment pore waters of cores at each of the eight stations. The group's main goal was to develop trace metals as indicators of the redox state in the ocean. If they could determine the deep sea's redox state through recent geologic history, it would place constraints on how much biological production and circulation have changed in the past. Certain metals (Mo, V, U, Re, and Cd) are highly enriched in very reducing sediments. The most important factors controlling the redox state of marine sediments are bottom water oxygen content and the rain rate of organic matter to the sediment-water interface. If they can develop a general relationship between the authigenic concentrations of these metals and the boundary conditions, it may then be possible to evaluate past changes in the redox state of the ocean by determining the concentration of these metals in sediments and in materials, such as carbonate shells, that have recorded the seawater concentration through time.

Halter also measured O₂ penetration with depth in each core and plans to make a poster from her findings, as well as provide a report on Emerson's findings.

Ph.D. candidate, **Peggy VanArman**, has been busy as usual. She recently completed one major experiment for doctoral dissertation research on growth and development of two species of Everglades crayfish during the summer, maintaining 150 aquaria for three months, taking measurements on young crayfish, initial number of about 1,400, every two weeks.

VanArman also coauthored a case study with Mrs. Nancy Marshall, codirector of the Arthur R. Marshall (Environmental)



The RV Thomas G. Thompson



Heather Halter (3rd from left) and scientists and students from the University of Washington.



Peggy VanArman measuring the water level in one of 150 tanks holding crayfish

Foundation, on the first cypress tree [ARM-LNWR] in Boynton Beach, Florida) held as part of Everglades restoration in February 2001. 🌿

Aquaculture Center Changes: More Fish, More Research, More Business

A new step in the operation of the Davie ARC (Aquaculture Research Center) is underway. Four years into a joint venture with Nova Southeastern University to grow fish in sanitized treatment tanks at the town's former sewer plant, Davie, Florida was poised to finally cut bait. Under a new, almost five-year lease, the town will no longer subsidize the Aquaculture Research Center.

The fish farm opened in 1997 at 6300 SW 36th Court and started in two of the town's old sewage tanks. The sewer plant, which closed in 1988, was a target for vandals and an eyesore. Its conversion into a fish farm was unique. We call it the ultimate in recycling," said **Bart Baca**, Ph.D., the facil-

ity's director and an NSU professor. It has grown to eight tanks and about 200,000 tilapia in various stages of growth. Currently, the fish farm has sales of about \$7,000 to \$10,000 a month, Baca said. The university wants to initially invest about \$180,000 in the farm and double its size, adding at least six new tanks. "We are making a commitment," Baca said. "This is a five-year lease and we hope to continue it for many years so this becomes a centerpiece of our freshwater fish program." Baca said the facility wants to branch out and farm shrimp and redbfish. Besides tilapia, it now has about 150,000 eels. According to Baca, tilapia is more popular than other freshwater fish like catfish and rainbow trout. "Right now, we have

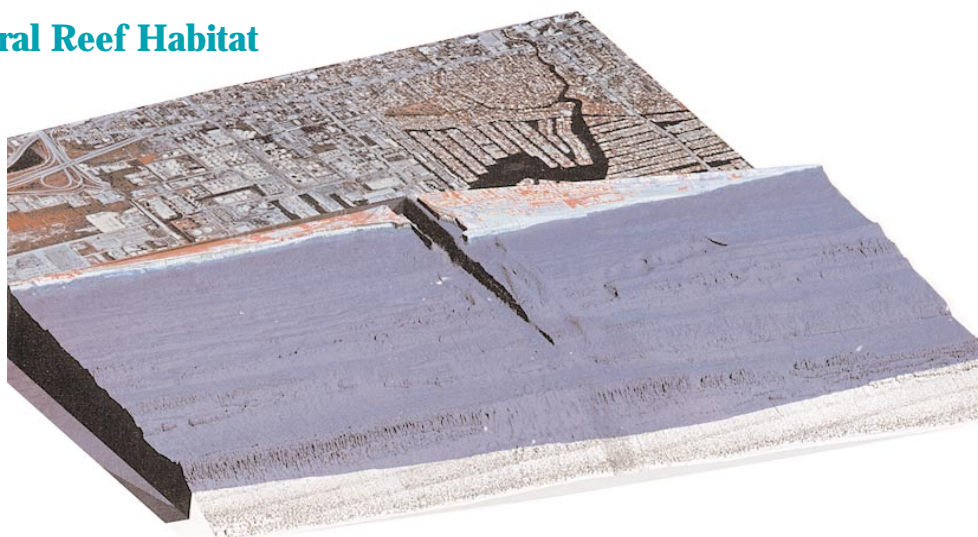
demand for three times what we can produce," Baca said. "The only way to meet that demand is to expand, invest, and take over the lease," he said.

The mission of the ARC remains to accomplish outstanding education and research in aquaculture. The NSU business school will partner with the NSUOC for sound business management of aquaculture operations and to develop aquaculture business courses and programs to serve needs of students. Baca will be joined by Phil Friedman, D.B.A., of the Huizenga School, who adds business acumen and content to the curriculum, operations, and research. 🐠

NCRI 3-D Visualization of Coral Reef Habitat

The NSU Oceanographic Center dean and National Coral Reef Institute's (NCRI) executive director, **Richard Dodge**, Ph.D., and NCRI Geographical Information Specialist, **Brian Walker**, have recently published a small photo layout in the Nov-Dec 2001 edition of *UnderWater Magazine* by the Association of Diving Contractors International pictorial titled "Visions in Sonar." The photo layout (page 62) displays a bathymetric survey recently conducted in southeast Florida (Broward County) during April 2001 using the Laser Airborne Depth Sounder (LADS) system. The survey encompassed an area from North Miami-Dade County, through the entire Broward County coastline, to south Palm Beach County (approximately 43 km), and from the shore eastward to depths of 130 feet (approximately 2.5-3.5 km offshore). The data collection was funded by Broward County Department of Planning and Environmental Protection.

The survey technique is a relatively new technology where a laser is shot from an airplane. A distance is extrapolated from the time it takes for that laser to return. Then, from the altitude of the plane, a depth below mean sea level is calculated. The laser is limited to relatively shallow water (less than 150 ft.), however, it is an economically and timely means of acquiring data. The resolution of the data depends on the spacing of the laser returns. The Broward survey is four-meter resolution, which means a point was taken approximately every four meters. The data is recorded as x, y, z (latitude, longitude, depth). These several million points are then processed using a variety of computer



The Port Everglades entrance channel in Broward County, Florida. This is Laser Airborne Depth Sounder (LADS) bathymetry data overlaid by a 1:24,000 scale aerial photograph mosaic looking west. Features include the New River north of the channel; old breakwaters running east/west; and a prominent, actively accreting coral third reef in foreground. Image created by Brian Walker of the National Coral Reef Institute and Nova Southeastern University.

programs to produce a triangulated irregular network (TIN). This is a data structure that represents a continuous surface through a series of irregularly spaced points with values that describe the surface at that point (elevation/depth). From these points, a network of linked triangles forms the surface. Once this surface is created, sun shading, color coding, and/or draping georeferenced airplane or satellite photography are all possible. Special mapping and imaging software enable the model to be zoomed and tipped to the desired orientation and processed into three-dimensional perspectives.

Using 3-D imaging software, two-dimensional views can be used to create three-dimensional anaglyphs (viewable with

3-D glasses). The anaglyph provides a unique view into the bathymetry that is unattainable by two-dimensional imagery. Multiple views are useful for identifying benthic features and habitats, including coral reefs. The well-known First, Second, and Third Reef terraces (5, 10, and 20 meter depth) are well depicted, as well as previous sand mining events, artificial reefs, and other seabed features like reef gaps and the old New River channel (just north of Port Everglades). This pictorial shows examples of the various stages of the data presentation. This data is extremely useful for a variety of applications in various fields such as coastal management, reef and geology science, and even telecommunications engineering. 🐠

Manatee Skeleton at Oceanographic Center

The Florida manatee (*Trichechus manatus latirostris*) is a large aquatic marine mammal native to Florida waters. It is a subspecies of the West Indian Manatee (*Trichechus manatus*). Manatees have large, gray-brown bodies that taper to a flat, paddle-shaped tail. The average adult manatee is about 10 feet long and weighs about 1,000 pounds. They have two flippers with three to four nails on each, and their head and face are wrinkled with whiskers on the snout. The manatee's closest relatives are the elephant and hyrax, a small furry animal that resembles a rodent. Manatees are believed to have evolved from a wading, plant-eating animal. The West Indian manatee is related to the West African manatee, the Amazonian manatee, the dugong, and Steller's sea cow, which was hunted to extinction in 1768.

Florida manatees have no natural enemies, and it is believed they can live 60 years or more. Many manatee mortalities are human-related. Most human-related manatee mortalities occur from collisions with watercraft. Other causes of human-related manatee mortalities include being crushed and/or drowned in canal locks and flood control structures; ingestion of fish hooks, litter, and monofilament line; entanglement in crab trap lines; and vandalism. Ultimately, however, loss of habitat is the most serious threat facing manatees today. There are approximately 3,000 Florida manatees left in the United States.

Florida West Indian manatees in the United States are protected under federal law by the Marine Mammal Protection Act of 1972, and the Endangered Species Act of 1973, both of which make it illegal to harass, hunt, capture, or kill any marine mammal. Florida manatees are also protected by the Florida Manatee Sanctuary Act of 1978. Florida Fish and Wildlife Conservation Commission (FWC) biologists are responsible for recovering, necropsying, and documenting all recovered manatee

carcasses, as well as coordinating rescues of injured manatees. The FWC also makes cleaned manatee skeletons available, on a semipermanent loan basis, for public display and education. This article describes the construction of a display case for a manatee skeleton, and the assembly of the skeleton in the case.

The skeleton is from a female manatee (MNW0002) that died in Crystal River, Citrus County, Florida, in January 2001. At the time of death, she was carrying a fetus, and she became trapped in the secondary cooling unit discharge pipe at the Crystal River Nuclear Power Plant. She was badly decomposed when she was collected for necropsy at the Marine Mammal Pathobiology Laboratory in St. Petersburg, Florida. She was 321 cm long, and her fetus was 112 cm long.

The skeleton was requested in 1999 from the Marine Mammal Pathobiology Laboratory in St. Petersburg, Florida. **Amy Paine**, NSU grad student, took the initiative to learn how to request the skeleton.

The skeleton arrived at the NSU Oceanographic Center in the spring of 2001, and the display was constructed during the summer of 2001 by **Edward O. Keith**, Ph.D., and Jessica Davis, a high-school intern working with Keith. The first step was to determine exactly how to construct an armature to support the skeleton. Several prototypes were examined before arriving at the final design.

After the armature was painted a neutral color, the bones were assembled on it. The vertebrae and skull went on first, and then the first few ribs. Then the shoulder girdle was added, and finally, the last ribs. The ribs were held on to the armature with plastic ties.

After the skeleton was assembled, the unfinished top of the base was covered with cloth arranged to simulate the animal's aquatic habitat, and then the clear plexiglass cover was placed on the base to complete the display. Keith's graduate level class in marine mammalogy assisted with the final assembly and cover placement. 🐡



Completed skeleton assembly with cloth draping and graduate level class in marine mammalogy.



Once the base was completed, the armature was constructed on it.



Jessica Davis with curved-spine armature, which was the design used in the final assembly.



NSUOC Graduate Student Amy Paine with the completed display. Amy investigated the availability of the skeleton and learned how one could be obtained from the Marine Mammal Pathobiology Laboratory.

EPA Grant Received

Andrew Rogerson, Ph.D. is Principal Investigator of a newly received grant from the Environmental Protection Agency. The research project is titled: *Prevalence and Survival of Microorganisms in Shoreline Interstitial Waters—A Search for Indicators of Health Risks*.

There are clues in the scientific literature which suggest that the microbiological quality of beach sand may constitute a health risk to bathers, particularly children who spend time in the “swash zone.” Some reports show that the presence of fecal organisms in sand is related to the number of beach users. Also, sand can act as a filter to trap and concentrate bacteria, spores, and cysts. It has a large surface area for microbial attachment, ample oxygen levels, higher temperatures, and a constant resupply of nutrients through wave action and tides. Thus, it may favor survival and even

growth of nonindigenous biota, including possible human pathogens.

The EPA study will build upon these clues and address the question of whether wet beach sand can harbor potential human pathogens, and in so doing constitute a health risk. Addressing this requires consideration of the different types of indicators appropriate to sand, pathogen survival and growth potential, sources, and routes of infection. It is postulated that potentially pathogenic organisms accumulate in interstitial space where they exploit localized favorable conditions. These organisms are periodically swept from surfaces and are transported to the surf zone where they pose a health risk aggravated by the abrasive nature of sand, the ingestion of contaminated waters, and the inhalation of aerosols rich in microbes. Thus, individuals exposed to the surf zone of densely

populated beaches may show a higher incidence of illnesses associated with either enteric or nonenteric pathogens.

The study has four objectives: (1) documentation of the number of “classical” fecal indicator organisms in sand, paying attention to whether they are free in interstitial space or attached (and possibly metabolically active) on sand particles; (2) enumeration of other nonindigenous microorganisms in sand including nonenterics, coliphage and several eukaryotic microbes; (3) monitoring of a laboratory-based microcosm approach to study the survival potential (and growth) of indicator organisms in sand relative to open water; and (4) correlation of microbial abundance data to incidences of beach-related indicators via a detailed questionnaire. The research will show whether there is an identifiable health risk to beach users. 🐡

Publications

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Yankovsky, A.E., B.M. Hickey, and A.K. Munchow, 2001: Impact of variable inflow on the dynamics of a coastal buoyant plume. *J. Geophys. Research*, 106, C9, 19,809–19,824. 🐡

New Floating Docks

The NSU Oceanographic Center installed three new floating docks this month. Built by Southeast Floating Docks Inc., each dock is thirty feet long and eight feet wide made up of three concrete modules. This improvement to the boat basin provides six additional boat slips. Basin electrical upgrades are in the works to support the new docks. (see back cover for pictures) 🐡

Artificial Reef Conference: NSU a Cosponsor

NSUOC was the proud sponsor, along with Broward County, Florida Fish and Wildlife Conservation Commission, and Florida Sea Grant, of the 2001 Florida Artificial Reef Summit titled: *Artificial Reefs—Into the New Millennium*. The summit was held October 17–20 in Fort Lauderdale and included over 150 scientists, managers, and environmental organizations. This meeting, the fifth state-wide conference on artificial reefs, brought together people involved in artificial reef projects throughout the state to discuss a variety of issues relating to legislation, construction, and management. Emergent themes included trends in materials, funding sources, and recognition of important artificial reef research. **Richard Spieler**, Ph.D., NSUOC professor, presented several talks during technical sessions, and graduate students from the NSUOC presented posters. **Richard Dodge**, Ph.D., NSUOC dean, was one of three sponsor representatives providing opening remarks and a welcome. 🐡

Officials at the U.S. National Oceanic and Atmospheric Administration (NOAA) recently announced that **Alex Brylske**, Ph.D., a 1997 NSU graduate (M.S. marine biology and coastal zone management), is the winner of the prestigious Walter B. Jones Memorial Excellence Award for Coastal and Ocean Resource Management. He was one of only four national recipients in the category of *Excellence in Coastal and Marine Graduate Study*, which “recognizes graduate students whose academic study promises to contribute materially to the development of new or improved approaches to coastal or ocean management.”

Alex received his award in an October 3 ceremony on Capitol Hill from North Carolina Congressman Walter B. Jones, Jr. (whose father established the award) and Scott B. Gudes, acting under secretary for oceans and atmosphere and NOAA administrator. Created by Congress as part of the 1990 reauthorization of the Coastal Zone Management Act, the Walter B. Jones Award honors individuals and organizations for their dedication and outstanding contributions in helping maintain healthy coastal and ocean resources, and in balancing the needs of these resources with human use.

The Jones award recognizes Alex's dissertation studies at the Florida Institute of Technology in science education (oceanography specialty). As part of his research in adult education and recreation ecology, he developed an innovative program to train dive tour operators and resource managers to reduce tourism-related damage to coral reef ecosystems. Since its inception in 1999, Alex has offered his unique program throughout the United States, Caribbean, Red Sea, and Southeast Asia to nearly 400 participants.

Alex's dissertation, *The Effects of Analogy-Based Instruction on Concept*



Alex Brylske (center, light suit) at awards ceremony.

Learning and Retention in a Nonformal Coral Reef Ecology Program, was a study examining the efficacy of analogy-based instruction with adult learners in a professional development setting. “Teachers, scientists and writers have long used the ‘reefs are like cities’ analogy to a point where it’s almost a matter of course when discussing coral reefs,” said Alex. “But no one has ever asked the simple question, does it really make understanding reef ecology any easier? So, inspired by reef scientists, who were also analogy advocates—from the Odum brothers to Bob Ginsburg—I decided to find out.” And the results were quite interesting. The research showed solid evidence that designing instruction around an over-arching analogy, and supplementing this with supporting analogies, appears to be a highly effective way of conveying scientific concepts to nonspecialists. Yet, consistent with prior research, his study also indicated that analogies might actually retard the learning process among those who hold expert-level knowledge of subject matter.

Alex's results were considered especially significant given that his subjects included a diverse group representing 17 different nationalities. Most similar work in the field has been limited to samples of convenience, homogenous groups such as undergraduates or among particular cultural settings.

In accepting the Jones Award, Alex remarked, “Perhaps the most distressing new prediction made by marine scientists is that human activities may eliminate all coral reefs within the next 50 years. So, I accept this award not on my own behalf, but on behalf of the thousands of scientists, resource managers, and tourism professionals who devote their lives to seeing that this dire prediction does not come true.”

Regarding NSU, Alex commented that, “At NSU, I received what I feel was a superb grounding and solid knowledge-base in ocean science and management. But rather than pursuing a career in research or management, my NSU experience inspired me to concentrate on how to effectively convey science to others, especially to adults and the public at large. Although I may not have won this award while at NSU, rest assured that the education I acquired there was vital to the success of this project.”

Alex is currently the marine conservation and education specialist with the Project AWARE Foundation, and senior editor of *Dive Training* magazine. He's also a former member of the Florida Governor's Ocean Committee. As a strong advocate for coral reef protection, Alex serves on the Board of Directors of the Coral Reef Alliance (CORAL). But Alex has not abandoned higher education. He's an adjunct professor at Edison Community College in Punta Gorda, Florida where he teaches oceanography. If you would like more information about Alex's project, he can be reached at Brylske@aol.com.

Cross Center Collaboration

A group of 42 Broward County high school science teachers participated in a “science teach-in” jointly hosted by the NSU Oceanographic Center and the Farquhar Center. The program was held November 8 at the NSUOC. The teachers received one in-service credit and attended an introduction session describing NSU in general and science curricular offerings. Next, teachers broke into smaller groups to join mini-classes highlighting various aspects of science. J.P. Keener, science head of Broward Schools, praised the effort, telling teachers they had experienced an outstanding example of teaching and teacher role-models at NSU. A fish-fry supper (from the Aquaculture Research Center) was held at the end of the session. The NSUOC's research vessel, the *RV Researcher*, took some teachers for intracoastal cruises. Faculty participants included **Andrew Rogerson, Edward O. Keith, Charles Messing, Barry Barker, Naomi D'Alessio, and Richard Dodge.**

MASTERCURRENTS

INSTITUTE OF MARINE AND COASTAL STUDIES

Winter 2002 Term (12 Weeks)
January 7–March 29

CORAL REEF GEOLOGY AND EVOLUTION

OCMB-7015 (33536)

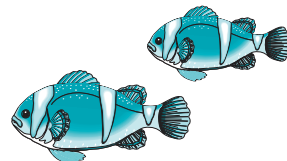
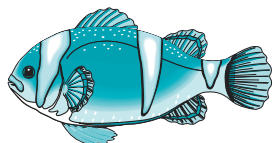
Throughout earth's history, bioconstructions—reefs being the most noticeable—have been focal points of organismal evolution, which is noted in the fossil record, as well as the growth fabrics and lithologies of the reef rocks. Organism-environment, and environment-sedimentology feedbacks create distinct signatures that allow us to gain detailed insight into the ecological functioning of reef communities long gone and the environment they lived in—if we can make the rocks talk.


This lecture series will delve into the following subjects:

(a) The definition of reefs and different reef concepts (biological, geological, stratigraphic, seismic); reef types and their dependence on basin morphology and tectonic setting; environmental controls of reef growth and its reflection in growth fabrics and lithology; calcification processes in reef environments; and carbonate lithology with special reference to reefs, growth fabrics of framestones, diagenetic processes in living and fossil reefs, framework, rubble and the importance of cementation

(b) The evolution of fauna and growth fabrics of reefal systems (stromatolitic systems of the Precambrian, noncoral reefs of the Paleozoic, “coral” reefs of the Paleozoic, scleractinian reefs of the Mesozoic); extinction and recovery events

(c) Special case study: the Caribbean coral reef fauna across time. Instructor: Bernhard Reigl, research scientist, NCRI, meets Mondays, 6:30–9:30 p.m. January 7–March 25, Classroom #1



M.S. degree specialties are marine biology, coastal zone management, and marine environmental science. Each course carries three credit hours or may be audited. Tuition is \$475 per credit hour (50 percent less for audit). Classes meet once a week from 6:30 to 9:30 p.m. at the Oceanographic Center (unless otherwise specified.) The winter term runs from January 7–March 29 (unless otherwise specified). Registration (\$25 nonrefundable fee) begins December 3. For further information, call Andrew Rogerson or Melissa Dore at (954) 262-3610 or 800-396-2326, or email imcs@nova.edu. More information can be found at the Web site www.nova.edu/ocean/. 

CONCEPTS IN PHYSICAL OCEANOGRAPHY

OCOR-5601 (32917)

This course deals with the basic physical properties of seawater; the temperature and salinity structure of the oceans; major current patterns; and the influences of waves, tides, and winds. Instructor: Alexander Yankovsky, Ph.D., assistant professor. Meets: Thursdays, 6:30–9:30 p.m. January 10–March 28, Classroom #1

SCIENTIFIC DIVING AND CORAL REEF ASSESSMENT

OCMB-9700 (33540)

This course is designed to provide continuing SCUBA diving education and teach basic scientific diving techniques, especially as applied to coral reef assessment. Upon successful completion of the course, the student will be a certified scientific diver in the NSUOC Scientific Diving Program. In addition, the student will have the opportunity to acquire higher recreational PADI certifications including: Advanced Open Water Diver, Rescue Diver, and several other specialty certifications. Instructors: David Gilliam and Lance Robinson, captain, research scientist, NSUOC diving safety officer. Meets Wednesdays, 6:30–9:30 p.m. January 9–March 27, Classroom #2. LIMITED TO 16 STUDENTS. Lab fee to be determined (at least \$450-enrollment dependent)

GIS AND REMOTE SENSING

CZMT-0639 (33538)/ MEVS-5023 (33537)/OCMB-6100 (33539)

This course provides hands-on training with the latest techniques in Geographic Information Systems and Remote Sensing. Course work includes lecture and hands-on computer training. Areas covered (utilizing both ERDAS Imagine 8.3 and ESRI Arcview 3.0) include GIS/Remote Sensing Theory; image georeferencing and mosaicking; image enhancement and classification procedures; accuracy assessment procedures; importing GPS polygons; establishing database and multimedia hot links; importing tables; joining; building queries; and charting and map creation. Instruction of class will be centered on application of these techniques to actual environmental case studies. This course is strongly recommended to students. The majority of all job openings currently require at least a passable knowledge of GIS/Remote Sensing. **\$100 lab fee** Instructor: Stacy Myers, adjunct professor, Meets: Mondays, 7:00–10:45 p.m., January 7–March 25. LIMITED TO 25 STUDENTS. Course held in Main Campus HPD New Assembly Building Microlab

ASPECTS OF MARINE POLLUTION

CZMT-0790 (32920)/MEVS-5100
(32919)

Deals with various forms of environmental pollution as they affect both the land and maritime environment. Focus on the role of microorganisms as causes and indicators of toxicity. Sources, measurement, and control of pollution in marine and coastal environments are discussed. Instructor: Don McCorquodale, adjunct professor. Meets: Wednesdays, 6:30–9:30 p.m., January 9–March 27, Classroom #1

PLANKTON ECOLOGY

OCMB-5606 (32918)

Traditionally, plankton have been dealt with under two broad headings: phytoplankton and zooplankton. While this categorization is useful, it does not reflect current research emphasis of the smaller members of the plankton community: bacteria (picoplankton) and the grazing protozoa (nanoplankton). This course will deal with these smaller members of the plankton community. Plankton ecology will begin with a summarization of the plankton environment in lakes, oceans, and estuaries. It will continue with the essential aspects of the biology and physiology of bacteria and protozoa. It will finish with the exploration of the functional role of these organisms within aquatic ecosystems. **\$20 lab fee** Instructor: Andrew Rogerson, professor. Meets: Tuesdays, 6:30–9:30 p.m., January 8–March 28, Classroom #1 🐡

**Teachers may take
recertification courses
for credit for \$800.
(nondegree seeking status)**

**Spring 2002 Term (12 Weeks)
April 8–June 28, 2002**

Coastal Ornithology

Instructor: Edward Keith

Marine Geology

Instructor: Pat Blackwelder

Biostatistics

Instructor: Mark Farber

Molecular Biology or Biology of Sharks

Instructor: Mahmood Shivji 🐡

Distance Education

INTERNATIONAL INTEGRATED COASTAL ZONE MANAGEMENT

CZMT-0614 (33542)/ MEVS-5017 (33541)

This web-based distance education course focuses on the international dimensions of Integrated Coastal Management. Students will first examine the major “big picture” issues affecting the world's coastal areas and oceans and will examine seven case studies that help bring alive the grave problems of mismanaging coastal and oceanic resources—the Black Sea, the Grand Banks and Newfoundland, Louisiana, the Mississippi River, and the Gulf of Mexico, Belize, the Marshall Islands, and Antarctica. The second part of the course will provide students with the opportunity to study major international conferences, treaties, and policy principles (including the Law of the Sea). In the final third of the course, students will examine regional and selected country coastal zone policies. Students completing this course will be familiar with the most important aspects of Integrated Coastal Management globally and will have a basis for comparison of these policies. Students will also be in a position to assess the costs and benefits of different coastal zone management strategies around the world. Instructor: Steffen Schmidt, adjunct professor, www.nova.edu/ocean/disted.html.

MARINE MAMMAL MANAGEMENT

OCMB-6330 (33543)

The course is designed to serve as a source of information and ideas providing an introductory awareness of a diversity of issues including the morphology, physiology, adaptation, and behavior of these species and their interaction with humans and other predatory mammals. A secondary objective is how marine mammal species are interconnected to the rest of the natural environment. A third objective is to help the student consider the linkages between the ways we regard marine mammals, and our actions towards them. Two papers are required. This Course is CD-ROM Based. Instructor: Keith Ronald, adjunct professor. www.nova.edu/ocean/marmam/marmam.html.

INTERNSHIP IN COASTAL POLICY

CZMT-0664 (34018) (three-credit course)

Students enrolled in this course are expected to invest the equivalent of three hours per week for 14 weeks (i.e., at least 42 total hours) in their internship. The internship can be done at a research organization; private company; consulting firm; local, county, state or federal government agency; or other approved venue that is related to coastal zone activities. In addition to the hands-on work, each intern will also keep an academic journal of the internship activities. This journal will be submitted for review for the final grade. The student's supervisor at the internship venue will also evaluate the student. (Permission and approval of supervising professor is required before you enroll in this class). Instructor: Steffen Schmidt, sws@iastate.edu 🐡

Defenses

THESIS:

Straccione, Nicholas C., “Coral Recruitment to Various Artificial Substrates in Miami Beach, Florida.” October 29. Committee Members: Joshua Feingold, Richard Spieler, Robert Pomeroy

CAPSTONE REVIEWS:

Doland, Jennifer, “Population dynamics of four northern seals: population estimates and the influence of internal and external factors on population flux.” August 29. Committee Members: Keith Ronald and Curtis Burney

Dorrian-Flores, Joan, “Seasonal and Annual Variations in Sizes of Nesting Loggerhead Sea Turtles (*Caretta caretta*) in Broward County, Florida.” October 3. Committee Members: Curtis Burney and Edward Keith 🐡

The Oceanographic Center “Goes the Distance” with a New Coordinator of Distance Learning

Nova Southeastern University has a proud history of innovation with distance learning, and the Oceanographic Center is quickly becoming a solid part of this heritage. Five distance learning courses are already available through the NSUOC. These courses are taken by graduate students and adult learners from Florida, across the United States, and internationally. Learning embraces a variety of technologies, such as CD-ROM, interactive online discussions and course materials (WebCT), or optional field trips to allow for hands-on activities.

The success of these courses has encouraged the Oceanographic Center to really “go the distance” with a newly appointed Coordinator of Distance Learning, **Jane Dougan**. Jane has been teaching two distance courses for the NSUOC, and is excited about the potential of building on the solid base already in place. Plans include offering an innovative coastal zone management graduate degree that would be available entirely by distance learning. As well, four-course distance graduate certificate programs will be of particular interest to target groups, such as professionals working in related fields and teachers seeking recertification. General interest courses are also envisioned; e.g. for retirees and newcomers to the region seeking to learn more about coastal zone ecology. Dougan has more than



Jane Dougan and Eduardo Koenig looking over some of the new courses being offered through distance learning

15 years experience designing, developing, and offering distance learning courses nationally and internationally. She sees the learning as “connected” rather than “distant,” especially with an interactive online format that links learners across time and place. This is also particularly suited to learning about our environmental “commons” such as water, with ample opportunity for linking place-to-place examples and case studies.

Graduate student **Eduardo Koenig**, for example, is originally from the Dominican Republic. Now studying coastal zone management at the Oceanographic Center, Koenig has completed three of our distance courses. He found the ability to take courses by distance beneficial in terms of flexibility—being able to pace the learning to his own needs—and especially in terms of sharing perspectives with students in other places and cultures. In some ways, Koenig reflects that the opportunity for this type of interaction was better than in a classroom setting; one could post and respond to messages at any time. He smiles when he recalls his surprise at discovering via interactive class discussion that his perspectives were echoed by a classmate in Singapore.

Dougan is also working with the Jane Goodall Institute in promoting Goodall’s “Reason for Hope” tour. She will be meeting with Goodall soon and will be discussing the possibility of a distance course titled “Reason for Hope.” The ultimate goal is to enhance the horizons of the NSUOC and NSU in the arena of environmental education.

To learn more about distance courses at the NSU Oceanographic Center, please visit our web site at: www.nova.edu/ocean/disted. Or get in touch with Dougan by phone (954) 262-3621 or email: douganj@nova.edu.

UNDERCURRENTS

Joint Science Program (Undergraduate)

A paper titled “Adhesion of tear proteins to contact lenses and vials,” was published in the August 2001 (v. 34) issue of *Biotechnology and Applied Biochemistry* and on the web at <http://bab.portlandpress.co.uk/bab/034/bab0340005.htm>.

This work was funded by a President’s Faculty Scholarship Award, and several undergraduate students from the Farquhar Center are on the paper as coauthors. They are Melissa Boltz, Rundeep Gadh, Roya Ghorsriz, and Donna Mangatt.

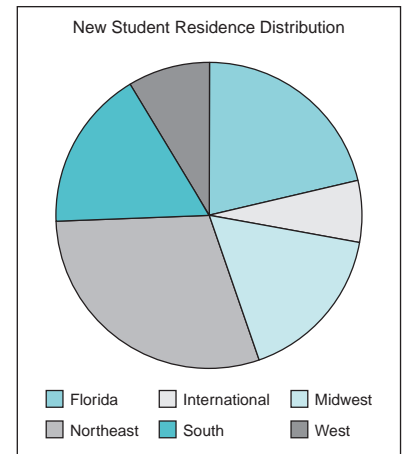
Edward O. Keith, Ph.D., and **Lester E. Janoff**, O.D., wish to express their thanks for all the support they received.

Ed Keith, Ph.D., and **Joshua Fiengold**, Ph.D., will be teaching a new undergraduate class, the biology and ecology of manatees. It is listed as MBIO 2910, introductory topics in marine biology. The one credit class involves a three-day trip to Crystal River for in situ observations of manatees (January 2–4, 2002). Class will meet on Tuesday nights from 6–8 p.m. at the main campus for five sessions starting January 8. 🌊

Fall Term Enrollment Largest in NSUOC History

With 50 new students enrolling throughout the 2001 calendar year, the Oceanographic Center ends the year on a high note. The largest new class in NSUOC history, our new students come from around the country and the world. Marine biology is still our most popular degree, with 46 percent of the incoming students enrolled in that program. Marine environmental sciences has had a huge jump in enrollment, capturing 16 percent of the new students. Another 16 percent of our new students are enrolled in our joint program, where students may choose to combine two of our three majors. With this record class size, the NSUOC is expanding its classroom capacity. As of the winter 2002 term, the NSUOC will have two complete classrooms in the Forman Building. We've also increased the size of our computer microlab. 🌿

Orientation was held on September 22, which was followed by a barbecue open to all NSUOC faculty and staff members and students.



Some of our "older" students enjoying the feast. Tilapia and shrimp were some of the featured delights.



Bart Baca and student, Cathy Mattison, cooking up some tilapia



Quite a crowd!



Ph.D. candidate, Dave McMahon shows his innovative side as he drains shrimp using a tennis racket.

Visiting Scholar

Yevgeny Lemeshko, Ph.D., from Marine Hydrophysical Institute (Ukraine) visited the lab from September 11 through October 25, 2001, to work on a joint paper with **Sasha Yankovsky**, Ph.D. While here, he stayed on the center's new houseboat. 🌿

20 Years and Counting

NSUOC Librarian, **Kathy Maxson** and faculty member, **Curtis Burney**, were honored at a luncheon in December for their 20 years with NSUOC. The annual event is held to honor all employees who have been with the university five years or more. 🌿



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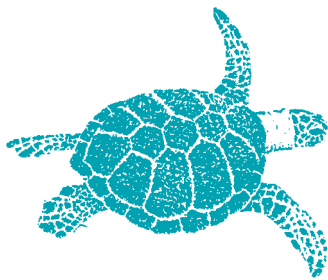
CURRENTS, Fall 2001



Dockmaster, Lance Robinson, showing off new floating docks, which were installed with the help of Industrial Divers Corp. and student Brian Ettinger



Lance Robinson and Abby Renegar stand on new floating dock.



Editor: Kathy Maxson



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