


Fall 1994

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NSU Oceanographic Center

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Currents



Fall 1994 • Volume VIII, Number 4

The Evolution and Classification of Placental Mammals Is under Laboratory Study

Dr. Mahmood Shivji and M.S. student **Marta Smith** are working on some new projects in genetic research, in collaboration with **Dr. Michael Stanhope** and Ph.D. student **Victor Waddell** of the Queen's University of Belfast in Northern Ireland. Dr. Shivji explains that they are addressing several questions pertaining to the evolution and classification of placental mammals.

According to Dr. Shivji, "Of particular interest to us are the relationships of two orders of marine mammals, namely the Sirenia, which include manatees and dugongs, and the Cetacea, which include whales, dolphins, and porpoises, to the remaining orders of mammals, most of which are land animals. Depending on the classification, there are between 15 and 25 orders of placental mammals, so the number of orders is controversial."

Part of the project involves reconstructing the evolutionary history of placental mammals. "Many researchers have been working on this problem," continues Dr. Shivji, "using traditional morphological and anatomical characters, such as teeth, vertebrae, skull, jaw, musculature, and so on. Despite this, the evolutionary relationships among the orders are still very controversial. What we are doing is using the DNA sequence of a spe-

cific single-copy nuclear gene, called the interphoto-receptor retinoid binding protein gene (IRBP), in an attempt to determine these evolutionary relationships.

"We are using a technique called polymerase chain reaction (PCR) to amplify and sequence the IRBP gene in the various mammal orders. The idea then is to compare the magnitude of the sequence divergence in these genes to estimate the relationships among the orders. The general procedure includes extracting total DNA from frozen mammal livers, amplifying the IRBP gene using PCR, and then sequencing the gene by means of an automated DNA sequencer. For example, we are attempting to resolve the relationships among manatees, elephants, hyraxes (shrew-like mammals), and armadillos, all of which represent different orders believed to be more closely related to each other than to any of the other mammal orders."

Dr. Shivji and

Ms. Smith are asking similar questions about Cetaceans, and trying to determine their evolutionary relationship to artiodactyls (cows, goats, pigs, deer, camels, hippos). "Traditionally," Dr. Shivji explains, "Cetaceans have been classified as a separate order from the artiodactyls. But the question remains as to whether they are so evolutionarily different that they deserve to be classified as a separate order."

(Continued on Page 2)



Marta Smith and Dr. Mahmood Shivji in the laboratory.

(Continued from Page 1)

In another project, Dr. Shivji is developing molecular genetic markers to identify the early life stages (eggs, larvae, and juveniles) of different species of fishes. He is looking at specimens from the U.S. South Atlantic, the Gulf of Mexico, and the Caribbean.

In conjunction with Dr. Shivji's evolutionary project, Ms. Smith spent four months this summer in the laboratory of **Dr. Michael Stanhope** at The Queen's University. There she used molecular genetic techniques to study phylogenetic relationships of certain mammals.

In explaining her work there, Ms. Smith states, "We looked at African elephants, aardvarks, hyraxes, and pigs. We analyzed the IRBP gene and, using sequence-alignment software, compared the DNA sequences of each animal to determine what changes had taken place in their evolutionary history."

Ms. Smith will continue this work in Dr. Shivji's laboratory. "The last species under study," she states, "are dugongs, manatees, and rough-tooth dolphin. When all of the sequences have been obtained from the marine species, they will be analyzed along with the previously sequenced species to determine their evolutionary relationships."

Currently, molecular studies are becoming very popular to resolve highly debated evolutionary issues. The only previous means for addressing such questions was using morphological characters of the animals.

Ms. Smith has taken on this study as her M.S. thesis project, from which she hopes to publish one or two scientific papers. She plans to go on for her Ph.D. degree in marine molecular genetics.

Marine Reef Study Underway

David Gilliam, a Ph.D. student working under the tutelage of his major professor, **Dr. Richard Spieler**, is making headway on his thesis project. At the moment, he has 40 reefs in place off Fort Lauderdale Beach in about 20 feet of water.

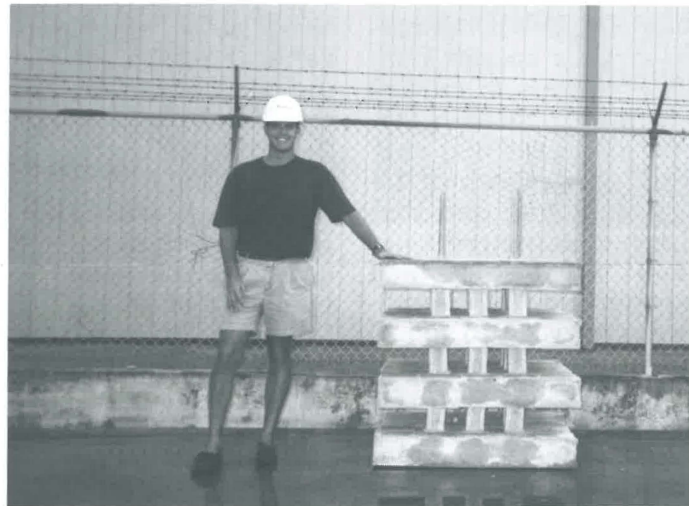
Gilliam will be examining four hypotheses involving the formation of fish assemblages associated with marine reefs (natural as well as artificial). In one part of his study, he will look at the effect of predators on the formation of fish assemblages. Some reefs will be caged to keep predators out, and control reefs will be only partially caged. Then he will compare new recruits in these two types of reefs monthly over a two-year period.

Gilliam also will compare the effects of a resident population of fishes on the acquisition of new recruits. "In the process," explains Dr. Spieler, "he will examine the lottery hypothesis, which states that

recruitment is a random, first-come, first-served process." To test another hypothesis, Gilliam will set out monthly larval fish traps to correlate the presence of larval fishes with numbers of new recruits.

Robin Sherman, a M.S. student also working under Dr. Spieler, has begun a project to look at 20 artificial reefs in 70 feet of water off Fort Lauderdale beach. She also will be looking at the effects of the resident fish population on recruiting, as well as the larval fish supply and the lottery hypothesis. "She will be looking at essentially the same things as Gilliam, only in a deep-water environment," said Dr. Spieler.

The reefs were placed in the water at the end of September. They are made of concrete block reinforced with waste concrete and the metal rebar. The entire project is being supported by the Florida Department of Environmental Protection, the Broward County Department of Natural Resource Protection, and the South Florida Fishing Classic.



David Gilliam with concrete block reef.



People on the Move

Dr. Gary Kleppel and Ph.D. student **Karen Roberts** visited the University of Rhode Island in Narragansett, October 12-21. They participated in an NSF study of carotenoid pigment conservation during passage through the guts of copepods. As guests of **Drs. Barbara K. Sullivan** and **Candace Oviatt**, Director of the Ecosystem Research Laboratory on the campus of the Graduate School of Oceanography, they conducted three experiments and presented a seminar on the nutritional ecology of zooplankton.

During November 17-20, Dr. Kleppel and Ms. Roberts traveled to Seabrook, South Carolina, to attend SECOR (Southeast Coastal Ocean Research) Meeting '94. The meeting brought an assemblage of scientists who work in the South Atlantic Bight and adjacent waters in order to elicit interaction from a variety of disciplines having a common interest. Ms. Roberts and Dr. Kleppel presented a poster entitled "Distribution of Fish Populations in the Natural and Mitigated Mangrove Forests in Southeast Florida." Dr. Kleppel also presented a paper entitled "Carbon, Nitrogen, and the Fate of New Production in Coastal Food Webs," co-authored by **Dr. Hans Pearl**.

Dr. Charles Messing attended a meeting of the Geological Society of America in Seattle, October 24-27. He presented a paper entitled "*In Situ* Growth and Sediment Production Rates in a Living Stalked Crinoid (*Chladocrinus decorus*)."

Drs. Richard Dodge and **Bart Baca** traveled to Panama November 4-10 to continue their field research study on an oil spill that occurred in the region. The study is being funded by Marine Spill Response Corporation.

Dr. Julian McCreary attended the Third International Scientific Symposium in Bali, Indonesia, November 22-26. The symposium's topic was "Sustainability of the Marine Environment: An Integrated Scientific Approach to Coastal Area Management," organized by the Indonesian Institute of Sciences and the Intergovernmental Oceanographic Commission (IOC) of UNESCO. The symposium

was an immediate follow-up to the U.N. Conference on Environment and Development that was held in Rio de Janeiro in June, 1992, calling for "protection of all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources."

On his way to Bali, Dr. McCreary stopped off at the University of Hawaii for three days, to visit **Dr. Dennis Moore**, former Director of the Oceanographic Center. On November 18 he presented a seminar entitled "On the Circulation of Thermocline and Internal Waters in Simplified Ocean Circulation Models."

Following the Bali meeting, Dr. McCreary attended another symposium on the campus of Kyushu University in Fukuoka, Japan, November 29-30. Here he presented an invited lecture on ocean circulation models. In his invitation letter, the convenor, **Dr. Arata Kaneko**, noted "The invitation to the western countries is devoted to a few of internationally authorized physical oceanographers who may have some concern in the Pacific western boundary currents which control the earth climate as well as the meteorological condition of the east Asian countries."

Dr. Barry Klinger attended the annual fall American Geophysical Union (AGU) meeting in San Francisco, which was held December 5-9. He presented a paper entitled "A Kinematic Model of Wind-driven Meridional Heat Transport."

Dr. Andrew Moore will present a seminar at Harvard University on December 15, entitled "Tropical Interannual Variability in a Coupled GCM." Dr. Moore worked as a Research Associate in Harvard's Division of Applied Sciences from 1989 to 1990, with **Dr. Allan Robinson**.

Dr. Richard Spieler and six of his graduate students will attend a meeting of the American Society of Zoologists in Saint Louis, January 4-8, 1995. They all will present posters on their research work. Ph.D. student **David Gilliam** will present a joint poster with M.S. student **Robin Sherman**. Sherman will outline her undergraduate research work on buoyancy in stingrays, and Gilliam will present his data on liver weights

of a different species of stingray. **Eric Hull's** poster will have to do with his research on the stress response of some sharks, and **Stacy Wolfe** will present her thesis work on the natural history of ocean surgeon fish. **James Sulikowski** and **Pat Quinn** will display their data on the natural history of the yellow ray.

Awards

In mid-October, **Cynthia Hancock**, president of National Week of the Ocean, presented to the University the tenth annual Marine Award. The award is co-sponsored by Galleria G'Vanni of Fort Lauderdale. **Dr. Curtis Burney**, Center faculty member, accepted the award for the University.

Recent Center Seminars

Several seminars have been presented at the Oceanographic Center since the last issue of *Currents* was published.

August 26: "Feeding Strategies, the Nutritional Environment and Zooplankton Production: Some Definitions," by the Center's **Dr. Gary Kleppel** and Ph.D. student **Carol Burkart**.

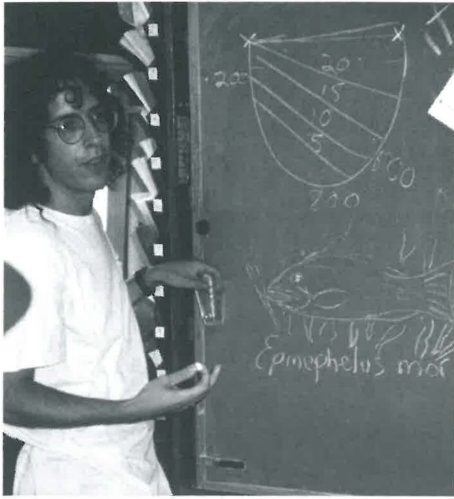
August 29: "The Egg Production of Calanoid Copepods in Coastal Waters of Florida and Its Relation to the Nutritional Environment," a M.S. thesis defense by **Kevin Carter**.

September 22: "Niño and Niña Events, 1980-1994, from Cane and Zeiak Simulations and Satellite or *In Situ* Observations," by **Dr. Claire Perigaud**, of the Jet Propulsion Laboratory in Pasadena, California.

October 21: "Stratigraphic Evidence from Reef Studies for a Double-High Sea Stand during the Last Interglacial Maximum," by **Dr. William F. Precht**, Director of Environmental Services at Consul-Tech Engineering, Inc., of Miami.

November 4: "The Influence of Maternal Diet on the Viability of Calanoid Copepod Eggs," by Ph.D. candidate **Carol Burkart**.

December 2: "Juvenile Reef Fish Recruitment Processes: A Multivariant Field Experiment," by Ph.D. candidate **David Gilliam**.



Dr. Barry Klinger explains physics of the Gulf Stream (see story on page 5).

Barry Klinger Joins Faculty

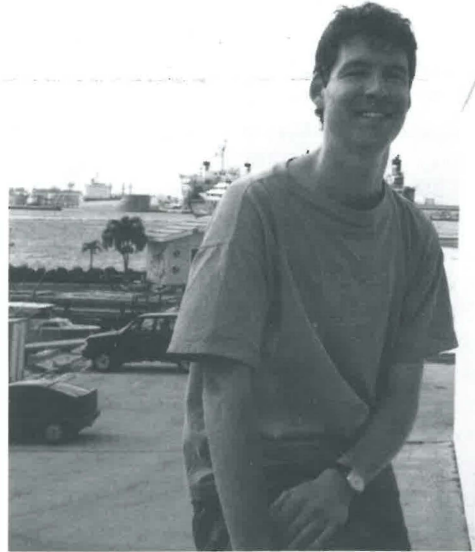
On September 1, **Dr. Barry Klinger** joined the faculty of the Oceanographic Center. He comes to us from the Department of Earth, Atmospheric and Planetary Sciences at M.I.T., where he was a postdoctoral fellow under **Dr. John Marshall**. He received the Ph.D. degree from the M.I.T./Woods Hole Oceanographic Institution Joint Program in 1992. He received the B.S. degree from M.I.T. as well.

For his Ph.D. thesis work in theoretical physical oceanography, Dr. Klinger tackled the problem of whether currents going along coasts create eddies at capes. He explains that "There is a Mediterranean outflow, which takes a sharp right turn at Portugal. I looked at whether the sharp turn was responsible for making giant whirlpools break off from the outflow and possibly drift across the Atlantic." He used rotating tanks in the laboratory to perform his research.

For his postdoctoral research, Dr. Klinger turned more to the computer, looking at how water gets to the bottom of the ocean. He set up computer models to see how the earth's rotation affects this process. "This water is part of the global circulation, which influences the earth's climate by redistributing heat from the equator to the poles," he explains.

Andrew Moore Becomes Faculty Member

Physical oceanographer **Dr. Andrew Moore** joined the faculty of the Oceanographic Center in mid-October. Before coming here, he spent two years at the Bureau of Meteorology Research Centre in Melbourne, Australia. There he was involved in climate research, and also worked on coupled ocean-atmosphere models of the tropical Pacific.



Dr. Andrew Moore at the Forman Building.

Here at Nova Southeastern Dr. Klinger wants to understand how the sinking water connects to the rest of the circulation. He will again be using computer models, focusing on the Labrador Sea, which is one of the important sources of cold water in the ocean. "Many observational expeditions are planned there in the next few years, so it will be good to understand the physics of the region," he reasons.

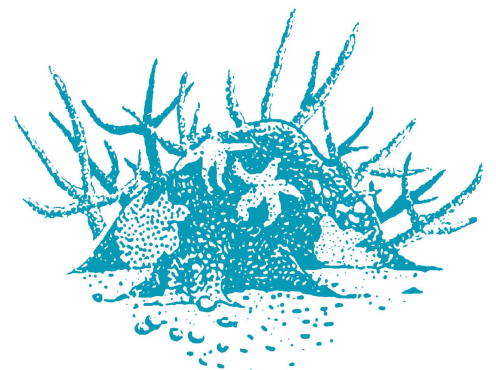
Dr. Klinger also will be teaching marine physics in the Institute of Marine and Coastal Studies during the winter term. As for his new surroundings, he states, "Even though I will be working with computer models, it is nice to see the ocean every day on the way to work, especially after being in an 18-story building in Cambridge for the past 9 years." Welcome aboard!

Dr. Moore received the B.S. degree from the University of London in 1983. In 1986, he received the Ph.D. degree from Oxford University, where he studied under **Dr. David Anderson**. His thesis was entitled "Data Assimilation in Ocean Models."

After earning his degree, Dr. Moore set off for Australia, where from 1986 to 1988 he worked as a postdoctoral fellow at the University of New South Wales. There he dealt with ocean data assimilation and some general fluid dynamics problems. Then in 1989 he moved on to the U.S. and spent one year as a postdoctoral fellow at Harvard University, working with **Dr. Allan Robinson**.

After his stint at Harvard, Dr. Moore moved back to Australia, where he worked for 2-1/2 years at the CSIRO Division of Atmospheric Research in Melbourne. His research centered on modelling greenhouse climate change and coupled modeling, as well as modelling the Gulf Stream. In 1992 he moved on to his most recent position at the Bureau of Meteorology Research Center in Melbourne - and that brings us to the present.

Now that Dr. Moore has returned to the U.S., he said of his latest move, "I fancied a change, and I wanted to teach graduate students. I spent the last five years working in government labs, so it was time for a change." At Nova Southeastern he will work on adjoint methods applied to the predictability of ENSO (El Niño/Southern Oscillation). He also will do some global coupled modeling. When asked about his new environment, he replied "The weather's great, and it is nice to work on the beach." In fact, he is eager to get back to rowing (as in racing shells) and to explore South Florida and the Bahamas. Welcome to NSU!



Research Expedition to Gulf Stream Serves as Unique Fund-Raiser

On November 12, the Oceanographic Center hosted a novel fund-raising event aboard the Shedd Aquarium's research vessel, *Coral Reef II*. Despite a week's delay due to bad weather, 10 hardy, paying guests, a Nova Southeastern vice-president, 4 faculty members, 4 graduate students, 2 caterers, and the captain and mate braved strong winds and high seas to cruise to the Gulf Stream off Fort Lauderdale for a rocky, yet unique educational experience.

On the way out, **Dr. Barry Klinger** talked about the Gulf Stream, describing its structure, origins, and the patterns of density and temperature distribution across the current. He also explained why the sea level is a little higher (about 1 meter) on the Bahamas side of the Stream than on the U.S. side.

Once the ship reached the Gulf Stream, **Dr. Charles Messing** continued educating the guests by deploying a 10-foot otter trawl in 250 meters of water. From the depths he retrieved some galatheid crabs (a.k.a. squat lobsters), which are relatives of hermit crabs. He also brought up 2 small flat fishes.

Next **Dr. Gary Kleppel** demonstrated the use of a CTD (conductivity/temperature/depth recorder) and dropped the instrument in about 200 meters of water. When the unit was brought back onboard, the data was downloaded onto a computer. Dr. Kleppel then was able to show the on-lookers the patterns of temperature and salinity changes with depth. He also took a deep-water plankton tow.

Because of the rough seas, the vessel returned to Port Everglades and cruised around in Port waters. During this time the plankton that were collected were examined under the microscope, and the images were projected onto a TV monitor for the benefit of the guests. They watched, for example, the flow of blood through a shrimp's tail fan. Dr. Kleppel discussed the feeding habits of copepods, and even the patterns of water flow as the copepods swept food toward themselves were visible on the screen. The guests also saw live dinoflagellates that were taken from the plankton tow. They witnessed ev-



Chris Jacoby, John Elmore, Rusty Hayes, Matt Rudolph, Dr. Barry Klinger, Dr. Tom Griffith, Carol Burkart, and Dr. Gary Kleppel.



Dr. Charles Messing (with crab), Kenneth Kent, John Peet, and Denise Leibmann.



Dr. Gary Kleppel with plankton tow.

everything from the phytoplankton at the base of the food chain to important plankton predators, such as arrow worms.

All in all, the cruise was a success, and already there is some discussion of a repeat performance next year. Weather willing, that is.

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UNDERCURRENTS

INSTITUTE OF MARINE AND COASTAL STUDIES

WINTER TERM SCHEDULE

M.S. degree specialties are **Marine Biology** and **Coastal Zone Management**. Each course carries three credit hours or may be audited. Tuition is \$315 per credit hour (50 percent less for audit). Classes meet once a week from 6:30 to 9:30 PM at the Oceanographic Center. The winter term extends from January 2 through March 24, 1995. For further information, call Helene at (305) 920-1909.

Descriptive Marine Physics (OCOR-5601): A CORE course that deals with the basic physical properties of seawater, the temperature and salinity structure of the oceans, major current patterns, and the influence of waves, tides, and winds. Instructor: **Dr. Barry Klinger** (Center faculty). Starts Tuesday, January 3.

Ports and Harbors (CZMT-0780): This course offers a comprehensive examination of modern trends in port and harbor engineering, maintenance, and management. It includes planning and layout of ports, harbors, and marinas; operation and maintenance of facilities; and environmental impact. Emphasis is on analysis of modern practices. Instructor: **Mr. Alan Sosnow** (Center adjunct). Starts Wednesday, January 4.

Food Webs of the Ocean (OCMB-6320): This is a three-part course: (1) presentation of general concepts relating to food webs, trophic dynamics, and the energetics of marine ecosystems; (2) description of some of the major ocean and coastal food webs, viewed both historically and with a focus on contemporary efforts to identify and understand the trophic links between them; (3) participation in a study of the food webs of the Port Everglades estuary, providing hands-on experience with sampling and ana-

lytical techniques. Instructor: **Dr. Gary Kleppel** (Center faculty). Starts Thursday, January 5.

Marine Mammals (OCMB-6330): Topics of discussion include marine mammals' physiological profiles, anatomical structure, energetics, feeding habits, population dynamics, and interactions with man and other species. Comparisons are made among the four major groups of marine mammals. Instructor: **Dr. Keith Ronald** (Center adjunct). Begins Monday, January 16.

Spring Term Schedule

The spring term extends from April 3 through June 23, 1995. Course descriptions will be presented in the next issue of *Currents*.

Coastal Water Resource Impacts (CZMT-0622). Instructor: **Mr. Stacy Meyers** (Center adjunct).

Methods in Plankton Ecology (OCMB-6320). Instructor: **Dr. Gary Kleppel** (Center faculty). To be held on Tuesdays.

Marine Geology (OCOR-5604): A CORE course. Instructor: **Dr. Pat Blackwelder** (Center faculty).

Aquaculture (OCMB-6200). Instructor: **Dr. Bart Baca** (Center adjunct). To be held on Thursdays.

Ph.D. Degree Offered

The Ph.D. degree in Oceanography also is offered at the Center. Tuition is \$2,100 per quarter. The degree program requires a minimum of 60 credits beyond the baccalaureate, 30 of which may be applied from the master's program. The remainder consists of at least 24 dissertation research credits and 6 credits from upper-level course work, which traditionally is taught in the tutorial mode. Ph.D. students are expected to complete the program within 5 years, a minimum of 1-1/2 years of which must be in residence.

New Students Swell List

The following M.S. students, along with one Ph.D. student, have registered in the Institute of Marine and Coastal Studies since last spring. Welcome aboard!

Pamela Bachman, MB: University of Connecticut

Kathy Baier, MB: Dana College

Heather Balchowsky, MB: University of Central Florida

Michele Biringer, MB: California University, Pennsylvania

Alexander Brylske, CZM: Norwich University

Charles Crick, Jr., MB: Middle Tennessee State

Marianus Datubara, MB: Universitas Nasional

Wende Evans, MB: Virginia Tech

Kimberly Ferran, JS: Texas A & M

Neysa Foy, MB: Clark, Atlanta

Tod Hale, MB: Oberlin College

Matthew Heilman, MB: University of Massachusetts at Amherst

Kevin Helmle, MB: St. Joseph's College

Brian Hicks, PhD: University of Maryland

Karie Holtermann: MB: University of North Carolina

Michael Hopkins, CZM: Pennsylvania State University

Lee Houchin, MB: Eckerd College

Erin Kerby, MB: Valparaiso University

Amy Lafitte, MB: Brenau College

Elizabeth Lu, MB: SUNY at Buffalo

Austin Ives, MB: Eckerd College

Yasser Kattan, MB: King Abdul University

Kevin Kittredge, MB: Grand Canyon University

Danielle Latiff, MB: University of Michigan

German Mendez, MB: National University, Mexico City

Paul Moen, CZM: Florida International University

Carrie Nelson, MB: Denison University

(Continued on Page 7)

(Continued from Page 6)

Stacie Perdue, MB: Pennsylvania State University

Diana Pulis, MB: Florida International University

Dana Rankin, MB: Nova Southeastern University

Ileana Ros-Lehtinen, Sp: Florida International University

Tim Shinaberry, MB: Michigan State University

Wendy Sotera, CZM: Stockton College

Sarah Suggs, CZM: University of Miami

Michelle Tatlock, MB: University of Evansville

Michelle Zurawski, MB: Lake Forest College

CZM: Coastal Zone Management

MB: Marine Biology

JS: Joint MB/CZM

Sp: Special Student

PhD: Dr. of Philosophy, Oceanography



Stacy Wolfe, Monika Grossmann, Dr. Mahmood Shivji.



Salama Al-Marri, Weiqing Han, Melissa Dore



Ike Chase, Pat Bellew, Barbara Maloney.



Brian Hicks, Austin Ives, Kevin Helmle, Ken Cook.

New Students Welcomed at Annual Party

On October 7, the annual student party was held in the Forman Building. As always, the purpose of the get-together was to welcome new students to the fold and to let the "old" students get reacquainted. The party was organized by **Melissa Dore, Kathy Maxson, and Helene Taylor.** The feast fare included chicken wings, macaroni and cheese, mozzarella sticks, spinach dip, parmesan stuffed mushrooms, a watermelon fruit bowl, and carrot cake, much of which was prepared by Ms. Dore.



Weiqing Han, Austin Ives, Karen Roberts.



Chris Gudman, Maria Smith, Chuck Featherstone.



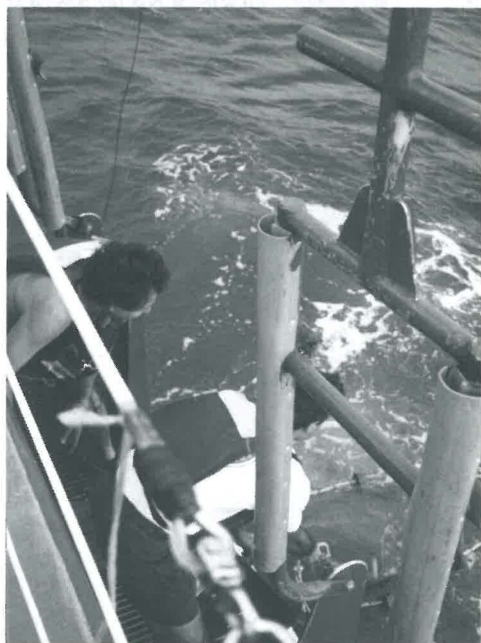
Kathy Maxson with Dr. Andrew Moore at the party.



Carrie Nelson, Michelle Zurawski, Tim Shinaberry, Michelle Tatlock, Erin Kerby, Kathy Baier, Wende Evans.

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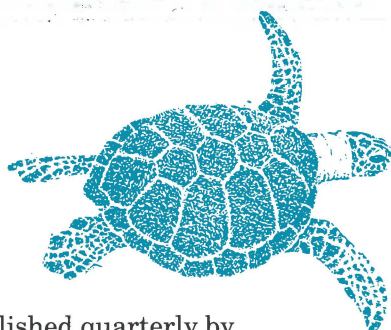
Drs. Charles Messing and Gary Kleppel.



Dr. Gary Kleppel.

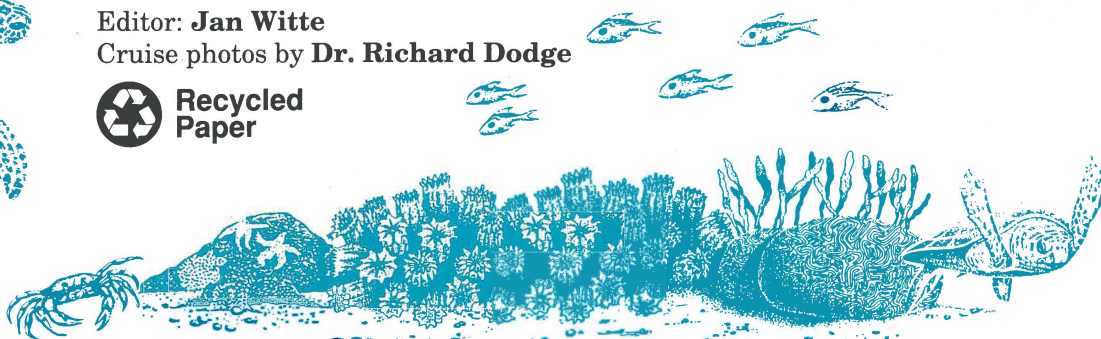


Dr. Gary Kleppel, Dr. Tom Griffith, Kenneth Kent, and John Elmore.



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