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The College of Marine Science at the University of South Florida

FRANK MULLER-KARGER, KENT FANNING, ALBERT HINE, WILLIAM HOGARTH, AND JACQUELINE DIXON

BIRTH OF A COLLEGE

The story of the College of Marine Science (CMS) began in an old U.S. merchant marine training station near the harbor in Saint Petersburg, FL (Fig. 1). The station sat on the 11-acre site that would later become the small branch campus of the University of South Florida (USF). Officially, the USF Marine Science program started in 1967 when three faculty—Harold Humm (founding director, and a marine phycologist), Thomas Hopkins (marine plankton and micronekton ecology), and Hugh Dewitt (ichthyology)—set up makeshift laboratories at the old training station and began to mentor graduate students working toward master's degrees. Their group was designated as the Marine Science Institute of the University of South Florida. By 1969, the group had doubled in size; it included a marine geologist (Thomas Pyle), an optical/physical oceanographer (Kendall Carder), and an ichthyologist (Ronald Baird). In 1971, a chemical oceanographer (Peter Betzer) joined the group, and thus all of the major subdisciplines of oceanography were covered. The Institute had been redesignated the Marine Science Department within the USF College of Natural Sciences, which itself was later incorporated into the USF College of Arts and Sciences. Much later, in 2000, the department formally became a separate USF college; although it reported to the USF provost on the main Tampa campus, it remained on the USF Saint Petersburg campus.

In the 43 yr since its official beginning, the Marine Science program at USF has greatly expanded in size and capability and is widely recognized as a leader in ocean science. There are now 27 faculty covering the subdisciplines of oceanography and other earth sciences, ~110 graduate students, ~\$20 million in annual research (mostly from federal sources), ~\$9 million endowment for student fellowships, 61 full-time support personnel (including engineers and technical staff in the College's Center for Ocean Technology), and 40 temporary staff.

Both the quality of the science conducted at the college and the campus' advantageous location have attracted the attention of marine-focused agencies, leading to the relocation of major programs and substantial personnel from around

the nation to Saint Petersburg. The groups that eventually became the Fish and Wildlife Research Institute (FWRI) and the Florida Institute of Oceanography (FIO) were already present on the peninsula in 1967. The addition of other entities has been ongoing over the lifetime of the USF Marine Science program. In addition to FWRI and FIO, six federal and state environmental research and operational agencies are now established in close proximity to the college, including the U.S. Geological Service (USGS) Coastal Geology division, the National Oceanic and Atmospheric Association (NOAA) National Marine Fisheries Service Southeast Regional Office, the U.S. Coast Guard, and the Tampa Bay Estuary Program. Several private research groups (SRI International is among them) are colocated in this research cluster. Together, the various ventures located on and adjacent to the peninsula make up the C.W. (Bill) Young Marine Science Complex (Fig. 1). This center of activity affords many exciting opportunities for basic and applied research and for graduate and professional education in marine science, engineering, and resource management. Approximately 700 people are employed here, making Saint Petersburg one of the largest marine science research complexes in the southeastern United States.

The rapid transformation of the USF marine science program is a tribute to the significant science, new knowledge, and important technological advances generated through collaborations of our faculty with many different groups: colleagues from other agencies and universities around the state, the nation, and the globe; other colleges of the University of South Florida; community business leaders (especially the Saint Petersburg Downtown Partnership); the City of Saint Petersburg (mayor, council, staff); a host of private citizens; members of Florida's legislature; federal government agencies; and the White House and Congress. A particular champion of the marine science cluster has been U.S. House of Representatives Congressman C.W. (Bill) Young.

GROWTH THROUGH ACCOMPLISHMENTS

Among the many highlights of the growth of USF CMS, several stand out. The first big boost came in 1978 when the Board of Regents of the Florida State University System (SUS) designated



Fig. 1. Saint Petersburg Training Station circa 1942. View of training station from the sea. Vessel on left is the *TV Tusitala*; the *TV Vigil* is on the right.

the department an SUS “Center of Excellence.” Each state university received one—and only one—of these designations. For us, it led to the near doubling of the faculty because it prompted the Florida legislature to give us permission and funds to hire eight new faculty.

Another milestone came in 1982, when the Florida Board of Regents established our independent Ph.D. program (we could only grant M.S. degrees before then). That program per-

mitted us to recruit higher caliber graduate students and thus greatly enhance the level of our oceanographic research. The ensuing expansion rapidly revealed a lack of laboratory and office space, and, after much effort, the State of Florida was persuaded to create a unique facility that nearly doubled the laboratory and office space available to the Marine Science Department. The resulting structure was jointly constructed by the SUS and the General Services Administration of Florida and would be jointly shared by the Marine Science Department and the state’s Department of Environmental Protection’s (DEP) Florida Marine Research Institute (which then became the Florida Fish and Wildlife Conservation Commission’s [FWC] FWRI in 2004 by legislative rearrangement of the FWC and the DEP) (Figure 2).

A prime component of the “joint” research facility was a satellite data facility that led, among other things, to our being able to take a leading position in U.S. satellite oceanography and coupled physical–biological numerical modeling. This greatly expanded research on the functioning of marine ecosystems. Completed and occupied in 1994, the space allotted to marine science was designated as the Knight Oceanographic Research Center (KRC) to honor the support of the William Knight family (see below). The additional space allowed us to hire more faculty and enhance student research efforts.

In 1993, CMS set up physical oceanography real-time system (PORTS) in partnership with NOAA and the Tampa Bay Harbor Pilots Association. This system of moorings and instrumented locations around Tampa Bay has provided critical data on currents, winds, tides, and other parameters to all marine interests. This program is valuable to the shipping industry as well as to the science of ocean monitoring—



Fig. 2. The C.W. (Bill) Young Marine Science Complex in the City of Saint Petersburg, FL. CMS of the University of South Florida is housed in the large T-shaped building on the Bayboro Peninsula (bottom half of the photograph) and in the three-story building shown in the upper right side of the photograph. The Fish and Wildlife Research Institute is also housed on the peninsula (left side of the photograph), and the USGS facility is shown in the upper left of the photograph.

leading, for example, to a greater than 60% reduction in the frequency of vessel groundings in the bay. After the west coast of Florida was ravaged by an undetected (“no-name”) severe storm in 1993, the experience of USF Marine Science in monitoring physical circulation and meteorological processes helped to persuade the State of Florida to fund the West Florida Shelf Coastal Ocean Monitoring and Prediction System (COMPS). In 1993, the department installed its first satellite-tracking antenna to download real-time imagery from space-based ocean-observing instruments; a second antenna was built on the Bayboro Peninsula in 1998, providing the capability to track NOAA and National Aeronautics and Space Administration (NASA) satellites covering the Gulf of Mexico, Caribbean Sea, U.S. East Coast, and part of the eastern tropical Pacific Ocean. These programs provide real-time imagery and data to researchers and the public on a 24 hour a day, 7 day a week basis.

Combined with our faculty’s impressive scientific credentials and scientific leadership, this infrastructure greatly facilitated our participation in the Southeast Coastal Ocean Observing Regional Association (SECOORA), the Gulf of Mexico Coastal Ocean Observing System (GCOOS), and the Caribbean Sea Regional Association (CaRA). The data produced in near real time also serve these elements of the U.S. Integrated Ocean Observing System.

In 1994, the Florida legislature provided funding for engineering positions at the Center for Ocean Technology (COT). This center is now a premier site for the development of ocean sensors for use in moorings and underwater vehicles. Its expansion included the establishment of a national center for microelectromechanical systems technology (MEMS) and the development of ocean sensors for Homeland Security. Because of the success of COT, the renowned SRI Corporation, located near Stanford University, established SRI International in Saint Petersburg to develop marine-related research and pursue marine technology solutions. SRI International thus became part of the C.W. (Bill) Young Marine Science Complex.

In 2009, CMS acquired Florida’s newest oceanographic research vessel, the R/V *Weatherbird II* (Fig. 3). This 115-foot, 194-ton vessel was purchased by USF for \$2.1 million for use by the FIO, a consortium of Florida’s public universities, private higher education institutions, and state agencies involved in marine research.

In 2010, the college further expanded its science footprint on the USF Saint Petersburg campus with a new Science and Technology facility planned jointly with the USF Saint



Fig. 3. The R/V *Weatherbird II*.

Petersburg campus and CMS. Approximately one half of the laboratory space in this new building is reserved for the college, and the college shares the classroom space with USF Saint Petersburg. Laboratory space for a new program in Marine Resource Assessment in the college will be mainly located in the new structure. Also the CMS outreach program, Oceanography Camp for Girls, will have storage and classroom space in the new structure.

These are only a few of the highlights of the very dynamic evolution of CMS. Over the years, our faculty members, staff, and students have led and participated in many prestigious national and international research expeditions and programs. We have provided leadership in scientific education at the graduate level using this infrastructure and capacity and we have established important workforce training and public outreach programs that link our scientific endeavors with resource management and public education. Among the scientific programs that CMS has participated in and remains engaged in are the Integrated Ocean Drilling Program, the International Marine Past Global Changes Study, the Integrated Ocean Observing System and several regional associations including the SECOORA, the GCOOS, and CaRA, the Ocean Observatory Initiative, the Global Ocean Ecosys-

tem Dynamics (GLOBEC), the National Ocean Partnership Program, the Tropical Ocean-Global Atmosphere and Tropical Atmosphere-Ocean program, the Carbon Retention in a Colored Ocean (CARIACO) Time-Series project, the Bermuda-Atlantic Time-Series Study, and many more. The CMS also was funded to provide nutrient analyses for the hydrography portion of the World Ocean Circulation Experiment.

In addition to the fundamental research conducted around the globe on shelf waters, coastal and estuarine waters, the deep ocean, and watersheds, CMS also researches socially relevant issues such as long-term sea-level rise, coral reef demise, recent paleoclimate change, ocean acidification, harmful algal blooms, fisheries management, water quality, shoreline change, oil drilling and the *Deepwater Horizon* Gulf of Mexico crisis, navigation, and various aspects of national and international security. Many of these investigations have led to the invention of new technologies and methodologies at the College's Center of Ocean Technology. Of particular note is the development of new technologies for moorings, unmanned underwater vehicles such as gliders and remotely operated vehicles, and data gathering via satellites. Our very active real-time satellite data system receives and processes data and then distributes it to the public. Our program has been at the forefront of marine environmental monitoring since the early 1980s.

Our faculty are active contributors to international and national proposal review panels, workshops, and investigation teams including the Ocean Studies Board; various National Research Council committees; NASA, NOAA, and USGS Earth observing planning teams (i.e., MODIS, SeaWiFS, GRACE, *Topex/Poseidon*, *Jason*); the University National Observatory System; and the presidential blue-ribbon U.S. Commission on Ocean Policy.

FUNDING THE RESEARCH

Research funding in marine science has grown since the Marine Science Institute was established in 1967. After growing slowly to \$7 million/yr in 1995–96, it increased to \$9–11 million/yr in 1999–2000, and then nearly doubled in 2000–01. The college now receives a significant portion (over 85%) of its research funding from federal sources and has established itself as a premier research entity within the university. Overall, the university receives about 48% of its external funding from federal sources, and CMS is one of the largest recipients of federal funding at USF.

GRADUATE STUDIES

CMS offers M.S. and Ph.D. degrees with specializations in biological, chemical, geological, and physical oceanography, as well as a brand-new additional focus area in marine resource assessment. Students are trained in an interdisciplinary manner. Both M.S. and Ph.D. candidates are required to complete a core course program covering the four basic oceanographic disciplines. Requirements for the M.S. degree include 32 credit hours of course and research work and defense of a thesis that makes an original contribution to oceanography. Candidates for the Ph.D. must complete 90 credit hours of course and research work, successfully complete written and oral comprehensive examinations, and defend a dissertation that represents a publishable contribution to marine science.

As part of a variety of national and international programs supported by the National Science Foundation (NSF), NOAA, NASA, the U.S. Navy, and other federal agencies, state agencies, and various private entities, students have participated in basic and applied research in the Pacific, Atlantic, Indian, and Antarctic oceans; the Gulf of Mexico; and the Caribbean, Norwegian, Arabian, and Bering seas.

One of the primary goals of the college has been to recruit excellent students by ensuring competitive stipends, fellowships, scholarships, and graduate assistantships. In addition to a substantial number of grant-supported graduate assistantships, today CMS awards 14 endowed fellowships. The college's premier fellowship, the Knight Fellowship, is awarded to an outstanding Ph.D. student applicant; it provides a yearly stipend plus expense funds and remains in force until the student graduates. The remaining 12 fellowships are awarded for an academic year. The Getting Fellowship—named in memory of Paul Getting, who greatly assisted the development of the Marine Science program at USF—honors outstanding first-year marine science graduate student applicants. The C.W. (Bill) Young Fellowship recognizes the support of Congressman Young for the Marine Science program and is given to a student working closely with the engineering group housed in the college's Center for Ocean Technology. The Lake Fellowship is given in memory of John B. Lake, publisher of the *Saint Petersburg Times*, who was instrumental in the advancement of marine science at USF. The Garrels Fellowship is awarded in memory of faculty member Robert Garrels, a world-renowned geochemist and member of the U.S. National Academies of

Sciences. The college also awards Gulf Oceanographic Fellowships, the Coastal Science Fellowship, and the Sanibel-Captiva Shell Club Fellowship. Von Rosenstiel Fellowships are reserved for first-time marine science graduate students. There is also the Murtagh Fellowship and the Parrot-Head Fellowship. The Riggs Fellowship was named to honor the late Carl Riggs, a past USF vice-president for academic affairs and a champion of marine science at USF. The Wachovia Bank Fellowship is reserved for an outstanding first-year student.

The endowed Sackett Prize, named in honor of the late Department of Marine Science Chair William Sackett, is given to a Ph.D. alumnus in recognition of outstanding research achievement.

CMS also has implemented several fellowship programs to recruit underrepresented minorities. Particularly relevant are the Bridge to the Doctorate fellowships funded by the NSF and the fellowships provided by the Alfred P. Sloan Foundation Minority Ph.D. Program to students who are beginning their doctoral work. The college has dedicated additional funds as a match to these programs to attract even more underrepresented minority students.

Since its inception, the Marine Science program at USF (first as a department and then as a college) has produced 483 graduates (145 Ph.D. and 337 M.S.). In 2003, the university administration committed funds to support a review of the Marine Science Ph.D. program. As part of that review, a self-study was conducted that provided some interesting results concerning our Ph.D. graduates, who numbered 92 at the time. Of the 92 graduates, professional information was obtained on 87 (or 95%). Thirty-three (or 36%) had become faculty members or researchers at universities. The institutions where they worked were quite diverse: Penn State, Cal Tech, University of Mississippi, Eckerd College, Saint Petersburg College, University of California at Irvine, University of Georgia, University of West Florida, Skidaway Institute, Florida Gulf Coast University, East Carolina University, University of Maine, University of Maryland, University of North Carolina (Wilmington), and SUNY, among others. Four of these universities were in foreign countries (three in Korea and one in Brazil). Eleven of the more recent graduates had postdoctoral positions (five at USF, and six external). Seven graduates were research associates (six at USF, one external). Three worked at private research institutions. Twenty (or 22%) worked in research-oriented agencies such as NOAA, Environmental Protection Agency (EPA), USGS, and

the state's FWRI; 15 of those 20 worked in federal agencies, and 5 in state agencies (in Florida and elsewhere). Eleven graduates worked in private businesses, most of which were oriented toward environmental research. Two had gone on to become licensed in and practice other professions. We learned that the majority of graduates moved out of state to achieve their professional goals, but 40 (or 43%) remained in Florida. In summary, it was clear that the vast majority of marine science Ph.D. graduates were indeed professionally applying their education. They continued to make original contributions to knowledge as well as transmit their knowledge to students and colleagues. A respectable number of them have become involved with practical applications of ocean science.

OUTREACH

In 1991, the Department of Marine Science established its Oceanography Camp for Girls. This summer program recruits girls transitioning from middle school to high school for a summer camp focused on coastal and ocean sciences. Its goal is to engage these girls in the wonders and vitality of science at a critical time in their lives, when they are developing lifelong interests. This ongoing science outreach project has been very successful, with hundred of girls experiencing the thrill of research in a supportive environment. It led to a much larger outreach effort involving telecasts to middle schools around the world (Project Oceanography) and establishing a Center for Ocean Sciences Education Excellence (COSEE), which were active during much of the 1990s through 2005. In 2010, the NSF funded the Coastal Area Climate Change Education program as a collaboration between USF, the University of Puerto Rico, the Tampa Bay Aquarium, and the Hillsborough County School System. The goal of this effort is engaging stakeholders in an educational planning effort focused on the impacts of climate change in low-lying coastal areas of Florida and the Caribbean. In addition to these programs, most of the laboratories in all disciplines conduct regular internship and teacher training programs.

MILESTONES

Some of the major milestones in the evolution of USF's CMS and its associated research complex in Saint Petersburg are presented below:

- 1967. Three faculty appointed to staff USF's Marine Science Institute.

- 1970. The first set of midwater micronekton and zooplankton are taken from a standard station in the open Gulf of Mexico by Tom Hopkins. This food web has been studied for over 30 yr, making it one of the most intensely studied food webs in the ocean.
- 1970. First NSF grant awarded to the department.
- 1971. Formation of the Marine Science Department complete.
- 1972. First contract from the Office of Naval Research (ONR) is awarded to the department.
- 1978. Florida Board of Regents designates the department as a “Center of Excellence.”
- 1979. Florida legislature allocates funds for eight new faculty positions.
- 1980. Robert M. Garrels (geochemist and member of the National Academy of Sciences) joins the faculty.
- 1982. Florida Board of Regents approves stand alone Ph.D. program in marine science at USF.
- 1982. Saint Petersburg Progress endows a faculty chair in marine science.
- 1982. First fellowship for a marine science graduate student established by Nelson Poynter Fund in honor of John B. Lake, publisher of the *Saint Petersburg Times*.
- 1985. William Knight family provides department with its first endowed fellowship for a marine science graduate student. Subsequently, the Knight family endows six more fellowships for graduate students.
- 1986. Gulf Oceanographic Charitable Trust endows two fellowships for marine science graduate students and USF receives the first matching funds (\$100,000) from Florida’s new major gifts program.
- 1988. The USGS selects USF as the home for its new Saint Petersburg Coastal and Marine Science Center and establishes a cooperative with USF.
- 1988. City of Saint Petersburg provides land and a new research facility for USGS (substantial laboratory renovations are financed by Saint Petersburg’s business community).
- 1988. Florida’s legislature provides funds for six new marine science faculty positions.
- 1988. *Saint Petersburg Times* endows Eminent Scholars Lecture Series.
- 1991. Ground-breaking for new joint research facility (140,000 ft²) to serve Florida’s Department of Environmental Protection and Department of Marine Science (USF).
- 1991. The department sponsors its first Oceanography Camp for Girls.
- 1993. In conjunction with Pinellas County and the Tampa Bay Harbor Pilots Association, PORTS is funded and begins producing physical data on Tampa Bay that is updated every 6 min, round the clock.
- 1993. First satellite ground-data receiving station installed.
- 1994. Florida legislature provides funds for five engineering positions to establish the COT within the Department of Marine Science.
- 1995. The CARIACO Ocean Time-Series Program is established.
- 1995. CMS faculty, staff, and students begin collaborative research within the Cariaco Basin Oceanographic Time-Series Program (CARIACO).
- 1996. First live satellite television broadcasts for Project Oceanography are transmitted to middle schools throughout the United States.
- 1997. The Florida Legislature initiated funding for COMPS, an ongoing program that, in combination with NOAA, monitors and models important physical processes on the West Florida Shelf for both scientific purposes and to provide guidance for commercial activities and for the management of ocean hazards by various state and local governmental agencies.
- 1997. USGS dedicates a second research facility (Getting Building) to accommodate their expanding coastal programs.
- 1997. Multiagency (ONR, NOAA, NASA, EPA), multi-investigator study of Florida’s western coastal ocean begins the Ecology and Oceanography of Harmful Algal Blooms (ECOHAB).
- 1999. USF establishes a Science Journalism Center consisting of a partnership between the Department of Marine Science and the College of Mass Communications.
- 2000. CMS created, with Peter R. Betzer named Acting Dean.
- 2000. Participation of CMS faculty, students, and staff in the Southern Ocean GLOBEC research effort begins.
- 2000. Florida legislature provides funds for eight permanent positions for engineers involved in MEMS research initiative within COT.
- 2001. Peter R. Betzer named permanent Dean.
- 2001. Faculty member Frank Muller-Karger nominated and appointed to the U.S. Commission on Ocean Policy by President G.W. Bush.
- 2002. CMS receives a 3-yr GK–12 Fellowship Award from NSF to foster the interaction between ocean scientists and public schools through fellowships to support CMS graduate students working and teaching in the schools.
- 2002. CMS receives a COSEE grant from NSF.

- 2003. Faculty reaches 30, including two African Americans.
- 2003. College becomes a member of the Consortium for Oceanographic Research and Education and the Joint Oceanographic Institutions.
- 2006. CMS receives \$8.5 million grant for advanced instrumentation from the Florida Technology, Research, and Scholarship Board (HB 1237; Florida House of Representatives: 2006 Legislative Session).
- 2009. Purchase of the R/V *Weatherbird II*.
- 2010. Inauguration of the joint USF Saint Petersburg–USF CMS and Technology building on the USF Saint Petersburg campus.
- 2010. Significant engagement in the response and study of the oil spill disaster of the British Petroleum *Deepwater Horizon* platform.

THE FACULTY AND THEIR RESEARCH

Cameron H. Ainsworth (Assistant Professor), Ph.D., University of British Columbia, 2006. Marine ecosystem-based resource assessment and modeling.

Peter R. Betzer (retired, Emeritus Professor, Marine Science Chair and Founding Dean of the USF CMS), Ph.D., Rhode Island, 1971. Chemical oceanography, chemical tracers, pollutant transfer, particle fluxes, role of organisms in modifying chemistry of seawater.

Norman J. Blake (retired, Emeritus Professor), Ph.D., Rhode Island, 1972. Ecology and physiology of marine invertebrates, inshore environmental ecology and pollution, reproductive physiology of mollusks and crustaceans.

John C. Briggs (retired, Marine Science Chair and Emeritus Professor), Ph.D., Stanford University, 1952. Ichthyology and marine zoogeography.

Mya Breitbart (Assistant Professor), Ph.D., University of California, San Diego/San Diego State University, 2006. Biological oceanography. Molecular techniques including metagenomic sequencing, diversity, distribution, and ecological roles of viruses and bacteria in a wide range of environments—including seawater, marine animals, coral reefs, and reclaimed water.

Robert H. Byrne (Distinguished Research Professor), Ph.D., Rhode Island, 1974. Chemical oceanography, physical chemistry of seawater, ionic interactions, marine surface chemistry, oceanic CO₂ system chemistry.

Kendall L. Carder (retired, Emeritus Professor), Ph.D., Oregon State, 1970. Physical oceanography, ocean optics, suspended-particle dynamics, instrument development, ocean remote sensing.

Don P. Chambers (Associate Professor, Physical Oceanography), Ph.D., University of Texas at Austin, 1996. Satellite observations including radar altimetry and satellite gravimetry, ocean dynamics.

Paula G. Coble (Associate Professor), Ph.D., MIT (Woods Hole Joint Program), 1990. Chemical oceanography, marine organic geochemistry, fluorescence and remote sensing of dissolved organic matter in seawater.

John Compton (Assistant Professor, moved to University of Cape Town, South Africa, 1996), Ph.D., Harvard, 1986. Inorganic geochemistry.

Kendra Daly (Associate Professor), Ph.D., Tennessee, 1995. Biological oceanography, marine plankton dynamics, influence of physical forcing on biological variability, role of marine biota in biogeochemical cycles.

Hugh DeWitt (moved to University of Maine, deceased), Ph.D., Stanford University, 1966. Marine ichthyology.

Jacqueline Dixon (Dean, CMS), Ph.D., California Institute of Technology, 1992. Volcanology and geochemistry of magmatic gases, igneous petrology.

Larry J. Doyle (Professor, deceased), Ph.D., USC, 1973. Marine geology, sedimentology, sedimentary processes of the continental margins.

Kent A. Fanning (Professor), Ph.D., Rhode Island, 1973. Chemical oceanography, pore-water geochemistry, nutrients in the ocean, marine radiochemistry.

Benjamin P. Flower (Associate Professor), Ph.D., University of California, Santa Barbara, 1993. Paleooceanography, paleoclimatology, isotope geochemistry, global climate change.

Boris Galperin (Associate Professor), Ph.D., Technion (Israel), 1982. Physical oceanography, boundary layers, turbulence, renormalization group theory, numerical modeling of oceanic circulation.

Robert Garrels (Professor, Member National Academy of Sciences, deceased), Ph.D., Northwestern University, 1941. Geochemistry.

Giselher Gust (Associate Professor, moved to the Technical University Hamburg, Hamburg, Germany, 1992), Ph.D., CO₂ dynamics, ocean turbulence, particle dynamics.

Pamela Hallock-Muller (Professor), Ph.D., University of Hawaii, 1977. Micropaleontology, paleoceanography, carbonate sedimentology, coral reef ecology.

Albert C. Hine (Professor), Ph.D., University of South Carolina, 1975. Carbonate sedimentology, coastal sedimentary processes, geological oceanography, sequence stratigraphy.

William T. Hogarth (Dean, 2007–10, CMS), Ph.D., North Carolina State University, Raleigh, NC, 1976. Former Assistant Administrator for Fisheries National Marine Fisheries Service NOAA/Department of Commerce.

David J. Hollander (Associate Professor), Ph.D., Swiss Federal Institute of Technology, 1989. Isotopic biogeochemistry, molecular organic geochemistry, carbon cycling in modern lakes and oceans, paleolimnology and paleoceanography, chemical sedimentology.

Thomas L. Hopkins (retired, Emeritus Professor), Ph.D., Florida State University, 1964. Biological oceanography, marine plankton and micronekton ecology, oceanic food webs.

Peter A. Howd (now at USGS, Assistant Professor), Ph.D., Oregon State University, 1991. Beach and inner-shelf processes, beach morphodynamics, wave-driven processes on coral reefs.

Michael Howell (Associate Professor, moved to Green Room Presents), Ph.D., University of South Carolina. Marine geology.

Chuanmin Hu (Associate Professor, Optical Oceanography), Ph.D., University of Miami, Physics Department, 1997. Ocean optics, river-ocean interactions, carbon cycling, algal blooms, coral reef environmental health and ecosystem connectivity, climate change and anthropogenic influence on coastal/estuarine water quality.

Harold Humm (Professor and founding Director of Marine Science program, deceased), Ph.D., Duke University. Marine macroalgae and biology.

Mark E. Luther (Associate Professor), Ph.D., University of North Carolina at Chapel Hill, 1982. Physical oceanography, numerical modeling of ocean circulation, equatorial dynamics, air-sea interaction, climate variability, estuarine circulation.

Frank T. Manheim (Marine Science Chair and Professor, moved to USGS in Woods Hole, MA, now retired), Ph.D., University of Stockholm, 1974. Aqueous geochemistry.

David Mann (Associate Professor, Biological Oceanography), Ph.D., MIT/Woods Hole Oceanographic Institution, 1995. Marine bioacoustics with a focus on hearing and sound production in fishes and marine mammals, neural mechanisms of hearing and sound production.

Gary T. Mitchum (Professor), Ph.D., Florida State University, 1984. Physical oceanography, ocean's role in climate variability, physical factors influencing biological variability.

Frank E. Muller-Karger (Professor), Ph.D., University of Maryland, 1988. Marine, estuarine, and environmental science; biological oceanography; remote sensing; nutrient cycles; anthropogenic and climate change impacts on coastal ecosystems.

Steve Murawski (Professor and Downtown Progress–Peter Betzer Endowed Chair), Ph.D., University of Massachusetts—Amherst, MA, 1984. Biological oceanography, population dynamics, marine ecosystem analysis.

David F. Naar (Associate Professor), Ph.D., University of California, San Diego (Scripps), 1990. Marine geophysics, plate tectonics, marine tectonics, midocean ridge processes, physical modeling using molten wax.

John H. Paul (Distinguished Research Professor), Ph.D., University of Miami, 1980. Marine microbiology and genetics, gene transfer mechanisms.

Ernst B. Peebles (Associate Professor), Ph.D., University of South Florida, 1996. Biological Oceanography. Fish ecology, stable isotopes, fish prey interactions.

Thomas Pyle (Associate Professor, moved to NSF, now retired), Ph.D., Texas A&M University, College Station, TX. Marine geophysics.

Ashanti J. Pyrtle (Chemical Oceanography, Assistant Professor), Ph.D., Department of Oceanography, Texas A&M University, 1999. Biogeochemical indicators, past events that have impacted marine, estuarine, and freshwater environments.

Terrence M. Quinn (now at University of Texas—Austin, Associate Professor), Ph.D., Brown, 1989. Paleoclimatology, paleoceanography, carbonate geology, isotope geochemistry.

Joan B. Rose (now at Michigan State University, Associate Professor), Ph.D., University of Arizona, 1985. Water pollution microbiology, risk assessment, coastal water quality, parasites and viruses.

William Sackett (Distinguished University Professor, Marine Science Chair, deceased), Ph.D., Washington University, St. Louis. Stable and radioactive isotope geochemistry in the marine environment.

Sang-Ik Shin (Physical Oceanography, Assistant Professor), Ph.D., University of Wisconsin—Madison, 2002. Climate and climate change modeling.

Christopher D. Stallings (Assistant Professor), Ph.D., Oregon State University, 2007. Marine ecosystem-based resource assessment and modeling.

Sarah F. Tebbens (now at Wright State University, Assistant Professor), Ph.D., Columbia, 1994. Marine geophysics, aeromagnetism, plate boundary processes, triple junction evolution, natural hazard assessment.

Joseph J. Torres (Professor), Ph.D., University of California—Santa Barbara, 1980. Biological oceanography, deep-sea biology, bioenergetics of pelagic animals, comparative physiology.

Edward S. Van Vleet (Professor), Ph.D., Rhode Island, 1978. Chemical oceanography, organic geochemistry, molecular biomarkers, hydrocarbon pollution.

Gabriel A. Vargo (retired, Emeritus Professor), Ph.D., Rhode Island, 1976. Biological oceanog-

raphy; phytoplankton ecology, physiology, and nutrient dynamics.

John J. Walsh (Distinguished Professor), Ph.D., University of Miami, 1969. Continental shelf ecosystems, systems analysis of marine food webs, global carbon and nitrogen cycles.

Robert W. Weisberg (Distinguished Research Professor), Ph.D., University of Rhode Island, 1975. Physical oceanography, equatorial ocean dynamics, estuarine and nearshore circulation studies.

Raymond Wilson (Associate Professor, moved to the California State University, Long Beach, 1998), Ph.D., UCSD—Scripps Institution of Oceanography, 1984. Ichthyology, fish population genetics, molecular evolution.

Qingnong Xiao (Physical Oceanography, Associate Professor), Ph.D., Nanjing University, 1994. Meteorology, assimilation of radar and satellite observations in models for improvement of predictions of mesoscale weather systems.

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