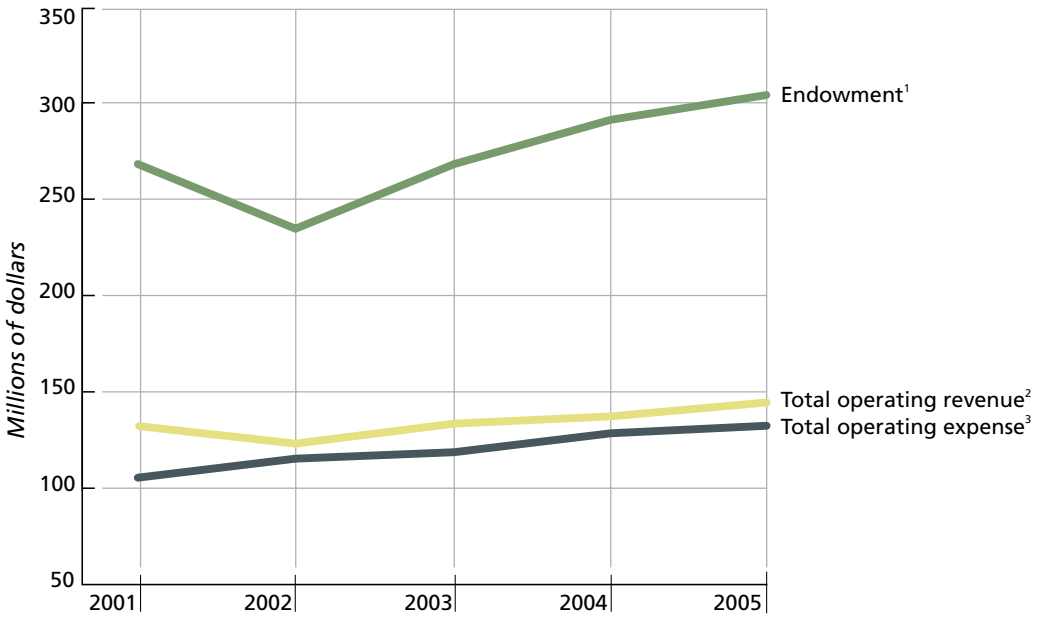
WOODS HOLE OCEANOGRAPHIC INSTITUTION

2005 Annual Report

Financial Trends



The Institution endowment ended 2005 at $305 million, with a 9.8 percent rate of return, outperforming our benchmark.

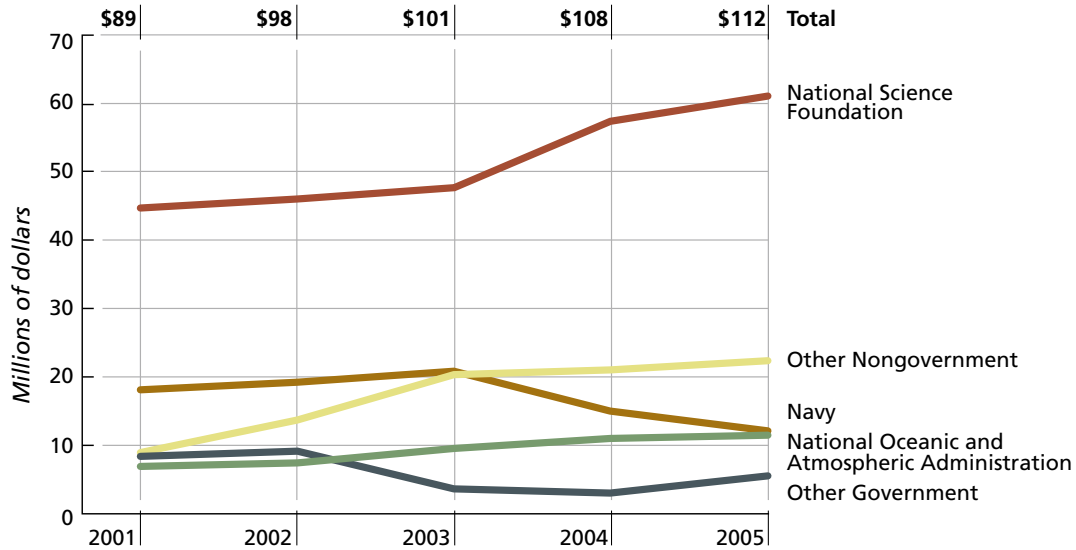
[1]*Endowment comprises cash and securities to provide income for maintenance of the organization. Market value is as of December 31.*

[2]*Total operating revenue is total funding of the Institution's research and education programs, including a component of endowment income appropriated for operations during the financial year ending December 31. See Financial Statements, Note 2, page 36.*

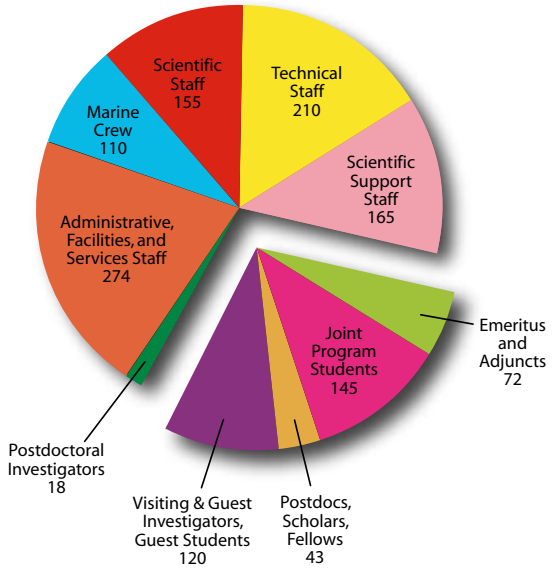
[3]*Total operating expense is cost incurred in support of research, education, and operations during the financial year ending December 31. See Financial Statements, Note 2, page 36.*

Research Funding

Totals in millions of dollars



The $4-million increase in research funding (up 3.5 percent over 2004) was driven mostly by growth in funding from the National Science Foundation and National Oceanic and Atmospheric Administration. Navy funding continues to decline as the Navy increases its emphasis on applied research.



WHOI employees totaled 932 in 2005; others affiliated with the Institution (separate wedge) totaled 380.

Woods Hole Oceanographic Institution is a private, nonprofit marine research and engineering, and higher education organization. Its mission is to understand the oceans and their interaction with the Earth as a whole, and to communicate a basic understanding of the ocean's role in the changing global environment. Established in 1930 on a recommendation from the National Academy of Sciences, the Institution is organized into five scientific departments, interdisciplinary research institutes and a marine policy center, and conducts a joint graduate education program with the Massachusetts Institute of Technology.

Chris Linder, WHOI

Peggy Hammer, UCLA

Front cover: Senior Engineering Assistant John Kemp is lead "sled dog" hauling equipment to deploy an ice-tethered profiler, an instrument that drifts with the pack ice, collecting water temperature and salinity data in the upper 2,600 feet (800 meters) of the Arctic Ocean. The profiler collects data four times per day and relays it via satellite to computers in Woods Hole. The team deploying the instrument in the Beaufort Gyre in August was part of Andrey Proshutinsky's expedition to study the remote waters of this deep Arctic basin.

Back cover: Engineering Assistant Andy Girard (tan pants) and workers lay out a 1-mile (1.5-kilometer) electro-optical cable in Panama, for deployment at an underwater observatory off Pacora Island. Data from the observatory, which connects to the Internet and the Liquid Jungle Laboratory, will help scientists understand mechanisms controlling greenhouse gases and nutrient cycling in the tropics. See the real-time Webcam: http://4dgeo.whoi.edu/panama/.

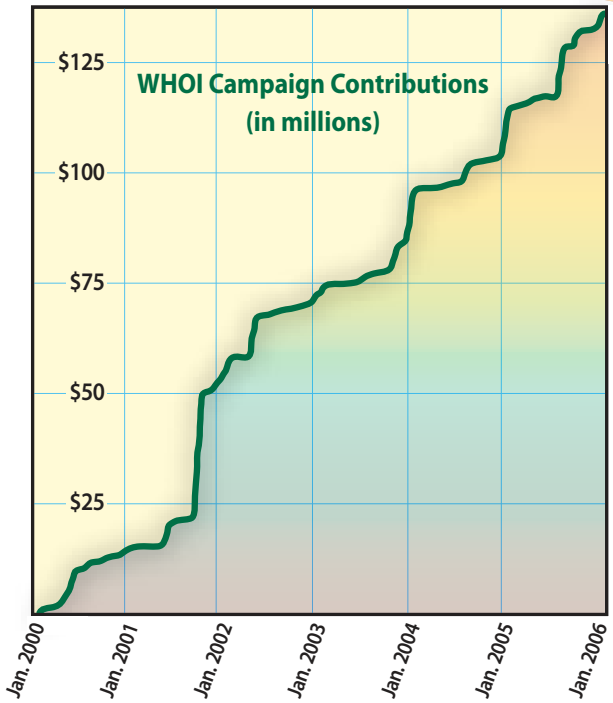
Design and Production: Jim Canavan

Editors: Mike Carlowicz, Shelley Dawicki, Jim Kent, Lonny Lippsett, Kate Madin, Stephanie Murphy, and Amy Nevala

The past year has affirmed a long-term paradigm shift in how our country values basic research. National defense as the driver of ocean sciences is gradually being replaced by a recognition that basic research is an engine for our global economic competitiveness. There are hopeful signs in the proposed increase in National Science Foundation budget for 2007, yet I expect an increasing burden for research support will fall on the private sector.

These trends have been emerging for some time, and we have been rising to the challenge to keep the Institution strong and support its leadership in ocean science research and education. In 2005, we gathered all our efforts under an eight-point plan that forms our roadmap for the near-term. The core of the plan is to improve our cost effectiveness while augmenting strong revenue streams and seeking alternative revenue sources.

$136.1 Million



Our plan

One: I will spend more time in Washington, D.C. advocating for ocean science funding, and making the case for ocean sciences as a driver of economic competitiveness. We have friends on both sides of the aisle, yet if we scientists don't take the lead, no one else will.

Two: The success of our $200-million fund-raising campaign is now more important than ever. At the close of the year we passed the $134-million mark, and we are ramping up our efforts to accelerate the campaign.

Three: Asia is the rising star in basic research, and we are building ties with Singapore, a new player, and strengthening long-standing relations with Japan.

Four: As my focus shifts to Washington and fund-raising, Jim Luyten, Carolyn Bunker, and the other vice presidents are shouldering more internal institutional responsibilities. This transition had been in motion for several years and in 2005 we formalized it, putting Jim Luyten in charge of day-to-day operations.

Five: We implemented a cost-cutting plan for 2006 to reduce overhead expenses and check the effects of spiraling costs for healthcare, retiree benefits, and energy.

Six: Jim Luyten is developing plans to provide more opportunities for applied oceanography, creating an environment that enhances the linkage of interested individual scientists with private industry and government funding streams we have not traditionally pursued.

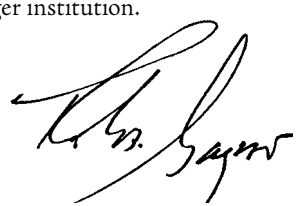
Seven: Related to the applied oceanography effort is a program to further develop industry sponsored research and manage our intellectual property, coordinated by Dan Stuermer, vice president, External Relations. This includes a system to identify and protect ideas generated by our staff, and generate revenue from those ideas.

Eight: Under the leadership of our new dean, Jim Yoder, new opportunities in partnering in undergraduate and graduate education are being pursued.

Tom Kleindinst, WHOI

Bob Gagosian, right, with Jim Moltz, chairman of the Board of Trustees.

This is a challenging environment we are working in today, where we need to do a better job communicating the value of basic science as a long-term investment in our country's health and prosperity. We have weathered rough seas before, and our financial position is strong. I believe that with the implementation of these efforts to control costs and develop new revenue, we will emerge from this period a stronger institution.



The funding system for basic science in this country has become so delicately balanced that a decline in real federal dollars of a few percentage points translates into a large change in the state of mind of our investigators. This is the condition we faced in 2005 and expect to continue for the foreseeable future.

While the Institution's share of federal dollars for ocean science remains stable around 15 percent (which it has been for years), more scientists are competing for a shrinking pie. As a result, investigators that had a funding success rate of three in eight proposals in 2000 are now seeing a success rate of one in eight or lower. Bridge support—institutional funding designed to "bridge" scientists across periods between grants—has risen from $1 million in 2000 to $4 million in 2005. We expect it to reach $6 million in 2006.

For scientists who, for the first time in their careers, are having to take bridge support, it is little consolation that the bridge support problem represents only five percent of our operating budget, and that we already have commitments of more than $100 million from federal agencies for 2006. They rightly see their pain growing in subsequent years, as the start-up of multi-year projects is pushed farther into the future, where the cost of operations will be higher.

The root cause is a steady devaluation of basic, curiosity-driven science as an investment in the future, and the rising role of applied, market-driven research. Mission agencies, such as the National Oceanic and Atmospheric Administration and the Office of Naval Research, are shifting their support to focus on their missions. We are addressing the root cause through advocacy for science in Washington and to the public, and wider promotion of the importance of basic science in addressing societal needs and in creating new markets.

D. Confar/PhotoGraphics Dept., UMass Dartmouth Library

Jim Luyten, right, with (from left) Henrick Schmidt of MIT and Brian Rothschild of the University of Massachusetts, Dartmouth, at a Congressional briefing on marine sciences and technology development opportunities.

Cost-cutting

We continued our administrative hiring freeze in 2005, and extended it into 2006, as well as freezing administrative promotions until a mid-year review in 2006. Since 2004, we cut 19 administrative staff positions, 14 of those by attrition. Reconfiguring pension and medical benefits led to savings of $5 million in 2005.

Applied oceanography

During the Second World War, the vast majority of our work was defense related, and highly applied—from developing smoke screen methods to protect landing parties, to anti-submarine warfare techniques. Today, a galvanizing force is the globalized economy, forcing more companies to seek differentiation through technology development, which plays to our strengths in research and engineering. The question of applied oceanography versus basic science is not an either/or proposition. To me, they can coexist. The question is how we can increase our applied work while maintaining a critical mass of creativity in basic work.

Intellectual property development

A hallmark of the Institution is the collaboration between scientists and engineers, each pushing the other to further innovation, and broadening the horizon of scientific questions that can be pursued. Cape Cod is sprinkled with small companies incubated at our Institution. In the past, our attitude was that we were not in the business of business. Today, we are seeking ways to encourage our most creative engineers and scientists to stay, yet derive revenue for the Institution from our intellectual property by applying structures and mechanisms found at most major universities. Our task is not to change who we are, but find a way to make this effort work in our independent-minded culture.

We have undertaken change of this scale in the past, and kept the soul of the organization strong. We know that when these efforts run their course, the Institution will look different from the way it does today. Yet, if we do this well, the Institution will be even more innovative and a magnet for those who hunger for scientific excellence.

Our research vessels and vehicles had another impressive year of operations in 2005, with nearly 800 days at sea and more than 100 *Alvin* and *Jason* 2 dives. *Atlantis* and *Knorr* were both equipped with new satellite communication systems providing 24-hour Internet access that enhance science activities, enable better ship-to-shore communication for crew and scientists, and provide better education opportunities for students and the public.

In September, a camera mounted on WHOI's remotely operated vehicle *Jason* 2 broadcasted real-time, high-definition video from the bottom of the Pacific Ocean via satellite to a worldwide audience—www.visions05.washington.edu. This demonstration provided a glimpse of the future, when networks of sensors will telemeter data from anywhere in the world's ocean in real-time back to a scientist's laboratory 24 hours a day, 365 days a year.

Despite exciting advances in sea-going technology, the nation's research fleet continues to operate under increasingly difficult conditions. Funds to operate the fleet have been flat since 2004. This, coupled with skyrocketing fuel prices, increasing regulatory requirements, and higher personnel costs have squeezed fleet operating budgets.

As a result, the National Science Foundation will reduce the number of ship days it funds from almost 3,000 days in 2005 to just over 2,000 days in 2006. Ship funding by other federal agencies is also flat or decreasing. This means some funded science programs will be delayed one or two years before going to sea, and most ships will operate on partial-year schedules. The prospects for 2007 do not look much better.

We need to redouble our efforts to persuade decision makers in Washington and the American public of the importance of ocean research, and the necessity of maintaining a strong research fleet to provide researchers with access to the sea.

—Robert Detrick
Vice President for Marine Facilities and Operations

Atlantis and *Alvin*

Days at sea: 241
Cruises: 9
Investigators served: 207
Nautical miles: 22,852
Alvin dives: 82

In January, for the first time, the submersible *Alvin* and the tethered vehicle *Jason* 2 were deployed off *Atlantis* on the same leg in the eastern Pacific to study a deep rift in the seafloor where ocean crust could be observed and sampled. After supporting chemistry, biology, and geology research at the East Pacific Rise, Galapágos Rift, and Juan de Fuca Ridge, *Atlantis* returned at year end to Woods Hole for maintenance. It was a rare homecoming, marking just the third homeport visit since the ship's 1996 launch.

Knorr

Days at sea: 179
Cruises: 5
Investigators served: 96
Nautical miles: 33,093

Knorr spent 8 weeks in early 2005 at a dry dock for installation of new decking and fittings for a 150-foot (45-meter) sediment corer. When complete it will be among the world's longest corers in operation. The vessel went on to log the most miles of the four WHOI vessels. Research took *Knorr* to the western and mid-Atlantic, where scientists conducted climate change studies and deployed moorings. In the equatorial and southern Pacific, scientists sampled the water column and studied currents flowing from the Antarctic.

Oceanus

Days at sea: 241
Cruises: 16
Investigators served: 205
Nautical miles: 29,909

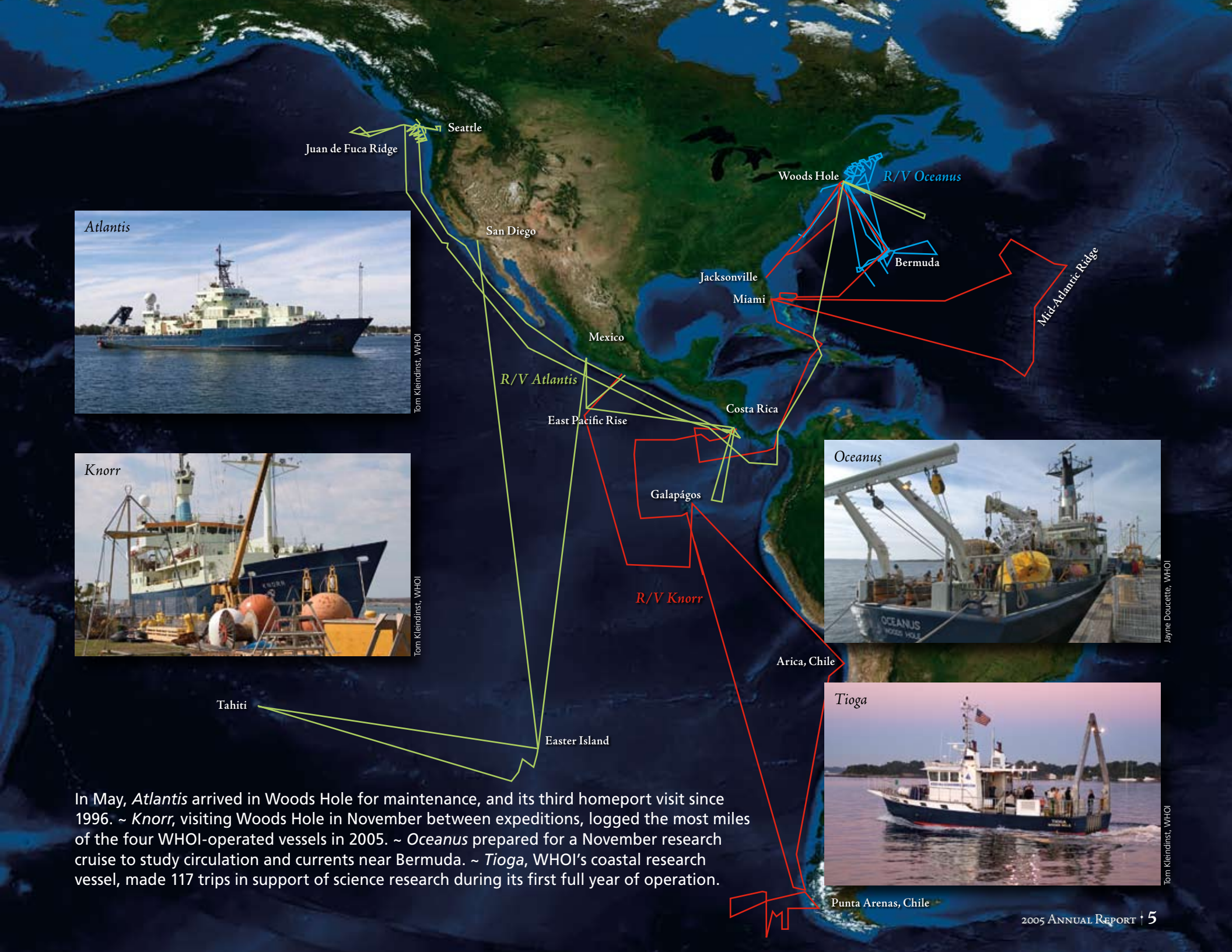
In 2005 *Oceanus* celebrated its 30th year of operations. Researchers on *Oceanus* spent much of the year focused on marine plankton—some menaces, others curiosities. In spring, researchers sailing from Boston Harbor to the Bay of Fundy detected signs of what would become an historic bloom of harmful algae, popularly known as red tide. From June until September the ship carried biologists and physical oceanographers into the Sargasso Sea to study phytoplankton blooms that occur as a result of swirling currents, called eddies.

Tioga

Days at sea: 132
Trips for education: 8
Passengers: 710

The coastal research vessel *Tioga*, launched in 2004, supported its first full year of science research and education efforts in New England, working as far north as the Merrimack River on the New Hampshire border and sailing as far south as the New Jersey coast. The 60-foot (18-meter) vessel proved ideal for engineers testing and deploying oceanographic instruments, including gliders, moorings, and buoys. Biologists used the vessel to scout for and eventually tag and monitor several endangered right whales. In September, one biologist used the vessel 24 miles offshore Nantucket to perform a rare partial whale necropsy at sea.

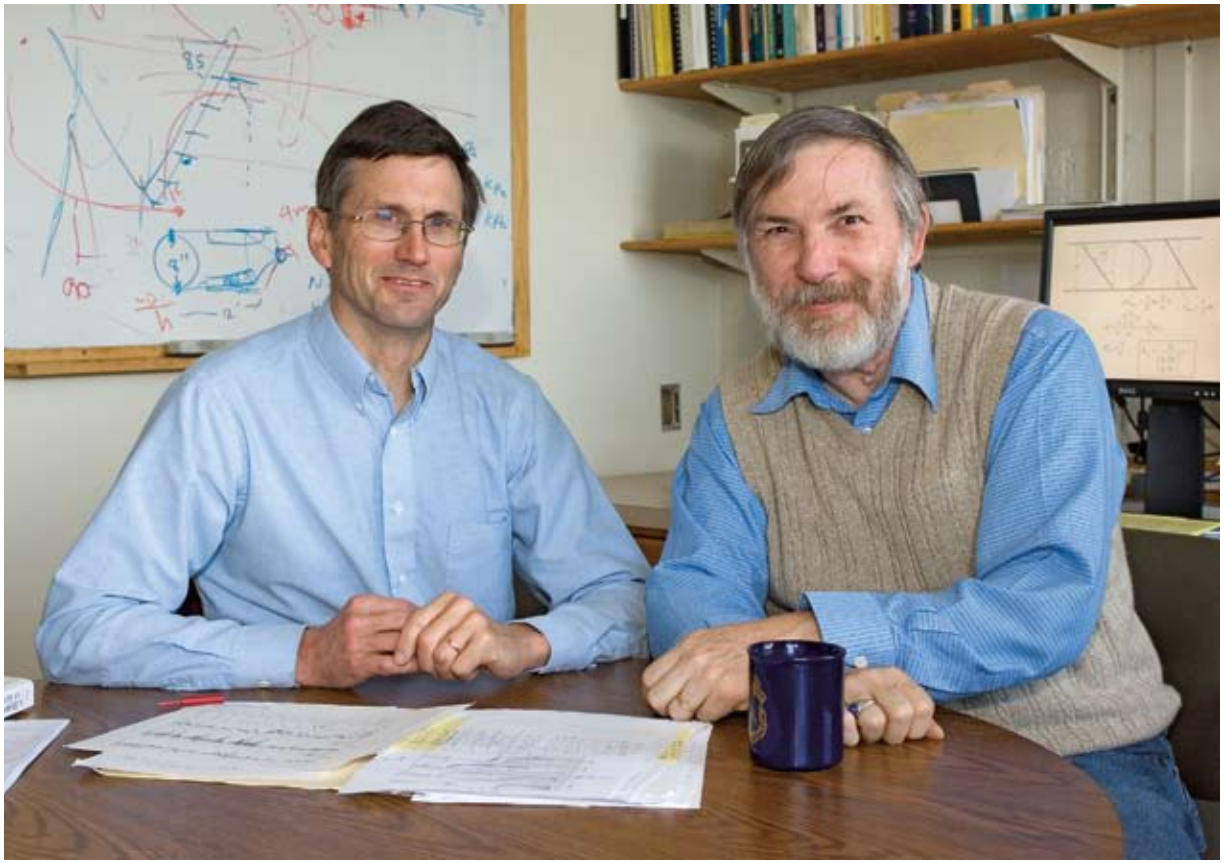
NASA, Earth Observatory



In May, *Atlantis* arrived in Woods Hole for maintenance, and its third homeport visit since 1996. ~ *Knorr*, visiting Woods Hole in November between expeditions, logged the most miles of the four WHOI-operated vessels in 2005. ~ *Oceanus* prepared for a November research cruise to study circulation and currents near Bermuda. ~ *Tioga*, WHOI's coastal research vessel, made 117 trips in support of science research during its first full year of operation.

The Applied Ocean Physics and Engineering (AOPE) Department is one of the foremost departments in the world in producing ocean instruments, sensors, and vehicles. We also take pride in our growing reputation in interdisciplinary ocean science and engineering. The Department's broad spectrum of activities revolves around five central themes: ocean acoustics and signal processing, environmental fluid dynamics, submersible vehicles, observing systems and sensors, and engineering services.

Environmental issues have loomed large in oceanography in recent years, and the 2005 huge red tide bloom in New England waters, which closed shellfish beds from central Maine to Massachusetts, provided a large, societally important issue for oceanographers to deal with. AOPE Associate Scientist Dennis McGillicuddy spent a large amount of his summer mapping this red tide bloom, and, as a result of both his observations and the numerical models he uses to interpret them, was able to contribute significantly to our understanding of how these harmful outbreaks work. Such efforts will hopefully lead to means of mitigation and perhaps even prevention.



Tom Kleindinst, WHOI

Jim Lynch, right, became chair of the Applied Ocean Physics and Engineering Department, taking over from Rocky Geyer, who returns to research.

Surf-zone oceanographers Steve Elgar and Britt Raubenheimer tackled a different coastal problem for the Navy: How do large craters (30 feet wide by 6 feet deep) on a beach—such as those produced by bombardment—erode under wave action? The fieldwork was quite challenging because Steve and Britt had to quickly instrument a hole they dug as the waves worked furiously to destroy their "anti-sand castle."

In acoustics, AOPE scientists Tim Stanton, Dezhang Chu, and others deployed a new broadband acoustic system that allows researchers to both quantify and classify fish populations. This system, which utilizes the acoustic resonances of fish swim bladders as a signal, promises to significantly improve the rapidly growing field of fish population assessment.

In a combination of AOPE's Remote Environmental Monitoring Units (REMUS) autonomous underwater vehicle technology and ocean acoustics, Boston University (BU) Guest Student Jason Holmes and Adjunct Scientist Bill Carey teamed up with AOPE personnel to attach a towed acoustic array to the REMUS vehicle, a smaller version of the systems towed by submarines. This advanced technology has allowed AOPE and BU researchers to carefully characterize ocean bottom acoustic reflectivity properties, and should eventually prove of great value to the Navy's anti-submarine warfare and mine-hunting missions.

Our department's future is determined largely by the new principal investigators we hire, and representing that new blood we welcomed sensor experts Sheri White and Rich Camilli, inverse theorist Gonzalo Feijoo to the scientific staff, and marine archaeologist Brendan Foley to the technical staff. These people represent not just new faces, but new directions for our department, and help keep our department an exciting and innovative place to work. We hope 2005 was just the beginning of a long and rewarding career for them.

—James F. Lynch, Department Chair

Courtesy of Hanu Singh, WHOI

The next generation fish finder

In 1996, Congress passed the Sustainable Fisheries Act, calling for direct action to stop or reverse the continued loss of habitats that fish need to spawn, breed, feed, or grow to maturity. To protect essential fish habitats, you first need to identify them. Therein lies the challenge: how to see through the oceans to find out what's down there?

To assess the abundance and habitats of groundfish such as rockfish, haike, cod, flatfish, and petrali, the NOAA National Marine Fisheries Service (NMFS) has relied on bottom trawling. That method isn't precise and has obvious disadvantages, especially in the rocky seafloor habitats preferred by groundfish. Sonar doesn't work well because it can't easily distinguish fish that bury themselves among rocks.

So NMFS tested an alternative. In 2005, it brought SeaBED, the underwater autonomous vehicle (AUV) developed at WHOI by Hanu Singh and colleagues, to survey seafloor areas proposed for protection off the coasts of Oregon and California.

SeaBED provided high-quality photomosiacs of groundfish habitats (above), giving scientists the ability not only to identify particular species but also to assess their relationships with invertebrates in the ecosystem, said Elizabeth Clarke, director of the NMFS Fishery Resource Analysis and Monitoring Division. Maintaining a constant altitude above the seafloor, SeaBED works well in near-bottom missions and maintains a consistent field of view, which is important for quantitative estimates of fish abundances, she said. The AUV is also cost-effective, because it can cover a 5-to-10-kilometer (3-to-6-mile) transect on a typical six-hour dive, and once SeaBED is deployed from a research vessel, the ship can go off and do simultaneous work to assess habitats.

"We think autonomous underwater vehicles have a lot of potential," Clarke said. So SeaBED will be back for another test in May 2006, this time equipped with a forward-looking (rather than a sideview) camera to improve fish identifications.

—Lonny Lippsett

In 2005, members of the Biology Department conducted research on a broad range of topics, addressing fundamental questions in subdisciplines from population biology and ecology, to the physiology and molecular biology of organisms in the sea. Biological subjects include viruses, bacteria and protists, phytoplankton, zooplankton, fishes, sea birds, and mammals. Questions were pursued in field studies in all the major oceans, in coastal areas and in the deep sea, as well as in model systems in the laboratory. The application of genomic technologies to understand organism function in the sea continues to grow. The development and use of new technologies for observation of organisms and biological processes is a continuing strength of the department. Many studies have practical implications for conservation and resource management. A number of Biology staff are actively involved in developing plans for ocean observatories.

This year saw the completion of two new laboratories on the Quissett campus, with nearly a third of the Biology scientific staff relocating to these buildings. Several of the department's microbiologists have their labs in the new Stanley W. Watson Laboratory, together with members of other departments who are pursuing related studies in biogeochemistry. The Marine Research Facility houses the marine mammal research group and other biologists studying systems ecology and population connectivity. This building also houses the Institution's CT scanning facility.

Promotions and appointments in the scientific staff illustrate the breadth of activities. John Waterbury and Mark Hahn were promoted to senior scientist. Waterbury is renowned for his seminal studies and leadership in marine microbiology. Hahn is a world authority on the molecular effects of chemicals in marine species. Associate Scientist Michael Neubert was awarded tenure this year. His research is in mathematical ecology. He uses mathematical approaches to understand the dynamics of ecological invasions, the ecology and economics of renewable resources, and the responses of ecosystems to disturbance. Tim Shank was promoted to associate scientist. Tim studies deep-sea systems, principally hydrothermal vents and seeps, with the goal of understanding population genetic structure and evolutionary processes. He combines molecular biology of species with ecological variables including physical, chemical, and geological processes.

Two assistant scientists joined the scientific staff last year. Mark Baumgartner is studying the ecology of top-predators in the context of ecology of their prey. His current studies focus on the right whale, and he employs innovative glider technology to observe the behavior of these whales over time. Rubao Ji is studying the dynamic spatial and temporal changes in food webs using coupled biological-physical models, focusing on the lower trophic levels. He also is involved in analysis of zooplankton population changes.

Scientific staff members continue to show high levels of productivity in their own research, and extensive contributions to the broader scientific enterprise, nationally and internationally. The staff provides leadership and other service to federal agencies, scientific journals, universities, National Research Council and other national committees, across the breadth of our departmental strengths (see page 26). Staff members provide leadership of two WHOI Ocean Institutes, the Center for Oceans and Human Health, and the vital fleet committee of the University-National Oceanographic Laboratory System. Such leadership activities benefit our own scientific enterprise, and help maintain the vitality of oceanography.

—John Stegeman, Department Chair

Tom Kleindinst, WHOI

Judy McDowell, right, becomes chair of the Biology Department in May 2006, taking over from John Stegeman, who will focus on directing the Woods Hole Center for Oceans and Human Health (page 22) and on his science. Judy, whose research interest is the physiological ecology of marine animals, has been with the Institution since 1975, most recently as associate dean for Academic Programs.

Mike Vakri, New Bedford Standard Tomes

Boom times for algae and science

The historic 2005 "red tide" of the harmful algae *Alexandrium fundyense* was the most widespread and intense in New England since 1972. Concentrations of toxic algae grew to 40 times the norm, and the tiny plants spread to waters not usually affected by the species, which can cause paralytic shellfish poisoning in humans.

Through a combination of good luck and good planning, WHOI biologists were perfectly positioned to document the event and to collect thousands of samples of algae-filled water and sediment. Funded by the Woods Hole Center for Oceans and Human Health (see page 22), a research team led by Dennis McGillicuddy, Deana Erdner, and Bruce Keafer (far right) went to sea on R/V *Oceanus* in May to examine the environmental conditions and biological phenomena that distribute and disperse *Alexandrium*. After the algae population exploded, NOAA funded the researchers to go back to sea on CRV *Tioga* and other vessels a dozen more times between May and December. Collecting samples here are, from left, summer students Theresa Black and Brenna Mahoney, summer guest student Angie Moliter and research assistant Kerry Norton.

On shore, Erdner, Linda McCauley, Norton, and a corps of students and research assistants in Senior Scientist Don Anderson's laboratory isolated and cultured the cells that wrecked so much havoc, analyzing the genetic and physiological makeup of *Alexandrium* communities from various locations. The study was founded on the idea that, as with humans, a single population is actually composed of different "races" or genotypes.

"We want to know *who* caused this bloom," said Erdner, research associate in the Biology Department. "Did oceanographic and environmental conditions favor the bloom of a certain genotype of *Alexandrium*? So far, it appears that no single genotype dominated, but it's too early to say for sure. We know there was a lot of genetic diversity at the beginning, middle, and end of the bloom."

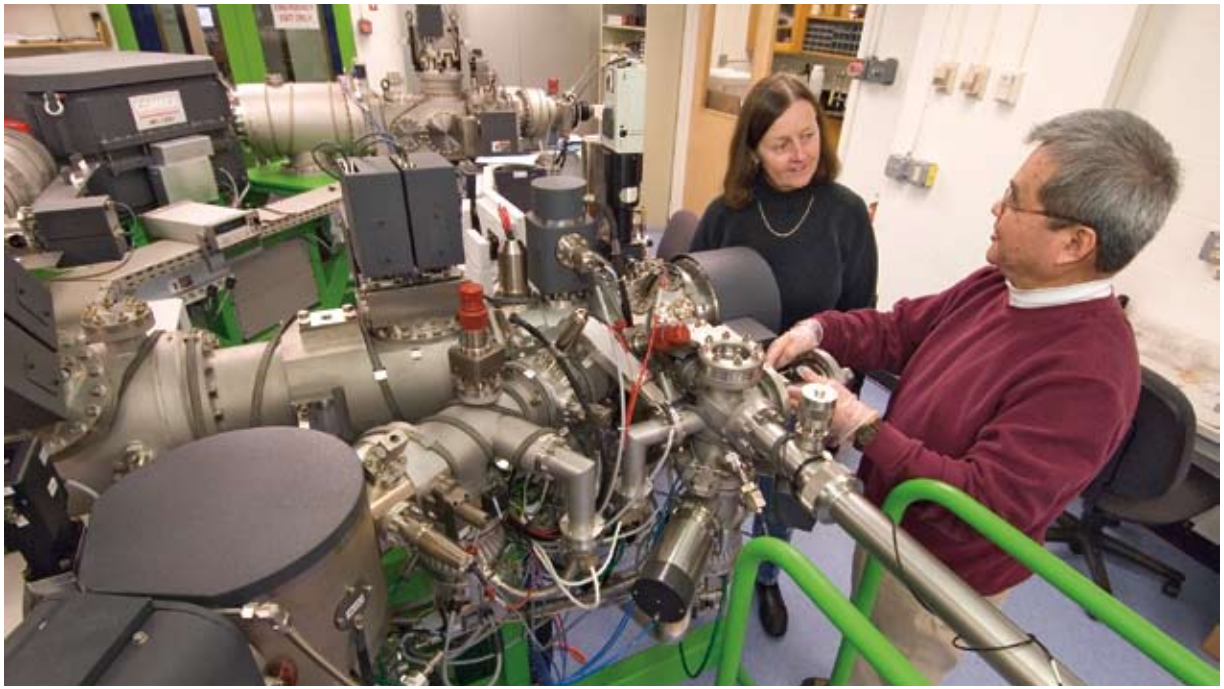
The investigative work will feed into computer models being developed to understand—and eventually predict—the conditions under which a bloom might develop and which type of algae might show up.

—*Mike Carlowicz*

The core strength of the Geology and Geophysics (G&G) Department lies in studies of the geology and geophysics of ocean basins and margins, and the underlying dynamics of the mantle that keep the tectonic plates in motion; the geochemistry of Earth systems, from processes deep within the Earth to interactions between geology and biology; climate change and its relation to ocean circulation; and coastal processes, including climatic effects on coastal systems and extreme events, such as hurricanes.

In 2005, G&G scientists conducted fieldwork around the world, both on shore and at sea. Jian Lin served as a U.S. Chief Scientist and co-led two international cruises on the Chinese research vessel *Dayang 1*. During this first around-the-globe scientific expedition by a modern Chinese research ship, Jian and colleagues discovered new regions of strong hydrothermal plumes in the equatorial East Pacific and Southwest Indian Ocean, and recovered sediment cores to investigate the history of mega-earthquakes and tsunamis near Sumatra, Indonesia. Stan Hart, with MIT/WHOI Joint Program student Matt Jackson and others, explored Vailulu'u seamount, an underwater volcano off Samoa, and discovered a new 1,000-foot (300-meter) volcanic cone in its crater, as well as extensive hydrothermal activity. Joan Bernhard initiated a project with colleagues off the coast of California to examine the effects of ocean disposal of carbon dioxide on benthic foraminifera.

The G&G Department takes pride in having some of the best sampling and analytical facilities in the world.



Tom Kleindinst, WHOI

Three years after damage from an electrical fire shut down the Northeast Ion Microprobe Facility, the ion microprobe was returned to WHOI after being completely rebuilt. It is now installed and operating under the direction of Nobu Shimizu, shown here with Susan Humphris.

Jim Broda is leading the design and implementation of a system that will collect cores up to 150 feet (45 meters) long, thereby accessing sedimentary records back further in time. Sea trials are planned for early 2007. Furthermore, an extension to the core repository has been completed for increased sample storage, and for staging the long-coring system.

At the National Ocean Sciences Accelerator Mass Spectrometry (NOSAMS) facility, which provides carbon 14 analyses to the ocean sciences research community, an extension was built to expand the sample preparation lab and house the new continuous-flow AMS system. In addition, after nine years as director of NOSAMS, John Hayes stepped down and was replaced by Bill Jenkins of the Marine Chemistry and Geochemistry Department.

Five new members of the scientific staff were appointed. Chris German from the National Oceanography Centre, Southampton, U.K. was hired as a senior scientist. His expertise is in the geology and geochemistry of seafloor hydrothermal systems and, as of January 2006, he will take over from Maurice Tivey who has served as Chief Scientist for Deep Submergence for the last year and a half. Two associate scientist appointments will strengthen our seismology group. Dan Lizarralde joined us from Georgia Institute of Technology. A 1997 graduate of the Joint Program, Dan is an active-source seismologist with research interests in continental margin structure, mantle dynamics, gas hydrates, and coastal hydrogeology. Juan Pablo Canales, a marine seismologist who studies ocean crustal structure, was appointed from the technical staff. Two assistant scientists were also appointed: Adam Soule is a volcanologist interested in the physics of lava flow emplacement, and Alison Shaw is a geochemist investigating the use of volatiles as geochemical tracers of cycling of material between the Earth's crust and mantle.

—Susan Humphris, Department Chair

Donatas Pupienis

Climate clues buried on the coast

The dunes along the Baltic Sea coast are telling a story. It's a tale of shifting winds, moving shorelines, and buried fishing villages. Massive mounds of sand are describing 6,000 years of climate change in Europe and perhaps around the world. Coastal geologist Ilya Buynevich is listening.

With sediment samplers and ground-penetrating radar (GPR), Buynevich (right) and Lithuanian colleague Albertas Bitinas (left) are reconstructing the history of the dunes. They are looking for "paleosols"—old soils buried under sand. These layers sometimes poke out as blackened ridgelines. More often, Buynevich and Bitinas find them with GPR signals that pierce the earth and reflect the past (they show up as darker, diagonal lines stretching to the surface in the subterranean map below).

Paleosols reveal the old land surface before windblown sands buried it. Bits of wood, pollen, charcoal, and shells can be dated through radiocarbon techniques; adjacent sands can be dated through optically stimulated luminescence. These geologic archives tell Buynevich about the strength and prevailing direction of Baltic winds at various times, and the climate conditions that caused them. When winds are calm, dunes stabilize and soil and settlements take hold. When winds are fierce and forest fires bare the landscape, dunes move landward, burying the soil and the man-made structures on it. Dating the border between these horizons tells Buynevich when the region's climate changed from warm and stable to cold and stormy.

For thousands of years, castles and villages grew up behind the dunes, protected from the relentless Baltic winds. At least 12 villages were ultimately buried. Buynevich and Bitinas hope to find those bits of human history that reflect natural history.

Buynevich is also studying dunes in Aquinnah on Martha's Vineyard, where conditions are similar. He's keeping an eye on research in Australia to see if the dunes are moving in synch with those in Lithuania and Aquinnah—a telltale sign of global climate changes.

—Mike Carlowicz

Scientists in the Marine Chemistry and Geochemistry Department had another busy year in 2005. Staff members could be found throughout the world's oceans on research cruises, back in the lab analyzing samples and working on new chemical techniques, and using models to understand everything from small-scale geochemical reactions to large-scale global processes. In 2005 four scientists joined the department, adding new and complementary skills.

Marco Coolen arrived from the Royal Netherlands Institute for Sea Research (Royal NIOZ). With his background in organic geochemistry and microbial biology (from the University of Oldenburg in Germany and the Royal NIOZ) he is one of the few investigators in the world who can look back in time at layers of marine and lake sediments and analyze ancient DNA sequences to learn, at the species level, which microorganisms had been living in the overlying waters at that time. Marco is a pioneer in this challenging new field of paleomicrobiology.

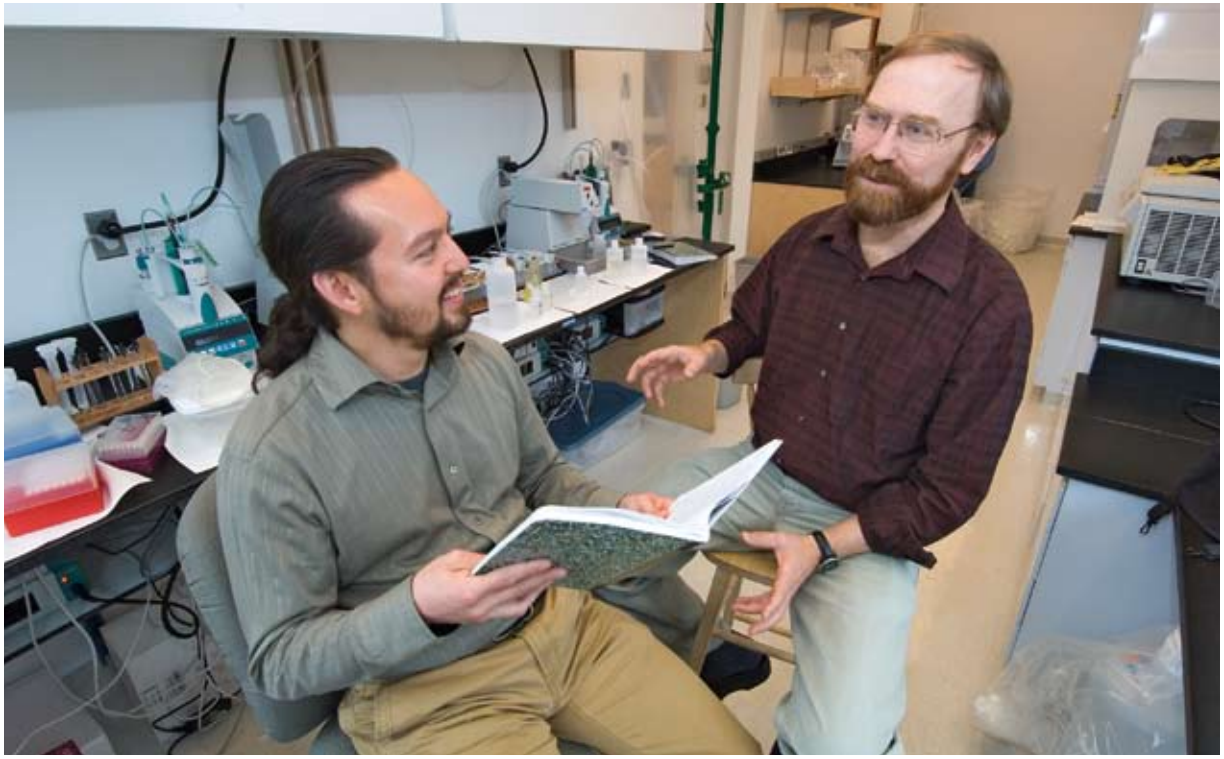
Olivier Rouxel was hired after being one of our WHOI postdoctoral scholars who was sponsored by the Deep Ocean Exploration Institute, having obtained his Ph.D. degree at Institut National Polytechnique de Lorraine in France and worked at the University of Cambridge in England. His area of specialty is the application of metal stable isotopes, which are natural chemical signatures that change slightly depending upon the extent of chemical and biological processing. Using special WHOI mass spectrometry facilities managed by Lary Ball, Olivier has applied his skills in isotope geochemistry to look at hydrothermal systems, marine sediments, weathering of rocks, and the biology and chemistry of the ancient oceans.

Dierdre (DeDe) Toole was also a WHOI postdoctoral scholar sponsored by the Ocean and Climate Change Institute. She came from the University of California, Santa Barbara, where she studied satellite oceanography, modeling, ocean optics, and analytical techniques to measure climate-relevant gases, in particular one called dimethylsulfide (DMS). These combined skills allow her to study the production by marine plankton of DMS, which may influence both the hydrologic cycle and the global heat budget through its role in cloud formation, and may alter rainfall patterns and temperatures.

Laura Robinson comes to us from a postdoctoral position at California Institute of Technology, following her Ph.D. degree from the University of Oxford. Her studies focus on past records of climate change, recorded in the skeletons of deep-sea corals. Her innovative studies allow us to look at deep ocean circulation in the past by measuring chemical signatures in corals bands, in particular carbon isotopic records from corals that are retrieved via deep ocean dredging or directly from research submersibles such as *Alvin*.

These scientists join a diverse MC&G scientific staff that study not just the fundamental chemical properties of the ocean, but who use chemical signatures as tracers to learn more about marine biology, geology, and physics, and more broadly, how the ocean and earth work today as well as in the past. These new scientists are a diverse group, from different fields and different countries, trained in some of the top labs in the world. We wish them well as they embark on fruitful WHOI careers.

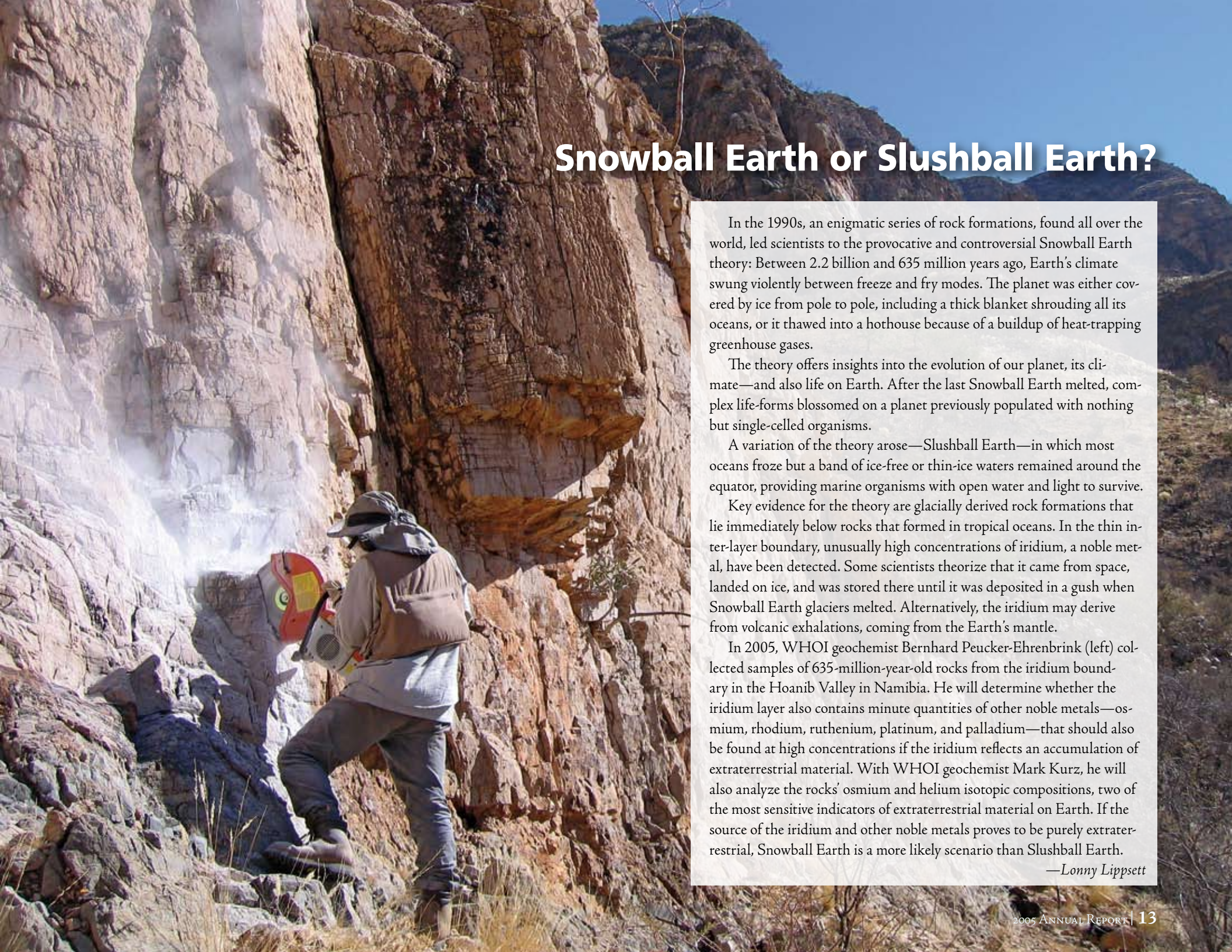
—Ken Buesseler, Department Chair



Tom Kleindinst, WHOI

Assistant Scientist Mak Saito, left, with Ken Buesseler, department chair, in the new trace metal clean lab in the Stanley W. Watson Laboratory. Mak studies trace metals in the oceans, especially their role as micronutrients for marine phytoplankton.

Ricardo Trinidade



Snowball Earth or Slushball Earth?

In the 1990s, an enigmatic series of rock formations, found all over the world, led scientists to the provocative and controversial Snowball Earth theory: Between 2.2 billion and 635 million years ago, Earth's climate swung violently between freeze and fry modes. The planet was either covered by ice from pole to pole, including a thick blanket shrouding all its oceans, or it thawed into a hothouse because of a buildup of heat-trapping greenhouse gases.

The theory offers insights into the evolution of our planet, its climate—and also life on Earth. After the last Snowball Earth melted, complex life-forms blossomed on a planet previously populated with nothing but single-celled organisms.

A variation of the theory arose—Slushball Earth—in which most oceans froze but a band of ice-free or thin-ice waters remained around the equator, providing marine organisms with open water and light to survive.

Key evidence for the theory are glacially derived rock formations that lie immediately below rocks that formed in tropical oceans. In the thin inter-layer boundary, unusually high concentrations of iridium, a noble metal, have been detected. Some scientists theorize that it came from space, landed on ice, and was stored there until it was deposited in a gush when Snowball Earth glaciers melted. Alternatively, the iridium may derive from volcanic exhalations, coming from the Earth's mantle.

In 2005, WHOI geochemist Bernhard Peucker-Ehrenbrink (left) collected samples of 635-million-year-old rocks from the iridium boundary in the Hoanib Valley in Namibia. He will determine whether the iridium layer also contains minute quantities of other noble metals—osmium, rhodium, ruthenium, platinum, and palladium—that should also be found at high concentrations if the iridium reflects an accumulation of extraterrestrial material. With WHOI geochemist Mark Kurz, he will also analyze the rocks' osmium and helium isotopic compositions, two of the most sensitive indicators of extraterrestrial material on Earth. If the source of the iridium and other noble metals proves to be purely extraterrestrial, Snowball Earth is a more likely scenario than Slushball Earth.

—Lonny Lippsett

Research in the Physical Oceanography Department is focused on the description and understanding of the evolving state of the ocean and its interaction with the atmosphere and the Earth, and its impact on climate change. Traditionally, we have identified ourselves with making new observations at sea but our scientists also contribute importantly in theory, numerical and laboratory modeling, and the design and fabrication of new instrumentation.

We continue to work in many parts of the global ocean. This past year has seen scientists from the department on cruises to the Arctic (Peter Winsor, Andrey Proshutinsky), Hudson Strait (Fiamma Straneo), the tropical Atlantic (Al Plueddemann), the eastern Pacific and Hawaii (Bob Weller), the western Pacific (Nelson Hogg and Steven Jayne) and the eastern North Atlantic (Terry Joyce and Mike McCartney). In addition, a major new program called CLIMODE (CLIvar MOde Water Dynamic Experiment) was begun with its inaugural cruise in November. The field phase of this ambitious study of the processes responsible for the formation and maintenance of the relatively homogeneous water mass found on the south side of the Gulf Stream will continue through the end of 2007. It involves a number of people in the department as well as several other institutions.

A major event of 2005 was the hosting of a visiting committee composed of five well-respected physical oceanographers from other American institutions and one trustee. The committee spent most of three days interviewing all members of the staff. They concluded that the "quality of the Department is unassailable: the WHOI Physical Oceanography Department presently remains one of the premier physical oceanography research groups in the world." The keyword is "presently" and in their report, the committee offered 18 recommendations designed to help keep the department at the forefront.

This past year saw the departure of Bernadette Sloyan who returned to her native Australia to pursue her interest in the Southern Ocean. We also hired three new assistant scientists. Leif Thomas comes to us from the University of Washington and has an interest in theoretical aspects of upper ocean physics and its coupling to the atmosphere. Mary-Louise Timmermans was a postdoctoral fellow in the department prior to accepting a position on the scientific staff. Her specialty is Arctic oceanography and she will strengthen our already substantial expertise in this area. Finally, Annalisa Bracco comes to us from the Abdus Salam International Center for Theoretical Physics in Trieste, Italy. Her specialty is numerical modeling, which she uses to gain understanding of problems related to climate variability, and mixing properties of passive (for example, floats) and active (i.e. plankton) tracers.

Four longtime department members retired this year: Marg Pacheco, Chris Wooding, Jack Reese, and Anne-Marie Michaels. Memorials for Dave Chapman and Ryan Schrawder, both of whom died prematurely the previous year, were commemorated. In addition, funds for a lecture series honoring the legacy of Senior Scientist Dave Chapman were secured through private donations and a generous award from the Office of Naval Research. It is expected that the first lecture will occur in the coming summer.

Finally, my term as Chair will end in July 2006. A search committee, headed by Senior Scientist Amy Bower, was formed in late 2005 to choose a new Chair.

—Nelson Hogg, Department Chair

Tom Kleindinst, WHOI

Associate Scientist Dave Fratantoni, left, with Nelson Hogg, confirming that a glider is operational before open-water deployment.

Peter Winsor, WHOI

The ultimate Arctic machine

Arctic research is tough enough above the ice. Now WHOI scientists have figured out a way to learn what's under it.

In July and August, WHOI researchers on a seven-week voyage across the Arctic deployed three experimental, torpedo-shaped floats that drift alone for months below meters-thick sea ice. Their mission—to continually record water temperature and salinity beamed to shore via satellite—is part of an ongoing, multi-nation effort to understand a largely-unknown Arctic current.

Researchers have long puzzled over ways to gather ongoing data about this ice-choked ocean, which is unreachable for part of the year even by icebreaking vessels. Then WHOI physical oceanographer Peter Winsor (below center) teamed up with engineers in the Institution's float group to design a smart, rugged float that Winsor dubbed "the ultimate Arctic machine."

It collects data, occasionally sends it to shore, then resumes its duties—despite jagged sea ice, fierce currents, and freezing water temperatures.

Most of the time it drifts in the water column to depths of 3,000 feet (900 meters). To send data, it pokes its hard, polyurethane-capped antenna above the waves (large photo). If the antenna bumps into surface ice, it simply descends and tries again later.

This winter, as sea ice thickens, two floats have been quiet about sending reports—as Winsor expected. But to his delight, a third continues to send weekly reports from open water between Svalbard (north of mainland Europe) and Franz Josef Land (north of Russia). Winsor, enthused by the team's overall success, continues to develop proposals to seed the Arctic with similar floats.

During the expedition, two ships shared icebreaking duties: the U.S. Coast Guard vessel *Healy* (below left), and the Swedish vessel *Oden* (below right). Both vessels hosted scientists involved in a myriad of Arctic-related research. For WHOI scientist Luc Rainville (far right) it meant dipping an instrument to depths of 14,700 feet (4,500 meters) to measure ocean turbulence. Scientists use that to help determine polar ice thickness, another step in understanding Earth's changing climate.

The National Science Foundation's Office of Polar Programs funded this research. Winsor is a WHOI Ocean and Climate Change Institute fellow.

— Amy Nevela

Martin Jakobsson, Stockholm University

Luc Rainville, WHOI

Peter Winsor, WHOI

Peter Winsor, WHOI

Research and graduate education at WHOI are always closely linked. Scientists, students and postdocs all benefit from an environment where scientists teach and mentor, and researchers and students participate in the observation, experimentation, and theory of ocean sciences and engineering.

This year the Institution's Joint Program with the Massachusetts Institution of Technology awarded 34 master's and doctoral degrees in ocean science and ocean engineering, bringing the degree total to 722. The September commencement ceremony, attended by 22 degree recipients, coincided with WHOI's 75th anniversary celebration, and many alumni/ae returned for graduation and other events. Twenty-five new students enrolled in the Joint Program, bringing the total fall 2005 enrollment to 139.

Thirty-five undergraduate summer fellowships were awarded in 2005 to students from 30 U.S. universities and three international schools. Fellows conducted independent research projects within WHOI research departments, the Marine Policy Center, or the Woods Hole Field Station of the United States Geological Survey. Five of the students will present their results at national science meetings.

In January 2005, WHOI held the first annual Celeste Fowler Memorial Art Show: A Celebration of Life, honoring the memory of Celeste, a Joint Program student and talented artist who died in 2004. The event showcased the artistic talents of current students, including their paintings, photography, woodworking, metalwork, drawings, knitting, quilting, and musical and theatrical performances.

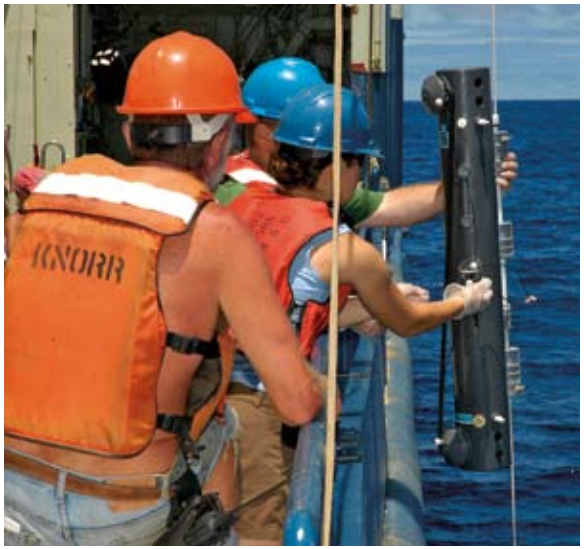
WHOI hosted the biannual Ocean Science Educator's Retreat this fall, featuring opening remarks from RADM Richard West, U. S. Navy (retired), president of the Consortium for Ocean Science and Education; a keynote address by Isaac Colbert, MIT dean for graduate students; presentations on graduate student trends; and a discussion on "Strategies for Enhancing Diversity in the Ocean Sciences."

For the third year, WHOI continued its partnership with New England Aquarium and the University of Massachusetts, in the National Science Foundation funded New England Center for Ocean Science Education Excellence, piloting K-12 formal and informal education activities. We also continued twice-yearly "Topics in Oceanography" teacher workshops, completing the tenth in this series.

In 2005 the WHOI postdoctoral community formed a Postdoctoral Association, whose members represented the postdocs on WHOI committees, organized a day-long WHOI postdoctoral research symposium, and planned career workshops for the spring of 2006.

Tom Kleindinst, WHOI

Dean Farrington, center, with graduating Joint Program students, class of 2005.



Cedar McKay, University of Washington

Joint Program student Anne Thompson, center, with Bosun Peter Liarikos, left, and Jim Moffett with a Go-Flo "clean bottle," used to sample trace metals. The team is studying effects of trace metals on cyanobacteria populations off Costa Rica.

The Joint Program Alumni/ae Association continues to provide valuable support to the Institution, offering advice to current students, providing evaluation of graduate education efforts, and contributing financial support for student research and career activities. This year the Association presidency transferred from James A. Austin, Jr. to Paul V. R. Snelgrove.

In November, John Farrington stepped down after 15 years as dean. To honor John, his colleagues sponsored a day-long symposium on the biogeochemistry of organic compounds in the oceans. Many of John's current and former graduate students attended the symposium. John's legacy includes strong, highly respected and well-run academic programs, excellent students and postdocs, and a wonderful staff. This is a great legacy to inherit, and I will try to build upon this superb foundation.

—James A. Yoder, Vice President for Academic Programs and Dean

The Coastal Ocean Institute (COI) and Rinehart Coastal Research Center promote scientific inquiry into phenomena that shape our coastal waters and ecosystems, encouraging innovative, interdisciplinary research and high-risk technology development. We also strive to translate the results of this basic research for citizens and policymakers, while providing a solid information base for resource managers.

In addition to six research projects initiated in 2005 (see map below), we undertook a wide range of activities to promote and communicate coastal research. We undertook a major expansion of the "current topics" section of our webpage (www.whoi.edu/institutes/coi/topicIndex.do?o=read&id=2) to provide better access to science information. This site now includes in-depth information on such topics as: natural hazards (tsunamis, hurricanes, and other storms); the moving shoreline; harmful algal blooms; coastal pollution; waves, tides, and currents and many others. Within each of these topics, we have provided feature stories and news releases, information on WHOI researchers who are working on the topic, related links, publications, etc. Our goal is to make the COI website a comprehensive resource for relevant information on all major coastal ocean issues, providing information to the public, students, researchers, and journalists.

Tom Kleindinst, WHOI

Don Anderson, right, and Jon Woodruff, a Joint Program student, with a sediment core from Saint Kitts, West Indies, which is part of a study that uses coastal flood deposits to reconstruct how hurricane activity in the Western North Atlantic has varied in response to past changes in climate.

We provided support for two postdocs this year. Rubao Ji is studying processes that control phytoplankton blooms on Georges Bank. Brian White is studying the role of internal waves in the horizontal transport of plankton. We initiated support for a COI Committee Fellow, Carin Ashjian, a biologist who is investigating the effects of climate change on Arctic coastal ecosystems. This fellowship has been funded entirely through the generous donations of COI committee members, allowing us one more fellow than we typically support.

Other COI fellows that we continue to support include John Trowbridge, who is taking a leadership role in the Ocean Research Interactive Observatory Networks (ORION) initiative; Heidi Sosik (jointly funded with the Ocean Life Institute), who works on phytoplankton ecology and biooptics and currently oversees the Martha's Vineyard Coastal Observatory; Jeff Donnelly, a geologist (jointly funded with the Ocean and Climate Change Institute) who is studying climate change recorded in sediments; and Chris Reddy, an organic chemist who studies the source, transport, and fate of organic compounds in seawater. We supported Jon Woodruff, a graduate student in Jeff Donnelly's laboratory (Geology and Geophysics Department), who is working on the geologic signature of major storms and tsunamis.

—Don Anderson, Institute Director

2005 COI Research Project Locations

Flow Cytometer Testing

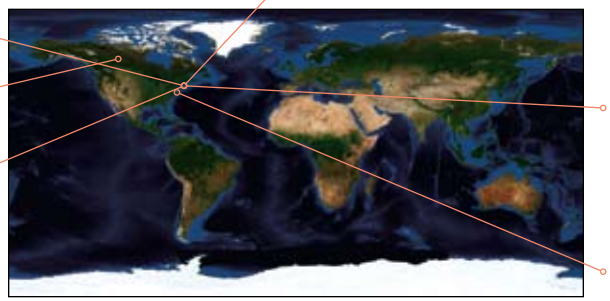
Martha's Vineyard, Mass.: Rob Olson and Heidi Sosik field tested their new submersible instrument for counting and identifying individual microscopic organisms, in order to better understand how coastal plankton communities are regulated. (This project is co-sponsored by the Rinehart Initiative for Access to the Sea Program.)

Climate Change and Carbon Export

Mackenzie River, Canada: Tim Eglinton and Liviu Giosan are studying links between permafrost destabilization and climate change, using organic carbon measurements in water as a marker for the extent of permafrost breakdown.

Modeling Coastal Waters

Martha's Vineyard, Mass.: Ruoying He is using data collected at the Martha's Vineyard Coastal Observatory to prepare a modeling framework to understand, monitor, and predict changes in the coastal ocean environment of that region.



How Does Seawater Infiltrate Coastal Sediments?

Waquoit Bay, Mass.: Ann Mulligan and Alan Gardner are developing a differential pressure data logger for long-term deployment to test the hypothesis that seasonal changes in groundwater elevation drive significant seawater circulation through coastal sediments.

Water Layering and Climate

Chatham, Mass.: Glen Gawarkiewicz is studying wintertime layering changes in offshore Cape Cod waters and the relationship of these changes to atmospheric forcing and their effect on coastal and offshore ecosystems.

Phosphorus and Phytoplankton Blooms

Chesapeake Bay: Sonya Dyhrman is examining dissolved organic phosphorus in a model estuary (the Chesapeake Bay), which ultimately could allow resource managers to target reductions of the most bioavailable phosphorus species.

The Deep Ocean Exploration Institute (DOEI) supports research in a diversity of oceanographic, geological, and technology fields all aimed at better understanding the dynamic planetary processes occurring in the deep ocean and within Earth's interior. These intertwined processes are the pulse of planet Earth. They help regulate where and how magmatism and earthquakes occur, and the evolution of ocean chemistry. They also profoundly influence biological, microbiological, and biogeochemical processes in the deep ocean and within Earth's interior. The development and implementation of innovative technologies that seek to image, sense, and sample remote areas of the deep ocean and Earth's interior are also essential elements of DOEI's mission.

To support these pursuits, in 2005 we funded six new research projects that encompass all of the Institute's research areas involving seafloor observatory science, fluid flow in geologic systems, and Earth's deep biosphere (see map below). Additional DOEI discretionary funding was provided to other researchers and students to help facilitate opportunities for science and engineering. In addition, DOEI currently supports two research fellows (Stan Hart and Greg Hirth, both G&G), one post-doctoral fellow and a graduate student in its efforts to expand the research options available to scientists and engineers in all departments at WHOI.

DOEI-sponsored activities have also included outreach in various forms. In 2005 Dan Fornari met with delegations in the U.S. Congress to discuss the importance of basic research and oceanographic research, and to support increased funding for the National Science Foundation. Dan also presented a keynote address, "Oceanography in the 21st Century," to senior management in the oil and gas industry in Houston as part of an international conference. Public and educational outreach is also a focus of DOEI activity through the Dive and Discover™ Web site. Dive and Discover continues to be an important part of the WHOI outreach program for K-12 students and the general public, and in 2005 received more than 46,000 visits per month. In 2005, Dive and Discover hosted Expedition 9, a revisit to the Galapágos Rift, which included *Alvin* diving and deep-sea camera exploration for hydrothermal vents. More than 26,000 online visitors followed the two-week expedition in May 2005.

—Dan Fornari, Institute Director

Tom Kleindinst, WHOI

Dan Fornari, left, with molecular ecologist Tim Shank and Tim's new sampling equipment on *Alvin*. The new equipment will allow Tim and his co-investigator, paleoecologist Joan Bernhard, to capture and preserve deep-sea organisms at full ocean pressure for studies of enzyme function.

2005 DOEI Research Project Locations

Developing Water Samplers for Autonomous Underwater Vehicles

Arctic: Richard Camilli, Hanu Singh, Terry Hammar, and Jeff Seewald are developing high-resolution mapping and sensing instruments for use on autonomous underwater vehicles.

New Sampling Methods for Noble Gases

Hawaii: Mark Kurz is developing new methods to recover seafloor lava samples to better preserve their noble gas content, possibly changing our understanding of mantle processes.

Seafloor Extensiometers Measure Deformation

Hawaii: Mark Behn and Jeff McGuire developed instruments to measure how the seafloor south of the Big Island is deforming, to advance understanding of seismic activity near oceanic volcanos.

Melting and Deep Mantle Processes Beneath Island Arcs

Western Pacific Arcs: Glenn Gaetani and Nobu Shimizu seek a better understanding of deep mantle processes by studying the behavior of certain elements during melting processes beneath volcanic island arcs in the western Pacific.

Links Between Earthquakes and Tsunamis

NW Indonesia: Jian Lin, Ralph Stephen, Di Jin, and Jason Goodman are studying the coupling mechanisms between earthquakes, seafloor deformation and the generation of tsunamis.

Developing 3D Models of Triple Junctions

SW Indian Ridge: Laurent Montesi is developing 3D mathematical models to better understand seafloor structures and rocks that are found along mid-ocean ridge spreading centers in different spreading environments.

Pursuing greater understanding of the ocean's role in climate change, the Ocean and Climate Change Institute (OCCI) launched support for a number of new research projects, one new OCCI fellow, and a graduate research assistant. The Institute also provided continued support for ongoing fellows and projects.

The OCCI funded several projects to establish or enhance Atlantic and Arctic Ocean observing systems and further the understanding of the roles of the Arctic and Northern Atlantic in abrupt climate change. Projects include looking at the deep Arctic as an indicator of climate shifts in the last millennium; laboratory studies of oceanic mixing and its role in climate change; placing constraints on past changes in the ocean conveyor using proxies; a numerical model simulation of freshwater-induced abrupt climate change; and enhancements of particle and carbon flux studies at Line W (a 250-mile instrument array off Cape Cod) and of freshwater export off southeast Greenland. The Institute is continuing support for projects looking at freshwater import and export from the Arctic; abrupt climate change as reflected in ocean sediments in the Arctic, Caribbean, and in the western north Atlantic; using gliders to obtain transoceanic sections of temperature and salinity between Greenland and the Iberian Peninsula; and a numerical study of the sensitivity of the Gulf Stream pathway to changes in the ocean conveyor.

The Institute supported Scott Doney (MC&G) in his third year as a fellow, Bernadette Sloyan (PO), who left WHOI to return to her home base in Hobart, Australia, and Jeff Donnelly (G&G, shared with COI), who examines natural archives of Holocene and Pleistocene environmental change in coastal regions. Peter Winsor (PO) was appointed a fellow in abrupt climate change. He is a specialist in Arctic oceanography and is doing numerical simulations of abrupt climate change and collecting new data in the Arctic from ships and drifting instrumentation.

Rosemarie Came, a previous Joint Program student in paleo-oceanography, matriculated and student support was shifted to a third year student in the Marine Chemistry and Geochemistry department, Nathalie Goodkin, who is using long-lived coral at Bermuda to study climate variability during the past millennium.

—Terrence Joyce, Institute Director

Tom Kleindinst, WHOI

Terry Joyce, center, examines a core from a coral with Anne Cohen, front, and Delia Oppo. Anne and Delia are funded by the Institute to study what tropical corals can reveal about past climate changes.

2005 OCCI Research Project Locations

Beaufort Slope Profiling Winch Mooring

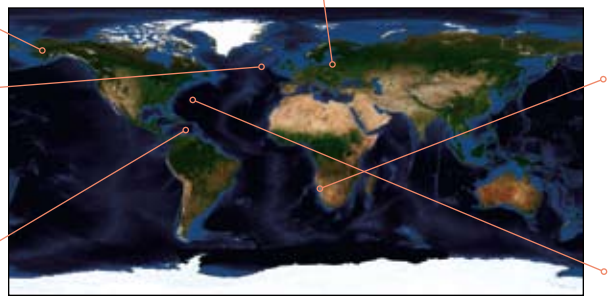
Beaufort Continental Shelf: Robert Pickart deployed a profiling mooring array along the continental shelf of the Beaufort Sea to measure the cumulative outflow of Pacific water, essential for understanding sea ice coverage in the Arctic.

Spray Gliders Climate Monitor

Greenland to the Iberian Peninsula: Brechner Owens is using water gliders to obtain transoceanic sections of temperature and salinity between Greenland and the Iberian Peninsula, in hopes of contributing to the global climate-observing network.

Reconstructing Past Climate Change in the Tropics

Cariaco Basin, southern Caribbean: Konrad Hughen and Scott Lehman identify the relative timing of abrupt shifts in climate and ocean/atmosphere interactions in the past from laminated sediment cores.



Archives of Climate Change

Curonian Spit, Lithuania: Ilya Buynevich uses ground-penetrating radar, radiocarbon and optical dating to identify abrupt climate changes and reconstruct the evolution and paleoclimate significance of coastal dunes.

Testing the Snowball Earth Hypothesis

Hoanib valley, Namibia: Bernhard Peucker-Ehrenbrink and Mark Kurz use a range of geochemical tracers to detect the presence of extraterrestrial material in marine sediments to test for the existence of global ice covers during the Neoproterozoic glaciations, known as Snowball Earth.

Radiocarbon and Deep Water Mass

The Bermuda Rise: Lloyd Keigwin studies millennial- and centennial-scale climate variability based on studies of carbon 14 in benthic foraminifera.

During 2005, The Ocean Life Institute (OLI) continued to foster research and hardware development under three broad themes: Discover Life, Sustain Ecosystems, and Develop Tools.

In 2005 OLI appointed three new Institute Fellows. Anne Cohen works on understanding how corals build their skeletons, and how climatic, environmental, and biological forces interact to shape their growth and composition. She uses computerized tomography scanning technology to quantify the impacts of changing ocean temperature and chemistry on rates of carbonate production by corals. Sonya Dyhrman is interested in how phytoplankton respond to their geochemical environment. Her research uses molecular tools to study the physiological ecology of different phytoplankton groups. She is currently examining the genetic capabilities that allow phytoplankton to respond to changes in carbon dioxide, phosphorus, and nitrogen supply. Jesús Pineda is working on the regional variability of populations of sedentary animals like barnacles and mussels. He will be investigating how ocean currents disperse and transport larvae, the processes that determine which larvae survive to reproduce, and the variability in different local populations.

Photo-Op

From left, Michael Moore, Scott Kraus of the New England Aquarium, and Larry Madin at a Congressional briefing on research issues related to the survival of the North Atlantic right whale.

Communication of research results and applications is an important Ocean Institute function, and in 2005 we hosted one international conference and two workshops. The International Invasive Sea Squirts Conference in April attracted nearly 100 scientists and managers to WHOI to explore the biology, ecology, impacts, and control options for the invasive sea squirt species that are causing serious problems in the Northeast and elsewhere. The papers presented in this meeting will be published in 2006 as a special issue of the *Journal of Experimental Marine Biology and Ecology*.

A second workshop on albatross population biology brought international experts together in April to discuss their studies of albatross demographic models. These mathematical representations of population cycles are essential tools for conservation of these endangered species.

In November, another workshop inaugurated the Reef Fish Connectivity and Conservation Initiative. Focusing on the imperiled Nassau Grouper in the Caribbean, this program will track connections among larval and adult stages of the fish to address critical conservation issues and help developing countries manage their coral reef resources sustainably.

In addition to 10 individual OLI research grants awarded in 2005, the new Tropical Research Initiative provided support for multidisciplinary research and technological advances in tropical regions around the world. Five grants were awarded through this initiative in 2005. Two of these projects will be based at the Liquid Jungle Lab in Panama, where OLI and WHOI continue to participate in the growth of this new field laboratory.

—Laurence Madin, Institute Director

2005 OLI Research Project Locations

Acoustic and Movement Dynamics of Free-ranging Norwegian Killer Whales
Vestfjord, Norway: Peter Tyack and Ari Shapiro studied calls and movements of these animals to better understand how they use sound to coordinate their traveling and social hunting.

Population Genetics of Bowhead and Right Whales
Labrador and Newfoundland: Michael Moore and Joint Program student Brenna McLeod studied DNA composition of whale bones from this region, and disproved the hypothesis that 16th century whaling was responsible for most of the decline of the North Atlantic right whale.

An Underwater Observatory
Panama: Scott Gallager, Steve Lerner, and Keith von der Heydt built the first of several components of a wireless and cabled observatory to better understand processes that affect primary and secondary production in the water column.

Nitrogen in Reef Ecosystems
Cayo Enrique reef, Puerto Rico: Karen Casciotti and Stefan Sievert studied sponge-associated microbial communities to better understand the dynamics of the marine nitrogen cycle in reefs.

Reconstructing Past Climate Change in the Tropics
Palau, Micronesia: Marco Coolen will study the impact of El Niño events from the last 100 years on the species diversity and abundance of fossil DNA in a marine lake to better understand past climate-change in this area of the Philippine Sea.

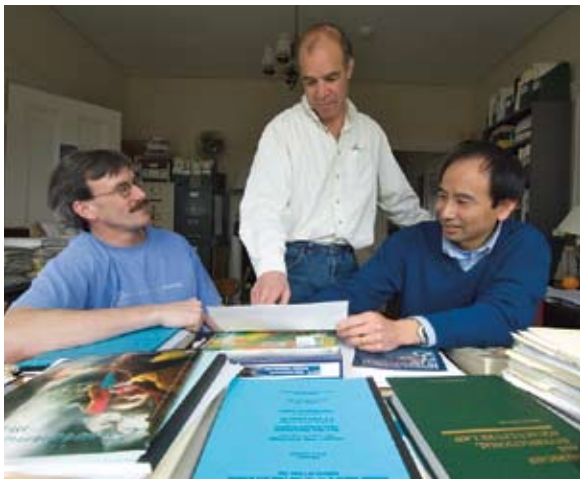
Ciguatera Fish Poisoning
St. Thomas, U.S. Virgin Islands: Don Anderson and Deanna Erdner studied the population biology of *Gambierdiscus toxicus* to gain insight into the links between toxic dinoflagellates, the environment, and the clinical manifestations of ciguatera, an illness associated with eating fish contaminated with dinoflagellate toxins.

The Marine Policy Center (MPC) conducts social scientific research that integrates economics, policy analysis, and law with the Institution's basic research in ocean sciences. Recent research has included projects that focus on the socio-economic aspects of large marine ecosystems and the economic consequences of shoreline change.

Large marine ecosystems (LMEs) are distinct ecological regions that extend from the coast to the edge of the continental shelf. LMEs are economically important, producing goods and services—including 95 percent of the world's fish yields—worth billions of dollars a year. Because LME coastlines are heavily populated, these ecosystems are often among the most polluted and degraded on Earth.

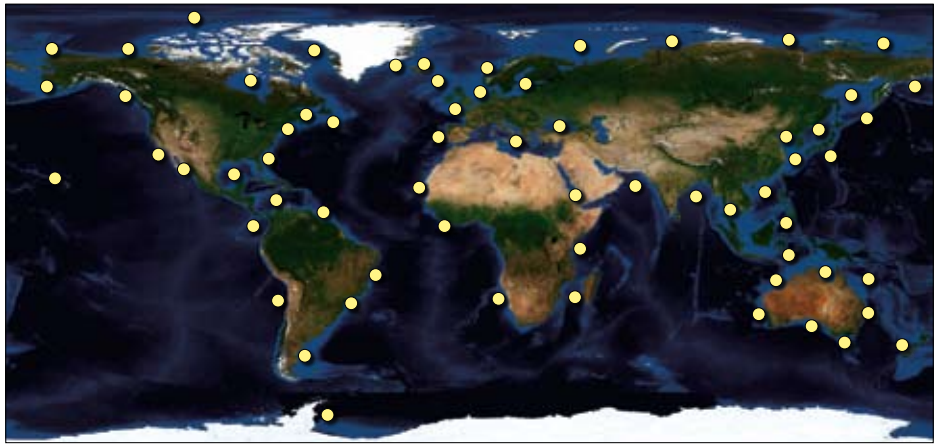
The economic value of LMEs demands that their resources and habitats are protected and managed sustainably for both present and future generations. Often this requires international cooperation, since most LMEs span the maritime jurisdictions of more than one country.

In 2005, Research Specialist Porter Hoagland and Associate Scientist Di Jin contributed to an international program to help developing nations implement a pragmatic approach to sustainable management of LMEs. Funded and organized by the United Nations Environment Programme and the World Bank–affiliated Global Environment Facility, the program uses a range of environmental indicators to assess the physical, biological, and human influences on ecological conditions, productivity, economic development, and governance of LMEs.



Tom Kleindinst, WHOI

From left, Research Specialist Porter Hoagland, Andy Solow, and Associate Scientist Di Jin.



In 2005, MPC researchers contributed to an international program to help developing countries improve management of large marine ecosystems (LMEs), distinct ecological regions that produce 95 percent of the world's fish yields.

The socioeconomic aspects have historically received the least study, and Hoagland and Jin took an important first step toward developing such a global assessment. They compiled a database on the marine activities of all coastal nations—including fish landings and aquaculture production, merchant fleets and cargo traffic, offshore oil production, shipbuilding, and tourism—and constructed indices that can be used to characterize the nature and level of marine activity in the world's 64 identified LMEs.

Combining these maritime indices with data on national rates of life expectancy, education, and per capita income, they developed a ranking of LMEs that can be used to prioritize those regions that are most likely to warrant international attention and support for organized programs of sustainable development.

Hoagland and Jin also underlined the need for more detailed information that can be used to tailor management approaches to particular countries and LMEs. They illustrated the point with in-depth case studies of two LMEs with similar socioeconomic profiles but very different levels of marine industry activity: the Benguela Current LME off southwest Africa and the semi-enclosed Yellow Sea LME in the Northwest Pacific.

MPC researchers are also addressing the economic effects of shoreline change in the United States. Continued growth in coastal populations is likely to intensify the consequences of erosion, severe weather, and sea-level rise, yet there are few reliable estimates of how all of the relevant natural hazards contribute to economic gains and losses.

In order to make informed decisions about the scale of the societal response to the moving shoreline, coastal managers and policymakers need specific estimates at local and regional levels that can also be aggregated to the national level. Working with WHOI coastal geologists, the MPC research team is developing estimates of costs associated with shoreline changes for Cape Cod. They are using data on the location and value of coastal properties, as well as geological data showing the growing influence of sea-level changes due in part to global warming.

—Andy Solow, Director

In its second year of operation, the Woods Hole Center for Oceans and Human Health continued studies to improve public health through enhanced understanding of how oceanic processes affect the distribution and persistence of human pathogens and toxin producing organisms. Two projects of note this year focused on the historic harmful algal bloom of *Alexandrium* in the Gulf of Maine, and the distribution and persistence of human pathogens in Lake Pontchartrain following Hurricane Katrina.

The bloom of *Alexandrium*—the worst since 1972—began just as Center investigators departed Woods Hole on May 9, 2005 on R/V *Oceanus* for a long-planned research expedition to study the harmful algae. The team, under the leadership of Don Anderson and Dennis McGillicuddy, documented the distribution of the toxic algae at the critical onset of the bloom, and collected samples to characterize changes in the bloom population. The team is also running numerical model simulations of the bloom to identify the underlying causes of the 2005 bloom and assess risks in future years.

In most years, *Alexandrium* grows to toxic levels in Penobscot Bay and Casco Bay in Maine and in Canada's Bay of Fundy. The potent neurotoxin from *Alexandrium* accumulates in the meat of filter-feeding bivalves, and while it does not harm them, it can cause Paralytic Shellfish Poisoning, characterized by paralysis and respiratory problems in humans and other animals that eat the shellfish.

In 2005, concentrations of toxic algae reached levels 40 times the norm, and the plants spread southward to regions of Cape Cod Bay, Massachusetts Bay, Nantucket Sound, and Buzzards Bay that are usually not affected by this species.

Shellfish beds in Massachusetts, Maine, and New Hampshire, as well as 15,000 square miles of federal waters, were closed to shellfishing for more than a month at the peak of the seafood harvesting season. Economists for the shellfish industry and the state of Massachusetts estimated that the bloom cost the seafood industry $2.7 million per week in lost revenues, with some estimates suggesting double that amount.

In the aftermath of Hurricane Katrina, floodwaters in New Orleans resulting from levee breaches were largely discharged into Lake Pontchartrain. These floodwaters are potentially contaminated with parasites and pathogens from human sewage, along with a mixture of organic and inorganic chemicals. Center investigators participated in a rapid-response project focused on the impact of the dewatering operation on the Lake Pontchartrain ecosystem, with an emphasis on examining the occurrence and distribution of pathogens that may have potential human health effects.

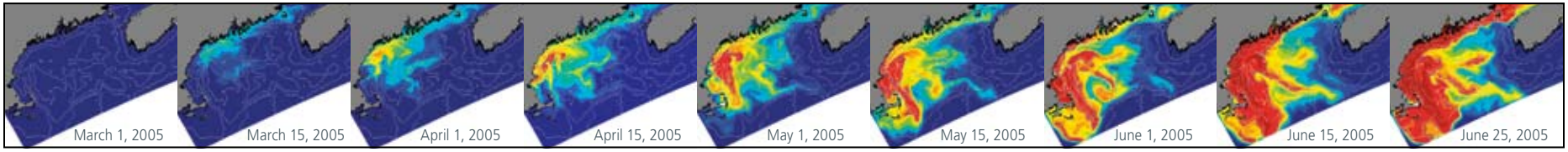
Center researchers Rebecca Gast (WHOI), Linda Amaral-Zettler (MBL), Martin Polz (MIT) and Chris Reddy (WHOI) are collaborating with other center teams at Louisiana State University, the University of Miami, and the University of Hawaii. The goals of the Woods Hole group are to quantify the dynamics of potentially pathogenic bacteria of the genus *Vibrio* in the floodwaters and sediments, to determine the presence and distribution of *Legionella* species pathogenic to humans, and to assess the general microbial diversity using clone libraries to determine the presence of sequence types related to known pathogens (which may represent unidentified human pathogens). Sampling of water and sediment from Lake Pontchartrain and nearby canals has recently been completed, and the teams have begun their intensive analyses.

Martin Polz, MIT

Students and researchers from MIT prepare for sampling of waters and sediments in Lake Ponchartrain, Louisiana. They collaborated with WHOI and other researchers to determine the effects of Hurricane Katrina on human pathogens in the lake.

The conditions resulting from the tragedy in New Orleans may represent a worst-case scenario for contamination of coastal waters. Information that we recover from this work can potentially inform future efforts concerning human health issues involving microbial populations and human pathogens in coastal areas.

—John Stegeman, Director and
Dennis McGillicuddy, Deputy Director



Results of a hindcast simulation after the 2005 *Alexandrium* bloom in the Gulf of Maine, in which red denotes the highest concentration of organisms and blue the lowest. *A. fundyense* cells germinated from cyst beds in the Bay of Fundy and in mid-coast Maine were swept south and west by coastal currents. A nor'easter in late May enhanced transport of the bloom into Cape Cod and Massachusetts bays.

The Cooperative Institute for Climate and Ocean Research (CICOR) coordinates and fosters interaction between WHOI and the National Oceanic and Atmospheric Administration (NOAA). CICOR administers NOAA-funded research, builds ties between researchers at WHOI and NOAA, and conducts education and outreach activities. The Institute is one of 13 national cooperative institutes.

CICOR's research themes focus on climate, marine ecosystems, and coastal research. The center supported 31 projects in 2005, totaling more than $7.5 million in funding. Since its inception in 2001, CICOR has supported 88 research projects and outreach activities, bringing the five-year budget to more than $26 million.

One role of the NOAA Cooperative Institutes is to engage the academic and private research communities in working with NOAA to develop plans for research. Together with the Northeast Science Center of NOAA's National Marine Fisheries Service, CICOR organized the Workshop on Planning Coordinated Research on Ecosystems, Climate, and Policy in the Northeast in January 2005. The workshop brought together individuals from over 30 institutions representing NOAA staff, fisheries and marine resource managers as well as scientists and oceanographers. Participants identified management needs for new research on harmful algal blooms, nutrients and contaminants, biodiversity, and fisheries.

In 2005, the Institute also sponsored a variety of lectures and outreach activities including an Indian Ocean Seminar Series cosponsored with WHOI's Ocean and Climate Change Institute. The two-week seminar series brought to WHOI world-renowned experts on the Indian Ocean from China, Australia, Japan, and the U.S. to discuss research and observing systems that would be most effective for improving understanding and predictive capability of the ocean-atmosphere interaction in the Indian Ocean.

In June CICOR underwent an administrative and science review by an external science review team organized by NOAA. The executive summary of the Review report suggested that the successful national and international collaborations initiated by CICOR should serve as models for the NOAA Cooperative Institute community to enhance NOAA's capacity building and education. Subsequent to the review CICOR is reorganizing its fellows to focus on key areas, such as coastal research, to promote further collaborations among NOAA partners.

Sean Whelan, WHOI

WHOI's Paul Bouchard (left) and NOAA Teacher At Sea, Eric Heltzel, launch a drifter that had been adopted by the WHOI Information Office and Exhibit Center. NOAA has deployed over 1200 drifting buoys that move with ocean currents around the globe collecting data using GPS and satellite technology.

Among CICOR's diverse research programs, the National Office for Harmful Algal Blooms, directed by Don Anderson, facilitated the rapid community response to the historic algal bloom that hit the Northeast (see page 9).

Robert Weller and Al Plueddemann's work with the high-quality Ocean Reference Sites (ORS) time series surface moorings continues to provide essential data for improving our understanding of atmosphere-ocean interactions and thus the efficiency of climate models.

CICOR welcomed Jeremiah Hackett as a postdoctoral scholar working with Don Anderson in the Biology Department. Jeremiah completed his Ph.D. degree in genetics at the University of Iowa and is now applying genomic data to the study of dinoflagellate harmful algal blooms and toxin production. Nancy Grumet, the CICOR-funded postdoctoral scholar in 2004 continues working with Konrad Hughen in the Marine Chemistry and Geochemistry Department. CICOR also supported three MIT/WHOI Joint Program students during 2005: Rob Jennings (Biology) defended his dissertation this year; J. Thomas Ferrar (Physical Oceanography) continues his analyses of air-sea interaction and upper ocean variability; and Carlos Moffat, who continues work with his thesis advisors Robert Beardsley and Breck Owens in Physical Oceanography on understanding the circulation of the coastal ocean of the shelf west of the Antarctic Peninsula.

—Robert Weller, Director

The Woods Hole Sea Grant Program is part of the National Oceanic and Atmospheric Administration's national Sea Grant network of 32 programs. Collectively, Sea Grant promotes cooperation between government, academia, industry, scientists, and the private sector to foster science-based decisions leading to better understanding, conservation, and use of coastal resources.

More than half of Woods Hole Sea Grant's annual budget of $1 million supports multi-year research projects in environmental technology, estuarine and coastal processes, and fisheries and aquaculture, as well as smaller, "new initiative" grants. Sea Grant research addresses local and regional needs, and many projects have national or even global implications.

In 2005, Sea Grant-supported 26 investigators at WHOI and other institutions who researched the population structure of important commercial fish species, harmful algal blooms, larval dispersal, distribution and settlement patterns, the development of a novel pattern recognition system to classify benthic habitats, metal accumulation in sewage, shellfish diseases, and groundwater transport of nutrients.

More than one-third of Woods Hole Sea Grant's budget is dedicated to research translation, outreach, and education. Sea Grant reaches its audience through one-on-one advice, training programs, publications, Web sites, workshops, and lectures.

Many Sea Grant outreach programs involve partnerships, such as with the Barnstable County Cooperative Extension Service, to provide technical expertise and demonstration projects on shellfish aquaculture and coastal processes. A partnership with the Waquoit Bay National Estuarine Research Reserve and the Massachusetts Coastal Zone Management Program provides research-based training to coastal policymakers (www.coastaltraining.org).

In the ocean science education field. Woods Hole Sea Grant introduced Beachcomber's Companion© in 2005, an award-winning publication and Web site (www.beachcomberscompanion.net) highlighting common Atlantic marine invertebrates. For over a decade, Woods Hole Sea Grant has partnered with colleagues at New Hampshire Sea Grant to provide marine career information to students (www.marinecareers.net). Woods Hole Sea Grant is also participating in a WHOI effort to promote effective research–outreach partnerships.

—Judith E. McDowell, Program Director

Tom Kleindinst, WHOI

WHOI biologist Simon Thorrold's ground-breaking research on fish otoliths (ear bones) as natural tags to reconstruct temperature histories and seawater chemistry shed light on the larval dispersal patterns of pelagic fish.

Jayne Doucette, WHOI

Sea Grant coastal processes specialist Jim O'Connell (center) introduces middle and high school teachers to a beach and dune profiling method—developed by WHOI geologist K.O. Emery—at a 2005 Topics in Oceanography workshop, a collaboration of Sea Grant with WHOI Academic Programs and the WHOI Exhibit Center.

Tom Kleindinst, WHOI

WHOI biologist Rebecca Gast, left, is working with Marine Biological Laboratory pathologist Roxanna Smolowitz to screen sediments, water, algae, and invertebrates to determine the environmental source of the QPX (quahog parasite unknown) disease organism.

With just two percent of Earth's oceans explored, outreach is an important means of conveying to the public the need for ocean science research and engineering. Outreach can involve judging science fairs, visiting classrooms, and mentoring young students, initiating stories and responding to media and public inquiries, mounting exhibits in the WHOI Exhibit Center and assisting with exhibits in other locations, and participating in ongoing lecture series, expeditionary Web sites like Dive and Discover, and broadcast documentaries.

Every year the Institution responds to thousands of requests for information and images, receives approximately five million visits to www.whoi.edu, hosts 30,000 visitors to our Exhibit Center and Information Office, and conducts ongoing outreach programs, which are often focused on relevant current events. In 2005, such events included the devastating tsunami in Southeast Asia, a historic harmful algal bloom (HAB) in New England, and ongoing concerns about global climate change.

Tom Kleindinst, WHOI

Teachers attending an educators workshop in November get a rare look at *Alvin*. The workshop, which focused on understanding tectonics and ocean crust formation, was led by WHOI Associate Scientist Maurice Tivey and Joint Program student Clare Williams.

Tsunami

Following the December 26, 2004 tsunami in southeast Asia, WHOI outreach included a special section on tsunamis in *Oceanus* magazine—which drew 12,000 online visits—focusing on WHOI's contribution to the development of a monitoring and warning system and research into seafloor earthquakes. News releases and other efforts to inform the media resulted in dozens of media articles around the world. Additional outreach efforts focused on teachers and students. Through the WHOI partnership in the NSF-sponsored Center for Ocean Science Education Excellence, Senior Scientist Ralph Stephen explained wave motion to middle schoolers in an ongoing ocean science education initiative, and maintaining a Web site, the Plymouth Wave Lab.

Harmful algal blooms

On May 9, WHOI scientists Dennis McGillicuddy, Deana Erdner, and Bruce Keafer were at sea off Cape Ann and the first to collect water samples that confirmed the worst algal bloom since 1972. The bloom persisted through July, when Senior Scientist Don Anderson and state and national officials briefed the media in Boston and Woods Hole on the outbreak and discussed current and future research into harmful algal blooms. Dozens of media interviews and more than 160 news stories resulted, while HAB-related articles in *Oceanus* magazine attracted approximately 20,000 online visits, and more than 12,000 visitors learned the latest information on a special Web site created for the outbreak on whoi.edu. Hundreds of summer visitors to Woods Hole, anxious about the implications of the bloom for humans, sought information about WHOI HAB research through inquiries at the Information Office and displays at the Exhibit Center.

Tom Kleindinst, WHOI

Engineer Ben Allen of the Oceanographic Systems Laboratory explains the operation of the autonomous underwater vehicle REMUS to the 2005-2006 Knight Science Journalism Fellows from MIT during a day-long visit October 21.

Climate change

Climate change continues to draw major interest from the public, with the Information Office receiving more than two hundred inquiries in 2005 on the impacts to humans and the environment from climate change. Many inquiries were directed to the "frequently asked questions" on the Ocean and Climate Change Institute Web site, which had 52,800 visits in 2005. Hundreds of print, broadcast, and electronic articles appeared in the media worldwide, with nearly a dozen documentaries about the subject featuring WHOI research and staff, including *Scientific American Frontiers* program "Hot Planet-Cold Comfort" in February, and programs on the History Channel, Discovery, and Fox Network News among others. Two dozen teachers from across New England attended a summer workshop organized by WHOI Academic Programs, Information Office, and Sea Grant featuring Assistant Scientist Fiamma Straneo explaining the climate implications of a freshening North Atlantic.

— Shelley Dawicki and Stephanie Murphy

PUBLIC POLICY AND SCIENCE POLICY

Scientists at WHOI contribute to the discussion of public and science policy issues at the state, national, and international levels. Here is a selection of their activities in 2005.

PUBLIC POLICY

Ruth Curry
"Bigger Hurricanes: A Consequence of Climate Change?" Briefing on greenhouse warming to members of the House and Senate

Sarah Das and Susan Humphris
Member, Board of Trustees, Sea Education Association

Rob Evans
"Interactions Between the Seafloor and the Oceans: From the Coastlines to Mid-Ocean Ridges." Briefing to the House Subcommittee on Fisheries & Oceans

Dan Fornari
Congressional testimony on the need for funding basic research, as part of AGI, AGU contingent to Massachusetts congressional delegation

Robert Gagosian
Member, U.S. National Commission for the United Nations Educational, Scientific, and Cultural Organization (UNESCO)

Rocky Geyer
Member, Ocean Studies Board
Member, Hudson River Contaminant Reduction Program Model Evaluation Group

Terry Joyce
Briefing on ocean currents and climate to the House Subcommittee on Fisheries & Oceans

Larry Madin
Member, Marine Advisory Panel, Conservation International

Andy Solow
Trustee, Lobster Conservancy, Friendship, Maine

SCIENCE POLICY

Don Anderson
Director, U.S. National Office on Marine Biotoxins and Harmful Algal Blooms

Carin Ashjian
Co-Vice Chair, Arctic Icebreaker Coordinating Committee, University-National Oceanographic Laboratory System (UNOLS)

Jim Broda
Member, Antarctic Research Vessel Oversight Committee

Alan Chave
Member, Ocean Research Interactive Observatory Networks (ORION) Engineering Committee

William Curry
Member and Chair, Science Committee, The International Marine Past Global Changes Study (IMAGES)

Scott Doney
Ocean Carbon and Climate Change (OCCC) program, Chair Scientific Steering Group

Dan Frye
Member, National Science Foundation ORION Engineering Committee

Chris German
Member, UK Astrobiology Society Steering Committee

Jason Goodman
NASA Outer Planets Advisory Group, Washington, D.C.

Stan Hart and Ray Schmitt
Member, Ocean Studies Board, National Academy of Sciences/ National Research Council

John Hayes
Chair, National Academy of Sciences, Section 15 – Geology

Susan Humphris
Member, Integrated Ocean Drilling Program Science Planning and Policy Oversight Committee

Lloyd Keigwin
Chair, Steering Committee, RAPID Climate Change Programme, Natural Environment Research Council, U.K.

Dennis McGillicuddy
Member, Biological Oceanography of Harmful Algal Blooms (BOHAB) Steering Committee

Andy Solow
Member, National Research Council Committee to review NASA science applications

Heidi Sosik
Member, ORION Coastal Observatory Science Requirements Committee

John Stegeman
Chair, Institute of Medicine—National Academy of Sciences Committee on Health Effects of Agent Orange in Vietnam Veterans

John Trowbridge
Member, ORION Science and Technology Advisory Committee

Peter Tyack
Member, Acoustic Criteria Panel, National Marine Fisheries Service

Barrie Walden
Member, Deep Submergence Science Committee

Bob Weller
Counselor, American Meteorological Society

Peter Wiebe
Chair, UNOLS
Chair, Georges Bank Program Executive Committee, U.S. Global Ocean Ecosystems Dynamics Program (GLOBEC)

Dana Yoerger
Committee member, Naval Studies Board, Committee on Distributed Remote Sensing for Undersea Warfare

Lisan Yu
Member, Indian Ocean Panel, International Climate Variability and Predictability (CLIVAR)

PROMOTIONS

AOP&E

Bob Brown
Senior Engineer

Dee Chausse
Administrative Associate I

Steve Faluotico
Senior Engineering Assistant I

Mark Grosenbaugh
Senior Scientist

Sheila Hurst
Administrative Associate I

Mark Johnson
Senior Engineer

Olga Kosnyreva
Research Assistant III

Stephen Liberatore
Senior Engineer

Glenn McDonald
Research Engineer

Jim Preisig
Associate Scientist with Tenure

Hanumant Singh
Associate Scientist with Tenure

Jay Sisson
Senior Research Assistant II

Ann Stone
Sr. Administrative Assistant II

Kelley Wiley
Sr. Administrative Assistant I

Max von der Heydt
Engineering Assistant II

BIO

Kimberly Amaral
Research Assistant II

Ellen Bailey
Sr. Administrative Assistant II

Mark Hahn
Senior Scientist

Michael Neubert
Associate Scientist with Tenure

Timothy Shank
Assistant Scientist

John Waterbury
Senior Scientist

G&G

Juan-Pablo Canales
Associate Scientist

Graham Layne
Senior Research Specialist

Jian Lin
Senior Scientist

Olivier Marchal
Associate Scientist

Jeff McGuire
Associate Scientist

MCG

Tyler Goepfert
Research Assistant III

Daniel Montluçon
Research Associate III

PO

Amy Bower
Senior Scientist

Paul Fucile
Senior Engineer

Brian Hogue
Engineer Assistant II

Steve Jayne
Associate Scientist

Sonya Legg
Associate Scientist with Tenure (on LOA)

Chris Linder
Research Associate III

A. Rick Rupan
Engineer Assistant II

Bernadette Sloyan
Associate Scientist (on LOA)

APPOINTMENTS

AOP&E

Richard Camilli
Assistant Scientist

Tito Collasius, Jr.
Engineering Assistant III

Jim Doutt
Research Associate III

Jim Edson
Adjunct Scientist

Gonzalo Feijoo
Assistant Scientist

Vicki Ferrini
Research Associate III

Robert Fuhrmann
Engineer II

Daniel Gomes-Ibanez
Engineer II

Cheryl Nedd
Senior Administrative Asst. II

Cliff Pontbriand
Engineer I

Dawn Quattlebaum
Senior Administrative Asst. II

Eric Savery
Engineering Assistant

Sheri White
Assistant Scientist

BIO

Mark Baumgartner
Assistant Scientist

Andrea Bogomolni
Research Assistant II

Lynn Davies
Research Assistant I

Jon Hare
Adjunct Scientist

George Heimerdinger
Research Assistant III

Rubao Ji
Assistant Scientist

Emily Miller
Research Assistant II

Kerry Norton
Research Assistant II

Harvey Walsh
Research Assistant II

Brian Wilson
Research Assistant II

G&G

Chris German
Senior Scientist

Ian Goldsborough
Laboratory Assistant II

Dan Lizarralde
Associate Scientist

Marjorie Parmenter
Research Assistant III

Roger Searle
Adjunct Scientist

Alison Shaw
Assistant Scientist

Jonathan Snow
Adjunct Scientist

Adam Soule
Assistant Scientist

Jess Tierney
Research Assistant I

MCG

Erin Bertrand
Research Assistant II

Marco Coolen
Assistant Scientist

Virginia Edgcomb
Research Associate III

John Farrington
Senior Scientist

Olivier Rouxel
Assistant Scientist

Dierdre Toole
Assistant Scientist

James Yoder
Senior Scientist

PO

Annalisa Bracco
Assistant Scientist

Changsheng Chen
Adjunct Scientist

Paul Fraser
Engineer Assistant II

Mark Lambton
Engineer Assistant II

Shirley McDonald
Sr. Administrative Assistant II

Lief Thomas
Assistant Scientist

Mary-Louise Timmermans
Assistant Scientist

Sean Whelan
Engineer Assistant II

AOPE

Jim Lynch received the Robert W. Morse Chair for Excellence in Oceanography Award.

Beatriz Mourino Carballido, University of Vigo (Spain), Special Ph.D. Award.

Ruoying He, 2005 WHOI Independent Study Award, for exploring new approach in ocean modeling. 2005 Coastal Ocean Institute Research Award, for developing coastal ocean interdisciplinary modeling system for the MVCO.

Ryan Eustice received the Best Student Paper at the International Conference on Robotics and Automation for "Exactly Sparse Delayed State Filters."

JP Student **Allison May Berg** was awarded the Rear Admiral Richard F. Pittenger, USN (Ret) Fellowship.

JP Student **Colleen Maloney** was awarded the RADM Richard F. Pittenger Fellowship for the academic year 2005-2006.

JP Student **Anna Michel** received the Best Poster Award at the 2005 Oceans Conference.

JP Student **Oscar Pizarro** received The Ruth and Paul Fye Best Paper Award for "Toward Large-Scale Mosaicing for Underwater Scientific Applications" *Journal of Ocean Engineering*, 2003.

JP Student **Weichang Li** received the Best Student Paper Award in Underwater Acoustics "Identification of Rapidly Time-Varying Acoustic Communication Channels" at the 150th Meeting of the Acoustical Society of America.

Don Peters and **Matt Naiman**, **Sheri White** and **Meg Tivey**, and **Dezhang Chu** and **Tom Austin** received Cecil H. and Ida M. Green Technology Innovation Awards.

BIO

Don Anderson received the Anton Brunn medal at the 23rd session of the Intergovernmental Oceanographic Commission.

Carin Ashjian was named a Coastal Ocean Institute Fellow.

Sonya Dyhrman was named an Ocean Life Institute Fellow.

Scott Gallager was elected as a member of the ORION Sensors Advisory Committee.

Rebecca Gast was elected vice president of the International Society of Protistologists, 2005-2006.

Darlene Ketten was the plenary/keynote Speaker at the How to See What Whales Hear-NIH-NIDCS special lecture.

Larry Madin was awarded First Institute Visiting Scholar, Auckland War Memorial Museum.

Judith McDowell received a Outstanding Alumnae/Alumna Award, Stonehill College.

Jesús Pineda was named a Ocean Life Institute Fellow.

Tim Shank received the OceanAGE scientist NOAA's Ocean Explorer's Award.

John Stegeman was listed by Thomson ISI as a "highly cited researcher" in pharmacology.

G&G

Mark Behn was the invited speaker (seismic anisotropy and mantle flow across continental North America) at the Earthscope National Meeting.

Joan Bernhard was the keynote speaker (biogeochemical controls on paleoceanographic proxies) at the Geological Society in London.

Karen Bice was the keynote speaker at the 7th International Cretaceous Symposium, Neuchâtel, Switzerland.

Margaret Boettcher received the Ruth and Paul Fye Award for Excellence in Oceanographic Research and the Panteleyev Award for commitment to improving the graduate student experience.

Jeff Donnelly was named a Fellow of the Coastal Ocean Institute, Ocean and Climate Change Institute, and the Ocean Life Institute.

Dan Fornari was named the Ridge2000 Distinguished Lecturer for 2005.

Glenn Gaetani was the keynote speaker at the Ringberg Workshop on inclusions in minerals and processes in the earth's mantle.

Stan Hart was elected to the American Academy of Arts and Sciences and was awarded an honorary degree, Doctor Honoris Causa, Institut de Physique du Globe, University of Paris.

Greg Hirth was the keynote speaker at the Electron Backscatter Diffraction Conference.

Matt Jackson received the Outstanding Student Paper Award at the Fall meeting of the American Geophysical Union.

Lloyd Keigwin was awarded the Edna McConnell Clark Chair.

Jian Lin was the keynote speaker at the China Symposium on future directions of marine geobiosciences, Tongji University. He was also the keynote speaker at the 5th Annual Meeting of the International Professionals for the Advancement of Chinese Earth Sciences (IPACES).

Dan McCorkle was awarded the J. Seward Johnson Chair and Education Coordinator.

Ken Sims was the keynote speaker at the 2005 Goldschmidt Conference.

Deborah Smith was the keynote speaker at the Women in Oceanography, Women's Committee dinner.

MCG

James Moffett received the Mary Sears Chair.

Scott Doney was named an Ocean and Climate Change Institute Fellow.

Joanne Goudreau received the Linda Morse-Porteous Award.

Margaret Tivey was awarded the J. Seward Johnson Chair, Educational Coordinator. She also presented the AGU Ocean Sciences Rachel Carson Lecture.

PO

Terry Joyce was named Chair of the Ocean and Climate Change Institute.

Sabine Mecking received the award for best presentation by a young scientist in physical oceanography, climate topic session, PICES meeting, Honolulu, HI.

Joe Pedlosky received the Sverdrup Gold Medal from the American Meteorological Society. He also received the WHOI Arnold Arons Award.

Kurt Polzin received the Nansen Medal from the European Geophysical Society.

Luc Rainville received the European Geophysical Union Young Scientists' Outstanding Poster Paper Award.

Fiamma Straneo received the award for Best Poster by a Scientist recognition at the Bjerknes Centenary Conference, "Climate Change in High Latitudes." She also received the Bjerknes Visiting Scientist Fellowship.

John Toole received the Columbus O'Donnell Iselin Chair for Excellence in Oceanography.

Peter Winsor was named an Ocean and Climate Change Institute Fellow.

Glen Gawarkiewicz, **James Lerczak**, and **Bob Pickart** were keynote speakers at the Gordon Conference.

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Arthur Zeikel

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Member, 12/1/05

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Honorary Member, 8/4/05

Townsend Hornor
Honorary Member, 9/11/05

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Gratia R. Montgomery
Honorary Trustee and Honorary Member, 2/19/05

David S. Saxon
Honorary Member, 12/8/05

For the sixth consecutive year, government sponsored revenue surpassed both budget and prior year results and the Institution completed 2005 in solid financial condition. Despite this performance, we expect the challenging federal funding situation to continue. Therefore, we reduced costs in 2005, trimmed the 2006 budget, and we are developing additional revenue sources.

This past year was one of change for finance and administration. The Investment Committee selected Timothy Stark to be WHOI's first investment officer. David Stephens, who has been with the Institution for nine years, assumed the role of controller after serving as WHOI's manager of government regulations. Through attrition, the controller's staff has been reduced from sixteen to thirteen and we are leveraging our investments in technology to bridge the gaps. We plan to continue our administrative hiring freeze, which has been in place since 2004. During that time, the Institution has eliminated nineteen administrative positions.

2005 financial highlights:

- Cash increased by $8.7 million due to a bequest from the estate of Claudia Heyman. The Institution received $10 million from the bequest in 2005 and the remainder will be distributed to WHOI in 2006.
- The Institution's assets grew by more than $30 million to $485 million. This increase is largely attributable to construction of new laboratories and to changes in the pension plan. The pension plan changes created an intangible asset valued at $13.7 million.
- The 2002 Clark Laboratory fire insurance claim was settled during 2005. The Institution has received $6.5 million from its insurer and has recognized uninsured losses of $2.2 million over the three years needed to restore the damaged laboratories.
- The Institution's accrued pension liability increased from $24.7 million in 2004 to $28.8 million in 2005.
- The endowment fund grew to $305.7 million in 2005 from $290.7 million in 2004 with a total return of 9.8%.
- Total sponsored research income was $112.4 million in 2005 compared with $108.5 million in 2004.
- Our total overhead recovery in 2005 was $56.4 million compared with $55.2 in 2004. At year-end, the institution had a cumulative overrecovery of $3.1 million.
- Gifts, grants, and pledges amounted to $18 million in 2005 compared with $15.3 in 2004.
- Endowment income of $13.6 million was distributed to operations during the year. Research received $4.9 million, education received $5.6 million and current operations received $3 million. Distributions from investment returns continue to be a critical source of revenue for the Institution and make up approximately 10 percent of operating revenues.
- The Institution spent $56.5 million on compensation during 2005. Included in this amount was $9.2 million for vacation, holidays and sick time. Other fringe benefits cost $10.5 million for a total compensation package of $67 million, 50 percent of our 2005 operating expenses of $134.6 million.
- The Institution invested $27.9 million on the construction and renovation of facilities during 2005. In addition, $1.3 million was invested in maintaining existing facilities compared with $895,000 in 2004.

During 2005, the Institution completed new laboratories on the Quissett campus and began planning Village laboratory renovations. We have taken steps to control spiraling health plan and retirement plan costs. We are undertaking an across-the-board assessment of the Institution's readiness to expand our applied work and seek beneficial industrial partnerships. Some of these changes are difficult, but the current financial strength of the institution should ease the transition to a new organizational model that includes applied market-driven research.

Tom Kleindinst, WHOI

Carolyn Bunker, left, with Department Administrator Deb Hamel.

Statement of Financial Positions

December 31, 2005 (with summarized information as of December 31, 2004)

	2005	2004
Assets		
Cash, unrestricted	$ 21,360,187	$ 12,669,547
Cash, restricted	1,027,019	382,421
Reimbursable costs and fees		
Billed (net of allowance for doubtful accounts of $210,351 for 2005 and $226,658 for 2004)	2,056,178	3,335,365
Unbilled	6,865,329	6,458,930
Interest and dividends receivable	328,632	276,130
Other receivables (Note 12)	771,182	2,970,530
Pledges receivable, net	4,807,837	6,879,190
Inventory	1,171,878	1,233,746
Deferred charges and prepaid expenses	651,835	1,402,357
Investments, pooled	307,996,468	287,277,109
Investments, nonpooled	5,070,498	5,237,388
Deposits with trustees for construction	3,038,552	24,278,081
Deposits with trustees for debt service	1,898,102	3,154,350
Prepaid postretirement benefit cost	788,826	639,297
Supplemental retirement	6,585,207	6,537,921
Intangible pension asset (Note 8)	13,674,720	-
Other assets	9,155,667	17,384,437
Deferred financing costs	1,225,865	1,268,753
	388,473,982	381,385,552
Property, plant and equipment		
Land, buildings and improvements	113,546,891	68,493,906
Vessels and dock facilities	7,180,241	6,442,869
Laboratory and other equipment	21,098,120	18,132,850
Construction in process	3,253,157	24,195,589
	145,078,409	117,265,214
Accumulated depreciation	(58,641,890)	(53,404,419)
Net property, plant and equipment	86,436,519	63,860,795
Remainder trusts	10,390,619	10,043,233
Total assets	$ 485,301,120	$ 455,289,580

	2005	2004
Liabilities		
Accounts payable and other liabilities (Note 12)	$14,445,771	$17,845,971
Accrued payroll and related liabilities	5,166,992	5,291,214
Payable for investments purchased	32,435	47,251
Deferred fixed rate variance	3,121,743	129,500
Accrued supplemental retirement benefits	6,585,207	6,537,921
Accrued pension liability (Note 8)	28,795,900	24,697,407
Deferred revenue and refundable advances	7,115,866	6,739,232
Bonds payable	54,850,000	54,850,000
Total liabilities	120,113,914	116,138,496

	Unrestricted	Temporarily Restricted	Permanently Restricted		
Net Assets					
Undesignated	$13,289,946	$ -	$ -	13,289,946	10,306,900
Pension	(14,039,903)	-	-	(14,039,903)	(23,705,136)
Designated	3,886,150	7,948,249	-	11,834,399	10,391,968
Pledges and other	-	3,929,354	11,760,091	15,689,445	18,020,853
Plant and facilities	29,868,877	-	-	29,868,877	29,968,854
Education	-	2,846,933	-	2,846,933	3,437,863
Endowment and similar funds	70,942,327	176,151,331	58,603,851	305,697,509	290,729,782
Total net assets	$103,947,397	$190,875,867	$70,363,942	365,187,206	339,151,084
Total liabilities and net assets				$ 485,301,120	$ 455,289,580

The accompanying notes are an integral part of these financial statements.

Statement of Cash Flows

December 31, 2005 (with summarized information as of December 31, 2004)

	2005	2004
Cash flows from operating activities		
Total change in net assets	$ 26,036,122	$ (2,490,673)
Adjustments to reconcile increase (decrease) in net assets to net cash provided by (used in) operating activities		
Depreciation and amortization	5,882,972	5,180,075
Change in split interest agreements	(378,137)	643,575
Allowance for uncollectible pledges	75,098	93,679
Discount on pledges	(127,932)	215,801
Net realized and unrealized (gain) loss on investments	(24,591,314)	(27,688,898)
Additional minimum pension liability	(14,055,206)	14,055,206
Contributions to be used for long-term investment	(2,395,237)	(2,553,132)
Gift of property	-	(5,034,355)
(Increase) decrease in assets		
Restricted cash	(644,598)	1,125,334
Interest and dividends receivable	(52,502)	221,811
Reimbursable costs and fees		
Billed	1,279,187	(1,606,730)
Unbilled	(406,399)	(1,788,301)
Other receivables	2,199,348	5,064,081
Pledges receivable	2,124,187	(2,341,974)
Inventory	61,868	(149,622)
Deferred charges and prepaid expenses	750,522	(626,839)
Deferred fixed rate variance	-	3,197,693
Other assets	8,228,770	(366,431)
Remainder trusts	-	(43,044)
Prepaid pension cost	(149,529)	149,529
Supplemental retirement	(47,286)	(280,882)
Increase (decrease) in liabilities		
Accrued pension liability	4,478,979	9,340,167
Accounts payable and other liabilities	(5,609,826)	(3,903,660)
Accrued payroll and related liabilities	(124,222)	(936,736)
Deferred revenue and refundable advances	376,634	1,423,096
Accrued supplemental retirement benefits	47,286	280,882
Deferred fixed rate variance	2,992,243	129,500
Net cash provided by (used in) operating activities	5,951,028	(8,690,848)

	2005	2004
Cash flows from investing activities		
Capital expenditures		
Additions to property and equipment	(26,175,431)	(20,007,169)
Endowment		
Receivable for investments sold	-	22,044,791
Payable for investments purchased	(14,816)	47,251
Proceeds from the sale of investments	95,045,755	130,132,661
Purchase of investments	(91,006,910)	(146,911,010)
Change in construction fund	21,239,529	-
Change in debt service funds	1,256,248	-
Net cash provided by (used in) investing activities	344,375	(14,693,476)
Cash flows from financing activities		
Borrowings under debt agreement	-	54,850,000
Loan payments	-	(10,724,206)
Deferred financing costs	-	(1,290,196)
Proceeds from bonds deposited into construction fund	-	(24,278,081)
Proceeds from bonds deposited into debt service funds	-	(3,154,350)
Contributions to be used for long-term investment	2,395,237	2,553,132
Net cash provided by financing activities	2,395,237	17,956,299
Net increase (decrease) in cash and cash equivalents	8,690,640	(5,428,025)
Cash and cash equivalents, beginning of year	12,669,547	18,097,572
Cash and cash equivalents, end of year	$ 21,360,187	$ 12,669,547
Supplemental disclosures		
Cash paid for interest	$ 663,969	$ 761,500
Noncash activity		
Gift of property	-	5,034,355
Construction in process additions remaining in accounts payable	2,240,377	4,523,689
Change in intangible pension asset	13,674,720	5,644,240

The accompanying notes are an integral part of these financial statements.

Statement of Activities

December 31, 2005 (with summarized information as of December 31, 2004)

	Unrestricted					
	Operating	Sponsored Research	Temporarily Restricted	Permanently Restricted	2005	2004
Operating revenues						
Fees	$ 232,291				$ 232,291	$ 576,649
Sponsored research						
Government		$ 70,174,037			70,174,037	67,496,538
Nongovernment		16,251,346	$ 4,910,827		21,162,173	21,012,293
Ships and subs operations		20,895,382			20,895,382	20,102,588
Sponsored research assets released to operations	112,409,418	(107,320,765)	(5,088,653)		-	-
Education						
Tuition	3,773,444				3,773,444	3,455,307
Investment return designated for education	3,867,255		1,761,590		5,628,845	5,585,654
Gifts			209,503		209,503	351,013
Education funds released from restriction	2,562,023		(2,562,023)		-	-
Investment return designated for current operations	3,464,870				3,464,870	3,381,128
Contributions and gifts, net of releases from restrictions of $737,803 and $884,486 in 2005 and 2004, respectively	12,385,611		(396,265)	$822,997	12,812,343	12,805,394
Contributions in kind	622,183				622,183	267,687
Rental income	743,687				743,687	660,191
Communication and publications	252,830				252,830	294,620
Other	533,062				533,062	544,184
Total revenues	140,846,674	-	(1,165,021)	822,997	140,504,650	136,533,246
Expenses						
Sponsored research						
National Science Foundation	42,551,224				42,551,224	41,499,749
United States Navy	12,094,074				12,094,074	14,223,555
Subcontracts	10,174,343				10,174,343	12,127,174
National Oceanic & Atmospheric Administration	10,480,622				10,480,622	8,514,822
Department of Energy	521,065				521,065	690,864
United States Geological Survey	1,469,623				1,469,623	999,024
National Aeronautics & Space Administration	980,943				980,943	741,428
Ships Operations	15,307,124				15,307,124	14,809,301
Submersible and ROV operations	5,588,258				5,588,258	5,293,287
Privately funded grants	4,323,674				4,323,674	3,126,607
Other	8,918,468				8,918,468	6,447,780

Statement of Activities (continued)

	Unrestricted					
	Operating	Sponsored Research	Temporarily Restricted	Permanently Restricted	2005	2004
Education						
Faculty expense	3,583,387				3,583,387	2,930,827
Student expense	4,175,946				4,175,946	3,963,605
Postdoctoral programs	413,616				413,616	369,900
Other	721,291				721,291	687,280
Rental expenses	538,897				538,897	498,164
Communication, publications and development	2,628,541				2,628,541	2,572,930
Fundraising expenses	2,620,896				2,620,896	2,507,237
Unsponsored programs	6,182,535				6,182,535	5,279,055
Other expenses	1,284,272				1,284,272	920,888
Total expenses	134,558,799	-	-	-	134,558,799	128,203,477
Change in net assets from operating activities	6,287,875	-	(1,165,021)	822,997	5,945,851	8,329,769
Nonoperating income						
Investment return in excess of amounts designated for sponsored research, education and current operations	3,153,328		9,121,972		12,275,300	19,535,160
Net realized/unrealized gains (losses) on interest swap	(640,157)				(640,157)	(4,020,690)
Change in value of split interest agreements	52,687		6,353	319,097	378,137	(643,575)
Contributions and gifts			5,000		5,000	15,502
Net assets released from restriction	5,000		(5,000)		-	-
Nonoperating expenses						
Other nonoperating expenses	(99,976)				(99,976)	(99,976)
Net periodic pension cost (Note 8)	(4,389,971)				(4,389,971)	(9,004,045)
Redesignation of gifts and transfers to operating	(1,090,000)		(404,458)	1,190	(1,493,268)	(2,036,589)
Write-off of fixed assets					-	(511,023)
Change in net assets from nonoperating activities	(3,009,089)	-	8,723,867	320,287	6,035,065	3,234,764
Change in net assets from operating and nonoperating activities	3,278,786	-	7,558,846	1,143,284	11,980,916	11,564,533
Change in additional pension minimum liability (Note 8)	14,055,206				14,055,206	(14,055,206)
Total change in net assets	17,333,992	-	7,558,846	1,143,284	26,036,122	(2,490,673)
Net assets at beginning of year	86,613,405	-	183,317,021	69,220,658	339,151,084	341,641,757
Net assets at end of year	$ 103,947,397	$ -	$ 190,875,867	$ 70,363,942	$ 365,187,206	$ 339,151,084

The accompanying notes are an integral part of these financial statements.

Report of Independent Auditors

To the Board of Trustees of
Woods Hole Oceanographic Institution

In our opinion, the accompanying statement of financial position and the related statements of activities and cash flows present fairly, in all material respects, the financial position of Woods Hole Oceanographic Institution (the "Institution") at December 31, 2005, and the changes in its net assets and its cash flows for the year then ended in conformity with accounting principles generally accepted in the United States of America. These financial statements are the responsibility of the Institution's management. Our responsibility is to express an opinion on these financial statements based on our audit. The prior year summarized comparative information has been derived from the Institution's 2004 financial statements, and in our report dated March 17, 2005, we expressed an unqualified opinion on those financial statements. We conducted our audit of these statements in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements, assessing the accounting principles used and significant estimates made by management, and evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

PricewaterhouseCoopers LLP

April 24, 2006

Notes to Financial Statements

1. Background

Woods Hole Oceanographic Institution (the "Institution") is a private, independent not-for-profit research and educational institution located in Woods Hole, Massachusetts. Founded in 1930, the Institution is dedicated to working and learning at the frontier of ocean science and attaining maximum return on intellectual and material investments in oceanographic research.

The Institution is a qualified tax-exempt organization under Section 501(c)(3) of the Internal Revenue Code as it is organized and operated for education and scientific purposes.

2. Summary of Significant Accounting Policies

Basis of Presentation

The accompanying financial statements have been prepared on the accrual basis and in accordance with the reporting principles of not-for-profit accounting.

The financial statements include certain prior-year summarized comparative information, but do not include sufficient detail to constitute a presentation in conformity with accounting principles generally accepted in the United States of America. Accordingly, such information should be read in conjunction with the Institution's audited financial statements for the year ended December 31, 2004, from which the summarized information was derived.

Net assets, revenues, and realized and unrealized gains and losses are classified based on the existence or absence of donor-imposed restrictions and legal restrictions imposed under Massachusetts State law. Accordingly, net assets and changes therein are classified as follows:

Permanently Restricted Net Assets

Permanently restricted net assets are subject to donor-imposed stipulations that they be maintained permanently by the Institution. Generally the donors of these assets permit the Institution to use all or part of the income earned and capital appreciation, if any, on related investments for general or specific purposes.

Temporarily Restricted Net Assets

Temporarily restricted net assets are subject to donor-imposed stipulations that may or will be met by actions of the Institution and/or the passage of time. Unspent gains on permanent endowment are classified as temporarily restricted until the Institution appropriates and spends such sums in accordance with the terms of the underlying endowment funds and in accordance with Massachusetts law, at which time they will be released to unrestricted revenues.

Unrestricted Net Assets

Unrestricted net assets are not subject to donor-imposed stipulations. Revenues are reported as increases in unrestricted net assets unless use of the related assets is limited by donor-imposed restrictions. Expenses are reported as decreases in unrestricted net assets. Gains and losses on investments and other assets or liabilities are reported as increases or decreases in unrestricted net assets unless their use is restricted by explicit donor stipulations or law. Expirations of temporary restrictions on net assets, that is, the donor-imposed stipulated purpose has been accomplished and/or the stipulated time period has elapsed, are reported as reclassifications between the applicable classes of net assets. Amounts received for sponsored research (under exchange transactions) are reflected in unrestricted sponsored research and

released to operations when spent for the appropriate purpose, or as deferred revenue if expenditures have yet to be incurred.

Contributions

Contributions, including unconditional promises to give, are recognized as revenues in the period received. Contributions subject to donor-imposed stipulations that are met in the same reporting period are reported as unrestricted support. Promises to give that are scheduled to be received after the balance sheet date are shown as increases in temporarily restricted net assets and are reclassified to unrestricted net assets when the purpose or items' restrictions are met. Certain releases from temporarily restricted amounting to $737,803 and $884,486 for the years ended December 31, 2005 and 2004, respectively, are netted against contributions and are included in unrestricted sponsored research. Promises to give, subject to donor-imposed stipulations that the corpus be maintained permanently, are recognized as increases in permanently restricted net assets. Conditional promises to give are not recognized until they become unconditional, that is, when the conditions on which they depend are substantially met. Contributions other than cash are generally recorded at market value on the date of the gift (or an estimate of fair value), although certain noncash gifts, for which a readily determinable market value cannot be established, are recorded at a nominal value until such time as the value becomes known. Contributions to be received after one year are discounted at the appropriate rate commensurate with risk. Amortization of such discount is recorded as additional contribution revenue in accordance with restrictions imposed by the donor on the original contribution, as applicable. Amounts receivable for contributions are reflected net of an applicable reserve for collectibility.

The Institution reports contributions in the form of land, buildings, or equipment as unrestricted operating support at fair market value when received.

Dividends, interest and net gains on investments of endowment and similar funds are reported as follows:

- as increases in permanently restricted net assets if the terms of the gift require that they be added to the principal of a permanent endowment fund;
- as increases in temporarily restricted net assets if the terms of the gift or relevant state law impose restrictions on the current use of the income or net realized and unrealized gains; and
- as increases in unrestricted net assets in all other cases.

Operations

The statement of activities report the Institution's operating and nonoperating activities. Operating revenues and expenses consist of those activities attributable to the Institution's current annual research or educational programs, all gifts received except those received for property, plant and equipment purposes and a component of endowment income appropriated for operations (Note 3). Unrestricted endowment investment income and gains over the amount appropriated under the Institution's spending plan are reported as nonoperating revenue as investment return in excess of amounts designated for sponsored research, education and current operations. Nonoperating revenue also includes the change in value of split interest agreements, contributions restricted for property, plant and equipment purposes, gains or losses on disposals of fixed assets, net realized/unrealized gains (losses) on interest swaps and the net periodic pension cost on the noncontributory defined benefit pension plan that is not reimbursed by the employee benefit fixed rate. Additionally, nonoperating activities includes redesignation of donor gifts and depreciation on certain government-funded facilities.

Cash and Cash Equivalents

Cash and cash equivalents consist of cash, money market accounts, certificates of deposit and overnight repurchase agreements with initial maturities of three months or less when purchased which are stated at cost and approximates market value.

Included in restricted cash at December 31, 2005 and 2004 is $782,927 and $142,991, respectively, representing advances received from the United States Navy and other U.S. Government and state agencies. Such amounts are restricted as to use for research programs. Interest earned on unspent funds is remitted to the federal government.

Also included in restricted cash at December 31, 2005 and 2004 is $244,092 and $239,430, respectively, representing cash restricted by the Massachusetts Department of Public Health. Interest earned on unspent funds is reinvested within the restricted cash account.

In addition, cash and cash equivalents include uninvested amounts from each classification of net assets (e.g., endowment).

Investments

Investment securities are carried at market value determined as follows: securities traded on a national securities exchange are valued at the last reported sales price on the last business day of the year; securities traded in the over-the-counter market and listed securities for which no sales prices were reported on that day are valued at closing bid prices. The value of publicly traded securities is based upon quoted market prices and net asset values. Other securities, such as private equity funds, for which no such quotations or valuations are readily available, are carried at fair value as estimated by management using values provided by external investment managers. The Institution believes that these valuations are a reasonable estimate of fair value as of December 31, 2005 and 2004 but are subject to uncertainty and, therefore, may differ from the value that would have been used had a ready market for the investments existed and such differences could be material.

Purchases and sales of investment securities are recorded on a trade date basis. Realized gains and losses are computed on a specific identification method. Investment income, net of investment expenses, is distributed on the unit method.

Investment Income Unitization

The Institution's investments are pooled in an endowment fund and the investments and allocation of income are tracked on a unitized basis. The Institution distributes to operations for each individual fund an amount of investment income earned by each of the fund's proportionate share of investments based on a total return policy.

The Board of Trustees has appropriated all of the income and a specified percentage of the net appreciation (depreciation) to operations as prudent considering the Institution's long and short-term needs, present and anticipated financial requirements, expected total return on its investments, price level trends, and general economic conditions. Under the Institution's current

endowment spending policy, which is within the guidelines specified under state law, between 4% and 5.5% of a 36-month average market value of qualifying endowment investments is appropriated. This amounted to $13,562,503 and $13,316,806 for the years ending December 31, 2005 and 2004, respectively, and is classified in operating revenues (research, education, and operations).

Deposits with Trustees

Deposits with trustees consists principally of investments in United States Government obligations and have been deposited with trustees as required under certain loan agreements. At December 31, 2005 and 2004, respectively, the amounts consist of $1,898,102 and $3,154,350 for debt service and $3,038,552 and $24,278,081 for construction purposes. Interest income on debt service amounted to $61,265 in 2005 and $20,766 in 2004 and is reflected in the statement of activities within other income. Interest income on construction funds amounted to $248,171 and $310,933 in 2005 and 2004, respectively, and is reflected in the statement of activities within other income.

Inventories

Inventories are stated at the lower of cost or market. Cost is determined using the first-in, first-out method.

Contracts and Grants

Revenues earned on contracts and grants for research are recognized as related costs are incurred.

The Institution received approximately 90% and 92% of its sponsored research revenues from government agencies including 55% and 57% of its operating revenues from the National Science Foundation and 11% and 14% from the United States Navy in fiscal years 2005 and 2004, respectively. Although applications for research funding to federal agencies historically have been funded, authorizations are subject to annual Congressional appropriations and payment.

Deferred Financing Costs

Costs incurred in connection with the placement of the Massachusetts Health and Educational Facilities Authority, Variable Rate Revenue Bonds, Woods Hole Oceanographic Institution Issue, Series 2004, have been deferred and are being amortized over the term of the obligation on a straight line basis.

Interest Rate Swap

The Institution has entered into an interest rate swap agreement on the Massachusetts Health and Educational Facilities Authority, Variable Rate Revenue Bonds, Woods Hole Oceanographic Institution Issue, Series 2004 Bonds in order to convert a portion of the variable rate debt to fixed rate, thereby economically hedging against changes in the cash flow requirements of the Institution's variable rate debt obligations.

Net payments or receipts (difference between variable and fixed rate) under the swap agreement along with the change in fair value of the swap are recorded in nonoperating activities as net realized/unrealized gains (losses) on interest swap.

Property, Plant and Equipment

Property, plant and equipment are stated at cost. Depreciation is provided on a straight-line basis at annual rates of 12 to 39 years on buildings and improvements, 10 to 15 years on vessels and dock facilities and 5 to 10 years on laboratory and other equipment. Depreciation expense on property, plant, and equipment purchased by the Institution in the amounts of $5,740,108 and $5,058,656 in 2005 and 2004, respectively, has been charged to operating activities. Depreciation on certain government-funded facilities (the Laboratory for Marine Science and the dock facility) amounting to $99,976 in 2005 and in 2004 has been charged to nonoperating expenses as these assets were gifted by the Government.

Construction commitments totaled $2,264,844 at December 31, 2005.

During fiscal 2005 and 2004, the Institution capitalized interest of $716,427 and $65,500, respectively.

Included in construction in process is $669,180 and $18,799,066 at December 31, 2005 and 2004, respectively, relating to campus development.

Conditional Asset Retirement Obligations

The Institution implemented Financial Accounting Standards Board Interpretation No. 47, *Accounting for Conditional Asset Retirement Obligations* during 2005. The effects of implementing this interpretation in 2005 were immaterial.

Use of Estimates

The preparation of the financial statements in accordance with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and the disclosure of contingent assets and liabilities at the date of the financial statements and the reported amounts of revenues and expenses during the period. Actual results could differ from those estimates.

3. Investments

The cost and market value of pooled investments held at December 31 are as follows:

	2005		2004	
	Cost	Market	Cost	Market
US treasury bonds	$ 27,200,000	$ 27,650,867	$ 27,200,000	$ 27,254,862
Corporate bonds	17,330,371	17,194,079	17,411,829	17,620,896
International bond funds	9,619,483	9,070,163	9,613,758	10,219,035
Private equity funds	51,018,353	69,197,823	40,003,133	52,910,222
Hedge funds	36,295,000	40,176,098	31,295,000	33,005,771
Domestic equities	46,578,718	55,288,876	48,425,676	59,816,051
International equities	48,693,352	62,668,897	50,282,579	63,791,628
Venture capital	28,375,188	26,702,972	28,027,323	22,611,951
Other	46,693	46,693	46,693	46,693
Total investments	$ 265,157,158	$ 307,996,468	$ 252,305,991	$ 287,277,109

The nonpooled investments with a cost of $5,200,020 and a market value of $5,070,498 at December 31, 2005 are invested in a private bond fund.

The following schedule summarizes the investment return on pooled and nonpooled investments and its classification in the statement of activities:

	Unrestricted	Temporarily restricted	2005 Total	2004 Total
Dividend and interest income	$ 1,996,691	$ 1,761,590	$ 3,758,281	$ 6,813,948
Investment management costs	(2,069,753)	-	(2,069,753)	(1,275,801)
Net realized gains	3,893,821	12,996,199	16,890,020	17,142,121
Change in unrealized appreciation	6,664,694	1,036,600	7,701,294	10,546,777
Total return on investments	10,485,453	15,794,389	26,279,842	33,227,045
Investment return designated for				
Sponsored research	-	(4,910,827)	(4,910,827)	(4,725,103)
Education	(3,867,255)	(1,761,590)	(5,628,845)	(5,585,654)
Current operations	(3,464,870)	-	(3,464,870)	(3,381,128)
Total distributions to operations	(7,332,125)	(6,672,417)	(14,004,542)	(13,691,885)
Investment return in excess of amounts designated for sponsored research, education and current operations	$ 3,153,328	$ 9,121,972	$12,275,300	$ 19,535,160

Investment return distributed to operations includes $442,039 and $375,079 earned on nonendowment investments for the years ended December 31, 2005 and 2004, respectively.

As a result of market declines, the fair value of certain donor restricted endowments is less than the historical cost value of such funds by $232,279 at December 31, 2005 and $434,022 at December 31, 2004. These unrealized losses have been recorded as reductions in unrestricted net assets. Future market gains will be used to restore this deficiency in unrestricted net assets before any net appreciation above the historical cost value of such fund increases temporarily restricted net assets.

Investment securities are exposed to various risks such as interest rate, market and credit risks. Due to the level of risk associated with certain investments, it is at least reasonably possible that changes in the value of investment securities will occur in the near term and that such changes could materially affect the market values and the amounts reported in the statement of financial position.

Endowment income for pooled investments is allocated to each individual fund based on a per unit valuation. The value of an investment unit at December 31 is as follows:

	2005	2004
Unit value, beginning of year	$ 4.1517	$ 3.9177
Unit value, end of year	4.3755	4.1517
Net change for the year	.2238	.2340
Investment income per unit for the year	.0173	.0361
Total return per unit	$ .2411	$ .2701

4. Pledges Receivable

Pledges that are expected to be collected within one year are recorded at their net realizable value. Pledges that are expected to be collected in future years are recorded at the present value of estimated future cash flows. The present value of estimated future cash flows has been measured utilizing a discount rate equivalent to U.S. Treasury yields of similar maturity (ranging from 2.36– 3.63, depending upon the anticipated pledge fulfillment date).

Pledges receivable consist of the following at December 31:

	2005	2004
Unconditional promises expected to be collected in:		
Less than one year	$ 2,127,027	$ 2,372,251
One year to five years	3,208,472	5,087,435
Reserve for uncollectible pledges receivable	(373,485)	(298,387)
Unamortized discount	(154,177)	(282,109)
	$ 4,807,837	$ 6,879,190

5. Contribution Receivable from Remainder Trusts

The Institution recorded $10,390,619 and $10,043,233 at December 31, 2005 and 2004, respectively, relating to various charitable remainder trusts in its statement of financial position. The receivable and related revenue is measured at the present value of estimated future cash flows to be received and recorded in the appropriate net asset category based on donor stipulation. During the term of these agreements, changes in the value are recognized based on amortization of discounts and changes in actuarial assumptions.

6. Deferred Fixed Rate Variance

The Institution receives funding or reimbursement from federal government agencies for sponsored research under government grants and contracts. Revenue is recognized as related costs are incurred. The Institution has negotiated fixed rates with the federal government for the recovery of certain fringe benefits and indirect costs on these grants and contracts. Such recoveries are subject to carryforward provisions that provide for adjustments to be included in the negotiation of future fixed rates. The deferred fixed rate variance accounts represent the cumulative amount owed to or due from the federal government. The Institution's rates are negotiated with the Office of Naval Research (ONR), the Institution's cognizant agency.

The composition of the deferred fixed rate variance is as follows:

Deferred Fixed Rate Variance asset, December 31, 2003	$ 3,197,693
2004 indirect costs	51,834,850
2003 adjustment	1,081
Amounts recovered	(55,163,124)
2004 change	(3,327,193)
Deferred Fixed Rate Variance liability, December 31, 2004	(129,500)
2005 indirect costs	53,394,255
2004 adjustment	(5,572)
Amounts recovered	(56,380,926)
2004 change	(2,992,243)
Deferred Fixed Rate Variance liability, December 31, 2005	$ (3,121,743)

As of December 31, 2005 the Institution has received a cumulative recovery in excess of expended amounts of $3,121,743 which will be reflected as a deduction to future year recoveries. This amount has been reported as liability of the Institution.

7. Bonds Payable

In fiscal 2004, proceeds were received from the offering of the $54,850,000 Massachusetts Health and Educational Facilities Authority (MHEFA) Variable Rate Revenue Bonds, Woods Hole Oceanographic Institution Issue, Series 2004, which were used to repay the MHEFA B Pool loans and are being used for campus construction. The bonds contain certain restrictive covenants including limitations on obtaining additional debt, filings of annual financial statements and limitations on the creation of liens. In addition, the Institution agrees that, subject to any governmental restrictions, its fiduciary obligations and limitations imposed by law, it will maintain unrestricted resources at a market value equal to at least 75% of all outstanding indebtedness. The bonds also require a debt service fund to be established. Included in deposits with trustees on the statement of financial position is the market value of the debt service fund of $1,898,102 and $3,154,350 at December 31, 2005 and 2004, respectively. The Series 2004 Bonds are collateralized by the Institution's unrestricted revenues. The interest rate for the Series 2004 Bonds is variable and set weekly, and at December 31, 2005, the rate was 3.46%.

The aggregate maturities due on long-term debt at December 31, 2005 are as follows:

Fiscal Year	Principal Amount
2008	$ 1,150,000
2009	1,200,000
2010	1,250,000
Thereafter	51,250,000
	$ 54,850,000

In June 2004, the Institution entered into an interest rate swap agreement, with a term through June 1, 2034. This swap effectively locks in a fixed rate of 3.79% per annum. The agreement has a notional amount of $54,850,000. At December 31, 2005 and 2004, respectively, the market value of the swap agreement amounted to a liability of $3,070,826 and $3,298,128 which is included in accounts payable and other liabilities. The value of the interest rate swap is reflected within accounts payable and other liabilities and nonoperating income/expense in the financial statements. Additionally, the Institution paid interest expense in association with the swap agreement of $867,459 and $722,562 which is reflected as part of the net realized/unrealized gains (losses) on interest swap at December 31, 2005 and 2004, respectively. For internal financial reporting purposes, the realized/unrealized loss on the interest rate swap is reflected in operating expenses, and interest income and interest expense related to the debt is reflected in operating income and operating expenses, respectively.

8. Retirement Plans

The Institution maintains a noncontributory defined benefit pension plan covering substantially all employees of the Institution, a restoration plan for certain senior employees and a supplemental benefit plan for certain other employees. Pension benefits are earned based on years of service and compensation received. The Institution's policy is to fund at least the minimum required by the Employee Retirement Income Security Act of 1974.

The Institution uses a December 31 measurement date for all of its plans.

	Restoration Plan Pension Benefits	
	2005	2004
Change in benefit obligation		
Benefit obligation at beginning of year	$ 1,319,056	$ 1,200,690
Service cost	20,615	25,699
Interest cost	66,098	86,005
Plan amendments	510,796	(190,939)
Actuarial (gain) loss	(275,626)	197,601
Benefit obligation at end of year	$ 1,640,939	$ 1,319,056
Funded status	$ (1,640,939)	$ (1,319,056)
Unrecognized net actuarial loss	33,773	355,726
Unrecognized prior service cost	525,887	(28,941)
Net amount recognized	$ (1,081,279)	$ (992,271)
Amounts recognized in the statement of financial position consist of		
Accrued benefit liability	$ (1,405,839)	$ (1,090,718)
Cumulative reduction in net assets	-	98,447
Intangible asset	324,560	-
Net amount recognized	$ (1,081,279)	$ (992,271)

	Restoration Plan Pension Benefits	
	2005	2004
Change in net assets attributable to change in additional minimum liability recognition	$ (98,447)	$ 98,447
Information for pension plans with accumulated benefit obligations in excess of plan assets		
Projected benefit obligation	1,640,939	1,319,056
Accumulated benefit obligation	1,405,828	1,090,718
Fair value of plan assets	-	-
Components of net periodic benefit cost		
Service cost	20,615	25,699
Interest cost	66,098	86,005
Amortization of prior service cost	(44,032)	87,650
Recognized actuarial loss	46,326	136,768
Net periodic benefit cost	$ 89,007	$ 336,122
Weighted-average assumptions used to determine benefit obligations at December 31		
Discount rate	5.75%	5.75%
Rate of compensation increase	4.50%	6.00%
Weighted-average assumptions used to determine net periodic benefit cost for years ended December 31		
Discount rate	5.75%	6.25%
Rate of compensation increase	6.00%	6.00%

As a result of plan amendments made to the Institution's noncontributory defined benefit pension plan, the Restoration Plan pension benefits had a corresponding change (see qualified plan for a summary of plan amendments).

Expected Contributions

The Institution anticipates contributing $47,570 to the Restoration Plan in 2006.

Estimated Future Benefit Payments

The following benefit payments, which reflect expected future service are expected to be paid as follows:

Years	Benefit Payments
2006	$ 45,570
2007	-
2008	1,816,663
2009	-
2010 and thereafter	-

	Qualified Plan Pension Benefits	
	2005	2004
Change in benefit obligation		
Benefit obligation at beginning of year	$ 177,927,242	$ 176,914,377
Service cost	5,922,793	7,006,323
Interest cost	9,751,495	11,250,529
Plan amendments	34,734,251	(27,041,213)
Actuarial (gain) loss	(3,985,084)	18,666,776
Benefits paid	(9,579,933)	(8,869,550)
Benefit obligation at end of year	$ 214,770,764	$ 177,927,242
Change in plan assets		
Fair value of plan assets at beginning of year	$ 150,616,331	$ 143,751,387
Employer contributions	1,927,020	-
Actual return on plan assets	12,958,470	15,734,494
Benefits paid	(9,579,933)	(8,869,550)
Fair value of plan assets at end of year	$ 155,921,888	$ 150,616,331
Funded status	$ (58,848,876)	$ (27,310,911)
Unrecognized net actuarial loss	27,551,799	36,107,982
Unrecognized prior service cost	17,257,176	(18,447,001)
Net amount recognized	$ (14,039,901)	$ (9,649,930)
Amounts recognized in the statement of financial position consist of		
Accrued benefit liability	$ (27,390,061)	$ (23,606,689)
Cumulative reduction in net assets	-	13,956,759
Intangible asset	13,350,160	-
Net amount recognized	$ (14,039,901)	$ (9,649,930)
Change in net assets attributable to change in additional minimum liability recognition	$ (13,956,759)	$ 13,956,759
Information for pension plans with accumulated benefit obligations in excess of plan assets		
Projected benefit obligation	214,770,764	177,927,242
Accumulated benefit obligation	183,311,949	174,223,020
Fair value of plan assets	155,921,888	150,616,331
Components of net periodic benefit cost		
Service cost	5,922,793	7,006,323
Interest cost	9,751,495	11,250,529
Expected return on plan assets	(10,689,353)	(11,708,592)
Amortization of prior service cost	(969,926)	1,343,266
Recognized actuarial loss	2,301,982	1,112,519
Net periodic benefit cost	$ 6,316,991	$ 9,004,045

In 2005, the Institution has reflected $1,927,020 of the net periodic benefit cost in the operating section of the statement of activities which represents the amount reimbursed through the employee benefit fixed rate as negotiated with the United States Government. The remaining $4,389,971 of net periodic benefit cost is reflected in nonoperating expenses. In 2004, the entire net periodic benefit cost of $9,004,045 was reflected in the nonoperating section of the statement of activities as no portion of the cost was reimbursed through the employee benefit fixed rate. In 2004, the Institution was required to record an additional charge of $13,956,759 to reflect a minimum balance sheet liability equal to the Plan's unfunded accumulated benefit obligation. In 2005, the accumulated reduction in net assets was reversed because an intangible asset was permitted to be established to offset the additional minimum liability on the statement of financial position.

	Qualified Plan Pension Benefits	
	2005	**2004**
Weighted-average assumptions used to determine benefit obligations at December 31		
Discount rate	5.75%	5.75%
Rate of compensation increase	4.50%	(3.5% prior to plan amendment)
Weighted-average assumptions used to determine net periodic benefit cost for years ended December 31		
Discount rate	5.75%	6.25%
Expected long-term rate of return on plan assets	8.00%	8.50%
Rate of compensation increase	-	3.50%

To develop the expected long-term rate of return on assets assumption, the Institution considered the current level of expected returns on risk-free investments (primarily government bonds), the historical level of the risk premium associated with the other asset classes in which the portfolio is invested and the expectations for future returns of each asset class. The expected return for each asset class was then weighted based on the target asset allocation to develop the expected long-term rate of return on assets assumption for the portfolio, net of expenses expected to be paid. This resulted in the selection of the 8.00% assumption.

Effective December 31, 2004, final average compensation for the Plan was frozen and equal to a participant's final average compensation determined as of December 31, 2004. A one year index of 4.5% will be applied to the frozen December 31, 2004 final average compensation for service performed during 2005. In addition, effective December 31, 2004, the minimum lump-sum benefit was amended to eliminate the 8% pay credit for years after 2005. These changes have been reflected in the liabilities as of December 31, 2004.

Effective January 1, 2006, the Qualified Plan was amended. The lump sum (introduced in 1999) will no longer be available on benefits earned after January 1, 2006. Benefits for service from 25 to 35 years introduced in 1999 will be removed. The lifetime benefit payable upon early retirement has changed from a 6% per year reduction to a 5% per year reduction. Minimum lump sum benefits equal to 5% of final average compensation times service replaces the minimum introduced in 1999 of approximately 8%. The preretirement death benefit has been reduced from 100% of the accrued pension benefit to 50% of the accrued pension benefit but not less than the participant's accrued benefit as of December 31, 2005. The 3-year vesting period (introduced in 1999) will change to a 5-year vesting service for employees hired after December 31, 2005. These changes have been reflected in the intangible asset and in the liability as of December 31, 2005.

Plan Assets

The Institution's pension plan weighted-average asset allocations at December 31, 2005 and 2004, by asset category are as follows:

Asset Category	**2005**	**2004**
Equity securities	57%	80%
Debt securities	17%	18%
Cash	3%	2%
Nonmarketable alternative investments	23%	-
	100%	100%

The following target asset allocation is used:

Asset Category	**Target Allocation**
U.S. equity	30%
Global excluding U.S. equity	12%
Emerging markets equity	3%
Hedge fund of funds	15%
Alternative investments	15%
Real assets	5%
Bonds	20%

The primary financial objectives of the assets of the Plan are to (1) provide a stream of relatively predictable, stable and constant earnings in support of the Qualified Plan's annual benefit payment obligations; and (2) preserve and enhance the real (inflation-adjusted) value of assets, over time, with the goal of meeting the anticipated future benefit obligations of the qualified plan.

The long-term investment objectives of the assets of the Plan are to (1) attain the average annual total return assumed in the Plan's most recent actuarial assumptions (net of investment management fees) over rolling five-year periods; and (2) outperform the custom benchmark.

Expected Contributions

The Institution anticipates contributing $6,000,000 to the Qualified Plan in 2006.

Estimated Future Benefit Payments

The following benefit payments, which reflect expected future service are expected to be paid as follows:

Years	Benefit Payments
2006	$ 14,725,939
2007	13,771,821
2008	13,638,214
2009	14,568,931
2010	13,651,305
2011 - 2015	75,261,192

	Supplemental Plan Pension Benefits	
	2005	2004
Change in benefit obligation		
Benefit obligation at beginning of year	$ 3,922,283	$ 3,430,977
Service cost	71,554	89,087
Interest cost	186,266	227,880
Actuarial loss	(428,816)	393,799
Benefits paid	(193,737)	(219,460)
Plan change	38,350	-
Benefit obligation at end of year	$ 3,595,900	$ 3,922,283
Change in plan assets		
Fair value of plan assets at beginning of year	$ -	$ -
Employer contributions	193,737	219,460
Benefits paid	(193,737)	(219,460)
Fair value of plan assets at end of year	$ -	$ -
Funded status	$ (3,595,900)	$ (3,922,283)
Unrecognized actuarial (gain) loss	(59,160)	331,548
Unrecognized prior service cost	39,351	1,316
Net amount recognized	$ (3,615,709)	$ (3,589,419)
Amounts recognized in the statement of financial position consist of		
Accrued benefit liability	$ (3,615,709)	$ (3,589,419)
Information for pension plans with accumulated benefit obligations in excess of plan assets		
Projected benefit obligation	$ 3,595,900	$ 3,922,283
Accumulated benefit obligation	3,277,938	3,402,514
Fair value of plan assets	-	-
Components of net periodic benefit cost		
Service cost	$ 71,554	$ 89,087
Interest cost	186,266	227,880
Expected return on earmarked reserves	(192,649)	(213,372)
Amortization of prior year service cost	315	315
Net periodic benefit cost	$ 65,486	$ 103,910
Actual return on earmarked reserves	$ 154,541	$ 160,610
Weighted-average assumptions used to determine benefit obligations at December 31		
Discount rate	5.75%	5.75%
Rate of compensation increase	4.50%	3.50%
Weighted-average assumptions used to determine net periodic benefit cost for years ended December 31		
Discount rate	5.75%	6.25%
Expected long-term rate of return on plan assets	8.00%	8.50%
Rate of compensation increase	4.50%	3.50%

The accrued supplemental retirement is matched by a "Rabbi" Trust with $6,585,207 and $6,537,921, respectively, as of December 31, 2005 and 2004. An additional accrual of $2,969,498 and $2,948,502 has been established for the excess of the "Rabbi" Trust assets over the accrued supplemental retirement benefits at December 31, 2005 and 2004, respectively.

Expected Contributions

The Institution does not anticipate contributing to the Supplemental Plan in 2006.

Estimated Future Benefit Payments

The following benefit payments, which reflect expected future service are expected to be paid as follows:

Years	Benefit Payments
2006	$ 396,872
2007	502,076
2008	576,642
2009	510,776
2010	519,166
Years 2011 - 2015	1,904,514

9. Other Postretirement Benefits

In addition to providing retirement plan benefits, the Institution provides certain health care benefits for retired employees and their spouses. Substantially all of the Institution's employees may become eligible for the benefits if they reach normal retirement age (as defined) or elect early retirement after having met certain time in service criteria.

	Other Postretirement Benefits	
	2005	**2004**
Change in benefit obligation		
Benefit obligation at beginning of year	$ 26,594,502	$ 33,153,875
Service cost	693,340	1,055,495
Interest cost	1,385,648	2,216,096
Plan amendment	-	(18,015,085)
Benefits paid	(1,440,682)	(1,278,178)
Actuarial loss	(1,626,986)	9,462,299
Benefit obligation at end of year	$ 25,605,822	$ 26,594,502
Change in plan assets		
Fair value of plan assets at beginning of year	$ 19,042,401	$ 16,213,670
Employer contributions	683,853	2,823,000
Actual return on plan assets	1,038,079	1,397,393
Benefits paid	(1,440,682)	(1,278,178)
Administrative expenses	-	(113,484)
Fair value of plan assets at end of year	$ 19,323,651	$ 19,042,401
Funded status	$ (6,282,171)	$ (7,552,101)
Unrecognized net actuarial loss	18,497,259	20,957,816
Unrecognized prior service cost (credit)	(11,426,262)	(12,766,418)
Net amount recognized	$788,826	$639,297
Amounts recognized in the statement of financial position consist of		
Prepaid benefit cost	$ 788,826	$ 639,297
Components of net periodic benefit cost		
Service cost	$ 693,340	$ 1,055,495
Interest cost	1,385,648	2,216,096
Expected return on plan assets	(1,475,831)	(1,456,524)
Amortization of transition obligation	-	853,549
Amortization of prior service cost	(1,340,156)	(526,577)
Recognized actuarial loss	1,271,325	830,490
Net periodic benefit cost	$ 534,326	$ 2,972,529

The Institution has reflected the net periodic benefit cost in operating expenses, as the amount is reimbursed through federal awards.

Weighted-average assumptions used to determine benefit obligations at December 31		
Discount rate	5.75%	5.75%
Weighted-average assumptions used to determine net periodic benefit cost for years ended December 31		
Discount rate	5.75%	6.25%
Expected long-term rate of return on plan assets	8.00%	8.50%

On December 8, 2003, Medicare reform legislation was enacted, providing a Medicare prescription drug benefit beginning in 2006 and federal subsidies to employers who provide drug coverage to retirees. The Institution decided not to reflect the future government subsidy in the fiscal 2004 expense. However, in December 2004, the Institution amended the plan to eliminate prescription drug coverage for all post-65 retirees effective January 1, 2006, and to encourage enrollment in Medicare Part D by reimbursing Medicare Part D premiums beginning in 2006. These changes have been reflected in the obligations as of December 31, 2004.

	2005		2004	
	Pre-65	**Post-65**	**Pre-65**	**Post-65**
Assumed health care cost trend rates at December 31				
Health care cost trend rate assumed for next year	10.0%	7.3%	11.0%	11.0%
Rate to which the cost trend rate is assumed to decline (the ultimate trend rate)	5.0%	4.3%	5.0%	4.3%
Year that the rate reaches the ultimate trend rate	2014	2013	2014	2013

Assumed health care cost trend rates have a significant effect on the amounts reported for the health care plan. A one-percentage-point change in assumed health care cost trend rates would have the following effects:

	2005	2004
	One-Percentage-Point Increase in Trend	**One-Percentage-Point Increase in Trend**
Effect on total of service cost and interest cost components	$ 365,522	$ 803,127
Effect on year-end postretirement benefit obligation	3,709,195	3,682,332
	One-Percentage-Point Decrease in Trend	**One-Percentage-Point Decrease in Trend**
Effect on total of service cost and interest cost components	$ (292,004)	$ (410,643)
Effect on year-end postretirement benefit obligation	(3,048,587)	(3,002,534)

Plan Assets

The Institution's postretirement benefit plan weighted-average asset allocations at December 31, 2005 and 2004, by asset category are as follows:

Asset Category	2005	2004
Equity securities	100%	82%
Debt securities	-	18%
	100%	100%

To develop the expected long-term rate of return on assets assumption, the Institution considered the current level of expected returns on risk free investments (primarily government bonds), the historical level of the risk premium associated with the other asset classes in which the portfolio is invested and the expectations for future returns of each asset class. The expected return for each class was then weighted based on the target asset allocation to develop the expected long-term rate of return on assets assumption for the portfolio, net of expenses expected to be paid. This resulted in the selection of the 8.00% assumption.

Expected Contributions

The Institution anticipates contributing $600,000 to the Retiree Medical Plan in 2006.

Estimated Future Benefit Payments

The following benefit payments, which reflect expected future service are expected to be paid as follows:

Years	Benefit Payments
2006	$ 1,189,099
2007	1,253,294
2008	1,342,660
2009	1,406,349
2010	1,474,308
Years 2011 - 2015	8,735,830

10. Commitments and Contingencies

The Defense Contract Audit Agency (DCAA) is responsible for auditing both direct and indirect charges to grants and contracts on behalf of the ONR. The Institution and the ONR have settled the years through 2003. The current indirect cost recovery rates, which are fixed, include the impact of prior year settlements. The DCAA issued an audit report on the completed audit of direct and indirect costs for the year ended December 31, 2004 on October 13, 2005. The audit resulted in no questioned direct or indirect costs. The 2005 costs remain subject to audit. Any adjustments will be recorded in the years they become known.

The Institution through its pooled investments is committed to invest $19,465,355 in certain venture capital and investment partnerships as of December 31, 2005.

The Institution is a defendant in legal proceedings incidental to the nature of its operations. The Institution believes that the outcome of these proceedings will not materially affect its financial position.

11. Related Party Transactions

In fiscal year 2005, the Institution passed through Federal Awards of approximately $794,000 to subgrantee organizations in which an individual associated with the subgrantee organization is also a member of the Institution's Board of Trustees or Corporation. The Institution also has other transactions such as legal services and other items with organizations where members of the Board of Trustees or Corporation are affiliated with the organizations. Total expenditures for these legal and other transactions were approximately $353,000 and $496,000 for the years ended December 31, 2005 and 2004, respectively.

The Institution has loans due from various employees for education advances and computer purchases. The amounts outstanding are approximately $693,000 and $643,000 at December 31, 2005 and 2004, respectively.

12. Clark Laboratory Fire

In October 2002, the Institution experienced a fire in the Clark Laboratory Building which resulted in contamination and damage to several laboratories, clean rooms and equipment. Since then, the Institution has coordinated with its insurance carrier and other interested parties to identify and quantify the damage caused by the fire. The Institution has received a total of $6,473,000 in cash from the insurance company of which $1,473,000 was received in 2005 and $1,000,000 was received in 2004. Approximately $8,661,000 in total was paid to various parties for fire related damages. Of this amount, approximately $1,798,000 was paid in 2005 and approximately $2,118,000 was paid in 2004. The total loss related to the fire was $2,188,000, of which $729,000 was recognized in 2005.

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