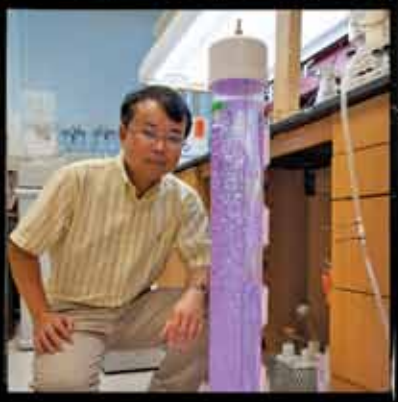
Remarkable Science for a Remarkable Time












2010 ANNUAL REPORT

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

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From the President...

Never before in the institution's 85-year history has the University of Maryland Center for Environmental Science's research been more important to the environmental future of Maryland, the region and the world.

This year has been a remarkable year for the Center. As environmental emergencies have transpired and debates arisen, the Center's experts have answered the call and provided the science-based guidance needed to help cope with the problems at hand.

Over the last year, UMCES experts have led the national debate on the environmental consequences of mountaintop mine removal, have educated members of Congress on the potential ecosystem-wide impacts of the Gulf of Mexico oil spill, and worked hand-in-hand with the State of Maryland to develop a science-based blueprint for restoring the environmental and economic vitality of the Chesapeake Bay. Individually, each of these societal contributions is a great achievement. Collectively, they provide insight into the quality of UMCES scientists and our rising prominence on the national stage.

Even during these difficult economic times, the Center's reputation for cutting-edge environmental research has allowed us to excel. Thanks to our actively engaged research faculty, the Center brought in more than $27 million in new research grants and contracts over the last fiscal year, the most in UMCES history. And during that same time, UMCES scientists published more than 150 scholarly journal articles, contributing new knowledge and understanding to the broader scientific community. Most importantly, our faculty's dedication to fostering the next generation of environmental scientists has helped our students earn graduate degrees from partner University System of Maryland institutions.

While 2010 was truly a remarkable year, it was just a stepping stone to a brighter future. To ensure the Center continues to flourish as one of the nation's leading environmental research institutions, we expanded our facilities at the Horn Point Laboratory with the opening of a new $11 million Shellfish Cultivation Facility and broke ground on a state-of-the-art Environmental Information Center. We began the replacement of our historic research pier at the Chesapeake Biological Laboratory and expanded our research enterprise with the addition of faculty members at the Baltimore-based Institute of Marine and Environmental Technology. These center-wide advancements will allow the Center to thrive in coming years.

I believe 2010 set a new high-water mark for the University of Maryland Center for Environmental Science. Even during the most challenging of times, the Center rose to the top, proving that science, ingenuity and passion for discovery still has the potential to lead us to a brighter tomorrow.

Sincerely,
Dr. Donald F. Boesch, President

MISSION

The University of Maryland Center for Environmental Science has a unique statutory mandate to conduct a comprehensive scientific program to develop and apply predictive ecology for the improvement and preservation of Maryland's physical environment. This mission is accomplished through research, education and public service.

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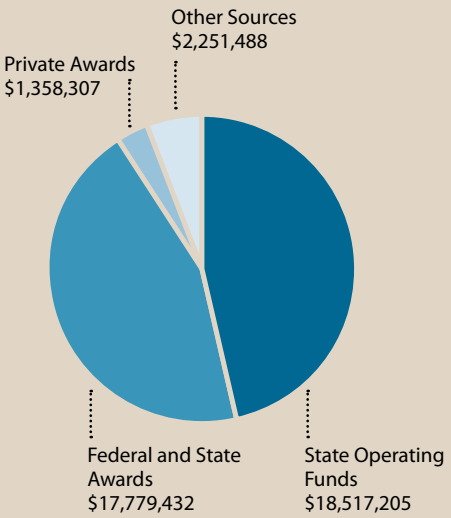
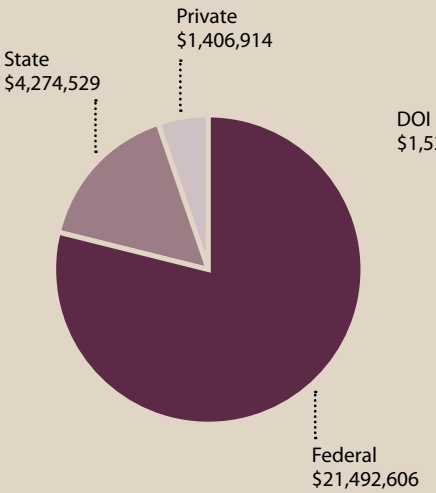
2010 FINANCIALS

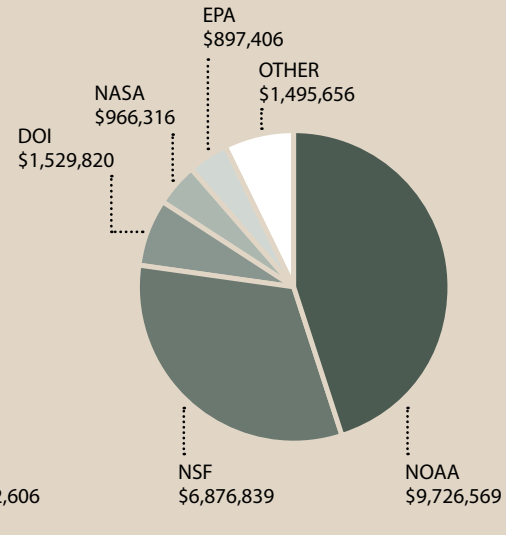
EXPENDITURES



RESEARCH AWARDS



FEDERAL AWARDS BY AGENCY



UMCES Horn Point Laboratory, Cambridge

UMCES Chesapeake Biological Laboratory, Solomons

UMCES Appalachian Laboratory, Frostburg

Institute of Marine and Environmental Technology, Baltimore

The University of Maryland Center for Environmental Science harnesses the power of science to transform the way society understands and manages the environment. By conducting cutting-edge research into today's most pressing environmental problems, the Center is developing new ideas to help guide our state, nation, and world toward a more environmentally sustainable future.

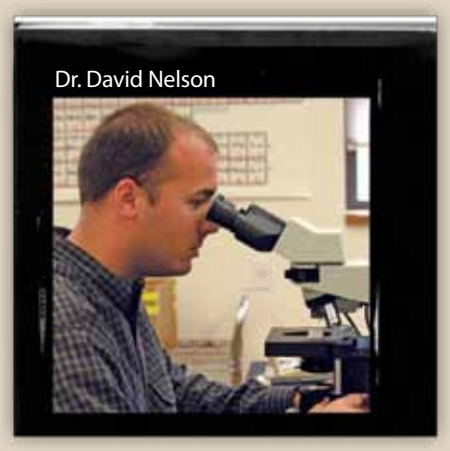
With locations throughout the State—the Appalachian Laboratory in the mountains of western Maryland, the Chesapeake Biological Laboratory at the mouth of the Patuxent River, the Horn Point Laboratory on the Eastern Shore, the Institute of Marine and Environmental Technology on Baltimore's Inner Harbor and the Maryland Sea Grant College located in College Park, the Center excels in bringing together interdisciplinary scientific studies in its pursuit of greater understanding about ecosystems and their natural processes.

Each laboratory is strategically focused on specific areas of research, education and scientific application, making the Center among the only institutions in the world to examine a large ecosystem—the Chesapeake Bay and its watershed—in its entirety.

As Maryland's only research institution solely focused on advancing scientific knowledge of the environment, UMCES is one of twelve institutions within the University System of Maryland. Providing professional research opportunities under the direct supervision of its leading faculty, UMCES annually supports more than one hundred exemplary graduate students through four collaborative programs—Marine Estuarine Environmental Sciences Graduate Program; Environmental Toxicology; Applied Ecology and Conservation Biology; and, Wildlife/Fisheries Management.

Expertise in Action

UMCES researchers are respected the world over for their contributions to the global scientific community. These papers are sampled from more than 150 peer reviewed papers authored by the Center's scientists in 2010.



Dr. David Nelson

RETHINKING THE EVOLUTION OF OUR MOST IMPORTANT GRASSES

A new analysis of fossilized grass-pollen grains deposited on ancient European lake and sea bottoms 16-35 million years ago reveals that a group of plants—called C_4 grasses—evolved earlier than previously thought. This new evidence casts doubt on the widely-held belief that the rise of this incredibly productive group of plants was driven by a large drop in atmospheric carbon dioxide concentrations during the Oligocene epoch.

The research team, led by Appalachian Laboratory researcher **Dr. David Nelson**, examined the carbon isotope signatures of hundreds of grass-pollen grains and found that C_4 grasses were already present on the landscape during the early part of the Oligocene, some 14 million years earlier than previously thought from geological evidence.

While the most well known C_4 plants are maize and sugar cane, both of which are critical to human consumption, there is a growing interest in their use as biofuels in order to capture carbon from the atmosphere to reduce increasing global carbon dioxide levels.

Dr. Allen Place

CURBING CHESAPEAKE BAY FISH KILLS THROUGH BIOTECHNOLOGY

Each summer, pollution-driven harmful algae blooms become more common in the Chesapeake Bay and its tributaries. Their days could be numbered however, thanks to new research that sheds light into why a particular type of algae emits a poison into the Bay's waters during bloom events.

Research conducted by a team of scientists including UMCES@IMET researcher **Dr. Allen Place** studied the behavior of the algal cell *Karlodinium veneficum* and discovered that this particular species releases a poison called karlotoxin to stun and immobilize the prey it plans to eat.

This is the first demonstration of Bay algae making a toxin for ecological advantage. Since higher prey means higher toxic blooms—which can result in fish kills—scientists believe that efforts to reduce the availability of its prey through nutrient reduction can reduce the frequency and intensity of future blooms and associated fish kills.

Urban, M., Nelson, D., Jimenez-Moreno, G., Chateauneuf, J., Pearson, A., Hu, F. Isotopic evidence of C_4 grasses in southwestern Europe during the Early Oligocene–Middle Miocene. *Geology*. 38:1091-1094. 2010.

Sheng, J., Malkiel, E., Katz, J., Adolf, J.E., Place, A.R. A dinoflagellate exploits toxins to immobilize prey prior to ingestion. *Proceedings of the National Academy of Sciences of the United States of America*. 107(5): 2082-2087. 2010.

UNDERSTANDING THE ENVIRONMENTAL CONSEQUENCES OF MOUNTAINTOP MINE REMOVAL

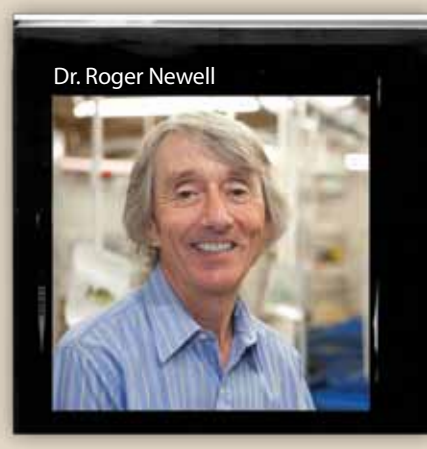
The consequences of mountaintop mine removal have been obvious to environmental scientists for years. The mining process—which clears upper elevation forests, strips the land of topsoil, and uses explosives to break up rocks before pushing them into adjacent valleys where they bury headwater streams—has an immediate and detrimental impact on the local flora and fauna. By detailing those consequences in a new comprehensive analysis, a group of leading environmental scientists has been able to elevate the mountaintop removal debate to the national level.

Writing in the journal *Science*, the group led by Chesapeake Biological Laboratory Director **Dr. Margaret Palmer** and Appalachian Laboratory scientist **Dr. Keith Eshleman**, used their findings to call on the federal government to stop the irreversible environmental impacts from mountaintop mining.

In their paper, the authors outline severe environmental degradation taking place at mining sites and downstream. Not only does the practice destroy extensive tracts of deciduous forests and bury small streams that play essential roles in the overall health of entire watersheds, but waterborne contaminants also enter streams that remain below valley fills and can be transported great distances into larger bodies of water. The authors also describe human health impacts associated with surface mining for coal in the Appalachian region, including elevated rates of mortality, lung cancer, and chronic heart, lung and kidney disease in coal producing communities.

Palmer, M., Bernhardt, E., Schlesinger, W., Eshleman, K., Foufoula-Georgiou, E., Hendryx, M., Lemly, D., Likens, G., Loucks, O., Power, M., White, P., Wilcock, P. Mountaintop mining consequences. *Science*. 327:148-149. 2010.

CHANGING CHESAPEAKE BAY ACIDITY POSES ADDITIONAL CHALLENGE TO OYSTER RESTORATION



While disease and harvest pressure are well understood as stressors to the Chesapeake Bay's historically low oyster population, new research from UMCES scientists shows that resource managers may need to begin addressing another environmental change impacting the oyster—the changing acidity of the Bay's waters.

Acidity is increasing in all aquatic systems worldwide associated with excess atmospheric carbon dioxide dissolving in water to form carbonic acid. Chesapeake Biological Laboratory doctoral graduate George Waldbusser, Horn Point Laboratory researcher **Dr. Roger Newell** and other colleagues examined 23 years of data collected from the Chesapeake Bay. They found that the upper Bay was unexpectedly becoming less acidic while areas in the middle of the Bay were becoming appreciably more acidic than predicted.

With additional lab studies, they examined how these observed spatial changes in acidity can affect rates of juvenile oyster shell formation. They found that acidic conditions, common in intermediate salinity regions of the Bay, inhibit the ability of juvenile oysters to lay down calcium carbonate to form their shell. They conclude that oyster restoration efforts in these more acidic regions of the Bay could be negatively impacted as thinner shells render juvenile oysters increasingly vulnerable to crab predation.

Their research finds that excess anthropogenic nutrient inputs promote increased phytoplankton growth in the low salinity upper regions of the Bay. There, plants grow luxuriantly and absorb large amounts of carbon dioxide from the water column, thereby making waters in that region less acidic. But when the phytoplankton die and are swept downstream, microbial respiration of the dead organic matter in intermediate salinity regions releases large amounts of carbon dioxide, making the water more acidic.

Waldbusser, G.G., Voigt, E.P., Bergschneider, H., Green, M.A., Newell, R.I.E. Biocalcification in the Eastern Oyster *(Crassostrea virginica)* in relation to long-term trends in Chesapeake Bay pH. *Estuaries and Coasts*. 1559-2723. 2010.

Highlights and Awards

UMCES LAUNCHES INSTITUTE OF MARINE AND ENVIRONMENTAL TECHNOLOGY

UMCES has expanded its environmental research mission into Baltimore's Inner Harbor by establishing the Institute of Marine and Environmental Technology (IMET) in partnership with University of Maryland, Baltimore County and the University of Maryland, Baltimore. UMCES@IMET researchers are working in several important areas related to finding new biotech-based solutions to protecting marine biodiversity, ocean and human health, marine bioenergy and marine ecosystems.

NEW SETTING FACILITY HELPS EXPAND OYSTER RESTORATION

In August, Governor Martin O'Malley joined University leaders to dedicate a new $11 million Oyster Setting Facility at the Horn Point Laboratory.

This new facility will help the laboratory more than double its annual production of oyster spat for Chesapeake Bay restoration, setting the stage for a significant expansion of the State's aquaculture and environmental restoration programs.

This new facility improves the efficiency of the oyster hatchery by allowing researchers to more easily "set" hatchery-reared larval oysters on oyster shells for transplanting in the Bay. By minimizing the number of times the spat on shell need to be handled, reducing pumping costs, and providing better quality water from the Choptank River to the tanks, production of seed oysters will improve and should result in more cost effective production.

CBL DIRECTOR COMMENDED FOR SCIENCE APPLICATION

Dr. Margaret Palmer was presented the 2010 President's Award for Excellence in Science Application by Dr. Donald Boesch for her work informing policymakers and the public about the environmental impacts of mountaintop mining. In his remarks, Dr. Boesch commended Dr. Palmer for her efforts to expand the impact of her research beyond academia and into the realm of public policy, noting that her scientific and policy leadership embodies the evolving role scientists must play in society.

In response to the significant public interest generated by her work, Dr. Palmer regularly speaks about mining's impact on the environment. She has testified before Congress and conducted numerous interviews with the national media.

REGIONAL STABLE ISOTOPE RESEARCH FACILITY OPENS AT AL

A new partnership among several regional institutions including Frostburg State University and West Virginia University has established a high-tech facility for using stable isotopes to study how past, present and future environmental changes influence terrestrial and aquatic ecosystems. With the opening of the Central Appalachians Stable Isotope Facility (CASIF) at the Appalachian Laboratory, researchers now have access to a powerful tool for understanding how and when environmental change occurs.

While research programs vary by scientist, the facility will be instrumental in expanding regional research into landscape ecology, remote sensing, plant ecology and hydrology. The facility will help scientists better understand long-term variability in the flow of the Potomac River, how nitrogen availability impacts the growth of trees in the northeastern United States and how invasive species can alter stream ecosystems.

CBL SCIENTIST RECEIVES HIGHEST USM AWARD

For his groundbreaking research focusing on population biology and ecology of fish, CBL researcher Dr. David Secor was presented with the University System of Maryland Regents' Faculty Award for Excellence.

As a fisheries biologist, a large proportion of Dr. Secor's research has focused on species that often have management conflicts: striped bass, bluefin tuna, white perch and sturgeon. As a consequence, his work has played a significant role in how these species are managed in Maryland and across the globe.

COMMUNICATING OCEAN SCIENCE WITH CONSERVATION INTERNATIONAL

The UMCES Integration and Application Network recently partnered with Conservation International to help tell the story of how marine managed areas can help communities adapt to climate change and create an environmentally and economically sustainable future.

Released as UMCES first contribution to Conservation International's ongoing "Science-to-Action" partnership, three new publications synthesize data collected over five years of natural and social science research in more than 70 marine managed areas (MMAs) in 23 countries. Drawing on the results of more than 50 studies, the Science-to-Action partnership offers recommendations for successful implementation of MMAs to maximize the benefits to people and nature. The findings and recommendations are presented in reader-friendly, richly illustrated booklets.

APPALACHIAN LABORATORY HONORS LOCAL ENVIRONMENTAL LEADER

The Appalachian Laboratory this year honored Ranger Sarah Milbourne of the Maryland Department of Natural Resources Park Service with the Richard A. Johnson Environmental Education Award. The award recognizes local citizens for their outstanding contributions to environmental education. It was presented to Milbourne for introducing thousands of western Maryland's children and adults to the wonders of the natural world while encouraging them to take an active role in protecting the area's environmental future.

DU PONT RAMS RETURN TO HPL

The two merino rams that graced the brick entry pillars of the Horn Point Laboratory for more than 50 years returned to their post on October 1, thanks to the diligence of local law enforcement, assistance from the Du Pont family, support from the local community and the handiwork of local craftsmen. In September 2009, the two 450-pound, concrete ram statues were stolen from the laboratory and subsequently destroyed. Thanks to the Du Pont family who employed a sculptor, the remnants of one ram were assembled into a new replica with the missing parts recreated from photos.

UMCES Scientists Respond to Gulf Oil Spill

When the oil rig Deepwater Horizon exploded on April 20, 2010, millions of gallons of crude oil began flowing into the Gulf of Mexico, forever changing the lives of Gulf Coast residents and causing untold environmental damage to the coastal ecosystem.

As an environmental research institution specializing in coastal environments, researchers from the University of Maryland Center for Environmental Science played an active role in determining long-term damage to the ecosystem and providing science-based analysis to policymakers and natural resource managers working to minimize the impact of this environmental tragedy.

A New Orleans native and former director of the Louisiana Universities Marine Consortium, UMCES President **Dr. Donald Boesch** was selected by President Barak Obama to serve on the seven-member National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling. Through a series of hearings and in its final report, the Commission provided the Obama Administration recommendations on how to prevent and mitigate the impact of future spills that result from offshore drilling.

Horn Point Laboratory Director **Dr. Michael Roman** and a team of scientists including faculty members **Drs. William Boicourt** and **Jamie Pierson** led a post-spill Gulf research cruise to collect data used to produce spatially-explicit, high-resolution maps and models to quantify the oil's effects on low oxygen and living resources. This work, funded by the National Science Foundation, is built upon a five-year study Dr. Roman led from 2003-2008.

Chesapeake Biological Laboratory toxicologist **Dr. Carys Mitchelmore**, a leading toxicologist who has researched the effects of dispersants on marine organisms, has testified before Congress on five occasions, outlining the environmental impacts of widespread dispersant use in the Gulf. She has been widely quoted in the media and has traveled to the Gulf region to meet with Federal officials and discuss the role dispersants should play in the cleanup effort.

Horn Point Laboratory fisheries oceanographer **Dr. Elizabeth North** is collaborating with a team of scientists to develop computer models on how subsurface oil spreads throughout the Gulf of Mexico. Their work takes into account currents, winds and the size of oil droplets to track the spill's movement so restoration teams could pinpoint the most likely locations of oil plumes below the water's surface. The NSF-supported project is based on Dr. North's previous work modeling the movement of oyster larvae in Chesapeake Bay.

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