University of Maryland
Center for Environmental Science

2012 ANNUAL REPORT

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

University of Maryland Center for Environmental Science

One of the world's premier research centers focused on ecosystem science, the University of Maryland Center for Environmental Science strives to advance knowledge of the environment and develop new ideas to guide our state, nation, and world towards a more sustainable future.

We harness 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.

We provide the scientific basis for policymakers, advocates, and corporate and civic leaders to address pressing environmental issues in our communities, including serving on Governor Martin O'Malley's Chesapeake Bay Cabinet and BayStat team.

With locations strategically placed between the mountains and sea, our research laboratories provide scientists direct access to Maryland's diverse natural ecosystems, allowing us to be a leader in the science of coastal environments and their watersheds.

At a glance

Year founded: 1925
Research laboratories: 4
Faculty members: 100
Graduate students: 90
Operating budget: $45.2 million
Value of grants awarded FY12: $23 million

We train and inspire the nation's next generation of environmental scientists and resource managers as part of the University System of Maryland's nationally ranked graduate program in marine and environmental science.

"The University of Maryland Center for Environmental Science has a unique role in the State supporting Maryland's international reputation for progressive environmental management and sustainable economic development." —University System of Maryland Chancellor William E. Kirwan

From the President

Board of Visitors Chair Ronald Kreitner and President Donald Boesch

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.

Tracing its roots to 1925, the University of Maryland Center for Environmental Science has had a long history of studying Maryland's unique ecosystems from the mountains to the sea, developing solutions to sustain the rich biodiversity and resources of our beautiful state. Through a combination of world-renowned research and a mandate to help inform public policy that affects all Marylanders, we play a key role in supporting Maryland's well-deserved reputation for progressive environmental management and sustainable economic development.

Right now, our science is helping to fuel Maryland's new economy. For example, we are cultivating public-private partnerships to develop renewable biofuels from marine algae. We are working closely with the Maryland Port Administration to ensure that as international commerce grows, invasive species don't hitchhike into the Chesapeake Bay through ballast water. We are helping one of our oldest industries, oystering, transition to technologically sophisticated and sustainable aquaculture. Most of our researchers live and work in relatively rural areas across our state, so we boast a broad footprint in science and technology development. We are also preparing the scientific work force of the future, training graduate students to fill roles in universities, the private sector, and public agencies to ensure sustainable development and management of resources.

In the future, the University of Maryland Center for Environmental Science will be working hand-in-hand with Maryland businesses and industry to apply science to the marketplace, creating new opportunities for progressive economic development and jobs in our state. We are already well positioned to further pursue energy alternatives, pharmaceuticals derived from marine organisms, development of sensitive environmental sensors, advanced waste treatment and remediation, and aquaculture food sources with less environmental impact.

I am proud of the work being done here in our laboratories to help our state, and our world, toward a prosperous and more sustainable future.

Dr. Donald F. Boesch
President

Making an Impact: Maryland's economy is fueled by science

Science not only fuels discovery, but it also fuels Maryland's economy. The University of Maryland Center for Environmental Science is developing technologies such as biofuels made from algae with local business start-ups, recommending best management practices to guide efficient and safe shale gas development, strengthening the Port of Baltimore by defending against invasive species, and growing oysters to help restore the Chesapeake Bay and the livelihood of hundreds of fishermen. Research laboratories situated throughout the state generate high-quality jobs in rural areas, while renowned faculty prepare graduate students to be members of a new work force in the sciences, sustainable development, and resource management.

Keeping the maritime shipping industry moving

The Chesapeake Bay has more than 150 invasive species, and the great majority of them hitched a ride on commercial ships entering the Port of Baltimore. **Mario Tamburri**'s Maritime Environmental Resource Center partners with the Maryland Port Administration to address this and other issues that affect the maritime shipping industry. Its mobile test platform, the only one of its kind in the world, tests treatment technologies that clean ballast water on ships to ensure they meet the necessary U.S. Coast Guard requirements to keep invasive species from entering waterways. The center has also recently established efforts to address other related Green Ship issues and innovations, including vessel biofouling, alternative fuels, and methods to reduce air emissions.

Dredging shipping channels keeps cargo in motion, and the millions of tons of silt from the Bay are being used to rebuild wildlife habitat on the Chesapeake Bay's disappearing islands, such as Poplar Island. There, **Court Stevenson** and **Jeff Cornwell** study how marsh grasses grow in dredge material on this three-mile long restoration project. As a receiving site for clean material dredged from the shipping channels approaching Baltimore, this project helps preserve the local economy (120,000 Maryland jobs depend on the Port of Baltimore) while restoring precious habitat for the Chesapeake's wildlife. •

Predicting the impact of sea level rise and storm surge on coastal communities

Ming Li can tell where the water will rise when a hurricane impacts the Chesapeake Bay. Using a complex computer model, he can predict where the water will creep and how far inland it will go—down to which block on the street should be evacuated. Relying on a combination of wind speed and water level data combined with land maps, the software developed by Li's lab successfully anticipated the impact of Hurricanes Irene and Isabel on coastal communities. It will prove to be invaluable for local emergency management officials to not only help prepare for storms, but to help plan coastal development to avoid destruction by more frequent and powerful storms and the inevitable rise in sea level—estimated to be twice the world's average—in the Chesapeake Bay over the next 100 years. •

Dan Gross/The Gazette

▼ Turning algae into a clean machine

Feng Chen sorted through hundreds of samples of algae collected from around the world until he found one that would most efficiently absorb carbon dioxide. Working with Maryland business start-up HY-TEK Bio, LLC, his goal was to use the strain, which happens to be from the Chesapeake Bay, to consume the greenhouse gas being released from the Back River Waste Water Treatment Plant's power plant flue. It is part of an ongoing test project supported by the Maryland Industrial Partnerships and the City of Baltimore. Not only would the algae clean emissions from the power plant, but it would also absorb excess nutrients from the waste being discharged into the Chesapeake Bay. This algae bioreactor is the first patent-pending technology of its kind to reduce greenhouse gas emissions on an industrial scale, with the added economic benefit of being able to harvest the algae for sale as pharmaceuticals, animal feed, and biofuels. Chen, in collaboration with his colleague Russell Hill and graduate students, is also exploring how algae can be harvested at low cost and converted economically into renewable biofuels to help reduce the world's dependence on fossil fuels. •

▲ Restoring the oysters for a healthy Bay and harvest

The Horn Point Laboratory's Broddus and Margaret Ann Jones Oyster Culture Facility—the largest of its kind on the East Coast—produces disease-free oyster larvae for use in research, restoration, education, and aquaculture. Partnering with the Maryland Department of Natural Resources, the Oyster Recovery Partnership, and others, the hatchery, directed by Donald "Mutt" Meritt, has to date deployed more than one billion oyster spat to the waters of the Chesapeake in the hopes of slowing the oyster decline and restoring the health of the Bay. Once the Bay's most valuable commercial fisheries, native oysters form aquatic reefs and feed countless watershed residents, and are critical to the Bay's environment and economy. •

▲ Making sustainable aquaculture a reality

Allen Place and graduate student **Aaron Watson** have helped move aquaculture towards being a more sustainable and profitable industry. They have developed a vegetarian food source that will allow the aquaculture industry to grow fish without feeding them fish, avoiding the depletion of already low fish stocks. The fish raised on vegetarian diet also are healthier to eat with fewer of the worrisome chemical contaminants, such as mercury, that show up in wild or even many farm-raised fish. Most fish species used in aquaculture are not currently sustainable because it takes more fish to feed them than are being produced, but the new vegetarian diet shows promise for making aquaculture more efficient and affordable. •

WORKFORCE DEVELOPMENT IN SCIENCE AND TECHNOLOGY

Ph.D. student **Jeanette Davis** earned first prize with her talk about sea sponges as a source of anti-cancer compounds at the NOAA-Educational Partnership Program's Education and Science Forum. **Ammar Hanif** was awarded a two-year graduate fellowship by Maryland Sea Grant to study menhaden fisheries. And **Jan Vicente** (pictured) was awarded the National Oceanic and Atmospheric Administration's prestigious Dr. Nancy Foster Scholarship to study the impact of ocean acidification on marine sponges.

These graduate students were trained through the Living Marine Resources Cooperative Science Center (LMRCSC) at the Institute of Marine and Environmental Technology in Baltimore, a program that helps prepare minority students for careers that support the sustainable harvest and conservation of living marine resources.

"These remarkable students are working side-by-side with highly respected scientists, and they are already making an impact in their field. The Living Marine Resources program helps us contribute to building a strong, well trained, diverse workforce in science and technology."

—Rosemary Jagus, LMRCSC Program Director

Year in Review

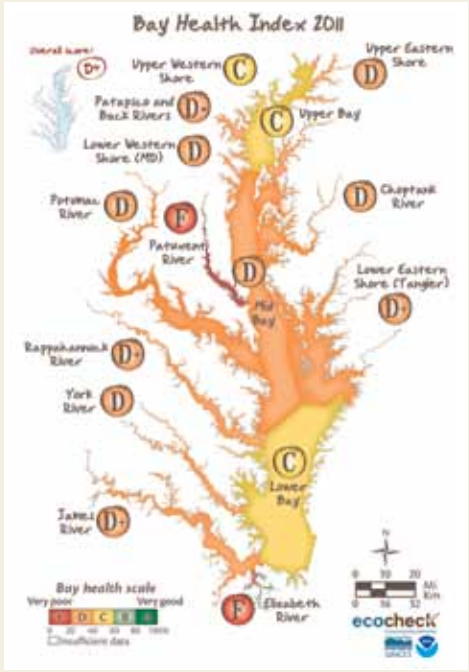
A snapshot of news and research from laboratories across the state.

NEWS

A national think tank called the **Socio-Environmental Synthesis Center (SESYNC)** opened in Annapolis as a result of the largest National Science Foundation grant ever awarded to the University of Maryland. The $27.5 million, five-year program promises to draw the best scientists from around the world to explore environmental topics and their societal impacts, and seek new and innovative solutions. •

The **Horn Point Laboratory's Broddus and Margaret Ann Jones Oyster Culture Facility** produced a record number of oysters as part of its restoration efforts for the Chesapeake Bay. In partnership with the Oyster Recovery Partnership and the Maryland Department of Natural Resources, the hatchery produced more than 880 million oyster spat (young oysters that are attached to a larger oyster shell), the fifth year in a row that production has exceeded half a billion. •

The Maritime Environmental Resource Center (MERC) partnered with NSF International, Great Ships Initiative, and Retlif Testing Laboratories to become the first U.S. Coast Guard-approved Independent Laboratory for evaluating and testing technologies designed to treat ballast water on ships. The MERC test facility evaluates the performance of treatment technologies before they are installed on ships. •



The annual **report card on the Chesapeake Bay** produced by EcoCheck scientists at the University of Maryland Center for Environmental Science's Integration and Application Network gave the nation's largest estuary a "D+" due to a sequence of weather events, including two devastating storms. The scientific assessment is done each year to enhance and support the science, management, and restoration of Bay. •

RESEARCH AWARD HIGHLIGHTS

The National Science Foundation is funding a major initiative to help prepare educators in Maryland and Delaware to teach climate change science in the classroom. The $5.8 million cooperative agreement supports implementation of the **Maryland and Delaware Climate Change Education, Assessment and Research (MADE CLEAR)** partnership, an effort to forge new ways to deliver effective and relevant climate change education that could serve as a national model. •

Scientists **Andrew Elmore** and **David Nelson** from the Appalachian Laboratory were awarded $653,018 from National Aeronautics and Space Administration (NASA) to study the growth rate of trees in a longer growing season. They will use satellite data to determine how the growth rate of trees in a longer growing season may impact the environment. •


Andrew Elmore


David Nelson

A one-year study funded by NOAA and the Coastal Response Research Center at the University of New Hampshire will help determine the potential impact of an oil spill on the development of the blue crab. The study is a collaboration between **Eric Schott** and **Sook Chung** of the Institute of Marine and Environmental Technology and **Carys Mitchelmore** and **Andrew Heyes** of the Chesapeake Biological Laboratory. •

Thanks to a grant from the Lenfest Ocean Program, fisheries scientists **Tom Miller**, **Ed Houde**, and **Dave Secor** from the Chesapeake Biological Laboratory will investigate the balance between fishing for menhaden and the value of the fish in the ecosystem. The goal is to help develop fishing management guidelines to ensure that this small but important forage species survives and thrives along with the other Bay creatures that depend on them. •

PEOPLE IN THE NEWS

Russell Hill

Professor and microbiologist **Russell Hill** was appointed director of the **Institute of Marine and Environmental Technology** after serving as interim director since 2011… Marine research leader and policy analyst **Fredrika Moser** was named director of **Maryland Sea Grant College** following more than a decade as assistant director for research and, since 2011, as interim director… Professor and fisheries scientist **Ed Houde** at the Chesapeake Biological Laboratory was named **Vice President for Education** to lead the accreditation process for joint graduate degrees and certificates… Landscape ecologist **Robert Gardner** retired after leading the **Appalachian Laboratory** as its director from 2005-2012 and professor for 18 years…The Horn Point Laboratory's **Michael Kemp** was awarded the University System of Maryland's highest honor, the **Regents' Faculty Award for Excellence**, in recognition of outstanding research in the fields of ecology, marine science, and environmental science… **Allen Place**, professor and biochemist with the Institute of Marine and Environmental Technology, was honored with **the President's Award for Science Application** for his research that takes diverse approaches to address practical problems, such as the causes of toxic algal blooms…In honor of outstanding contributions to environmental education in Western Maryland, **Dana McCauley** and the Crellin Elementary School were given the **Richard A. Johnson Environmental Education Award** by the Appalachian Laboratory for creating unique educational opportunities through the study of the environment. •


Ed Houde


Dana McCauley

RESEARCH IN THE NEWS

Mid-Atlantic suburbs can expect an early spring thanks to the heat of the big city

Spring is indeed arriving earlier—and autumn is ending later—in the suburbs of Baltimore and Washington, D.C. The reason? The urban landscape traps heat in the summer and holds it throughout the winter, triggering leaves to turn green earlier in the spring and stay green later into autumn.

"We are trying to understand how forests function so we can understand how they might respond to global warming," said Andrew Elmore. "With more detailed data, we can do a better job of predicting what might happen to a forest impacted by urbanization."

Using high-resolution satellite data collected over the past 25 years to look at the number of days that trees have green leaves in the forests of the Mid-Atlantic, scientists found that urban heat islands extended the growing season in areas within 20 miles of the city. •

Study confirms oil from Deepwater Horizon entered food chain in Gulf of Mexico

Since the explosion on the BP Deepwater Horizon drilling rig in the Gulf of Mexico in 2010, scientists have been working to understand its impact on the environment. A study confirms that oil from the Macondo well made it into the ocean's food chain through the tiniest of organisms, zooplankton.

"Traces of oil in the zooplankton prove that they had contact with the oil and the likelihood that oil compounds may be working their way up the food chain," said Michael Roman.

Oil contains polycyclic aromatic hydrocarbons (PAHs), which can be used to fingerprint oil and determine its provenance. The researchers were able to identify the Deep Water Horizon well's unique signature in the Gulf of Mexico. •

Landmark study of leatherback turtle migration identifies Pacific danger zones

A major study of migration patterns of the leatherback turtle has identified high-use areas in the Pacific Ocean for this critically endangered species.

"This information on their movements is essential for identifying hot spots and assessing where limiting fishing may be effective for protecting leatherbacks," said Helen Bailey.

Leatherbacks are the widest-ranging marine turtle species and are known to migrate across entire ocean basins, increasing the risk that these animals may be caught in fishing gear. •


Scott Hansen

'Talking' bacteria on sponges can trigger movement that inhibits biofilm formation

When enough bacteria get together in one place, they can make a collective decision to grow an appendage and swim away. This type of behavior has been seen for the first time in marine sponges, and could lead to an understanding of how to break up harmful bacterial biofilms.

"Anything we can discover about this bacterial communication could be really important in understanding how bacteria become pathogenic in humans or how they form film on teeth or internal medical devices," said Russell Hill.

Marine spongs harbor complex and diverse bacterial communities that are an ideal place to study how bacteria talk to each other using small chemical molecules. •

Strategic Plan: *Focus on the Future*

Focus on the Future is the theme of the University of Maryland Center for Environmental Science's 2012 strategic plan. It will help guide us over the next five years, as well as help communicate the direction of our outreach efforts. The strategy builds on our scientific strengths while adjusting course in the four previous areas of focus: science to support ecosystem-based management, linking observing systems and forecasts, multi-scale ecosystem restoration, and the regional consequences of climate change and variability.

Energy Choices
Evaluate and communicate the environmental opportunities and consequences of energy production alternatives.

Society is being faced with a number of energy choices that should be informed by knowledge of the environmental, societal, and economic consequences. These choices provide new challenges and opportunities for biotechnologists, landscape and population ecologists, geologists and geochemists, climate and atmospheric scientists, hydrologists, toxicologists, and environmental economists, all of which are represented on the faculty.

Human Welfare
Support resilient ecosystems and human health across the land-ocean continuum.

The vast majority of the world's population is located along the coast. Our science has effectively focused on the health of ecosystems and living resources, paving the way for future attention on the causes, impacts, and mitigation strategies that minimize the risks to humans. The faculty is eminently qualified to address this focus through the study of sustainable fisheries management and environmentally compatible port operations, including understanding and managing emerging threats, such as from climate change, sea level rise, and invasive species.

Water Security
Understand, evaluate, and reduce the environmental consequences of the demand for water for agricultural, industrial, and human use.

Population demands for reliable water supplies are likely to increase given ongoing climate and land use changes that influence the quantity and quality of fresh water supplies. These concerns go beyond issues of civil engineering, considering societal impacts on the quality of water available both for human use and to sustain important ecosystem services. Research and assessment to address these issues is inherently multi-disciplinary and would likely lead to increased collaboration among our laboratories, forging new partnerships and collaborations.

Genes to Ecosystems
Understand and apply genetic regulation of key ecological processes.

This interdisciplinary focus brings together researchers with expertise in molecular biology, population and community ecology, fisheries and wildlife science, and biogeochemistry. The emerging knowledge also has significant potential for commercialization for uses ranging from waste remediation to drugs and biofuels.

Global Reach
Enhance the capacity for international collaboration and training around the world to develop expertise in environmental research, application, and management.

Our scientists are engaged in collaborative research and science application around the world. These activities enhance environmental science and its applications here in Maryland, and likewise help extend our highly regarded accomplishments in the Chesapeake region to other regions of the world. We have the potential to build strong institutional partnerships around the world, leading toward robust expert and student exchanges and instructional programs.

Graduate Education and Workforce Development
Seek accreditation for the award of joint graduate degrees in the Marine-Estuarine-Environmental Sciences (MEES) Program.

This will enable us to operate a joint program with our most significant educational partner, the University of Maryland, College Park.

Additionally, accreditation would enable us to offer professional development courses for credit and certificates. In doing so, we can serve an important and underserved market, thereby contributing to the development of Maryland's workforce and strengthening relationships with private and public sector employers.

The 2012 strategic plan Focus on the Future *is available online at umces.edu/strategic_plan.*

Contributors

We sincerely thank our many donors. Every gift is important and greatly appreciated.

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Mr. and Mrs. V. Raul Felipa

Fred and Lesley Israel

Photo by Donna Green Israel

SUPPORTING SCIENCE

Fred and Lesley Israel generously support the education of the next generation of scientific leaders, our graduate students, through their family foundation. Living for more than 30 years on the Eastern Shore along Broad Creek, where a substantial oyster bar once flourished, they understand that the restoration of the Chesapeake Bay begins with doing our science homework.

"We started by sailing, and ended up falling in love with the Bay," said Lesley Israel. "We see the evidence of the changes that have been happening and support serious efforts to preserve it."

The Israels are benefactors to local, national, and international organizations, including the University of Maryland Center for Environmental Science's Horn Point Laboratory in Cambridge.

"We can make a difference in the future of the Bay, and Horn Point is the leading edge for that," she said. "They can provide the arguments, the statistics, and the methods. Then we have to pay attention. They provide the real science that will work if it's implemented."

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We apologize if we inadvertently omitted any names of those who supported our work over the past year.

Support the University of Maryland Center for Environmental Science's efforts to ensure a healthy and prosperous environment for the Chesapeake Bay and the world. Visit umces.edu/giving or contact David Balcom at 410-234-8857 or dbalcom@umces.edu

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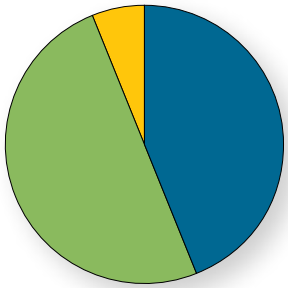
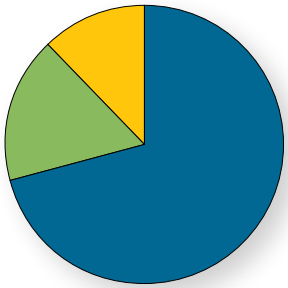


Expenditures

- State Appropriation: 44%
- Contracts and Grants: 50%
- Other: 6%

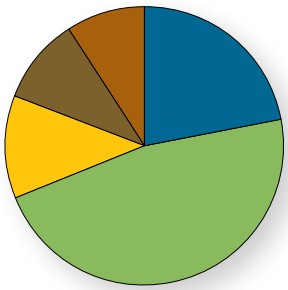
$43.8 million



Research awards

- Federal: 71%
- State: 17%
- Private: 12%

$23 million



Federal awards by agency

- National Science Foundation: 22%
- National Oceanic and Atmospheric Administration: 47%
- Department of Transportation: 12%
- Environmental Protection Agency: 10%
- Other: 9%

$16.4 million

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Future Scientists

The University of Maryland Center for Environmental Science prepares students for careers in research, management, environmental protection, and sustainable economic development.

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