University of Maryland Center for Environmental Science

2011 ANNUAL REPORT

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

FACULTY

Robert Anderson, Professor Emeritus
Helen Bailey, Research Assistant Professor
Hongsheng Bi, Assistant Professor
William Boicourt, Professor
Walter Boynton, Professor
Daniel Cadol, Postdoctoral Research Associate
Mark Castro, Associate Professor
Shenn-Yu Chao, Professor
Feng Chen, Associate Professor
J. Sook Chung, Assistant Professor
Louis Codispoti, Research Professor
Victoria Coles, Research Associate Professor
Lee Cooper, Research Professor
Jeff Cornwell, Research Associate Professor
Byron Crump, Associate Professor
Andrew Elmore, Assistant Professor
Katia Engelhardt, Research Associate Professor
Keith Eshleman, Professor
Solange Filoso, Professor
Tom Fisher, Professor
Matthew Fitzpatrick, Assistant Professor
Robert Gardner, Director/Professor
J. Edward Gates, Professor
Patricia Glibert, Professor
Michael Gonsior, Assistant Professor
Jacqueline Grebmeier, Research Professor
Lawrence Harding, Research Professor
Lora Harris, Assistant Professor
Andrew Heyes, Associate Professor
Robert Hilderbrand, Associate Professor
Russell Hill, Interim Director/Professor
Raleigh Hood, Professor
John Hoogland, Professor
Edward Houde, Professor
Rosemary Jagus, Associate Professor
Todd Kana, Research Associate Professor
Stephen Keller, Assistant Professor
Michael Kemp, Professor
Victor Kennedy, Professor
Hali Kilbourne, Research Assistant Professor
Dennis King, Research Professor
Evamaria Koch, Associate Professor
Jonathan Kramer, Director
Laura Lapham, Assistant Professor
Ming Li, Professor
Thomas Malone, Professor Emeritus
Donald Meritt, Senior Agent
Thomas Miller, Director/Professor
Carys Mitchelmore, Associate Professor
Raymond P. Morgan II, Professor
Laura Murray, Research Professor
David Nelson, Assistant Professor
Roger Newell, Professor
Nicholas Nidzieko, Assistant Professor
Elizabeth North, Associate Professor
Judy O'Neil, Research Assistant Professor
Cindy Palinkas, Assistant Professor
Margaret Palmer, Professor
Kennedy Paynter, Associate Professor
James Pierson, Research Assistant Professor
Louis Pitelka, Professor Emeritus
Allen Place, Professor
Michael Roman, Director/Professor
Christopher Rowe, Associate Professor
Lawrence Sanford, Professor
Alyson Santoro, Research Assistant Professor
Johan Schijf, Assistant Professor
Eric Schott, Research Assistant Professor
David Secor, Professor
Court Stevenson, Professor
Diane Stoecker, Professor
Cathlyn D. Stylinski, Senior Agent
Mario Tamburri, Research Professor
Robert Ulanowicz, Professor Emeritus
Lisa Wainger, Research Associate Professor
Michael Wilberg, Assistant Professor
Michael Williams, Research Associate Professor
David Wright, Professor Emeritus

2010 GRADUATE STUDENTS

Ali Barba
Lynda Bell
Maira O. Bezerra
Jennifer Bosch
Jennifer H. Bryan
Dana Bunnell-Young
Cara Campbell
Emily A. Christenson
Virginia Clark
Christian Conroy
Alyssa-Marie Currie
Jeanette Davis
Rosemary M. Fanelli
Jessica Faux
Dan Feller
Lindy Fine
Melinda K. Forsyth
Caroline Fortunato
Yonghui Gao
John Gardner
Laura Gemery
Kate Gillespie
Jake Goodwin
Cassie Gurbisz
Ammar Hanif
Peng Jia
Dave Kazyak
Anthony G. Kaufman
Dong Yoon Lee
Andrew (A.K.) Leight
Linjuan Li
Yun Li
Katherine (Wen-Cheng) Liu
Wei Liu
Jinfeng Ma
Erin Markin
Kathleen Marshall
Nicole C. Mehaffie
Sarah A. Mellace Rains
Kevin Meyer
Nicole Millette
Naomi Montalvo
Aimee R. Neeley
Meghann E. Niesen
Michael H.P. O'Brien
Adam Peer
Ryan Powell
Cortney Pylant
Jason Robinson
Robert Sabo
Zianab Sankoh
Adam Schlenger
Maggie Sexton
Yini Shangguan
Kristi Shaw
Lindsay Tempinson
Jeremy Testa
Keota Silaphone
Lorie Staver
Emily Stefansson
Becky Swerida
Jacqueline Tay
Kim Vest
Jan Vicente
Brianne Walsh
Hui Wang
Aaron Watson
Roy Weitzell
Lisa M. Wilt
Quingyun Yu
Jindong Zan
Danielle Zaveta
Fan Zhang
Mengjie Zhang

Here at the University of Maryland Center for Environmental Science, our renowned faculty join aspiring graduate students to engage in cutting-edge research focused on our most valuable assets—the environment and its natural resources.

We are Maryland's premier research institution aimed at advancing scientific knowledge of the environment. Comprised of 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 at Baltimore's Inner Harbor, and Maryland Sea Grant in College Park, we excel in bringing together interdisciplinary scientific studies in pursuit of a greater understanding about ecosystems and their natural processes.

By conducting research into today's most pressing environmental problems, we are developing new ideas to help guide our state, nation, and world toward a more environmentally sustainable future. As part of this mission, we have the responsibility to prepare future scientists and environmental stewards to meet the growing environmental challenges facing society today and the science needs of tomorrow.

We are extensively involved in graduate education, providing professional research opportunities under the direct supervision of leading environmental scientists. We support more than 100 exemplary students each year through four collaborative graduate programs in Marine Estuarine Environmental Sciences, Environmental Toxicology, Applied Ecology and Conservation Biology, and Wildlife and Fisheries Management.

The interdisciplinary depth of these programs, coupled with the ability to develop sound disciplinary foundations, provides us with the distinctive opportunity to prepare students for science-related careers in advanced research, teaching, resource management, environmental protection, and sustainable economic development. Graduates hold prestigious appointments in academia and in state and federal agencies.

Graduate education not only allows us to contribute to a legacy of hundreds of scientists well prepared to tackle tomorrow's challenges, but it also adds excitement, vitality, and creativity to our ongoing research. Working and learning at our laboratories, students help to attract and retain some of the world's best researchers interested in being part of an educational enterprise and feeding off the enthusiasm of their students.

We hope to address the great environmental challenges of the 21st century by producing highly capable scientists who will serve as tomorrow's scientific leaders. Our success for more the 40 years is frequently cited as a tangible example of the advantages of our strong University System of Maryland.

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.

PRESIDENT DON BOESCH RECOGNIZED FOR ENVIRONMENTAL LEADERSHIP

Maryland Public Television recognized **Dr. Donald Boesch**, president of the University of Maryland Center for Environmental Science, with the Outdoors Maryland Award for Stewardship of the Environment for his longstanding contributions to environmental stewardship and conservation. The award honors individuals or institutions for their commitment to celebrating and caring for the world around us.

In addition to leading five environmental research laboratories across the state, he is active in educating the public and policymakers about environmental and resource management. He is recognized for his unique ability to translate science in ways that are useful not only to his fellow Marylanders, but to people around the world.

Boesch also received the Maryland-Asia Environmental Partnership's Energy and Environmental Leadership Award, which recognizes a Maryland leader who has provided both state and national leadership on energy and environment issues.

UNIQUE NEW BARGE TESTS BALLAST WATER TREATMENT TECHNOLOGIES

A unique 155' mobile testing platform was dedicated into the University of Maryland Center for Environmental Science research fleet. This unique barge will be used to test emerging ballast water treatment technologies in the maritime shipping industry with the goal of reducing the introduction of invasive species into local waterways. There are already more than 150 invasive species now living in the Chesapeake Bay that originated in other ports.

The barge is part of the University of Maryland Center for Environmental Science's Maritime Environmental Research Center, established in partnership with the Maryland Port Authority, with additional support from the U.S. Maritime Administration, National Oceanic and Atmospheric Administration, and American Bureau of Shipping to provide test facilities and expertise to address key environmental issues facing the international maritime industry.

The dedication ceremony was led by Congressman Elijah Cummings (Maryland's 7th District) and included leadership from the U.S. Maritime Administration, Maryland Port Authority, and the University of Maryland Center for Environmental Science.

FISHERIES SCIENTIST TAKES HELM AT CHESAPEAKE BIOLOGICAL LABORATORY

Internationally renowned fisheries scientist **Dr. Thomas Miller** was appointed director of the Chesapeake Biological Laboratory. The oldest publicly supported marine laboratory on the East Coast, the 125-person lab has a long history of research excellence in fisheries, environmental chemistry, and coastal ecosystems.

A member of the faculty since 1994, Miller has been a leader in developing approaches to manage several Chesapeake Bay species, including recent successful efforts to ensure the sustainability of the blue crab population.

Former director **Dr. Margaret Palmer** stepped down after six years to lead a new national environmental synthesis center supported by the National Science Foundation. SESYNC, the national Socio-Environmental Synthesis Center, is dedicated to creating synthetic, actionable science related to the structure, functioning, and sustainability of socio-environmental systems. She will keep her joint faculty appointment with University of Maryland Center for Environmental Science and College Park, as well as continue her research programs.

PRESIDENT'S SCIENCE APPLICATION AWARD

Dr. Larry Sanford received the President's Award for Excellence in Appreciation of Science for his contributions to the understanding of sediment transport processes of multiple sized particles in the Chesapeake Bay and transmitting that information to managers in an understandable way. Those efforts have led to marked improvements in the understanding of role of sediment in Bay water quality issues and serve as a basis for restoration implementation.

FISHERIES BIOLOGIST RECOGNIZED FOR RESEARCH ON JAPANESE CRAB POPULATIONS

Fisheries biologist **Dr. David Secor** was honored by the Japanese Society of Fisheries Science for research into how typhoons and low-oxygenated waters impact crabs in Osaka Bay.

By analyzing 24 years of data, Secor and study co-author Hiroyuki Ariyama of Japan found that hypoxic (low-oxygen) water is one of the driving forces behind the mortality of juvenile crabs, and normal oxygen levels in nursery areas are critical for juvenile crabs to become part of the adult crab population. Their research suggests that major weather events such as typhoons improve conditions for the juvenile crabs, as the storms help mix stratified waters and disrupt the persistent hypoxia found near the bottom where the crabs live.

The Best Paper of 2010 award was presented as part of the Society's annual conference in Tokyo.

APPALACHIAN LABORATORY PRESENTS ANNUAL ENVIRONMENTAL EDUCATION AWARD

The Appalachian Laboratory presented its **Richard A. Johnson Environmental Education Award** to the Maryland Park Service's Caroline Blizzard for helping elevate environmental stewardship and understanding in the western Maryland community.

The award, presented by lab Director **Dr. Robert Gardner**, recognizes local citizens for their outstanding contributions to environmental education. Ranger Blizzard was recognized for her work engaging visitors at the Deep Creek State Park Discovery Center and her personal contributions to local schools and civic organizations.

Ranger Blizzard has spent a lifetime helping western Maryland residents and visitors better understand and appreciate nature through her work as a certified interpretive guide, directing the Deep Creek Lake State Park Discovery Center and developing the Maryland Department of Natural Resources' "Becoming an Outdoors-Woman" program.

RESTORATION ECOLOGIST LAUDED FOR ADVANCING ROLE OF SCIENCE IN THE PUBLIC

In honor of her scientific work informing policymakers and the public about the environmental impacts of mountaintop mining and restoration ecology, **Dr. Margaret Palmer** was awarded the University System of Maryland Board of Regents' Faculty Award for Excellence in Public Service.

Palmer changed the national debate about mountaintop removal mining for coal and its negative consequences for the nation's water resources. Her research demonstrated that the practice destroys mountains and streams and poisons the water.

Throughout her career, Palmer has sought to understand what controls stream ecosystem structure and function. She focuses on restoration ecology and how land use, hydrology, and geomorphology influence the health of running-water ecosystems.

The Board of Regents' Faculty Award recognizes distinguished performance by educators and researchers in the University System of Maryland. Palmer is the eighth University of Maryland Center for Environmental Science faculty member to be honored with the award, joining Drs. Patricia Glibert, Rodger Harvey, Edward Houde, Thomas Malone, David Secor, Diane Stoecker, and Allen Place.

PIONEERING FISH EXPERT RECEIVES LIFETIME ACHIEVEMENT AWARD

An expert in the early life of fish—those crucial first 100 days that set the pattern for survival and abundance in adulthood—**Dr. Edward Houde** was honored with the American Fisheries Society's Elbert H. Ahlstrom Lifetime Achievement Award for his pioneering work and highly productive career studying the early life stages of fishes.

Houde, who has conducted his research at the Chesapeake Biological Laboratory for more than 30 years, was an early leader in research focusing on forage fish—like bay anchovy and menhaden—that set the stage for recent developments in ecosystem-based management, an area in which he has also been a leader.

His pioneering work on the early life stages of fishes has resulted in fundamental advances in the understanding of larval physiology, swimming performance, feeding ecology, growth, mortality, and development, laying the groundwork for his current interest in fisheries management—or how to ensure the survival of those fish into adulthood.

Faculty and researchers at the University of Maryland Center for Environmental Science are respected around the world for their contributions to the global scientific community. This is a sampling of more than 150 peer-reviewed papers authored by our scientists in 2011.

DROP IN OYSTER POPULATION DUE TO OVERFISHING, DISEASE, AND HABITAT LOSS

Led by the Chesapeake Biological Laboratory's **Dr. Michael Wilberg**, a study that analyzed the drop in the oyster population in the Chesapeake Bay found that harvesting oysters not only reduces the population but also degrades the habitat since oyster shells provide the primary habitat for future generations.

Suitable oyster habitat in Maryland's portion of the Bay have declined by about 70% since 1980. In addition, two oyster diseases, Dermo and MSX, thrive during drought periods when salinities in the Bay increase, causing natural mortality to increase.

"The collapse of eastern oysters in the Maryland waters of the Chesapeake Bay is among the largest documented declines of a marine species,"* said Dr. Wilberg. *"The magnitude of the decline raises concerns about the potential for continued loss of natural oyster beds throughout much of Maryland waters. Therefore, we recommend a moratorium on fishing until reefs and self-sustaining populations are restored."

The oyster population in the upper Chesapeake Bay has been estimated to be 0.3% of population levels of the early 1800s due to overfishing, disease, and habitat loss. Even with these low population levels, mortality due to fishing continues to be substantial at approximately 25% of the population per year since 1980.

The research team developed population models based on data from a long-term scientific survey of oysters conducted by the Maryland Department of Natural Resources and harvests from reefs in Maryland waters. Their approach provides estimates of abundance, fishing mortality, and mortality from other sources, such as disease.

Conservation measures have recently been enacted by the State of Maryland to protect more oyster reefs. Maryland has one of the last oyster fisheries that relies upon wild populations and not aquaculture.

Michael J. Wilberg, Maude E. Livings, Jennifer S. Barman, Brian T. Morris and Jason M. Robinson. Overfishing, disease, habitat loss, and potential extirpation of oysters in upper Chesapeake Bay. *Marine Ecology Progress Series* (2011), 438:131-144.

A DECLINE IN DEAD ZONES: STUDY SHOWS EFFORTS TO HEAL CHESAPEAKE BAY ARE WORKING

Efforts to reduce the flow of fertilizers, animal waste and other pollutants into the Chesapeake Bay appear to be giving a boost to the Bay's health. A study that analyzed 60 years of water quality data found that the size of mid- to late-summer oxygen-starved "dead zones" leveled off in deep channels of the Bay during the 1980s and has been declining ever since.

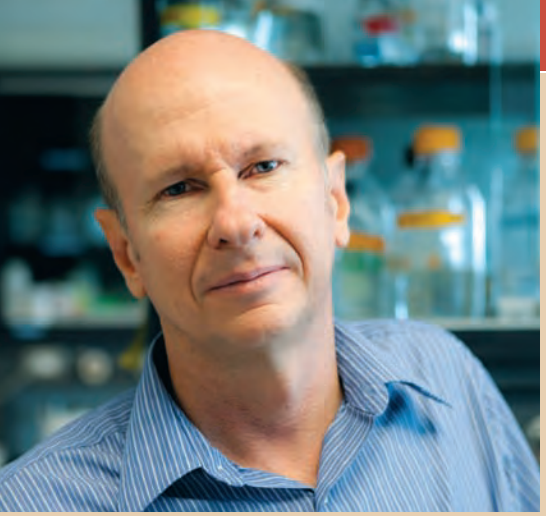
The research team included Horn Point Laboratory ecologist **Dr. Michael Kemp** and The Johns Hopkins University's Rebecca Murphy. They determined that the size of the dead zone in mid- to late-summer has decreased steadily since the late 1980s and that the duration—how long the dead zone persists each summer—is closely linked each year to the amount of nutrients entering the Bay.

The timeline coincides with the launch of state and federal efforts to reduce the flow of algae-feeding pollutants into the Bay. Water treatment plants began to pull more pollutants from their discharge, and air pollution control measures curbed the movement of nitrogen from the atmosphere into the Bay.

"The real breaking story is that total nitrogen load to the Bay has decreased by about 20 percent over the last two decades,"* said Dr. Kemp. *"A certain portion of this decrease comes from improved farming practices and new sewage treatment plants. But a big part of it is due to reduced atmospheric deposition of nitrogen. Thus, air pollution control meant to improve human health has the collateral benefit of helping to clean up the Bay."

Another part of the study looked at a trend that has troubled some Bay watchers. In recent years, Chesapeake researchers have seen an early summer spike in dead zones. They feared that keeping more nutrients out of the Bay was not improving its health. But the new study found that the early summer jump in dead zones was caused by stratification influenced by climate forces, not by the runoff of pollutants.

Rebecca R. Murphy, W. Michael Kemp and Willliam P. Ball. Long-Term Trends in Chesapeake Bay Seasonal Hypoxia, Stratification, and Nutrient Loading. *Estuaries and Coasts* (2011) 34:1293-1309.



THE QUEST TO DERIVE PHARMACEUTICALS FROM MARINE NATURAL PRODUCTS

Institute of Marine and Environmental Technology Interim Director and Professor **Dr. Russell Hill** served as the co-editor of a special issue of *Current Opinion in Biotechnology* on the potential of pharmaceutical biotechnology.

Currently there are more than a quarter million marine species that have been identified, and it is estimated that four times more actually exist. The editors concluded that with the remarkable biodiversity and new research tools to identify novel compounds, there is a need to increase the effort for the discovery of drugs from marine organisms.

***"This astounding diversity of life provides a huge resource for the discovery of potential new drugs for the treatment of disease,"* said Dr. Hill.**

Research by a small number of academic scientists, limited efforts by major pharmaceutical companies, and the work of a few small biotechnology companies has resulted in the discovery of hundreds to thousands of novel compounds every year. However, efforts at discovery of "drugs from the sea" over the past 40 years have yielded only a handful of marine-derived compounds that have been approved for the treatment of human disease.

More recently there has been an impressive pipeline of marine-derived compounds in clinical and preclinical trials, indicating that several more marine drugs should soon be approved for pharmaceutical use. The most important contribution in initial discovery of promising marine bioactive compounds will likely remain in the hands of academic scientists and governmental agencies that both support academic research and participate in the discovery process.

Although it is the efforts of these smaller groups that could yield great benefit, success is also contingent on their inherent entrepreneurial spirit by founding small biopharmaceutical companies that capitalize upon their expertise. Scientists such as Dr. Hill and his colleagues at the University of Maryland Center for Environmental Science's Institute of Marine and Environmental Technology are well situated to remain at the forefront of new discoveries with important human health implications.

Russell T. Hill and William Fenical. Pharmaceuticals from marine natural products: surge or ebb? *Current Opinion in Biotechnology* (2010) 21:777–779.

STREAM STUDIES OFFER GUIDANCE FOR LAND DEVELOPMENT

Dr. Robert Hilderbrand and his former graduate student Ryan Utz (Ph.D. 2010) conducted a series of studies on the impact of urbanization on streams at the Appalachian Laboratory. They found that stream form and function vary substantially among landscapes, so the severity of adjustment following urbanization may vary as well.

***"Differences in the region and type of stream need to be considered as communities decide how and where development and urbanization take place to minimize impact to stream health and resiliency,"* said Dr. Hilderbrand.**

Stream size and shape, hydrology, and benthic sediment composition are structured by regional climate, topography, and geologic setting. Interregional comparisons show that such diversity in stream form probably leads to differences in the degree of degradation in urbanized settings. Regardless of the mechanism, invertebrates appear to vary among regions in tolerance to urbanization with differing degrees of habitat alteration.

The stream factors that Hilderbrand and his student studied in Piedmont and Coastal Plain regions included overall size and shape, particle movement, sediment deposition, and chemistry during flood phase. The frequency, magnitude, and duration of flood events all change to a relatively greater degree along gradients of urbanization in the Coastal Plain than in the Piedmont.

They also discovered that Coastal Plain streams were more resilient to accept high sedimentation rate and the re-establishment of invertebrates in disturbed habitats. Densities of invertebrates in Coastal Plain urban streams rebounded from physical disturbance more rapidly than those in Piedmont urban streams. In other words, streams in the Piedmont region are more sensitive and recover slower to urbanization than those in the Coastal Plain.

Ryan M. Utz and Robert H. Hilderbrand. Interregional variation in urbanization-induced geomorphic change and macroinvertebrate habitat colonization in headwater streams. *Journal of the North American Benthological Society* (2011) 30:25-37.

The saying goes: "Give a man a fish, and he'll eat for a day. Teach a man to fish, and he'll eat for a lifetime." But teach a man the science of fish, and we all benefit.

Every year more than 100 graduate students come to the University of Maryland Center for Environmental Science to work side-by-side with some of the best environmental scientists in the world. Studying everything from the effects of development on stream ecosystems to new ways to feed fish in aquaculture, these men and women are training to solve environmental problems today so we have a better world tomorrow.

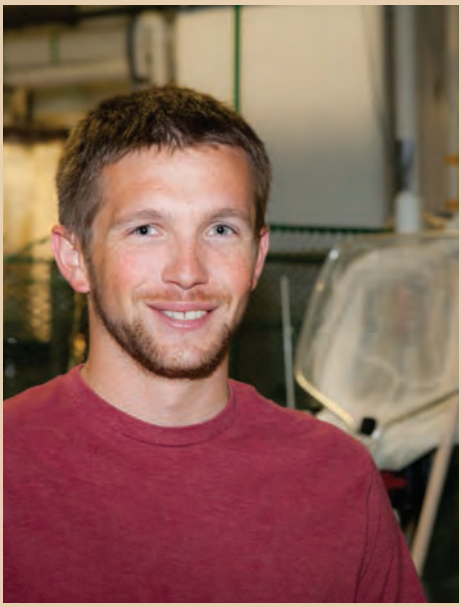
ADAM PEER

How maternal characteristics in striped bass affect their reproductive process and success

In species like cod, older and larger females produce stronger, larger offspring who may bear a better chance of survival in the ocean. Adam Peer is working with his advisor Dr. Thomas Miller at the Chesapeake Biological Laboratory to see if the same holds true for striped bass.

"Most fishermen have either a commercial or recreational interest in catching the biggest fish in the population,"* said Peer. *"We wanted to see if larger females are contributing more offspring, and if so, what kind of impact could this have on the future success of the population."

After tracking offspring from egg to juvenile in the Patuxent River, his preliminary results show that large females may not necessarily yield more juvenile survivors. Now he's trying to figure out if this is true on a larger scale—and if so, why.



AARON WATSON

Importance of taurine in vegetarian fish diets

Faced with overfishing of our oceans and the pollution of fish by PCBs and mercury, aquaculture is rising as a commercially viable and healthy food alternative. But how do you farm predatory fish such as cobia and sea bream without feeding them more fish? Aaron Watson has been experimenting with vegetarian fish diets to find out.

"The human population is expanding and protein demand is expanding, and that necessitates aquaculture to expand,"* said Watson. *"We've maxed out on fish oil and fish meal production and need to find alternatives."

Watson has been working with advisor Dr. Allen Place at the Institute of Marine and Environmental Technology to develop a vegetarian diet for fish that includes plant proteins and algae instead of fish meal. He has helped prove that taurine—an amino acid found in energy drinks and used by body builders—is essential for fish to grow on a vegetarian diet.

ROY WEITZELL

Effects of urbanization on stream ecosystems

A recent study found that 70 percent of headwater streams in Baltimore have been buried by development. Roy Weitzell is trying to prevent the same thing from happening elsewhere. Working with advisor Dr. Andrew Elmore in the Appalachian Laboratory, he is developing methods to model stream burial using remote sensing and geographic information systems (a computer program that allows him to map and analyze data) to see how habitats are connected in headwater streams.

"I'm looking at how much habitat is being destroyed and how it affects the ability of the bugs and fish that live in the water to move around and complete their life history,"* said Weitzell. *"Bugs have to fly from one stream to another to colonize a new habitat or mate. If those streams are farther away, they might not make it. Fish can't move through burial areas, so they can't find refuge or migrate to spawn."

Since each of the counties in the Potomac River watershed is in control of its own development, Weitzell has been modeling the distribution of stream burial to see how the amounts have changed over time and the policies that impact decision-making. The goal is to use this data to help decision makers guide development away from remaining habitat or implement ways to minimize its impact.

NAOMI MONTALVO

Bacteria associated with marine sponges

The giant barrel sponge is so large that a scuba diver can fit inside, but man is not its only visitor. Diverse groups of bacteria live there. Naomi Montalvo has been characterizing the bacterial communities that live on two different species of ancient sponges living on different sides of the world to understand the relationship between the microorganisms and their host.

"Marine sponges are the most prolific sources of new pharmaceutical compounds,"* said Montalvo. *"Sometimes they are produced by sponges or by microganisms living on the sponge. The more we understand about sponges and their communities, the more compounds we can discover. Every time we lose a species of sponge, we lose all of their bacteria and pharmaceutical and ecological potential."

Working with her advisor Dr. Russell Hill at the Institute of Marine and Environmental Technology, she has been looking at bacteria that can only be found in these sponges to understand the symbiotic relationships, such as whether the bacteria offers a chemical defense against predators and overgrowth, as the first step to unlocking its medical potential.

CHRIS CONROY

Importance of contingent behavior in juvenile striped bass

Childhood can have a major impact on any individual, and it turns out to be the same for fish. A movement of just 50 kilometers in the months following hatching can have a lifetime of consequences for striped bass.

Chris Conroy has been working with faculty advisor Dr. David Secor in the Chesapeake Biological Laboratory to identify patterns of juvenile migration within natal estuaries using otolith chemistry, or analyzing the growth rings on their earbones.

"We know that juveniles use a range of habitats within these estuaries,"* said Conroy. *"We're now trying to determine when these young fish move between these habitats and what spurs them to move."

When individuals are classified by movement patterns, the resulting groups are called contingents. Differences in growth may lead to the formation of these contingents, and their movements may lead to differences in growth, condition, and even survival. Better understanding of the complex spatial structure of juvenile populations may lead to improved management for the species as a whole.

REBECCA FOX

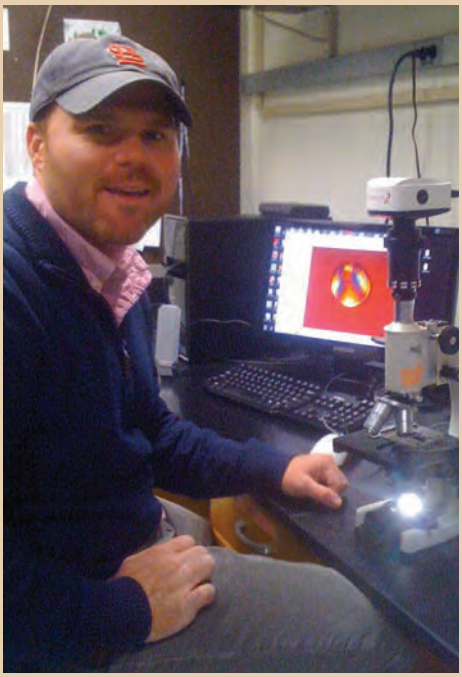
Nitrous oxide and methane emissions from agricultural areas

A common practice to reduce agricultural nitrogen from entering our waterways is to conserve or restore wetlands and create vegetated buffers that protect water resources from pollution. These management practices create conditions conducive for denitrification, the process by which nitrate is converted to nitrogen gas, which makes up 78% of our atmosphere.

Otherwise, the nitrate leaches into the groundwater and travels with the water to streams, surface water bodies, and eventually to the ocean. Rebecca Fox has been working with her advisor, Dr. Thomas Fisher at the Horn Point Laboratory to find locations where enhanced denitrification is occurring.

"When we look at watersheds, we can only account for 25-30% of the nitrogen that enters the watershed,"* said Fox. *"The rest of the nitrogen is missing. We hypothesize that it is reduced to nitrogen gas and released into the atmosphere as a result of denitrification."

Denitrification also produces nitrous oxide, which is a highly potent greenhouse gas. Fox has measured high concentrations of this greenhouse gas in groundwater surrounding agricultural areas.



JAKE GOODWIN

Identifying bivalve larvae with polarized light

The rainbow of colors and swirling patterns may look like something out of a psychedelic art show, but the images Jake Goodwin sees on his computer screen give up the secrets of the eastern oyster's identity.

It has long been difficult for scientists to tell the difference between larvae of bivalves such as oysters, clams, and mussels. Goodwin is working with advisor Dr. Elizabeth North in the Horn Point Laboratory to test a novel technique that uses polarized light to help make the identification.

"When you shine polarized light on bivalve shells they emit species specific patterns,"* he said. *"Then you can use pattern recognition software, similar to facial recognition software used by the FBI, to classify bivalves. You can achieve accuracies in the 90% range."

He has been growing bivalves in different conditions—looking at how food, temperature, salinity, and water densities affect the analysis technique—to test its precision and accuracy. He hopes to combine his scientific methods one day with a degree in environmental policy to help make good environmental decisions for the betterment of the public.

University of Maryland Center for Environmental Science faculty advised graduate students through the completion of their theses in the Marine Estuarine Environmental Sciences program, Environmental Toxicology, Applied Ecology and Conservation Biology, and Wildlife and Fisheries Management. In all, approximately 100 graduate students are conducting cutting-edge research toward the completion of a Master's of Science (M.S.) or Doctorate in Philosophy (Ph.D.).

PH.D.

William J. Connelly (Dr. Edward Houde)
"Scales of variability in the size composition and community structure of fishes in estuarine ecosystems"

Karen M. Eisenreich (Dr. Christopher Rowe)
"Comparative sub-lethal effects of polybrominated diphenyl ethers following simulated maternal transfer and dietary exposure in two species of turtle"

Rebecca J. Fox (Dr. Thomas Fisher)
"Dynamics of metabolic gases in groundwater and the vadose zone of soils on Delmarva"

Peng Jia (Dr. Ming Li)
"Wind driven circulation dynamics and salt balance in a wide shallow lagoonal estuary"

Christopher J. Kelly (Dr. Roger Newell)
"Growth and physiology of eastern and suminoe oysters and the implications of increased habitat complexity for associated oyster reef fauna"

Christopher W. Moore (Dr. Mark Castro)
"Factors influencing surface atmosphere exchange of gaseous elemental mercury in western Maryland"

Eli K. Moore (Dr. H. Rodger Harvey)
"Tracking protein from primary production to sediments using marine proteomics"

Marcela Suarez-Rubio (Dr. Todd Lookingbill)
"Exurban development: quantification, forecast, and effects on bird communities"

M.S.

Jennifer S. Barkman (Dr. Michael Wilberg)
"Assessment of populations with spatially explicit dynamics and the consequences for Marine Protected Areas"

Nicole Barth (Dr. Cynthia Palinkas and Dr. Evamaria Koch)
"Impact of breakwaters on sediment characteristics and submerged aquatic vegetation"

Allison R. Chandler Shideler (Dr. Edward Houde)
"Patterns in distribution, growth, and trophodynamics of striped bass early life stages in the estuarine transition region of upper Chesapeake Bay"

Amanda R. Colton (Dr. Thomas Miller)
"An evaluation of the synchronization in the dynamics of blue crab (Callinectes sapidus) populations in the western Atlantic"

Ji Li (Dr. Patricia Glibert)
"The effect of ambient N:P ration and light on the nitrogen uptake and growth of select estuarine and oceanic dinoflagellates"

Maude E. Livings (Dr. Michael Wilberg)
"Developing spatially explicit assessment tools for eastern oysters in Chesapeake Bay"

Carlos Lozano (Dr. Edward Houde)
"Dynamics of ingress, hatch dates, growth, and feeding of Atlantic menhaden, Brevoortia tyrannus, larvae in the Chesapeake Bay mouth"

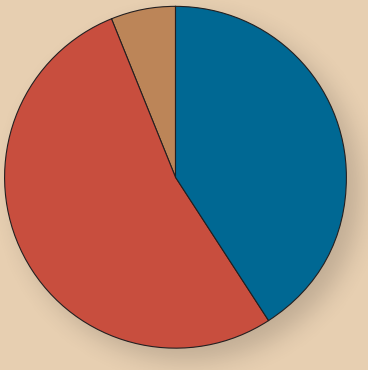
Kathleen S. Marshall (Dr. Johan Schijf)
"The influence of iron and manganese oxides on production of marine sedimentary cerium anomalies"

Angela Sjollema (Dr. Ed Gates)
"Bat activity and migration in the vicinity of proposed wind facilities along the Mid-Atlantic Coast"

Alison M. Zoll (Dr. Johan Schijf)
"Sorption of yttrium and the rare earth elements on the marine macroagla Ulva lactuca"

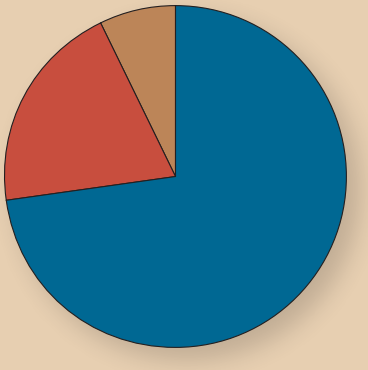
EXPENDITURES

- State Appropriation: $18,643,729
- Contracts and Grants: $24,457,104
- Other: $2,524,577



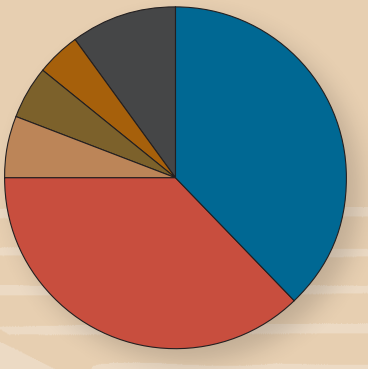
RESEARCH AWARDS

- Federal: $17,385,115
- State: $4,710,636
- Private: $1,765,337



FEDERAL AWARDS BY AGENCY

- NSF: $6,763,003
- NOAA: $6,669,489
- DOT: $1,133,296
- EPA: $970,338
- DOI: $674,995
- Other: $1,715,893



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