Smithsonian Environmental Research Center

Winter 2005/2006

S | E | R | C

Exploring Mercury Pollution

Turmoil in the Soil | Antarctic Productivity | Land Use Where It Matters

Dear Reader,

Much of SERC programs focus on land-sea interactions of the Chesapeake Bay. Indeed, SERC scientists and educators are working intensively on the ecology of the Nation's largest estuary and its watershed. In this issue of the SERC Quarterly you will find news of Pat Megonigal's research on effects of rising levels of CO_2 in the atmosphere on soil microbes and carbon stores in wetlands of the region. Don Weller, Tom Jordan with collaborators Matt Baker and Ryan King analyze land-use effects on nutrient discharges from watersheds of the Bay. Further, SERC is providing increased public access and new public education programs at our Rhode River home base on the shores of the Bay.

SERC Principal Investigators also conduct research across the continent and around the globe, as highlighted in this issue of the SERC Quarterly. Cindy Gilmour studies mercury transformations and transfers in ecosystems from the Florida Everglades to the Canadian Experimental Lake Area. Patrick Neale led a cruise as Chief Scientist aboard the Research Vessel Nathaniel Palmer to measure effects of ultraviolet solar radiation on plankton and the food web in the Southern Ocean. Catherine deRivera with Greg Ruiz, collaborator Paul Jivoff, and I found that native blue crabs limit the distribution of invasive green crabs along the Mid-Atlantic Coast. Leading SERC's fourth "Electronic Field Trip", Jess Parker and Mark Haddon are preparing live satellite broadcasts on forest ecology from the Wind River Canopy Research Crane in Washington State. More than 24 million school children have pre-enrolled for this distance learning opportunity.

All of these crucial research and education projects are funded by extramural grants and contracts, and by generous support from donors and volunteers.

Sincerely,
Tuck Hines

Cover photo: A researcher dives for core samples in Ontario (story page 4).

New Board Member

Marlin Fitzwater has recently joined SERC's advisory board. A novelist and lecturer Fitzwater spent a decade in the front row of history as press secretary to Presidents Reagan and Bush. He has been a business man, journalist, civil servant, and presidential adviser. Today, he is an adviser and lecturer for the Marlin Fitzwater Center for Communication at Franklin Pierce College in New Hampshire. He also serves on the Advisory Board of the George H.W. Bush Presidential Library Foundation and the Franklin Pierce College Board of Trustees.

Eye on Education

Spring Peeper Hike
Animal Track Casting
Let's Make a Tube Worm
Design Your Own Plankton Competition
Volunteer Trail Clean-Up
Early Morning Bird Walk

Opening Doors . . .

Our new Outreach Program has been launched with exciting offerings for everyone. Our program offers an unprecedented opportunity for the public to enjoy the Smithsonian's 3,000-acre research center with walking tours of undisturbed old-growth forest and canoe excursions through miles of undeveloped shoreline. Our spring line-up of activities includes parent-child activities for pre-schoolers, hands-on experiments for school-aged children and adults, projects for home-schoolers as well as a book club and lunch-time speakers series.

SERC is now open from 9:00 a.m. to 4:30 p.m. Monday through Saturday for general visitors and has special programs for the public throughout the week. In addition to exploring local ecology, our programs will teach visitors about the research we're doing here and how it relates to important issues such as global warming, invasive species, land use, water quality, watershed ecology and Chesapeake Bay fisheries.

A new quarterly publication, "The SERC Sun" will help advertise our programs, and the calendar of events available on our website provides a monthly listing of all public events and specific lists geared to various audiences.

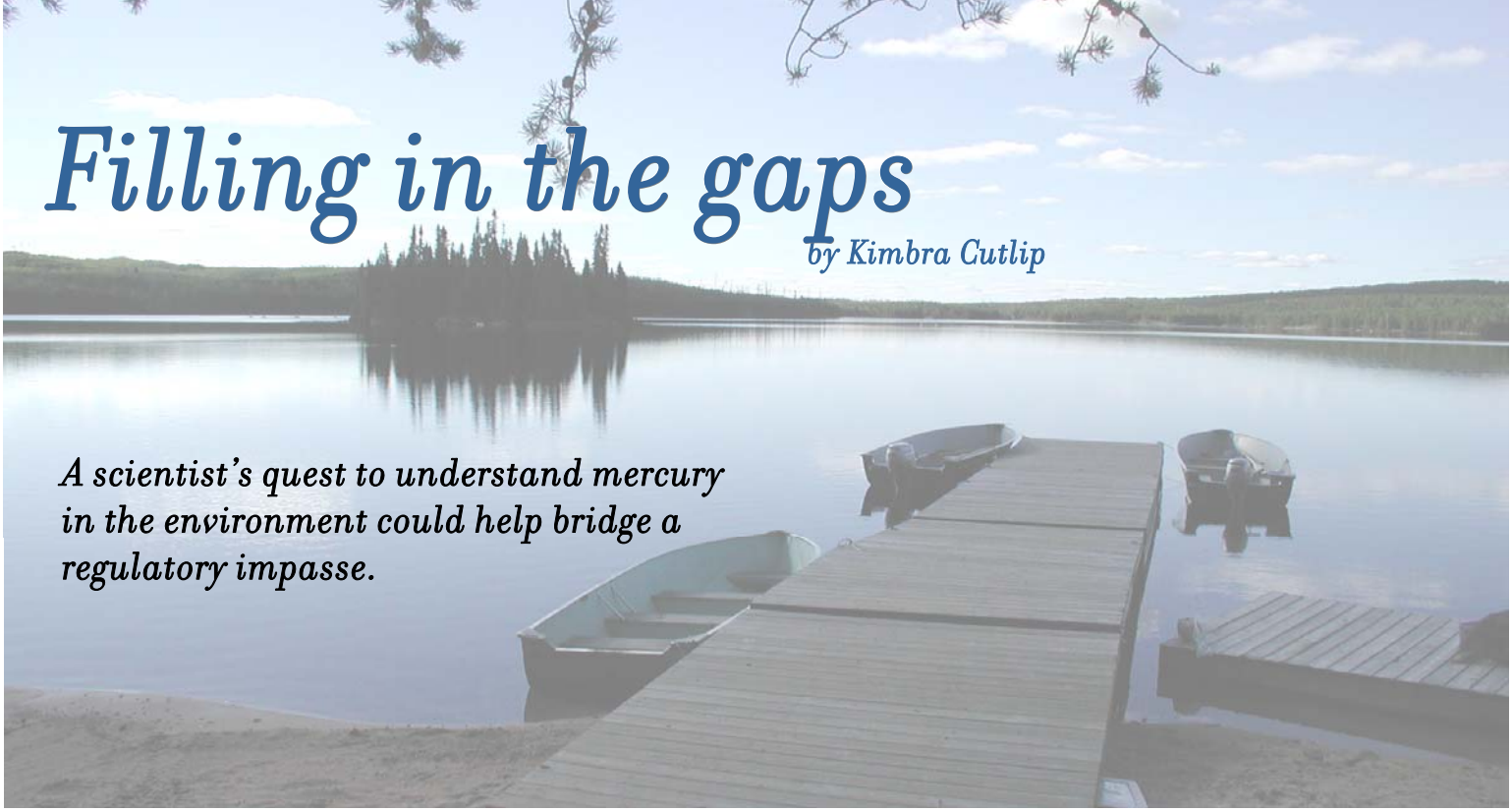
Go to http://www.serc.si.edu/public_programs/

Tree-mendous Technology

the science and technology of studying the treetops

On March 7th, SERC's newest electronic field trip will take 24 million students high into the treetops in the Wind River Canopy Research Crane in Carson, Washington. Forest ecologist Jess Parker will take the students on a tour of the canopy to discuss forest ecology and the technology available to study it.

The forest canopy is a microclimate of its own, one that absorbs sunlight and rain, removes particles like dust and pollen, and even affects the pH of rainwater as it makes its way down to the forest floor. Parker developed a portable, accurate new instrument to measure the vertical profile of forest canopies, and is now seeing aspects of the forests never seen before. The result is the equivalent of the first CAT-scan of a forest.



Filling in the gaps

by Kimbra Cutlip

A scientist's quest to understand mercury in the environment could help bridge a regulatory impasse.

New U.S. food guidelines suggest we all "choose fish more often for lunch or dinner," while the American Heart Association touts the benefits of eating fish for its heart-healthy Omega3 fatty acids. At the same time, the EPA cautions some people against eating more than a few servings of certain fish and advises consumers to check for local advisories before eating any fish not commercially caught. Even if no advisory exists, "consumers are advised to restrict consumption [of non-commercial fish] to one meal per week."

Choosing to eat fish is no longer a simple affair. At issue, the presence of high levels of dangerous toxins found in fish the world over.

In 2004, the United States alone issued 3,221 advisories on fish consumption, 2,436 of them for mercury. While there are other toxins appearing in fish, mercury is at the top of the list, and the clear threat to human health that it poses prompted the Environmental Protection Agency to issue the first Clean Air Mercury Rule in March of last year. Aimed at lowering industrial mercury emissions by about 20 percent in five years and 70 percent by 2018, the rule has been controversial. Some say it should be more rigorous while others dispute the impact of any such regulation no matter how aggressive.

Once a common household item found in everything from thermometers to cosmetics and paint, mercury pollution is abundant in our landscape. While the coal-fired power industry is responsible for the majority of new mercury emissions from the United States and at the center of much of the regulatory debate, it represents only a small fraction of the total mercury in our environment because 150 years of contamination is already stored in the soils. Some say that reducing current emissions will have little or no impact on the threat to human health while those seeking more rigorous regulation argue that it's the new supply of mercury to the environment that poses the biggest threat.

While the debate rages on in Washington, microbial ecologist Cynthia Gilmour is steadily working on answering questions that might help settle the matter. Gilmour is trying to understand how mercury reacts in the environment and how it accumulates in food webs—information that may ultimately predict the most effective methods for reducing the threat to human health.

Once released into the atmosphere through industrial emissions, mercury is carried to the ground by rain and accumulates in sediments and soils. This inorganic form of mercury does not accumulate in food webs, but under certain conditions, natural bacteria can convert it into an organic form called methylmercury.

That's where the trouble starts. In aquatic environments, small organisms such as filter-feeding oysters eat the bacteria and thus consume the methylmercury. Then larger organisms such as fish eat the filter-feeders. The

more they eat, the more methylmercury they accumulate in their bodies. As even larger fish eat the little ones, the process continues and methylmercury concentrations "biomagnify" up the food web until, by the time a nice juicy filet arrives on your dinner plate, it can contain up to a million times more mercury than the water from which it came.

Because bacterial mercury methylation occurs mainly in wetlands and aquatic sediments, aquatic organisms including wading birds and commercially important fish, are particularly susceptible. As awareness of mercury levels in fish has climbed in recent years, nearly every region in North America has been faced with issuing fish consumption advisories.

Fixing the problem will rely on understanding where the mercury in fish is coming from and exactly how it's getting there. Gilmour and her colleagues are exploring the processes by which microbes convert mercury pollution into methylmercury. One idea she is exploring is that as mercury "ages" in soils, it becomes more tightly bound within particles and is less readily taken up and methylated by bacteria.

Researchers Becca Morris and Ken Sandilands collect sediment cores to trace the fate of mercury they have added to this experimental lake in Ontario, Canada.

She and her colleagues are testing this hypothesis as part of the Mercury Experiment to Assess Atmospheric Loading In Canada and the United States—a.k.a. METAALICUS. In one field study at the remote Experimental Lakes Area in northwest Ontario, they are depositing mercury into a small lake and its watershed at levels equivalent to the current mercury deposition in the highly-impacted Eastern United States, and tracking what happens to it.

According to Gilmour, there are two unique aspects of the study. "This is the first study where the deposition of mercury to a whole, intact ecosystem has been experimentally manipulated," she said. The second unique feature of the study is that they are able to trace the behavior of newly deposited mercury separately from older mercury contamination in the ecosystem. Gilmour and her colleagues are using slightly different variations of mercury called isotopes. Most elements, like mercury, are made up of multiple isotopes, or variants with the same number of protons but differing numbers of neutrons in the atom's nucleus. This difference accounts for a very slight difference in mass or atomic weight. Mercury contains seven different stable isotopes—seven forms which do not degrade over time. (Radioactive isotopes are unstable and decay over time.) Generally, isotopes of the same element have the same chemical characteristics and react in the same way, but that slight difference in atomic weight allows Gilmour to keep track of the mercury she adds in her field experiments.

When the team adds a mercury stable isotope somewhere in the experimental watershed, they can track it in follow-up samples by measuring the ratio of that isotope compared to others. When that ratio rises above the expected "background" levels, they know it represents mercury they have added to the system.

To further refine their understanding of the way mercury behaves in the ecosystem, they are also able to differentiate between the mercury they add in different areas of their study site. "We are using three different stable mercury isotopes, one each on the lake surface, an adjoining wetland, and the upland watershed, which allows us to follow the behavior of mercury deposted to each part of the ecosystem individually," Gilmour said.

Understanding how ecosystems respond to changing levels of mercury will help predict how effective mercury emissions regulations will be, and how rapidly methylmercury contamination of fish may decline in response to emissions reductions. "If the older mercury contamination in sediments and soils is readily methylated and bioaccumulated, then the response time to emissions reductions is going to be very long," Gilmour said. "However, if most methylmercury is formed from recent mercury pollution, then we may see a rapid response to emissions reductions."

Field Notes:

Collecting samples in the Ross Sea

Native Wards off Invader

When a new species lands in foreign territory devoid of its natural predators and parasites, it has an automatic advantage over the natives. With the stage thus set for invasion, the new species can come to dominate. But not always. Recent evidence gathered by Catherine deRivera and her colleagues shows that, at least in some cases, the locals not only hold their own but prevent invasive species from spreading unchecked.

Their work shows that the native blue crab (*Callinectes sapidus*) is limiting the spread of the invasive European green crab in U.S. East Coast waters south of the Delmarva Peninsula. The European green crab (*Carcinus maenas*) has been charged with nearly decimating the soft shell clam fishery in the North East, but it hasn't gained ground everywhere.

By surveying bays from Maine to Virginia, deRivera found that the European green crab population declines in direct proportion to the abundance of blue crabs. In the Chesapeake Bay, where blue crabs are most abundant, there were no European green crabs at all. Regardless of temperature, habitat or presence of other predators, the one factor that remained consistent with the shift in green crab abundance was predation by blue crabs. As the first documented example of predation by a native species limiting the range of a marine invader, deRivera's work suggests the need for more study and illustrates the importance of maintaining healthy native populations.

Antarctic Expedition

They're too tiny to see with the naked eye, but they drive one of the most significant forces in the global climate machine. That's why photobiologist Patrick Neale is compelled to spend weeks chasing them around one of the coldest corners of the world. Neale led a team of researchers on a 45-day Antarctic cruise to study phytoplankton and other micro-organisms in the Ross Sea.

Like all plants, phytoplankton use the carbon from carbon dioxide ($C0_2$) to create plant tissue through photosynthesis. The resulting tissue or organic matter is called "primary production." Because of their abundance, phytoplankton are responsible for much of the world's primary production. Over time, as phytoplankton die and sink into the depths, they transport vast quantities of carbon from the atmosphere to the ocean floor--a process believed to be an important regulator of atmospheric CO_2.

During his expeditions south, Neale has been investigating the effects of ultra-violet radiation and vertical mixing on the photosynthesis there. "Ultimately we should be able to better estimate the productivity of the Southern Ocean, which is an important part of the global carbon budget," Neale said. "At least the preliminary results from our field measurements. . .suggest that the Ross Sea phytoplankton are among the most UV sensitive in the Southern Ocean," Neale said.

Mapping It Out

When it comes to predicting, and ultimately protecting healthy ecosystems, it's not just how much land is developed or how much is farmed that matters, it's where and how. According to studies by Don Weller, Matthew Baker, Ryan King and Thomas Jordan the arrangement of different land uses and their relationships to one another and the topography, all play an important role in predicting the impact of land use on aquatic systems.

It sounds like common sense; a forest that lies between a farm and a stream will block or absorb more nutrient runoff than a forest that is not associated with a farm. However, many current methods of predicting the impacts of land use on streams don't factor in this type of information. Rather, they treat all streamside forests the same, whether or not they are downhill from a source of nutrient runoff.

"The simple proportions of disturbed land cover types, such as cropland or developed land, in a watershed can be good predictors of aquatic conditions," Weller said, "but focusing on source areas and how things are connected to the stream tells us more of what we want to know."

Using Geographic Information Systems (GIS) to analyze data from contour maps, land cover maps and other sources, the researchers have developed new methods that factor in such things as the distance of various types of land use to the water, how topography affects the direction of runoff from disturbed areas, and amount of forest along the path of water flow between nutrient sources and streams. Their work provides potentially powerful tools for restoration and conservation management.

Turmoil in the Soil

There's a battle going on underground in marshes and other wetlands that could have serious implications for global climate. The struggle pits microbe against microbe in a competition for the energy resource carbon, and a new study by Patrick Megonigal suggests that it's the plants of these marshes, specifically plant roots, that wield the power to determine the winner.

Below ground microbes come in many different types. Just as humans use oxygen for metabolism, one group of microbes, the iron reducers, uses iron oxides, which are familiar to us as rust. Methanogens, on the other hand, use carbon dioxide and release methane, a significant greenhouse gas. Thus, the amount of methane emitted from the marsh is determined by which species of microbe dominates in the soil. Megonigal's studies showed that in the spring--when plants are most productive and the increased activity in the roots makes iron in the soil available to microbes--the iron reducers prevailed. But, as the summer wore on and plant growth slowed, the iron reducers began losing ground literally to the methanogens. By August, 80 percent of the total underground metabolism in the marsh was by methane producers.

Megonigal suggests that the iron reducers are generally more efficient than the methane producers, and when there's an abundance of iron around, they out compete them. But when there's less iron, the methane producers take over. Though it's still early, this work could have implications for controlling methane if we can figure out how to manipulate plants to support iron reducers over methane producers. One solution may be as simple as introducing a useable form of iron into the soil so that the iron reducers have what they need to win out over their competition.

Sink or Source?

In another recent study, Megonigal questions a long-held assumption that soil may act as one of the earth's natural buffers against rising carbon dioxide. As industrial development and global CO_2 levels continue to rise, it has been presumed that soil may serve as a sink for some of the excess carbon. Megonigal's work suggests the opposite, however. Increased atmospheric CO_2 may actually have a "priming effect," stimulating microbes in the soil to decompose old stores of organic matter in the soil and release CO_2 in the process.

"Adding a little labile CO_2 could stimulate the decomposition of old, recalcitrant carbon in the soil," Megonigal said.

Megonigal and his colleagues exposed marsh plants grown in pots in a greenhouse to both normal and elevated CO_2, and found that soil microbe respiration of old soil carbon increased by 157 percent in the pots exposed to elevated CO_2. This suggests that rather than serving as a sink for excess carbon, soil just may be a source of excess carbon and soil microbes will amplify CO_2 concentrations.

SIGHTINGS

The cable channel **Discovery Health** featured SERC graduate student Sarah Kolesar collecting in the field and discussing the natural history of jellyfish. The half-hour show "Dr. Know" aims to debunk scientific myths with quirky and sometimes ridiculous demonstrations. The episode "Sting Rays," which aired the second week in January, explored remedies for jellyfish stings.

Candy Feller's virtual mangrove trail was featured in a NetWatch article in **Science** magazine September 23.

Mario Sengco was interviewed by Radio Producer Marc Airhart for a future segment about harmful algal blooms on the program **Earth and Sky**.

Work by Catherine deRivera, Greg Ruiz, Anson Hines and Paul Jivoff received media attention when it appeared in a paper in the December issue of **Ecology**. The story, about the influence of Blue crab populations on the range of the invasive European Green Crab in the Chesapeake Bay, was picked up by the **Annapolis Capital**, and Channel 13 – **CBS Evening News** which aired an interview with Tuck Hines.

SERC's construction of a rain garden and bog in front of the new dorm was covered by the **Annapolis Capital** and Anne Arundel County public school system's cable network–**Channel 96** which featured student participation in the planting for the show Chesapeake Connections.

The large-scale monitoring program partnership between the National Estuarine Research Reserve, the National Marine Sanctuary Program and SERC was featured in the December 22 issue of **The Homer News**, in Homer, Alaska. The online version can be seen here:
http://www.homernews.com/stories/122205/news_20051222057.shtml

Strength in Numbers

Denise Breitburg received **$27,387** for Long-Term Mesocosm Studies of Competitive Interactions Between Diploid *Crassostrea ariakensis* and Crassostrea Virginica from the U.S. Department of Commerce, and **$19,968** from the State of Maryland for Food-Web Monitoring for Adaptive Multi-Species Management.

Anson Hines received **$400,000** for The Blue Crab, *Callinectes sapidus*: An Integrated Research Program of Basic Biology, Hatchery Technologies and the Potential for Replenishing Stocks from the State of Maryland.

Richard Osman received **$299,694** for Thresholds and Multiple Stable States in Southern New England Shallow Water Estuarine Communities from the U.S. Environmental Protection Agency.

Mario Sengco, Wayne Coats and Don Anderson received **$486,755** from NOAA ECOHAB for Role of parasitism on HAB dynamics: *Amoebophrya* sp. ex *Alexandrium tamarense*.

Cindy Gilmour received **$59,411** from the Electric Power Research Institute for Effects of Changing Fly-Ash Pond Chemistry on Methylmercury Production; and third-year funding for a three-year **$126,123** grant from the Florida Department of Environmental Protection for Aquatic Cycling of Mercury in the Everglades: Linking Everglades Restoration, Land and Air Management.

Greg Ruiz received **$56,912** from the U.S. Department of Commerce for An Analysis of the Effectiveness of Ballast Water Exchange in Controlling Invasive Species in the Great Lakes Basin and Chesapeake Bay; **$529,000** from the U.S. Department of Homeland Security for Investigation into the Distribution of Ballast Water Tracers in Coastal Waters; **$164,965** from the U.S. Deptartment of Commerce for Full Scale Study: demonstration project for the full-scale, ship-based application of a ballast water verification method to vessel arrivals on the U.S. Pacific Coast; and **$203,630** from the State of Maryland for Shipboard Evaluations of Venturi Oxygen Stripping During Continuous Routine Vessel Operations.

Tom Jordan received a grant of **$149,000** from USDA for Effects of agricultural conservation practices on nitrate losses from cropland of the Choptank River basin". This is part of a **$439,000** two-year award with the University of Maryland.

Mark Haddon received **$82,365** from the U.S. Deptartment of Commerce for Student Training in the Aquatic Research.

Dennis Whigham received **$25,000** from the Chesapeake Bay Trust for SERC Bog-Wetland Project.

Civil Science

Dennis Whigham gave a briefing to Congressional staff on October 26 on the subject of hurricane impacts, wetland loss and the future of coastal Louisiana. The briefing was organized by the Ecological Society of America which was announcing the initiation of a new ESA effort in which teams of experts including Whigham will work together to provide ecological expertise to policy-makers as needed.

Thomas Jordan attended a congressional briefing with Association of Ecosystem Research Centers members and a representative of the National Ecological Observatory Network (NEON) to inform congressional staff about progress with NEON planning and about plans for other new research initiatives in national synthesis of long-term ecological research.

Minutes: scientific and professional meetings and presentations by SERC staff

SERC researchers presented the following 24 talks at the Estuarine Research Federation Meetings at the Virginia Institute of Marine Sciences in October.

Boyer, J. N.; Dailey, S. K., Bioavailability of DON from Everglades Marsh, Mangroves, and Florida Bay.

Anderson, J. T.; Boynton, W. R.; Jordan, T. E.; Cornwell, J. C., Phosphorus fluxes and transport in the middle Patuxent estuary, Maryland.

Borgatti, R.; O'Neil, J. M.; Dennison, W. C.; Feller, I. C., Effects of nutrient enrichment on nitrogen fixation in the mangrove microbial communities in Bocas del Toro, Panama.

Breitburg, D. L., Predicting effects of eutrophication and overfishing on upper trophic levels in estuarine food webs: disentangling effects of multiple stressors.

Breitburg, D.; Nice, A.; Adamack, A.; Fulford, R.; Lipton, D.; Lung, W.; Jordan, T.; Weller, D.; Rose, K., The importance of scale and location to the ecological and economic benefits of restoration.

Burrell, R. B.; Breitburg, D. L.; Kolesar, S. E., Opposing waves of ctenophore and sea nettle population spread: a landscape perspective on gelatinous zooplankton dynamics.

Dallmeier, F.; Megonigal, J. P., MAREO: Contributions of the mid-Atlantic region to the development of a National Ecological Observatory Network (NEON).

Fofonoff, P. W.; Ruiz, G. M.; Carlton, J. T.; Lambert, G.; Hines, A. H.; Steves, B. P., Which coastal habitats are most invaded? - A database analysis for the coasts of North America.

Fulford, R. S.; Breitburg, D. L.; Newell, R. I.; Luckenbach, M., Assessing the ecological costs and benefits of oyster population recovery in Chesapeake Bay: Management from a food-web perspective.

Fulford, R. S.; Breitburg, D. L.; Newell, R. I.; Luckenbach, M., Planning oyster population recovery from an ecological perspective: Where should we put them and why?

Gallegos, C. L.; Biber, P. D., Effects of eutrophication on light penetration and implications for seagrass communities: Looking beyond the obvious.

Graham, E.; Tuzzolino, D.; Burrell, R. B.; Breitburg, D. L., Spatial and temporal patterns of ctenophore abundance and reproduction in the Rhode River.

Hines, A. H., Fishery failures and aquaculture expectations: Implications of shifting in modes of estuarine food production.

Jordan, T. E.; Cornwell, J. C.; Anderson, J. T.; Boynton, W. R., Do sea salts or sulfate mobilize iron-bound phosphate from estuarine sediments?

Joye, S. B.; Feller, I. C.; Lee, R. Y., Primary Production and Nutrient Fluxes in Mangrove Soils and Microbial Mats.

Kolesar, S. E.; Breitburg, D. L., Effect of low dissolved oxygen on swimming speeds, encounter rate, and predation by *Mnemiopsis leidyi* ctenophores on naked goby larvae.

Lovelock, C. E.; Feller, I. C.; Ellis, J.; Schwarz, A.; McKee, K. L.; Hancock, N.; Nicholls, P.; Sorrell, B., Contrasting responses of two New Zealand mangroves to nutrient enrichment.

McKee, K. L.; Feller, I. C.; Lovelock, C. E., A global comparison of belowground responses by mangroves to nutrient enrichment

Megonigal, J. P.; Wolf, A. A.; Drake, B. G., Elevated atmospheric carbon dioxide stimulates decomposition of soil organic matter in a brackish marsh.

Newell, R. I.; Fulford, R. S.; Cerco, C. F.; Breitburg, D. L.; Koch, E. W.; Fisher, T. R., The influence of eastern oysters on ecological processes in Chesapeake Bay: Insights from recent modeling studies.

Ruiz, G. M.; Fofonoff, P. W.; Steves, B.; Carlton, J. T., Spread of nonindigenous marine species in North America: Patterns and predictions.

Weller, D. E.; Baker, M. E.; King, R. S.; Jordan, T. E., Effects of land cover on aquatic systems: does spatial arrangement matter?

Wilson, M. D.; Watts, B. D.; Brinker, D. F.; DeLuca, W. V.; Marra, P. P., The ecological role of the Chesapeake Bay in supporting marsh bird communities.

Feller, I. C.; Lovelock, C. E., Responses to nutrient enrichment in nitrogen- vs. phosphorus-limited mangrove forests.

Cindy Gilmour gave a talk "Interaction of mercury with dissolved organic matter under sulfidic conditions" at the Society for Environmental Toxicology Annual Meeting in Baltimore, MD.

Wayne Coats will participate in a MD Sea Grant meeting concerning the program's research prospectus on conservation, restoration and sustainable use of coastal and watershed resources.

Wayne Coats presented a talk "Parasitism of Chesapeake Bay Red-Tide Dinoflagellates" at the Center of Marine Biotechnology, University of Maryland Biotechnology Institute in Baltimore, MD.

Wayne Coats is a panel Member for NSF Division of Biological Infrastructure, Living Stock Cultures and a member of the External Tenure Review Committee, Biology Department, WHOI.

Dennis Whigham will be attending a meeting of a new committee (http://www.umces.edu/la-restore/) that has been put together to develop a concepts paper on the restoration of coastal Louisiana.

The committee was developed to provide input to the upper administration of the Corps of Engineers. This committee is an outgrowth of the National Technical Review Committee of which Dr. Whigham has been a member for the past few years.

Thomas Jordan attended the annual meeting of the Association of Ecosystem Research Centers (AERC) and was voted President-Elect (to become President of AERC in November 2006).

Patrick Megonigal gave an invited symposium presentation at the annual Soil Science Society of America Meeting. Symposium Topic: Denitrification in the Riparian Stream Continuum. Presentation Title: "Beyond Denitrification: Alternative Pathways of N_2 Production."

Chuck Gallegos gave a talk to the Chesapeake Bay Program Chlorophyll Criteria Team and met with managers from the Chesapeake Bay Program to discuss estuarine indicators.

Catherine deRivera presented a talk, "Spatial patterns of nonindigenous invertebrates in West Coast Reserves and Sanctuaries," at the Western Society of Naturalists' meeting.

Rick Osman presented a talk, "Effects of Invasive Species on Marine Aquaculture and Potential Methods of Control," at the Interstate Seafood Seminar in Ocean City, MD.

Dr. Bert Drake presented a talk, "How Plants and Ecosystems will respond to rising atmospheric CO_2 climate change," at McGill University, Montreal, Canada; NASA, KSC, FL, Smithsonian Institution.

NEW PUBLICATIONS

Neubauer, S.C., Givler, K., Valentine, S., Megonigal, J.P. 2005. Seasonal patterns and plant-mediated controls of subsurface wetland biogeochemistry. *Ecology* 86:3334-3344.

Rearick, M.S., Gilmour, C.C., Heyes, A., Mason, R.P. 2005. Measuring sulfide accumulation in diffusive gradients in thins films probes by means of purge and trap followed by ion selective electrode. *Environ. Tox. Chem*. 24:3043-3047.

Jewett, E.B., Hines, A.H., Ruiz, G.M. 2005. Epifaunal disturbance by periodic low dissolved oxygen: native versus invader response. *Marine Ecology Progress Series* 304:31-44.

deRivera, C.E., Ruiz, G.M., Hines, A.H., Jivoff, P.R. 2005. Biotic resistance to invasion: Native predator limits abundance and distribution of an introduced crab. *Ecology* 86:3364-3376.

Marsh, A.S., Rasse, D.P., Drake, B.G., Megonigal, J.P. 2005. Effect of elevated CO_2 on carbon pools and fluxes in a brackish marsh. *Estuaries* 28:694-704.

Bettarel, Y., Kan, J., Wang, K., Williamson, K.E., Cooney, S., Ribblett, S., Chen, F., Wommack, K.E., Coats, D.W. 2005. Isolation and preliminary characterisation of a small nuclear inclusion virus infecting the diatom *Chaetocerus* cf. *gracilis. Aquatic Microbial Ecology*, **40**: 103-114.

Ribblett, S.G., Palmer, M.A., Coats, D.W. 2005. The importance of bacterivorous protists in the decomposition of stream leaf litter. *Freshwater Biology*, 50:516-526.

Weiss, J.V., Emerson, D., and Megonigal, J.P. 2005. Rhizosphere Iron(III) Deposition and Reduction in a Juncus effusus L.-Dominated Wetland. *Soil Science Society of America Journal* 69(6):1861-1870.

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For information about The SERC Report,
contact: Kimbra Cutlip
443-482-2325 / cutlipk@si.edu

Smithsonian Environmental Research Center
PO Box 28 /647 Contees Wharf Road
Edgewater, Maryland 21037