Winter 2004

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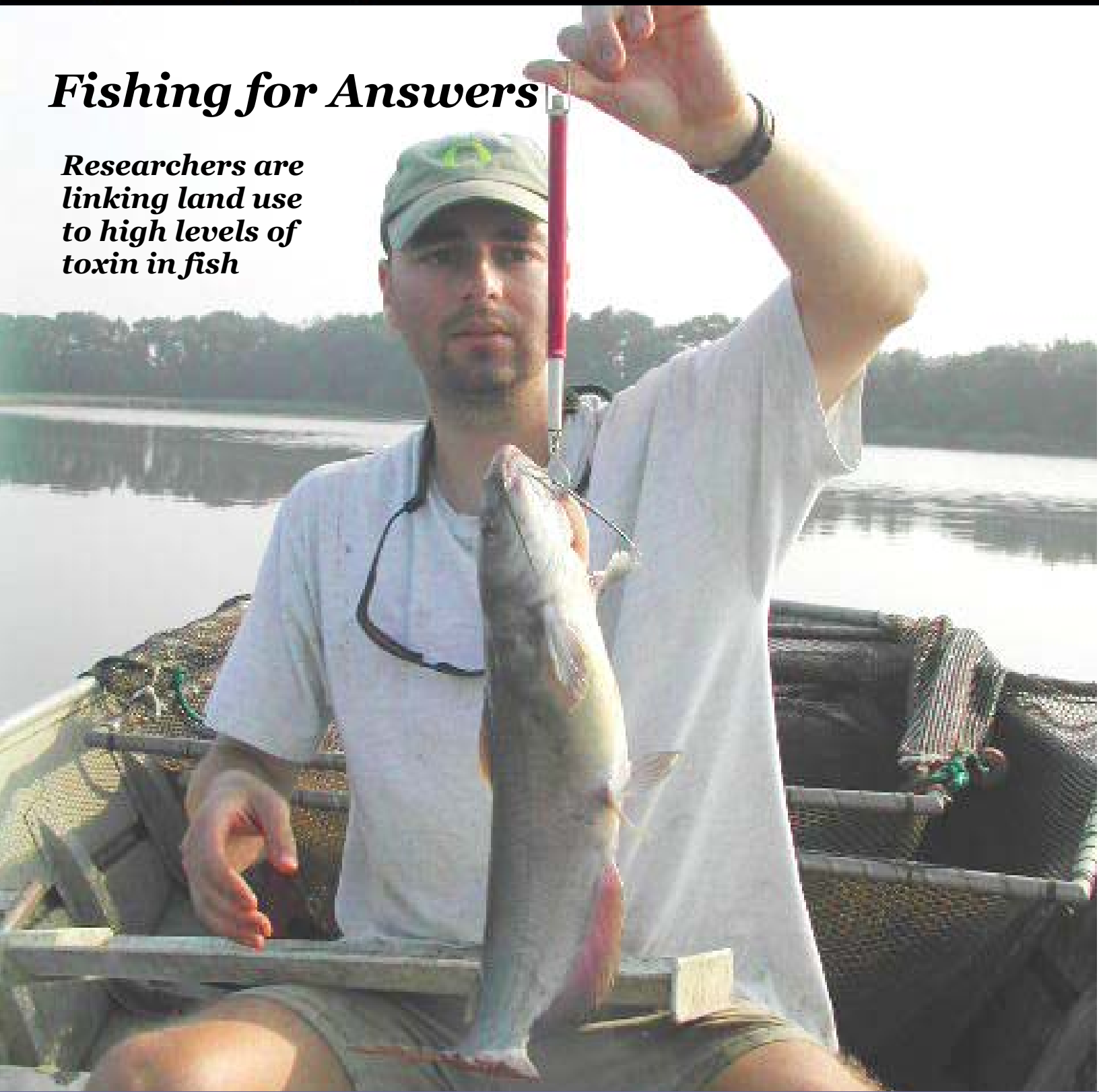
Smithsonian Environmental Research Center

Fishing for Answers

Researchers are linking land use to high levels of toxin in fish



Dear Member of the Board,

SERC is 40 years old in 2005. It has grown from a small research outpost to a major international research and educational center in a very short time. The vision of my predecessors as well as the present day staff supplemented by the Board has strongly positioned SERC as a force in ecological research in the coastal zone. As our scientific presence has grown, so has the public's perception of our work. Our research is seen as anywhere where the "land meets the sea".

This year will bring a series of exciting events which will further both our research and educational activities and extend SERC's leadership in such fields as wetlands biology, invasive species, professional training and disease ecology to name just a few. Our public education programs will once again be felt across the country through an electronic field trip. Our facilities are being enhanced and we will cut the ribbon on our first free standing dorm, allowing the SERC community to further extend its 24/7 environment.

Our most important event in this New Year will be the launching of our 50th Fund Campaign. The campaign subcommittee met in December with central Smithsonian development officials and is very excited by this decadal challenge to provide the financial security and flexibility so that when 2015 arrives we can look back and see another set of great accomplishments.

So, Happy New Year to you all and as importantly

HAPPY ANNIVERSARY!

Ross B. Simons
Director

In Memoriam

SERC board member **Edward O. Wayson Jr.** died unexpectedly in early December. The SERC community was shocked and saddened by the loss of Ed. His presence and contribution to SERC's growth over the last five years was immense. He will be missed not only here, but throughout the philanthropic community.

Smithsonian Environmental Research Center Advisory Board

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Edward O. Wayson, Jr., Managing Partner in the law firm Cooter, Mangold, Tompert & Wayson, LLC

The next board meeting will be held at SERC on Monday, April 11th from 9a.m. to 1:30p.m.

Focus :

World Water Quality

On October 18, thousands of people around the world scooped a little vial of water from their local streams and bays in a united effort to celebrate the second annual world water monitoring day. SERC hosted the official kick-off event on its pier along the western shore of the Chesapeake Bay with an address from U.S. Department of State Assistant Secretary John F. Turner, U.S. EPA Administrator Michael O. Leavitt..

The distinguished speakers were joined by foreign dignitaries, students, and other guests as they conducted water quality tests, explored the Rhode River on one of the Center's research vessels and took samples of fish and invertebrates from surrounding waters. The actvities aimed to help raise awareness and stimulate international interest in the importance of ensuring clean water for people around the world.

SERC hosted the first World Water Monitoring Day in 2003 which included 4,800 sites in the United States and 433 sites in 23 other countries. This year, participants from all 50 states and 35 countries registered to receive a testing kit from the American Clean Water Foundation which founded and organized the event. Results of the tests are posted on the foundation's website where they provide a snapshot of global water quality and may help illustrate water quality trends throughout the years.

As part of this broad mission, SERC has been studying and disseminating results of water quality studies in the Chesapeake Bay watershed and other sites around the world throughout its 40-year history. Through collaborative relationships and grants for specific projects, SERC partners with NOAA and EPA on research and environmental education throughout the coastal zone.

http://smithsonian.tv/videos/serc/
http://www.worldwatermonitoringday.org/

Distinguished guests enjoy the day's events.
Top: America's Clean Water Foundation President, Robbi Savage, Assistant Secretary , U.S. State Department, John Turner, SERC Director, Ross Simons, and E.P.A. Administrator Micheal O. Leavitt.

Beneath Still Waters

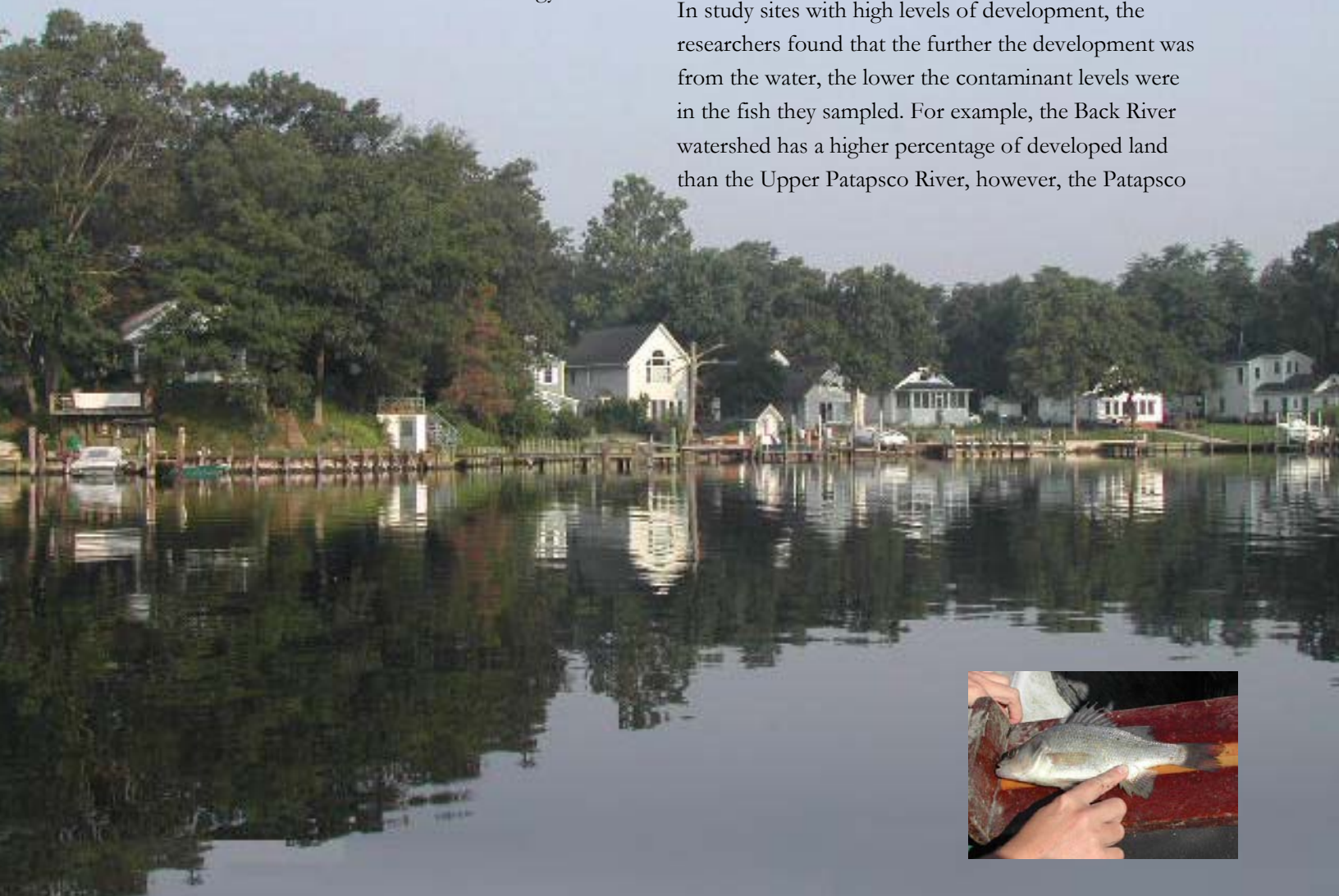
New study finds a strong connection between development near watersheds and PCB levels in fish.

Twenty-five years after PCBs (polychlorinated biphenyls) were banned, the toxic agents, known to cause significant health problems in humans and animals, are still turning up in dangerous levels in fish caught in the Chesapeake Bay watershed. Surprisingly, it may not all be coming from high-suspect areas like Baltimore Harbor. According to a recent study by Smithsonian Environmental Research Center (SERC) scientists, areas where there is relatively little development are likely to have white perch with PCB levels above the recommendation for human consumption, particularly if the development is close to the shore.

Currently PCB consumption advisories are in effect for several fish species in less-industrialized areas of the Bay. The new study published in the December 15 issue of "Environmental Science and Technology" may shed light on the source of these PCBs and direct managers to identify areas of high probability for PCB contamination. The team, led by SERC scientist Ryan King, measured PCB levels in fish from 14 tributaries within the Chesapeake Bay watershed and correlated their findings with the amount, type and distribution of developed land in each location. Their findings indicate that higher levels of PCBs show up in white perch where development is most intense and closest to the shore.

"We found that the amount of development, particularly high density residential and commercial development, and the proximity of development to the watershed were incredibly strong predictors of contaminant levels in white perch tissue," said King.

In study sites with high levels of development, the researchers found that the further the development was from the water, the lower the contaminant levels were in the fish they sampled. For example, the Back River watershed has a higher percentage of developed land than the Upper Patapsco River, however, the Patapsco



has more development near the water. The study found more PCBs in perch caught in the Patapsco than in the Back. According to King, this trend was consistent even in watersheds with much lower levels of development.

Although PCBs have been banned since 1979, they remain in the environment for a very long time, and therefore it is not surprising to find reservoirs of them today. "The idea that there would be new active sources of PCBs is probably pretty unlikely," said King, "but PCBs take a very long time to degrade, and older areas of development may still be acting as non-point sources of these contaminants."

According to King, current patterns of development and land use tend to follow historical trends. So new development often occurs close to old development where PCBs are likely to be lingering in the environment.

Efforts to identify waterways most likely to contain fish with high levels of PCBs have often focused on historical reservoirs or areas where PCBs were once manufactured, stored or discarded. But this new study highlights the need for further investigations into the sources of PCB contamination and the need to look at development patterns within the watershed to identify areas for testing.

"Our study really points to the serious implications of development in the environment," King said. "It shows that there may be a lot of things going on in watersheds related to development, and it provides strong evidence that environmental and ecological conditions in subestuaries of the Bay are tied to land use in their associated watersheds."

King is now an assistant professor at Baylor University. The study was funded by the Environmental Protection Agency Science to Achieve Results program and the Maryland Department of the Environment.

Teaming Up Against Invaders

Alien species have invaded U.S. waters at a dramatically increased rate in recent decades, causing serious ecological and economic impacts. And because invasive species are a global problem, management efforts to reduce new invasions and control their impacts will take a network of experts working in sites around the world in a concerted effort across disciplines. In answer to this need, the Smithsonian Environmental Research Center (SERC) and Portland State University (PSU) have joined forces to establish a network of knowledge to help tackle the problem of invasive species.

The new "Aquatic BioInvasion Research and Policy Institute" was officially established on Tuesday, Oct. 26, during a signing ceremony in Portland, Oregon. The Institute combines the respective strengths of SERC and PSU in marine and freshwater systems. By blending a wide range of disciplines (such as biology, environmental sciences, economics, engineering and social sciences), this endeavor seeks to develop novel approaches to research, management and policy for biological invasions.

The Institute is advancing an ambitious array of activities from the Atlantic to the Pacific coasts. SERC's Chesapeake Bay laboratories will be the base for Atlantic coast research while Portland State University will serve as the home base for the Aquatic BioInvasion Research and Policy Institute. From these two centers, the Institute plans to establish a broad consortium of researchers, resource managers, industry representatives and students from many additional organizations that participate in this program. Congressmen David Wu (D-Ore.) recently said in support of the initiative, "As a member of the House of Representatives Science Committee, I understand the potentially devastating effects of invasive species within freshwater and marine systems, and the need for extensive research on this subject. I strongly support the partnership between Portland State University and the Smithsonian Environmental Research Center and will continue working on channeling federal resources for national invasive species research." According to Greg Ruiz, director of the marine invasions research lab at SERC, the problem of biological invasions is increasingly viewed as a sustainability issue. The veined rapa whelk (Rapana venosa) for instance has affected shellfisheries in the Mediterranean and Black Sea and may threaten New England shellfisheries, as its range expands from its recent foothold in the Chesapeake Bay. The European Green Crab, a voracious predator on shellfish, has invaded both coastlines of the United States, affecting both commercial and non-commercial species. "Invasions are by their very nature a complex and multi-disciplinary issue," said Ruiz, "involving the interaction of biology with environmental science, and the economics and engineering inherent in the shipping and trade industries."

Portland State University President Dan Bernstine and SERC director Ross Simons sign the MOU and officially launch the new Aquatic BioInvasion Research and Policy Institute as SERC's Greg Ruiz, Congressman David Wu, and PSU's Mark Systma look on.

SERC director Ross Simons said "The magnitude of the problem of aquatic invasive species requires creative new intellectual systems to develop solutions." The new Aquatic BioInvasion Research Program is intended to provide a catalyst for multidisciplinary understanding of biological invasions. "The creation of this institute bringing together world class experts in both the biological and social sciences will lead to fresh approaches and resolution of some of the most biologically vexing problems of our times," said Simons.

"This East Coast-West Coast partnership is good for Portland State University, for the region and for the nation," said Daniel O. Bernstine, president of PSU. "The scientists from PSU and the Smithsonian Environmental Research Center have strong reputations for the excellent work they are doing in the area of aquatic invasive species. Our work together will support students, expand research opportunities and enhance sustainability efforts in Oregon and nationwide, particularly related to commerce, which is so important to our economy."

Opening the Dialogue on Distance Learning

On Monday November 8 representatives of 23 Smithsonian units and offices visited SERC to participate in the Smithsonian's first distance learning (DL) symposium. The goal of the day-long "Smithsonian Dialogue on Distance Learning" was to share best practices and discuss ways to collaborate on distance learning projects.

SERC Director Ross Simons opened the event, and Undersecretary for Science David Evans welcomed the participants, underscoring the importance of SI units exploring and using this new way of disseminating information. SERC Distance Learning Coordinator Dottie Klugel described SERC's approach to distance learning with its combination of videoconferences and Electronic Field Trips (EFT) and DL partners Diane Wilkinson and Sal DeAngelo from ProjectVIEW shared some of their extensive knowledge on the real-life challenges and successes of bringing videoconferences to schools. They discussed the pros and cons of the various technologies and highlighting the need for teacher involvement during the creation of a program. The morning closed with a live videoconference with SERC's VC partner Ball State University.

During the afternoon, participants shared information about their own unit's activities or interest in the field of distance learning. Several Smithsonian units currently do some kind of distance learning, and many are interested in learning how to get started. The discussions continued throughout the afternoon and underscored the need for continued communication among SI staff involved or interested in distance learning technologies and activities. After the symposium, a DL-at-SI listserv was set up for that purpose.

The symposium can be viewed online at: http://smithsonian.tv/videos/serc/

EYE on Education

The 2004 field season came to a close in the Middle of December as students participating in the Student Training in Aquatic Research program collected the last of their field data. SERC had 4,266 student visits in 2004, a 17 percent increase over 2003. Field trips will resume on April 4. The *Estuary Chesapeake* program for grades 4-6 is already fully booked through the spring.

In an effort to increase communications between the science and education communities at SERC and to keep education staff and volunteers informed about current research activities, School Programs Coordinator Jane Holly is organizing a series of "lunch with a scientist" throughout the winter months. Bill Deluca of the Avian Ecology Lab kicked off the series on Wednesday, December 8.

Students in the Student Training in Aquatic Research Program are using the winter months to analyze their field data and meet with SERC scientists and technicians to increase their understanding of research at SERC. At the STAR symposium in May 2005, the students will present the results and conclusions of their independent research projects.

On November 1, Jane Holly and Amy Erb promoted SERC education programs at the Association of Independent Maryland Schools conference in Baltimore, MD.

Dottie Klugel guides teachers through an exercise during a teacher training workshop on the Rhode River.

On November 5, Mark Haddon and Dottie Klugel represented SERC at the Smithsonian Teacher's Night in the new National Museum of the American Indian.

From November 30 through December 2, Mark Haddon visited nine middle school classes in the El Paso school district in Texas, as part of the Smithsonian Scholars in Schools Program organized by The Smithsonian Associates. Funded by the Ford Foundation, this program aims to increase science literacy in selected schools. Students at Slider, Clarke, and Montwood middle schools learned about watersheds and SERC blue crab research during a 90-minute session. The education effort was featured in local media, including Fox News and Channel 7.

Birds of a Feather

According to a new SERC study published in Science, American Redstarts that end up raising chicks late in the summer may suffer for it the following year. Male birds that don't succeed with their first nest often try again, and end up with a second nest of chicks to raise. According to the study, this means they don't have time to complete their molt before migrating to winter grounds and may have to molt en route.

It translates into a greater effort on these late-season fathers, and when their new feathers come in, according to the study, they come in duller than those of birds which had the chance to molt before migration. And duller feathers could mean less success in the mating game the following year.

The American Redstart, known as the Christmas Bird in its Caribbean wintering grounds graced the cover of Science Magazine on December 24th in conjunction with an article by former SERC post Doctoral Fellow Ryan Norris and Dr. Peter Marra.

Science The New York Times AP Associated Press

SIGHTINGS

Associated Press released an article about the blue crab enhancement project on December 9th which appeared in local papers including the Annapolis Capital, Washington Times, and others.

Zoogoer magazine published an article titled "Hatching a Plan for Blue Crabs" in the Jan/Feb 2005 issue that focuses on the blue crab enhancement project.

Denise Breitburg's work was recently featured for a cover story in **Chesapeake Quarterly** 3:3-6 "Recovering Resilience: Can restoration bring back the Bay's buffers?" By Erica Goldman.

The **AP Wire** distributed a story about the new "Aquatic BioInvasion Research and Policy Institute." The story was published in over 40 newspapers including the **New York Times.**

Pete Marra was quoted in an article in the Oct. 22 issue of **Science** magazine about the potential impacts of West Nile virus in Hawaii where it was recently found. The article was titled: "Hawaii Girds Iteself for Arrival of West Nile Virus" and was written by Erik Stokstad. Science, Vol 306. p.603.

Strength in Numbers

Greg Ruiz and the Invasive Species Lab received awards totalling more than 428,900 this quarter. The State of Maryland, University of Maryland Center for Environmental Science awarded $185,417 to examine effects of low oxygen as ballast water treatment.

New Zealand Ministry of Fisheries awarded $160,585 for "Verification of mid-ocean ballast water exchange by commercial ships arriving to New Zealand", 2004-2005.

The Prince William Sound Regional Citizens' Advisory Council awarded $61,196 for the period 13 October 2004 through 30 June 2005 for the proposal "Northward Spread of Marine Nonindigenous Species along Western North America: Assessing Risks of Colonization for Alaskan Waters."

Ruiz received a sub-award of $21,735 from University of Maryland Center for Environmental Science out of a total grant of $75,784. The SERC portion will cover October 2004 through November 2005 for the proposal "Evaluation of Full-scale Venturi Oxygen Stripping to Prevent Ballast Water Invasions."

Pat Neale was awarded $45,000 from NIST in continuing support of SERC's joint UV radiometer network and database system.

Mark Haddon received $14,000 from a Smithsonian Innovation Grant for "It's all in the Watershed" educational program

Denise Breitburg was awarded $3000 ROF funds from Marine Science Network for travel to the ASLO meeting in Spain, June 2005. Breitburg also received $1800/y for two years from CCRE to collect pilot data on Cassiopea jellyfish.

On Oct. 4-5 Director Simons visited the Kennedy Space Center to negotiate an extension on the MOU with NASA and SERC for mutual research programs. Simons also visited the C02 research site of Bert Drake to assess post-hurricane damage. Kennedy Space Center Director, Jim Kennedy and Simons agreed to an extension of the cooperative research agreement and a jointly sponsored workshop in 2005 focusing on environmental research at the Space Center.

MERCER AWARD

The Ecological Society of America recognized Rick Osman and his colleagues with the Mercer Award for an outstanding ecological research paper published by one or more "younger" researchers (under 40 years). The paper is "Biodiversity, invasion resistance, and marine ecosystem function: Recognizing pattern and process", by John J. Stachowicz, Hether Fried, Richard W. Osman, and Robert B. Whitlatch; Ecology 83:2575-2590. With due credit to the younger authors (Stachowicz and Fried) and the older ones (Osman and Whitlatch), the award recognizes the paper as a "seminar contribution" that is "one of the very few studies in marine environments that explicitly test the effects of diversity on ecosystem function…testing the an issue of key practical importance – the degree to which diversity per se affects invasion resistance."

Civil Science

Denise Breitburg met with Congressman Wayne Gilchrest to participate in a briefing and discussion on the potential introduction of C. ariakensis (the Suminoe oyster) to Chesapeake Bay.

On November 30, SERC attended a reception at the U.S. Department of State to celebrate the completion of the Department's Two Bays One World project. SERC Distance Learning Coordinator Dottie Klugel supported teacher training and curriculum development for this project in cross-cultural understanding. Through the project students in Washington D.C., Maryland, and Bangladesh compared the ecology and culture of the Chesapeake Bay area with that of the Bay of Bengal. At the reception students from Maryland and D.C. displayed their newly gained knowledge of both areas through a series of posters and presentations.

From the Podium

SERC hosted the following Weekly Seminars:

- **October 21:** Nina Caraco, Institute for Ecosystem Studies, "Atmospheric carbon dioxide and stoichiometry of phytoplankton: A link to global carbon storage?"
- **October 28:** Mark Minton, SERC, "Plant Naturalizations: Surviving the Gauntlet of Environmental Stochasticity."
- **November 4:** Isabell Bisson, SERC, "The evolution of migration in the Cassin's Kingbird: evidence from phylogeny, vocalization, and morphology."
- **November 9:** Eric Roden, University of Alabama, "Controls on Phosphate Mobility in Anaerobic Sediments: Microbial FE (III) Oxide Reduction vs. Iron-Sulfide Mineral Formation."
- **November 16:** Susan Sollie, Utrecht University."Correlations between Water Level, Vegetation and Nutrient Status in Littoral Zones– A Field Study in the Ijsselmeer Area, The Netherlands." **November 18:** Wayne Coats, SERC "Viral Infection of Chesapeake Bay Diatoms."
- **December 2:** Gary Brewer, Yale, "Ecosystem Management: Fads and Fantasies vs. Doing it Right."
- **December 9:** Bill Fagan, Fragmentation and Connectivity in Rivers: Issues for Conservation and Restoration Ecology."

Evening Lecturers:

October 20, Dr. Doug Gill, University of Maryland "Reproductive failure in a native orchid? A fire of hope for conservation."

November 17 Dr. Cindy Gilmour, SERC "Understanding mercury pollution: Where does mercury come from and how does it get into aquatic food webs?"

Weekly Seminars Coming Up

- **January 27, 2005 11:00 AM**
  David Gorchov, Miami University and SERC, "Competetive Effects of Invasive Plants on Native Plants."
- **February 03, 2005 11:00 AM**
  Catherine deRivera, SERC, "Limits to Range Expansion of the Invasive Green Crab."
- **February 10, 2005 11:00 AM**
  Maria Tzortziou, SERC, "Dissolved organic matter budget of the Rhode River watershed."

Minutes: scientific and professional meetings and presentations by SERC staff

Karen Carney gave an invited seminar at the department of Biology, University of Indiana titled "Sweating the small stuff: the functional implications of microbial community change" December 7th, 2004.

Melissa McCormick gave a talk entitled "Orchid-fungal fidelity: a marriage meant to last?" on Nov 23rd **at Montpellier University (France)** and another talk entitled "Fungal associations in eastern North American *Platanthera* spp." at the symposium New Perspectives on the Systematics and Ecology of Orchids on Nov 19th in **Toulouse France**.

Whitman Miller attended the semi-annual meeting of the **Aquatic Nuisance Species Task Force** in Arlington, VA (November 16-17) and presented a talk to the Task Force and the public entitled "Smithsonian Institution: NIS Activities, FY04". As a member of the ANS Task Force, Miller represents the Smithsonian on matters of aquatic invasions.

On November 1, Jane Holly and Amy Erb promoted SERC education programs at the **AIMS conference** in Baltimore, MD organized by the Association of Independent Maryland Schools.

Pat Megonigal presented an invited paper co-authored by Bert Drake titled "Changes in Pathways of Anaerobic Microbial Metabolism in Response to Elevated CO2" at the annual **Soil Science Society of America Meeting**.

Denise Breitburg participated in the workshop: Evaluating the Design and Implementation of the **Chesapeake Bay Shallow Water Monitoring Program. STAC.** Nov. 30-Dec 1. Annapolis, Maryland.

Thomas Jordan participated in the symposium and business meeting of the **Association of Ecosystem Research Centers,** November 18-19, at the Smithsonian Ripley Center

Tom Jordan presented a seminar at the **Chesapeake Biological Laboratory** on: Changes in Phosphorus Biogeochemistry along an Estuarine Salinity Gradient on October 14.

Candy Feller was a delegate at the **NEON Regional Congress** in North Bonneville, WA, Oct. 19-21. Feller has been appointed to the NEON. Consortium Development Team.

Feller also attended the **LTER meeting** in Cape Canaveral, Florida with over 100 participants.

Greg Ruiz gave a talk at **Portland State University** on October 1 titled "Marine BioInvasions in North America: Past, Present, and Future."

Dennis Whigham, Don Weller, Matt Baker and Ryan King (recently moved from SERC to Baylor University) and Chuck Gallegos attended the **4th Annual EPA STAR EaGLe meeting** in Duluth, MN. The SERC group gave

presentation on their estuarine indicators work and also presented five posters.

Bert Drake and Colleagues presented the poster: Hurricane Frances reduced net ecosystem carbon exchange 30% in a scrub oak ecosystem in central Florida At the annual meeting of the **Ameriflux network of eddy covariance sites in the US** supported by the DOE

Pat Megonigal, Tuck Hines, Jess Parker, Tom Jordan participated in the planning meeting for the **Mid-Atlantic Regional Ecological Observatory (MAREO)** in collaboration with NZP-CRC and other environmental organizations to help organize and develop the National Ecological Observatory Network funded by NSF.

Denise Breitburg organized and participated in the **biennial NOAA Synthesis project workshop** held at SERC. The workshop was attended by Fritz Reidel, Tom Jordan, Don Weller, and Kathy Boomer from SERC, and PI's from University of Virginia, University of Maryland and Cadmus, Inc., as well as the Director of NOAA Coastal Ocean Program, and the project officer.

Chesapeake Community Modeling Workshop on Modeling the Chesapeake Bay Watershed was attended by Don Weller, Tom Jordan, and Kathy Boomer.

An all hands meeting for **ASC Eagles Project** in Harper's Ferry was attended by Whigham, Baker, Marra, and Hines.

Chris Brown, Catherine deRivera, Basma Mohammad, and Brian Steves of the Marine Invasions Lab attended the **Western Society of Naturalists** annual meeting, Nov 11 - 14. Chris Brown presented a poster, "Genetic variation of the invasive gastropod Littorina saxatilis (Olivi) in San Francisco Bay, evidence for geographic source location," and Catherine deRivera presented a talk, "Carcinus maenas invasion alters the demography and microhabitat use of the native crab Hemigrapsus oregonensis ."

Dennis Whigham presented "Scale: The ecological importance of knowing the linkages between processes and patterns at small and large scales," at a meeting of **Spa Creek Watershed Association and Jug Bay Wetlands Sanctuary** in October.

NEW PUBLICATIONS

Norris, D.R., Marra, P.P., Montgomerie, R.. Kyser, K., Ratcliffe, L.M., (2004) Reproductive effort, molting latitude and feather color in a migratory songbird. *Science*

Carney, K.M., and P.A. Matson. (In press) The influence of plant community composition and diversity on soil microbial communities. *Microbial Ecology*.

Carney, K.M., and P.A. Matson. (In press) Plant communities, soil microorganisms, and soil carbon cycling: does altering the world belowground matter to ecosystem functioning? *Ecosystems*.

King, R. S., J. R. Beaman, D. F. Whigham, A. H. Hines, M. E. Baker, and D. E. Weller. In press. Watershed Land Use is Strongly Linked to PCBs in White Perch in Chesapeake Bay Subestuaries. Environmental Science & Technology (in press). ES&T is the #2 journal (out of ~150) in terms of impact factor in the Environmental Sciences and is second only to Science & Nature in the number of library subscriptions of all ecological/environmental journals.

Marra, P., 2004. "The influence of climate on the timing and rate of spring bird migration" Oecologia. Available On-line at: http://www.springerlink.com/index/10.1007/s00442-004-1725-x

Carney, K.M., P.A. Matson, and B.J.M. Bohannan (2004) Diversity, composition, and function of tropical soil nitrifiers across a plant diversity gradient and among land use types. Ecology Letters 7: 684-694.

Cleland, E.E., M.D. Smith, S.J. Andelman, C. Bowles, K.M. Carney, M.C. Horner-Devine, J.M. Drake, S.M. Emery, J. Gramling, D.B. Vandermast. (2004) Invasion in space and time: non-native species richness and relative abundance respond to interannual variation in productivity and diversity. Ecology Letters 7: 947-957.

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

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