

The

# Crest

*Current Issues in Coastal Ocean and Estuarine Science*

## VIMS to Begin New Ecosystem Management Study

For years, fisheries within Chesapeake Bay have been managed on a species by species basis, with management plans that do not take into account factors such as the abundance of competitors, predators, and forage species. With a funding commitment of \$629,000 from the Virginia Environmental Endowment (VEE), scientists at VIMS will soon launch an innova-

tive three-year project that will focus on developing a model for multi-species management of sustainable fisheries within the Chesapeake Bay. This is a new approach that will consider the entire ecosystem and be based on the development of a food web model for the lower Chesapeake Bay. Scientists now know that population levels of

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## CBNERRVA Receives Coastal America Partnership Award

William Reay and Eric Wooden of CBNERRVA were recently recognized by Coastal America for their work in a 10-acre tidal wetland restoration monitoring project at the Ft. McHenry National Monument in Baltimore, Maryland. The Ft. McHenry Wetland Restoration Team received Coastal America's 2000 Partnership Award. The team included participants from the National Aquarium in Baltimore, federal agencies, state and local governments, universities, and various community organizations working to restore and maintain critical wetland habitat within Baltimore Harbor. The project, initiated in 1997, focused on a wetlands mitigation site that was created for the construction of the Ft. McHenry tunnel. This wetlands site is important because it is located at the head of a tidal tributary that receives water from three mostly urban watersheds and because it is located at a highly visible public access site, Ft. McHenry National Park, that receives approximately 600,000 visitors annually.

The restoration effort of the wetlands at Ft. McHenry National Park was noted in the 1999 Coastal America Progress Report. At that

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The 46-year Trawl Survey will provide basic information to underpin the ecosystem management study, which will begin in July.

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## The Crest

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Chesapeake Bay  
National Estuarine  
Research Reserve  
in Virginia

a fair Bay Spring  
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# VIMS Shoreline Permit Application Reports Now Available Online

Tom Barnard & Karen Duhring

The Wetlands Advisory program of the Center for Coastal Resources Management at VIMS has introduced an updated, online format for its Shoreline Permit Application Reports. Over the past thirty years, the VIMS report has been the primary source of environmental input to the tidal wetlands decision-making process implemented by local Wetlands Boards, VMRC, DEQ, and other permitting agencies. The types of projects reviewed by VIMS wetland scientists in this program include riprap revetments, bulkheads, breakwaters, marinas, boat ramps, compensatory mitigation and dredging. Reports prepared for each permit application are now posted to the Center's web page for online viewing and downloading.

Innovations that are now standard in the new VIMS Shoreline Permit Application Report include a color photograph, location maps, each project's advisory comments and recommendations. Hand-held GPS units are used to collect site-specific coordinates, a necessary link missing in traditional shoreline assessments. Each project's GPS location can be related to resource and shoreline inventories contained in a geographic information systems (GIS) database maintained by the Center's Comprehensive Coastal Inventory program. Useful coverages contained in the GIS database include inventories of watersheds, tidal and non-tidal wetlands, submerged aquatic vegetation, erosion control structures and previously permitted projects.

The process of generating the reports was streamlined using a computer program that automatically inserts the various report components into a standard template. The Tidal Wetlands Database has been updated to process the growing number of records used to track cumulative impacts to tidal wetlands in Virginia. Projects involving beaches and dunes were added to this database. Even electronic signatures are used to signify the report is official.

Tidal wetland information is also presented on a watershed level. Location maps included in each report illustrate how watersheds extend across city and county boundaries. This format should encourage consideration of the watershed perspective in the tidal wetlands permitting process.

The reports are posted to the Center for Coastal Resources Management web site as soon as they are available. Staff at each locality and the VMRC representative are notified by e-mail when reports for their jurisdiction are available online. Electronic distribution to local, state and federal permitting agencies will reduce paperwork, administration costs and time delays. Each applicant and authorized agent will continue to receive a copy of the report in the mail to ensure they receive a copy. Anyone else interested in the VIMS assessment of proposed shoreline projects may download and view the reports.

The Center's web page also contains other useful information about wetlands, including the *Wetlands Management Handbook*, numerous technical reports, self-guided education units, newsletters, and other features

on subjects dealing with all aspects of shoreline and wetlands management. Log onto the Center for Coastal Resources Management web site at: [www.vims.edu/ccrm](http://www.vims.edu/ccrm). A link to the online Shoreline Permit Application Reports is located just below the Wetlands Program icon. Several search choices are available including application number, locality, name of applicant and watershed.

The technical innovations included in this format change represent the latest step in the Wetland Program's long term efforts to provide decision-makers with the best scientific advice available. The integration of our GIS and permit activity databases with Internet technology enhances this effort via improved access, time savings and the utilization of expanded data sets.

## VIMS Shoreline Permit Application Report # 01-9876

APPLICANT:	SMITH, VINCENT I. M.
Immediate Waterway:	Ware River
Locality:	GLOUCESTER COUNTY
Purpose:	Erosion Control
Application Type:	Wetlands
Site Inspection:	4/23/01
Report Date:	5/1/01



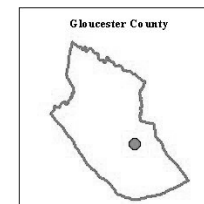
## Type of Activity

Bulkhead (ft)	100
Fill Saltmarsh Cordgrass Community (Type I) (ft <sup>2</sup> )	400

## Proposed Extent

Total Impacts (ft <sup>2</sup> )	0
Total Impacts (Wetlands)	0
Total Impacts (Subaqueous)	0
Total Impacts (Beach/Dune)	0
Total Fill (ft <sup>2</sup> )	400

## Project Location



Virginia Institute of Marine Science  
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P.O. Box 1346, Route 1208 Greate Road  
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Example of the first page of a VIMS Shoreline Permit Application.

# Catholic High School Wins Virginia Blue Crab Bowl and Places Sixth in National Competition

Battling claw-to-claw in the final moments of a cliffhanger race, Catholic High School of Virginia Beach overcame last year's champions, Grafton High School, in the regional Blue Crab Bowl (BCB) held Feb. 3 at the College of William and Mary.

The Blue Crab Bowl, a round-robin, double-elimination academic tournament, is the regional competition for the National Ocean Science Bowl. This year's event drew nearly 100 of Virginia's best high school science students. All questions are about the world's oceans. The purpose of the Bowl is to provide a forum in which students who excel in math and science receive national recognition for their diligence and talent while broadening their awareness and understanding of the oceans.

This event is a cooperative effort between the Sea Grant Marine Advisory Program, Virginia Institute of Marine Science, College of William and Mary; and the Department of Ocean, Earth, and Atmospheric Sciences and the Center for Coastal Physical Oceanography, Old Dominion University. More than 40 faculty, staff and graduate students from both colleges donate many hours of their time to ensure the success of this exciting event.

The team from Catholic High, which was runner-up to Grafton High last year, captured an all-expense-paid trip to Miami, FL, where they represented Virginia in the National Ocean Sciences Bowl competition in April.

Lexington High School, Lexington, MA, captured the National Ocean Sciences Bowl for the fourth year in a row.

After intense competition, the final standings were Catholic in first place, with Grafton in second place. Tied for third place were Rustburg High School and Broadwater Academy from Exmore.

The Catholic High School team was captained by senior Duncan McConaugha and coached by Dr. John McConaugha. Team members are Denise Harmeyer (grade 12), Allison Mathews (grade 11), Kyle Chavers (grade 10) and Nicholas McConaugha (grade 10).

Contrary to many competitions, students didn't need to be on the winning team to have a positive experience at the Bowl. Says Thomas Jefferson High School team coach John Fornshell, the event "enhanced the students' interest in the marine sciences and gave them a sense of achievement. It's a contest in which intellectual development was more important than winning. This is a rare achievement and one that has made my students say, 'Let's do this again next year' both times I've brought a team. Even though they were not finalists, they felt good about their experience."

And it wasn't necessary to have previous experience nor upper-class status to advance to the finals. In fact, Broadwater Academy's third-placed team consisted entirely of sophomores, all of whom were competing for the first – and only – time. The Broadwater team will have all new members each year, explains coach John Chubb. Because the team is fielded from his sophomore science class, a new group of students will have their chance for every annual competition.

The National Ocean Sciences Bowl is a collaborative effort between the Consortium for Oceanographic Research and Education (CORE) and the National Marine Educators Association (NMEA). Financial sponsorship is provided by federal marine agencies and other sponsors.

Local sponsors of the regional Blue Crab Bowl include Virginia Sea Grant, ODU's Center for Coastal Physical Oceanography, the Mid Atlantic Marine Education Association, The Old

Point National Bank, and Domino's Pizza.

For further information, please contact Susan Haynes via phone at (804) 684-7735 or e-mail at shaynes@vims.edu or check the

Blue Crab Bowl web site at <http://www.vims.edu/bcb>. For information on other competitions around the country and the National Ocean Science Bowl visit <http://core.cast.msstate.edu/nosb.html>



Catholic High School, shown here, placed sixth nationally in their first appearance at the National Ocean Science Bowl Finals.

## Captain of Virginia's Winning BCB Team 2000 Continues Making Strides

Kevin Ford, a senior at Grafton High School, and captain of Grafton's 2000 BCB team (which placed first in the state competition), has been working in the Fisheries Genetics Program at VIMS since September. Kevin is being mentored by Dr. Pindaro Diaz, a postdoctoral researcher from Mexico, and Dr. John Graves, Chair, VIMS Dept. of Fisheries Science. Since last fall, Ford has learned a series of sophisticated molecular genetic techniques including the isolation of genomic DNA. Utilizing existing techniques, he developed a relatively rapid means of identifying tuna species. His procedures allow specific identification of fillets as well as early life history stages (eggs and larvae) that are often difficult to discriminate. Identification is used to verify species and to enforce regulations on the sale of certain species.



Dr. Pindaro Diaz and Kevin Ford in the Fisheries Genetics Lab at VIMS.

He was recently accepted as an undergraduate at University of California San Diego and plans to pursue a graduate degree in marine science. VIMS congratulates Kevin!

## Seafood Seminars Postponed until Fall

The VIMS Sea Grant Marine Advisory Seafood Education Seminar program will not be held during Spring 2001 due to kitchen repairs. Check the seafood education website at <http://www.vims.edu/adv/seafood/seminar2.html> for updates, or call (804) 684-7169 for additional information.

## VIMS Council Welcomes New Members

Eight new members of the VIMS Council begin their terms in the spring of 2001 Council President, Thomas Blackburn, recently announced. "We are indeed fortunate to have these extremely outstanding members on our Council. We all look forward to working with them in support of the mission of VIMS."

**Larry Thomas Price**, General Manager Smurfit-Stone Container Corporation, Mill Division – West Point Mill. Price received his MBA from the College of William and Mary and his BS, Electrical Engineering from West Virginia Institute of Technology. He is a 17-year veteran of the pulp and paper industry. He was with Chesapeake Paper Products Company from 1983 until 1997. Prior to assuming his present post, he was Vice-President of Operations for St. Laurent Paperboard's mill in West Point.

**Cynthia V. Bailey**, Vice President, Associate General Counsel-Regulatory Fort James Corporation. Bailey received a BS from the College of William and Mary, her MS from the Medical College of Virginia, Virginia Commonwealth University and JD from the University of Richmond School of Law. She served as the Assistant Attorney General, Commonwealth of Virginia, Director of the Department of Waste Management, Commonwealth of Virginia prior to joining Fort James in 1991. She has also served as a member of the Virginia Council on the Environment, Virginia Emergency Response Council and the Virginia Safety & Health Codes Board.

**William Tayloe Murphy, Jr.**, Smith, Murphy & Taliaferro law firm. Murphy received a BA from Hampden-Sydney College and an LL.B. from the University of Virginia.

He served in the U.S. Navy aboard the U.S.S. Newport News and on the Staff of the Supreme Allied Commander, Atlantic (NATO) Norfolk, Virginia. He has practiced law in Virginia since 1960. Murphy served in the House of Delegates for 18 years and sat on numerous committees including the Appropriations Committee, Conservation and Natural Resources, Chesapeake and its Tributaries, and as a member of the Chesapeake Bay Commission.

**Former Secretary of State Lawrence Eagleburger**, Senior Foreign Policy Advisor, Baker, Donelson, Bearman and Caldwell, Law Firm. Eagleburger received a BS and MS from the University of Wisconsin. He joined the U.S. Foreign Service in 1957. Eagleburger has served in various positions under Presidents Nixon, Carter, Reagan and George Bush. He also served on the American Red Cross Board of Governors and currently serves as chairman of the International Commission on Holocaust Era Insurance Claims.

**G. Waddy Garrett**, Senior Consultant, Royster-Clark Company. Garrett graduated from the United States Naval Academy and the U.S. Naval Nuclear Power School. He earned an MBA from Harvard Business School. He was Chairman and CEO of Alliance Agronomics, Inc. a family owned business until January of 2000.

**Governor Linwood Holton**, Governor, Commonwealth of Virginia, 1970 - 1974. Governor Holton received his BA from Washington & Lee and his LL.B. From Harvard Law School. He is currently with McCandlish Kaine in Richmond and has served as President of the Center for Innovative Technology and Chair of the Metropoli-

tan Washington Airport Authority, Assistant Secretary of State for Congressional Relations and Chair, Republican Governor's Association.

**Joseph V. Gartlan, Jr.**, Virginia State Senator 1972-2000. Senator Gartlan received a BS and JD from Georgetown University and served in the U.S. Navy from 1943-1946. During his seven terms in the Virginia Senate, Gartlan served on numerous committees including, Chairman of the Senate Committee for Courts of Justice, Senate Finance, Privileges and Elections, Chairman of Finance Subcommittee on Health and Human Resources among others. He was also a member of the Chesapeake Bay Commission for many years and served as its Chairman in 1981, 1982, and 1985. He is currently a member of the Board of Directors for the Alliance for the Chesapeake Bay.

**R. Bruce Bradley**, President Landmark Communications. Bradley



Case Whittemore (l) welcomes new member Waddy Garrett.

graduated from Villanova University with a BS in Business Administration and received an MBA from Old Dominion University. Prior to becoming President of Landmark in January 1999, he was President and Publisher of the Virginian Pilot, Director of Marketing for the Greensboro News & Record, and the Roanoke Times and World News.

## Marina Program Launched

The Virginia Marina Technical Advisory Program at VIMS, in partnership with the Department of Environmental Quality's Coastal Program and the Department of Conservation and Recreation, launched its Virginia Clean Marine Program in January. Setting a goal of reducing nonpoint source pollution in Virginia's coastal waters by offering technical advice to marinas and recreational boaters, the program recognizes marinas that incorporate "best management practices" that exceed minimum laws and regulations. To date, eight marinas – Ginny Point Marina, Locklies Marina, Port Kinsale Marina, Tidewater Yacht Agency, Inc. Washington Sailing Marina, Wormley Creek Marina, York River Yacht Haven, and Coan River Marina – have pledged to work toward clean marina

designation. A best management practices guidebook was developed for this program and is available online at [www.vims.edu/adv/vamarina](http://www.vims.edu/adv/vamarina).



### The Virginia Clean Marina Guidebook



Commonwealth of Virginia  
Virginia Clean Marina Program

## Web Based Education Hub Developed by VIMS/Sea Grant Educators

Marine Advisory Program educators Lisa Ayers Lawrence and Frances Lee Larkin were recently awarded \$44,128 from the Chesapeake Bay Program to create *Chessie*, a web-based education hub. *Chessie* will provide educators watershed-wide with one-stop shopping for accurate and useful information on Bay issues and

topics, teaching materials, and research data suitable for classroom use and will provide researchers with a contact point for educational outreach. The first phase of the *Chessie* website will debut online this fall. For more information, contact Lisa Ayers Lawrence at [ayers@vims.edu](mailto:ayers@vims.edu).



## In the Middle of the Storm.... Just Where VIMS Scientists Plan to Be

Virginia's coastal residents well know how a hurricane's pounding waves and powerful currents can erode an entire beach or deposit a new sandbar. VIMS researchers are now working both at home and abroad to explore how the shape of the seafloor influences the storm-driven erosion and accumulation of marine sediment. Their findings will help improve the computer models used to help manage coastal resources and erosion.

The most recent phase in VIMS' on-going seafloor research began in February, when graduate student Art Trembanis traveled to New Zealand's North Island with technicians Bob Gammisch and Todd Nelson to deploy two instrumented tripods. During March, the trio returned to the island with VIMS Director Don Wright to retrieve the tripods and download the collected data.

The research, funded by the U.S. National Science Foundation, represents a major collaboration between VIMS and the National Institute of Water and Atmospheric Research (NIWA), its overseas partner in New Zealand. VIMS and NIWA formalized a General Cooperation Intention in 1998 to foster cooperation in education and research.

NIWA researchers Terry Hume and Mal Green deployed their own seafloor tripod during the most recent field season, bringing the total number of tripods in the study to three.

The New Zealand research builds on earlier studies along the U.S. East Coast, in which VIMS researchers

partnered with colleagues at MIT, Woods Hole, and Scripps to study how currents erode, transport, and deposit marine sediments on the inner continental shelf. Research proposed by VIMS geologist Stephen Kuehl and colleagues would continue the work, tying it into the international collaborative effort of the MARGINS program (see article on page 6).

Results of these field studies are being used to help improve the computer models that scientists use to understand and predict erosion and accumulation of coastal sediments. The ultimate goal of the research, says Wright, is "to better model coastal erosion and the movement of sediment, pollutants, and other materials across the inner continental shelf."

Present-day computer models treat the seafloor as if it were consistently smooth or rippled or rocky. These relatively simple models have helped researchers better understand the major processes that control sediment motion and distribution, but they fail to realistically simulate the full complexity of the interplay between seafloor "roughness," bottom currents, and sediment transport.

"Models usually assume homogeneity of roughness," says Wright, "but along a coastline like we have in Virginia, homogeneity is the exception rather than the rule."

The roughness of Virginia's coastal seafloor is a product of the continuing rise in sea level since the end of the last Ice Age. As Virginia's coastline pushes slowly landward, it leaves



VIMS' pod being retrieved by helicopter from New Zealand waters.

behind a bumpy trail of relict oyster reefs, deep tidal channels, and marshy hummocks of peat.

The team's study site in New Zealand's Tairua-Pauanui embayment provides a comparable environment, but on a smaller scale particularly conducive to fieldwork. Previous surveys using side-scan sonar showed that the floor of the 10-km-long bay comprises a discrete patchwork of small, sandy ripples; larger, gravelly ripples; and rocky outcrops.

In mid-February, a helicopter ferried the team's three tripods from a local rugby field to the bay, where the researchers anchored them in about 20 meters of water. Once switched on, the tripods' sensors began storing hourly readings in onboard solid-state memory.

The team scheduled their study during the Southern Hemisphere summer and early autumn to maximize the likelihood that a tropical cyclone might impact the site. "Storms are when everything happens on the shelf," says Wright. "Most sediment gets moved during storms, not fair weather."

And sure enough, nature complied. Tropical Cyclone Paula blew past New Zealand in early March, providing a unique opportunity for the team's tripods to record feedbacks between sediment behavior and seafloor roughness during the height of a storm.

In late March, the researchers retrieved the tripods and downloaded what Wright describes as "an excep-

tional data set." The team is now busy analyzing those data.

Each tripod used in the study stands about 2 meters tall and weighs about a ton. A host of D-cell batteries power its state-of-the-art sensors. The sensors use sound waves, light beams, pressure readings, and electromagnetic fields to measure current velocity, turbulence, and the concentration of sediments suspended in the water.

Unlike previous sensing techniques, many of the new sensors are non-intrusive. Thereby allowing the researchers to observe the behavior of the system free from any artificial influences introduced by the instruments themselves.

Sound sensors on the tripods include an Acoustic Doppler Velocimeter. The ADV focuses three sonic beams on a 1-centimeter cube located 15 centimeters from the sensor. By recording and analyzing how these intersecting beams reflect off particles in the water, the ADV can determine the speed and 3-dimensional motion of currents through that spot. Because the ADV emits 10 sonic pulses each second, it can resolve not only the average velocity of the local current, but its short-term variations as well. This is crucial for obtaining the type of high-resolution data that the team needs to understand the complex interplay between bottom roughness and sediment motion.

Another sound sensor is the Acoustic Doppler Current Profiler.



VIMS scientists preparing to dive during a recent research cruise in New Zealand. (L to R - Bob Gammisch, Don Wright and Wayne Reisner.)

## Continental Margins - Where the Action Is

For geologists, continental margins are where the action is. Along margins great rivers dump their sediments, coral reefs form, volcanoes erupt, and colliding plates build mountains. The rocks that form along continental margins thus record many of the significant events in Earth's history.

VIMS geologist Dr. Steven Kuehl and colleagues at VIMS and around the world have now established an interdisciplinary program to systematically study these margins.

The objectives of the 10-year MARGINS program, funded by the U.S. National Science Foundation, are ambitious. Says Kuehl, "the stated goals are to rewrite the book when it comes to understanding the processes that operate on continental margins, from mountain top to abyssal plain."

A more thorough understanding of these physical, chemical, and biological processes will help geologists better decipher the record of past changes in climate, landscape, and human activity that are preserved in marine sediments.

MARGINS research will also allow policy makers to better manage how humans interact with the margin environment. The importance of that environment is clear. Continental margins provide many of humanity's mineral and fossil-fuel resources, and hold an ever-increasing percentage of the human population. Nearly two-thirds of humanity—more than 3.5 billion people—now live within 150 kilometers of a coastline. Within three decades, that figure is likely to reach 75 percent.

To achieve its goals, the MARGINS program needs to address the obstacles that have hindered past margin research. These include the sheer size of the margin environment, the wide range of time and space scales on which margin processes operate, and the parochial nature of much past margin research.

The very feature that defines a continental margin—its position at the boundary between land and sea—has traditionally hindered efforts to understand the processes by which margins form and evolve. That's because the physical boundary that defines a margin has also acted as a disciplinary boundary between land-based and marine geologists.

The "Source to Sink" initiative, one of the four main components of the MARGINS science plan, is specifically designed to help break down some of



Dr. Steve Kuehl, center, and VIMS students Tara Kniskern and Dave Fugate on a research cruise collecting seabed samples for future MARGINS work.

these disciplinary barriers. As its name implies, the initiative encourages researchers from many different fields to collaboratively view rivers, their tributaries, and their submarine distributaries as parts of a holistic sedimentary system, rather than as separate entities.

Kuehl and colleagues recently submitted a 3-year "Source to Sink" proposal to trace the origin, transport, and deposition of sediments within New Zealand's Waipaoa Sedimentary System, or WSS for short. The WSS lies along the east coast of New Zealand's North Island and encompasses the main body of the Waipaoa River, its headwaters and nearby streams, and the continental shelf and canyons that collect the river's sediments or funnel them further offshore. It was previously deemed a model site for "Source to Sink" field projects.

If funded, Kuehl's team will begin fieldwork later this year. His team is both interdisciplinary and international, with scientists from VIMS, five other U.S. research institutions, and three research partners in New Zealand, including the National Institute of Water and Atmospheric Research (NIWA). VIMS and NIWA signed a General Cooperation Intention in 1998 to foster cooperation in education and research.

The WSS is an ideal field laboratory because its small size eases logistics and because its distinct boundaries provide a closed system whose sediment budget can be calculated readily. Research in the WSS also benefits from the large quantities of

sediment that the Waipaoa carries for a river of its size.

"Because the river's discharge rates are so high, its sedimentary signals are huge," says Kuehl. "That makes them easy to measure."

The Waipaoa's extreme turbidity is largely due to human activity. Between 1870 and 1900, ranchers burned most of the Waipaoa's beech and podocarp forests to sheep pasture, which gullies and landslides quickly began to scour. The resulting sediments now choke the river's floodplain, which in some areas has risen 10 meters since the turn of the century. This vast plug of sediment is presumably making its way offshore, where the researchers expect it will leave a clear signal in seafloor sediments.

"The same sorts of things are going on in Virginia," says Kuehl, noting the increased turbidity and shoreline erosion experienced in the Chesapeake since European settlement, "but in a much less extreme way."

Thus the WSS provides a field laboratory in compact caricature. "It only takes about two hours to drive from the river's mouth to

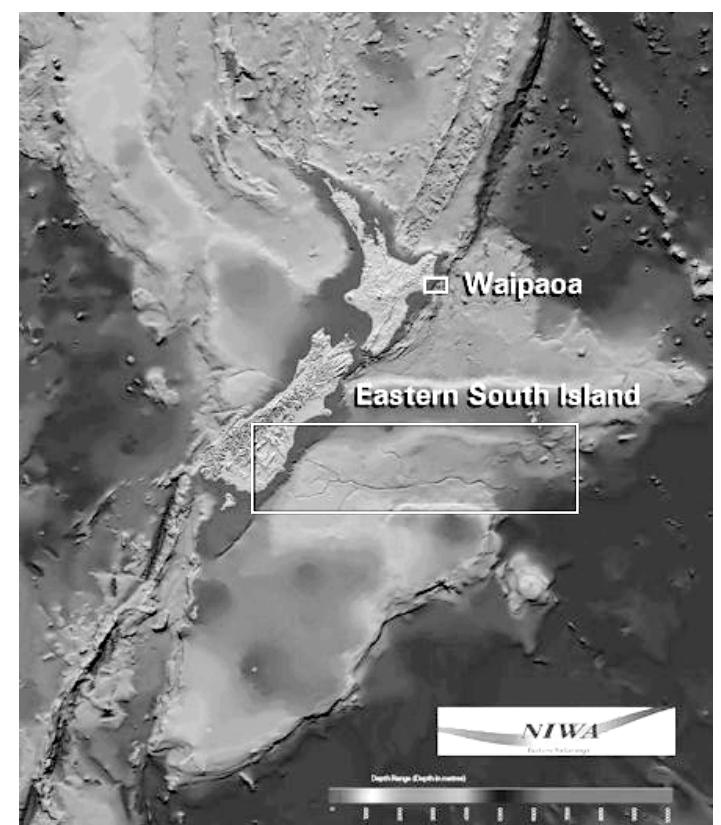
its headwaters," says Kuehl, "and the continental shelf is narrow, only about 30 to 40 km wide." Moreover, because the Waipaoa carries so much sediment, its seafloor deposits are written in large, easily readable print.

Kuehl and his team hope to use the passages that humans have recently penned in those sediments to help decipher the record of significant prehistoric events.

"We like to view human impacts in the Waipaoa as an opportunity rather than a problem," says Kuehl. He notes that deforestation in the Waipaoa basin probably increased sedimentation there by a factor of 10, comparable to what geologists might expect following a volcanic eruption or change in climate. Studying the Waipaoa's recent human signal should thus allow geologists to better understand such events elsewhere.

The Waipaoa's extreme sediment load provides another unique research opportunity for Kuehl's team. Kuehl notes that water in rivers, even very turbid rivers like the Amazon, is typically less dense than the salty seawater into which it flows. Thus, a river's freshwater discharge usually floats atop the salt water beneath. The Waipaoa's sediment-laden discharge is unique in that it can be denser than seawater, or "hyperpycnal."

*Continued on page 8*



This composite shows elevation of New Zealand and bathymetry of surrounding ocean floor. MARGINS research is proposed for the Waipaoa and Eastern South Island sites.

## Aquaculture and Agriculture - Working Together for Solutions

In 1996, clam hatcheries on Virginia's Eastern Shore began to claim that runoff from local farms was harming their aquaculture operations. Hatchery owners alleged that the use of plastic sheeting on tomato fields was helping to channel pesticides and heavy metals into area waters, killing clam larvae. Tomato growers argued that "plasticulture" allowed them to use fewer pesticides, and is a recognized "Best Management Practice" for arid environments.

Since then, scientists from VIMS, other universities, and several state agencies have been working alongside the clam and tomato farmers to help clarify the science behind their competing claims, and to develop management solutions acceptable to both parties. Their efforts have been funded since 1998 by a grant from the Virginia Department of Agriculture and Consumer Services (VDACS).

Those efforts are now bearing fruit. Tomato farmers are beginning to voluntarily implement the changes in farming practice that research shows

are most likely to reduce the effects of runoff on neighboring clam hatcheries.

"The big story," says Mark Luckenbach, director of VIMS Eastern Shore Laboratory, "is not that the research itself is all that startling, but that it was done in such a collaborative way."

Luckenbach has conducted the research along with fellow VIMS scientists Mory Roberts, Mike Unger, and Mike Newman, with assistance from the Eastern Shore Resource Conservation and Development Program and the local Soil and Water Conservation District. Area tomato farmers and landowners have also been important contributors, allowing the researchers free access to their fields and property, and underwriting the sometimes expensive changes in farming practice that the research suggests.

Gretchen Arnold, a research specialist at the VIMS Eastern Shore Lab, points out that the research has also benefited from its multi-disciplinary approach. Arnold, who has managed the field studies on the project for



Clam aquaculture on Virginia's Eastern Shore.

the past three years, notes that the research involves land-use characterization, agricultural science, environmental chemistry, toxicology, and ecology.

In a preliminary 1996 study, the researchers caged grass shrimp larvae (which have known sensitivity to pesticides) in six watersheds along the Eastern Shore. By monitoring the health of these larvae during a two-month period, the team found that mortality peaked following heavy rains in those watersheds exposed to runoff from plasticulture operations. Although the research didn't uncover the direct

cause of the mortality, it did suggest a strong need for improved management practices.

The team used the VDACS grant to study the impacts of plasticulture runoff in more detail, and to test how various management practices might mitigate those impacts. They confirmed that water quality in tidal creeks is most affected by pulses of runoff following heavy rain, and thus realized, says Luckenbach, that those effects "could be eliminated or reduced by controlling the run-off from fields." Tomato farmers have responded by installing retention ponds, modifying existing buffer zones to better control runoff, and altering the way they use pesticides.

Luckenbach notes that the response of the farmers to the suggested changes has been remarkably rapid. "There was almost no lag between the research and the implementation of management strategies," says Luckenbach.

His team has so far found little evidence that plasticulture is having any chronic effects on native organisms in affected waters. For instance, they have observed no relationship between plasticulture in a watershed and toxicity levels in migrating finfish or bottom-dwelling invertebrates.

"However," cautions Luckenbach, "that doesn't mean the toxins aren't there. It may simply be a detection problem." His team continues to monitor for any long-term effects by measuring levels of organic pesticides and heavy metals within the tissues of oysters that they have deployed in their field sites.

The ultimate goal, says Luckenbach, is to contribute to a better understanding of how sustainable tomato cultivation can be practiced without negatively impacting the health of coastal waters.

## Marine Finfish Culture Activities

By Mike Oesterling

During 2000, the VIMS Marine Finfish Culture Program achieved a milestone with the spawning of captive cobia (*Rachycentron canadum*). The project is ongoing with the continued culture of juvenile cobia from that spawning. Cobia are considered prime candidates for commercial aquaculture because of an expanding market as a food fish, a fast growth rate, and their adaptability to confinement systems. Indeed, the cobia that are currently in the VIMS recirculating water grow-out facility have demonstrated both the fast growth and adaptability aspects. After only 200 days of growth, the juvenile cobia weigh an average of 2 pounds, with some fish topping the scales at 3 pounds. These animals are part of a graduate student's Master degree thesis and will contribute much usable information to fish culturists. Plans are currently being made for the upcoming season to continue the development of aquaculture protocol for cobia.

While not as momentous as the cobia spawning, the Marine Finfish Culture Program has just completed the spawning of spot (*Leiostomus*

*xanthurus*). These fish were collected in the fall prior to their migration out of Chesapeake Bay to offshore spawning areas, held within a 1,000-gallon recirculating water system for final maturation, and spawned in early January using hormonal injection techniques. Unlike cobia, spot are not considered candidates for aquaculture based upon their appeal as a food fish. Rather, cultured spot are being investigated for their potential as a live-bait for the recreational fishing industry. The Marine Finfish Culture Program is working cooperatively with a private individual who intends to grow fingerling spot to a bait size, test market the animals, and evaluate the potential for large-scale spot production. This project is being



Graduate student Patrick Kilduff injects an anesthetized spot in preparation for spawning

supported in part by the Fishery Resource Grant Program administered by the Virginia Sea Grant College Program.



## Faculty Awards

### Carl Friedrichs

Dr. Carl Friedrichs, Dept. of Physical Science, was a recipient of the 2000 Presidential Early Career Award for Scientists and Engineers (PECASE). This award is the highest honor bestowed by the U.S. government on outstanding scientists and engineers who are in the early stages of establishing their independent research careers. "These awards acknowledge much more than past performance," said National Science Foundation director Rita Colwell, "They represent our expectation that these women and men will continue to provide leadership in science, engineering and higher education well into the millennium." Friedrichs was one of only four oceanographers among the 56 recipients of the 2000 award



Carl Friedrichs

A member of the VIMS faculty since 1993, Friedrichs was recognized for, "an exceptional interdisciplinary approach to understanding sediment dynamics and its impact on marine ecology, and his extensive experience with mentoring programs for undergraduates and high school students." His research focuses on the ways in which sediments moving through estuaries and around

coasts affect the biology in such bodies of water. In his research, Friedrichs and his students are critically examining traditional theories predicting how sediments are cycled through estuaries. His work has shown a connection between patterns of mixing in the tidal currents and the transport of muddy sediment upstream along estuaries. "This work can have great significance for the health of the Chesapeake Bay and of human beings who live around it," said Don Wright, Dean and Director of VIMS. Intense sediment transport by tidal currents, for example, hampers the ability of bottom-dwelling (benthic) organisms to recruit and feed."

Friedrichs also received a four-year National Science Foundation CAREER grant for \$499,000 to support his sediment dynamics research.

### Jack Musick

Dr. Jack Musick, VIMS Acuff Professor of Marine Science, received an Outstanding Faculty Award by the State Council of Higher Education in Virginia. In a special ceremony at the Executive Mansion on February 16, Governor Gilmore and Secretary of Education Wilbert Bryan honored Musick and other outstanding educators from the Commonwealth.

Since joining the VIMS faculty in 1967, Musick has mentored 31 Masters and 36 Ph.D. students. His students have, in their own right, gone on to achieve great success in government, academia and industry, a reflection of the strong mentorship they received from Musick.



Jack Musick

"The success of Dr. Musick's program has been, and continues to be, evidenced by the fact that it attracts students from all parts of the United States, as well as those from foreign countries. Success of this program is also reflected in the placement of its graduates in academic positions at major universities, and in career positions within federal and state government agencies. His contributions to the program at VIMS have resulted in an internationally recognized center for ichthyological research where students pursue perhaps the widest

variety of research interests on fishes available anywhere in the country," said Dr. Thomas A. Munroe, of NOAA and the National Marine Fisheries Service.

Musick has authored, or co-authored 100 scientific papers and five books in the field of ichthyology and marine conservation. In the past five years, he has presented over 30 invited presentations including a recent trip to Japan where he spoke in three cities on "Criteria to Define Endangered Marine Species." He is currently Co-Chair of the International Union for the Conservation of Nature Shark Specialist Group a role which requires a well-respected and high profile scientist.

Musick also received an American Fisheries Society Distinguished Service Award. Kenneth L. Beal, President of the American Fisheries Society said, "Dr. Musick has lead the preparation of and has co-authored four Society Policy Statements on long-lived marine fish resources. These efforts are widely recognized by the aquatic resource conservation community."

### Linda Schaffner

"Your passion for research, your devotion to education and your unwavering commitment to encouraging women in science represents the best traditions of the College of William and Mary." With these words, Rector, J. Edward Grimsley, presented Dr. Linda Schaffner with the 2001 Thomas Jefferson Teaching Award during the Charter Day ceremony on February 9, 2001. She was also praised for her leadership of the National Science Foundation's Research Experience for Undergraduates Program (REU) at the School of Marine Science. The REU program is recognized nationwide and is one of the few programs in marine science that recruits minority undergraduates. In 1995, Schaffner received the School of Marine Science Outstanding Teacher Award.

In her remarks, Schaffner said, "We have the resources and knowledge to train our students to recognize and embrace the complexities of coastal ocean science. We are confident that they, in turn, will find new and better solutions to the problems that we struggle with today."

Schaffner, an Associate Professor in the Dept. of Biological Sciences is well known for her work with bottom dwelling (benthic) organisms. Her current research includes a multi-institutional project to examine sediments from three regions of Chesapeake Bay which exhibit high levels of contaminants and evidence of impacts on fish and benthic organisms that are a key component of estuarine food webs. She is also involved in research to determine how natural physical processes, such as storm activity and strong currents, control the dynamics, biodiversity and productivity of benthic communities in estuarine and other coastal habitats.



Linda Schaffner

### Liz Canuel

Dr. Elizabeth Canuel, Department of Physical Sciences, recently received a William and Mary Alumni Fellowship Award. The award, given annually, recognizes younger faculty members who are "outstanding teachers." While five awards are given, Canuel received the single award dedicated to a faculty member involved in graduate education. Canuel and her co-PI Dr. Michael Kelley (Dept. of Applied Sciences) also recently received one of the first Collaborative Research Grants. These awards are designed to support collaborations between faculty across campus and are jointly funded by VIMS, the College of William and Mary and the Applied research Center (ARC).



Liz Canuel

### Continental Margins continued from page 6

Unlike regular surface plumes, hyperpycnal flows move along the seafloor, and can significantly affect seafloor sediments and bottom-dwelling organisms. Kuehl notes that Tropical Cyclone Bola, which struck New Zealand in 1988 with torrential rains, "flushed a plug of sediment out of the Waipaoa system that left a 1-meter-thick layer of goop on the continental shelf, wiping out the bottom community."

Kuehl's team expects that studying these extreme cases will provide fresh insights into the more mundane problems facing oysters and other bottom

dwellers in places like the Chesapeake Bay.

Kuehl's team plans to conduct their submarine research using a pair of instrumented tripods brought to New Zealand this winter for a related VIMS research project (see page 5). These, combined with river monitoring equipment provided by NIWA and box cores for taking shallow sediment samples, should allow the team to trace the passage of sediment from sheep pasture to seafloor in real time.

Kuehl hopes that future work using the resources of the Ocean Drilling Program will extend the team's reach farther beneath the seafloor and farther back in time.



## Former Student Funds Scholarship

Former VIMS student, Jamie Jackson, left marine science for computer science and a career with the highly successful Internet company YAHOO. She did not, however, forget the people she knew at VIMS nor their commitment to marine education. Last year, Jackson contacted Dr. John Milliman, former Dean of Graduate Studies, and told him she wanted to fund a scholarship to be established in his name. In the fall of 2000, Kelly Johnson became the first recipient of the Milliman Scholarship. Johnson, a master's student in the Department of Fisheries Science, graduated from North Dakota State University (NDSU). "I spent several summers doing field work in marine related areas and fell in love with marine science," she said. As part of her

undergraduate study in zoology, she had an opportunity to begin work in genetics utilizing microsatellites and "allozymes." When Dr. Peg Mulvey, VIMS Dept. of Environmental Sciences, gave a seminar at NDSU Johnson became interested in the graduate education program at VIMS. After researching VIMS on the Internet, Johnson decided VIMS had both the graduate education and the strong genetics research opportunities she wanted. As a first year VIMS student, Johnson is taking the required core courses as well as planning her own research. "I love it here," she says, "receiving this scholarship has enabled me to be in a premier education and research facility. It is quite challenging and exciting. And, I love the Virginia weather!"

Kelly is investigating the genetic relatedness of several species of shore fishes that occur in Bermuda and along the U.S. south Atlantic coast. Her results will increase our understanding of the population structure of widely distributed marine fishes, information that is necessary for effective management. In addition, the data will allow her to test various hypotheses regarding the temporal patterning of the colonization of Bermuda.

"As the cost of supporting students continues to rise, it is great to see private funds support for our academic program. I am most grateful to Ms.



Kelly Johnson, first-year Masters student, in the Fisheries Genetic Lab.

Jackson for her contribution—it is clearly making a big difference for one deserving student," said Dr. John Graves, Chair, Department of Fisheries Science and Johnson's major advisor.

## Kauffman Aquaculture Center Campaign

Mr. and Mrs. John Kauffman have committed \$500,000 as a challenge grant to construct an aquaculture facility on their property in Topping, Virginia. Their home and surrounding property and a supporting endowment was bequeathed to VIMS in 1997 to be used for marine education and research programs. VIMS will immediately begin a campaign to raise the \$500,000 match needed to construct the facility.

Dr. Stan Allen, Director, Aquaculture Genetics and Breeding Technology Center (ABC) at VIMS explains that developing disease resistant strains of oysters offers the opportunity for a strategy of immense magnitude – genetic rehabilitation of oysters in the lower Chesapeake Bay. "Replacing oysters on a reconstructed reef is a multi-million dollar enterprise among various agencies in and around the Chesapeake Bay," says Allen.

"Building reefs is one thing, seeding them with oysters capable of growing, reproducing and repopulating reefs and surrounding areas which will in turn grow and reproduce, is essential if restoration efforts are to be meaningful."

The facility, The Kauffman Aquaculture Center, will be used for research to advance the development of disease resistant oysters through technological innovation for aquacul-

ture and restoration efforts. The Center will include laboratories to grow and study non-native and genetically enhanced native oysters in isolation. The techniques developed at the Center will have a wide array of application worldwide in shellfish and finfish aquaculture.

At the same time disease resistant stocks can be used for genetic rehabilitation, they can also serve as an agent

of economic development. At present, wild oysters cannot survive to market size in sufficient quantities to warrant investment in oyster farming. Disease resistant strains provide an opportunity to redress this because they can withstand diseases for at least an extra six-month period. Continual improvements will extend this advantage. "Our progress in selection for disease resistance is hastened by new developments in ABC's molecular lab concerning oyster genomics and mapping important genes," said Allen.

"The Kauffman's support provides an opportunity to advance research that can have very significant long-term implications for both oyster culture and reef restoration efforts in Chesapeake Bay," said Dr. Gene Bureson, Director of Research and Advisory Service at VIMS.



Rendering of the proposed Kauffman Aquaculture Center in Middlesex County.

### *Middle of the Storm* continued from page 5

This sits atop the tripod and points upward. The ADCP measures the average current velocity in every 25-cm layer between the sensor and the water surface. It also measures turbulence, and the concentration of suspended particles.

Light sensors on each tripod operate on the same basic principle as the acoustic sensors, but emit and receive infrared light rather than sound waves. The team employs light sensors

because they are much better than sound sensors at measuring the concentration and motion of very fine sediments such as mud and clay.

Pressure gauges on the tripods measures the depth of the overlying water column, and thus provide information on tides and wave height. This helps the researchers relate sediment motion to the daily tidal cycle or the passage of storms.

The final tool in the researchers toolbox is an electromagnetic sensor that provides back-up measurements of current velocity by detecting the motion

of seawater, an electrolyte, past 4 electrodes protruding from its small spherical body.

Together with before and after surveys of the seafloor, these sensors provide a detailed 3-dimensional understanding of how seafloor roughness influences sediment motion, and vice versa. It is important to remember, notes Wright, that the interaction between seafloor and sediment goes both ways.

"Water turbulence is proportional to roughness," says Wright. Thus as a sediment-laden water current moves

from a rough patch of seafloor to a smooth one, turbulence decreases, as does the amount of sediment the water can hold. Deposition of this sediment changes the seafloor's shape, which in turn alters the turbulence of water moving above and can result in further erosion or accumulation.

This type of complex feedback is exactly what the researchers are hoping the tripods they deployed in New Zealand will help them to better understand. These feedbacks can then be incorporated into computer models used right here at home.

## New Graduate Courses for Science Teachers

Through lectures and plenty of hands-on laboratory experience, VIMS faculty and Sea Grant marine educators worked together last fall to provide middle and high school science teachers with a wealth of information, materials and innovative techniques that they could take directly back into their classrooms. Eighteen regional teachers completed *Experimental Design in the Marine Science Laboratory*, a one-semester graduate course presented for the first time at VIMS during fall 2000. "There's no delay in going back and testing it on the kids," said Jane Butler, a science teacher at Grafton High School, "Everything is so hands-on and we're making contacts with experts in our field." Brinda Jones, whose marine biology classes at Warwick High School in Newport News grew from 15 students in 1992 up to 112 in the fall of 2000 said, "It's hard to find new lab experiments to

bring to the classroom. This is great, my classes have really bloomed."

A second course for science teachers is being offered this summer, July 1 - July 6 at VIMS Eastern Shore Laboratory in Wachapreague, VA. (attendance on July 4 is optional)

### Current Environmental Issues in Marine Science: Case Studies from Virginia's Eastern Shore

Two (2) graduate credits in marine science available from Virginia Institute of Marine Science School of Marine Science, College of William and Mary (MS 548); recertification credits may also apply. Tuition and lodging provided. Fee: \$20 registration fee and a few meals at participant's expense.

Instruction will be provided by VIMS faculty and marine education staff from the VIMS Virginia Sea Grant Marine Advisory Program. Activities will include field surveys, laboratory exercises and internet

applications. Implementation of course content and activities for the secondary science classroom will be emphasized. Course concepts will address selected Virginia Standards of Learning in life science, biology, earth science, physics and chemistry. Course content will include:

- Physical Oceanography (tides, waves, currents, barrier beach processes)
- Chemical oceanography (dissolved oxygen, water quality, impact of pollutants)
- Marine ecology and biology (estuarine and barrier island habitats, biodiversity, fisheries biology)
- A look at current VIMS research in shellfish aquaculture, non-

indigenous species, toxicology, fisheries management and more.

For more information, contact:

Susan Haynes (804) 684-7135, Vicki Clark (804) 684-7169, John Graves (804) 684-7352, or Mark Luckenbach (757) 787-5816



Teachers study interactions in aquatic foodwebs in Dr. Emmett Duffy's lab at VIMS.

## Knauss Fellows

Dean of Graduate Studies, Dr. Mike Newman, announced that three students in the School of Marine Science were awarded Knauss Marine Policy Fellowships for 2001. "These are highly competitive awards: having three recipients speaks very well of the quality of our education program in the School of Marine Science."

These awards match highly qualified graduate students with hosts in the legislative branch, executive branch or appropriate associations or institutions in the Washington, DC area. The fellowship was established in 1979 to provide a unique educational experience to students with an interest in ocean, coastal and Great Lakes resources and in the national policy decisions that affect these resources.

Krisa Arzayus, Ph.D. student, Dept. of Physical Sciences, is working at NOAA Office of Global Programs in Silver Spring, MD. "Specifically, I am working with the global carbon cycle research program where I will be involved establishing a Carbon Cycle Program Office which will serve as a coordinating venue for the Carbon Cycle scientific steering group and interagency working groups, as well as an outreach post for Congress and other interested parties who need information on the current issues surrounding carbon cycling" Arzayus explains. "I am learning firsthand how scientific research is funded by working with program managers in climate

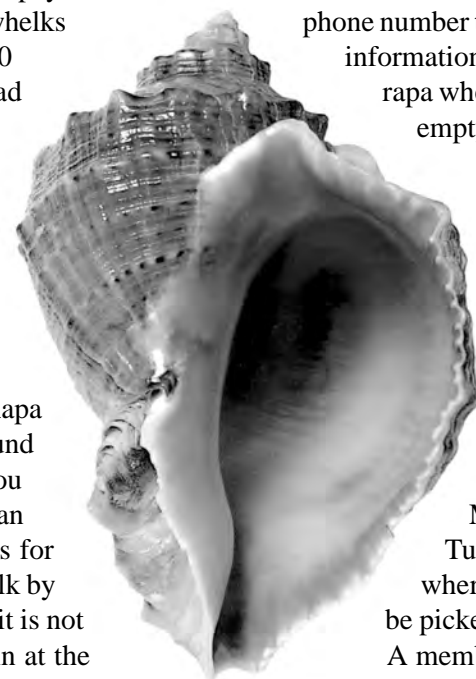
change-related research topics both within NOAA and across agencies." As a Knauss Fellow, she has had the opportunity to observe, if not participate in, important policy decision-making processes, attend congressional briefings and hearings, and research proposal review panels.

Rebecca Arenson Masters Student in the Dept. of Coastal and Ocean Policy, is assigned to NOAA, National Ocean Service, Management & Budget Office, Division of Policy, Analysis, and Communications. "I am helping with legislative and budget issues. Often I have had to help assemble reports to congress (that they have requested for implementation of specific funding issues), I also have had the opportunity to research legislation relevant to national ocean sciences to answer questions submitted from congress or that pertain to mandated activities and funding."

Masters Student Elizabeth Mountz, Dept. of Coastal and Ocean Policy, is working with the Great Lakes Taskforce in Senator Mike Dewine's (OH) office. She is working with all of the congressional members from the Great Lakes region to develop policy. "I'm working on a variety of issues, such as water diversions from the Lakes, invasive species, and slant-drilling for oil and natural gas. I'm learning how different entities from non-government organizations up to the federal government interact."

## Rapa Whelk Bounty

Once again, VIMS scientists need your help in collecting Rapa whelks. This is very important to help in mapping the Rapa distribution and gathering information on the various age classes of the whelk in the Chesapeake Bay. Beginning on April 16, 2001 VIMS will pay a \$5.00 bounty on all live whelks collected, and \$2.00 bounty on each dead whelk or empty whelk shell collected. While the whelks are much more valuable for research if they are alive, the scientists are interested in any Rapa whelks that are found and reported. If you find a whelk you can make arrangements for pick-up of the whelk by VIMS personnel - it is not necessary to remain at the site. To keep the whelk alive please keep it in a bucket of river water in the shade. Please do NOT put live whelks in the freezer or on ice. We have set up a VIMS Rapa Hotline at (804) 684-7361; please use this number to report Rapa whelks



and request pick-up. VIMS staff can monitor this line 24 hours a day, 7 days a week. All callers should provide information about the collection of the rapa whelk including the caller's name, the collector's name (if different from the caller), the date on which the whelks were collected, a phone number to call for additional information, the status of the rapa whelk (live, dead, empty shell), the number of rapa whelks, the place where the rapa whelk was collected (for example, off Ocean View near Harrison's Pier or in the James River just above the Monitor-Merrimac Bridge Tunnel), and the place where the whelk(s) can be picked up.

A member of the VIMS staff will return your call and verify the pick-up location as well as your mailing address which is needed to pay the bounty. If you do not leave your phone number, VIMS cannot pay the bounty.



## VIMS Scientists to Explore Human Imprint of Pollution on Antarctic Sea Ice

For many, Antarctica represents an unpolluted refuge from the modern world. With no industry and only 4,000 temporary inhabitants dotting an icy expanse larger than the United States, it seems the continent would retain a primal purity.

Recent research suggests otherwise.

Indeed, some volatile pollutants, such as the pesticide hexachlorobenzene, occur in higher concentrations in Antarctica than in the temperate and tropical latitudes where they are produced and used.

VIMS researchers Rebecca Dickhut and Hugh Ducklow will travel to Antarctica next September with graduate student Amy Chiuchiolo to begin investigating the role that sea ice plays in injecting these “persistent organic pollutants,” or POPs, into polar food webs.

Their visit to the waters of the Antarctic Peninsula will be the first in a pair of trips down under, courtesy of a 2-year grant from the U.S. National Science Foundation. The work builds on research conducted in the Chesapeake Bay during the last several years by Dickhut’s current graduate student Padma Venkatraman.

Previous work on polar pollution has focused on the Arctic, due to concerns by Arctic governments about the effects of such contaminants on indigenous peoples. Because people such as the Inuit occupy the top of the food chain, feasting on polar bears and other marine mammals, they face a serious threat of biomagnification—the

process by which contaminants become increasingly concentrated as the food pyramid narrows from the large number of primary producers at its base to the few predators at its peak.

Arctic research shows that levels of polychlorinated biphenyls (PCBs), a known carcinogen, are 2-10 times higher in Inuit newborns than in babies born further south. PCBs were once widely used in electrical equipment, but their manufacture was banned in the U.S. in 1977 because of evidence that they build up in the environment and cause harmful effects.

Dickhut and Ducklow’s research turns the Arctic work on its head, both in geography and ecology. Instead of concentrating on the effects contaminants may have on top predators, Dickhut says they seek to understand “the mechanisms by which POPs are getting into the base of the Antarctic food web.”

They hypothesize that sea ice plays a crucial role. A skirt of sea ice slowly expands around Antarctica each austral winter (from May through September) and then quickly contracts with the warmer temperatures of the austral spring. This floating fringe of sea ice is huge, and can at its maximum extent nearly double the solid surface of the continent.

Dickhut and Ducklow reason that POPs condense from the air onto the vast sheet of sea ice during the long winter, and then melt along with the sea ice into the surrounding seawater come spring.



Scientists extract an ice core during a Ross Sea expedition.

Unfortunately, release of contaminants in this manner would coincide with Antarctica’s renowned spring phytoplankton bloom. During this bloom, increasing daylight and a rich supply of nutrients fuel algae, also released from the melting sea ice, to generate a population explosion among the tiny marine plants that nourish the rest of the Antarctic ecosystem.

Thus in Dickhut and Ducklow’s proposed scenario, phytoplankton growth and POP concentrations peak in seawater simultaneously.

“You’ve had six to eight months of deposition all injected at once into the plankton system,” says Ducklow. From there, the pair suspect the contaminants could quickly and efficiently infiltrate up the Antarctic food chain, passing from phytoplankton to zooplankton such as krill, then to fish, and on to apex predators such as Adelle penguins, skua seabirds, seals, and whales.

Ducklow is also interested in looking down the food chain, to explore how decomposition by marine bacteria affects the longer-term fate of persistent organic pollutants in Antarctic waters. As their name implies, POPs persist in nature for a long time—10s to 100s of years. They are ultimately broken down by sunlight and the action of microbes. Studying the mechanisms by which marine bacteria break down POPs may thus one day help scientists accelerate the process.

To test their sea-ice hypothesis, the VIMS team must sample POP concentrations in each suspected reservoir—air, sea ice, seawater, and the tissues of plankton and microbes. Because their work will focus on the base of the food chain, Dickhut and Ducklow expect to

encounter contaminant concentrations that are very low.

“We’ll be measuring in parts per billion and lower,” says Dickhut. “That’s like trying to find a coffee table in the state of Texas,” adds Ducklow.

Previous Arctic researchers, who sampled from the blubbery tissues of top predators where POPs tend to concentrate, had a much easier time, working with concentrations a thousand times higher.

Because of the low concentrations in the reservoirs they plan to study, the VIMS team must sample large volumes to obtain a detectable signal. “We might have to get a cubic meter of ice per sample,” says Ducklow.

“We have to make sure we get measurable levels,” adds Dickhut. “And since you only get one or two trips to Antarctica, you don’t have a lot of time to play with, so you’d rather overkill and collect even more.” All the team’s samples will be returned to VIMS for analysis. This will further complicate the logistics of an already rigorous expedition.

To reach their study site at 64° south latitude, the VIMS’ scientists will sail from Punta Arenas, Chile aboard the 308-foot research ice-breaker *Nathaniel B. Palmer*. The voyage will bring them across notoriously windy and wave-tossed seas that sailors have dubbed the “roaring forties.”

Ducklow tells of watching a solid wave of cold green water roar past his 6<sup>th</sup>-deck porthole during a 1996 Antarctic passage aboard the *Palmer*, then falling to the floor as the ship dropped 70 feet into the trough of the next wave. His stomach followed a few moments later.



Rebecca Dickhut and Hugh Ducklow of VIMS will begin a new study in Antarctica in Fall 2001.

# Mid-Atlantic Scallop Closed Areas Set to Reopen

By Dr. William DuPaul

Two sea scallop resource areas in the mid-Atlantic closed since 1998 to protect concentrations of small scallops are set to reopen in the spring of the 2001-2002 fishing year, which started on March 1<sup>st</sup>. The two areas, Hudson Canyon South and the Virginia Beach Closed Area, have an estimated total scallop biomass of 65.7 million lbs., of which 14.5 million lbs. are scheduled for harvest in 2001 and 14.7 million lbs., in 2002. The harvest estimates were obtained from the August 2000 survey conducted by the National Marine Fisheries Service and the June and September 2000 surveys con-

ducted by VIMS scientists and students on the F/V *Alice Amanda* from Hampton, Virginia. As currently envisioned, each fishing vessel with a full-time scallop permit will be initially awarded three fishing trips in 2001, with a maximum catch up to 17,000 lbs. of scallops per trip. The mid-Atlantic Closed Areas are historic fishing areas frequented by scallop vessels from Virginia, New Jersey, and New York.

The year 2000 was a very successful year for the Virginia scallop industry. More than 8.9 million lbs. of scallops were landed in Virginia ports, worth more than \$37.3 million. This

does not include several hundred thousand pounds of scallops landed by Virginia-based boats in the Port of New Bedford after fishing on Georges Bank. Portions of the Georges Bank Closed Area I and the Nantucket Lightship Closed Area were reopened in 2000 to a limited harvest of 4.5 million pounds after a six-year closure.

The reopening of mid-Atlantic areas, along with good recruitment in other fishing areas, portends good news for Virginia's scallop industry.



## Imprint of Pollution on Antarctic Sea Ice continued from page 11

"I'll probably get seasick, but I'm still going!" laughs Dickhut.

Unfettered by land, the intense winds of the roaring forties drive the surface of the Southern Ocean in a huge circumpolar current that effectively isolates Antarctica's coastal waters from the rest of the world ocean.

Based on this isolation, scientists assume that the POPs detected in Antarctica's resident marine organisms are reaching the continent through the air—via what they call the "grasshopper effect." Dickhut and Ducklow's research will help to test this assumption.

Understanding how the grasshopper effect might help pollute Antarctic marine ecosystems requires a brief foray into the world of contaminant chemistry.

Some POPs are relatively non-volatile, which means that they are unlikely to evaporate into the air at normal surface temperatures. These include polycyclic aromatic hydrocarbons (PAHs), produced by incomplete burning of fossil fuels, and Kepone, the pesticide that began entering the James River during the 1960s.

Non-volatile POPs tend to stay put, adhering to mud and clay particles and thus accumulating in river and coastal sediments near where they are produced or used. Dickhut and her students, as well as others at VIMS, have previously studied these types of POPs in sediments and organisms from the James, York, and Elizabeth rivers.

However, other POPs—such as the pesticides hexachlorobenzene (HCB) and hexachlorocyclohexane

(HCH), as well as some PCBs—evaporate relatively easily at normal surface temperatures. Because of this property, these compounds are lifted into the air by the same processes that carry water vapor skyward to produce clouds and rain. And like water vapor, which on a global basis enters the atmosphere in the tropics and exits at the poles, these compounds cycle slowly but consistently poleward through time.

Individual POP molecules may rain out of the atmosphere during their poleward voyage, but if the underlying water or land is warm, they quickly "hop" back into the air through renewed evaporation—hence the "grasshopper effect." Yet as an air mass travels away from the tropics into colder and colder climes, the proportion of molecules that hop back into the air continually decreases. By the poles, the grasshopper aren't hoppin', and any gaseous pollutants that condense and fall to the frigid surface remain trapped there.

The grasshopper effect may help explain the troubling fact that HCH levels in polar regions exceed those in the tropical zones where this insecticide is primarily used. After a farmer in India or other tropical lands sprays his or her rice fields with HCH, residual molecules may simply evaporate and then slowly but surely cycle poleward through the atmosphere to accumulate in polar zones.

By comparing samples taken from different reservoirs and during different seasons, Ducklow and Dickhut should be able to calculate a budget that can be used to track the passage of these grasshoppered POPs through Antarctic sea ice and into the local food chain.

September provides a particularly important window of opportunity for the team's research effort. This is when the sea ice begins to melt and relatively high concentrations of POPs flood the surrounding seawater. "Our cruise is purposefully scheduled to catch the end of the winter season," notes Ducklow.

The VIMS team will follow their September 2001 cruise with another trip in January and February 2002 to the Palmer Research Station. During the second trip the team will work both on land and sea to collect samples that they can tie into the long-term scientific databases available via Palmer's Long Term Ecological (LTER) Program.

Ducklow says that the project "is the best example I've ever had of a new idea that just kind of floated up to me that became a proposal that got funded. I was on Padma's thesis committee with Becky and I started to think about sea ice melting, and that

pollutants probably accumulate on the ice. It was just an out-of-the-blue thing."

Both agree that formulation of their sea-ice hypothesis represents a "great example of teamwork" between Dickhut, a contaminant geochemist, and Ducklow, a biological oceanographer.

Within a month of their initial brainstorming, the two had submitted a formal proposal to NSF's Office of Polar Programs that combined Ducklow's research experience from four previous Antarctic trips with Dickhut's expertise in contaminant chemistry. The proposal that led to their upcoming work was funded in December 2000.

If that work proves successful, the pair plan a future return trip to Antarctica to trace the movement of POPs into the upper levels of the Antarctic marine ecosystem.

## Student Receives NSF Graduate Fellowship

Chris Earnhart, a Ph.D. student in the Department of Environmental Sciences, recently received a three year NSF graduate fellowship which pays for an \$18,000 stipend and \$10,000 per annum towards tuition and educational costs. He received it under the discipline of immunology focusing on oyster defense mechanisms.



Ph.D. student Chris Earnhart in the VIMS Immunology lab.

## VIMS Study Poses New Questions on River Carbon

The ability of scientists to accurately predict future climate change requires a realistic understanding of Earth's carbon cycle. Research by VIMS scientists Dr. James Bauer and Ph.D. student Peter Raymond, now suggests that the carbon in river water may be much older—and vary more in age—than previously thought. Their findings, presented in a recent issue of the journal *Nature*, may help resolve a fundamental paradox facing those trying to assess Earth's carbon budget.

By studying water from the Amazon and several North American rivers, including the York, Raymond and Bauer determined that some of the carbon in these waters was thousands of years old. Previous thinking held that river carbon was at most a few decades old.

Researchers have long assumed that rivers play an important role in Earth's carbon cycle by carrying to the sea the carbon that land plants remove from the atmosphere via photosynthesis. When land plants die and decay, the carbon in their tissues enters the soil. As rivers erode the soil, they carry this carbon to the ocean. Once in the ocean, this carbon may sink to deep waters. There, it can become trapped for thousands of years, effectively removing it from the atmosphere and thus helping to lessen the greenhouse effect.

Based on this assumption, oceanographers expect to find large amounts

of river-derived carbon in the ocean. “We know that continents supply a lot of carbon to the oceans,” says Bauer, “but current techniques tell us it's not there.”

The paradox of this missing carbon has long vexed oceanographers. But Raymond and Bauer's results suggest that much of the river-derived carbon may not be “missing”—once in the ocean, it simply may not look like what it started out as on land. Traditional thinking holds that the carbon that rivers carry to the ocean was only recently extracted from the atmosphere by land plants. This “young” carbon can be detected in a water sample by measuring the proportion of stable and radioactive carbon atoms it contains. Oceanographers have thus looked for large amounts of young carbon in their seawater samples as a fingerprint of land-derived carbon—but in vain.

Raymond and Bauer took a different approach, using the carbon-dating technique on water samples from rivers rather than the ocean. Their results show that the carbon in the rivers they studied is on average 670 years old, much older than previously suspected. They also found that the age of the various types of carbon in the samples varied much more than once thought.

“Our research,” says Bauer “shows that young carbon in rivers is the exception rather than the rule.”



R/V Bay Eagle on the York River, one of the sites Bauer and Raymond studied.

River-borne carbon may thus be more abundant in the ocean than previously thought, but scientists will need to look at something other than its age in order to identify just how abundant it really is.

About 40 percent of the carbon in river water occurs as tiny suspended particles. The rest of river carbon is dissolved in the water. Raymond and Bauer found that particulate river carbon is especially old—the average age of such samples from the rivers studied ranges from around 700 to almost 5,000 years old. This suggests that much of the particulate carbon in

these rivers derives not from land plants but from ancient carbon stored in rocks and deep soil layers beneath the rivers' drainage basins.

The dissolved carbon is younger—but still much older than expected. Raymond and Bauer attribute their samples' unexpected age in part to the action of bacteria. Laboratory experiments by the pair show that bacteria in river water preferentially feast on younger carbon, thus enriching the remaining river water in older carbon that plants extracted from the atmosphere long ago.

The pair's research poses as many questions as it answers. One is whether the unexpected age of their samples may, like fossil-fuel burning, reflect a human disturbance to the natural carbon cycle. “Human activities such as agriculture may have modified the rivers' input of carbon to the ocean,” says Bauer. In this scenario, tilling of soil in areas surrounding the Chesapeake Bay and other heavily farmed areas may bring older soil carbon to the surface, where rivers can then carry it to the sea.

Raymond and Bauer qualify their findings by noting that they have so far looked at samples from only a handful of rivers. However, they note that the rivers they studied likely provide a good model for the river systems that contribute almost 60 percent of the freshwater delivered to the North Atlantic each year.

Bauer next plans to study water samples from other river systems in North America and New Guinea to determine if the current findings apply elsewhere around the globe.

## VIMS Welcomes Faculty Members

**Dr. Deborah A. Bronk**, Associate Professor, Physical Sciences. B.S., University of Miami; Ph.D., University of Maryland, Horn Point Environmental Laboratory.

Dr. Bronk's research focuses on the cycling of nitrogen in marine and estuarine environments. Specific research includes the role of dissolved organic nitrogen (DON) in microbial food webs, and the utilization of marsh-derived and phytoplankton-derived DON as a nitrogen source for phytoplankton and bacteria.

**Dr. Jesse E. McNinch**, Assistant Professor, Physical Sciences. B.S. University of Southwestern Louisiana; M.S. University of North Carolina at Chapel Hill; Ph.D. University of North Carolina at Chapel Hill.

Dr. McNinch's research interests are the observation and prediction of shoreface and shoreline changes in response to underlying geology, physical and sedimentary processes on cape-associated shoals, and other inner-shelf sedimentary features.

**Dr. Ratana Chuenpagdee**, Assistant Professor, Coastal & Ocean Policy. M.Sc. University of Wales, Bangor; Michigan State University; Ph.D., University of British Columbia.

Dr. Chuenpagdee's primary interest is in developing public decision-making processes for resource management and policies.

**Dr. Robert L. Hicks**, Assistant Professor, Coastal & Ocean Policy. B.A. North Carolina State University; Ph.D. University of Maryland.

Dr. Hicks' major research interests are environmental and resource economics, non-market valuation, natural resource damage assessment, and the economics of commercial and recreational fisheries. Hicks was with the National Marine Fisheries Service for the past three years.

**Dr. Rochelle D. Seitz**, Research Assistant Professor, Biological Sciences. B.A., Colgate University; M.S., The College of William and Mary; Ph.D., The College of William and Mary.

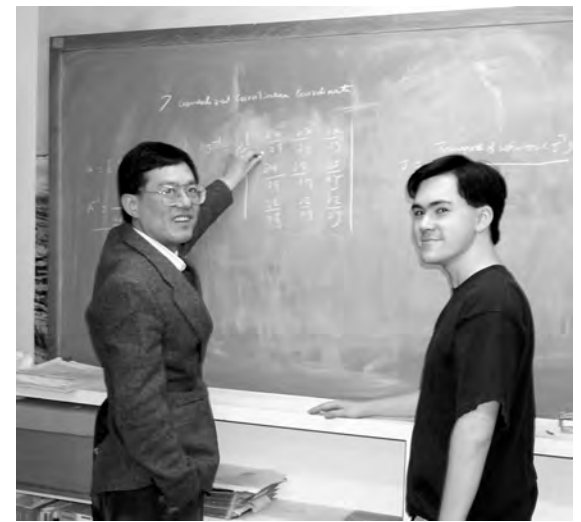
*Continued on page 15*

## Computational Science Student Receives Fellowship

Richard Mills, Computational Science graduate student in the Computer Science Department at William and Mary recently was awarded a Department of Energy (DOE) Computational Science Graduate Fellowship for his work with Dr. Harry Wang, VIMS Dept. of Physical Science and Dr. Andreas Stathopoulos, Computer Science Department. Since last fall, Mills has taken classes and worked with Wang and others in the VIMS modeling program. His work included combining advance numerical computation with VIMS three-dimensional physical-chemical-biological numerical model to enhance the model performance and improve predictive capability. As an undergraduate

studying geophysics, Mills became interested in the various computational applications and realized that his main interest was in developing the cutting edge methods required for solving the most computationally demanding problems that arise in geosciences. He and Wang are working on both the numerical methods and the computer code required for parallel computing implementation of the model. "Many parallel applications do not fully utilize the capabilities of today's hardware," said Mills. "I am interested in designing parallel numerical algorithms that not only have good numerical properties, but are better tailored to the computing environments they run in, thus enabling scientists to more fully utilize their

available computing resources." The DOE fellowship, good for up to four years, covers all tuition and fees, provides some money for research related expenses and includes a monthly stipend. Dr. Robert Voigt, Director of the Computational Science Program at William and Mary, explained that the DOE awards are perhaps the most competitive in the nation. "The program seeks to identify and provide support for the very best computational science graduate students in the nation. We are very pleased to have one of our students receive such an award," said Voigt.



Dr. Harry Wang, VIMS, Dept. of Physical Sciences, and student Richard Mills.

### *New Ecosystem Management Study continued from page 1*

commercially important fishes are greatly affected by the abundance of their prey, their predators and their competitors. These relationships change over the life history of a species, and can be greatly influenced by the environment. Fishing, as well as environmental fluctuations, can seriously alter community structure, impacting the abundance of predator and prey species. "The delineation and understanding of such interactions are critical to the sustainable management of the lower Bay ecosystem," said Dr. John Graves, Chair Department of Fisheries Science, VIMS. "The award from the Virginia Environmental Endowment provides us with a unique opportunity to develop a model that will allow fishery managers to forecast the impacts of various actions on the ecosystem as a whole"

This work will build on VIMS Juvenile Trawl Survey, a 46-year series monitoring the abundance of juvenile fishes in Chesapeake Bay and tributaries and some environmental conditions. The project will be coordinated with researchers at other institutions on the Bay who are also working on various aspects of the food web within Chesapeake Bay. Ultimately, these data will be used to develop a more comprehensive model for fishery managers, allowing them to predict the outcome of various scenarios. For example, currently striped bass populations are up. What impact do elevated levels of striped bass have on their prey species such as bay anchovy, blue crab, and menhaden? How do these impacts

affect other species such as bluefish, red drum, and weakfish that also feed on bay anchovy, blue crab and menhaden? Scientists feel that some of the data necessary to understand these kinds of food-web interactions are not known. As the model is developed, the needs for further food web research will be highlighted. "Building a dynamic model will force us to take inventory, to see where information is needed to develop predictive capabilities," explains Dr. Richard Wetzell, Chair Department of Biological Sciences at VIMS and co-director of the project.

The grant from the Virginia Environmental Endowment will also permit researchers at VIMS to update the Status of Stocks and Species Information document they developed in 1995. The original document, which included a synopsis of information on important recreational fishes of Chesapeake Bay, will be revised and expanded to include data on the feeding habits and relationships of many important forage species, as well as several non-resident species in the lower Chesapeake Bay. This document will be available on the VIMS web site.

Gerald P. McCarthy, Executive Director of Virginia Environmental Endowment, stated that "This work will enable scientists to develop the knowledge and applications needed by managers to make decisions based on a complex and far more complete suite of information." The goal of the work is to develop an ecosystem based fisheries management plan with models that will provide better tools to forecast the impact of a management act or

environmental event on a particular species as well as on the ecosystem as a whole. Sustainable fisheries are essential to maintain ecological, economic and social benefits provided by the resources.

McCarthy said that VIMS has just the right combination of experience, skills, and information to undertake this important and groundbreaking work. "This initiative will eventually change the way the fisheries of the Chesapeake Bay are managed, and allow for

the possibility of sustainable fisheries in the Bay for generations to come." He added, "VIMS is taking a leadership role in coordinating the scientific work on sustainable fisheries research in the Bay. They are inviting their colleagues to work cooperatively so that the Living Resources goals of the Chesapeake 2000 Agreement may be reached. The Endowment is very excited at this new direction and honored to be able to help."

### *CBNERRVA*

*continued from page 1*

time, long-term monitoring in the Ft. McHenry wetlands was an aspiration of the restoration effort, but not a realization. The implementation of the long-term monitoring aspect of the project did not happen until CBNERRVA became involved with the National Aquarium in Baltimore and the Ft. McHenry Restoration Team. With funds provided by NOAA, CBNERRVA established long-term water quality and meteorological stations at the restoration site and conducted training workshops on those stations for staff of the National Aquarium in Baltimore and environmental science students at Morgan State

University. Students at Morgan State University are under the direct supervision of Dr. Livingston Marshall, a VIMS alumnus.

Coastal America is an organization that encourages and promotes the partnership of federal, state, and local governments, tribal, non-governmental organizations, and private entities working together on coastal conservation, restoration, and education projects.



Dr. William Reay and Eric Wooden (third and fourth from left) receive Coastal America Award.

# Marine Industry Trends

By Tom Murray

Perhaps no fishery in Virginia better illustrates the evolution from wild harvest to aquaculture than the hard clam (*Mercenaria mercenaria*). As the graph below illustrates, the harvest of "public" hard clams has continued to decline over the past decade. The overall level of effort by watermen to harvest clams on the public bottom has also declined. For example, in 1980 the state issued 475 permits to harvest clams by hand. The current figure is 191. Over the same period, the number of licenses held to harvest clams by patent tong has increased slightly from 133 in 1980 to 160 in 2000.

At the same time, there has been a growing clam aquaculture industry in Virginia and the country. During 1998 (the most recent year for which aggregate data are available), a reported production of 177,575,000 clams from 360 farms generated farm gate sales of \$50,076,000. Of that total, Virginia and Florida were by far the largest suppliers, respectively producing 40% and 43% of the total farm supply. Virginia's growth in clam culture has shown an increase in supply from an estimated 30 million littlenecks in 1991 to 43.7 million in 1995 and 70.5 million during 1998. While the state of statistics gathering for farm-raised products is not keeping pace with industry expansion (in fact it's getting worse) industry estimates indicate that at the end of the year 2000 the state's farms will provide nearly 100 million Virginia littleneck clams to its diverse markets.

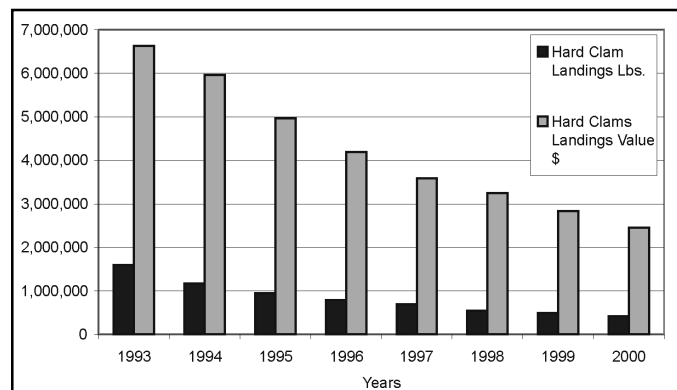


Figure 1. Hard Clam Wild Harvest and Values 1993-2000

sales have grown from an estimated \$5.4 million in 1995 to \$12.7 million in 1997; \$9.5 million in 1998 and, most recently, \$15.9 million in 1999. Estimates of Florida's production point to an increase to 200 million clams in the year 2000, compared to the reported 76.3 million sold by Florida clam farms in 1998. Further, the USDA reports Florida's clam planting intentions for the year 2000 at 421,925,000 clams. This, in view of the average reported survival rates of 67% for 1998 and 53% for 1999, suggests continued pressure on clam market channels.<sup>1</sup>

Other factors are emerging which would serve to support an expanded farming sector for hard clams. As of February 1999, the U.S. Department of Agriculture (U.S.D.A.) initiated a pilot hard clam crop insurance program through the "Federal Crop Insurance Corporation" issued as Aquaculture (Shellfish-Clam) Crop Provisions. The three states selected for the pilot program are Massachusetts, Virginia, and Florida, who currently account for almost 90% of the farm-raised clam harvest. While only in its first year, the program reportedly has written crop insurance on the majority of the hard clam aquaculture farms in these select

industry locations. With crop peril insurance, the availability of production loans and facility expansion loans is greatly enhanced, and one of the longstanding constraints to developing aquaculture, (i.e., limited access to private sector financing) has been, at least temporarily, mitigated.

In certain states, policies and programs have significantly accelerated the growth in the supply of hard clams.

Most notably perhaps, the State of Florida has expanded employment opportunities in the clam aquaculture industry by funding a "Job Training Partnership Act" aimed at providing the infrastructure to introduce clam aquaculture as an economic stimulant. During the past eight years, these programs have provided the necessary support to introduce shellfish aquaculture as a means of economic growth in rural coastal communities. In that sense, the programs may be impacting the overall market by adding more products without offsetting growth in market size.

While no detailed price analysis has been completed in recent years, preliminary analysis (confirmed by industry anecdotes) suggests that there has been some softening or flexibility in average prices received in the major growing states. It is believed by most in the supply network that this is associated with the dramatic increase in hard clam products available (as reflected in Figure 2).

Figure 3 illustrates, in a simple way, the leveling in the per-unit value of the hard clam product at the "farm gate," which has apparently accompanied increasing supply.

As noted above, the state of Florida reportedly produced and marketed an estimated 134,000,000 hard clams worth \$15.9 million during 1999. The farm sales were made at an overall average price of \$.118 per clam. Although no more recently published data are available nationwide or for Virginia's clam aquaculture industry, it is generally reported that the leveling of prices for Virginia's product as of 1998 has continued and producer prices remain at about the same level; i.e. about \$.15-\$.16 per clam for Virginia product. The production of Virginia's farmed hard clams has continued to expand and through successful industry marketing has increased revenues to producers overall.

<sup>1</sup> Florida reportedly produced 134 million hard clams in 1999. Florida Agricultural Statistics Service. June 2000.

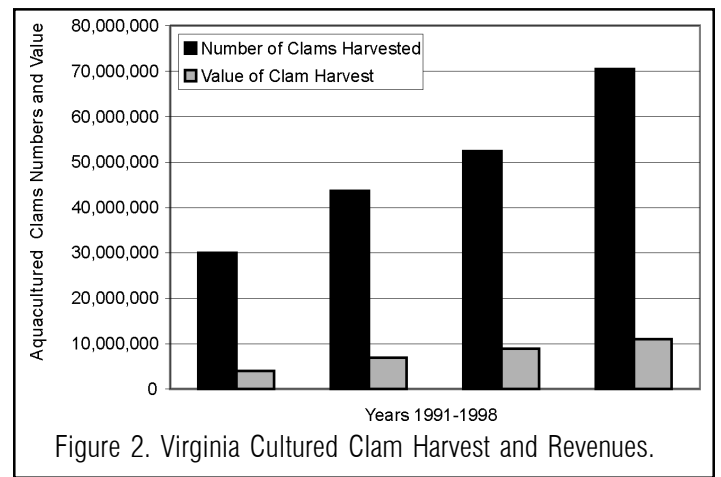


Figure 2. Virginia Cultured Clam Harvest and Revenues.

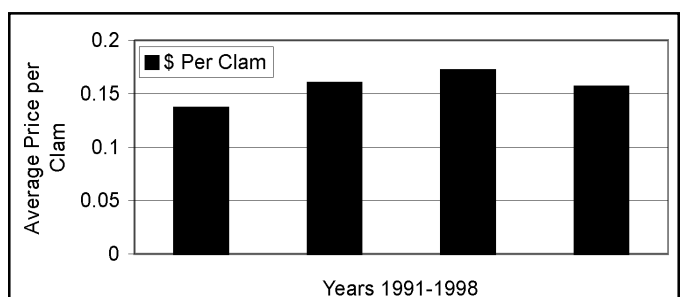


Figure 3. Virginia Aquacultured Hard Clam Price Flexibility 1991-1998

## New Faculty continued from page 13

Dr. Seitz's research interests center around benthic community ecology, particularly changes in benthic invertebrate diversity with environmental stress, predator-prey dynamics, top-down versus bottom-up control of benthic systems, and conservation biology.

**Dr. Courtney K. Harris,** Assistant Professor, Physical Sciences. B.S. University of Virginia; M.S. University of California at Berkeley; Ph.D. University of Virginia.

Dr. Harris' research interests include 3-D modeling of river plume, wave resuspension, and wind-driven circulation effects on flood deposits; as well as quantification and prediction of

shelf and estuarine sediment transport over contrasting temporal and spatial scales. She comes to VIMS from the US Geological Survey in Woods Hole.

**Dr. Deborah Steinberg,** Associate Professor, Biological Sciences. B.A., University of California, Santa Barbara; Ph.D., University of California, Santa Cruz.

Dr. Steinberg is interested in zooplankton ecology and physiology, coastal and deep-sea food webs, nutrient cycling, and marine detritus ("marine snow"). She comes to VIMS from the Bermuda Biological Station for Research (BBSR) where she coordinated the Bermuda Atlantic Time-series Study, as part of the Joint Global Ocean Flux Study (JGOFS).

# Calendar of Events

## —May—

- 4, 11, 18, 25 - Public Tour, VIMS Campus, 2pm.  
Teaching Marsh Tour, 3pm.  
13- College of William and Mary Graduation  
15-17 - Wetlands ID Delineation Workshop  
17 - VIMS Council Meeting  
20 - Watermen's Heritage Day at the Watermen's Museum in Yorktown.  
VIMS exhibits and activities

## —June—

- 2 - Gloucester County Riverfest. Exhibits and activities. 10am - 5pm.  
VIMS Boat Basin. Aquarium Visitors Center in Watermens Hall open.  
9 - Aquarium Open 10am - 2pm

## —July—

- 1-6 - Graduate Education Course MS 548.  
Eastern Shore Laboratory, Wachapreague, VA

For more information call 804/684-7101 or 804/684-7011.

\*See below for complete Public Tour information.\*

Visit our website at: [www.vims.edu](http://www.vims.edu)

## Stranded Sea Turtle Program Underway

The season for sea turtles in the Chesapeake Bay and its tributaries is here again and VIMS scientists urge anyone who finds a stranded sea turtle to call the sea turtle stranding hotline (804) 684-7313. "We need your help," says Kate Mansfield of VIMS, "we can't continue collecting this valuable data without help from our local residents, visitors and fishermen. All information is important to us and helps us learn more about these marine animals." VIMS scientists have been collecting data on sea turtles in Virginia waters for 22 years and respond to any stranded sea turtle (alive or dead) found north of the James River.

Up to 10,000 loggerhead sea turtles are in the Bay during the summer. Turtles start to arrive in the Bay when the water temperature approaches 66 degrees F, and migrate out of the Bay to wintering grounds off of North Carolina or as far south as the Florida coast when temperatures drop to around 60 degrees F. Chesapeake Bay provides summer feeding grounds for both adult and juvenile loggerheads and juvenile Kemp's

ridleys. Kemp's are the most endangered of all sea turtles and one of the most endangered animals in the world. Ridleys forage in the shallow waters around the margins of the Bay while loggerheads most often utilize deeper water, near channels. Green and leatherback turtles have on occasion been found in Bay waters.

If you see a stranded sea turtle anywhere north of the James River, please contact: VIMS Sea Turtle Stranding Hotline (804) 684-7313. If you find a LIVE stranded sea turtle after business hours, please contact the stranding pager (804) 684-6197. Both numbers are checked frequently during the day and after hours. When calling, please leave your name, phone number, date, description of the turtle and information on the location of the turtle.



## Public Tours of VIMS Campus

Beginning in May, walking tours of the VIMS campus will be offered each Friday. The docent led tours will begin in the Aquarium Visitor Center and conclude in the Teaching Marsh. Groups of more than 6 should call in advance. For additional information, please contact Christine Evans at (804) 684-7735 or Susan Polk at (804) 684-7846.

**Tour Schedule - every Friday:**  
April 27 - June 15: 2pm  
June 22 - September 14: 10:30am  
September 21 - Nov. 16: 2pm

**Saturday Schedule**  
**June 2 - September 1**  
Visitor Center and Lobby open  
10am - 2pm

## VIMS Auction

A week on the French Riviera brought the most lively bidding at the third VIMS auction on Saturday, March 3, 2001. Nearly 200 people attended to bid on items including a kayak, antique chairs, dinners, spa passes, art and jewelry. More than 140 local merchants and individuals supported the event with their donations. Proceeds support the Hargis Library Endowment. Auction Chair, Carrie Garland and more than a dozen volunteers and VIMS personnel began working in the fall to plan and organize the event. "We exceeded our goal this year and are very happy to be able to provide nearly \$30,000 to the Hargis Library Endowment to support all aspects of library operations. It was a pleasure to work with everyone here and I would like to personally thank all the great volunteers and VIMS people who contributed so much of their time and energy to make this the best auction ever," said Garland.



More than 200 guests attended the Third Annual VIMS Auction.