

The *C*zest

Current Issues in Coastal Ocean and Estuarine Science

VIMS Scientists Successfully Spawn Cobia

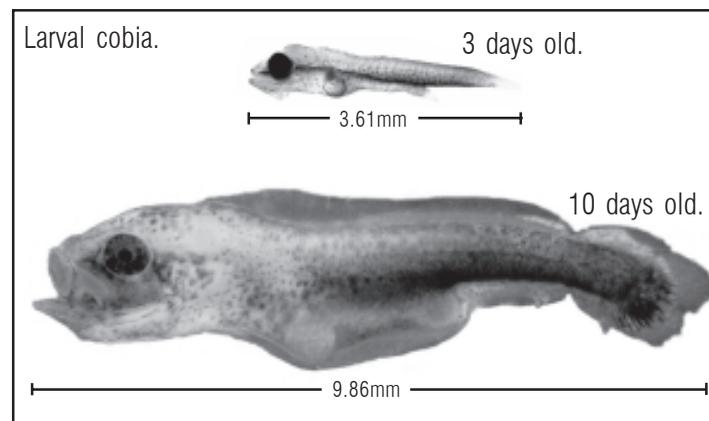
A milestone in marine finfish aquaculture was achieved at the Virginia Institute of Marine Science (VIMS) on June 15 when cobia were induced to spawn in a recirculating water system. According to Mike Oesterling, VIMS aquaculture specialist, this is the initial step in the development of cobia aquaculture. Dr. Bill DuPaul, head of the Virginia Sea Grant Marine Advisory Program, explained

that, "cobia are considered prime candidates for aquaculture development because of their fast growth rate as juveniles and an expanding demand for them in the seafood marketplace."

"Cobia are highly-prized both as a food-fish and a recreational trophy fish," said Oesterling. "We've been investigating the potential for cobia culture for four years now. But, this is our first attempt at spawning." Previ-

ous work was conducted on wild-harvested juvenile cobia that were obtained from commercial watermen. Those studies set the stage for the spawning by

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NMFS Faculty Position Established at VIMS

The National Marine Fisheries Service (NMFS) announced that VIMS and Hampton University (HU) are now part of its Cooperative Marine Education and Research (CMER) Program. This innovative partnership provides universities a senior level NMFS scientist to serve as a full-time visiting professor. Through NMFS support, the scientist will teach classes at VIMS and Hampton University, mentor students and serve as a liaison with NMFS and other federal programs. This is the first time that two schools have been involved in the CMER program. Other universities, in the program are University of Rhode

Island, University of Massachusetts and Rutgers. U.S. Senators Robb and Warner along with U.S. Representatives Bateman, Pickett, Sisisky, and Scott secured funding for the program this spring. The search for a full time CMER professor is underway. NMFS

will provide a pool of potential candidates to be screened and interviewed by a joint VIMS/HU/NMFS committee. Plans are to fill the position by the fall semester 2000

Dr. Michael Vecchione, Director of NMFS Systematics Lab (VIMS,

Ph.D. 1979) is currently at VIMS two days a week to initiate the program. Vecchione said, "VIMS has a long history of interaction with the NMFS Systematics Laboratory. This is an

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Through the CMER Program, VIMS students will have the opportunity for research cruises aboard NOAA vessels like the R/V Gunther shown here.

The Crest

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Chesapeake Bay
National Estuarine
Research Reserve
in Virginia

a fair Bay Summer 2000
Vol. 10, No. 2

Scientists Discover New Species of *Perkinsus*

A description of a new species of a marine protozoan, named *Perkinsus chesapeaki*, recently published in the latest issue of the journal *Parasite* resulted from a research project conducted in the laboratory of Professor Mohamed Faisal, VIMS Department of Environmental Sciences in collaboration with Dr. Shawn M. McLaughlin, NOAA/MDDNR Cooperative Oxford Laboratory.

The cooperative research effort to characterize the new species of *Perkinsus* parasite began three years ago when Dr. McLaughlin sought the expertise in Dr. Faisal's laboratory to identify pathogens of the softshell clam. Two morphologically distinct *Perkinsus* species were isolated from the clams and successfully cloned in continuous culture. The investigators identified the first isolate as the oyster pathogen, *Perkinsus marinus*, and the

second isolate as a new species of *Perkinsus* based upon unique morphological and life cycle characteristics exhibited by the two isolates in culture. Dr. Ehab Elsayed, a visiting scientist at Dr. Faisal's lab, contributed to the efforts of adapting *Perkinsus* spp. to culture conditions.

The researchers then launched a series of investigations to further examine the biochemical, molecular, and ultrastructural characteristics of softshell clam *Perkinsus* species. Dr. Ben Tall, from the Food and Drug Administration, and Dr. Adel Shaheen, a visiting scientist at Dr. Faisal's lab conducted zoosporulation studies and described the ultrastructural details of zoospores.

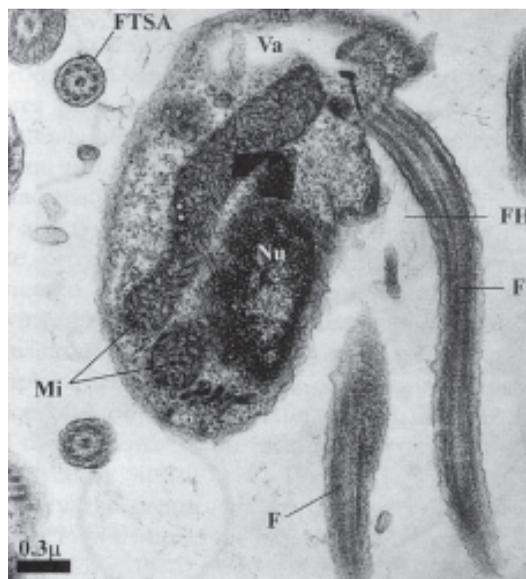
Dr. Shaban Kotob, a Research Assistant Professor at the Department of Environmental Sciences at VIMS and Dr. Peter Van Berkum, a senior scientist at the U.S. Department of Agriculture, joined forces to apply a molecular biology approach to the investigations using gene cloning and sequence analysis. "Molecular typing and phylogenetic analysis were required to provide the quantitative estimates of genetic relatedness of the two isolates to the genus *Perkinsus*," said Dr. Kotob.

Although researchers have found *Perkinsus marinus* (Dermo) in softshell clams, it is too early to say whether *Perkinsus chesapeaki* may be found in oysters. Dr. Mohamed Faisal emphasizes "These findings are

new and much more research must be done before we know the extent of the parasite's presence and whether the parasites are harmful to clams or other marine mollusks."

McLaughlin explains that in the early 1990s an increase in *Perkinsus* sp. infections was observed in softshell clams at some sites in the Chesapeake Bay following a series of extremely hot and dry summers. This paralleled increased infections in oysters during the same period. "The unique morphology of the parasites found in fixed tissues of some of the softshell clams led us to question whether clams were infected with the same parasite found in oysters or another unidentified species," said McLaughlin.

Perkinsus parasites may be found in bivalves worldwide in warmer coastal waters and are found in numerous bivalves without causing mortality. However, pathogenic species of *Perkinsus* have caused serious disease and mortality in other bivalves including the eastern oyster, blacklip abalone, Portuguese clams and cultured Japanese scallops. Dr. McLaughlin is currently investigating virulence factors of *Perkinsus* parasites and their potential role in pathogenicity. These investigations will be conducted in collaboration with Spanish researchers studying a similar parasite causing severe losses of commercial clams in Europe.



A zoospore of *Perkinsus chesapeaki*.

NMFS Faculty Position
Established at VIMS
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excellent opportunity for increased interaction in an area that is strategically located in the mid-Atlantic region. Additionally, NMFS scientists will be involved in the education of young scientists who need to be well prepared to deal with future problems and issues." Vecchione will continue his affiliation at VIMS and will teach a deep-sea biology class in the fall and invertebrate zoology in the spring. The deep-sea biology course will include a 2-week research cruise aboard a NOAA vessel.

According to Dr. John Graves, Chair, VIMS Dept. of Fisheries Science, "This appointment allows us to support additional students and offer

new classes to both graduate and undergraduate students. In addition, the CMER Program provides access to NOAA vessels for teaching and field work and increased opportunities for research funding." "The guidance and cooperation we receive from VIMS and NMFS will help our research program and student recruitment," said Dr. George Burbank, Head of Marine Science at Hampton University.

In addition to funding the faculty position, the program also provides annual funds for research in areas of specific interest to NMFS. These funds will support research for three to four students each year. Currently Bruce Collette and Tom Monroe and Mike Vecchione of the NMFS National Systematics Lab are adjunct faculty in VIMS' Department of Fisheries Science.

\$500,000 Challenge Grant

VIMS recently received a challenge grant of \$500,000 from the Massey Foundation to create an unrestricted endowment at VIMS. This challenge has been met by an anonymous donor with the expectation that we will raise an additional \$500,000 in the next five years for a total unrestricted endowment of \$1.5 million. A campaign to meet the endowment campaign match is underway. The income from this generous endowment will provide increased flexibility to fund cutting edge research and critical education needs and will benefit the entire VIMS community.

Researchers Discover New Pollutants Infiltrating Virginia Rivers

By Robert Hale and James Schultz

Historically, some chemicals that have performed as originally intended also have caused unforeseen problems when released into the environment. Polychlorinated biphenyls (PCBs) and dichloro diphenyl trichloroethane (DDT) are two such examples. VIMS researchers have recently discovered that another chemical with detrimental environmental properties—a widely used class of fire retardants known as brominated diphenyl ethers (BDEs)—have become dispersed throughout the Roanoke and Dan rivers, in south central Virginia.

The biological effects caused by BDEs are not immediately obvious to the eye, but interactions of these chemicals with cellular metabolism may lead to long-term damage to exposed organisms, including humans. Medical researchers suspect that BDEs may impair immune system responses, disrupt endocrine function and delay intellectual and physical development. BDEs are also of mounting concern in Europe, where Swedish researchers have recently reported that concentrations of BDEs in human breast milk have been

doubling every five years. Although overall levels remain low, the dramatic increase over time is alarming.

“Although we don’t yet know the full extent of their toxic effects, we do know that BDEs are persistent and that they can bioaccumulate to high levels,” says Dr. Robert Hale, associate professor in the Department of Environmental Sciences. “We’re finding that their environmental properties rival those of PCBs. BDEs persist in the field, accumulate in aquatic animals and exhibit similar modes of toxicity. They’re bad news—particularly since we continue to release them.”

PCBs were used as insulators or fire retardants in hydraulic fluids and electrical transformers. Although PCB manufacture was halted in the 1970s, the chemical, nevertheless, persists in measurable quantities in soil and water, and in the bodies of many fish and animal species worldwide, even in areas far removed from their original point of manufacture. Implicated as a cause of liver cancer in lab animals, PCBs may cause eye, skin and respiratory irritation in people in direct physical contact.

BDEs, on the other hand, continue to be widely used in the production of flame-resistant plastics, in the housings of personal computers and as a constituent of foam padding in seat cushions. Because BDEs have only recently been identified as an environmental threat, their release to the biosphere is not explicitly regulated by the federal government or the states.

The BDEs were detected by VIMS in the course of a study supported by and in collaboration with Virginia’s Department of Environmental Quality (DEQ), examining the extent of contamination in edible fish from state tributaries. After the discovery of the BDEs, the Commonwealth formed a task force consisting of DEQ, the Virginia Health Department, VIMS, and several other state and federal agencies to further investigate the extent of pollution throughout the Dan and Roanoke river watersheds.

The source of the BDEs and their route of entry to the rivers is currently uncertain. However, the polyurethane foam production process may be key. VIMS research has already shown that BDEs can be released to the atmo-

sphere from foam manufacturers’ exhaust stacks.

“Our data show that these BDEs have been widely released without anyone really noticing,” Hale says. “The BDEs detected to date are likely the top of the iceberg. Even if we found the source today and eliminated it, the chemicals already released will remain in the environment for years to come. And the longer they are used, the greater these levels will be.”

An article on VIMS’ BDE research was recently featured in the journal Environmental Science and Technology



Dr. Rob Hale and research team. Top row, L to R: Greg Mears, Dr. Rob Hale, and Mike Gaylor. Bottom row, L to R: Mark LaGuardia, Ellen Harvey, Matt Mainor, and Mara Jacobs.

Sea Scallop Research Resumed in June

By Sally Mills

Scientists in the Marine Advisory Program are gearing up for another season of sea scallop research in the Mid-Atlantic Closed Areas. This is a cooperative effort among VIMS, the National Marine Fisheries Service (NMFS), and commercial fishermen. A 15-day trip to the Hudson Canyon South site took place in June aboard the vessel, *Alice Amanda*, owned by Mark Shackelford of S&S Marine in Hampton, Virginia, and captained by Kenny Brown of Gloucester Point. Under the direction of Dr. William DuPaul, students and researchers are planning a second survey to the Virginia Beach site in August. The 2000 survey provided baseline information to help resource managers set harvest limits for scallops in these two areas, which are scheduled to re-open in March 2001.

Among other things, the data are used to estimate total biomass in each closed area, or an estimate of the number of pounds of scallop meats available for harvesting. That information directly impacts how the opening of an area will take place, including the length of the opening and the number of vessel trips allowed. Final decisions are made by the New England Fisheries Management Council with input from NMFS and the Sea Scallop Plan Development Team.

Researcher Dave Rudders has been part of the sea scallop research team for three years and has witnessed some refinements in the equipment used to conduct surveys. One advancement that is sure to help resource managers is the “inclinometer,” an instrument adapted from torpedoes. Its small sensor indicates when the dredge is in contact with the ocean bottom.



This 10-minute commercial survey tow yielded 30 baskets of 4-inch scallops.

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MARSH Project Will Help Save Tidal Wetlands

The Center for Coastal Resources Management (CCRM) initiated a new MARSH (Monitoring Active Replenishment of Subsiding Habitat) Project this spring. The project involves studying vegetation changes occurring on tidal marshes in the York River system and evaluating several management options that may mitigate these changes. The goal of the four-year study is to obtain information needed to develop the policy and management responses that can preserve these critical habitats. According to Dr. Carl Hershner, Director of the CCRM, "The MARSH Project represents a unique opportunity to work towards preserving a valuable, fairly pristine wetland, rather than restoring a lost marsh or fixing a degraded wetland as is usually done."

Tidal wetlands are an important natural resource that provide habitat for a variety of species, protect shorelines from erosion, and help improve water quality by trapping pollutants and sediments. Recent changes noticed in the plant communities of Chesapeake Bay area marshes have alarmed many scientists and residents. These cases show an increasing dominance of the plants typically found at the lowest and wettest parts of tidal marshes, which is believed to indicate that the marshes are being inundated with water and

slowly sinking away. The MARSH Project seeks to document the relationship between marsh surface elevation and the composition of its plant community, and then to evaluate the potential for controlling the marsh vegetation by raising the level of the marsh surface.

When sea levels rise, most marshes can match the encroaching waters by growing vertically as sediment and plant material accumulate on the marsh surface. However, over the past several decades there has been a documented acceleration of the rate of sea level rise in Mid-Atlantic coastal regions. "We have certainly altered the amount of sediment in coastal waters and taken over many areas of shoreline that wetlands would normally invade," says Hershner. It is assumed that these and other factors are preventing some wetlands from accreting enough material to maintain themselves. "The MARSH Project will explore methods to allow the marshes to keep pace with a relative rise in sea level," explains Dr. Kirk Havens, Assistant Director of the CCRM.

Experimental studies will be conducted at Lee, Sweet Hall, Cousiac and Hill marshes in the Pamunkey River, where VIMS has conducted wetland studies for the past 30 years. One of the most promising methods for



Dr. Kirk Havens (l) and Dr. Gene Silberhorn (r) studying vegetative communities in the area of the experimental MARSH Project.

raising the marsh surface is spray dredging. In this procedure, material dredged from the river bottom will be sprayed in thin layers onto the surface of study areas in the marshes. If the vegetation can be successfully managed by adding material to the surface of the marsh, spray dredging could be a beneficial use for the matter dredged up during navigation channel maintenance.

The MARSH Project has been funded for its first year by the owners of the study marshes themselves, demonstrating the cooperative nature that has characterized this project so far. VIMS is seeking additional funding for this unique endeavor which is joining scientists and landowners in the effort to save our wetlands.

Virginia's Changing Coastal Community - Indicators of Change

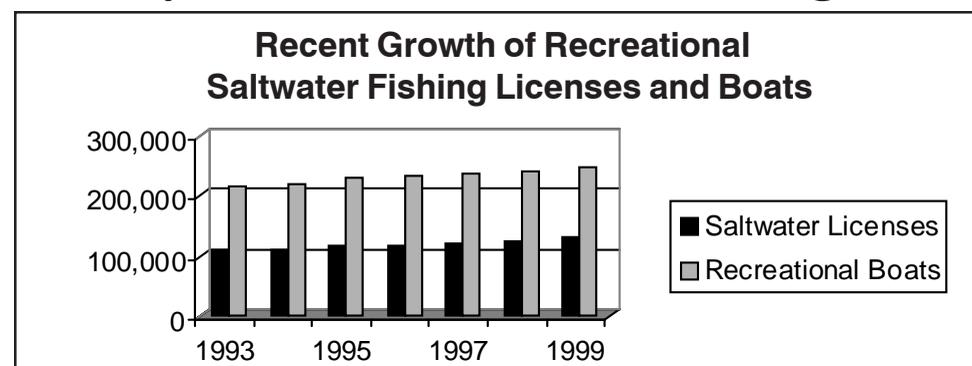
By Tom Murray

With this issue of *The Crest*, we will begin to chronicle trends in the current use of the Chesapeake Bay's resources by its diverse marine-related industries. By documenting selected indicators of the vibrant pace of expansion, contraction, and overall change, which has been the hallmark of the 20th century, we can gain some insight into the path our marine-related community is following as the next century on the Bay unfolds.

As the "Discovery," the "God-speed," and the "Susan Constant" headed up the James River in 1607 they could not have realized how important a part the surrounding waters would play in the history and economy of Virginia. Growth has not come without displacement, and the competition for use of the commons will grow along with the people who look to it for food and fun and industry and wonder.

Population, and in particular, coastal population, is growing rapidly in Virginia. Overall, the last century saw more change in the region than the previous 300 years combined.

According to the U.S. Bureau of the Census, during the period 1995-2000 Virginia ranked 10th



among all states in largest net population growth. The graphic above further projects Census estimates through the first quarter of this century. Relative to the rest of the nation, Virginia is expected to grow in population by 28% and place 8th in largest net population growth.

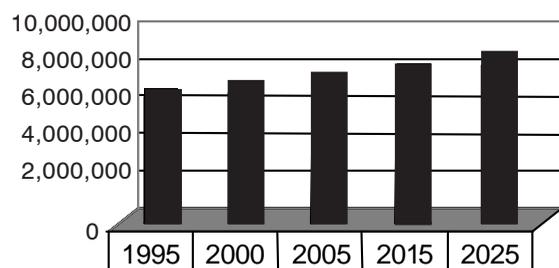
During the next decade, population growth and per capita income increases will continue to increase demand for recreational activity, as federal and state statistics regarding participation in saltwater angling and

private boat ownership in Virginia indicate.

The activity of private boat anglers is of critical importance in the Commonwealth. It is estimated that two-thirds of the total economic activity associated with recreational saltwater angling in Virginia is contributed by private boat anglers.¹

A brief review of the trends in Virginia's population and boat ownership shows a citizenry who owns more boats per capita. For example, prior

Virginia Population 1995-2025



Year	1995	2000	2005	2015	2025
Population	6,618	6,997	7,324	7,921	8,466

New Pound-Net Design Spares Young Fish

By James Schultz

Within the last decade, balancing the competing interests of fisheries conservation, strong consumer desire for fresh fish, and a proud tradition of fishing for profit and pleasure has become increasingly difficult. VIMS graduate student Christian Hager, a licensed commercial fisherman, may have found part of the solution.

In two studies underwritten by the Potomac River Fisheries Commission (PRFC), Hager has shown that an inexpensive modification to traditional pound nets can, under optimal conditions, permit the escape of more than 80 percent of small fishes that by law cannot be retained for sale. Traditionally such juveniles are thrown back in the water—supposedly without damage. In fact, most die from the trauma of physical handling and/or oxygen deprivation. This “bycatch” is a continuing problem because it kills fish before they can provide a return to the fishery and before they can reproduce.

Hager’s innovation involves the addition of rings and slots to traditional netting. Field tests were used to determine optimal sizes for both mechanisms. Sub-legal flat fish, such as flounder, are able to slip through the slots, while cylinder-like finfish, such as trout, escape through the rings. Larger,



Commercial fisherman David Bradley and his son Bill with Chris Hager, raising “pocket” to harvest fish from pound net.

legal fishes cannot fit through either opening and are thus retained for harvest.

“Allowing sub-legal fishes to exit a pound net before it’s fished eliminates all the stresses associated with handling. Released fishes are completely healthy,” Hager says. “This new approach works without any effort expended by the fisherman. Over time, fishermen will actually catch more legal fish with less effort, and the

fisheries will realize a greater yield-per-recruit due to the reduction in juvenile mortality. These modifications work. Everybody’s happy.”

Pound nets are staked seasonally in shallow estuarine areas to capture fish as they migrate in and out of river systems. The basic concept behind the nets’ design pre-dates European arrival in North America and takes advantage of fishes’ tendency to funnel, or travel in one direction along boundary edges.

Once inside a series of three interconnected enclosures, fish are trapped, and few can find the narrow openings by which they entered the trap.

“It’s essential that we begin to deal with the negative impacts of bycatch on the fisheries,” says Hager. “We have to figure out ways to avoid killing the juveniles before they can contribute to their species’ reproductive effort. If fishing methods don’t allow for pre-mortality culling of sub-legal bycatch, then legal restrictions on size limits accomplish nothing.”

Hager’s new pound-net modifications are slated to be adopted in the Potomac River by the end of 2001. The PRFC will modify one net free of charge for each fisherman, placing two panels consisting of 1 7/8” rings and 7/8” x 5” slots at right angles to one another in each corner. Eventually, he hopes that fishermen throughout the Chesapeake Bay watershed—including those involved in the haul-seine fishery—might be persuaded to give the bycatch-reduction devices a try.

“Looking down the road, if this design is universally adopted, it will assist in the recovery of stocks that have been seriously depleted,” Hager says. “Reduce juvenile mortality and, as the fisheries rebound, you’ll see greater sustainable yields.”

CBNERRVA Teams with New England Aquarium for the 1st of Five “Coastal Science for Lawyers” Pilot Workshops

A glorious spring day at the New England Aquarium (NEAq) in Boston was the setting for the premier of the NERR Coastal Science for Lawyers workshops. Fifty-four law students and practitioners from the Boston area attended the “crash course” in basic coastal science. Law students from Harvard University, Northeastern University, Boston University, Boston College and Suffolk University Law Schools along with lawyers from the Massachusetts Department of Environmental Quality were represented in the audience for the program.

The “Science for Lawyers” workshops were developed by Dr. David Niebuhr, education coordinator for CBNERRVA, VIMS graduate

and assistant research professor of education at the College of William and Mary in conjunction with Lynda Butler, professor of law at the William and Mary School of Law. The project is supported through a grant from NOAA to CBNERRVA and the College’s Environmental Science and Policy Cluster (ESPC).

Participants were treated to a variety of speakers who conveyed a sense of the vast amount of information required for them to make “informed decisions” about environmental issues. Along with Dr. Niebuhr, speakers included Dr. Gerry Schubel, coastal scientist and CEO of the NEAq; Dr. Scott Kraus who spoke about international regulations and right

Juli Harding Honored

Juli Harding, Ph.D. was awarded the first Thatcher Award at the College of William and Mary commencement ceremony on Sunday, May 13, 2000. The Thatcher Award was established to recognize excellence in graduate and



professional study. While earning her Ph.D., Juli published 12 papers as first author and was co-founder of the Virginia Oyster Reef Teaching Experience for science educators. She also served as the co-principal investigator for the Veined Rapa Whelk Project since the non-native whelk was found in Chesapeake Bay in 1998. Through her performance, Juli has set a high standard for future recipients of this prestigious award and honored her School and her discipline.

whale research; Dr. Michael Tlusty addressed the clash of politics and science in aquaculture development; Ms. Britt Anderson, J.D. (assistant director of the ESPC) who presented a discussion on the role of the “public trust doctrine” in environmental legislation; and Dr. Michael Connor who gave two presentations on water quality issues and on environmental risk assessment and the scientific method.

This project will continue through this coming September, when four additional pilot workshops will be held throughout the country. Tentative plans have been made to offer workshops in Seattle, Baltimore, Raleigh and Williamsburg. For additional information on the “Coastal Science for Lawyers” please contact Dr. David H. Niebuhr, Education Coordinator, CBNERRVA at 804-684-7144.



NOAA Officials Visit Reserve Site

NOAA officials recently visited with VIMS Scientist and Research Coordinator for the Chesapeake Bay National Estuarine Research Reserve - VA, Dr. William Reay for an overview of current research. Some of the research highlighted during their visit included activities conducted by the VIMS Seagrass Restoration Program, essential fish habitat research examining the importance of intertidal habitats to commercial and ecologically important fin and shellfish, characterization of resident and transient fauna associated with constructed oyster reef habitats, and the NERRS system-wide water quality and meteorological monitoring program.

Scott Gudes, Deputy Under Secretary for NOAA, Captain Ted Lillestolen, Deputy Assistant Administrator for National Ocean Service also visited the Godwin Islands Reserve site while on campus. Virginia Delegate Harvey Morgan and his wife Helen Morgan joined the group. Delegate Morgan was the primary sponsor of a

1999 bill creating the Virginia Estuarine and Coastal Research Reserve System, which when combined with the national system, enhances the Commonwealth's ability to conduct research and education activities to support coastal resource management efforts.

By providing a long-term protected research site and supporting monitoring data, Reserve sites become a focus area for research and education activities for both VIMS and other universities/institutes. CBNERRVA currently has 5 institutes conducting research within the Virginia system. A case in point is CBNERRVA's involvement with Hampton University (HU) graduate and undergraduate environmental studies. Masters student Erica Holliman along with her faculty advisor Dr. Debbie Bodolus are currently involved in a project looking at the effects of urbanization on fish utilizing intertidal wetland habitats. Holliman is using the Goodwin Islands component of CBNERRVA as a pristine reference



Visitors discussed current research at the Goodwin Islands Reserve site. (l) to (r) Dr. Debbie Bodolus, Hampton University; Capt. Ted Lillestolen, National Ocean Service; Delegate Harvey Morgan; Sec. Scott Gudes, NOAA; and Dr. William Reay of VIMS.

site for her investigation. Eric Wooden, CBNERRVA Monitoring Coordinator, and an alumnus of both HU and VIMS, has been instrumental in developing a working relationship with Hampton University. This program exposes HU students to the National Estuarine

Research Reserve System (NERRS) program and research opportunities in estuarine environments. NERRS is a network of protected areas established to promote informed resource management through research and education activities.



VIMS Scientist Studies Oysters in India

As part of the ongoing research investigating the risk, feasibility and potential associated with use of a non-native oyster species in Virginia's estuarine and marine waters, Dr. Francis O'Beirn, of VIMS Eastern Shore Laboratory, recently visited a number of locations in India. Why India? India is purported to be within the natural range of the Suminoe oyster, *Crassostrea ariakensis*, one of the species VIMS scientists have been evaluating for several years. Unlike other locations within the range of this oyster, the populations within India (primarily located on the west and northwest coasts) have up to now

remained relatively undisturbed from fishing, aquaculture and pollution pressures. Therefore, they retain much of their natural state from an ecological and a natural history perspective.

O'Beirn's travels took him from the southeast coast of India (Tutticorin) along the west coast (Cochin and Goa) to the northwest province of Gujarat. By also visiting areas outside the range of *C. ariakensis* O'Beirn had the opportunity to acquire tissue samples of other oyster species and to evaluate the environment and species interactions within these ecosystems.

At each location, O'Beirn evaluated the overall habitat including

temperature and salinity regimes. He also studied the location of oysters (intertidal vs. subtidal, or both), structure of oyster beds, organisms associated with the beds, interactions between oyster species, predatory species and disease causing organisms. Of particular interest was the degree of fishing pressure and other anthropogenic influences. Tissue



A shore based fishery primarily for smaller intertidal oysters, harvests the meats directly from the substrates.



The oyster fishery is rudimentary and low tech. Fishermen use cane poles to locate oysters on the river bottom and then imbed the pole in the bottom and dive down along it to retrieve oysters which are then thrown into the canoe.

samples of all oyster species were taken for genetic analysis to verify species identification.

Genetic probes, developed by Dr. Kim Reece at VIMS, will also be used to facilitate the identification of some parasitic disease causing organisms, such as *Perkinsus marinus* or Dermo that has devastated native oyster populations. "Identifying potential disease causing organisms is an important aspect of this research and will have major implications when decisions are made regarding use of

non-native oyster species," said O'Beirn.

It is hoped the information generated by this trip will aid in the decision-making process regarding use of a non-native oyster species in the Chesapeake Bay. "An added benefit of my trip" said Dr. O'Beirn, "has been the increased probability for future collaborative efforts with Indian institutions, in particular the Suganthi Devadason Marine Research Institute in Tutticorin, Tamil Nadu and Gujarat Agricultural University."

American Shad Focus of Unique Study

By James Schultz

A highly migratory fish like the American shad doesn't remain in one place too long. This behavior has made it difficult for researchers to determine the kind of environments shad prefer as nursery areas for their young.

Exactly what kind of habitats shad prefer is the subject of a three-year study conducted by VIMS Ph.D. candidate Donna Marie Bilkovic. Reproductive vitality is of particular concern because shad populations have been on a slow but steady decline for more than 100 years. Although recent surveys indicate that shad levels in the York and Rappahannock rivers have stabilized, apparently due to a fishing moratorium, questions remain about the shad's long-term prospects.

Beginning in spring 1997, Bilkovic, colleagues and volunteers collected shad eggs and larvae from the Mattaponi and Pamunkey rivers—relatively pristine tributaries whose prevalence of shad, while low by historical standards, is at the highest level of other Virginia estuaries—in order to map the shad's use of the rivers as spawning and nursery grounds. Bilkovic is now in the process of developing a habitat-suitability index, based on shad egg and



Ph.D. student Donna Bilkovic collecting shad eggs and larvae.

larval distribution, and incorporating within the index computerized data on river flow, current, geographies and patterns of land use.

"Although these fish have been under moratorium for years, the populations are still low," Bilkovic says. "Obviously, traditional fisheries management hasn't been completely effective. We're trying to figure out what habitat is essential if this population is to expand."

Initial findings indicate that shallow, fast-current areas with high levels of dissolved oxygen seem to be ideal spawning spots. Consistently fewer shad eggs were found in deep, sluggish water. Topographic features above and below the waterline also seem to play an important role. Preliminary analysis indicates an abundance of

eggs in reaches of sandy sediments and gravels, wide and shallow sandbars, and extensive falls of dead trees and branches.

"What we're doing is picking apart the shad's life cycle and looking at critical stages," says Bilkovic's faculty advisor Carl Hershner, director of the VIMS Center for Coastal Resources Management. "Everybody acknowledges that if we're going to be successful in managing the fishery, we're

going to need to be effective in protecting habitat. It's not merely a matter of throwing a fence around tidal rivers and not messing them up anymore. It's a matter of figuring out what conditions enable the fisheries to survive and thrive."

Hershner says that Bilkovic's investigation, co-funded by the American Fisheries Society and VIMS, is the first of its kind to be conducted in Virginia and is notable for its acknowledgment of ecosystem complexity. Boosting shad populations will not simply be a matter of isolating one key variable and then modifying that variable to change the existing equation. Rather, the entirety of the complex interactions of a complete ecosystem must be accounted for and integrated within models to encourage a holistic approach to resource management.

"It's a brand new approach to the issue," Hershner says. "You have to go in with a basic concept and be willing to change on the basis of your findings. We know more about the American shad than when we started. Now we're learning new ways to make shad-habitat management much more effective."

Cobia
continued from page 1

providing information on handling and holding cobia in captivity.

Using funding from a National Sea Grant aquaculture initiative grant, personnel from the VIMS finfish aquaculture program arranged for the capture of broodstock fish by recreational cobia fishermen and transferred the fish to holding facilities at the VIMS Gloucester Point campus.

Once at VIMS, the fish were administered a hormonal implant to stimulate the release of eggs and sperm, and were placed in a 7,500 gallon recirculating water system equipped with filtration units and egg collection devices. Within 48-hours of the hormonal implants, the six female cobia (several weighing close to 50 pounds) and three male cobia began spawning.

"We collected fertilized eggs on June 15, and on June 16 the fish were still producing eggs. Literally, the fish have produced millions of eggs," Oesterling explained. "The eggs were

then taken to our larval culture facility for hatching and further on-growth."

The overall goal of the cobia culture project is to produce juvenile fish and investigate the requirements for commercial culture. Additionally, vital life history information will be obtained during the larval and early juvenile stages of the cobia. As the young cobia grow, they will be the subject of different growth studies aimed at providing valuable information for the continued culture of cobia.



Marine Scientist Jeff Tullock and Aquaculture Specialist Mike Oesterling examine cobia eggs in VIMS' Marine Finfish Facility.

VIMS Annual Fund Board Named

Great news from the Development Office! VIMS' very first Annual Fund Board of Directors is hard at work. Charter members of this Board are John Dayton (chairman), Hallieford; Weston Conley, Morattico; Carrie Garland, Arlington; George Grant, Gloucester Point; Wade Hayhurst, Kilmarnock; Peter McHugh, Hampton; Jackie Partin, Gloucester; Austin Roberts, Kilmarnock; Jack O'Shaughnessy, White Stone; and Virginia Lascara, Yorktown.

This group will focus on community outreach and expanding unrestricted gifts to VIMS.

From the Coleman Bridge to Menai Bridge

VIMS Professor Leads Field-Course in Wales

By Roger Mann and
Consuela Goldman

During spring semester, seven VIMS students had an opportunity to study a Northern European coastal system with rocky shores, large tides, and a maritime climate. Supported by VIMS, the intensive field study course was developed and led by Dr. Roger Mann, Dept. of Fisheries Science. "Our students are primarily familiar with the mid-Atlantic estuarine system bordering the mid-Atlantic shelf, with a continental climate, large watersheds, and small tides. I wanted to expose them to a system that is vastly different. Besides, being a University of Wales alumnus, this was like going home to a new profession, teaching where I used to be a student," said Mann. This was also the first major exchange between VIMS and the School of Ocean Science at the University of Wales, Bangor since the two universities established a formal collaborative agreement.

The final miles of the trip to Menai Bridge took the travelers through the Snowdonia mountain range. Passing through the Ogwen Valley at about 1000 feet above sea level, between the snow topped mountains of the Glyders (over 3000 ft) and the Carneddys (over 3400 ft), and the mountain lake of Llyn Ogwen they passed through some of the oldest exposed rock on earth—quite a change from the Chesapeake region!

The long trip ended with a short passage over the Menai Straits into the

village of Menai Bridge - the home the School of Marine Science of the University of Wales. In best style the travelers stayed at the Liverpool Arms, the oldest hotel and eating and drinking establishment in Menai Bridge. Here everyone was treated to typical Welsh hospitality and huge breakfasts and dinners. Culinary delights included fried breakfasts, black pudding, gammon steaks, kippers, fish and chips and more. As student Lawrence Carpenter commented. "It was a combination of a cultural and scientific experience."

After visiting the Menai Bridge lab, the students spent the afternoon in the rocky intertidal in the Menai Straits. This tidal excursion is over 6-meters (18 feet) on spring tide, and current velocities through the narrow sections of the Straits exceed 6-knots at certain stages of the tide. There is classic vertical zonation of macrophyte algae from short *Pelvetia* in the splash zone to broad Laminarians over 2- meters long at low spring tide. Each macrophyte zone harbors its own arrays of associated organisms.

Another field trip included a drive over the Welsh mountains, through snow on top of Llanberis Pass, and down to Harlech on the Irish Sea Coast. Harlech is famous for its castle, built in the 13th century on an outcrop of late Cambrian rock that extends almost to the sea edge. The original castle had, on its seaside, the "sea gate" to allow access to the castle by ships. That sea gate is now several



VIMS crew on mud flats after cockle survey.

hundred meters from the high tide line and separated by lines of dunes. The battlements of Harlech castle provide a splendid classroom from which to lecture on dune formation over human history!

South of Harlech is another environment that is novel to visitors from the mid Atlantic. After crossing a causeway (that is submerged at high tide) the class visited a cobble beach. Cobble is actually boulders from local erosion, that cover the beach from high to low tide, about 50 meters of exposure. A wealth of tide pool organisms shelter below the cobble, while the wind insures that sand does not accumulate when the tide goes out. In fact the wind dries the surface of the sand, blows away the dried surface and deposits it as a graded size fraction at the base of the dunes shoreward of the cobble. The class also visited the Mawddach estuary to the south of Harlech to view the classic longshore spit formation at the mouth of the estuary.

We visited Caernarfon Castle on the south side of the western end of the Menai Straits. The Kings Tower of Caernarfon Castle provided a superb, if somewhat cramped classroom with a northward view across the Menai Straits. The focus of our attention was a very large intertidal mud and sand flat named Newborough Warren, which we visited with a undergraduate class from Marine Sciences at Menai Bridge. The intertidal at Newborough Warren extends out over nearly a kilometer at low tide from the fringing salt marsh. It was quite a walk out to the site. VIMS student Janet

Nestlerode noted, "We passed through sand dunes, passing horses and cows to the mudflat - which was quite extensive—probably another kilometer to the water's edge." At first glance the intertidal appears quite barren, especially after the rocky shore community, but it is in fact a natural laboratory where the results of predation are well documented. Together with students from Menai Bridge, the class sampled cockles (a small clam similar to the hard clam of the Chesapeake Bay) from the high to the low tide line. Near the high tide mark bird predation results in only marginal numbers of clams. At mid tide level, over 300 meters away, clams are exposed for a shorter period, bird predation is less and all size classes are present. At low tide (at least another 300 meters walking) only large clams are present, and then in small numbers. Crab predation near low tide keeps numbers low, and those that survive do so by reaching a refuge size from the local predator.

The final field day began with a trip to Cwm Idwal in the mountains. Darwin visited this site, with its exposed rock striation, before his voyage on the Beagle, and the experience is thought to have helped him formulate some of his early thoughts on evolution over geological time. Cwm Idwal has a classic oligotrophic lake which flows over the terminal moraine and down the Ogwen Valley to the northern end of the Menai Straits only 25 kilometers away. Standing on the terminal moraine we could see from the snow



Dr. Roger Mann in intertidal zone showing students broad leaf Laminarians, a type of seaweed.

Continued on next page

New Experimental Design Course for Teachers

By Susan Haynes

The VIMS Educational Policy Committee is pleased to announce the recent establishment of a new catalog course designed to increase the instructional and outreach capabilities of the School of Marine Science. The course, MS 548 Technical and Continuing Education in Marine Science, will provide graduate-level instruction to public school teachers and other professionals who require postgraduate certification or special training. By providing a mechanism for individual SMS faculty to make significant instructional contributions to the community, this new offering expands the mission of the SMS beyond the present scope of our traditional graduate school program.

MS 548 will function as a topics/problems course in that individual faculty or teams of faculty will formulate a course description, identify a client group, seek department approval and then EPC approval. The first approved offering has been developed by Dr. John Graves of the Fisheries Science Department and Ms. Susan Haynes of the Sea Grant Marine Advisory Program. Participating faculty are Dr. John Brubaker, Dr. Elizabeth Canuel, Dr. Emmett Duffy, Dr. Mark Patterson and Dr. Peter Van Veld.

MS 548-01 Experimental Design in the Marine Science Laboratory

Through lectures and hands-on laboratory sessions, a faculty team will

guide teachers to develop innovative techniques for advancing middle and high school student learning and problem solving skills. Emphasis will be on quality experimental design. Perspectives from five different marine science research programs will be represented. Significant background information and demonstration materials will be provided.

Offered biweekly on Wednesday evenings during the fall semester, each class will be composed of a three hour combined lecture/laboratory session.

Class size is set at 20 to maximize access and interaction between scientists and participants in a laboratory environment.

This course specifically addresses the Standards of Learning for Virginia's Public Schools in Earth Science, stressing the interpretation of maps, charts, tables and profiles; the use of technology to collect, analyze, and report data; and science skills in systematic investigation.

Additionally, the course focuses on the .1 standard for each discipline of

Virginia's high school standards of learning under which students plan, understand and conduct scientific investigations. Various content objectives within each discipline will also be covered.

This course is supported through a generous grant from the Chesapeake Bay Restoration Fund and the Virginia Recreational Fishing Development Fund.

VIMS is pleased to be able to offer this exciting educational opportunity to the community.



Auditorium Named For Former Director

The VIMS auditorium has been named in honor of Dr. J. L. McHugh, VIMS director from 1951-1959.



Dr. J. L. "Laurie" McHugh on VIMS campus pier in the late 1950's.

A native of western Canada, McHugh brought a new perspective to research at the laboratory. One of the most exciting was the careful exploration of the lower James River's unique water properties, yielding new concepts of a two-layered estuarine circulation, and relationships between currents and the movement of oyster larvae. The resulting reports and papers have come to be regarded as classics in estuarine science. During his tenure as director, increasing

attention was directed at oyster mortality in the Bay with growing emphasis on a fungus as the cause. The scientific staff was increased by three scientists and a consulting biologist. Special research on sport fisheries was instituted and plans were drawn up for a new research vessel, the *R/V Pathfinder*, and a 7,618 sq. ft. annex, Brooke Hall, to provide classroom, office and laboratory space. Efforts to engage the public and especially local students in marine science were also underway. A 12-part series, *Watery Worlds*, appeared in the Daily Press and 15 public education television segments were produced. The McHugh years were active and set the tone for many of the programs and activities carried on today at VIMS.

Menai Bridge

continued from previous page

caps of the mountains and down a complete watershed (which includes classic glacial hanging valleys) to the intertidal - all in one vista. "We hiked the whole watershed in one day. Imagine doing that around here," said student Mindy Gensler at the end of the day.

From Cwm Idwal we drove across the Menai Straits and to the North West point of the island of Anglesey. Our next field site was the sea cliffs of Craig Gogarth, to be viewed from the light house at South Stack. The 400 steps down from the cliff top to the suspension bridge across to South Stack Island induced a little vertigo in some party members, but all survived to view the sea birds on the vertical

world of the cliffs, approaching 80 meters high in places.

The trip continued with one final field site. Treaddur Bay is a rocky embayment exposed to the full force of the Irish Sea tides and waves. Like the Menai Straits it has classical macrophyte zonation, but all the plants in the mid-tide levels are only a few centimeters long, as opposed to a meter or so in the Menai Straits. The wave energy at Treaddur bay is so high that only short plants survive.

We continue to build on the collaborative program between VIMS and Marine Science at Menai Bridge. As part of the program four Welsh Masters students are spending several weeks at VIMS this summer. The Drapers Company of England has provided support for this collaboration, which has proven to be beneficial to research, students and faculty.

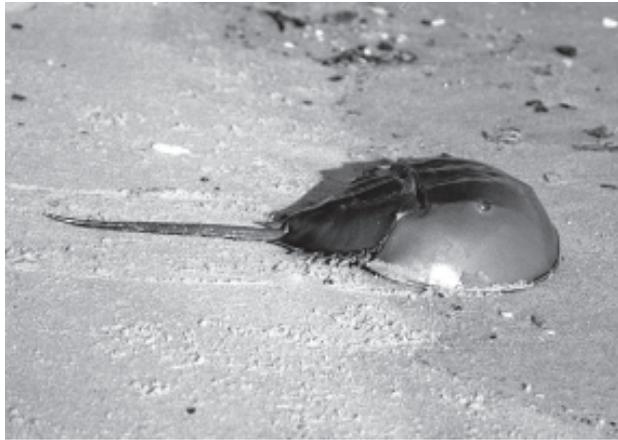


Chris Richardson (r), professor from Menai Bridge, with VIMS students during cockle survey.

Horseshoe Crab Research is Timely

By Sally Mills

A new study underway in the Marine Advisory Program is looking at ways to reduce impacts to the horseshoe crab - a preferred bait in wide-spread use among conch pot fishers. According to marine advisory specialist Bob Fisher, "It is widely known that the horseshoe crab population is down. This research hopefully will yield a conservation approach that will reduce human impacts on that population."



The research began in December 1999 aboard a 45-ft. commercial conch-potting vessel equipped with a hydraulic pot-puller. The traps used were traditional wooden traps currently used by commercial fishermen. The study was conducted 35 miles off Cape Henry, Virginia, in 24.4 to 30.4 m of water. From geological maps, the bottom type is considered to be fine to medium sand. Traps were set in lines running north to south along the continental shelf.

Testing consisted of alternating control traps with treatment traps within various lines. Each line fished between 50-55 traps spaced approximately 215 feet apart.

Preliminary results from the Cape Henry study using 350 pots indicate no significant difference in catch between using a whole female or two whole males (which is standard commercial practice) versus a half-female or two halves of male crabs per bag. Results from other resource areas in Virginia are currently being evaluated to explore the potential of reducing the amount of bait used to one-third or one-fourth of a horseshoe crab per pot.



Virginia's Changing Coastal Community - Indicators of Change continued from page 4

research indicated that over the period from 1973 to 1980, boat ownership in the Commonwealth grew more rapidly than population — rising from 1 boat for every 43 citizens in 1973 to 1 for every 38 in 1980. The most recently available 1999 information indicates a boat registration to population ratio of 1 registered per every 34 citizens.²

Virginia's pleasure boat market reportedly recorded its best advance in over a decade during 1999. Industry and government consensus estimates indicate that boat-related retail sales were up 20% last year nationwide. According to the industry, new boating

participants entering the market and established boaters "trading up" fueled this growth. The increased spending in the boating market is tied to the eight-year-long general economic expansion and financial benefits accruing to those in the boat owning demographic profile. According to the Fifth District Federal Reserve, during 1999 all manner of economic measures in Virginia gained, including personal incomes, commercial bank deposits, residential building permits, and commercial and industrial lending. While the last quarter of the year reflected some slow-down in growth, by any measure the marine

Students Teaching Students

Thanks to the Virginia Power Scholarship Fund, VIMS/SMS graduate students will soon hone their teaching skills while providing essential training to their fellow students. Four graduate students with exceptional knowledge of computer software and technologies won the Virginia Power Teaching Scholarships this year. They will apply their skills to teach courses this spring and summer on web site design, Visual Basic, computer-aided statistics, and geographic information systems.

Jennifer Rhode and Alessandra Sagasti shared their knowledge of computer programs for scientific data analysis in a one-week course in May. Also in May, Katie Farnsworth taught students to apply computer tools for visualizing spatial data. Such geographical information systems are

quickly becoming essential tools for coastal resource management. Paul Liu will teach two courses this summer. One will enhance student's skills in visual Basic programming and the second will provide much needed training in Web site design.

Support for these Teaching Scholarship Awards is provided by Virginia Power and is intended to foster teaching excellence of outstanding students while simultaneously providing essential training to students that would otherwise not be available from SMS graduate offerings. Awarded for the first time this year, the Virginia Power Teaching Scholarships will be conferred annually to deserving students who have identified an instructional need and possess the credentials to provide training in that area.



Ph.D. student Paul Liu teaching a summer course for SMS students.

recreational business *surged* into the new century.

Future issues of *The Crest* will explore the often challenging transitions in public access and use of the state's marine resources as well as their relationship to Virginia's goals of sustainable use of our valuable resource—the Chesapeake Bay.

Hopefully, the information summarized here will be useful in stimulating further discussion of Virginia's changing coastal communities.



¹ Source: U.S. Bureau of the Census, PPL-47, and Table 1.

² Saltwater License Data represents sales by the Virginia Department of Game and Inland Fisheries and none of the data includes VMRC "Non-Commercial Licenses" for charter boats, piers and rental boats or saltwater recreational crab licenses, or "Food Fish" licenses.

³ "Saltwater Angling and its Economic Importance to Virginia." VIMS SRAMSOE NO.339 1997.

⁴ "Recreational Boating in Virginia." VIMS SRAMSOE No. 251 1981.

Web Notes

VIMS's web site is a great source of information for everyone. New links are continuously being added and several new and beneficial changes are being made this summer. The most recent are a VIMS alumni page and the VIMS Gift Shop Online.

The new VIMS Alumni page will be posted by mid-summer and will offer opportunities for alumni to remain active in the VIMS community. One link will be called "Stay Connected," which will provide an easy and convenient way to find or stay in touch with colleagues. Alumni can post their information and any updates they would like to share. There will also be links that will provide a calendar of events, *The Crest*, and a site about our Alumni mentoring program. A large portion of the web site will be devoted

to the "Scholarships and Giving OnLine" link which donations can be made to several different scholarships and programs.

Need to do fast and convenient gift shopping? The VIMS Gift Shop online will make this possible at the end of the summer. This link will provide pictures and descriptions of all products available. For now orders will have to be phoned in to the VIMS Gift Shop, eventually it will be a secure site, and credit card orders will be possible.

The VIMS web site is continuously evolving. Keep up to date by making it one of your most frequently used bookmarks. If you have questions, comments or additions contact the webmaster at the home page at: www.vims.edu.

Award Winning Bridge Website Receives Renewed Funding from National Oceanographic Partnership Program

VIMS/Virginia Sea Grant educators Lee Larkin and Vicki Clark were recently awarded a \$337,930 grant from the National Oceanographic Partnership Program for continued support for the award-winning Bridge website (<http://www.marine-ed.org/>). The Bridge is a nationally-recognized online clearinghouse for K-12 ocean science educa-

tion materials. The grant will be used to maintain and expand the website with an increased focus on developing classroom activities using current ocean science data. Webkeeper Lisa Ayers Lawrence said, "Since the site opened in August 1998, the BRIDGE has had more than 1,250,000 hits from 88 countries."



VIMS Council members visit Woods Hole Oceanographic Institute May 2-3. (L-R) Ed Holland, Case Whittemore, VIMS Director of Development Page Hayhurst, Arthur Bryant, Kathleen Bennett, VIMS faculty member and tour guide Carl Friedrichs, WHOI Reunhart Coastal Research Center Director Rocky Geyer, and Carroll Owens.

Third Master Oyster Gardeners Training Course Held

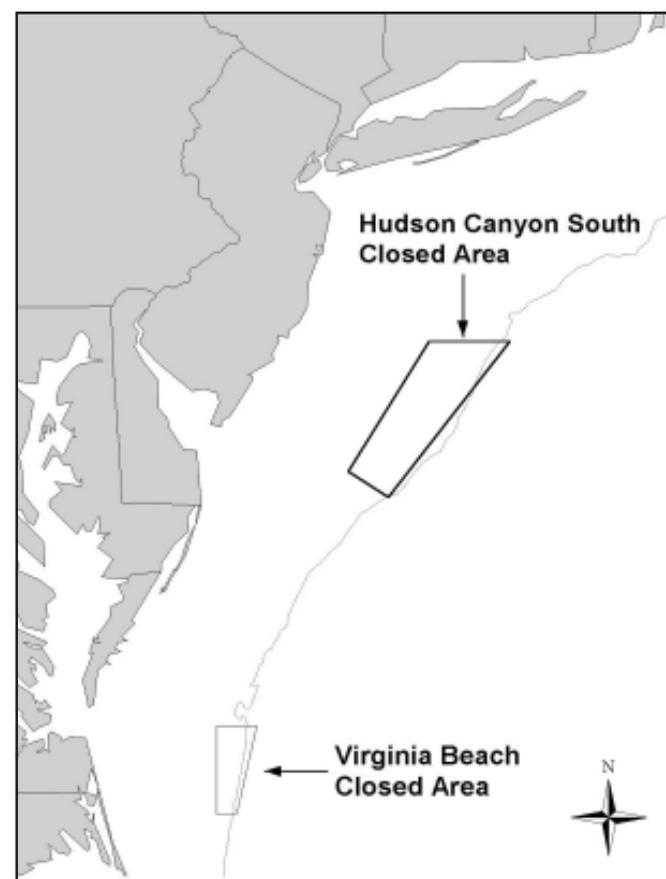
Fifteen participants completed the third annual Master Oyster Gardeners Training in June. This intensive 4-day course provides gardeners with in depth information on the biology, diseases and predators, current research and projects directly related to

restoring oysters in the Bay. VIMS faculty provide instruction. Those completing the course are available as a resource to other gardeners in their community. Currently there are over 2,000 gardeners in Virginia.

Sea Scallop Research continued from page 3

By synchronizing its output with GPS location data, one is able to more closely identify the length and area of the dredge tow path. The result is a more accurate assessment of dredge efficiency, which is critical in calculating an estimate of biomass. "Typically," said Dave, "many variables can affect the efficiency of the dredge. Weather, the type of bottom being dredged, and the skills of the vessel captain are prime examples."

Similar survey work was recently completed in three closed areas of the Georges Bank off the New England coast. As a result of those efforts, a decision was made by NMFS to open Closed Area II last June for a period of five months. During that time, over six million pounds of scallops were harvested. Area II is scheduled for re-opening again this summer along with two other areas, Area I and Nantucket Lightship, with the potential to harvest over 16



Map shows the two mid-Atlantic areas closed to sea scallop commercial fishing. These areas were the focus of the recent collaborative survey conducted by both VIMS and the sea scallop industry.

million pounds of scallop meats, depending upon the level of finfish bycatch. VIMS scientists will again conduct research aboard commercial scallop vessels in these areas. Specifically, they will examine dredge modifications to reduce finfish bycatch and the inadvertent harvest of small scallops.



Calendar of Events

—July—

- 19: Tidal Wetlands Education Workshop
28: Governor's School student presentations

—August—

- 12: Alumni Crabfest
14: Annual Fund Board Meeting
24: Sea Grant Science Writing Workshop
28-29: New Student Orientation

—September—

- 8: Reception for Art Competition
16: Tidewater Oyster Gardening Float Building Workshop
21: VIMS Council Meeting, Eastern Shore Lab
Outdoor Writers Association Meeting
22, 23: Genetic Aspects of Oyster Reef Restoration
22,23,24: VIMS Exhibit State Fair Richmond

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

Visit our website at: www.vims.edu

VIMS Stranded Sea Turtle Hotline

Summertime means sea turtles are on their way to the Chesapeake. Turtles enter the bay when sea temperatures rise in the late spring to about 66° F and stay until the temperatures drop below 60° F in the fall. The Chesapeake Bay is an important foraging area for juvenile loggerhead's and Kemp's Ridleys. Kemp's Ridleys are the second most abundant sea turtle in the Bay and are the most endangered of all sea turtles. They usually become stranded during their migration into and out of the Bay.

Ridleys forage in the shallow waters around the margins of the Bay while loggerheads most often utilize deeper water near channels.

VIMS scientists have been collecting data on sea turtles in Virginia waters for 20 years and manage a statewide database of sea turtle strandings that is the longest running database for juvenile Kemp Ridleys and loggerheads in existence. Turtles that become sick or are injured are held at VIMS until they are returned to their natural environment. The VIMS sea turtle

team responds to any stranded sea turtle (alive or dead) found from the James River north to the Potomac

If you find a stranded sea turtle call the turtle hotline. This number is checked frequently during the day and after hours. Leave a detailed message on the turtle's location, directions on how to find it, and a telephone number where the reporter may be reached.

**Turtle Hotline:
(804) 684-7313**



In Memory of "Captain Tony" Penello

VIMS lost one of its champions last month with the passing of Captain Tony Penello. During the past two decades, Captain Tony served the Institute in numerous ways. He enabled a variety of scientific field projects to be performed within the Bay as well as offshore by the use of his 100 foot fishing trawler *Anthony Anne*. Biological work involving sea turtles, sharks and rays, as well as major tagging efforts were conducted with the benefits of Captain Tony's long fishing experience, as well as his able vessel. Geological studies along the continental shelf have also been performed from the *Anthony Anne*.

Captain Tony was a mentor to many of the fisheries graduate students who participated in research projects aboard the *Anthony Anne*. He inspired them to be all that they were capable

of being by the example that he represented throughout his own life. He was especially generous to these students; giving his time, his genuine concern for their projects and his encouragement to reach for their goals. Captain Tony also supported the Institute through his gifts as a charter member of the Founder's Society. He worked very hard to enlist the support of citizens to further the mission of the Institute. Even when he died, he requested that his friends might make contributions to VIMS in memory of him. Tony Penello was a person that stood up for what he believed in, and he believed in VIMS with all of his heart. The VIMS community will remain grateful for his support and the inspiration that he provided to those who were fortunate enough to become a friend of The Captain.



Captain Tony Penello, center, with VIMS alumni Richard Krause (l), and Dean Grubbs (r).