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VIRGINIA INSTITUTE OF MARINE SCIENCE
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The Crest

Current Issues in Coastal Ocean and Estuarine Science

Experimental Fishery on Georges Bank Holds Promise for the Scallop Industry

By David Rudders and John Olney Jr.

Portions of the closed areas of Georges Bank may be reopened to scalloping. At least that is what some scientists, and the sea scallop industry may be proposing to the New England Fishery Management Council at upcoming meetings. The basis for this recommendation stems from the promising findings of an experimental fishery that was conducted this summer in closed area #2 on Georges Bank. The experimental fishery, which represents a joint effort among the Virginia Institute of Marine Science, Sea Grant's Marine Advisory Program, the University of Massachusetts at Dartmouth, the Fisheries Survival Fund, and the National Marine Fisheries Service, was designed to quantify the scallop resources in closed area #2 on Georges Bank. The data from the survey has yet to be fully analyzed, but preliminary observations indicate dense concentrations of large scallops in some portions of the closed area.

If the New England Fishery Management Council decides to open up these areas, it could be a large economic boost for the scallop industry in Virginia. In 1996, over 116 scallop vessels fished out of Virginia and these vessels landed in excess of 5 million pounds of shucked scallop meats. In 1996 and 1997, Virginia was ranked second only to Massachusetts possessing the

SCALLOPS
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A crewmember aboard the F/V *Guidance* sorts scallops after a ten minute tow on Georges Bank.

New VIMS Center Boosts Aquafarming

By James Schultz

For centuries, the oceans' abundance has been taken for granted. Overfishing was thought impossible: stocks were far too fertile and robust. But human population increase, technological advance and soaring commercial demand have placed unprecedented pressure on many species. Reversing these trends—while keeping fish as a primary menu item—will require a mix of creativity, innovation and new applied technology.

"We're leaving the era of hunting-gathering in the oceans and entering one of propagation and culture," says Dr. Stan Allen, Professor of Marine Science and Director of the VIMS Aquaculture Genetics and Breeding Technology Center (ABC). "Seafood will have to come from aquaculture. As in agriculture, we'll have to increase abundance and variety through genetics and breeding."

Created in 1997, VIMS' Aquaculture Center is the only center in the U.S. dedicated to shellfish breeding. The Center will be a primary resource for aquafarmers seeking to improve the quality of brood stock. Central to that effort will be the application of genomics— the study of the organization of genes on chromosomes. Genetic "maps" of

AQUAFARMING
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Rare Book Donated to VIMS Library

VIMS library recently was given a rare natural history book published in 1711. The book contains 60 large prints of crustaceans, shells, minerals and fossils from the Mollucas Islands The book is unique in that it has a three-page, handwritten manuscript index, written 100 years later, which updates the illustrations by their Linnaean names. This is the first book of its kind in the VIMS library collection.

An illustrated page from the rare book donated to the VIMS Library.

A Letter From the Dean and Director

Over the past few years, the programs and activities at VIMS have been evolving at an ever-quickening pace and have become increasingly interdisciplinary and complex in scope. Keeping our varied constituents abreast of what we are doing has become a formidable challenge.

By means of this newsletter, we hope to provide a more comprehensive overview of activities at VIMS, with particular emphasis on those activities that are now riding, or approaching, the Crest of new discoveries.

This newsletter incorporates several institute publications including the *Waterfront News* published quarterly by Sea Grant Marine Advisory Program and *a fair Bay* published by CBNERR-VA as well as articles appearing in the recent *Virginia Wetlands Report* published by the Wetlands Program, Department of Resource Management and Policy. The purpose is to highlight current research and activities in all departments as well as special conferences and outreach events. The interdisciplinary nature of our work and the related advisory service aspects of our mission are better communicated through a single publication.

We hope that you will find this quarterly publication to be informative and valuable.

Dr. L. Donelson Wright
Dean and Director

The Crest

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William & Mary VIMS
Virginia Institute of Marine Science
School of Marine Science

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Sea Grant Virginia *Waterfront News* Vol. 6, No. 1

Chesapeake Bay National Estuarine Research Reserve in Virginia

a fair Bay Fall 1998/Winter 1999

President of the Consortium for Oceanographic Research and Education Honored at Charter Day

Adm. James D. Watkins, U.S. Navy (Retired) received an honorary doctoral degree during Charter Day ceremonies at the College of William and Mary on February 6, 1999.

Throughout his career, Adm. Watkins has been a staunch proponent of education particularly in math and science. In a recent presentation at VIMS, he said, "Science should proactively involve and integrate education, and education should incorporate the most current science. Education means formal, classroom and informal, science centers and aquarium. It means everything from kindergarten to doctoral levels."

In 1994, Admiral Watkins was asked by the Joint Oceanographic Institutions to establish the Consortium for Oceanographic Research and Education (CORE) to broaden representation to the 50 U.S. academic institutions which make up the U.S. oceanographic community. CORE's mission is to enhance

Adm. James D. Watkins, U.S. Navy (Retired)

visibility and appreciation of the oceans by decision-makers at all levels of government and by the American public. CORE also works to strengthen links between oceanographic science, technology, research and development in academic, the Federal Government and industry. As a result of CORE's efforts, Congress authorized and funded the National Oceanographic Partnership Act of 1996. VIMS is a member institution of CORE.

Prior to being elected President of CORE, Adm. Watkins served as Secretary of Energy under President Bush. The development of the first comprehensive national energy strategy and the subsequent passage of the Energy Policy Act of 1992 highlighted his accomplishments at DOE. From 1982 to 1986, he served as the Chief of Naval Operations, capping a distinguished naval career that spanned nearly four decades. He graduated from the U.S. Naval Academy and received his Masters Degree in Mechanical Engineering from the U.S. Naval Postgraduate School and the Oak Ridge National Laboratory.

In Memoriam

Dr. Craig Smith

The VIMS community was saddened by the sudden death, in January, of Dr. Craig Smith, Associate Professor of Marine Science, Department of Environmental Science. Craig came to VIMS in 1971 to study the environmental chemistry and motion of oil spills in coastal waters. He later worked on the organic geochemistry of contaminated Coastal Atlantic sediments, and mentored several graduate students. In the 1980s, Craig began to develop environmental applications of laboratory data systems . His recent research centered on storage and retrieval systems for Chesapeake Bay environmental data that are now in use by the State of Virginia. Craig's knowledge of organic chemistry and computer science was a valued resource for the VIMS community, and he demonstrated scientific and personal achievements that inspired us all. The entire VIMS community will miss Craig, his insight, his effort and his inspiring example.

For information on the educational fund in Craig's honor, contact Lisa Phipps at 804-684-7099.

Invader Threatens Stressed Ecosystem

By James Schultz

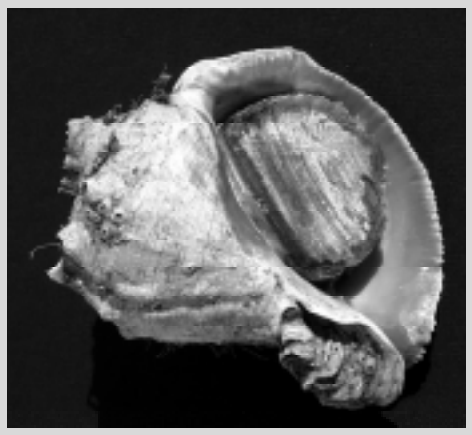
With the discovery of the veined Rapa whelk in Chesapeake Bay last July, Dr. Roger Mann and his colleague Juliana Harding embarked on a crash course to learn everything possible about this marine hitchhiker from waters some 6,000 miles away.

The *Rapana venosa*, or veined rapa whelk, was found in the lower James River during summer 1998 by a routine VIMS trawl survey. To date, adult rapas have been found as far north as the mouth of the Rappahannock River.

"How will it affect benthic communities? We don't know," says Roger Mann. "In Virginia waters we're in a kind of redwood forest where the biggest get bigger and bigger and older and older. My main worry is that these animals will move to areas where there is no commercial fishing and thus no predation. What will control its spread then?"

Marine Scientist Senior Juliana Harding in Molluscan Ecology with adult *Rapana venosa*.

With an appetite for oysters, clams and mussels, the softball-size *Rapana venosa*, the veined rapa whelk, is robust and fertile, long-lived, tolerant of low salinity and oxygen levels and resistant to pollutants. Other than humans and several species of larger animals, few rapa-whelk predators are known to exist. Now the Rapa, a native of the Sea of Japan with a range normally limited to the Yellow and East China seas, has come calling in Virginia waters.



Learning More

Like its small, land-based cousin, the common snail, this whelk is a gastropod; literally, a "stomach foot" a predatory mollusk, with a one-piece shell, a head bearing tentacles and eyes, and a single appendage that doubles as both an organ of locomotion and a tool for prey capture. The rapa may live as long as 20 years.

In other areas where it has made inroads, notably in the Black Sea, the rapa whelk has decimated large bivalve populations. The whelk's expansion is also regarded as a primary reason for declining mussel populations in Bulgarian waters. Yet, in other areas, most notably the northwestern portions of the Black Sea, the whelk has had little impact on the local marine ecosystem.

Scientists are not sure how fast the rapa will spread in Virginia waters, or what creatures may emerge to challenge it. Fundamental questions about the rapa's reproductive cycle remain unanswered, and little is known about how environmental effects will act to constrain or encourage whelk population growth. To rein in the rapa's spread, Mann hopes that the whelk may eventually become part of the diets of sea turtles and sting rays, and perhaps even of humans.

"Trying to predict the impact of non-indigenous species is very difficult. An introduction of species A influences species B and there's a cumulative, cascading effect," he points out. "Like it or not, over time they become part of the biosphere. These are slow-growing animals; you won't see the Bay covered with them next week."

Living rapa whelks are currently under observation to learn more about feeding habits and reproductive behavior at VIMS. Mann's program offers a $2-per-rapa bounty to fishermen for living specimens. Current rapa research updates are posted regularly on the VIMS Rapana Research web page (www.vims.edu/fish/oyreef/rapven.html).

SCALLOPS

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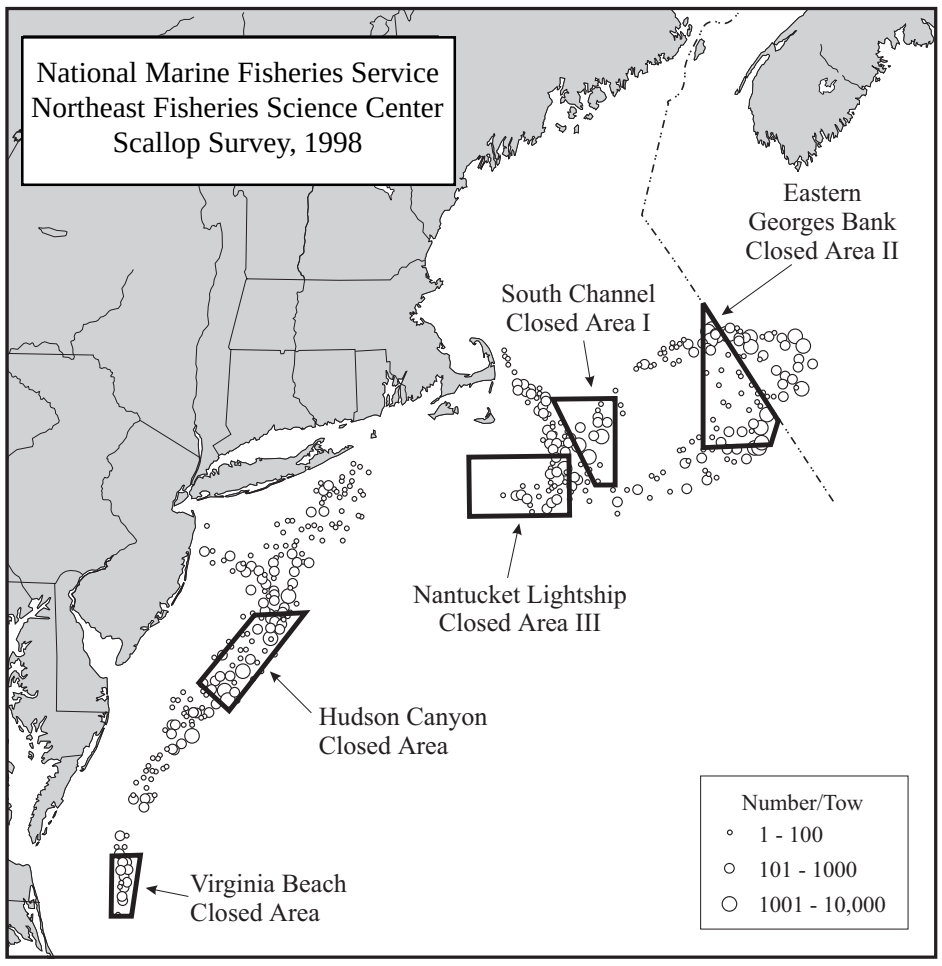
highest percentage of total scallop landings on the East Coast. Even a limited amount of fishing in the closed areas of Georges Bank could greatly benefit Virginia's scallop industry.

Three portions of Georges Bank totaling 5,500 square miles were closed in 1994 after decades of intense fishing pressure had reduced the numbers of several commercially important groundfish species. Population levels of cod, haddock, and several species of flounders were at all time low levels, and declining, when the emergency closures were enacted.

Scallop vessels, in turn, were hit very hard by this closure. Even though the scallop populations in the closed areas were at stable levels, the ban prohibited the use of all mobile gear in those regions. Scallopers, already heavily regulated, were now unable to fish on some of the historically most productive scallop areas of the Bank. This action displaced fishing effort, and concentrated it in the remaining open areas in southern New England and the mid-Atlantic, producing greater fishing pressure on the scallop populations in those areas.

The experimental fishery was undertaken in August and September of 1998 to quantify scallop distribution and density within the closed area. The study consisted of six commercial vessels each staffed with a scientific team. The F/V *Celtic*, F/V *Thor*, F/V *Guidance*, F/V *Eileen Marie* (all from New Bedford, MA), the F/V *Christian and Alexa* (from New Jersey), and the F/V *Good News* (from Newport News, VA) were the commercial vessels randomly selected to participate in the study. Dr. William DuPaul, VIMS Professor of Marine Science, and graduate students David Kerstetter and David Rudders served as scientists aboard two of the participating vessels.



Each vessel sampled 160 predetermined stations with 10 minute tows over the course of the 14 day trip. The gear used by the vessels consisted of two standard 15-foot New Bedford style dredges. Experiments were conducted to obtain estimates of dredge efficiency, and modifications were made to this gear to conduct experiments on minimizing groundfish bycatch. In all, over 1,000 tows were completed by the participating vessels. Information gathered during the experiment will provide estimates of scallop biomass and distribution, finfish bycatch, and dredge efficiency. These findings, once fully analyzed, will be issued to the New England Fishery Management Council, who will then decide the appropriate course of action for closed area #2 of Georges Bank. It is possible that the analysis of these data could provide an appropriate level of harvest for scallop vessels in the closed areas.

This survey represents two important milestones in scallop management. Results from this project indicate the possibility that closed area management represents a viable tool for the management of the sea scallop resource. Second, the collaboration of industry and scientists that was necessary to complete this project was unprecedented on such a large scale, and will hopefully serve as a model for future cooperative efforts among fishermen, scientists and managers.

Sea Grant Virginia

Blue Crab Bowl/ National Ocean Sciences Bowl

By John Olney, Jr.

On February 27, 1999, VIMS and the Center for Coastal Physical Oceanography at Old Dominion University co-hosted the second annual Blue Crab Bowl on the VIMS campus in Gloucester Point. The Bowl is an regional academic competition of the National Ocean Sciences Bowl which was created for high school teams to test their knowledge of the world's oceans. Sixteen teams competed for the regional title, and an opportunity to compete in the national tournament that will be held in Washington, DC on April 10-12. Sponsored by the Consortium for Oceanographic Research and Education(CORE), Virginia Sea Grant, and the National Marine Educators Association (NMEA), the competition was structured in a quiz show format with ocean-related questions in the field of biology, physics, chemistry, geography and geology.

Lord Botetourt High School of Daleville emerged as the victorious team, defeating Catholic High School from Virginia Beach in the championship round. They will advance to the national competition and compete with the winners from the other seventeen regions that range from Florida to Alaska. Third place went to Lancaster High School.

Along with an all expense paid trip to DC, the Lord Botetourt team will also receive a day aboard the VIMS sixty-five foot research vessel R/V *Bay Eagle*. In addition, the coach of the Lord Botetourt team was given a scholarship of $750 to attend the National Marine Educators Association conference in Charleston, South Carolina this summer. All competitors received a medallion for participating, and all coaches received a $40 professional development scholarship to attend either the regional Mid-Atlantic Marine Education Association conference in North Carolina, or the Chesapeake Bay Educational Conference in Hampton.

"Teams were comprised of participants from all over the state who worked very hard to prepare for this competition. In our eyes, all of the students are winners for taking the initiative to get involved," said Susan Haynes, Marine Science Educator for Virginia Sea Grant and the Virginia Institute of Marine Science, "Participating in this event exposes students to new academic and career possibilities for their future, and gives them the opportunity to meet with top research faculty in the field of marine science."

VIMS and ODU faculty, staff, and graduate students served as judges and officials for the event, with VIMS Director for Research and Advisory Service, Gene Burreson and ODU professor Arnoldo Valle-Levinson serving as the Chief Science Judges. The moderators, who run the individual matches, were Mark Patterson, Carl Hershner, John Olney, and Bill DuPaul from VIMS, and Fred Dobbs, Kris Holdereid, Greg Cutter, and Bruce Lipphardt from ODU.

Members of the Lord Botetourt High School team, winners of the 1999 Blue Crab Bowl.

Schools that participated in the event were Broadwater Academy from Exmore, Wilson High School from Portsmouth, Alleghany High School from Covington, Central Shanandoah Valley Regional Governor's School from Fishersville, Rustburg High School from Rustburg, James River High School from Buchanan, Explorer Post #7, Lord Botetourt High School from Daleville, Osbourn High School, Manassas, Maury High School from Norfolk, Catholic High School from Virginia Beach, Lancaster High School from Lancaster, Hayfield Secondary School from Alexandria, Essex High School from Tappahannock, and James Madison High School, Vienna.

The Blue Crab Bowl is co-hosted by the Virginia Institute of Marine Science, college of William & Mary; Old Dominion University, Department of Ocean, Earth, and Atmospheric Sciences and the Center for Coastal Physical Oceanography; and Virginia Sea Grant. The National Ocean Sciences Bowl is conducted as a partnership between the Consortium for Oceanographic research and Education (CORE) and the National Marine Educators Association (NMEA) with financial sponsorship from the Office of Naval Research, Oceanographer of the Navy, National Aeronautics and Space Administration, National Science Foundation, U.S. Geological Society, and other agencies and private sources.

AQUAFARMING

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major agricultural crops are now under development. Genetic maps for shellfish will allow ABC researchers to pinpoint and select out DNA markers for such traits as disease resistance, growth rate and other desirable characteristics.

"The ultimate aim is to enable aquafarmers to choose their seed from improved varieties—a spectrum of choices," Allen explains. "They'll have control of their stock. Now, it's take it or leave it."

From The Ground Up

The Center will concentrate its genetic research efforts first on oysters and the creation of a viable oyster-centered aquaculture. Clams and scallops will follow. Eventually, marine finfish may appear on researchers' rosters.

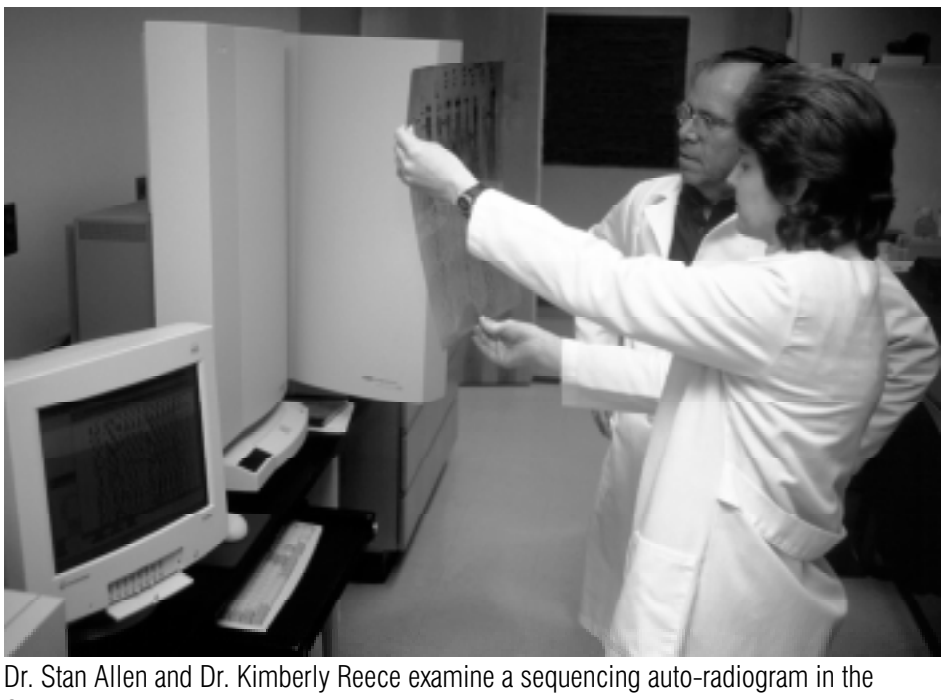
Organizationally, the Aquaculture Center is putting in place both an administrative and facilities plan. Two hatcheries, one on the VIMS main campus at Gloucester Point and the other at the Institute's Eastern Shore Laboratory in Wachapreague, will concentrate on the production of improved brood stock. An Eastern Shore brood-stock "farm" that will house shellfish juveniles is also envisioned.

VIMS is also seeking funds for an aquaculture germ plasm resource facility, or AGPR. The facility would comprise three major physical components: a quarantine area to hold non-native species over several generations, without fear of environmental consequences; a freezer/ storage section where reproducing cells of valuable local and imported species can be stockpiled; and an extensive fin and shellfish DNA archive.

"Until we finish our core structure, we won't be able to leverage our expertise," Allen points out. "Nothing will hold us back then but our imaginations."

In the long run, Allen believes, the creation of the Aquaculture Center adds to a larger international movement underway to preserve and protect biodiversity by taking a less haphazard and more deliberate approach to marine harvesting. Farming fish won't come without effort, however.

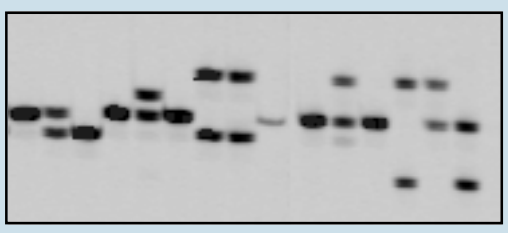
"People don't realize the effort involved to domesticate wild animals," he says. "With agriculture it took 2,000 years. Compared to that time line, this approach looks almost instantaneous."



Dr. Stan Allen and Dr. Kimberly Reece examine a sequencing auto-radiogram in the Oyster DNA Laboratory.

The Genetics Advantage

Historically, livestock and other domesticated animals have been bred for hardiness, disease resistance, growth rate, size and taste. Selective breeding has usually unfolded slowly, over many generations, and has involved considerable trial and error. Genomics should greatly accelerate these selective breeding programs, allowing for rapid development of a wide variety of strains and types. Because DNA markers can be used to accelerate the introduction of economically important traits, what once took decades may, eventually, consume only months.



For Virginia's beleaguered oyster, its disease-ravaged population reduced to a fraction of former abundance, genetic engineering offers the prospect that improved hardiness could allow the oyster to increase in numbers. While populations may not rebound to the millions noted in the first half of the 20th century, any significant increase would be welcome news to those interested in rejuvenating one of the state's most important marine industries.

"We don't know that we'll be able to restore the natural populations," says ABC assistant director Kimberly Reece, a VIMS Assistant Professor of marine science. "It would be great if we could develop oysters that could be put back into the field. The bottom line is that we're trying to optimize species that will do well in aqua-culture."

Microscopic Phytoplankton Live Large

By James Schultz

"The world wouldn't exist as we know it without phytoplankton," says biological oceanographer Dr. Walker Smith, a leading phytoplankton expert and Professor of Marine Science, Dept. of Biological Sciences. "All marine species depend on them."

Yet for all their abundance, phytoplankton are hardly immune to stress brought on by human activity or changing environmental conditions. Burgeoning numbers of people living on or near coasts have led to sharply increased discharges of everything from fertilizers to toxins, which can cause algal blooms which can harm other aquatic life. At other times, climate fluctuations—alterations in ocean currents, rainfall, salinity and changeable concentrations of trace metals in seawater—have led to mass phytoplankton dieoffs.

Smith, head of VIMS' Phytoplankton Ecology Laboratory, coordinates a team of researchers that uses the latest in laboratory techniques to probe more deeply into the lives, habits and behaviors of phytoplankton. In particular, Smith and his colleagues are interested in environmental factors which control phytoplankton growth and species distribution.

"Although we have a lot of information about phytoplankton, the more we learn, the more questions we have," Smith points out. "There are a lot of things we thought we knew—but now realize we don't know that well. Some of the connections we're finding are almost like science fiction."

Dr. Walker Smith (r) aboard the R/V *Nathaniel B. Palmer* in the Ross Sea, Antarctica.

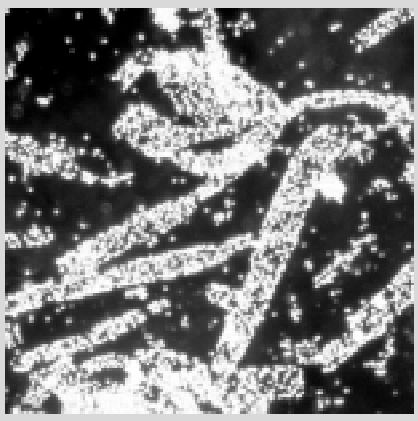
A Critical Role in Climate Change?

With increasing concern about the extent and nature of climate change has come anxiety about the role of carbon and carbon dioxide in raising average world temperatures. The world's oceans are enormous carbon "sinks," trapping and retaining carbon so that it is not released as an atmosphere-warming greenhouse gas. Smith and his team are interested in the interactions between pools of organic carbon at the ocean surface, and how dissolved organic and inorganic carbon are metabolized by phytoplankton. In related studies, he is also investigating the role of dissolved iron in relation to phytoplankton productivity and growth.

Thus far, his phytoplankton studies have focused primarily on processes occurring in the Ross Sea near Antarctica. Antarctic oceans are thought to be critical in controlling the marine carbon cycle, in part due to their role in producing large, deep masses of water that circle the globe and influence local weather patterns.

Climate change may also be influenced by the microorganism *Phaeocystis*, a creature that releases sulphur compounds into the atmosphere. By increasing cloud cover and decreasing rain, sulphur appears to be mitigating predicted warming rates. Smith says that while he and his colleagues are conducting ongoing studies of *Phaeocystis*, little is known about their prevalence and behavior.

"There's no doubt this organism plays a major role in ocean-atmosphere interaction," Smith contends. "Whether or not it is increasing in numbers or whether it plays a role in climate change is open to debate. We don't yet have reliable information."



Roughly 120 times smaller than the width of a single human hair, phytoplankton exist in all marine environments, from the surface waters of the Chesapeake Bay to the frigid waters surrounding Antarctica. They anchor the base of the oceanic food web, supporting invertebrates, fish and mammals, and are the driving force in oxygen production. Planetary life as it is today known would be impossible without these minuscule single-cell organisms.

For more than fifteen years, Smith has concentrated his research on waters near the South Pole. However, in July he moved his entire program from the University of Tennessee to VIMS to expand his research in and near the Chesapeake Bay to investigate the abundance and growth of phytoplankton near the Virginia and Maryland coasts. Such knowledge will be critical, he contends, to understand the impact of people on marine environments. "It is truly amazing how little we know about estuaries," he says. "There's a lot more we need to know in order to mitigate human influence."

National Estuaries Day Comes to Life at York River State Park

By April Bahen

Have you ever touched a nurse shark? How about dressed up like a sea star to find out what it would be like to lose one or two of your legs and still have to get around and try to eat? Did you know about the corduroy roads used in late colonial days to bring logs from the forest across the marsh to the current York River State Park site? If you came to the 10th annual National Estuaries Day/ York River Fall Festival you experienced all of those topics. Canoe trips, nature hikes, boat rides, environmental exhibits, the Eastern Virginia Mountain Bike Association demonstrations, music by Tim Seaman, the Ocean Encounters audience participation show and animal exhibit, and kids activities were all a part of the fun and education held Saturday, October 17, 1998 at York River State Park in Croaker, Virginia. This event is a special day that is held each year to remind and inform the general public about the importance of our estuarine habitats.

This year the festival was renamed the York River Fall Festival to show the connection with the Governor's campaign, Fall River Renaissance which all Virginia State Parks took part in to promote riverine health. September 19 - October 19 was dedicated Fall River Renaissance to encourage all Virginia residents to protect our rivers for our quality of life and prosperity and for ecological health.

Estuaries Day participants enjoy a canoe trip.

An exciting addition to the fanfare this year was the presentation of the Gourmet Seafood Dinner and Starlight Ball. This scrumptious feast was held as a benefit for the Friends of York River State Park who support activities at the park as well as the educational activities of the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA)/Virginia Institute of Marine Science (VIMS) at the park. The dinner included delicacies from the Chesapeake Bay and featured the swing/big band music of Swing Shift. The dinner dance was held outside under the stars. A warm bonfire, delicate luminary candles lighting pathways to the stage, and crystal clear weather all contributed to a spectacular evening that everyone enjoyed. The Friends plan to put the dinner on again next year with expectations that it will be even more beautiful and delicious than the first year.

The weather was absolutely a gorgeous fall day! It was a perfect day to experience the beauty and serenity of nature and learn why these waterways and our watersheds are so important to the environment and to all humans. Be sure to come out next year to learn much more about estuaries; gateways to the ocean. If you missed us this year and would like to take a look at some pictures from past Estuaries Days visit our webpage (http://www.vims.edu/cbnerr/estday/index.html).

Reality By the Numbers

By James Schultz

Computer modeling at VIMS began in the 1970s, with a partnership between the Institute and the then state Water Control Board to provide information relating to water quality and wastewater discharge allocation. In the intervening quarter century, with increasing computer power and development of more sophisticated software, VIMS researchers are now able to create three-dimensional models of physical and biogeochemical processes in the Chesapeake Bay and its tributaries and estuaries.

Their computer programs incorporate and simulate such physical processes as tidal height, current; water turbidity, or extent of sedimentation, which affects the marine food chain; chemical composition of water, including salinity and the amounts of pollutants present; and recently, biological modeling, or the complex behavior of organisms in native habitats.

"Our goal is to answer the basic question: What if?" says Dr. Albert Kuo, one of the team leaders and VIMS Professor of Marine Science. "Our models are used as tools to answer practical as well as basic questions and to make predictions."

New Projects, New Opportunities

Key to successful prediction is the effectiveness with which models mimic the complexity of the natural world. Food abundance, for example, is dependent upon more than one variable. Water temperature and salinity and speed of current play major roles. The degree to which water flow stirs up and disperses sedimentation, for instance, affects water clarity. In turn, water clarity affects photosynthesis. If light cannot penetrate but so far into the water column, the base of the food chain is damaged, leading to decreased numbers of the smallest animals consumed by larger creatures, and so on up the marine ladder of life.

"A computer model takes an holistic approach," says Dr. Harry Wang, Assistant Professor of Marine Science. "You take many factors into consideration, like water velocity and density, wind and tidal forcing. You can go in and look at these processes in detail and their likely impacts."

Among the Institute's several modeling projects now underway is one for the Virginia Marine Resources Commission that examines the downstream movement of clam larvae from sanctuaries and death rates due to decreased salinity. The group is also working with the U.S. Army Corps of Engineers and Environmental Protection Agency on a large-scale, long-term evaluation of water quality in the Chesapeake Bay as efforts intensify to reduce nutrient runoff and restore the bay's environmental health. Other projects including tracking the harmful microorganism *Pfiesteria* in the Great Wicomico River and a feasibility study of the effects of building in the upper Chesapeake Bay a containment island for dredged material.

For VIMS marine scientists, the ability to represent reality in digital form offers enormous advantages.

One of the group's most ambitious efforts, led by Dr. John Boon, Professor of Marine Science, involves using a Geographic Information System, or GIS. The GIS helps to evaluate how construction of a third bridge-tunnel crossing to connect northern and southern parts of Hampton Roads would affect water circulation, sedimentation, salinity, current speed and other physical factors affecting marine organisms. "GIS provides the necessary link between physical processes and the precise place where they occur in both the model world (a cell in a mathematically defined grid) and the real world (a point or line in the water or between the water and the land), says Boon. "High speed computer and satellite imagery make it possible to reference the same point in both worlds."

"Coastal development is inevitable," Kuo points out. "If your goal is to minimize impact on the environment, you need a numerical model. It's cost-effective, fast and fairly reliable."

For their projects, the team uses a combination of on-site mini-supercomputers and personal computers, with on-line access to national supercomputer centers as needed.

CBNERRVA Excels at Federal Review

By Dave Niebuhr

CBNERRVA recently hosted a team of auditors from the National Oceanographic and Atmospheric Administration's (NOAA) office of Ocean and Coastal Resource Management who conducted a "312 Review" of VIMS' reserve program. The term "312 Review" originates from the section of the Coastal Zone Management Act authorizing the National Estuarine Research Reserve System and establishing a triennial federal audit of each of the state programs funded under the system. Each National Estuarine Research Reserve undergoes a 312 Review every three to four calendar years. The 312 Review committee investigates the reserve's performance in research, monitoring, education and management. They use background examination of reporting documents, interviews with agency personnel or other constituent groups which directly, or indirectly, work with the Reserve and products designed and services originating from the Reserve.

The review team was lead by NOAA-staffer, Maggie Ernst and included NOAA program specialist Matt Menashes and a NOAA intern, Knauss Fellow (and SMS doctoral student) Rebecca Boger. The review committee examined and evaluated key elements of the research, education and monitoring program at CBNERRVA. They also interviewed essential VIMS and state personnel who work directly with the Reserve including: Gene Burreson and Page Hayhurst of VIMS; Mike Murphy, Laura McKay, Jeannie Lewis and Virginia Whitmer of the Virginia Coastal Program; and Tom Cervenak and Stephanie Turner of the Department of Conservation and Recreation, York River State Park.
In addition to the formal interviews, a public meeting was held to receive comments from the public at large.

In the Evaluation Findings Report, the review team was pleased with the working relationship between the Reserve and VIMS while noting that "The missions of VIMS and the Reserve are closely aligned." They also commended CBNERRVA on their many successes and growth in program development since their last review in 1994.

Research coordinator, William Reay, led the team to the Catlett and Goodwin Islands where he described CBNERRVA research and monitoring efforts. The team determined that "....the Reserve has succeeded in encouraging a significant and increasing level of research activities at the four component sites." After spending time learning about the Reserve's educational efforts from Education coordinator, David Niebuhr, and assistant education coordinator, April Bahen, the 312 reviewers felt that "The Reserve promotes a nurturing educational environment for students from the middle-school through post-doctoral levels." And while discovering the education connection between York river State Park and the Reserve, the team was provided with a rare, restful moment of a canoe trip, complete with soaring bald eagles, during an otherwise busy week.

VIMS Council Names New Members

At its January meeting, the VIMS Council three new members to fill vacancies created by retiring members.

Albert J. Baciocco, Jr. Vice-Admiral U.S. Navy (Ret.) who is currently head of the Baciocco Group, a consulting practice principally related to technology, planning, investment management and implementation. Admiral Baciocco served as Chief of Naval Research from 1978 to 1981 and as Director of Research, Development, Test and Evaluation from 1983-1987.

Eva S. Teig, is Senior Vice President-External Affairs and Corporate Communications with Virginia Power. Prior to joining Virginia Power, Ms. Teig spent nearly two decades in local and state government service beginning as an urban planner with the city of Portsmouth and culminating as Secretary of Health and Human Resources under Governor Baililes. She also currently serves as Chairman of the State Chamber of Commerce's Education committee and sits on the Virginia Business Higher Education Council.

Edward M. Holland, served in the Senate of Virginia and the Virginia General Assembly from 1972-1996 where he held seats on the Commerce and Labor Committee, Education and Heal Committee and chaired the Committee of Courts and Justice. Currently, he is director and foundation member of the Tidewater Research Foundation Inc.

The Council is composed of business, industry and maritime leaders and serves as an advisory board for VIMS.

Tautog Research

By Mike Arendt

In the fall of 1998, scientists from the Sea Grant Marine Advisory Program at VIMS began studying the daily activity and seasonal residence of adult tautog (*Tautoga onitis*) using ultrasonic tagging technology. Tautog activity and utilization of structure and natural bottom habitats will be described prior to the planned deployment of artificial reef materials on the Eastern Shore of Virginia. In addition to addressing a fundamental biological question, this study will contribute to understanding fish/artificial reef interactions. This research is funded by the Recreational Fishing Development Fund of the Virginia Marine Resources Commission and VIMS.

The tautog is one of two temperate species in the wrasse family (Labridae) which constitutes an important game fish species. Because the tautog is the second most abundant reef fish in the lower Chesapeake Bay in the spring and fall, they are ideal for studying activity before and after construction of an artificial reef. Although the tautog is a popular reef fish with anglers, little is known about the activity and behavior of this fish in the wild.

Understanding the activity and residence of this species could have important management implications. Overexploitation is more likely to occur in species that remain localized for long periods of time than in species exhibiting a high degree of movement. Stock assessment measures must be designed with an understanding of the magnitude of short- and long-term movements made by the species. Residence patterns and seasonal migrations also reflect seasonal habitat preferences. This idea of determining essential fish habitat is crucial to understanding a species behavior and is federally mandated by the Magnuson-Stevens Sustainable Fisheries Act.

A tautog is implanted with an ultrasonic tag and released on a wreck near Cape Charles, VA.

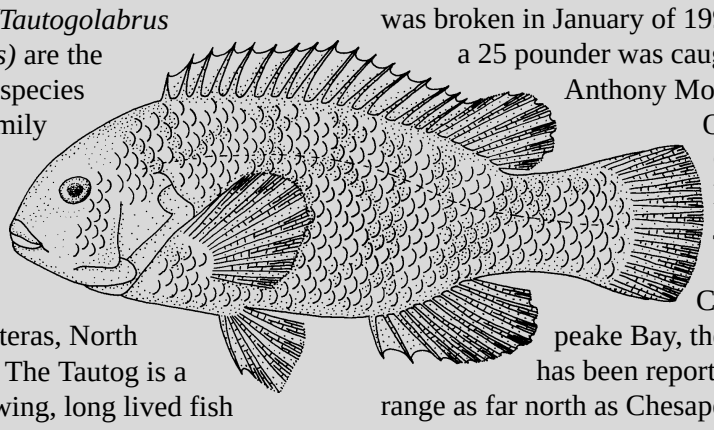
The tautog used in the study will be tagged with ultrasonic tags, enabling these fish to be detected on an interminable basis by utilizing two differing methods of tracking. Tautog will be manually tracked from a boat using an ultrasonic receiver and an acoustic hydrophone. On multiple occasions, individual tagged fish will be followed for 48 consecutive hours. Intensive manual tracking will provide a detailed account of daily activity. Tautog will also be tagged, released and tracked using submerged receiver/hydrophone devices. Submerged monitors record detection of tagged fish on a continuous basis for the battery life of the tag (3 ½ months). The data from these monitors provide the most detailed picture of adult tautog activity and residence to date. For this portion of the study, tagged tautog will be group released.

An ultrasonic transmitter tag (16 mm x 48 mm; 18.5 g in air) will be surgically implanted into the body cavity of each individual tautog. A long green conventional tag will be placed in the dorsal musculature of the tautog for quick recognition when these fish are caught by anglers. The ultrasonic transmitter and the green conventional tag both include an identification number and a phone number to call should any of these tautog be caught. In addition to the green external tag, other indications that a tautog is carrying an internal ultrasonic tag include surgical staples in the belly and an incision mark or scar. A $50 cash reward will be offered to anyone who catches a tagged fish and allows them to be examined. (Note: It is necessary to examine the fish intact and in fresh condition for tag wound condition and healing, and stomach contents.) While researchers hope that none of these tautog will be caught, a cash reward is being offered to emphasize the importance of informing VIMS if the fish have been captured and removed from the study site.

The main study area is on the Bay side of the Eastern Shore of Virginia. Conventional tag returns from tautog tagged and released in the lower Chesapeake Bay indicate that when movement to a new site occurs, the distance traveled can often be considerable. For example, a tautog tagged and released near Cape Charles, VA, in fall 1997 was recaptured at the Cape Henry Wrecks in spring 1998. Given this degree of movement, it is important that all tautog anglers in the Lower Bay be aware of this study. For more information about this study, call Jon Lucy at (804) 684-7166 or Mike Arendt at (804) 684-7647 or (757) 885-5751 (pager).

Sea Grant Virginia

The tautog is one of 500-600 species of fishes in the mainly tropical wrasse family (Labridae). The Tautog *(Tautoga onitis)* and the Cunner, *(Tautogolabrus adspersus)* are the only two species of this family that are commonly found north of Cape Hatteras, North Carolina. The Tautog is a slow growing, long lived fish with males possibly living longer than thirty years and females living approximately twenty-five.



For 11 years, Virginia held the IGFA world tautog record of 24lbs with a fish caught off of Wachapreague, Virginia in 1987. The record was broken in January of 1998 when a 25 pounder was caught by Anthony Monica in Ocean City, New Jersey. In the Chesapeake Bay, the tautog has been reported to range as far north as Chesapeake Beach, Maryland but it is most commonly found from Gwynn's Island to the Bay mouth.

A Special Symposium To Be Held at the 1999 Annual Tidewater Chapter Meeting of the American Fisheries Society

The Tidewater Chapter of the American Fisheries Society will hold its annual meeting at VIMS in Gloucester Point, Virginia on 12-14 March 1999. The membership includes fisheries biologists employed by private and public sectors, academicians, researchers and graduate students at various colleges and universities, fisheries managers and private individuals, all of whom share interests in marine, estuarine, and anadromous fisheries ecology and management.

A special symposium is planned that will highlight the use of saltwater fishing license revenues to fund research in support of fisheries management. The Symposium will consist of 8-12 presentations and be chaired by Mr. Jack Travelstead. Each talk will be followed by a question and answer period during which scientists, graduate students, and other members of the audience will have an opportunity to discuss or debate methodologies, data analysis, and interpretations of results.

This planned AFS-Tidewater Chapter symposium will provide VMRC commissioners, Recreational Fishing Advisory Board (RFAB) members and the public with an unusual opportunity to attend a professional fisheries meeting where scientists, graduate students and managers ask critical questions and objectively discuss research results. The symposium will be sponsored by funds from the Recreational Fishing License Fund and will emphasize the RFAB's positive influence on recreational fisheries management and research. The proceedings of the symposium will be covered by the local media and summaries of the presentations will be made available for distribution. For further information please contact Dr. John Olney at (804)684-7334 or by email (olney@vims.edu).

Mini-School of Marine Science Spring Programs

The Mini-School of Marine Science series will continue this spring with two new programs. A four-week series of Special Topics including presentations on Oyster Research; Non-Native Species: *Rapana venosa*, Blue Crabs and Marine Habitat, and Coastal Land Use and Shoreline Erosion Management Strategies will be presented in Richmond at the Science Museum of Virginia beginning April 28. In June, the Environmentally Sensitive Landscaping course will be held at the VIMS Gloucester Point campus. Both sessions will include four weeks of classroom presentations and one-day of lab and hands-on demonstrations at VIMS. The courses are free and open to the public.

For additional information, call (804) 684-7101 or email (programs@vims.edu).

Latest Returns From the Game Fish Tagging Program

By Jon Lucy

Close to completing its fourth year of tagging selected coastal species, the Virginia Game Fish Tagging Program has realized a dramatic increase in tagged fish recaptures. Compared to 221 tag returns during calendar year 1997, the program has already recorded over 600 recaptured fish by October of 1998. The largest number of returns were for black sea bass, bringing the total tag return numbers from 431 (1995-1997) to over 1000. The program, which was started in 1995, is operated and supported cooperatively by the Recreational Fishing Development Fund under the Virginia Marine Resources Commission, and the VIMS Sea Grant Marine Advisory Program.

A small sample of interesting 1998 tag returns includes:

• Two small black sea bass (6.5-8 inches) were tagged on October 13, 1998, one at the Hampton Roads Bridge Tunnel, and one at the Monitor Merrimack Bridge Tunnel. They were both recaptured offshore on November 18 at the 4A Buoy Dry Dock about 18 nm southeast of Rudee Inlet. This data helps document the rapid fall movement of juvenile sea bass out of the Bay.

• An 11 inch tautog tagged March 30, 1995, on the Winthrop Wreck off Virginia Beach was recaptured on the same wreck on July 26, 1998. It had grown to 14.5 inches during its 3.3 years at large. The growing evidence that tautog may stay on the same site for long periods in Virginia waters is important to managing the stock.

• Cobia returns continue to document that spawning size females return annually to the same areas of lower Chesapeake Bay after over-wintering in the south Atlantic. On June 29, 1996, an estimated 44 inch cobia was tagged on the Inner Middle Ground Shoals inside the Bay mouth. It was recaptured on July 5, 1997 on the same shoal and released. It was recaptured once again on June 29, 1998, and once again on the Inner Middle Ground Shoal. It was estimated to have grown to 45 inches. The cobia's return to the Inner Middle Ground Shoal documents a multi-year cycle of returning to the same location in the Bay. This corresponds with several previous cobia returns that show individuals of similar size to this one, returning to the general area of release in the lower Bay on successive years.

Geoff White releases a tautog into the lower York River.

• Fall movement of young black and red drum southward to North Carolina has been found to be even more rapid than the 9-10 days demonstrated by 1996-97 tag returns. A 15 inch red drum (tagged October 9, 1998 in Rudee Inlet), and 8.5 inch black drum (tagged October 14 in Sandbridge) were recaptured one day later in the Kitty Hawk area surf (red drum) and at the Nags Head Pier (black drum). In contrast, an 18 inch red drum tagged inside Rudee Inlet on October 25, 1997 was recaptured March 24, 1998, inside the same inlet, indicating the possible over-wintering of the fish in Rudee.

The program's 1997 report is currently available free and the 1998 report will be available in the spring. For information contact Sea Grant Communications, VIMS, P. O. Box 1346, Gloucester Pt., VA 23062. Phone (804)-684-7170; email: bdk@vims.edu

Sea Grant Virginia

Catch and Release Symposium Focusing on Marine Recreational Fisheries

With broad sponsor support, including the National Sea Grant Office, National Marine Fisheries Service, Atlantic States Marine Fisheries Commission, and American Fisheries Society, the National Symposium on Catch and Release in Marine Recreational Fisheries, will convene December 5-9, 1999 in Virginia Beach, Virginia. The event targets marine anglers, fishery researchers and managers, charter-party boat and pier operators, saltwater fishing media representatives, fishery resource conservation and education leaders, fishing tackle manufacturers, marine recreational fishing associations, and others with significant interests helping make catch and release fishing work better for anglers and marine fish stocks.

Among the diverse issues addressed will be marine anglers perceptions and use of effective catch and release practices, the role catch and release plays in marine angling ethics and fisheries conservation, improving outreach and education on catch and release for the marine angling community, concerns of anglers and fishery managers regarding release mortality impacts on size and bag limit determinations, and current research on release mortality in estuarine and marine fish. Catch and release fishing conflicts will be examined as well as differences in catch and release practices among private boat, party-charter boat, and pier-shore fisheries.

Participants will develop research and outreach agendas through unique consensus-building sessions. Research papers will provide a special focus on circle hook studies. The symposium's proceedings will be published through the American Fisheries Society. For information, contact: Mr. Jon Lucy, Catch and Release Symposium, Virginia Sea Grant, Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Point, VA 23062; (804-684-7166; FAX 804-684-7161; e-mail: lucy@vims.edu).

National Symposium on Catch and Release in Marine Recreational Fisheries

Sea Grant Virginia

Visiting Scientist from National Laboratory in South Korea

Dr. Jae-Hac Lee, Director of the Biological Oceanography Division of the Korea Ocean Research Institute (KORDI) is spending the next year at VIMS working with scientists in several departments. Dr. Lee's primary interests are tidal flats, wetlands and benthic ecology. "In South Korea," says Dr. Lee, "the expansive intertidal mudflats are highly productive and economically valuable. However, the ecosystems are under enormous pressure due to encroaching development." Mud flats and sandy bottom environments in the Chesapeake Bay share many characteristics with comparable areas in South Korea. Intertidal flats in South Korea are harvested extensively for algae, clams and worms and represent one of the most productive, natural marine resources in Korea. Run-off and associated pollutants are major concerns, "The problems and challenges are enormous in relation to our land size," explains Dr. Lee. While South Korea and Virginia are similar in size, South Korea supports a population of approximately 44 million as compared to Virginia's population of 4 million. Over the next year, Dr. Lee will also be looking at current wetlands restoration research at VIMS.

Dr. Richard Wetzel and Dr. Jae-Hac Lee

Last spring, Dr. Richard Wetzel, Professor of Marine Science, Dept. of Biological Sciences at VIMS, visited KORDI. Working in collaboration with Dr. Lee and other KORDI scientists, Wetzel and others at VIMS are developing a conceptual ecosystem model for tidal flats in the western region of Korea. VIMS scientists will develop the mathematical model while Korean scientists provide ecological data. "We have much to learn from our colleagues at KORDI," said Wetzel, "South Korea has a long history in the utilization as well as the need to conserve marine habitats because as a nation they are so dependant on the resources of the sea and tidal flats."

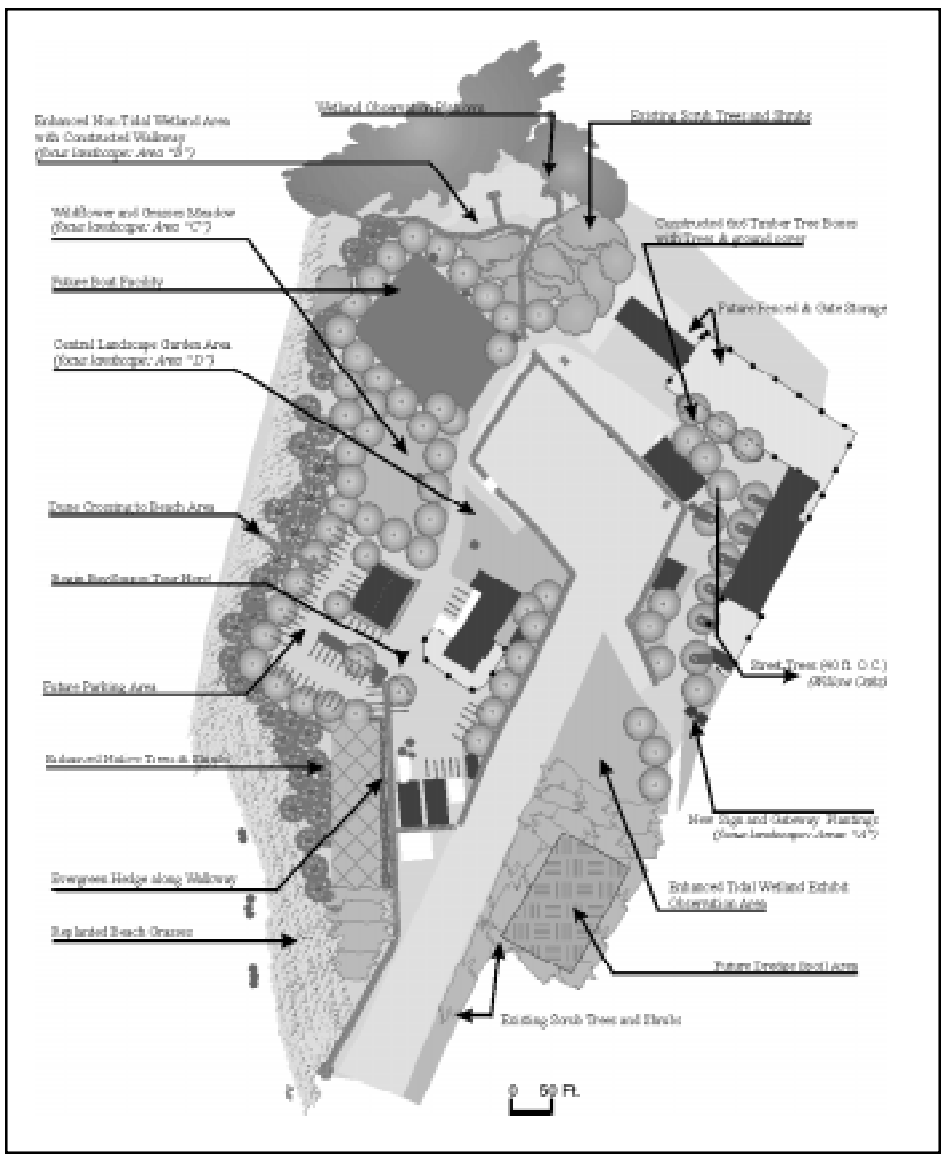
KORDI is one of five international marine research institutes with whom VIMS has agreements to share scientists, data and students.

Educational Landscape Center

Plans are well underway to create an educational landscape center in the VIMS boat basin. “This is an excellent opportunity for us to practice what we preach,” says Dr. Carl Hershner, Chair, Department of Resource Management and Policy. “One of the practices we routinely recommend is environmentally sensitive landscaping to minimize impacts of shoreline development.” This practice includes using native plant species that are adapted to the local climate, require minimal maintenance, and need almost no fertilizers or pesticides to flourish.

All of the planned onsite activities, along with their associated structures make the boat basin an excellent area for demonstrating various aspects of managing waterfront development. Spread over the boat basin site are examples of almost every kind of shoreline structure, various types of wetlands, different kinds of best management practices for stormwater and sediment control, and examples of approaches to design of marinas, boat maintenance facilities, and dredge material containment areas. The landscape project will utilize all of these opportunities for teaching, by developing educational pathways and appropriate signage to maximize the potential of the site. The landscaping is designed to incorporate as many examples of wetland and shoreline plants as possible to support both graduate and outreach course offerings in coastal botany.

The project is designed to be implemented in stages as facilities in the boat basin area are improved. Much of the work along the shoreline will be undertaken this year, with the interior of the site planned for completion following replacement of the bulkhead. Some elements of the project such as the small teaching marsh, the dredge material rehandling basin, the aquaculture isolation facility, and vessel maintenance facilities will be constructed as funding is identified. The overall goal is to develop the site as a working marina, research area and educational site.



Plans for renovations to VIMS Boat Basin and the Environmental Landscape Center.

Searching for Tiny Giants

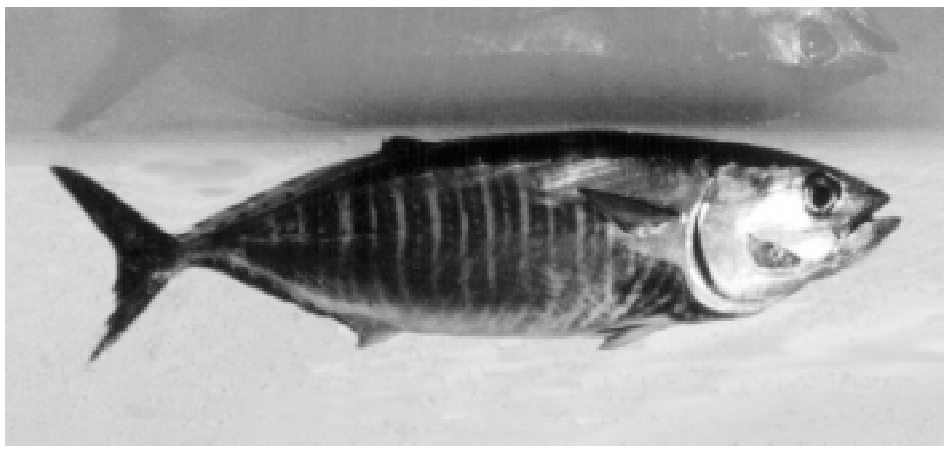
By Dr. John Graves

Of all the tunas, the bluefin tuna *(Thunnus thynnus)* is the largest and most valuable. Giant bluefin tuna reach weights in excess of 1500 pounds, and individuals have sold at auction in Japan for more than $20,000—quite an incentive for the commercial fishery. Bluefin tuna are also highly prized by recreational fishermen, noted for its fighting ability as well as excellent table fare. Of course, being popular with both commercial and recreational fishermen has its down side—in the Atlantic Ocean bluefin tuna are severely overexploited. It is estimated that today there are less than one-fifth of the breeding individuals there were in 1975!

Bluefin tuna are managed by the member nations of the International Commission for the Conservation of Atlantic Tunas (ICCAT). ICCAT scientists have divided Atlantic bluefin tuna into separate western and eastern Atlantic stocks, with the eastern stock being about ten times as large as the western stock. The existence of separate western and eastern stocks is based primarily on the presence of distinct spawning grounds in the Mediterranean Sea and Gulf of Mexico. Conventional tagging studies indicate that bluefin tuna cross the Atlantic, but it is not known if adult bluefin tuna consistently return to the same area to spawn. Understanding if bluefin tuna demonstrate spawning site fidelity is fundamental to the assumption of two stocks.

Researchers at VIMS, Texas A&M University, and the University of Maryland are using powerful, new techniques to analyze genetic variation and the chemical composition bluefin tuna otoliths (ear bones) in a collaborative effort to elucidate bluefin tuna stock structure. If bluefin tuna exhibit spawning site fidelity, the distribution of variation of rapidly evolving genetic markers should be different between samples of fish that spawn in the Mediterranean Sea and Gulf of Mexico. Because the chemical composition of the waters of the western and eastern Atlantic are slightly different, detailed chemical analysis of bluefin tuna otoliths, which incorporate elements from the seawater in which the fish swim, should provide information on where a fish was spawned.

Both the genetic and chemical studies require samples of bluefin tuna that are known to be of the eastern or western Atlantic stocks. That is not an easy order to fill! Bluefin as young as one year old may have crossed the Atlantic Ocean in either direction, so catching a fish in the east or west does not necessarily mean it was spawned there. To be certain of the origin of a fish, researchers are focusing their analyses on very small bluefin (young-of-the-year) that could not have traversed the Atlantic (see picture at right). Hopefully, studies of these tiny bluefin will unlock some of the mysteries about the movements and behaviors of their giant relatives.



Twelve-inch bluefin tuna captured off Oregon Inlet, NC, in the fall of 1998. This is a young-of-the-year, spawned late spring or early summer 1998 in the Western Atlantic Ocean.

Environmental Toxicology and Risk Assessment

By Dr. Michael Newman

A new web site and two short courses will soon be completed by the VIMS Environmental Toxicology and Risk Assessment (ETRA) Group. They will greatly enhance VIMS advisory service in the area of environmental risk assessment by providing a web site containing key information and hot links, and by providing specialized training to resource managers. Currently such information is scattered across the global computer network and risk assessment literature, obligating the resource manager to spend many days accumulating enough information to assess the risk from contaminants.

The VIMS ETRA Group will teach two short courses this summer: Quantitative Methods in Environmental Toxicology, and Practical Statistics of Environmental Measurement. They will familiarize resource managers, risk assessors, and students with current methods of evaluating environmental chemistry and toxicity data.

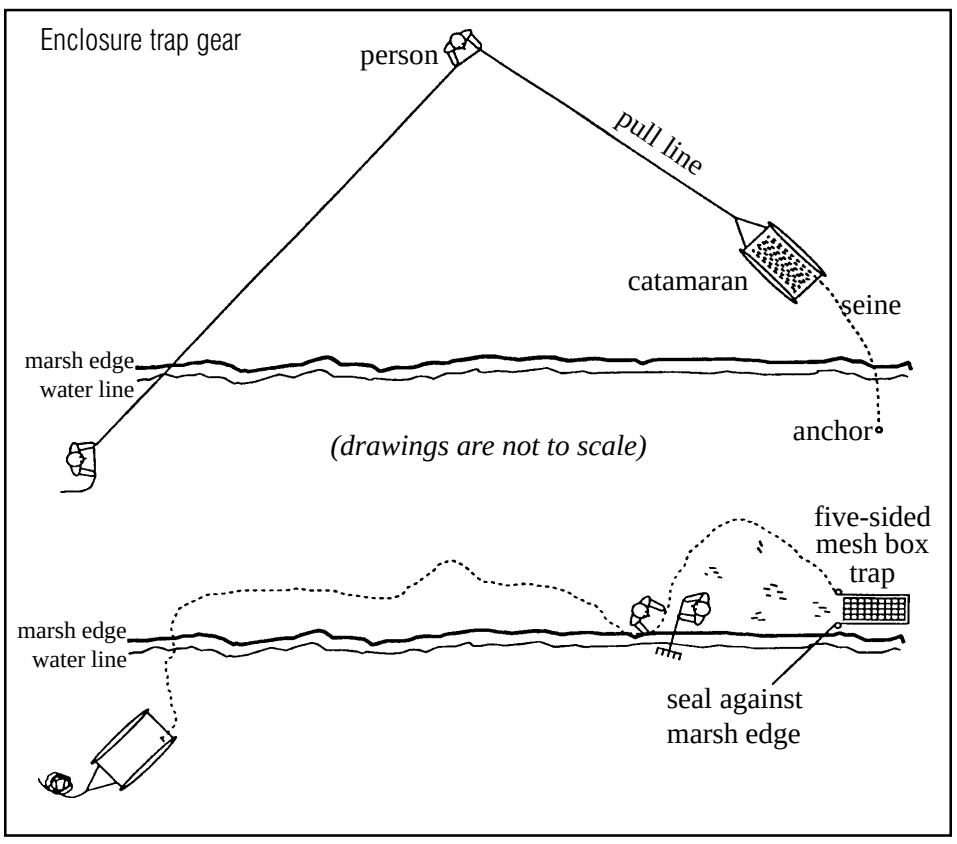
The web site and more courses will continue to be developed. The chemical agent component of the risk assessment web site is nearing completion. Future plans are to expand the site to include risk information for infectious agents, habitat modification and introduced species. Next summer another course, The Basics of Environmental Risk Assessment, will be added to the VIMS short courses. It will provide living resource managers and students with a working knowledge of the risk assessment process as applied to chemical contaminants.

The global environmental community is quickly shifting to a risk assessment context for making sound decisions about the dangers associated with pollution and the resources to be spent on clean up. The risk assessment tools and training for regional resource managers being developed and implemented by VIMS is a key service to managers in the Bay area.

Farewell to a Fellow

By April Bahen

Giancarlo Cicchetti, a recent VIMS Ph.D student, finished a research project for the Chesapeake Bay National Estuarine Research Reserve in Virginia (CBNERRVA) that involved identifying and quantifying large nekton (free-swimming organisms; fishes and blue crabs) that utilize erosional marsh edge habitat at a pristine site, the Goodwin Islands, in the CBNERRVA. An erosional marsh edge does not gradually slope, but drops off a couple of feet into the water with the sides unvegetated; like the edge of a bluff. At the bottom of the erosional marsh edge is an unvegetated flats area which grades into a sea grass bed. Of the three areas, the marsh edge was chosen as a study site for larger organisms because it proved to be the area of greatest activity.



The project began in 1997 and was a partial continuation of his dissertation project on the quantification, utilization and trophic interactions of nekton and crabs in three groups of habitats, salt marsh, unvegetated flats, and seagrass beds, at the Goodwin Islands near the mouth of the York River. In other words, he numerically demonstrated how fish and crabs use different habitats and how energy was transferred between the fish and crabs. The CBNERRVA project filled in some of the gaps for which Cicchetti's dissertation project did not account and also filled a void for the CBNERRVA research program concerning the quantification of fish populations and habitat utilization in the reserve sites.

Though a connection between the two projects can be concluded, Cicchetti was not attempting to show a definite connection between the two projects because he did not sample larger fish numbers at both sites. It is relatively safe to assume that, at times, larger fish would pass through the more gently graded slope areas to get to the erosional marsh edge or use the less graded areas to feed since these two types of gradation usually alternate on a saltmarsh edge.

In Cicchetti's research, the sampling method used a 1 ½ meter diameter galvanized sheet metal drop ring suspended from the front of a boat on a boom. This was dropped into the water and cut into the substrate trapping everything within the ring. The only problem with this method was that it sampled a small area and did not trap many large fish. Therefore, Cicchetti felt the second project was necessary to fill in the gaps of finding out what larger organisms used the habitats.

In the CBNERRVA project, a 5' long, 3' wide Catamaran was used that had a spool of 1/4" mesh net off the stern. The net was pulled out by hand in a triangle shape with the marsh edge making up one of the sides of the triangle. The net making up the other two sides was then walked towards the marsh edge and the organisms were funneled into a bag attached to the end of the net which was placed at the marsh edge. (See figure above.)

During this research, Cicchetti identified which animals lived in the habitat and which were only using the habitats at certain times for certain purposes but not living there. The CBNERRVA project concluded that all of the larger organisms were transients.

Export of organisms was examined quantitatively by examining gut content to determine energy flows amongst the organisms and between habitats. Export is the concept of certain organisms primarily being found in a studied habitat moving into or through another habitat with the possibility of becoming food for the animals in a second habitat. It is also the concept of animals from an outside habitat coming into the habitat being studied and taking animals as food from the studied habitat. In the case of Cicchetti's work, he was looking at animals that would leave the three main habitats, for example silversides, and become prey for species such as striped bass. He also looked at animals outside of the main habitats, such as a speckled sea trout, moving into the sites and eating animals from the studied sites, such as striped killifish.

Sampling device developed by Giancarlo Cicchetti for his research.

The projects are important firsts because there has been very little research done on small fringe marshes such as the ones Cicchetti was sampling. In the past, larger marshes that could hold tidal creeks have been the area of study, while the smaller fringe marshes were not studied possibly due to fact that these areas are not easy to sample.

Conclusion

Cicchetti's work showed that these creekless, fringe marsh areas are very important not only to the trophic interactions of the animals within the studied areas, but also to those in adjacent deep water habitats that abut the salt marshes, unvegetated flats, and sea grass bed habitats. Many of the larger organisms that use the studied habitats are commercially important species. So, not only is it important to preserve these areas for ecological reasons, but also for resource management/commercial purposes.

The only situations where one finds a salt marsh gently sloping out onto an unvegetated flat and then into a sea grass bed is in a pristine environment. Many of these areas have disappeared and have been replaced by bulkheads. In some instances, there have been attempts to restore these areas. The Army Corps of Engineers uses their dredge spoil to partially fill in shallow water areas that are adjacent to land to create the gentle slope that comprises the natural salt marsh fringe, unvegetated flats, and sea grass bed gradation. Preserving or restoring as many fringe marsh areas as possible is important because they provide nursery and feeding grounds and are areas of high production for coastal communities.

Aquarium Auction

On January 16 more than 200 people turned out for the first ever VIMS auction. With support from more than 50 local businesses and contributions from numerous VIMS faculty and staff, the auction raised approximately $10,000 for the Aquarium and Visitor Center. Carrie Garland organized the event with assistance from the VIMS Docent Guild and VIMS employees Libby McDonald and Sharon Dewing.

Musician Steve Bennett provided entertainment during the evening.

The Aquarium and Visitor Center has been under renovation since June 1998. Proceeds from the auction will be used to re-stock the aquariums and develop new exhibits. Throughout the spring exhibits and animals will be installed. Curator Patrick Richardson is also proceeding with plans to open the Aquarium and Visitor Center on weekends during the summer.

Responding to the Chesapeake Executive Council Directive for Wetlands Protection and Restoration Goals

Dr. Carl H. Hershner

"By this directive, we reaffirm our commitments ... to take steps to achieve a net resource gain as a long-term goal for wetland restoration in the Chesapeake Bay basin, recognizing the role wetlands play in the overall health of the Bay and its living resources."

With this statement, the Chesapeake Executive Council, committed partners in the Chesapeake Bay Program to an aggressive effort to halt the loss of wetlands in the watershed, and to reverse the trend by restoring and creating wetlands. Virginia, Maryland, and Pennsylvania each committed to development of a jurisdiction- specific strategy for achieving net gain goals. The first iteration of this strategy is due in December of this year, with updates in 2000 and every five years thereafter. The states also agreed to identify quantifiable goals for a net gain in wetlands acreage and function by the end of 1999.

To assist states in development of their strategies for achieving net gain goals, the Bay Program Wetlands Workgroup developed a template for strategy content. The template is not intended to be a rigid outline for the state plans, but rather is designed to suggest content which would be useful in making the plans consistent across the watershed. The template suggests six elements.

The first element is a Goal and Objectives Statement for the state. The 1997 Chesapeake Bay Program Directive identifies a no net loss, net resource gain in both acreage and function goal. It is assumed that this will be the starting point for each of the states.

Inventory and Assessment of Wetlands Resources is the second element recommended for the strategy. This section would provide a brief overview of the historic and/or current wetlands resources of the state. It provides a context for the no net loss/net resource gain goal, and may provide some rationale for targeting of management and restoration efforts (e.g. regional concentrations of losses of a particular type of wetland, or regional opportunities for restoration of certain types of wetlands).

Evaluation of Existing and Needed Protection Mechanisms is potentially the most critical element in the initial state strategy document. This section would identify what is currently being done in wetlands management and what can/needs to be done to achieve the state goals. Given that effective achievement of a "no net loss, net resource gain" goal will generally require more than just regulatory program activity, it is important for the state to identify nonregulatory programs which impact wetland resources. In many areas, the most significant gains in wetland resources will be derived from nonregulatory programs.

Strategy Development and Implementation Plans is the actual identification of what will be undertaken. The Workgroup suggested that states particularly consider four things in their strategy: ways to address losses; ways to achieve gains; education/outreach programs; and information management (mechanisms for tracking and reporting strategy implementation).

Monitoring Progress will generally involve two activities: field inventories of wetland resources to track natural changes; and record keeping of regulatory and nonregulatory program activities to track anthropogenic changes. The Bay Program is currently considering a proposal to initiate a status and trends monitoring program based on remote sensing of the entire watershed. This is expected to capture the general trends in the resource. Individual states are expected to desire more accurate tracking of the regulatory and nonregulatory program impacts than will be available through remote sensing, and so will probably emphasize record keeping protocols.

The final element in the recommended strategy template is a glossary of terms. This is important primarily to facilitate interjurisdictional data sharing. Since there will be a desire to view the status of the resource at a watershed scale, it will be important that there be some consistency in the protocols for identification of wetland losses and gains.

Dr. Burreson Participates in Meeting in Thailand

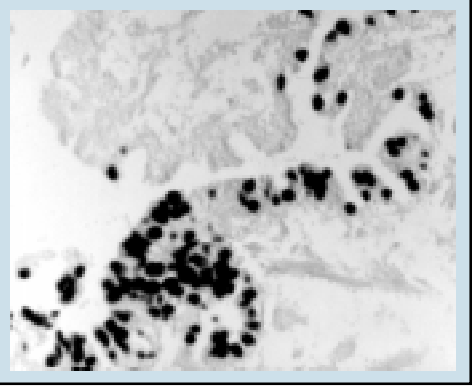
Dr. Eugene Burreson, Director for Research and Advisory Services, was one of 15 scientist worldwide selected to participate in a recent meeting to address the need for standardization and validation criteria for DNA-based molecular diagnostic techniques for the detection of aquatic animal pathogens and diseases. The panel was convened at the Network of Aquaculture Centres in Asia-Pacific, Bangkok, Thailand, by the United Nations Food and Agricultural Organization. Dr. Burreson was the only invitee with expertise in molecular diagnosis of molluscan diseases.

Dr. Burreson and colleagues at VIMS have developed molecular diagnostics for the detection of important oyster pathogens in the Chesapeake Bay region. These diagnostic tools have revolutionized rapid and specific diagnosis of *Haplosporidium nelsoni* (MSX Disease) and *Perkinsus marinus* (Dermo Disease). At the meeting, it was recommended that VIMS be named the International Reference Laboratory for diagnosis of Perkinsus and Haplosporidium infections in molluscs. These infections occur worldwide and VIMS is internationally recognized as the world leader in diagnosis of these pathogens.

Many disease-causing organisms of aquatic animals can be difficult to detect in their hosts using traditional diagnostic methods. Using recently developed tools that detect the parasite's genetic material, DNA, these organisms now can be more easily identified.

There are two types of DNA-based disease diagnostics. Polymerase chain reaction, or ***PCR***, finds a particular portion of a parasite's DNA within a mixture of host and parasite DNA and copies it millions of times. This amplification allows detection of the parasite, much like PCR used in forensic science allows identification of an assailant from DNA of bodily fluids collected at a crime scene. ***DNA probes*** also find a certain region of DNA, but instead of making copies they have special tags attached so that the bound probe can be seen when looking at the sample with a microscope. PCR tells if the parasite is somewhere in the sample, while DNA probes show the exact location of the parasite in the host tissue. The accompanying picture shows the MSX DNA probe bound to MSX cells in tissue from an infected oyster. The MSX cells appear black because of the tag attached to the DNA probe.

VIMS Disease DNA Lab is currently working on creating these tools for the dinoflagellate *Pfiesteria,* which has recently been implicated as a causative agent in fish kills, and for the hard clam disease QPX.



John Morrissey

Juvenile tiger shark.

Workgroup on Endangered Species

In March, a small international group of senior scientists with expertise in fish populations will meet at VIMS to begin work on an American Fisheries Society (AFS) initiative to define endangered marine fishes in North America. The group will try to find ways to answer the critical question: What quantitative criteria can be used to estimate risk of extinction? The American Fisheries Society has information on more than 60 stocks considered at risk because of habitat decline or overfishing. Dr. Jack Musick, Professor of Marine Science, Department of Fisheries Science, is leading the dozen scientists from the United States, Canada and Australia. "We are looking at both late maturing species and all species with threatened habitat," said Musick who is currently co-chair of the Shark Specialist Group of the International Union for the Conservation of Nature. Others participating include Dr. Carl Safina, Head of the Living Ocean Campaign, National Audubon Society and Marta Nammack, a former VIMS student and currently with the Office of Protected Resources, National Marine Fisheries Service. The workgroup is sponsored by the Pugh Charitable Trust and the National Marine Fisheries Service. The workshop is scheduled to coincide with the Tidewater American Fisheries Society meeting enabling members of the workgroup to interact with local AFS scientists.

Calendar of Events

—March—

5-7 Science Museum of Virginia Bay Days
Broad Street Richmond
VIMS Exhibits

10 Peninsula Center, Oyster Point Series, 12 Noon (bring lunch)
Dr. Stan Allen: Genetic Engineering and Aquaculture

11-13 American Fisheries Society Meeting, Tidewater Chapter
VIMS

—April—

3 Daffodil Festival, Gloucester County

21 Peninsula Center, Oyster Point Series, 12 Noon (bring lunch)
Dr. Herb Austin: Status and Trends in Commercial and Recreational Fisheries

24 Garden Week Tour
VIMS Educational Landscape Center

28 Mini School of Marine Science: Special Topics
Science Museum of Virginia: Richmond
Dr. Gene Burreson: Oysters In Virginia: Past, Present and Future
Dr. Roger Mann: The Rapa Whelk in Virginia Waters

—May—

1 Oyster Fair '99
Christchurch School, Middlesex County

5 Mini School of Marine Science: Special Topics
Science Museum of Virginia: Richmond
Dr. Rom Lipcius: Blue Crabs
Dr. Robert Orth: Marine Habitat: Sea Grasses

12 Mini School of Marine Science: Special Topics
Science Museum of Virginia: Richmond
Dr. Wolfgang Vogelbein: Aquatic Disease

—May (con't)—

12 Peninsula Center, Oyster Point Series, 12 Noon (bring lunch)
Dr. John Graves: Current Issues in Billfish Research and Management

19 Mini-School of Marine Science: Special Topics
Marcia Berman: Comprehensive Coastal Inventory
Scott Hardaway: Shoreline Erosion Strategies

22 VIMS Open House
10:00 AM – 4:00 PM

22 Responsible Landscaping for Wildlife, Water Quality and Profit Workshop,
York River State Park, featuring new Nature Plant Arboretum

—June—

1, 8, 15 Mini School of Marine Science: Native Plants
Gloucester Point Campus

4, 11 Responsible Landscaping for Wildlife, Water Quality and Profit Workshop,
York River State Park, featuring new Nature Plant Arboretum

6-12 20th Annual Meeting of the Society of Wetland Scientists
Norfolk Marriot, Norfolk, Virginia

19 Native Plant Workshop
VIMS Educational Landscape Center
10:00 AM – 3:00 PM

26 Science for Donors Day
VIMS

28-July 1 Master Oyster Gardener's Course
VIMS

For more information call 804/684-7101 or 804/684-7011
Visit our website: http//www.vims.edu

Dangers to Blue Crabs Accelerating

By James Schultz

Once thought invulnerable, Virginia's blue crab population is apparently in decline. According to a new VIMS study, the numbers and size of spawning adult females decreased substantially in the mid to late-1990s.

For instance, numbers have declined about 70 percent while size has been reduced approximately 10 percent. Since the number of eggs a female produces is proportional to size, smaller females produce fewer offspring. Depopulation appears, therefore, to be accelerating, given a convergence of adverse conditions, from environmental to human-induced.

"We've concluded the blue crab is being heavily exploited. We're deeply concerned about the status of the spawning population," says study leader Dr. Romuald Lipcius, VIMS Associate Professor of Marine Science. "You can get a high recruitment of juveniles from a relative few adult females, but it may lead to a false sense of security. The fishery could collapse if a low spawning stock is hit by something like a tropical storm or intensified fishing rates."

The study has analyzed data from the VIMS trawl survey from 1979 to 1998. Researchers stress that the current slump is not a matter of a low point in a low cycle. Rather, the historic lows seem part and parcel of a persistent long-term decline.

"Most thought that environmental influences outside the Bay controlled recruitment," Lipcius points out. "We are now convinced that spawning stock has been impacted by human influence."

Solutions To Budding Crisis

In part, crab harvesting has increased due to better technology. Land-based shedding operations can accommodate larger numbers of animals, in controlled conditions of salinity, temperature and oxygen content. Consumer demand remains robust, particularly for soft-shell crabs.

Considering the economic value of the blue crab fishery, and as part of a pending VIMS proposal to the Virginia Marine Resources Commission, Lipcius and his colleagues will propose a comprehensive plan utilizing sanctuaries in the nurseries and spawning grounds, and dispersal corridors linking the two. The deep-water "dispersal corridors" are migration pathways to the lower Chesapeake Bay that should protect up to 25 percent of spawning adult female blue crabs.

At the heart of the proposal is the idea that fishing can and should continue, but at a reduced rate. "It's a selective protection with minimal impact on crabbers," Lipcius explains. "What we're trying to do is recommend something that would be equitable across all the fisheries."

Lipcius believes there's still time to prevent the blue crab from going the way of the oyster. "It is better to be aggressive and proactive than to invite disaster by waiting for definitive information that population collapse has actually occurred." he says.

"In the past, managing fisheries in a risk-prone way has led to collapses. We have to manage in a risk-averse fashion," Lipcius contends. "We feel we could be pretty close to the edge of the cliff with reference to the blue crab. This is the most serious situation I've seen in the 12 years I've been here."

Todd Mathes, Department of Fisheries Science, measures a blue crab during a monthly VIMS Trawl Survey.