

MARINE NOTES

SPOTLIGHT ON RESEARCH

Land Use and Water Quality: *Connecting Ecology and Economics*

BY MERRILL LEFFLER

As land use goes, so goes the health of Chesapeake Bay — and, for that matter, the health of estuarine and near-shore waters throughout the world.

Land in the Bay watershed, as it has been progressively cleared for agriculture and urban development, has become a conduit for eroding soils and contaminants that flow directly into streams and rivers or indirectly through groundwater seepage that leads to the Chesapeake. An estimate put forward by the Maryland Department of the Environment several years ago held that for every acre of forest cleared

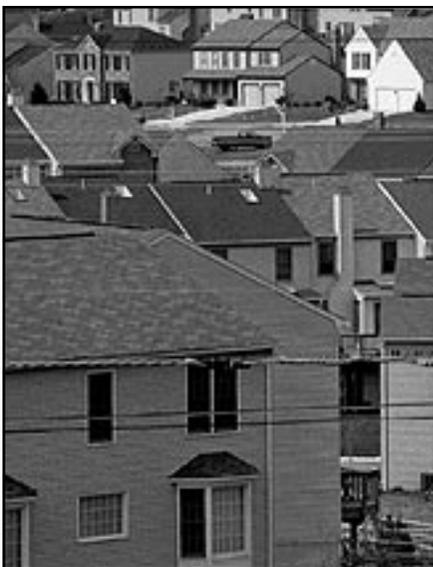
for development, some 240 to 420 pounds of sediment enter the Bay.

The impacts of this runoff on the Chesapeake have been as various as they are many — loss of underwater grasses and habitat for fish, depletion of oxygen and changes in food webs are only a few examples.

Old Problems, New Approaches

That water quality depends on land use is not new news. A major aim of the Chesapeake Bay Program, like aquatic restoration programs around the nation, has been to stop
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Land Use, *continued*

soil erosion and slash nutrient loading in runoff and groundwater.

The newer news, however, is that researchers have begun to detail just how different land uses affect soil erosion and nutrient transport to estuaries like the Chesapeake. In the Rhode River, for example, a sub-estuary of the Bay's western shore, David Correll and his colleagues at the Smithsonian Environmental Research Center have for some years been measuring runoff through forests, pastures and crop lands.

"Many studies have been done of nutrient cycling and flow through specific ecosystems," says Correll, "but few have analyzed nutrient flows through landscapes containing several different kinds of ecosystems." Long-term measurements are critical, since flows can vary enormously from year to year. As Correll pointed out in a recent workshop on Land-Use Effects in the Mid-Atlantic Region, one pasture area on the Rhode River discharged an average of 100 to 200 parts per billion nitrate during 1989-1991; during 1982 and 1992, however, the mean nitrate concentrations discharged from the same pasture were from 1,000 to 1,300 parts per billion. These wide-ranging variations, the result of an-

nual rainfall differences as well as natural differences in similar-use landscapes, could be missed in short-term monitoring.

Correll's work in the Rhode River and other watersheds in the Bay basin is providing the kind of numbers that clearly demonstrate how pastures, crop land and forest stands radically affect soil erosion and nutrient flow into the Bay. Such measurements provide the kind of detail needed to construct mathematical models that can predict impacts of different types of land development on water quality.

Of Maps and Models

Models, says Robert Costanza of the Chesapeake Biological Laboratory, part of the University of Maryland's Center for Environmental and Estuarine Studies (CEES), are like maps. "They are abstract representations of complex territory. While no one map or model is right for an entire range of uses," he points out, "their usefulness can best be judged by their ability to help solve the navigational problems you are interested in." What kind of navigational problems? Perhaps the effect of clearing pasture land for residential and business development in a large river system; or the impact on a local creek of clear cutting a forest stand

for a new golf course.

The ability to better predict how proposed changes in land use are likely to affect aquatic health could give planners and resource managers new tools for trying to balance economic development, growth and environmental protection. That ability could give a more rational basis for designing zoning regulations or reaching decisions on new roads or waste treatment plants.

Costanza and his colleagues at CEES and the University of Maryland's Institute for Ecological Economics have been constructing sophisticated computer-based models that can account for the effect of different types of land uses in a large watershed. Such modeling depends on the technology of geographical information systems, or GIS. GIS is a computerized system for digitally storing, manipulating and analyzing "snap shots" of land or water features from maps and, increasingly in recent years, aerial and satellite-based photography. Land features include such information as its use (forest, crop, residential), elevation and slope, and types of soil that can then be displayed in numbers of different ways.

Costanza and Thomas Maxwell have constructed a "spatial" model that can calculate the flow of water, soil and nutrients through a complex mosaic of different land uses. The

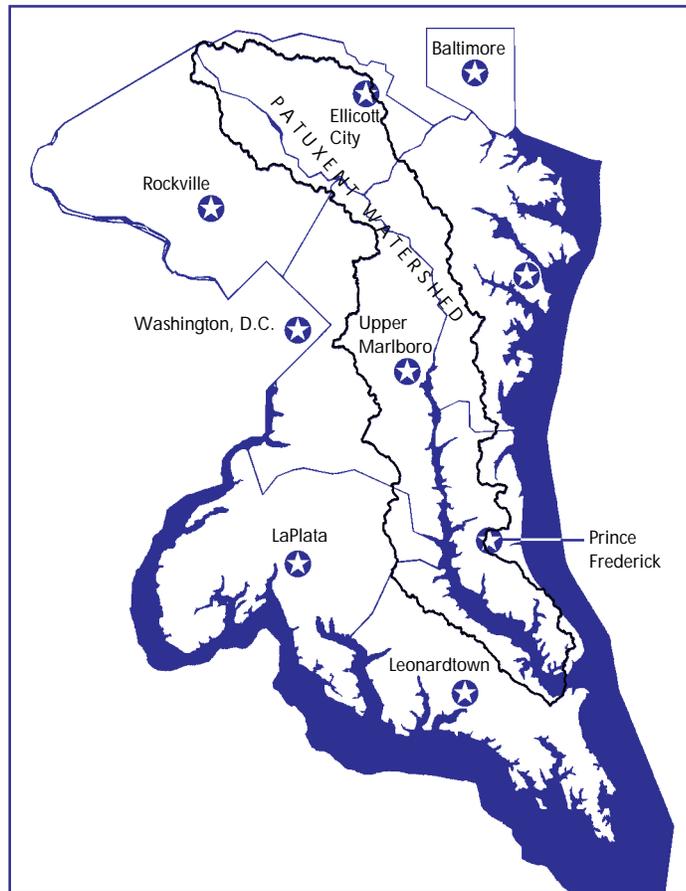
model first divides the landscape into cells of some 100 acres each; based on GIS information, each cell is then assigned a particular use — for instance, forest, cropland, pasture, residential — together with a corresponding set of ecological characteristics. (The quality of the assigned ecological conditions depends on long-term measurements and analysis, such as those that Dave Correll has been doing in the Rhode River.)

At the heart of such spatial modeling is the ability to simulate the vertical and horizontal movements of water, soil and nutrients. Using specially designed software programs that Costanza, Maxwell and Ed DeBellvue have been developing, the model can calculate the horizontal exchange of flows among adjacent cells and vertical flows above and below the sediment for different types of land use and climatic conditions.

Modeling the Patuxent River Watershed

Over the last several years, Costanza, Maxwell and DeBellvue have applied their efforts to a Patuxent Landscape Model and related models. The Patuxent Model can mathematically mimic the effect of past land-use changes on water quality and then simulate the effects of proposed changes — for example, the clearing of forests or conversion of agricultural lands for commercial development or new roads or residential housing. They have been using GIS data, produced by the Maryland Office of Planning, data that show striking land use changes between the early 1970s and today.

The Patuxent River's headwaters originate in Montgomery and Howard counties and meander about 70 miles through seven counties before emptying into the Chesapeake at Solomon's Island. The 926-square-mile Patuxent watershed is a complex mix of rapidly growing urban and suburban development, agricultural lands and forests — some 46 percent is forested and 32 percent is in farmland. It is a watershed in which population doubled between



Surrounding one of Maryland's most heavily used rivers, the Patuxent Watershed drains a rapidly changing landscape. Researchers like Robert Costanza and Nancy Bockstael are creating new ways to predict changes in the 926-square-mile watershed, where development is spreading outward from large urban areas. (Map courtesy of Nancy Bockstael, Department of Agricultural Resources, University of Maryland, College Park.)

1970 and 1990. With this population growth has come the conversion of agricultural lands and forests for housing, businesses, roads, shopping centers. The resulting changes in the flow of water and soil off the land make their impact in degraded water quality, loss of underwater grass, and the smothering of fish and shellfish habitat.

Linking Economics to Ecology

For the most part, ecological models like the Patuxent Landscape Model, while they are used to run different scenarios of land use changes, generally ignore the way human behavior affects changes in land use, says Nancy Bockstael, an environmental economist with the Department of Agricultural and Resource Economics at the University of Maryland College Park. Ecologists, she says, might analyze the effects of changes in land by compar-

ing the watershed in 1980 and 1995, or they can assume changes that are likely to occur in the future and run their model to see what the impact will be. Those models, however, are not designed to analyze behavioral factors that influence land use change — they impose human behavioral change hypothetically.

As Robert Gardner, a landscape ecologist at the CEES Appalachian Research Lab, points out, economic factors "are often a dominant force affecting landscape change." At the same time, "the pattern of resources in a landscape often dominates economic development." Ecologists, he says, often ignore the connections between economics and ecology.

With recent support from the Environmental Protection Agency, Bockstael and Costanza have teamed up to connect ecological modeling with economic modeling. Perhaps the most important contribution of

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A Chronology of Environmental Decisions and Major Studies Related to the Chesapeake Bay



1960 — Maryland departments of Chesapeake Affairs and Economic Development are created.

1965 — Department of Water Resources established.

1968 — The first Chesapeake Bay Water Quality Conference is held.

1970 — Maryland enacts Tidal Wetlands Law.

1971 — Sediment Control Law is enacted.

1972 — Federal Water Pollution Control Act (Clean Water Act) is enacted by Congress.

1975 — Maryland enacts conservation easement legislation.

1976-1982 — Baywide study funded by the U.S. Environmental Protection Agency (EPA).

1977 — The second Chesapeake Bay Water Quality Conference is held.

1980 — Maryland and Virginia establish the Chesapeake Bay Commission.

1982 — Maryland enacts the Stormwater Management Law.

1983 — EPA Study research results released. The Chesapeake Bay Agreement (CBA) is signed by Maryland, Virginia, Pennsylvania, Washington, D.C., Chesapeake Bay Commission and the EPA.

1984 — Maryland enacts the Critical Area Act. Bay Liaison Office opens.

1987 — The 2020 Commission is selected and an objective for 40% reduction in Chesapeake Bay nutrient loading is signed by CBA participants.

1989 — Nontidal Wetlands Act is enacted in Maryland. Commission on Growth in the Chesapeake Bay Region is formed.

1990 — Federal Coastal Zone Management Act (1972) is amended to address nonpoint source pollution.

1991 — Maryland enacts Forest Conservation Law.

1992 — Maryland enacts the Economic Growth, Resource Protection and Planning Act. CBA endorses the Tributary Strategy Plan.

1993-1994 — Maryland's ten Chesapeake Bay tributary basins begin developing plans.

1997 — Maryland's Tributary Strategies will be reevaluated to determine progress made.

Land Use, *continued*

the economists, says Bockstael, is to model human land use conversion and how it is related to both the ecological and economic features of the landscape.

Working with Ivar Strand and Jackie Geoghegan, environmental economists at College Park, Bockstael is trying to develop a model that will "predict future land use changes in a specific area given such information as its history, zoning and other land use restrictions, features of the surrounding landscape, and its level of regional economic activity." With such information, she says, "we can predict the probabilities that a parcel of land with certain characteristics will stay in its present land use or convert to alternative uses." For example, scenarios can be developed which examine how different zoning strategies can affect the probability of land use conversions.

Such modeling can help us in other ways, says Bockstael. Suppose nutrient management became mandatory for all agricultural lands — "such a policy could drive more land out of farming, thus increasing the probability of conversion to an alternative use," she conjectures. The economic model could be used to predict the probabilities of such land conversion; it would then drive the ecology model to assess the affects of that land conversion on water quality. It could be, she points out, that alternative uses might have a more negative impact on aquatic health.

Integrating the ecological and economic models is no simple feat. To begin with, says Jackie Geoghegan, the Patuxent Land Model operates on a time scale of a day or less. "The economic models," she points out, "work on an annual basis. This means that the timing of the exchange of information and these different time scales must be carefully thought out." There are also issues of geographical scale. "The ecosystem model divides the study area into cells of some 100 acres each, but for land use conversion decisions, this is much too large



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relative to individual parcel size," she says. The models are being estimated independently and will eventually be linked in the simulation stage.

The Future

Policies designed to protect the health of coastal waters or other ecosystems are often based on economics, politics and best guesses about ecological impacts of changes in land use. New modeling approaches aim at giving a firmer ground to best guesses that could influence future development.

A major conclusion of the 1991 Governor's Commission on Growth in the Chesapeake Bay Region was the key role of land use to Maryland's environmental future: "How people use Maryland's land determines the fate of Chesapeake Bay." The Commission recommended that development be directed away from farms, forests and other important environmental resources and proposed concentrated development as opposed to sprawl.

According to Ed Risse of Synergy

Planning, Inc., for example, if Fairfax, Virginia (with its suburban sprawl development), were settled like the planned community Reston, Virginia (with its medium density development), two-thirds of Fairfax would likely still be open land available for recreation, agriculture or future planned development. Also, there would have been far less need for extensive roads, new schools or other infrastructures, a potentially large savings for taxpayers.

What are the specific effects of such different types of development on water quality? What are the effects on runoff? On nutrient loading? On fisheries? It is such questions that new developments in modeling may be able to help answer. For planners and policy makers, such capabilities may make it possible to forecast the effects of development and to make better tradeoffs among politics, economics and the environment — achieving a balance that will ultimately save money and help protect the health of the Chesapeake Bay. ■

Columbus Center Researchers Move In

The Columbus Center, a spectacular research center located by the waters of Baltimore's Inner Harbor, opened the doors in mid-March for its first occupants — scientists specializing in marine biotechnology. The \$160 million Columbus Center, which will continue to open in phases over the next year, will be the only national center dedicated exclusively to marine biotechnology research and education.

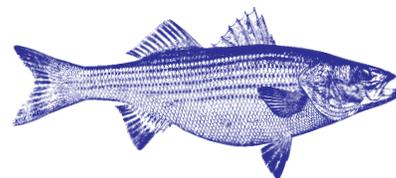
The first phase of the center's opening began with the moving of researchers, professors, students and scientific equipment into the 257,000-square-foot building. Dr. Rita Colwell, president of the University of Maryland Biotechnology Institute (UMBI), and Dr. Madilyn Fletcher, executive director of the Center of Marine Biotechnology (COMB), as well as other COMB researchers, have received international recognition for their work in marine biotechnology.

In their new Columbus Center home, researchers plan to generate practical, and potentially profitable, discoveries from the richness of life in the world's oceans. Applications of their work include increasing seafood production, engineering microbes to remove environmental contaminants, designing new pharmaceuticals, and developing new industrial products of commercial value.

"As a scientist, I can't tell you what an exciting opportunity this is," said Yonathan Zohar, whose research on the fundamental processes of finfish endocrinology holds promise for advancing hatchery production of such species as striped bass.

The Columbus Center's mission includes three components: re-

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Columbus, *continued*

search, education and reaching out to the public to spread the excitement of scientific inquiry. After the official opening of the Columbus Center's research component this spring, the Science and Technology Education Center (SciTEC) will open this fall for students throughout the Baltimore region. The Columbus Center's public grand-opening will take place in the spring of 1996, when its Hall of Exploration becomes the Inner Harbor's newest attraction. The Hall of Exploration is designed to teach the public about marine science and research at the Columbus Center. Among other unique experiences, it will feature a 20-foot walk-through rockfish, a working waterfall and a horseshoe crab theater.

STORM Center Collects Data

A new center, called the Storm Tracking and Observational Reports to Media (STORM) Center, uses a network of volunteers to collect data on the impact of storms on beaches.

Established in 1994 by Stephen P. Leatherman, Professor and Director of the Laboratory for Coastal Research at the University of Maryland, College Park, the center is funded through a grant from the Climate Prediction Center of the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service. The volunteers, or STORM Watchers, are located in communities along the east coast of the United States, and are a diverse group of

people of all ages, including many retirees. Landscape architects, students, engineers, educational coordinators, professors and many other people concerned about the future of their beaches are among those participating.

STORM Watchers visit their assigned beach location weekly to collect data and fill out a storm impact reporting form. These data are invaluable for comparison between pre-storm and post-storm data. They send the forms in monthly via computer, mail or fax to the STORM Center for analysis. When the National Weather Service forecasts storm events, STORM Watchers make additional observations, especially before and after the event. These include flooding/overwash measurements, wind conditions and unusual occurrences. In some cases, they take video and/or photographic records of the beach.

The results of the STORM Center's analysis are available for use by television, radio and newspaper staff reporting on storm events, scientists from federal government agencies such as the National Weather Service, state agencies and local governments, by universities and high schools and by consulting firms and landscape architects.

For information about the STORM Center, or if you would like to become a STORM Watcher, contact Lora Schleicher at: Laboratory for Coastal Research, University of Maryland, 1113 LeFrak Hall, College Park, Maryland 20742, phone 301-405-4074.

Computers and Kids Track Migrations

The NOAA National Marine Sanctuaries and Estuarine Research Reserves program is enlisting the help of children to track the migratory patterns of waterfowl and marine mammals. The children gain from early exposure to biology and telecommunications while the sanctuaries benefit from the collected data.

In a program called "Journey North," the Stellwagen Bank National Marine Sanctuary in Massachusetts

has schoolchildren assisting in the collection of data on the migratory patterns of the Right Whale and waterfowl. As well as providing valuable observations for the reserve, the program establishes telecommunications as a teaching tool in the classroom.

Gray's Reef National Marine Sanctuary, which has a similar program tracing the Right Whale, shares its information with Stellwagen Bank. In Oregon's South Slough National Estuarine Research Reserve, a local elementary school monitors migratory birds on the reserve. They then send out the information for other participating elementary schools along the west coast and in Mexico. Tom Gaskill, education coordinator for the reserve, believes the program helps the local school children to see beyond their immediate, rural surroundings.

Seedlings at Cost



The Maryland Department of Natural Resources Buckingham Forest Tree Nursery in Harmans, near the Baltimore/Washington Airport, offers seedlings at cost to individuals

and organizations, with a minimum of a quarter acre of land. Citizens are encouraged to plant trees as windbreaks, to improve wildlife habitat and control erosion, and to buffer streams for the prevention of pollution. Neighbors can join together to plant along their property lines, and communities are encouraged to plant seedlings in media strips, parks and other common areas.

Seedlings are offered in minimum quantities: 250 conifer seedlings in multiples of 50, and 100 hardwood seedling in multiples of 25. There are dozens of species available and for the first time, some species are being offered at even greater savings.

Those interested in purchasing seedlings for planting this spring should contact Buckingham Forest Tree Nursery at 1-800-TREES-MD.



Oyster Disease Research Program Workshop

The Chesapeake Bay's renowned oyster industry virtually collapsed in the late 1980s, although landings had been gradually declining for nearly a century. From Baywide harvests exceeding 100 million pounds in 1880 — when the Bay's virgin oyster bars were heavily exploited by sailing schooners — landings have plummeted to well under 100 thousand pounds a year. And although overharvesting greatly contributed to the demise of the fishery, oyster diseases have exacted a more recent and devastating toll.

A Targeted Response

Largely in reaction to economic losses associated with the collapse of the oyster fishery in the Chesapeake Bay, Congress enacted legislation in 1991 to support research on oyster diseases. The \$1.5 million for the Oyster Disease Research Program, though appropriated yearly by Congress since 1991, was included in the Administration's budget only for 1995. The current budget, for 1996, does not include a separate appropriation for oyster disease research, and funding remains uncertain.

For the current year, plans for oyster disease research are receiving input from a wide range of stakeholders, guided by a steering committee comprised of representatives from NOAA's Chesapeake Bay Program Office, the Virginia and Maryland Sea Grant Programs, the U.S. Department of Agriculture, the Chesapeake Bay Program Living Resources Subcommittee, and representatives from the west, northeast, and mid-Atlantic oyster industry.

To set research priorities for this year — and to develop a long-range strategy for the oyster disease program — the steering committee, in January 1995, convened a planning workshop hosted by the Virginia and Maryland Sea Grant programs.

Researchers pointed out that chief among their scientific accomplishments to date has been the

ability to culture *Perkinsus* ("Dermo") in the laboratory. This breakthrough has markedly enhanced researchers' ability to study the parasite, just as new, rapid diagnostic methods for both Dermo and MSX have facilitated studies of distribution and prevalence of the disease.

Other oyster disease research has enhanced scientists' abilities to identify oyster stocks with natural genetic resistance to Dermo, an essential first step in the development of disease-resistant strains of oysters. Investigators have also made progress in understanding the physiological aspects of host-parasite interactions.

A Difficult Charge

The number of issues to be covered is wide ranging and complicated. Conference attendees agreed on several major topics related to oyster disease: disease life cycles, host-parasite interactions and mechanisms of disease resistance; development and application of diagnostic methods for all diseases of oysters; environmental influences on disease processes; taxonomy, phylogeny, and population genetics of both host and parasites; development and application of selective breeding strategies;

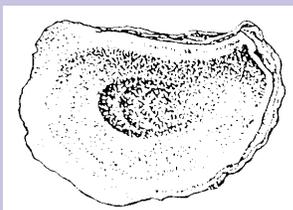
development and testing of geographic and mathematical models to improve understanding of disease dynamics; and the design, application and evaluation of disease management strategies for enhanced protection (including transfer of aquaculture technologies).

Although research to date has focused primarily on the two parasitic oyster diseases — Dermo and MSX — causing the greatest mortalities in oyster populations on the East coast, William Rickards, Director of Virginia Sea Grant, noted that the program's research awards are not restricted to these two diseases. Any disease that causes significant declines in the oyster fishery is important, he said. According to Rickards, the program especially encourages inter-institutional and multi-investigator approaches.

For information about the oyster disease program, call Virginia Sea Grant (804- 924-5965), Maryland Sea Grant (301-405-6371) or the NOAA Chesapeake Bay Office (410- 267-5661).

Elizabeth Hens, Virginia Sea Grant, contributed to this article.

Parasites Devastate Oyster Populations



Two protozoan parasites — **Dermo** (*Perkinsus marinus*) and **MSX** (*Haplosporidium nelsoni*) — are responsible for the majority of disease-related oyster mortalities in the Chesapeake Bay. These parasites, though harmless to humans, are deadly to oysters. Both pathogens prefer high-salinity waters (salinities greater than 15 ppt), but the range and virulence of the diseases vary

from year to year, depending on climate and rainfall. In general, Virginia has lost more oyster resources to disease than has Maryland because of higher salinity waters.

Infections from both diseases usually occur in the summer between an oyster's first and second year, and generally intensify during the second year, killing the oyster before it reaches market size. MSX is typically found in waters from Massachusetts to South Carolina; Dermo, from the Chesapeake Bay to Florida and around the Gulf of Mexico. Although the life-cycle of Dermo has been described by scientists, the mode of transmission for MSX remains unknown, despite years of scientific research.

Bay-Wise Campaign Launched



The Maryland Sea Grant College and Maryland Cooperative Extension Service have teamed up with the Maryland Department of Agriculture in a public outreach program designed to reach hundreds of thousands of homeowners on gardening techniques that can help protect the Chesapeake Bay.

The outreach effort includes three 30-second video public service announcements produced by Maryland Sea Grant on the need for controlling soil erosion, minimizing fertilizer use and trying alternatives to pesticides. Viewers are asked to call an 800 number at the University of Maryland Cooperative Extension Service's Home and Garden Information Center for new fact sheets on backyard actions they can take to protect the Bay.

Audio tapes of the announcements are also being provided to radio stations and MDA has sent hundreds of posters advertising the program to libraries and public agencies throughout the state.

For copies of the brochures, contact Maryland Sea Grant at 301-405-6376 or the Home and Garden Information Center at 800-342-2507.

Conferences, Etc.

Restoring Oyster Reefs

In Williamsburg, Virginia, on April 23-26, researchers, managers and others will gather to discuss the restoration of oyster reefs in the Chesapeake Bay.

Everyone knows that the Eastern oyster is in trouble. Oyster reefs which once lined the edges of estuaries like the Chesapeake are largely gone, decimated by overharvesting, disease and environmental degradation. Attempts to keep a sustainable fishery going in the Chesapeake virtually collapsed when diseases such as MSX and Dermo — beginning in the 1950s but especially since the mid-1980s — began to kill vast areas of oyster grounds in Virginia, Maryland and elsewhere.

Underlying the decline of the Eastern oyster is the oyster reef. Like corals in tropical waters, the oyster is a reef-building animal. Before commercial harvesting intensified in the 19th century, reefs broke through the surface of the water — in some areas, they could be a hazard to navigation. Exactly what role the oyster reef played, not only for the oyster but for the Bay as a whole, remains the subject of intense speculation. Many feel that the oyster reef

provided key habitat for a number of Bay species, helped to filter and therefore clear the Bay, and in general served a pivotal role in the health of the Bay ecosystem.

In order to examine the role of oyster reefs and the attempt to bring them back, the Virginia Institute of Marine Science (VIMS), College of William and Mary, will host the three-day conference, "Oyster Reef Habitat Restoration," in Williamsburg. The conference, organized by VIMS and the Virginia Marine Resources Commission, is supported and sponsored by a number of organizations throughout the Bay, including the Sea Grant programs of Virginia, Maryland and South Carolina, the Chesapeake Bay Foundation, NOAA, EPA and others.

The conference will begin at the beginning — with presentations about the distribution of oysters from the Pleistocene to the present. The presenters will turn their attention to restoration efforts not only in the Chesapeake Bay (Maryland and Virginia) but also in Louisiana, Alabama, Texas, South Carolina, North Carolina, and elsewhere.

On the second day, presentations will focus on the functions of oyster reefs as three-dimensional structures and their importance in coastal ecosystems. One session will also focus on oyster diseases, a key — some might say *the* key — to restoring oysters along the East Coast.

The third day — a half-day — will end with a discussion of economics, including "nonindustrial" reasons for restoring the Chesapeake Bay oyster.

Registration for the entire meeting, which will be held at the Williamsburg Marriott Hotel, is \$65. For more information, call Mark Luckenbach, VIMS, 804-787-5816 (e-mail: LUCK@vims.edu).



Research/Extension

Regional Research Program

The Mid-Atlantic Regional Marine Research Program (RMRP) is continuing to pursue ways to facilitate the exchange of information between and among marine research institutions and management agencies within the region. In response to the Mid-Atlantic Research Plan, which identified data management, synthesis and interpretation as a high priority need for research methods in the mid-Atlantic region, the program has completed a series of activities related to information transfer. A technical report on "Data Management in the Mid-Atlantic Region," commissioned by the Mid-Atlantic RMRP, is now available.

This technical report represents a first step in regional data management by recommending the actions needed to ensure efficient utilization of marine-related data and information by scientists and managers within the region. In addition, as examples of the regional strategy and recommendations in this report, the Mid-Atlantic Research Plan, along with the Mid-Atlantic Research Inventory, are currently available in a hypertext version for PC Windows. This and other electronic forms of the Research Plan will soon be available via ftp at the new Mid-Atlantic World Wide Web and gopher addresses: <<http://www.mdsg.umd.edu>> and <<gopher.mdsg.umd.edu>>. For more information, write to the Mid-Atlantic RMRP, 2200 Symons Hall, University of Maryland, College Park, Maryland 20742.

Recreational Boating Provides \$1 Billion Impact in Maryland

Maryland recreational boating expenditures total \$1.01 billion annually, stimulating new economic activity totalling some \$980 million annually in the state of Maryland, according to the results of a Maryland Sea Grant study released in Annapolis at the 17th Annual Maryland Marine



Trades Conference.

Led by Douglas W. Lipton, Coordinator of the University of Maryland Sea Grant Extension Program, the report finds that, on average, boaters of all classes each contribute \$5,136 annually to the state economic output. Those expenditures generate over 18,000 full-time equivalent jobs in the Maryland economy, and 34 percent of the expenditures result in actual wage payments and compensation to Maryland residents.

Maryland state and county governments benefit as well with sizable tax revenues from the recreational boating expenditures. The state and local income tax generated is \$4.3 million, an amount that is in addition to an estimated \$3 million in taxes paid directly by the boaters themselves. This tax revenue does not count state excise taxes on boat sales, or local slip taxes.

Funded through the cooperative efforts of the Maryland Boating Administration of the Maryland Department of Natural Resources and the Marine Trades Association of Maryland, the study aimed at evaluating spending by boaters, and determining how that spending affects both the state economy and Maryland businesses, from marine-related firms such as marinas and boat dealers to restaurants and service establishments. Support for the analysis was also provided by the Maryland Sea Grant College Program and the University of Maryland Cooperative Extension Service.

Overall, boaters spend over \$1

billion annually in boating activities. The study breaks those activities into three main areas: \$438 million spent on boating trips for items such as boat fuel, food and lodging, fishing supplies, clothing and equipment; \$428 million spent on boating-related expenditures such as slip fees and maintenance; and \$144.5 million spent in the purchase of either new or brokered used boats.

The study focuses strictly on the activities of registered and documented private recreational boats in Maryland during the summer of 1993, and does not take into account the additional impact that transient boaters and others who spend money with Maryland marine trade industries likely have.

According to Lipton, the study means that the boating industry is showing signs of rebounding from the deep recession of the late 1980s and early 1990s which means good news for Maryland's economy. Lipton plans on updating the Maryland study annually based on new figures on boating registrations and price inflation.

The results of the study have been published in a report titled, *Recreational Boating in Maryland: An Economic Impact Study*, by Douglas W. Lipton and Scott Miller. Copies of the publication are available for \$5.00. For more information about the study or to order a copy of the report, call Maryland Sea Grant, 301-405-6376, or fax a request to them at 301-314-9581.

SCOPE Workshop

A recent workshop on estuaries and coastal ecosystems, convened under the auspices of the International Council of Scientific Union's (ICSU) Scientific Committee on Problems of the Environment (SCOPE), brought researchers together to refine our approach to understanding the ecological responsiveness of these dynamic systems.

According to Donald Scavia,

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Workshop, *continued*

Director of NOAA's Coastal Ocean Program, whose program provided partial support for the workshop, "I hope that we can begin to develop synthetic assessment mechanisms for estuaries collectively that build on limited or inconsistent information obtained from studying estuaries individually. This workshop is a first step in doing this." Also contributing support for the workshop were the National Science Foundation and the National Research Council.

Organized and chaired by John Hobbie of the Ecosystems Center, Marine Biological Laboratory in Woods Hole, Massachusetts, the meeting brought together 38 estuarine and coastal scientists including the following individuals with Maryland ties: Donald Boesch, Walter Boynton, Steven Brandt, David Correll, Bob Costanza, Chris D'Elia, Ed Houde, Mike Kemp and Tom Fisher.

The results of the workshop on Estuarine Synthesis, held from February 23-26 at the National Academy of Sciences' Beckman Center in Irvine, California, will be published this year in a SCOPE book.

Sea Grant Programs On-Line



Since its inception, Sea Grant's primary role has been to serve as a conduit for new knowledge — knowledge that can answer pressing questions about such issues as coastal hazards, threatened fisheries and seafood safety. Sea Grant supports a wide range of scientific and technical research and interprets the results of that research for policy makers, resource managers and those in marine-related businesses.

Sea Grant programs have produced a variety of materials, from award-winning videos, radio programs, newsletters and magazines to

books and fact sheets. Workshops sponsored by Sea Grant help those in the commercial fishing industry learn current safety techniques — lessons that have saved lives. Sea Grant fact sheets and how-to videos help aquaculturists, seafood processors and others sharpen their skills and improve their chances of contributing to the marine economy.

Sea Grant offers a direct pipeline into the large network of universities engaged in marine research and policy studies as well as providing a direct link to the nation's main ocean agency, the National Oceanic and Atmospheric Administration (NOAA).

By contacting Sea Grant, resource managers, educators and citizens can find information about fisheries, aquaculture, marine engineering, marine biotechnology, new marine product development, marine ecosystem research, marine education materials, seafood processing and seafood safety, and a range of other marine-related topics.

Placed in universities in every coastal region of the country, Sea Grant works from the bottom up to provide information about local and regional issues. Taken together, the Sea Grant programs represent a national resource, a wealth of information for business and education and an aid to the wise management and use of our common marine resources.

In addition to the traditional print and nonprint media, Sea Grant has recently begun to use the electronic superhighway. Many Sea Grant programs now have individual home pages on the World Wide Web, grouped under regional home pages. They are working diligently to make their resources available electronically. If you're interested in sampling what's available from Sea Grant, log on to the home pages listed below.

NORTHEAST REGION

MIT Sea Grant College Program

Web server: <http://web.mit.edu/afs/athena/org/s/seagrant/www/mitsg.htm>

Contact: Kathy deZengotita: kdez@athena.mit.edu

Woods Hole Oceanographic Institution Sea Grant Program

Gopher server: gopher.who.edu (port 70)

Web server: <http://www.who.edu/html/who.html>

Contact: Tracey Crago: tcrago@who.edu

MID-ATLANTIC REGION

Mid-Atlantic Region Network (Maryland, Virginia, New Jersey, Delaware, North Carolina)

Web server: <http://www.mdsg.umd.edu/>

Contact: Dan Jacobs (MD): jacobs@mbimail.umd.edu

SOUTHEAST REGION

Florida Sea Grant College Program

Web server: <http://gnv.ifas.ufl.edu/~seaweb/hp/basicpag/basicpag.htm>

GREAT LAKES REGION

Ohio Sea Grant College Program

Web server: <http://www-ohio.osc.edu/seagrant.html>

Wisconsin Sea Grant Institute

Web server: <http://h20.seagrant.wisc.edu/home.html>

Great Lakes Information Network (GLIN)

Web server: <http://www.great-lakes.net/2200/o/glinhome.html>

AquaNIC (Aquaculture Network Information Center at Purdue)

Gopher server: gopher://thorplus.lib.purdue.edu/11/databases/AquaNIC

PACIFIC REGION

Alaska Sea Grant College Program

Gopher server: info.alaska.edu, to Univ. of Alaska, to Univ. of Alaska Fairbanks, to Sea Grant

Web server: http://info.alaska.edu/UA/UA_Fairbanks/SeaGrant

Contact: Carol Kaynor: fnck@aurora.alaska.edu

Hawaii Sea Grant College Program

Gopher server: gopher.hawaii.edu (under UH College Information Services)

Oregon Sea Grant College Program

Gopher and Web server addresses will be available Spring 1995

Contact: Joe Cone: conej@ccmail.orst.edu or Lori Larsen: larsenl@oes.orst.edu

NOAA

National Sea Grant College Program

Web server: <http://www.noaa.gov/> to Office of Atmospheric Research to Office of Oceanic Research Programs to National Sea Grant College Program

End Notes

Noteworthy



■ **Jobs.** *Marine Educator, University of Georgia Marine Extension Service, Skidaway Island, Georgia.* The Marine Education Center on

Skidaway Island offers marine science programs to K-12 groups, junior college and college students, educators and elderhostelers. The person hired for this position will instruct students and teachers in lecture, laboratory and field trip settings and prepare lectures and course materials on complex marine science topics.

Qualifications desired include an Ed.D., Ph.D. or Masters degree in science education with a minimum of five years teaching experience and a strong publications record. The salary range is \$32,000-39,000 for the 12-month, non-tenure track position. To apply, send by *April 30, 1995*, a letter of application, current vita or resume and four letters of reference to: Director, Marine Extension Service, Room 29, Ecology Building, The University of Georgia, Athens, Georgia 30602-2206.

■ **Seminars, Etc.** *Researching Environmental Law: A Comprehensive Workshop on Information Sources and Research Techniques.* In an intensive two-day workshop at The George Washington University's Jacob Burns Law Library, June 1-2, November 16-17 and December 7-8, participants will learn how to locate and use printed and on-line sources of documents that constitute the body of federal environmental law.

The workshop will review the major environmental laws and the Federal rule-making process; it

also introduces sources and strategies critical to researching state and international environmental law. Designed for environmental professionals, the workshop costs \$575 (paid at least 14 days in advance) or \$600. For registration information, call 202-223-1111.

Publications, Etc.

■ **Vanishing Lands.** A new 47-page booklet, *Vanishing Lands: Sea Level, Society and Chesapeake Bay*, describes the history, science



and human impact of sea-level rise.

The attractive booklet is designed for teachers and others interested in how rising sea levels and eroding shores can reshape the coastline, especially in an estuary such as the Chesapeake Bay. The booklet was produced by Stephen Leatherman and others at the University of Maryland's Laboratory for Coastal Research, in conjunction with the U.S. Fish and Wildlife Service.

Vanishing Lands can be used as a companion to the video of the same name, produced earlier. Both the video and the book cite examples of vanishing Bay islands, and current land use practices that threaten the natural evolution of wetlands and other vulnerable

areas at the water's edge.

Copies of the booklet are free while they last. Call the Fish and Wildlife Service at 410-573-5583, or write them at 177 Admiral Cochran Drive, Annapolis, Maryland 21401.

■ **Stream Restoration Handbook.** The Izaak Walton League of America's Save Our Streams (SOS) Program recently published *A Citizens' Streambank Restoration Handbook*. This 111-page book by SOS Director Karen Firehock teaches citizens about stream ecology, assessing watershed pollution problems, enlisting technical assistance and designing a stream restoration project that uses vegetation and natural stream forces to improve habitat and water quality and restore aesthetic values. The handbook also includes project budgeting information, case studies of successful SOS restoration projects, and an extensive bibliography.

According to Firehock, "America's streams have been diked, dammed, channelized and piped underground — destroying critical fish and wildlife habitat. *A Citizen's Streambank Restoration Handbook* provides alternatives to these destructive practices."

To order, send a check for \$15, payable to the Izaak Walton League of America to: 707 Conservation Lane, Gaithersburg, Maryland 20878-2983 or call (800)Bug-IWLA for more information.



Calendar

APRIL

16-22 — National Week of the Ocean

National Week of the Ocean is sponsored by a Fort Lauderdale-based group dedicated to educating young people to develop a sense of stewardship towards the ocean. It is chaired by astronaut/aquonaut Scott Carpenter.

National Week of the Ocean members encourage year-round ocean study from the arts to commerce, history, foods and endangered sea creatures to issues such as offshore drilling or ocean dumping. Once an interest is developed, those involved are encouraged to take some action, with preservation of the ocean as the goal. Those who wish to implement an event-oriented goal can order celebration kits for \$5.00 each. Topics include a campus-wide Week of the Ocean; a School Marine Fair to showcase student projects; or a community festival such as that held annually in Fort Lauderdale. For more information, send a self-addressed, stamped #10 envelope to National Week of the Ocean, Inc., P.O. Box 179, Ft. Lauderdale, Florida 33302.

22 — Tree-Mendous Maryland Tree Planting

Chesapeake College, Easton. The Department of Natural Resources will conduct a free "Tree Planting and Care and Maintenance"

workshop which will teach participants to select species and sites as well as site, prepare ground, maintain trees, including proper pruning, fertilization, mulching and insect and disease control. Participants will work in the classroom as well as do hands-on activities outdoors. The workshop is part of the Tree-Mendous Maryland program to encourage tree planting. The registration deadline for the workshop is April 17. For more information or to register, call Tree-Mendous Maryland, 410-974-3776.

23-24 — Oyster Reef Habitat Restoration

Williamsburg, Virginia. To examine the role of oyster reefs and the attempt to restore them, the Virginia Institute of Marine Science (VIMS), College of William and Mary, will host a three-day conference, "Oyster Reef Habitat Restoration," supported and sponsored by a number of organizations throughout the Bay, including the Sea Grant programs of Virginia, Maryland and South Carolina, the Chesapeake Bay Foundation, NOAA, EPA and others. For conference details, see page 8. Registration for the entire meeting, which will be held at the Williamsburg Marriott Hotel, is \$65. For more information, call Mark Luckenbach, VIMS, 804-787-5816 (e-mail: LUCK@vims.edu).

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