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MARINE NOTES

SPOTLIGHT ON RESEARCH

Multispecies Management in the Chesapeake Bay — A Far Future?

BY MERRILL LEFFLER

Ten years ago, Maryland banned the taking of striped bass from its portion of Chesapeake Bay— at least until clear signs indicated the fishery was recovering, Maryland's controversial action was part of a Congressionally backed restoration plan that required states from Maine to North Carolina to make major changes in striper fishing in their coastal waters. Those changes included raising the minimum catch sizes — in some cases from 18 inches to 32 inches — and reducing the daily creel limit. The aim was to allow striped bass to mature so they could return to their native rivers in the Bay to spawn. And they have.

Today striped bass are back, and the state has declared the fishery recovered. A rare success story — and a heartening one at a time when the Chesapeake's oyster fishery has been nearly eliminated and concern is mounting over a possible decline of blue crabs. Only recently, however, have questions been asked about the implications of the striper recovery for the productivity of the Bay ecosystem as a whole, for the abundance of other popular species, bluefish and weakfish, for example. Does the increasing abundance of stripers mean anything with respect to the prey they all go after — anchovy and menhaden and crabs, for that matter?

Some fishermen have speculated that diminishing crab stocks—if in fact they are decreasing—could have more to do with voracious predation by stripers than human predators. This conjecture was based on large numbers of small crabs found in the stomachs of some striped bass.

There has not yet been evidence to support the argument that stripers have put a dent in the crab population, at least according to studies by the Maryland Department of Natural Resources and the Virginia Institute of Marine Science. Though those studies are probably right, says Ed Houde, a fisheries scientist at the Chesapeake Biological Lab, part of the University of Maryland's Center for Environmental and Estuarine Studies (CEES), striped bass might be having an impact on crab dynamics. "Historically, you"

(Continued on page 2)

Bluefish, croaker, sea trout, striped bass, menhaden — as one species comes and another goes, does this signal the effects of natural cycles of the impact of fisheries management efforts, or both?

Does a boom for one species mean a bust for others?

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Multispecies Management, *continued*

would guess that they [stripers] had little impact," he says. "But sea grass" habitats have been disappearing in the Bay for years, and young crabs rely heavily on those grasses. Crabs may now be more vulnerable to predation, perhaps far more than they would have been."

Whether or not further research turns Up a significant relation between striped bass and crabs, the issue raises a question that offshore fisheries managers from Georges Bank to the Bering Sea have been struggling to answer for years — namely, does a boom for one species mean a bust for others? How does the harvesting of one fish species affect the abundance and dynamics of other species? And do we need to account for such interactions in fishery management plans in the Chesapeake?

Multispecies Management

Ed Houde and Tom Miller, also at CEES' Chesapeake Biological Lab, have undertaken a literature review and synthesis to ask just that question. With support from the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC), they are focusing on the multispecies nature of Bay fisheries and possible interactions. "The goal," says Miller, "is to ask whether" there is even compelling evidence that we need to adopt a multispecies approach in the Chesapeake."

Some years ago, Harley Speir of the Maryland Department of Natural Resources examined a set of sportfishing data collected in the same location to see if he could detect an inverse relation between striped bass and bluefish catches. If bluefish catches were up, he asked, were striped bass down or vice versa? He found no such connection. For the most part, though, such investigations in the Bay have been cursory, mostly localized, and they've played no part in fisheries management. "We've primarily considered the" effect of removal rates of one species on the abundance of that species," says Speir. "We've never" examined to see if removal of that species will affect other ones." Until now, no multispecies studies, let alone management practices based on multispecies models, have been undertaken in major estuaries like the Chesapeake. Most research has been done in offshore fisheries, for example, Georges Bank and the North Sea. In the North Sea multispecies model.s — such as the Multispecies Virtual Population Analysis — have had an impact on how quotas are set.

Multispecies models often predict results contrary to conventional wisdom — a problem for fisheries managers.

(That commercial fisheries have been collapsing is not a shortcoming of multispecies models, says Miller, as much as the general failure of management practices — simply too many fish being caught.)

"What a multispecies approach" should presumably allow you to do," Miller says, "is to modify the catches" of individual species based upon the removal of other components in the food web." Are there ecosystems" where these ideas are firmly in practice? Not fully, says Miller, who points out that trophic food webs are extraordinarily complex and depend not only on predation and competition among species for a variety of prey, but a host of other factors — climatic conditions, physical proper-ties, let alone human issues of commercial and sportfishing, together with their political implications.

A symposium on multispecies management several years ago in The Hague pointed to these problems directly. From a fishery manager's perspective, while species-interaction models may be conceptually more realistic than managing single species alone, their complexity and the results they produce may run counter to conventional wisdom. As Ed Houde points out, multispecies analysis in the North Sea shows clearly "that most" fish are killed by other fish" through" predation and that "how you manage" top predators such as cod and whiting can have major impacts on other fish in the system." Multispecies models," however, often lack sufficient data, so as realistic as they may be conceptually, they may not adequately represent the ecosystem because of their incompleteness. In the North Sea, for instance, the multispecies model considers only nine species and then only from the post-larval stage — meanwhile, the model treats the North Sea itself as a single box.

Nevertheless, what makes the idea of multispecies management attractive, says Houde, is its taking into account interactions among species and the effects of fishing on relative abundance, predator-prey relationships and competitive relation-ships among species. For example, the harvest of a top predator (like striped bass or bluefish) may allow numbers of its prey species (like menhaden) to increase, affecting populations not only of prey species, but also of species it consumes in the food chain, what ecologists call a cascade effect.

What is the effects of the Bay's changing ecosystem on blue crab stocks? Concern over habitat changes and overfishing have led Maryland Governor Parris Glendenning to institute new harvest regulations specially aimed at protecting female crabs.

The Bay's biggest catch — beyond striped bass, blue crabs and bluefish — ia menhaden, some 200,000 tons a year.

If multispecies management has a future for the Chesapeake, the review and synthesis by Houde and Miller could provide a stepping stone. The two researchers will scour historical records in trying to detect trends over the years among important popular and commercial species, among them, striped bass, bluefish, flounder, sea trout, croaker and blue crab. They will be looking for cycles of abundance and occurrences of explosive growth and collapse. "We will look" to see if there are clear indications of variations in abundance between species that suggest predator-prey interactions," says Miller. "For"instance, if bluefish are abundant, are menhaden less abundant?"

Menhaden and anchovy are major prey of bluefish, striped bass, weakfish and other finfish — they are the two most abundant fish in the Bay and on the whole east coast. Unlike anchovy, which travel in small schools and for which there is no commercial fishery, menhaden are the major commercial finfishery in the entire Chesapeake, some 200,000 tons a year.

Bluefish catches are down along the east coast — multispecies modeling may help to explain why.

Bay harvests of menhaden have remained steady, though there are no limits on those harvests — on the other hand, bluefish landings along the east coast have declined sharply in recent years. Is there any relationship? Right now, it is impossible to say.

Teasing out underlying causes is an important goal of their study, says Miller: "Can we find some-" thing in the data that suggests we need to consider them in unison rather than in isolation — if not for the whole Bay ecosystem, at least for key components?"

For example, he asks, do we see variations in catch related to phytoplankton productivity of the Bay if it is a particularly wet or dry year? "Certain things we can" factor in quantitatively," he says," "like river runoff, seasonal water" temperature, estimates of productivity and sea grass coverage over time." In other words, not all shifts" in abundance will be due to multispecies effects of fishing, predation and competition."We're" not trying to find a single smoking gun," Miller says."

One problem they face is that the historical data he and Houde will be using — records of abundance, for example — weren't collected with their interests in mind. While there are statistics on commercial landings, landings are a measure of catch, not necessarily of abundance. Furthermore, the records on recreational catch are poor to nonexistent. "We will have" to assume fishing effort [the total fishing gear in use over a period of time] was constant or, in scaling, somehow, convert catch statistics to species abundance."

For now, that's the best they can do.

Fisheries Management and Ecosystem Stability

There is another view to multispecies management beyond predator-prey and competitive relationships among fish, one that has to do with the effects of fisheries on the health or the stability of the ecosystem itself. Just how important is the ecological role of certain species — of oysters, for instance; perhaps of menhaden? Such multispecies management considerations are a first step on a long road that could lead to ecosystem-based management of our fisheries.

We have already learned much, in the past two decades, about the interconnectedness of the Chesa peake Bay ecosystem. The widespread decline of underwater grasses and an increase in summer depletion of oxygen in bottom waters, for example — both attributed to excessive nutrients entering the Bay — have meant the loss of healthy habitat for young crabs, oysters and other species. Overnutrification has overfertilized these waters and led to explosive algal growth far beyond the Bay's assimilative capacity. Consequently, a major goal in the cleanup of the Chesapeake Bay is the reduction of nutrients by 40 percent — such reductions, it is hoped, will significantly lower algal production and such consequences as oxygen depletion.

The Bay's poor assimilative capacity, some have argued, may also be due to the near-elimination of oyster stocks and oyster reefs. Several years ago, Roger Newell of the CEES Horn Point Environmental Lab estimated that oyster stocks in

(Continued on page 10)

Science and Ethics

Call them left brain, right brain. Detail people versus big picture people. Verbal or visual. Whatever you call them, those in the sciences and those in the humanities often see the world —come at the world — in different ways.

Professor Ken Tenore, Director of the Chesapeake Biological Laboratory (CBL), one of the laboratories of the University of Maryland Center for Environmental and Estuarine Studies, is trying very hard to bridge that gap, and he is doing so with a sense of mission.

"So many science students have the most minimal training in the humanities," Tenore says, noting that the kind of well-rounded training that scientists received just decades ago has been missing in the high-tech, narrow focus of current science curriculum. "We have lost a generation," he says.

Concerned that a generation of scientists have now been trained without the benefit of a study of ethics, of values, Tenore is determined to do something about this — and he has. Since 1993, with.support from the National Science Foundation, Tenore has overseen the development of a program named "The Solomon's House Project."

That project helped to bring Chris McClellan, a graduate student from Notre Dame University, to CBL this summer to learn more about the day -to-day endeavors of working environmental scientists, and to teach a course to science graduate students in the theories and values of science. "Solomon's House," explains McClellan, refers to more than the location of the laboratory. (CBL is in Solomons Island, Maryland.) It recalls the community of scientists described by the English philosopher Francis Bacon, a community that supplied uncorrupted truth to the inhabitants of Bacon's Utopia, New Atlantis.

Truth, especially of the uncorrupted variety, is hard to come by, notes McClellan, referring to the increasing complexity of the relationship between science and society. "Bacon envisioned a world where" science would not be corrupted by the influences of society," McClellan" says, "but now we understand that" this division [between science and society] is a false one."

"There is still a 'Solomon's" House,"' says Tenore, in the goals," values and ethics of the scientific community, though the relationship between science and society is interwoven and complex.

"The life of a good truth," the

Truth, Science and Ethics

playwright Ibsen once said, "is about ten years."

The conscientious science student may argue that some truths have held out much longer than that, though scientists also know that this year's unpopular hypothesis may turn out to be next year's accepted truth. In a recent article about science and the Chesapeake Bay, Don Boesch, President of the Center for Environmental and Estuarine Studies, referred to a "history of heresies," scientific findings that went against the grain of generally accepted principles, until they were finally incorporated into the public mind. He cites the recognition of nitrogen's importance in the Bay's nutrient budget — once questioned but now accepted — as an example.

How long does it take for such a truth to find its way into the public consciousness? According to Boesch, about ten years.

At the University of Notre Dame, Chris Hamlin and Philip Sloan study the history and philosophy of science, and Hamlin heads an undergraduate program in Science, Technology and Values. They both traveled to CBL during the summer to work with Ken Tenore on expanding the "Solomons House Project" to other environmental laboratories.

"We have been fortunate to have this connection," Sloan says, noting that the connection between those who study the philosophy of science and those who practice the craft of

science is not always strong. Sloan notes that the "integration" of scientists and philosophers "will not be easy."

For one thing," Sloan says, "science" is not a reflective discipline." While philosophers may spend endless hours questioning basic principles, scientists tend to focus on observations— and collecting data.

Grant Gross, head of the Chesapeake Research Consortium, feels that much of the current approach to the ocean sciences grew out of funding patterns during and following the World Wars, the majority of which came from military sources with particular needs—such as mapping the ocean floor.

In fact, according to Grant Gross, scientists probably spend too much time gathering data, and not enough time thinking about what they mean. "The universities have failed us in this" regard as well," he says. Both Tenore" and Gross agree that most funding agencies want to see the gathering of new data, not the processing of old data. Says Gross, "We tend to fund" 'exploration' rather than 'science.'"

The Notre Dame Connection

Ken Tenore's interest in ethics and science led him to spend his sabbatical at Notre Dame as a visiting scholar in the Reilly Center for Science, Technology and Values, where he pursued further study in the philosophy of science. "Many of the terms" we scientists use to describe such concepts as hypotheses come from the tradition of logical positivism — about which we scientists know very little," he says.

Tenore points out that there are elements of science — so-called "cognitive values," such as elegance, simplicity and grace — that are just as central to how science works as the scientific method. He feels that marine laboratories, with their transdisciplinary approaches to problems, provide a natural place for an academic melding of science and philosophy to blossom.

At the same time, Philip Sloan cautions against superficial integrations. "A number of years ago we decided as a society that we had to 'humanize' doctors," he says. The result was not always meaningful — at times required courses in the humanities only presented prospective doctors with what he calls a "veneer" of humanism." The course at CBL taught last summer by Chris McClellan works hard at going beyond the veneer of humanism. Students studied not only the logical underpinnings of science, but also science's social context and the issue of ethics, including fraud and plagiarism. They ended with an examination of environmental ethics.

"We plan to continue this" effort into the future," says Tenore. If courses like these are successful, the next generation of researchers should know much more about ethics and philosophy — and according to Tenore they should make much better scientists.

—JACK GREER

Horton Meets Easterbrook

Well-known write Tom Horton squared off with Greg Easterbrook, author of *A Moment on Earth: The Coming of Environmental Optimism*, during a September debate at the Center for Environmental and Estuarine Studies Chesapeake Biological Laboratory in Solomons Island, Horton, while admiring much of Easterbrook's work, took issue with the notion that we are on the verge of an age of environmental optimism.

He cautioned Easterbrook that they were having this debate in a state that claims the rockfish (striped bass) as its state fish and the skipjack as its state boat. Where else, he asked, would a state university take a terrapin as its mascot? This region has also already seen half of its wetlands disappear, the demise of its once famed oyster industry, and the loss of much of its bottom habitat, especially the submerged grass beds that shallows — putting people in no mood for easy optimism.

One of the most unsettling dimensions of Easterbrook's work, Horton noted, was its appearance at a time when political winds were shifting away from environmental concerns. "This is not his fault," Horton said, "but it is disturbing."

During the lecture and debate, Easterbrook demonstrated an impressive command of acts and figures and presented a convincing case that we have accomplished much in this country to protect air, water and land. He also argued that many reviewers had misunderstood and misrepresented his book — and that some reviewers had even gone so far as to issue retractions. "I support a carbon tax," Easterbrook said, trying to make clear that he was not an anti-environmentalist.

"I came away with a much better understanding of his position," said Wayne Bell, Vice President of CEES, who watched the debate as it was broadcast over the Interactive Video Network (IVN) to Sea Grant, the Horn Point Environmental Laboratory and other sites. "The message that local and national environmental laws have in fact made a difference needs to be heard."

According to Bell and others, Horton made a particularly strong point when he emphasized the importance of local and regional approaches to environmental problems. "Solutions may seem reasonable in the abstract," Horton said, on large temporal or spatial scales, but in the "here and now" the degradation of the places we love takes on much more immediate meaning.

Student of the Chesapeake

Jill Stevenson lifts the lid of a freezer at the University of Maryland'.s Chesapeake Biological Lab, releasing the pungent smell of dead fish. "Isn't she beautiful?" she asks," smiling. From the freezer .she takes the severed head of a sturgeon, its mouth agape, breathing frost.

"A cow," Jill explains, "from the" Hudson River."

One can't help but wonder, looking at Jill's bright and enthusiastic smile, what has brought her to this great enthusiasm for sturgeon, even dead ones.

The answer begins, no doubt, a long time ago, but one important waypoint between Jill's studies in geochemistry at Columbia University and the staring sturgeon in her hands was the summer of 1991. That summer Jill came to the Chesapeake Bay as part of a Maryland Sea Grant Research Experiences for Undergraduates (REU) program, sponsored by the National Science Foundation. Student fellows are paired with researchers on Bay-related science projects, mostly at the University's Center for Environmental and Estuarine Studies and its two Bay laboratories, the Chesapeake Biological Laboratory (CBL) and the Horn Point Environmental Laboratory (HPEL).

During that summer Jill worked with research scientist Jeff Cornwell at the Horn Point Lab, near Cambridge. She worked with others as well, who both challenged her and supported her, she says. The work — on sediments and biogeochemistry — was not easy.

"The exposure to the Bay and" the research community was really important. I also got a very good sense of graduate school," she says." "After that, I decided to wait for a" couple of years [before going back to school]."

She did not wait to go back to Nature. Right out of college, Jill worked with the Conservation Career Development Program, taking urban kids into the woods. "I lived in a" tent," she says, "at the foot of Old Rag Mountain." In her care were" eight young people from Newark, New Jersey. She set them to work on the Old Rag trail with picks and shovels — for nearly six weeks. "We moved a lot of rock," she says. "There were many erosion problems," due to overuse."

For her efforts she won an "Excellence Award" from the Shenandoah" National Park. Working with young people and living outdoors had great appeal, but, she says, "I missed the water."

Drawn back to the 13bay, Jill worked for the Chesapeake Bay Foundation, the largest Bay education and advocacy group in the region. She ran a canoe program for middle and high school students and adults, working out of Harrisburg, Pennsylvania. One important focus was the Susquehanna as it passes through Lancaster County, site of heavy fertilizer inputs to the Bay down-stream. "But I still wasn't .seeing"enough of the Bay," she says." Her next move took her into Maryland, where she helped to manage a CBF education program for the northern Bay.

"I love to watch the changes in the Chesapeake," she says. "The ospreys leaving and coming back. And there are many inspiring people who work on the Bay."

In January 1995, Jill entered graduate school at the University of Maryland, where she now works with David Secor and others on the Atlantic sturgeon. "My whole day revolves around the Bay," she says, adding, "I don't want to leave."

Beyond being near the Chesapeake Bay, Jill wants to make a difference. "The ideal job," she says," is one where I can solve a problem." Graduate school is an important step toward her goal. "Without graduate school," she says, "I couldn't do what I wanted to do."

One important benefit of the REU program, says Jill, was that it helped her decide what to do with her life. "I asked myself, 'Do I really want to do this?"' she says. "Yes," she answers, "I do."

—JACK GREER

S T U R G

That giant 500-pound sturgeon once roamed the bottom waters of the Chesapeake Bay tributaries and were once part of a surprise to tho who associate sturgeon caviar with Russia's Caspian Sea. That these ancient creatures are no longer nat to the Chesapeake should be less o a surprise, conditioned as we are t the impact of human activities on other once-abundant species — oysters and shad and herring and submerged grasses.

Atlantic sturgeon (Acipenser oxyrichus) — which date as far ba as the Cretaceous period 150 millio years ago — have fared even wors perhaps because of their special habitat needs, let alone their peculi biology, says Dave Spector, a fishe scientists at the Chesapeake Biological Lab, part of the Universi of Mary-land System's Center for Environ-mental and Estuarine Studi

Cruising low to the river botto their hanging whiskers on the alert for potential food, sturgeon suck u benthic molluscs, worm, gastropod and other inhabitants of sediment. during spring and summer in the Chesapeake, it is these bottom hab tats that are often starved for oxyge thus making a desert of some stur-geon feeding grounds.

Then there is the matter of the slow sexual maturity — for males, to 12 years, females st least 14 yea If they aren't netted by commercial

ON — LOOKING AHEAD

and recreational fishermen before maturity, females are often harvested at first maturity for their valuable roe. That is the case in the Hudson River where a dozen or so sturgeon fishermen operate operate, according to Jill Stevenson, a graduate student working with Secor. A mature female sturgeon may bring a fisherman two or three thousand dollars for the roe; then there is a market for the flesh as well, known in New York as "Albany Beef."

Even when the sturgeon do reach maturity, they produce a relatively small number of eggs — ten times fewer than the number of eggs produced by striped bass or shad. Furthermore, unlike striped bass which release fertilized eggs into the water, sturgeon deposit their large, sticky eggs on hard surfaces. Siltation of bottom habitats and the loss of submerges grasses may have greatly reduced the areas that sturgeon need to successfully reproduce. There is no evidence of reproduction in Bay waters in more than 20 years — the sturgeon that have been spotted are thought to be visitors from other estuaries where there are still remnant populations.

Despite these seeming odds against restoring sturgeon to the Chesapeake, Dave Secor is an optimist about the potential for success and has been working with the Maryland Department of Natural Resources, with the U.S. Fish and Wildlife Service, with NOAA's National Marine Fisheries Service, with the Hudson River Foundation and with Maryland Sea Grant to try to determine what it will take to bring sturgeon back to the Bay. Such a restoration, he says, will depend on using hatchery-produced sturgeon.

Since 1993, the USFWS Northeast Fishery Center in Lamar, Pennsylvania, has been producing large numbers of juveniles from large sturgeon captures in the Hudson River. While young sturgeon are already being stocked in the Hudson River, some basic questions need answers if there is to be a good chance of survival. What kind or habitats should juveniles be stocked into? What kind of environments would best promote populations to reproduce? Do we even have sufficient habitats in Bay waters anymore?

Overfishing may have reduced sturgeon numbers, but have habitat problems prevented them from reestablishing themselves? For example, how does hypoxia (severe oxygen depletion) in vast stretches of bottom waters in spring and summer affect sturgeon behavior? It is questions such as these that Secor is investigating the lab with small hatchery-reared fish.

Raising young sturgeon has been a new experience and a challenge to keeping them healthy, says Secor. Because they hug the bottom of the tank where everything collects (for instance, uneaten food, feces), they are quite prone to bacterial infection — consequently, he has had to keep the tanks immaculate, while treating the fish with antibiotics. They are now large enough for the first experiments, which will study the combined effects of fish size, hypoxia and temperature on growth and survival. Similar laboratory experiments will be repeated next year as well, to see if older fish respond differently to similar conditions. These experiments coupled with current monitoring of bottom habitats and the feeding habits for Atlantic sturgeon in the Bay. "Habitats in the Bay could be measured in terms of their potential contribution to sturgeon growth.

Within the next couple of years, he hopes, it will be possible to determine those habitats appropriate for tagging and release. "Despite the uncertainty about the success of sturgeon reintroduction in the ChesApeake Bay, we will never know unless we try," says Secor. The disappearance of sturgeon from the Bay, he points out, was brought about by centuries of exploitation and alterations to their habitat. Their recovery would be an important indicator of improvement of water quality, habitat and management of our fisheries resources." MERRILL LEFFLER

Summer Research Programs

Both of Maryland Sea Grant's summer research programs ended in mid-August, when student fellows presented results of their summer's work at seminars held at UM College Park and the Horn Point Environmental Laboratory of UMCEES. The Research Experiences for Under- graduates in Estuarine Processes, supported by a grant from the National Science Foundation, and Fellowships in Ocean Remote Sensing, funded by the National Aeronautics and Space Administration, completed their seventh and fifth years, respectively.

Participants in these programs are recruited nationally; the REU program participants are upper level undergraduates, while the NASA program also supports first or second-year graduate students. Each of the fellows was paired with a scientist-advisor and conducted an independent research project. REU students worked at the CEES Horn Point Environmental Laboratory or the Chesapeake Biological Laboratory,while NASA fellows worked at the Goddard Space Flight Center or on the University of Maryland College Park campus. Each program has an introductory orientation session, as well as regular lectures of interest to the students.

Fellows, their home colleges, research topics and advisors were:

REU:

• **Brian J. Farina** *(Auburn University)* A study of the effect of bivalve suspension feeders and benthic boundary layer flow on nutrient recycling. (Advisor: Dr. Roger Newell, Horn Point Environmental Laboratory)

• **Rebecca C. Feldwlck** *(University of South Carolina)* The release of mercury, copper, and total protein during the decay of the diatom, *Thalassiosira weissf10gii.* (Advisor: Dr. Rodger Harvey, Chesapeake Biological Laboratory)

• **Jennifer R. Gormer** *(Salisbury State University)* The effects of light intensity and nutrient concentration on predation by the mixotrophic dinoflagellates, *Ceratium furca* and *Gymnodinium sanguineum*. (Advisor: Dr. Diane Stoecker, Horn Point Environmental Laboratory)

• **Kevin M. Groskowski** *(Harvard University)* The role of denitrification in the nitrogen cycling of a tidal freshwater marsh. (Advisor: Jeff Cornwell, Horn Point Environmental Laboratory)

• **Shawn S. Jefferson** *(Duke University*) Determination of intracellular aketogluterate, glutamine, and glutamate pools in the N2-fixing marine cyanohacteria, *Trichodesmium* spp. as indicators of stress-status in N-metabolism. (Advisor: Dr. Doug Capone, Chesapeake Biological Laboratory)

The 1995 class of REU students gathers at the CEES Chesapeake Biological Laboratory, part of their summer-long exposure to marine science.

Undergraduate students from around the country come to the Chesapeake Bay to study estuarine dynamics and remote sensing.

• **Tim Kreps** *(Manchester College)* Study of the escape behaviors of the ctenophore, *Mnemiopsis leidyi*, in relation to predation by *Chrysaora quinquecirrha*. (Advisor: Jennifer Purcell, Horn Point Environmental Laboratory)

• **Kathleen M. McDaniel** *(Clemson University)* Salinity, temperature and size effects on habitat preferences of juvenile striped bass. (Advisor: Dr. David Secor, Chesapeake Biological Laboratory)

• **Mila Plasvic** *(University of Vermont)* An investigation of the onset of the protozoan parasite, *Perkinsus marinus,* in the eastern oyster, *Crassostrea virginica.* (Advisor: Don Meritt, Horn Point Environmental Laboratory)

• **Olga Polyakov** *(University of Maryland)* Correlation of hydro- graphic data with wind and riverine forcing events. (Advisor: Dr. Leonard Walsted, Horn Point Environmental Laboratory)

• **Jennifer Stone** *(5alisbury State University)* Effects of simulated predation on zooplankton community structure in mesocosms of three volumes. (Advisor: Dr. Ed Houde, Chesapeake Biological Laboratory)

• **Cary S. Sullivan** *(Coastal Carolina University)* The effect of scale on *Acartia tonsa* egg production and mortality and the initial recruitment of *Acartia tonsa* into the MEERC tank.s. (Advisor: Dr. Mike Roman, Horn Point Environmental Laboratory)

• **Matthew B. Sullivan** *(Long Island University, Southampton)* The effects of salinity on the denitrification rate of Choptank River sediments. (Advisor: Dr. Todd Kana, Horn Point Environmental Laboratory)

• **Laura L. Taylor** *(University of Maryland)* An investigation into the food habits of grazers and predators within SAV mesocosms and their relationship to ecosystem complexity. (Advisor: Laura Murray, Horn Point Environmental Laboratory)

NASA:

• **Karen Zabicki** *(Texas Christian University)* Detection of cyanobacterial blooms using imagery from the Coastal Zone Color Scanner (CZCS). (Advisor: Chris Brown, NASA Goddard Space Flight Center)

• **Lori Keith** *(University of Maryland)* Use of Geographic Information System (GIS) to analyze land use in an estuarine watershed. (Advisor: Lola Olsen,NASA Goddard Space Flight Center)

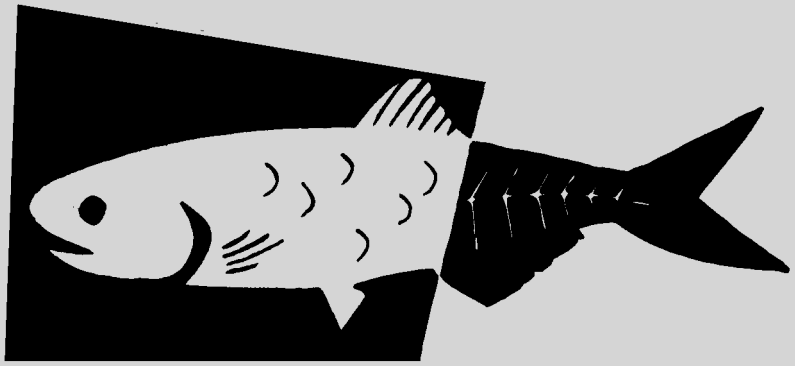
• **Nathan Graf** *(Harvard University)* The influence of dissolved organic material on bio-optical properties inestuarine and coastal waters. (Advisor: Neil Blough, University of Maryland College Park, Chemistry)

• **Paul Griffin** *(Texas AM university)* Models of physical circulation in the Caribbean and E. Pacific. (Advisor: Ji Carton, University of Maryland College Park, Meteorology)

• **Andrea Weiss** *(Brown University)* Interannual variability in the onset of Antarctic phytoplankton blooms using data from the Coastal Zone Color Scanner (CZCS). (Advisor: Kevin Arrigo NASA Goddard Space Flight Center)

• **Eric Luft** *(University of Maryland)* Tracking movements of the Greenland ice sheet using interferograms of Synthetic Aperture Radar (SAR) data. (Advisor: Mark Fahnestock, NASA Goddard Space Flight Center)

Maryland Sea Grant plans to offer both programs again in the summer of 1996, subject to availability of support from the funding agencies. They will be open to students who will have completed at least two years of undergraduate work by summer 1996. The REU is further restricted to students who will be enrolled as undergraduates that summer and are U.S. citizens or permanent residents. Application materials will be available in late 1995; for further information, call Sea Grant at (301) 405-6371.



Can America Save Its Fisheries?

America fisheries may be in the difficult, if not dire, straits, though claims that close to three-quarters of the world's fish stocks are in trouble are "sensationalized." This was the view of Michael Sissenwine, of the National Marine Fisheries Service, who opened Sea Grant's first national forum at the Press Club in Washington, D.C. on September 11 with a description of fishing stocks worldwide. According to Sissenwine, a more accurate if unconsoling figure is that about 40 percent of fish stocks are overutilized.

The Sea Grant-sponsored event, which attracted more than 150 journalists and other attendees, brought together resource managers, fishermen, environmentalists and scientists to explore the difficulties that attend fisheries policy. Those difficulties are not inconsiderable.

"We fight each other on the water," said Native American Billy Frank, Chairman of the Northwest Indian Fisheries Commission, who is no stranger to fisheries disputes, having been arrested some ninety times as a result of fishing protests. Frank, who defends Native American rights to a subsistence and ritual fishery, argues that fishing means more than dollars. "There has to be a balance between jobs and our natural resources," Frank said. Several commentators agrees that "the handcuffs need to be taken off the Fisheries Councils." The Councils, created by the Magnuson Act to oversee fisheries management in each region of the U.S., require greater flexibility to be effective, according to the Center for Marine Conservation and others.

If a number of panelists agreed that the fish belong to all of us, Michael Orbach, an expert in fisheries policy at Duke University, pointed out that "ownership entails obligation."

According to George Reiger, outdoor writer, conservationalist, and keynote speaker, "Greed, not science, continues to dominate fisheries management."

William Amaru, a groundfisherman from New England said it this way: "We in this country have got to realize that we have values — only then will we solve the fisheries problem."

For further information on the Fisheries Forum and a copy of the Resource Handbook, contact Ben Sherman, Sea Grant National Media Relations Coordinator (301) 405-6381.

Shark State of Mind

The University of Maryland's highly touted public television series, "Maryland State of Mind," hosted by Scott Simon, continues to shine the spotlight on fascinating research and exploration underway across the University of Maryland System. The most recent installment tools several environmental stories, focusing on the environmental biology program offered jointly by the University of Maryland Eastern Shore and the Salisbury Sate University, the ecological economics initiative underway at the Center for Environmental and Estuarine Studies, and the shark research of University of Maryland College Park zoologist, Eugenie Clark, who is popularly known as the "Shark Lady," was expanded into a half-hour program and shown on October 5 on Maryland Public Television, according to John Lippincott, the Associate Vice Chancellor for Advancement, who has been instrumental in launching the "Maryland State of Mind" series. The series is made possible in part by underwriting grants from such companies as CellularOne, Sylvan Learning Systems, and Black & Decker.

Seafood Specialist Joins Sea Grant Extension

Tom Rippen has joined the Maryland Sea Grant Extension Program as a Seafood Technology Specialist. Rippen, whose office will be based at the University of Maryland Eastern Shore, will work with the seafood industry in Maryland on processing techniques and product development. His appointment represents a joint effort of the Cooperative Extension Service, the Center for Environmental and Estuarine Studies and the University of Maryland Eastern Shore. The Maryland Department of Natural Resources is also helping to support the effort, according to Rippen.

"The need for this position was" expressed very clearly by the seafood industry," says Doug Lipton, who heads the Maryland Sea Grant Extension Program. "In this time of downsizing and consolidation we were able to answer this need by joining forces within the University." By cooperating," Lipton says, the different units of the University were able to accomplish what none of them had the resources to do separately.

Rippen has already begun to visit seafood plants in Maryland, and plans to develop a series of educational programs, building on work he had begun with Virginia's seafood industry. "A major emphasis will be on training," says Rippen, who hopes to work with others in the region to stage coordinated training programs. With new seafood processing regulations expected from the Federal Food and Drug Administration (FDA) in 1996, this training will prove both timely and important.

Multispecies Management *continued*

the late 19th century could have filtered, on average, the entire Chesapeake Bay in three to five days; in 1988, it would have taken more than a year. With the further decline of oysters since then as reflected in lowered harvests and monitoring, such filtering comparatively would take even longer. Newell's estimates helped catalyze concern over the oyster's ecological role — and while oysters continue to be managed primarily for commercial use, for the first time resource managers have begun to acknowledge and take into account the oyster's ecological importance.

Menhaden may also have an important ecological role in the Bay by sequestering nitrogen in the enormous amounts of phytoplankton they consume: since they move out into coastal waters, they become potential exporters of nitrogen. A number of CEES scientists have argued that menhaden could sequester and export much more nitrogen by limiting the commercial catch to fish aged at least three to four years. (Menhaden generally do not reach sexual maturity until age two; the largest menhaden on record, at three pounds, was eight years old.) That is not the case now. "In the lower part" of the Bay," says Ed Houde, "a" fishery is hammering on them at most of the ages, from juvenile stages through age one and two."

We are still a long way from using commercial and recreational landings as a tool for managing nutrient levels or other measures of Bay health. The complexity of trophic food webs, let alone the political and social issues at stake, may make that more an ideal than a reality. But before they can become practical tools, such issues as multispecies and ecosystem-based management must first become part of the ongoing conversation — and that has begun. The far future may hold surprise connections between striped bass and crabs, between oysters and menhaden that we cannot yet foresee.

End Notes

Noteworthy

Marine Education Specialist Hired

Adam Frederick, a science teacher from Frederick County, has joined Baltimore's new Columbus Center as a Maryland Sea Grant Extension Education Specialist. Frederick will serve as a major point of contact for teachers in search of information and curricula in the field of marine and environ- mental science.

His location at the Columbus Center will place Frederick in the midst of a hold experiment in science and education, where students, teachers and others will be able to see marine science in action, specifically marine biotechnology, a sophisticated field not often easy to view or understand. The Columbus Center will have laboratories especially equipped for demonstrations with educators and students, as well as an exhibit hall with interactive displays.

Frederick's interest in marine science runs deep — his own graduate work has involved studying the growth and survival of oysters in controlled conditions — and he will help serve as a liaison among other parts of the university community with a focus on marine science education, such as the Center for Environmental and Estuarine Studies.

"I have been wanting to" work with a much larger student base for a long time," says Frederick, "and this will give me that opportunity." He is especially excited, he says, for the chance to teach environmental science in the inner city.

Educators and others can reach Adam Frederick at the Columbus Center (410) 547-8727.

Retirement of Senator Claiborne Pell

Senator Claiborne Pell, widely recognized as the "father" of Sea Grant, has announced his retirement from the Senate. Pell, a strong supporter of education and known as the originator of the "Pell Grants" for students, helped to start the University-based Sea Grant program after a casual week-end visit to the University of Rhode brought him face-to-face with John Knauss, then Dean of the College of Marine Sciences.

Pell and Knauss had a long and unplanned conversation about the status of marine resources and marine sciences, and the need for more support of research and education. Why not do for marine resources what the Land Grant universities and their Cooperative Extension Services had done for agriculture? Why not have Sea Grant Colleges? they asked.

Pell introduced legislation in 1965, and the Congress passed the National Sea Grant College Program Act in 1966.

"Pell's presence and leadership will be sorely missed," said Chris D'Elia, Director of Maryland Sea Grant. "He is the model of a true statesman."

Conferences Etc.

AAAS Conference in Baltimore

"Where Science Comes to Life" will take place in Baltimore, Maryland on February 8 -13 at the Baltimore Convention Center. Rita R. Colwell, President of the American Association for the Advancement of Science (AAAS) and President of the Maryland Biotechnology Institute, will give the President's Lecture at 6:30 on February 10. Among a wide range of scientific panels will be a series on the Chesapeake Bay and a session on biotechnology and aquaculture, organized by Yonathan Zohar of the Center of Marine Biotechnology. To register call (202) 326-6417.

EMECS 97 in Stockholm

The next international conference on the Environmental Management of Enclosed Coastal Seas (EMECS) has been scheduled for August 1997. This will be the third EMECS conference, following the first in Kobe, Japan in 1990, and the second in Baltimore, Maryland in 1993.

According to Professor Bengt-Owe Jansson, director of the Stockholm Center for Marine Research, who is taking the lead in staging the conference, EMECS will join with the Stockholm Water Symposium, a meeting held annually to examine issues of water supply, quality and equity. This combined meeting will have as its theme, "With Rivers to the Sea," joining freshwater concerns with those of coastal seas. According to Jansson, the treatment of water in this comprehensive way will help overcome the separation that exists between disciplines and bring together experts who may not often have an opportunity to cooperate, allowing for an especially holistic approach to the water cycle.

By convening during the summer of 1997, EMECS will also become part of the large 1997 Stockholm Exhibition, which celebrates the centennial of the famous 1897 exhibition held in Stockholm. For more information about EMECS, including a summary of EMECS 93, write the University of Maryland Coastal and Environmental Policy Program at either Sea Grant (0112 Skinner Hall, College Park, MD 20742) or CEES (Box 775, Cambridge, MD 21613). Or contact the Stockholm Center for Marine research, University of Stockholm, S-106 91 Stockholm, Sweden.

Calendar

CBL Seminars

November 3
Dr. Greg Garman,
Department of Biology, Virginia Commonwealth University
"Back to the Future: Historical Ecology of the James River"

November 10
Dr. Simon Thorrold,
Old Dominion University
"Geochemical Tracers in Otoliths:" Natural Markers in Stock Identification and Migration Patterns in Marine Fishes"

November 17
Dr. Sam Wainwright,
Rutgers University
"Food Web Studies in the Delaware River and the Pribilof Islands, Using Stable Isotope Ratios"

December 1
Dr. Richard Tankersly,
University of Maryland,
Baltimore County
"Against All Tides: Mechanisms" Utilized by Postlarval Crabs for Invading Estuaries"

December 8
Ms. Anne Swanson,
Executive Director,
Chesapeake Bay Commission
"Chesapeake Bay Management:" Finding the Nexus Between Science and Policy"

HPEL Seminars

November 1

Dr. Mark Castro,
Appalachian Environmental Laboratory, UMCEES
"Nitrogen Dynamics in Upland" Forests of the Chesapeake Bay Watershed."

November 8
Don DeAngelis,
National Biological Service,
University of Miami
"Trophic Interactions in Florida Everglades Ecosystem"

November 29
Keith Eschelman,
Appalachian Environmental Laboratory, UMCEES
"Comparative Analysis and Regionalization of Hydrochemical Responses of Small Forested Watersheds in the Eastern U.S. "

Maryland Marine Notes

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