MARYLAND

Research, Education, Outreach *February-March 1994*

MARINE NOTES

SPOTLIGHT ON RESEARCH

The Blue Crab in Winter

Perhaps the only man legally fishing in Maryland's icy waters for blue crabs early this winter was Tom Maurer. A research assistant with the Chesapeake Biological Laboratory, he began his crabbing in mid-December this year, usually meeting up with Lonnie Moore at his workboat on calm mornings and traveling with him out to the mid-Bay mainstem or up some of its major tributaries. Moore is a watermen used to making a living catching blue crabs, but he knows he won't see any of this winter catch ever make it to market.

For this kind of crabbing, they aren't carrying crab pots or trot lines or long-handled nets — the tools of the summer crab trade. They work instead with an iron dredge — the weapon of choice for winter crabbing. Twenty times a day under leaden skies and light to moderate winds, Maurer has to muscle the dredge up to the stern and heave it overboard. Relaxing, he takes a LORAN reading, then watches the cable whine out until he can feel the teeth bite in and the line go taut. Gunning the engine, Lonnie Moore starts gouging a bumpy swath across 100 yards of Bay bottom.

They are dragging a dredge that measures 6 feet wide at the mouth with knife-like teeth 4 to 7 inches long. Inserted in the dredge is a fine net with 15 mm mesh for holding tiny crabs. On more than half the hauls — after clawing through an entire football field of mud — the dredge comes up empty of crabs. The rest of the time, the catch averages about 10 crabs. The highest haul for a single tow in Maryland waters has been 60 crabs.

Since dark comes early these months, the researcher and the watermen are usually tying up at a dock around 4 p.m. From one winter's day on the Bay, they typically bring back only 200 crabs — and a notepad full of numbers.

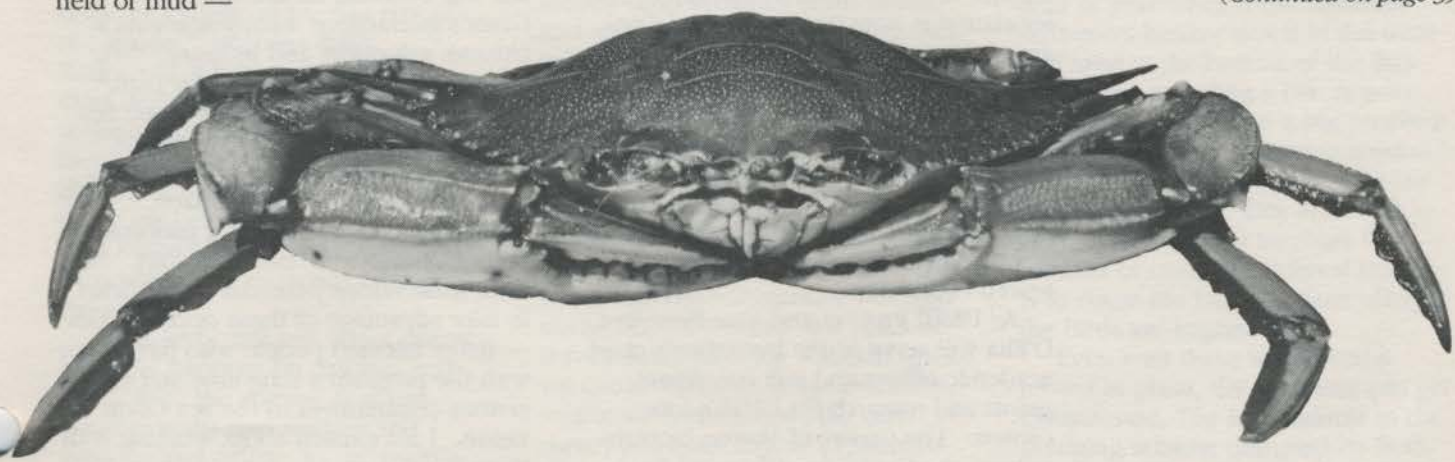
Counting Crabs

Where do blue crabs go in winter? This question has bewitched biologists for decades. But it's another kind of question that bedevils nearly every waterman every winter, and it goes like this: come summer, how many big, catchable blue crabs will there be in Chesapeake Bay this year?

The answer for last year: there were probably 653 million catchable crabs swimming around in the Chesapeake Bay during crabbing season in 1993. The year before there were only 440 million. And the year before that, 1991, there were as many as 893 million.

These population estimates include all the crabs in the Bay down to half an inch in size that are overwintering at depths of five feet or deeper. These estimates are among the findings recently reported from the largest survey to date of the Chesapeake blue crab in winter.

(Continued on page 3)



D'Elia Named UMBI Provost, Mackiernan Becomes Interim Sea Grant Director

Chris D'Elia

Gail Mackiernan

Rita R. Colwell, President of the University of Maryland Biotechnology Institute (UMBI), has named Chris D'Elia as Provost and Vice President for Academic Affairs at UMBI. "As sometimes happens after a long search, you find that the best person is in your own backyard," said Colwell. D'Elia, currently Director of the Maryland Sea Grant College, will replace Richard Neville, who has served as Acting Provost since 1991. Gail Mackiernan will take over as Interim Director of Maryland Sea Grant when D'Elia moves into his new position on March 1, 1994.

D'Elia is a tenured professor at the Chesapeake Biological Laboratory and well known for his work on nutrients and on coral reefs. In the Chesapeake region he played a key role in directing attention toward nitrogen as an important factor in the overenrichment of the estuary.

Appointed Director of Maryland Sea Grant in 1989, D'Elia served as a member of numerous scientific, legislative and management groups focused on Chesapeake Bay issues. He was also active in national Sea Grant efforts. As President of the Sea Grant Association, D'Elia more recently promoted a national initiative in marine biotechnology which resulted in proposed legislation to fund through the National Sea Grant program a major research effort in that field. The legislation is now pending before Congress. He served as Chairman of the Board of the Mid-Atlantic Regional Marine Research Program, an effort to coordinate research talent and resources on regional environmental issues that cross state borders. He also holds offices in several professional societies and is a past President of the Estuarine Research Federation.

As UMBI Provost and Vice President, D'Elia will serve as the institution's chief academic officer and will coordinate grants and research for UMBI's four centers: The Center of Marine Biotechnology, the Center for Advanced Research in Biotechnology, the Center for Agricultural Biotechnology and the Medical Biotechnology Center.

Gail Mackiernan's academic training took place at the Johns Hopkins University and the Virginia Institute of Marine Science. When she joined Maryland Sea Grant in 1986, she brought broad experience in Chesapeake Bay issues, having worked at the Chesapeake Biological Laboratory, the Chesapeake Bay Program and the Army Corps of Engineers. In her current role as Assistant Director for Research, she has had responsibility for directing Maryland Sea Grant's research program. "Sea Grant will be in very capable hands," says D'Elia. "No one is as familiar as Gail Mackiernan with the opportunities research provides to address environmental problems and economic opportunities in the marine realm."

Mackiernan has also been principal investigator for the Research Experiences for Undergraduates (REU) program, a National Science Foundation initiative which provides talented undergraduate students with fellowships to work for a summer with scientists on estuarine and environmental research projects. Maryland Sea Grant is the only Sea Grant program in the nation which serves as an REU site. This summer will mark the fifth year for the program.

As Interim Director, Mackiernan says she will continue to strengthen Sea Grant's interactions among academics, citizens, educators and industry. "We are now developing a five-year plan," Mackiernan says, "which will guide Sea Grant's activities well into the future." There are a number of new opportunities for Sea Grant on the horizon, Mackiernan notes, including national initiatives in marine biotechnology. "We have tremendous potential at Sea Grant to take advantage of these opportunities — many talented people who have been with the program a long time and have a serious commitment to the Sea Grant vision. I am excited about working with them."

Blue Crabs, *cont.*

With three years of data [biologists] say they can now come up with a good answer to the waterman's perennial question: how many crabs this year?

Scientists now believe they have more reliable numbers to chart the up-and-down populations of blue crabs in the Bay — thanks in part to all that cold-weather dredging by Maurer and Moore. Their work is just one part of an ambitious Baywide survey. While Maurer continues collecting crabs from the mid-Bay, a crew from the Maryland Department of Natural Resources will start dredging the upper Bay in February, and a crew from the Virginia Institute of Marine Sciences will be carrying on their all-winter work in the lower Bay. By the time these three groups wrap their work in March, they will have dug crabs from nearly 1,000 sites in the Bay.

This winter survey is using crude iron dredges and a complex sampling design to address some basic questions asked by biologists and watermen. Directing the project are Brian Rothschild and Jon Volstad of the Chesapeake Biological Laboratory and Rom Lipcius of the Virginia Institute of Marine Science, who is coordinating winter work in the southern Bay. With three years of data they say they can now come up with a good answer to the waterman's perennial question: how many crabs this year?

"The day before the beginning of the season, we could have an estimate of the number of crabs that could be caught on the first day of the season," explains Brian Rothschild, a fishery scientist and chief designer of the sampling scheme. On day one, "we know how many crabs in the Bay are above the minimum size and how many are below the minimum size," says Rothschild. He even has maps showing where all those crabs spent the winter.

He is less confident about describing what happens on day two and after. With the coming of warm weather crabs start moving and growing and dying. As the population starts to change, life gets more complicated for fishery biologists. They are looking for ways to estimate how fast the small crabs grow into legal crabs. "From that," he says, "we would know the rate at which new crabs would be pumped into the fishable population each day."

Figuring out those growth rates for crabs will take more time and perhaps new techniques. Estimating even the age of crabs is notoriously difficult: fish tags tried on crabs usually drop off when crabs moult, and after females stop moulting they stop growing.

Scientists on the survey are hoping to explain and perhaps predict the sudden surge of new crabs that often enters the crab fishery in August and September — sometimes glutting the market and dropping the dockside price, especially after Labor Day when the summertime demand slacks off. "If we had ten years of survey data," says Jon Volstad, "then we could work out better estimates."

For six winters now, the crab survey has been largely experimental, as researchers focused on designing and dredging, then re-designing and re-dredging to devise a sampling plan that would give a good pre-season prediction of the Bay's blue crab populations. According to Rothschild the survey is now ready for operational use as an annual management tool.

Running the Numbers

Scientists go dredging in the dead of winter because they know blue crabs are easier to find. That's the time of year when these beautiful swimmers hunker down in the mud and sand at the bottom of the Bay. "If you are sampling a fish population, you usually have a big problem because they are swimming around," explains Rothschild. "But crabs are like trees, because they are fixed. And it is a lot easier to count the number of trees in the forest than it is to count the birds — particularly if the birds are migrating."

Even with these winter crabs rooted in place, the sampling can get complicated. The key features in the dredging scheme designed by Rothschild and his colleagues include:

Winter Survey Estimates of Blue Crab Populations in Chesapeake Bay

Year	Total Number of Crabs in Bay	Total Number Harvested	Exploitation Rate
1991	893,000,000	274,500,000	30.7
1992	440,000,000	164,100,000	37.3
1993	653,300,000	?	?

According to the survey, exploitation rates in the crab fishery are increasing, while crab populations are not.

- Random samples dredged from different depths in the mainstem and major rivers of the northern Bay, the mid Bay and the southern Bay.
- Experiments documenting how each dredge tow captures only 15% of the crabs in its path (approximately one in seven).
- Nearly 1,000 tows a year, each running approximately 100 meters as verified by LORAN or GPS readings.
- A variety of statistical techniques to account for the patchy nature of crab settlement patterns (half the tows come up empty; others have hundreds of crabs).
- An annual index giving the average number of crabs dredged out of out of every 1,000 square meters of bottom. For 1991 the index was 13.4 crabs and the Maryland harvest was 91.5 million pounds. In 1992, the winter index was only 6.6 crabs and the year's harvest dropped to 54.7 million pounds.
- Multipliers that convert this annual index into an annual population count.

One result of all that dredging and multiplying has been an index and a population count that roughly tracks with harvest totals over the last several years. (See accompanying box.) Another result has been new insights into where blue crabs go in winter.

Playing the Numbers

These new population counts could become an important part of the growing debate over how best to manage blue crabs in the Chesapeake. There are now at least six crab indexes that help predict blue crab harvests, but this pre-season index and population count may prove among the most helpful for quick management response to changes in the fishery. Because of fears of overfishing, resource managers and lawmakers at both ends of the Bay are considering controversial changes this winter that could cap fishing effort in this historic fishery.

And there is in the winter survey some evidence that a cap could make sense. According to the survey, exploitation rates in the crab fishery are increasing, while crab populations are not.

- In 1991, for example, the survey estimated a population of 883 million crabs, and watermen that year caught 274 million of those crabs. That gives an exploitation rate of 30.7% for commercial fishing. Add in another 70 million crabs caught by recreational fishermen — a rough, but conservative estimate — and the rate jumps above 38% for 1991.
- In 1992, when the population count was only 440 million crabs, watermen caught more than 164 million, giving a commercial rate of 37%. When the recreational catch is factored in, the total exploitation rate climbs above 46% for 1992.
- Final harvest figures for 1993 are not yet finished in Virginia, but the evidence from Maryland shows that exploitation continues to rise. The population came in around 653 million crabs Baywide, a drop of 250 million crabs from 1991, but Maryland watermen by themselves were taking out 153 million — nearly 10 million more crabs than they caught in the boom year of '91.

Though Volstad warns that exploitation rate is increasing, especially in

Maryland, he is leery about adding rough estimates of recreational catch to fairly accurate estimates of commercial catch. "We know there is a substantial sport fishery for crabs because we see so many people out there fishing. But we don't have any realistic estimates (of recreational catch)."

From Virginia Rom Lipcius warns, "There is potential for major decline. We are in a low period right now, and when you continue heavy fishing pressure during a low period, you are in a position to cause a major decline — but not necessarily a collapse."

What the Numbers Mean

Our classic picture of the blue crab in winter has stood largely untouched for nearly 30 years. With the cool weather of fall, mature female crabs begin their passage south, headed for their hatching grounds near the mouth of the Bay where they crowd together waiting for spring. Male crabs, on the other hand, tend to linger in the tributaries and mainstem of the upper and middle Bay until cold weather sends them scuttling for Bay bottom where they can dig in, turn down their metabolism and hibernate over winter. With the new winter data, biologists are beginning to retouch this portrait, filling in empty spaces and even altering the outline with some unexpected findings about the species.

Large numbers of female blue crabs, it turns out, don't finish their fall passage before winter hits. These late-season travelers end up hibernating further north in the mainstem of the mid Bay and even the upper Bay. In the 1993 survey, more than 40% of the crabs found in the deep layers of the mid Bay by the 1993 survey were females who will hatch eggs next season. In the upper Bay nearly 10 percent of the deepwater crabs were maturing females.

Come spring, all those up-Bay females are at risk of capture as they head south for the spawning grounds at the mouth of the Bay. "Those females still have to run the gauntlet — the spring and summer crab pot gauntlet — in order to make it to the lower Bay and spawn," explains Rom Lipcius, a scientist who has studied Virginia's controversial winter dredge fishery. "It's fairly clear that if you want to protect the spawning stock, you cannot just emphasize the dredge fishery in the lower Bay. Many of the females who are going to spawn — sometimes as high as 50% — are still up throughout the Bay."

To protect the spawning stock, you cannot just emphasize the dredge fishery in the lower Bay. Many of the females who are going to spawn — sometimes as high as 50% — are still up throughout the Bay.

The winter dredge fishery in Virginia has always been controversial with many watermen in Maryland who read about Virginia dredges scraping up a catch that is 90% females. Virginia watermen, on the other hand, hear that some Marylanders are running between 800 to 1,500 crab pots a boat. During the fall run of sooks headed south and the spring run, all those pots also take a big bite out of the number of females who might end up hatching eggs that season.

The survey's findings about small blue crabs are reinforcing some ancient, instinctual beliefs about the value of seagrass beds. The VIMS crew sampled in shallow beds, not just with dredges, but with suction techniques, and they found high counts of small blue crabs nearly everywhere. "Seagrass is critical for the youngest juveniles, " says Lipcius because that is where they go to escape predators. "Blue crabs would survive without seagrasses, but not in large numbers."

Chesapeake Bay, he points out, is only three or four times larger than Delaware Bay, but the Chesapeake crab harvests are usually 20 times larger. The difference, says Lipcius, is the large seagrass beds that still remain in the lower Bay, beds that offer nursery grounds for millions of young crabs which will eventually enter the fishery. Preserving those habitats, he says, is one of the keys to preserving the blue crab bounty in the Chesapeake.

Insights like these about seagrasses and life cycles are the reasons for annual surveys like this. Winter surveys, with all the cold weather dredging and the number crunching that follows, are perhaps the grunt work of Bay science, justified because they bring new answers to old questions, questions like how many crabs do we have and where do they go.

As the dredges go down, year after year, and the reports come in, year after year, these surveys of the blue crab in winter will keep altering our classic picture of the species, often in small ways, adding details and deeper coloring, illuminating how we need to act to save the Bay's last great fishery.

— Michael W. Fincham
Maryland Sea Grant College

The Battle over Blue Crabs: *Capping the Last Great Fishery*

A major debate about the blue crab fishery has been heating up in the halls of Annapolis and Richmond over the fall and winter. Worried about increasing fishing pressure on fluctuating crab stocks, resource managers and lawmakers at both ends of the Bay have been considering controversial changes in this historic fishery.

In Maryland these changes could include requiring a license for the first time for any and all recreational crabbing — even for old fashioned Maryland traditions like end-of-the day, end-of-the-dock crab netting. The rough estimate is that up to a half-million Marylanders net a few crabs here and pot a few crabs there. Their total take could equal 25% to 50% of the commercial harvests. In a good year that means 12 to 25 million pounds or more in Maryland alone. Virginia made a start on recreational licenses last year, requiring licenses for any crabber who used more than two pots or caught more than one bushel a day.

There may be more debate about a new recreational license in Maryland where the Department of Natural Resources wants to use the new license to eliminate an oddity called the non-commercial license. Now held by about 10,000 people, the license allowed crabbers to use an unlimited amount of trotline and up to 50 traps or rings — as long as they don't take more than two bushels a day. With all that gear, observers suspect an active black market for blue crabs has been in swing along a lot of the highways and backroads around the Bay.

The proposed recreational license would only allow ten traps and 1,000 feet of trotline — a gear allowance opposed as too broad by the Chesapeake Bay Foundation. The new license would also set a new limit of one bushel per person per day and two bushels per boat.

Major debates this winter will center on changes proposed for commercial crabbing. In both states fishery managers have started work on "capping the fishery," and that's where the controversy comes in: For a hundred years the blue crab fishery has been open to anyone who could buy a commercial license. Capping the fishery means putting a hard limit on the number of men and women who can go crabbing for money on the Chesapeake.

Why do managers want this limit? Because they think there is a limit on how many crabs can be fished out of the Bay and still leave a healthy fishery — just as there was a limit on how many shad and rockfish and oysters could be fished out. The common tragedy that played out with each of these fisheries went something like this: with early declines in harvests, the laws of supply and demand sent prices rising, spurring more watermen to work longer hours and harder days depleting a dwindling resource at an even faster rate.

With the crash of these mainstay fisheries, the gold rush for blue crabs has grown more frantic, causing many observers to warn that another crisis could be coming. "There are all these early warning signs that we are teetering close to trouble," warns Jack Travelstead of the Virginia Marine Resource Commission. The clearest sign came two years ago when Baywide crab harvests dropped from 91 million pounds in 1991 to 54 million pounds in 1992. For Virginia "that was one of the lowest levels since the 1950s," explains Travelstead.

Even before the slump of '92, there were other, subtler signs of trouble. For several years more watermen than ever before were entering the crab fishery where they were working longer hours and setting out more crab pots than during any era in Bay history. What the scientists call catch-per-unit effort was cut in half. Compared to earlier years watermen were working twice as hard to catch the same number of crabs.

The harvest clearly had maxed out, but the influx of hard working fishermen just as clearly had not. How long could blue crab stocks hold out under this kind of con-

stantly increasing assault? After the recent crashes of rockfish and oysters, a blue crab crisis would triple the tragedy. "A lot of the watermen are worried," explains Travelstead. "The crab fishery is their last resource. When that is gone, they are gone."

In Maryland capping the fishery starts with the Department of Natural Resources asking the Maryland legislature for authority to limit the sale of commercial licenses. There are about 6,000 watermen holding commercial crab licenses now, plus several thousand watermen holding general unlimited licenses that allow them to fish any commercial species — including crabs. To slow down the flow of crabbers entering an overcrowded fishery, DNR had already set a two-year waiting period for new licenses.

Under the new approach the flow of new entries would halt, and over several years the number of licensed crabbers would change — perhaps even be cut in half. If current legislation passes, DNR would be able to stop selling commercial licenses, thus halting entry into the fishery. "No new licenses would be issued until we come up with a number (of crabbers) that everybody agrees should be in the fishery," explains Steve Early of the Tidewater Fisheries Division in Maryland's Department of Natural Resources.

DNR would also limit the number of crab pots that watermen set out — a move that may stir as much controversy as limited entry. Over the last decade crabbers have dramatically jumped the number of pots they set out each year. According to Tom Horton in *Turning the Tide*, watermen who once worked perhaps 100 pots were fishing up to 400 by the mid-80s and even 800 pots were not unusual. Now some crews of two or three watermen have been working 1,000 to 1,500 pots per boat.

"Limiting the number of licensees won't do it (cap the fishery) unless you also limit their effort," says Early. "Fishermen are well noted for their ability to be innovative in applying effort to a fishery." DNR is proposing a limit of 300 pots per license, which they estimate is now the average number of pots in use by watermen. They also propose a limit of 900 pots per boat. The legislation asks no authority to set daily catch limits.

At the south end of the Chesapeake, the Virginia Marine Resources Commission has no plans for limiting crab potting this year, but it already moved last fall to begin capping the most controversial fishery in the Bay — the winter dredge fishery for blue crabs. That fishery focuses on the waters just inside the mouth of the Bay — waters crammed with "sooks," adult pregnant female crabs who migrate south during the fall to overwinter along the bottom while their sponge-like egg masses mature for spawning.

Virginians feel protective in a worried way about one of their traditional fisheries, arguing that a fishery that lasted through so many decades of good harvests is probably not to blame for any recent slumps. They cite esti-

(Continued on page 7)

Changes in Regulations: Recent and Proposed

Worried about increasing fishing pressure on blue crab stocks, fishery managers in Maryland and Virginia are in the process of implementing or proposing a number of new changes designed to slow down or cap fishing effort.

CHANGES IN MARYLAND

In Place

■ A two-year waiting period for new commercial licenses is already in place

Proposed

■ Limited entry into the commercial fishery. DNR would stop selling commercial licenses until the number of licensed crabbers declined through attrition. Over 6,000 now hold crabbing licenses.

■ A limit of 300 crab pots per license and 900 pots per boat.

■ Abolition of the non-commercial "limited crab catcher" license now held by about 10,000 people.

■ A new sport crabbers license allowing crabbers to use 10 traps and 1,000 feet of trotline with minimum gear separation of 100 feet.

■ A sport crabber catch limit of one bushel per day per person, not to exceed two bushels per boat.

CHANGES IN VIRGINIA

In Place

■ A new sport crabbing license allowing the use of 5 crab pots. No license required for fishing two pots and taking one bushel a day.

■ Limited entry into the commercial winter dredge fishery after December 1. No new licenses could be sold until the number drops below 225 licenses.

■ The daily catch limit cut from 25 barrels a day to 20 barrels in the dredge fishery.

Proposed

■ One gear change requiring one 2 & 5/16-inch ring in upper portion of each crab pot to allow small crabs to escape.

Capping the Fishery, *cont.*

mates that only 15% of the Bay's spawning stock are lost here. Eugene Cronin and other scientists put the number near 20%.

After this winter, however, Virginia will sell no new dredging licenses. Watermen have this year as a window for entering the fishery and being grandfathered in for the future. Starting next winter, no new licenses will be available until the number of dredgers drops below 225 through attrition. What worries Virginia experts the most is the same thing that worries Maryland experts — the rapid addition of so many new fishermen into fishery that is not adding enough new crabs.

Managing the blue crab fishery is never simple or non-controversial in Maryland — and this year the effort could be especially complicated. As legislative proposals move onto the table in Annapolis, lawmakers in a number of committees will probably hear testimony from groups as diverse as DNR, the Maryland Waterman's Association, the Maryland Saltwater Fisherman's Association, the Chesapeake Bay Commission, the Chesapeake Bay Foundation, EPA, NOAA, and the U.S. Fish and Wildlife Service as well as from university researchers at a number of labs and individual scientists like Eugene Cronin. If, after all the hearings and headaches, the legislature and DNR take the first giant steps towards capping the state's last great fishery, they could surely change forever the way millions of Marylanders go after their favorite shellfish.

By the same token, if no one takes any steps and the fishery fails like shad and oysters and rockfish once did, then the changes that follow could be even more painful for everyone.

— Michael W. Fincham
Maryland Sea Grant College

Focus on Past Spotlight Articles

Managing Striped Bass

In response to our November 1993 Spotlight story, "Striped Bass Success Story: A Model for Fisheries Management," we received the article below highlighting the important role of the U.S. Fish and Wildlife Service in bringing back the striped bass.

For the Fish and Wildlife Service, the success of the Striped Bass program comes as a profound reward for many years of research and effort. The Service began work on striped bass restoration in 1985. Under the Emergency Striped Bass Restoration Act, Congress designated the Service as lead federal agency to determine the cause of the fishery's decline.

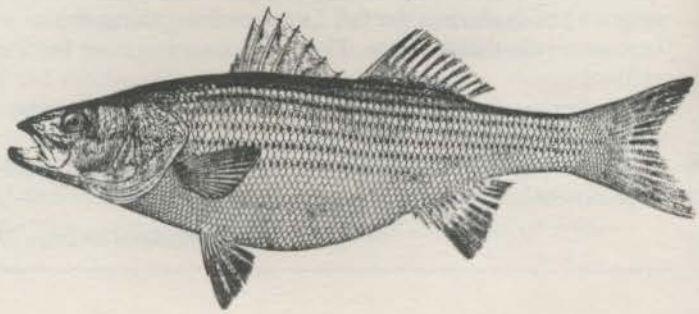
Towards that end, water quality problems on spawning grounds were evaluated. Concurrently, a coast-wide striped bass tagging and hatchery program was initiated to estimate rates of exploitation and natural mortality, and to determine if hatchery-reared fish could supplement wild stocks in severely depleted rivers.

A central database, designed and managed by the U.S. Fish and Wildlife Service, stores coast-wide stocking information, fishery dependent and independent survey data, and migratory data from tag returns, upon which management decisions have been based.

Since 1984, nearly 8 million marked hatchery-reared striped bass fingerlings have been released into the wild. In 1988, hatchery fish comprised 50% of Maryland young-of-the-year striped bass in some rivers. Today, as hoped, hatchery fish are far outnumbered by wild fish. While evaluation studies continue on the potential contribution of hatchery fish to depleted wild stocks, hatchery-reared striped bass marked with coded wire tags are used primarily to gather information on population dynamics and migratory patterns to answer management questions.

The Service, encouraged by the success of the striped bass program and the increased support from ASMFC in enforcing management plans, is beginning restoration work on coastal populations of American shad and Atlantic sturgeon.

Linda Andreasen
U.S. Fish and Wildlife Service



MEES Students Receive Knauss Fellowships

Two graduate students in Marine-Estuarine-Environmental Sciences (MEES) at the University of Maryland were recently awarded Knauss Marine Policy Fellowships. Amy J. Santin, who is pursuing a joint degree program in law and marine-estuarine-environmental sciences, will work with the Merchant Marine and Fisheries Committee, Fisheries Management Subcommittee. Don MacLean, a master's student in marine-estuarine-environmental sciences, will work in the U.S. Department of the Interior Fish and Wildlife Service in the Division of Habitat Conservation.

Amy worked recently as a law clerk for NOAA and also interned for three years at the Maryland Department of the Environment's Water Management Administration. She plans a career in marine policy with an interdisciplinary approach. She sees the Knauss Fellowship as a means of "defining exactly what it means to do policy work, and providing a framework within which I can test how useful the skills I have obtained in law school are when applied to an area other than traditional, litigation-oriented law."

Don's interests are in wetland restoration and environmental planning and policy. He has worked in the field of environmental consulting, done volunteer work for the Nature Conservancy and at several state parks, and taught courses at the University in resource management and public policy. Through the Knauss Fellowship, he hopes "to gain a better understanding of the interactions of policymakers and scientists, and the functions and values of wetland habitats."

The Knauss Marine Policy Fellowship Program, begun in 1979 and coordinated by NOAA's National Sea Grant Office, provides graduate students across the nation with an opportunity to spend a year working with policy and science experts in Washington. Over the years fellows have worked in the legislative and executive branches of the federal government in locations such as the offices of U.S. Senators and Representatives, on Congressional subcommittees and at agencies such as the National Science Foundation and the National Oceanic and Atmospheric Administration. Fellowships run from February 1 to January 31 and pay a stipend of $24,000.

Sea Grant Directors around the nation submit applications for students they feel are strong candidates for a Knauss Fellowship to the National Sea Grant Office which, after a rigorous review process, makes the fellowship awards. Depending on the number and quality of applicants, one or more fellowships may be awarded for each state program. This year there were 52 applicants and 25 awards. The application deadline for next year's fellowship program is September 1, 1994. For more information or an application brochure, write: Susan Leet, Maryland Sea Grant College, 0112 Skinner Hall, University of Maryland, College Park, Maryland 20742.

REU Fellowship Reminder

Applications are now available for the summer 1994 Research Experience for Undergraduates (REU) program. Funded by the National Science Foundation and coordinated by Maryland Sea Grant, these fellowships offer twelve undergraduate students the opportunity to work with scientists on major marine research projects that focus on the Chesapeake Bay. Call (301) 405-6371 and request an REU brochure and application materials. Applications are due *March 11, 1994.*

Ocean Remote Sensing Fellowships Available

Maryland Sea Grant, with funding from the National Aeronautics and Space Administration (NASA), is sponsoring a summer 1994 fellowship program in the Remote Sensing of the Oceans for advanced undergraduate and beginning graduate students. The twelve-week program (June 6-August 26) pairs each student with a scientist at the University of Maryland or NASA's Goddard Space Flight Center to work on ongoing research using satellite and aircraft remote sensing to address oceanographic problems.

Applications are invited from undergraduate students who have completed at least two years of study towards a bachelor's degree and from first- to second-year graduate students with an interest in earth remote sensing. Minority, women and handicapped students are especially encouraged to apply.

Fellows receive a stipend of $3,000, a housing allowance for dormitory costs and round-trip travel expenses. Application, transcripts and other information are due by *April 15, 1994*. A brochure describing the program and application materials is available from Maryland Sea Grant; call (301) 405-6371.

Noteworthy

Call for Papers

1994 Chesapeake Research Conference. The Chesapeake Research Consortium (CRC) is seeking abstracts for this conference, which will be held June 1-3, 1994 in Norfolk, Virginia. The conference is for scientists and managers concerned with basic applied research and will focus on the latest scientific findings about the Bay and its watershed.

Sponsored by CRC and the U.S. EPA Chesapeake Bay Program, the conference will include plenary speakers, presentation sessions and posters on topics such as watershed management, coastal protection, landscape ecology, ecological modeling, environmental economics and technological innovations in the Chesapeake Bay basin.

Abstracts of 250 words for paper or poster presentations are due by March 21, 1994. For submission information, call, (410) 326-6700.

Funding Available

NOAA Coastal Ocean Program. Funds are available to initiate a five-year multidisciplinary effort to develop and test scientific strategies for assessing and predicting the effects of multiple stressors on coastal resources in specific coastal or Great Lake ecosystems/watersheds.

About $500,000 is available to initiate one or more site-specific programs with FY 1994 funds for the first 12 months of effort, to being in the fall of 1994. Proposals may request support for up to four more years, although funding will be in annual increments and will be dependent upon satisfactory progress and Congressional appropriations.

Cooperative proposals among NOAA and other federal scientists, academic investigators and state resource managers are strongly encouraged.

Send planning letters by *April 1, 1994* to: Marjorie Ernst, NOAA Coastal Ocean Office (NCOP), 1315 East-West Highway, Room 15140, Silver Spring, Maryland 20910, phone: (301) 713-3338, fax: (301) 713-4044, OMNET: M.Ernst.

Graduate Student Job

Graduate Student Traineeship, Smithsonian Environmental Research Center, Edgewater, Maryland. The person hired for this Traineeship will assist with a Sea Grant-funded study of Introduced Ballast-Water Plankton Communities and Associated Risk of Estuarine Biological Invasions. This will include research on non-indigenous aquatic organisms (primarily invertebrate larvae, dinoflagellates and diatoms) associated with the ballast water of ships. The research project will test the viability of organisms that are being released into Chesapeake Bay waters with ballast water from commercial vessels. Laboratory experiments and field surveys will be used to measure the susceptibility of Chesapeake Bay to ballast-mediated invasions.

Applicants must be currently enrolled in a graduate program in Maryland. Prefer a student with a strong background in marine/estuarine ecology and experience with planktonic organisms, especially larval invertebrates. The successful graduate student trainee will assist in various aspects of the research and will have time to develop a thesis topic related to the project.

This position pays a 12-month stipend of $11,482, health benefits and some support for fees. It is funded for at least two years and will begin in February 1994. To apply, send a curriculum vitae/resume along with a letter describing your interests/goals to: Greg Ruiz, Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, Maryland 21037; or send as e-mail to: ruiz@serc.si.edu. For more information, write the address above or call (301) 261-4190.

Media Specialist Position

National Media Relations Specialist, National Sea Grant College Network. A full-time specialist is sought to coordinate national and regional media relations for Sea Grant, a national network of 29 university-based research, outreach and education programs dedicated to the protection and wise use of U.S. ocean, Great Lakes and coastal resources. Based at the University of Maryland, College Park, the position requires some travel.

Requirements include a bachelor's degree (master's degree preferred in journalism, English, communications, public relations or science) and five years of professional experience in public or private sector communications and excellent oral and writing skills. Salary commensurate with experience.

To apply, send by *March 15, 1994,* a letter of interest, current resume, and names and addresses of at least three references to: Maryland Sea Grant College, 0112 Skinner Hall, University of Maryland, College Park, MD 20742. For more information, call (301) 405-6376.

Maryland Marine Notes
Volume 12, Numbers 1 and 2

Maryland Marine Notes is published ten times per year by the Maryland Sea Grant College for and about the marine research, education and outreach community around the state.

This newsletter is produced and funded by the Maryland Sea Grant College Program, which receives support from the National Oceanic and Atmospheric Administration. Editor, Sandy Harpe. Send items for the newsletter to:

Maryland Marine Notes
Maryland Sea Grant College
0112 Skinner Hall
University of Maryland
College Park, Maryland 20742
phone (301) 405-6376
fax (301) 314-9581

MARYLAND SEA GRANT

Publications

Sea Grant Information

The National Sea Grant Depository (NSGD), located at the University of Rhode Island's Pell Marine Science Library on the Narragansett Bay Campus, houses a complete collection of Sea Grant documents (some 21,000 titles from the 29 programs across the continental U.S., Alaska, Hawaii and Puerto Rico). These are available to the public worldwide via the publications database and the quarterly *Sea Grant Abstracts (SGA)* All publications are available on loan for one month (limit of 10 items) free of charge. Reference and online search services are provided. Telephone, mail and interlibrary loan requests are welcome.

Holdings include journal reprints, technical and advisory reports, handbooks, maps, manuals, directories, books, annual reports, conference proceedings, and newsletters produced by Sea Grant-funded researchers and staff. Topics include oceanography, marine education, aquaculture, fisheries, coastal zone management, marine recreation, and marine law.

The National Sea Grant Office is studying the possibility of providing access to the NSGD database via Internet.

For search services or to borrow a document, call (401) 792-6114 or write the NSGD, Pell Library Building, University of Rhode Island, Bay Campus, Narragansett, Rhode Island 02882.

In addition, SGA's 30,000-plus bibliographic records (from 1968 to date) are now offered on CD-ROM by the National Information Services Corporation, Suite 6, Wyman Towers, 3100 St. Paul St., Baltimore, Maryland 21218, (410) 243-0797.

Maryland's Oyster Navy

The Chesapeake Bay Maritime Museum recently announced the release of a new book, *Maryland's Oyster Navy: The First Fifty Years*, written by Norman H. Plummer and published in conjunction with Washington College's Literary House Press. The 105-page book gives a scholarly account of the state's first attempts to police the harvesting of the Bay's oysters by commercial watermen.

Maryland's Oyster Navy begins in 1868 with the appointment of the State Oyster Police force. Its first boats were chartered steamers; in 1869, recognizing the need for a dedicated vessel, the state commissioned the steamer *Leila*, and later supplemented it with two sloops. The State Oyster Police eventually became the State Fishery Force, the forerunner of today's Department of Natural Resources Police.

The book documents the troubled early years of the force and its progressive improvement through the early twentieth century. Norman Plummer, the Museum's Curatorial Chairman, presents a survey of this early conservation effort, using detailed descriptions to record the politics and patronage involved in the management of the force, and to give a sense of the public reaction to the state's effort to enforce the restrictions on oyster harvesting. Gun battles and midnight raids toughened the young force almost at once, and the accounts of these skirmishes take the reader back to a time when Maryland's oyster pirates made life on the Bay a high-seas adventure. *Maryland's Oyster Navy* is the eleventh publication released by the Museum as part of its publications program. For price information or to order the book, contact the Museum Store in St. Michaels at (410) 745-2098.

Journal Articles

Ammonia assimilation enzymes in a thermophilic bacillus sp. of marine origin. H. Schreier and E.M. Kellner. 1993. Current Microbiology 27:301-305. This article describes a study which was the first to examine the physiology of ammonia assimilation in a marine bacillus, using Bacillus sp. FE-1, a spore-forming thermophilic marine bacterium isolated from sediments of the West Florida escarpment cold seep, an environment containing communities resembling those associated with hydrothermal vents discovered along East Pacific Rise ridge crests. For a copy of the article, call Hal Schreier, (410) 783-4808.

Aquaculture Research

The University of Maryland Biotechnology Institute has published a new booklet, *Aquaculture at the Center of Marine Biotechnology: Research Programs*, a directory of 1993/94 research projects. Copies of the booklet are available free of charge from: University of Maryland Biotechnology Institute, Office of Development and Communications, 4321 Hartwick Road, Suite 500, College Park, Maryland 20740, phone (301) 403-4696, fax (301) 403-4693.

Calendar

FEBRUARY

28 — Marina Industry Guidelines
Annapolis, Maryland. The Environmental Protection Agency has funded the International Marina Institute (IMI) to conduct seven regional workshops for the marina industry on the latest federal guidelines on nonpoint source pollution, storm water permits and boat sewage. The free workshops will be held during February and March in Boston, Ft. Lauderdale, Annapolis, Chicago, Houston, San Francisco and Portland, Oregon Marina and boatyard managers and trade association leaders are invited to attend. For more information or to register, contact Neil Ross at IMI, (401) 294-9558.

27-March 1 — Shellfish and Crabs
Baltimore, Maryland. The Shellfish Institute of North America/National Blue Crab Industry Association annual convention will include discussions on: FDA seafood inspection, nutritional labeling, hot sauce and oysters, *Listeria* research, import policies, and thermal processing. For more information, call (703) 524-8883.

MARCH

7 — Marine Trades Association
Annapolis, Maryland. The Sixteenth Annual Conference of the Marine Trades Association of Maryland (MTAM) will be held at the Loews Annapolis Hotel from 8:30 a.m. to 4:30 p.m. Marine trades industry representatives will talk about issues of concern to marina owners and operators and to boat dealers, such as the impact of legislation and policy decisions and successful marketing strategies. The conference costs $40.00 for MTAM members and $60.00 for nonmembers. To register, contact MTAM, (410) 267-7469.

8-11 — Marine & Estuarine Science
Atlantic City, New Jersey. This conference on Marine and Estuarine Shallow Water Science and Management in the Mid-Atlantic Region will address current regulatory needs in the mid-Atlantic region (Connecticut through North Carolina). The registration fee is $125.00 ($40.00 for full-time students). Space is limited to 450 people, so register early. For further information, contact: Ralph Spagnolo, EPA, by telephone: (215) 597-3642, or on internet: spagnolo.ralph@epamail.epa.gov.

March 16 and April 6 — Lectures on Marine Biotechnology
Baltimore, Maryland. Lectures will be held at 4:00 p.m. in the seminar room at the University of Maryland's Center of Marine Biotechnology (COMB) in Baltimore's Inner Harbor. Light refreshments will be served immediately before the seminar. For more information, contact Russell Hill, (410) 783-4817 or Rosemary Jagus, (410) 783-4889.

March 16 — Evolutionary aspects of an energy-yielding pathway in the methanogenic Archaea, James G. Ferry, Virginia Polytechnic Institute

April 6 — Species diversity in deep-sea environments, Fred Grassle, Institute of Marine and Coastal Sciences, Rutgers

APRIL

April 8 — Environmental Symposium
Baltimore, Maryland. The University of Maryland School of Law is sponsoring the 1994 Quinn, Ward and Kershaw Environmental Symposium on "Corporate Environmentalism: How Environmental Concerns Are Changing Corporate America." The symposium costs $75.00 for general admission and $35.00 for government and public interest admission. The symposium will be held from 8:30 a.m. - 4:00 p.m. in Westminster Hall. A reception will be held following the program. The registration fee includes continental breakfast, luncheon and reception. Seating is limited. For more information, contact Laura Mrozek, (410) 706-8157.

Printed with soybean ink on recycled paper containing 10% postconsumer waste.

Maryland Sea Grant College
0112 Skinner Hall
University of Maryland
College Park, Maryland 20742