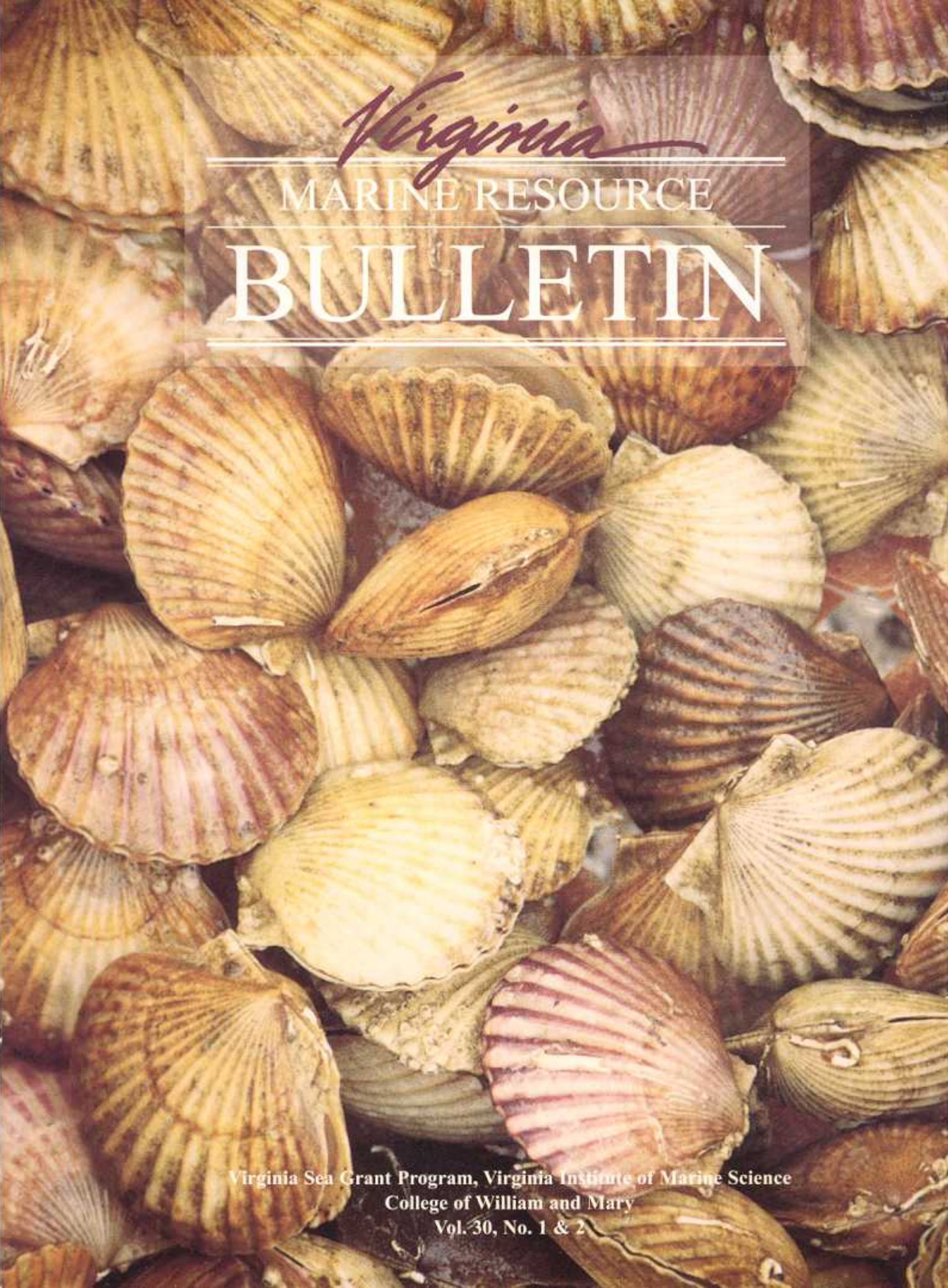

Virginia MARINE RESOURCE BULLETIN

Virginia Sea Grant Program, Virginia Institute of Marine Science
College of William and Mary
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Virginia
MARINE RESOURCE
BULLETIN

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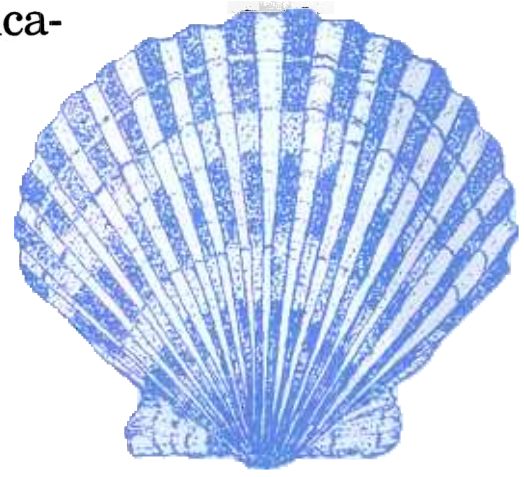
Much of the work performed in the name of science does not make the news because it does not herald a new cure, or a discovery bound to have a tremendous impact on society or on everyday life. However, many research projects do have an impact, even if we—the public—are unaware of it.

This issue of the *Bulletin* highlights behind-the-scenes projects conducted by Virginia Sea Grant. The first is about the development of a new, very successful product—scallop medallions—for the seafood industry. The second is about scallop fishing gear, and about resource conditions in places currently off-limits to scallopers. Limited fishing in the now-closed grounds may prove instrumental to alleviating fishing pressure in other areas. A third, long-term project involves bringing the best marine education resources to educators and students via the World Wide Web. The site is found on the Virginia Institute of Marine Science web page.



Behind the Scenes Sea Grant Success: Scallop Medallions

Americans are generally aware that technology is an integral part of North American life, yet few are probably cognizant of how it permeates all of our lives. Some technological products are obvious and ubiquitous: cars, computers, TVs, VCRs, and household appliances. Other technologies that effect our lives are more subtle and probably not thought about a lot: the taste of any one soft drink, the softness of some white breads, the sweetness of fruit juices, the texture and color of sugar.

The science which governs food can be divided into a number of areas. Here are two broad groupings, both of which are applicable to the recent, successful Virginia Sea Grant work which assisted industry in producing sea scallop medallions: food technology, the application of science and engineering to the refining, manufacturing, and handling of foods; and food science, the applied science which deals with the chemical, biochemical, physical, physiochemical and biological properties of foods.

Consumer Expectations

Anyone who has traveled knows that a pizza in Italy does not taste like a pizza from Ohio. Similarly, some European countries have fruit juices which would not, because of their lack of sugar, be palatable to American culinary tastes.

Not only is the taste of a product part of consumer expectations, but also its appearance. Hot dogs that are too red or too brown are bound to raise suspicion. The size of the product may also make consumers wonder if the food is what it is being billed as.

Scallops can come in all different sizes; however, when consumers order this product they often are expecting the larger sea scallop. In the U.S., the larger scallop (*Placopecten magellanicus*) is harvested in the mid-Atlantic and in New England. The large scallop commands a substantial share of the domestic market, and is sought throughout the distribution chain.

Changing Resource Conditions, A Problem Made Into an Opportunity

The sea scallop size that is very marketable corresponds to a 20-30 meat count* (see the "Meats Per Pound" sidebar for explanation of this industry jargon). During the last part of 1996 and throughout 1997, the domestic landings of the preferred size were reduced because of stock declines. When domestic scallops are not as readily available, processors routinely look to other countries as a source. Two scallop processors had a vested interest in the same source of raw material, that being small scallops harvested in Argentina by Virginia-based vessels and imported into the U.S. The sales of these scallops were not going well in face of the competition from Chinese bay scallops. The two scallop processors—Neptune Fisheries and Wanchese Fish Company—contacted Virginia Sea Grant Specialist Bob Fisher for assistance in developing a product, namely a restructured product made up of the smaller, (60-120 meat count) Argentina scallops. Facing considerable losses in scallop sales, industry was in need of the larger (20-30 meat count) scallops to fill the market void.

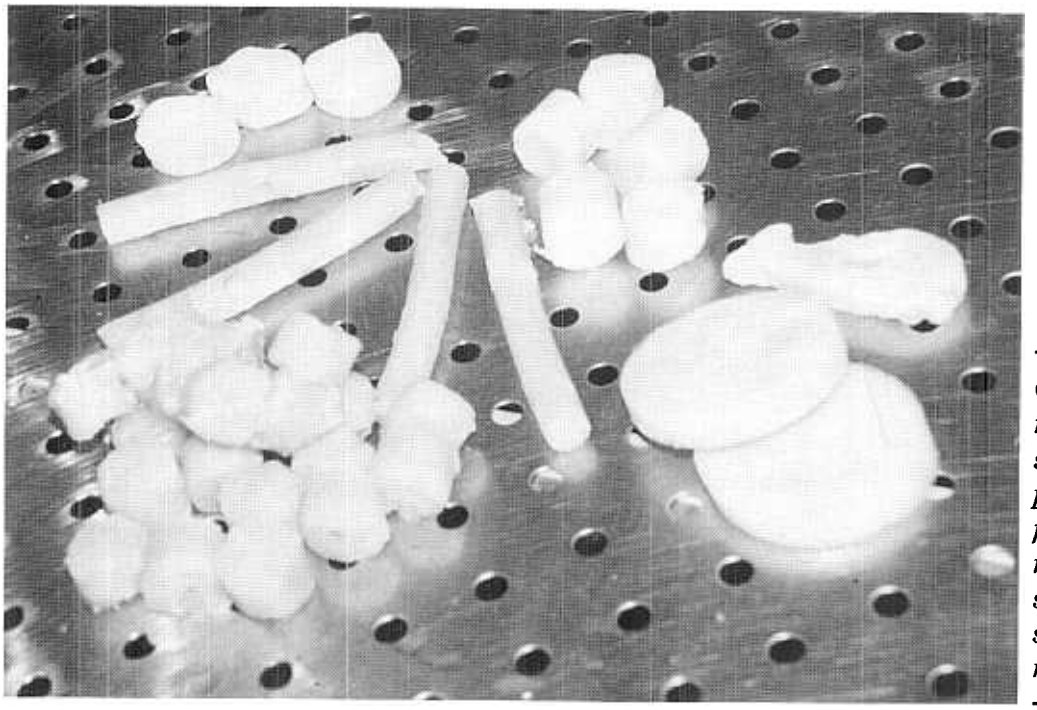
Traditionally, various hydrolyzed proteins have been used as binders in restructured products. These are "heat-set" binders, which require a heat treatment for functional binding. Applying a heat process for binding scallops would restrict the product to the frozen market and would result in an inferior product. The goal was to form a scallop which could be distributed within current fresh, frozen, and breaded scallop markets. The success of restruc-

*A scallop "meat" is the muscle which opens and closes the animal's shell. A 20-30 meat count means that a pound would be made up of 20 to 30 individual muscles.

Meats Per Pound?

Jargon is jargon, and the seafood industry has its fair share. "Meats per pound" is a term used to describe a food product and its size.

The whole scallop is not a complicated animal; opening up the shell one will find a mantle and sensory "eyes" which are able to detect light. When the mantle is peeled away, the reproductive organ becomes visible, as do the gills and adductor muscle. When you order scallops, you are actually ordering adductor muscles, the white muscles which open and close the scallop shell. In industry the muscle is called a meat. A scallop opens its shell to filter feed, and closes it (in any number of ways) to escape predators. The younger the scallop, the more likely it will swim quickly away from whatever is approaching it.



On the left are restructured seafood products in the form of medallions, sticks, patties, shapes, and nuggets.

turing small scallops to mimic large scallops hinged on the use of a binder which would be activated under refrigerated temperatures (cold-set technology). A Neptune Fisheries representative recognized the potential of a product called Fibrimex, a binder currently being used within the red-meat industry to restructure pieces into various forms that meet consumer expectations. Samples of Fibrimex were obtained for testing with scallops and shrimp. To facilitate product development, a working committee was formed, consisting of members from both scallop processing firms, engineer consultants, and Fisher, from Virginia Sea Grant.

In theory, all things may seem possible. However, just because a technology works for red-meat does not mean that it can be applied to seafood products. In the case of applying cold-set technology to restructure small scallops, the role of Virginia Sea Grant was not to reinvent the wheel, or even to take the time to scientifically analyze the specific chemical binding site mechanics, but to utilize the existing technology to produce a viable product in the shortest time possible.

Currently, several scallop companies along the East Coast are producing formed scallops from a variety of raw material sources to supplement their product line.

Fibrimex had already been approved by the U.S. Department of Agriculture (USDA), the federal Food and Drug Administration (FDA), and Agriculture Canada, so it made sense to pursue the possibilities of this binder, providing applied research and advisory assistance to develop a product. Even so, the work necessary to apply cold-set technology to scallops, and to get the product on the market was considerable. The product development stage was quickly followed by mass production. With Fisher's assistance, industry was able to accomplish the task in less than a year.

At the time of initial marketing efforts, the larger 20/30 meat count scallops were scarce and expensive. Once the medallions penetrated the scallop market, benefits were soon realized: a lower cost product.

Fisher served multiple roles in the development of the final, marketed product. He worked with industry to identify the binder usage level to optimize product quality and processing parameters to facilitate production; recommended appropriate processing machin-

ery; and served as a contact point between industry and the FDA and U.S. Department of Commerce concerning product labeling. Additionally, Fisher assisted with marketing strategies, even coining the "Scallop Medallion" market name.

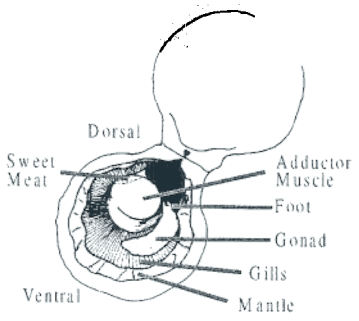
The Specifics

The process itself consists of adding a determined amount of enzyme-activated binder to a specific amount of small (60-150 meat count) scallops. All scallop surface areas are coated by the binder. The scallops are then stuffed into plastic, 1-1.5 inch diameter tubular casings, and refrigerated to allow setting (binding is accomplished by protein cross linking). Once the scallops and binder are set, the casings are stripped, and the scallop logs are sliced at predetermined lengths to mimic the size of natural, large scallops.

Economic Benefits

The development of the scallop medallion has had a tremendous economic impact within the scallop industry in Virginia and the nation. Not only did the two original firms benefit, employment in the local processing plants increased. Currently, several scallop companies along the East Coast are producing formed scallops from a variety of raw material sources to supplement their product line. Most of these processors rely on the initial processing parameters identified through the assistance of Virginia Sea Grant. Fisher continues to test other cold-set binders and is applying this technology to various seafood products.

A technical report entitled *Seafood Restructuring Using Cold-Set Binding Technology* has been produced. To receive this publication, please refer to page 23 for ordering information.



Virginia Sea Grant Specialist Bob Fisher forming a restructured scallop product.

Recent Sea Scallop Research

The U.S. scallop (*Placopecten magellanicus*) fishing industry is facing considerable, if not drastic changes in the next few years. It has been determined that the scallop resource is overfished and that the stock must be rebuilt within a decade. All of this is in the wake of an amendment to the Magnuson Fishery Conservation and Management Act. * Importantly, the amendment changed the definition of overfishing. It is now a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield (MSY) on a continuing basis. MSY is like interest money; the capital—or in this case, a larger portion of the reproductive stock—must stay intact.

At the same time that measures are being considered to rebuild the scallop resource, managers are trying to mitigate economic and sociological impacts by proposing different time frames for the rebuilding effort.

A Bit of Background

In the U.S., the sea scallop fishery began in the mid-Atlantic area in the early part of the century, the 1920s. A decade later, the fishery expanded when large concentrations of scallops were discovered on Georges Bank. After World War II, commercial landings rapidly increased, reaching a peak of 17,174 metric tons of scallop meats** valued at more than $145 million in 1990. Even though the fishery was being heavily exploited, a fishery management plan was not in place until 1982.

As is the case with many fisheries, various means have been used to manage the industry. The first management plan targeted the size of the scallop meat. The size and age of an animal were supposed to be reflected in the size of the scallop meat. An underlying problem with this approach was that it assumed that the animal is uniform over a wide geographic area. Scientific work has indicated that the size of the meat may not be the best indicator of age since different areas may produce different sizes. The size of the meat can be influenced by the reproductive stage (when mature scallops gear up for spawning, most of the energy goes into producing sperm and eggs), the water depth, and even the season.

The next management approach was to change the focus to restricting fishing effort by limiting vessel days at sea, crew size, the size of fishing gear, and the entry of new vessels into the fishery. The size of the scallop dredge rings and trawl net mesh was increased to allow the escapement of smaller scallops.

The focus of the fishery management plan was to maintain, or keep in place, smaller scallops which would soon be reproducing. However, because of previous, higher than sustainable levels of fishing, the scallop fishery was highly dependent on a one year class, the recruiting year class.*** This is precarious, since a year class could "fail" because of unfavorable environmental conditions. The new regulations being put into effect are intended to alleviate some of the pressure by structuring a fishery with multiple year classes. In doing so, current regulations are designed to minimize the catch of three-year-old scallops.

* The name of the act now is the Magnuson-Stevens Fishery Conservation and Management Act. Amendment #7 to the Atlantic Sea Scallop Fishery Management Plan is the response of the New England Fishery Management Council to the new mandates of the Magnuson-Stevens Act.

** The scallops you order in a restaurant are actually just one part of the animal: the adductor muscle which opens and closes the animal's shell.

***The members of a new generation (after they develop through larval and juvenile stages) are called a year class. The recruiting year class is the one that is available to be harvested.

Virginia Sea Grant Sea Scallop Work

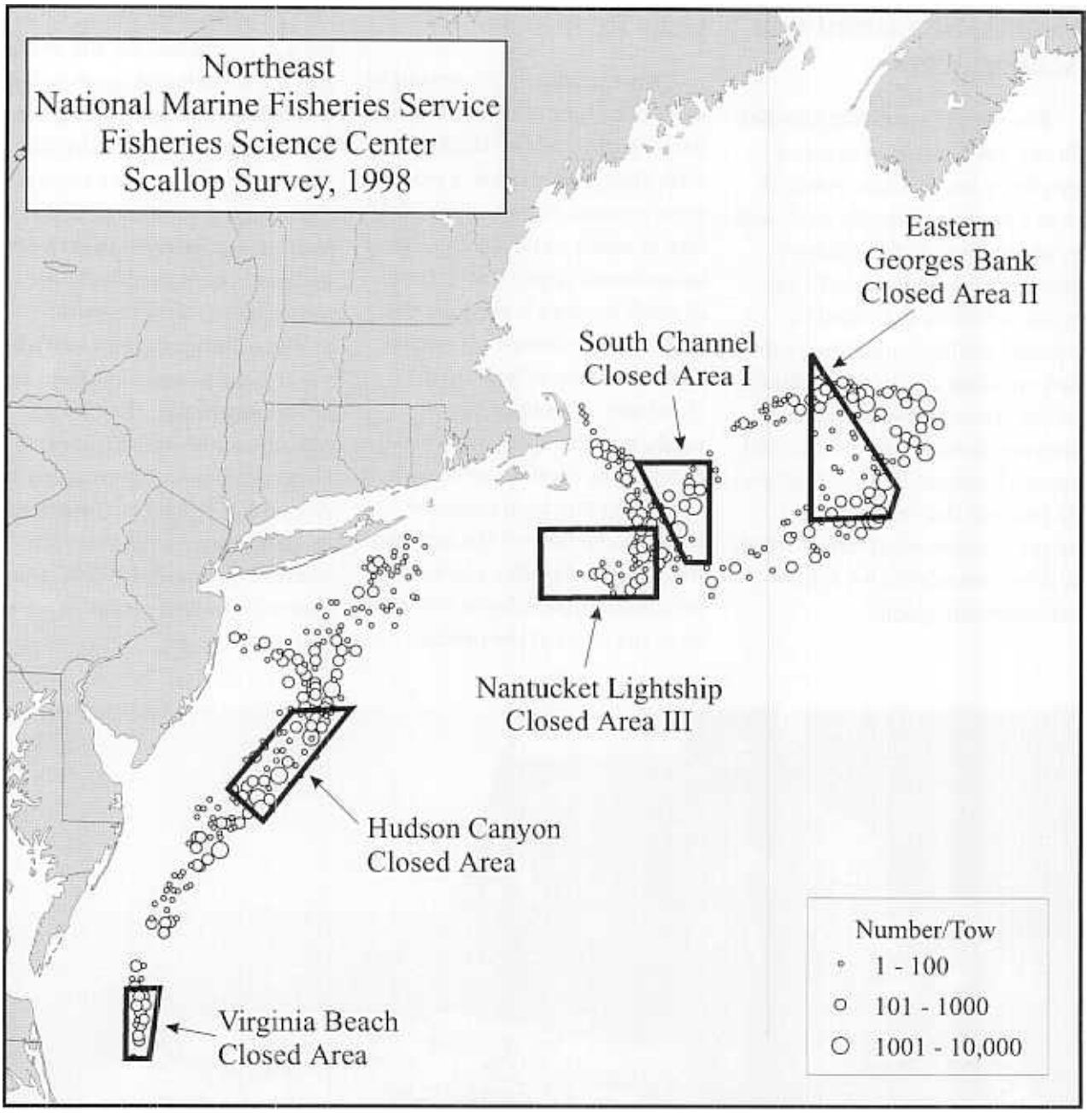
For several years Virginia Sea Grant has conducted research involving sea scallops, research that was and is directly pertinent to management of the fishery. Recent research dealt with the types of fishery gear used to harvest scallops, and, this past fall, with the resource conditions in the closed fishery areas on Georges Bank. This most recent research project has the promise of defining the benefits of an area management strategy which is being considered for future management plans.

Gear Research

Approximately 85 percent of scallops caught are harvested by what is called a New Bedford style dredge. A dredge is made up of a metal frame—some 12-16 feet in width—and a chain bag of welded steel rings. Escapement of small scallops is through the rings and the inter-ring spaces. The other type of gear used, trawl nets of braided twine mesh, is made up of a body and a codend; the bivalves are collected by the net and then funneled through the body of the net into the codend. Smaller scallops escape through holes in the mesh as in the rings of the dredge.

The latest regulations called for a 3.5" ring size for the dredge and a 5.5" diamond mesh in both the codend and body of the trawl; scallop dredges are limited to a total of 30 feet and the sweeps of the trawls are not to exceed 144 feet. It was believed that the two different gears would harvest the same sizes and numbers of scallops; however, data confirming this did not exist at the time of the regulation. The Magnuson-Stevens Fishery Conservation and Management Act prohibits bias of one group or gear type in a fishery over another, giving impetus to this gear comparison research.

National Marine Fisheries Service scientists, Paul Rago, Dan Dolittle, and VIMS scientist Bill DuPaul (left to right) discuss sampling protocol for a large catch of sea scallops in the Georges Bank closed area.



Various factors can change how a gear harvests. For instance, in previous studies of trawls and dredges, it was found that reduced catches of small scallops do result from an increase in trawl mesh size and in dredge ring sizes.

To address gear performance under the current size regulations, Virginia Institute of Marine Science (VIMS) researcher Bill DuPaul and graduate student Dave Rudders conducted research on commercial sea scallop vessels in the mid-Atlantic area, on trips from New Jersey down to the North Carolina border. (Trawls are used on smooth sand bottoms while dredges can be used on both smooth and rocky bottoms.)

Different resource conditions—in terms of location and time of year—were sampled simultaneously with trawl and dredge vessels. The dredge ring size was 3.5 inches and the trawl mesh size was 5.5. A large enough sampling of the same populations would allow solid observations of how the gears fished in different circumstances. Two concepts are used to determine what is happening during harvesting: selectivity and

efficiency. In very general terms, the first relates to the size of scallops which are captured by the gear; the second applies to how much the gear catches under the same circumstances.

Preliminary research results indicate that trawls are more efficient at harvesting scallops smaller than 90 mm (3.54 inches), while dredges are more efficient in catching those greater than 90 mm. A trawl basically skims across the bottom and a dredge scrapes this surface. Trawls may simply be skimming over the bottom surface and overtop of the larger scallops (which are often settled into the bottom surface). Because dredges have more solid contact with the bottom surface, the gear is more effective in harvesting the larger scallops.

The final report has been submitted to the National Marine Fisheries Service (NMFS) and copies can be obtained from VIMS. Ordering information is on page 23.

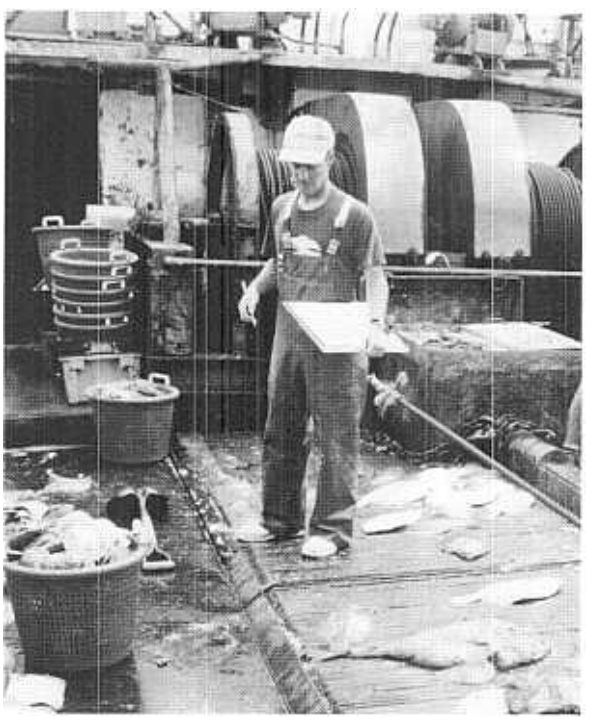
Resource Conditions In Closed Areas

Since 1994, three parts of Georges Bank have been closed to protect groundfish. In April of this year, one area off of the mid-Atlantic was closed to protect large quantities of two-year-old scallops. In total, the sanctuaries in New England cover some 5,000 square miles; in the mid-Atlantic, 1,900 miles are off-limits.

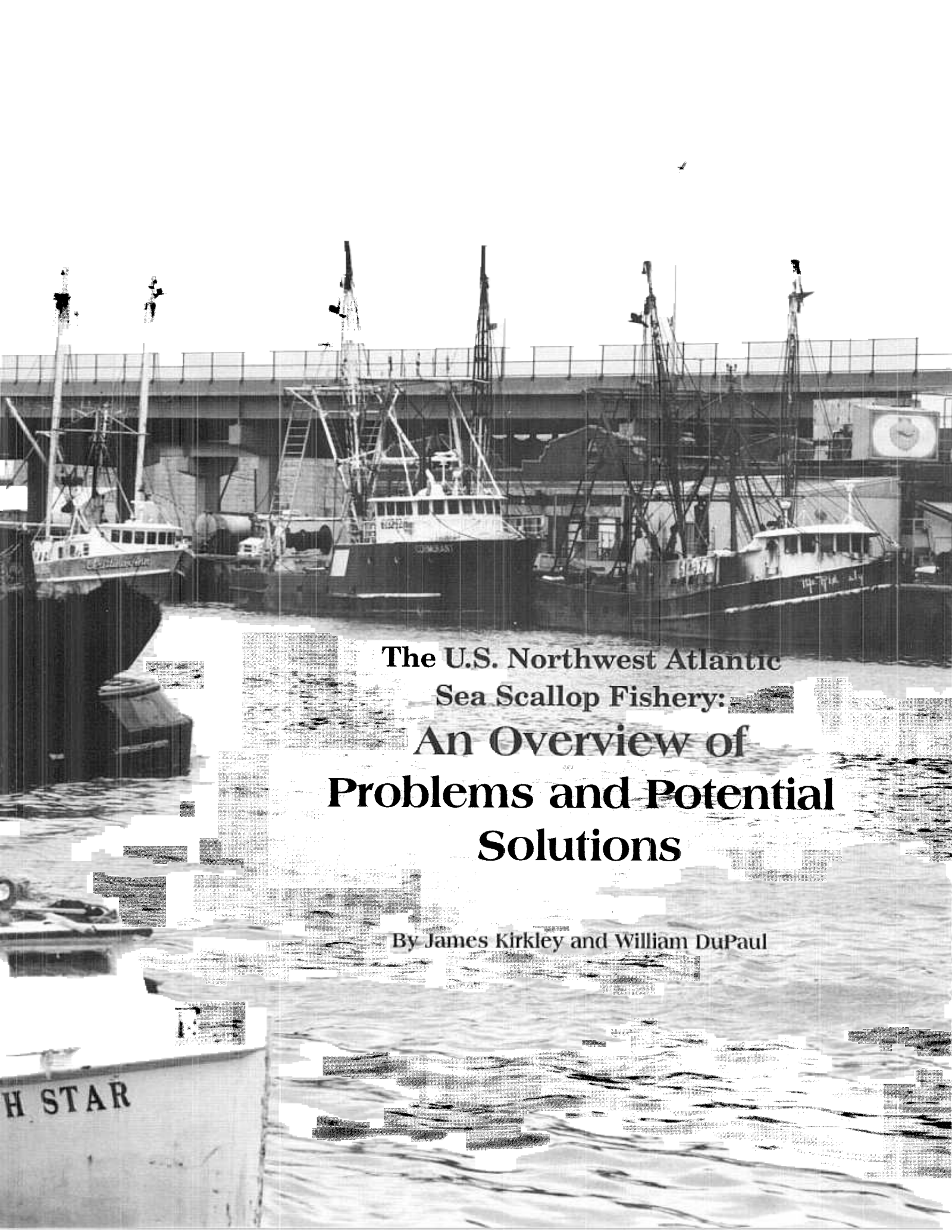
In a joint project, researchers have been sampling the areas closed on Georges Bank to check the abundance of the scallop resource. The project is being conducted by NMFS; Virginia Sea Grant at VIMS; and the University of Massachusetts at Dartmouth's Center for Marine Science and Technology (CMAST). Six vessels sampled Closed Area II; over 160 stations were sampled per vessel to determine the abundance, and how the resource is distributed spatially. Additionally, researchers tested different twine tops for dredges as a possible means of reducing finfish by-catch and conducted depletion experiments in an effort to determine the harvest efficiency of scallop dredges.

The logic behind sampling the closed zones is that if the scallop resource is plentiful in the sanctuaries, opening them to fishermen could alleviate some of the pressure on other areas and could lessen the economic impact of impending restructure restrictions. Different strategies are being considered, such as opening the closed areas during certain times of a year to avoid fish spawning times and spawning aggregations. Ultimately, allowing scallopers access to this resource may help minimize the impact of recent mandates on commercial fishermen, many of whom are expected to experience economic hardships.

As this issue of the *Bulletin* went to press, data results had not been tabulated. However, the closed areas on Georges Bank have an abundance of scallops. In some areas, dredges completely filled within ten minutes. The next step will be for the data to be analyzed by a team from NMFS, VIMS, and CMAST to determine the amount of scallops that could be harvested from the closed areas while still staying within the overall objectives of the management plan.



Graduate student Dave Rudders participating in the scallop survey on Georges Bank.



The U.S. Northwest Atlantic Sea Scallop Fishery: An Overview of Problems and Potential Solutions

By James Kirkley and William DuPaul

Problem Overview

The U.S. northwest Atlantic sea scallop, *Placopecten magellanicus*, fishery is one of the most valuable, in terms of ex-vessel or dockside value, fisheries of the United States. Prior to extremely restrictive regulations imposed between 1994 and 1998, the ex-vessel or landed value of sea scallops routinely ranked fifth among all individual species landed in the United States. The fishery is prosecuted from Maine through North Carolina with the larger fleets and removals coming from New Bedford, Cape May, and Hampton Roads' vessels. The two major fishing areas are Georges Bank and the mid-Atlantic.

There are two primary gear types and two product forms for sea scallops. The major gear in terms of landings and activity is the dredge; small quantities, typically less than 15 percent of total landings, are harvested with a trawl and are highly dependent upon year-class strength. The major product form is scallop meats; small quantities of product in the shell, however, are regularly landed. Prior to 1994, 300 or more scallop dredge vessels regularly harvested sea scallops.

In Virginia, the sea scallop fishery has traditionally been the most important fishery in terms of ex-vessel revenues. The blue crab fishery typically produces the second highest revenue. In 1994, the ex-vessel value of sea scallops landed in Virginia equaled $35.6 million. The fishery generated more than $94 million in total sales to the state economy. Total full-time equivalent employment from the fishery for the state equaled 1,908 individuals. That is, total sales of sea scallops among harvesters, processors, restaurants, and retail markets generated employment opportunities, in terms of full-time equivalent units, for 1,908 individuals. At the local or community level, the fishery has even more importance.

Since 1983, the U.S. northwest Atlantic sea scallop fishery has been subject to regulation. The initial regulations during the 1980s and early 1990s attempted to control the age at entry or age at first capture. Two basic regulations were used: (1) for product landed in meat weight form, the average number of meats per pound (MPP) or meat count was restricted to 30 MPP with a 10 percent tolerance; and (2) for product landed in the shell, a minimum shell height of 3.5 inches, with a ten percent tolerance, was imposed. In actuality, the shell-height restriction, plus the ten percent tolerance, was relative to 400 measured scallops (i.e., if more than 40 out of 400 shell were found to be smaller than 3.5 inches, the vessel owner was found to be in violation of the regulation).

The age-at-entry regulations were found to be inadequate to regulate the fishery and prevent the resource from being over fished. A variety of practices by industry allowed smaller scallops than originally intended by the regulations to be regularly harvested and landed. In response, Amendment #4 was developed by the New England Fishery Management Council (NEFMC), the Council having primary management control of the fishery, and implemented under the U.S. Secretary of Commerce in March 1994. Amendment #4 imposed regulations on the number of allowable days at sea per year, crew size, gear size and configuration, and reporting requirements. Of all the various regulations, however, the number of allowable days at sea has been the most troublesome for industry. The allowable days were established in accordance with a decreasing schedule based on target fishing mortality rates to meet the overfishing definition at that time based on a level of spawning stock age. For the 1998 fishing year (April 30, 1998 through March 1, 1999), the industry is allowed 142 days per year, but that is to be reduced to 120 days in 1999. At 142 days, many of the vessel owners are either unable to cover their total costs or can only cover the costs by foregoing maintenance. Failure to maintain vessels poses potential safety problems for crew.

Not only are vessel operations highly regulated, but there

are also several closed resource areas. Three areas on Georges Bank are closed to nearly all types of fishing. The closure of Georges Bank was done, however, to help restore the stocks of groundfish. The mid-Atlantic areas are closed only to scallop fishing and only for the purpose of rebuilding the sea scallop resource.

The closure of Georges Bank, however, not only reduced the allowable areas which could be fished by scallop dredge vessels, it also forced the New England and mid-Atlantic fleets to increase or concentrate their fishing activities on the remaining open Georges Bank and mid-Atlantic resource areas. The increased concentration has likely generated considerable economic waste and the harvesting of scallops below the optimum size. In a 1997 report by DuPaul and Kirkley, it was shown that scallops allowed to grow for 17 months between ages 2.5 and 4, even with 20 percent natural mortality, would more than double their weight. Preventing the harvesting of small scallops, thus, offers substantial returns to industry.

The current story on Georges Bank is also troublesome. The closed areas have not been fished in over four years. Based on recent preliminary at-sea experiments on Georges Bank collaboratively done with industry, National Marine Fisheries Service (NMFS), University of Massachusettes at Dartmouth, and the Virginia Institute of Marine Science, it is thought that the scallop resource is extremely high. Moreover, some areas may be experiencing unusually high natural mortality rates because of the large number of scallops competing for food and space.

What is more alarming, however, is that the Sustainable Fishing Act (SFA) of 1996 will require even more restrictive conditions on the fishery. The SFA, except when not possible, requires that marine resources managed under the Magnuson-Stevens Fishery Conservation and Management Act be rebuilt within a seven or ten year horizon. The SFA also imposes a new target fishing mortality level to meet a new definition of overfishing based on a stock age which would maximize yield. However, this new definition requires considerably more restrictive management measures than that required by the 1994 definition. In order to rebuild the scallop resource, the Northeast Fisheries Science Center staff with NEFMC staff have estimated that only 35 to 70 days at sea could be allowed per vessel. These allowable days at sea imply the obvious for all vessel owners, except those with sufficient capital to stay in the fishery until more days are allowed—simply, bankruptcy of the vessel owners and related businesses.

The U.S. northwest Atlantic sea scallop fishery is, thus, in considerable trouble. The scheduled number of allowable days at sea for 1999 may cause severe financial hardship for the fleet. If fully implemented as presently required, the SFA will impose severe hardship. If the closed Georges Bank areas are not opened to some limited scallop fishing, the mid-Atlantic and other Georges Bank resource areas cannot support the entire fleet, and the resource will become even more jeopardized by the harvesting activities of the entire fleet.

Approximately 15 percent of scallops in the mid-Atlantic are harvested with a trawl.

A Potential Solution

Solving the sea scallop fishery problem will not be an easy task. First, it is relatively well known that the fleet does have substantial excess capacity. In other words, there are more vessels than necessary to harvest allowable levels, and each vessel is catching considerably less than it could without all the management restrictions. Second, the present regulatory regime severely limits vessel productivity and prevents them from operating efficiently. Third, the only way to realize the goals and objectives of the SFA is to drastically reduce fishing activity by the fleet.

It is the third problem which poses the greatest challenge to management and industry. In simple terms, realizing the goals and objectives of the SFA and Magnuson-Stevens Act requires a reduction in the total harvesting capacity. A reduction can be accomplished with natural market forces which will reduce the number of days until the necessary capacity is forced out of the fishery through bankruptcy. Alternatively, the fleet may be reduced through some type of buyback program in which vessels are purchased, removed from the fishery, discarded or scrapped, or sold to individuals in other nations.

A buyback program, while necessary, will not, however, provide an interim solution. An interim solution is necessary to allow industry the opportunity to work with appropriate public agencies to develop a buyback program which is satisfactory to the NEFMC and NMFS.

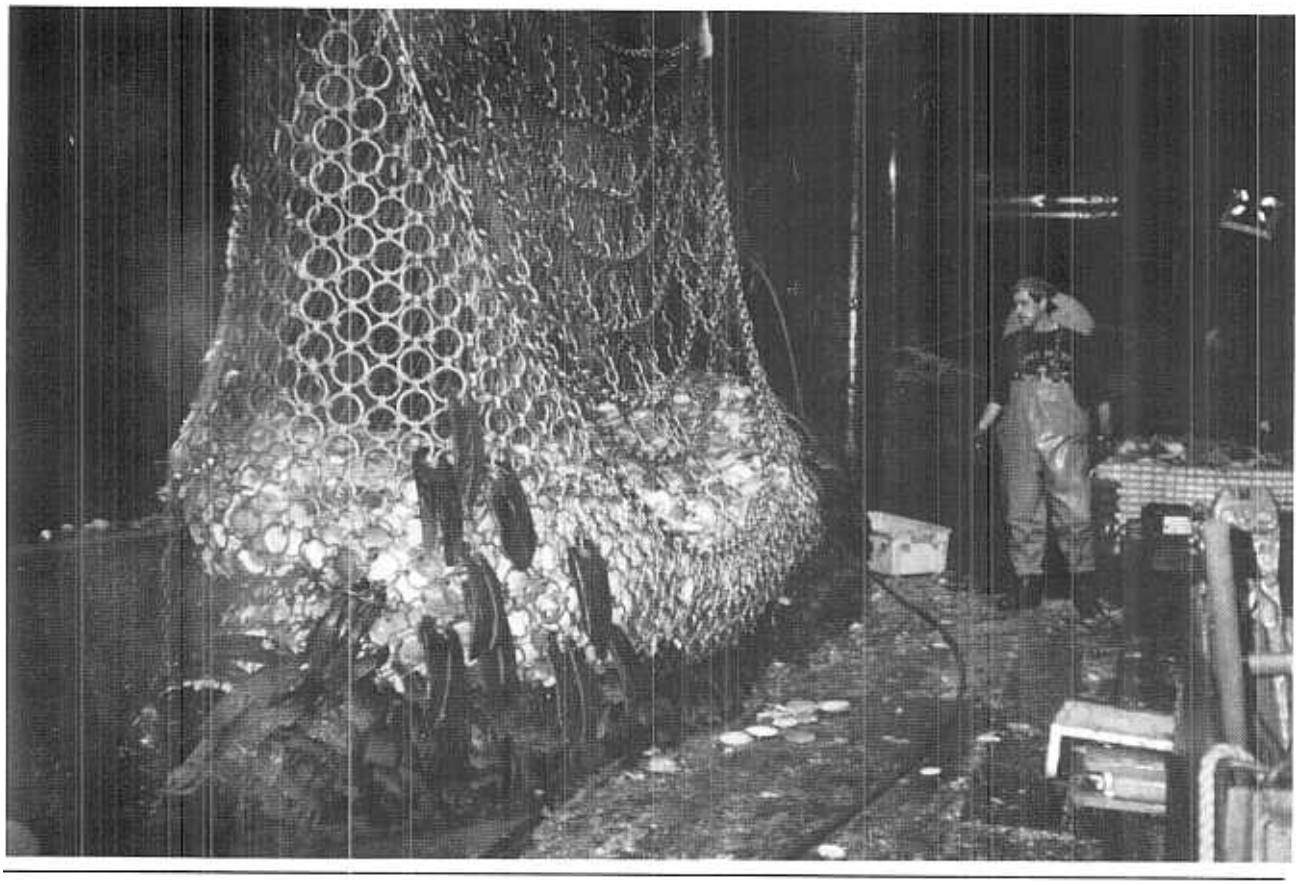
The most feasible interim solution is to permit controlled access to the scallop resource in the closed areas of Georges Bank. This should be followed by a major amendment to the Sea Scallop Fishery Management Plan to allow the development of area management strategies. The controlled access must be designed to ensure the continued rebuilding of the groundfish stocks, prevent over harvesting of sea scallops, and allow sufficient time during the 1999-2000 fishing year to develop a buyback program. Any type of access also must be fair and equitable regardless of the geographic proximity of ports to Georges Bank. Last, any opening of Georges Bank must satisfy the requirements of NMFS and the NEFMC.

During an interim period of controlled fishing on Georges Bank, it is requested that a working group of individuals from industry, government, and academia be formed and assigned the responsibility to develop a buyback program. The first order of business will be to determine the number of vessels which need to be removed from the fleet. This can only be determined, however, by working with the NEFMC and NMFS; this is because the number to be reduced must be consistent with achieving the stated goals and objectives of management and the SFA.

The next major problem relative to a buyback program is the determination of how the program is to be financed. Should a buyback be paid for with 100% public financing, 100% private financing, or some mix of public and private financing? If there is to be any public financing, what should be the basis for using public monies?

Presently, it is thought that the fleet should be reduced by 70 to 100 active full-time vessels. In a 1993 study, Kirkley and DuPaul determined that approximately 90 vessels could operate at full capacity and harvest a maximum sustainable yield of 20 million pounds. Considering gear and other factors, a buyback in the scallop fishery could require up to $70 million. Regardless of whether or not the buyback requires $70 million or even somewhat less, the remaining vessels in the fishery would simply not be able to provide private financing for the buyback.

What basis is there for a publically-sponsored buyback? First, the "Americanization" of our fisheries in 1976 sent a signal to the banking community that fishing was a good business, a business that would be supported and well-managed by the U.S. government. Second, Congress created various financial programs to encourage entry or to expand capital in the fisheries.



Night-time photograph of a scallop dredge being hauled on-board during survey work in Closed Area II. This tow represents the largest number of scallops harvested during the survey.

In fact, a present working document by the U.S. Task Force on Federal Investment in Fisheries identifies 30 programs which have helped the American fishing industry. Given the nature of the various subsidy programs, it is clear that most of the programs were intended to expand America's fishing industry.

There remains another basis for considering public funding for a buyback program. It has been stated in numerous studies and government reports that society is not receiving the maximum possible benefits from the marine resources because of excess harvesting capacity and over fishing. Reducing the capacity should restore the benefits to society. Since society would receive benefits, there is a question of whether or not society would be willing to pay to receive such benefits. This is a question which cannot be easily answered, but one which needs to be considered when determining how a buyback program should be financed.

A remaining important issue is the cost of a buyback versus the cost of allowing the economic structure to collapse. If there are widespread bankruptcies from the SFA or current regulations, the infrastructure which previously supported the industry will be lost. In addition, the Commonwealth of Virginia and the U.S. Treasury will lose tax revenues. After seven or ten years, attempts to reestablish the necessary infrastructure will be quite costly. Overall, the cost to society from allowing widespread bankruptcy could exceed the cost of a publically-financed buyback. This latter issue is one which needs to be seriously considered when determining the source of funds for a buyback program.

BRIDGE

Ocean Sciences Education
Teacher Resource Center
http://www.marine-ed.org/

Ocean Science
- Biology
- Physics
- Chemistry
- Climate and Atmosphere
- Technology
- Use and Management

Resource Pavilion
- Elementary
- Information Centers
- Lesson Plan Collections
- On-line Expeditions
- National Projects
- On-line Publications
- On-line Data
- Student Opportunities
- Guiding Student Research
- Career Information

People and Places
- Aquariums
- Organizations
- Research Institutions
- Academic Programs
- School Project Pages
- Regional Pages

Professional Development
- Grants and Awards
- Teacher Programs
- Professional Organizations
- Summer Opportunities

Researchers
- Getting Involved
- Contributing to the Bridge

Discussion
- Bridge Discussion List
- Other Discussion Lists
- Ask An Oceanographer

An On-line Resource For Educators and Students

Access to the World Wide Web is easy but the results of a search can be gargantuan. Sorting through results to find what is accurate and pertinent can be a formidable process. Knowing that teachers are hard-pressed for any extra time for class planning, Sea Grant Education Specialists Lee Larkin and Vicki Clark developed a highly recognized site with all the resources an educator will probably ever need.

Long before computers were commonplace, Virginia Sea Grant educators were working with the technology, realizing its importance to her field. Virginia Sea Grant has long been in the business of providing information to teachers and students, maintaining a library of resources. The ideal part of providing information on the web is that stockpiling publications for distribution is greatly lessened. Entire publications, lesson plans, and connections to other sources of marine science information can be placed on the website, cutting down on publishing costs. Even more important—a website can provide access to people who might not have the time or money to travel to a marine lab. Perhaps best of all, the information is in a form which is understandable, and not mired in scientific jargon. The Bridge website can be accessed through the National Marine Educators Association home page; the address is http://www.marine-ed.org/.

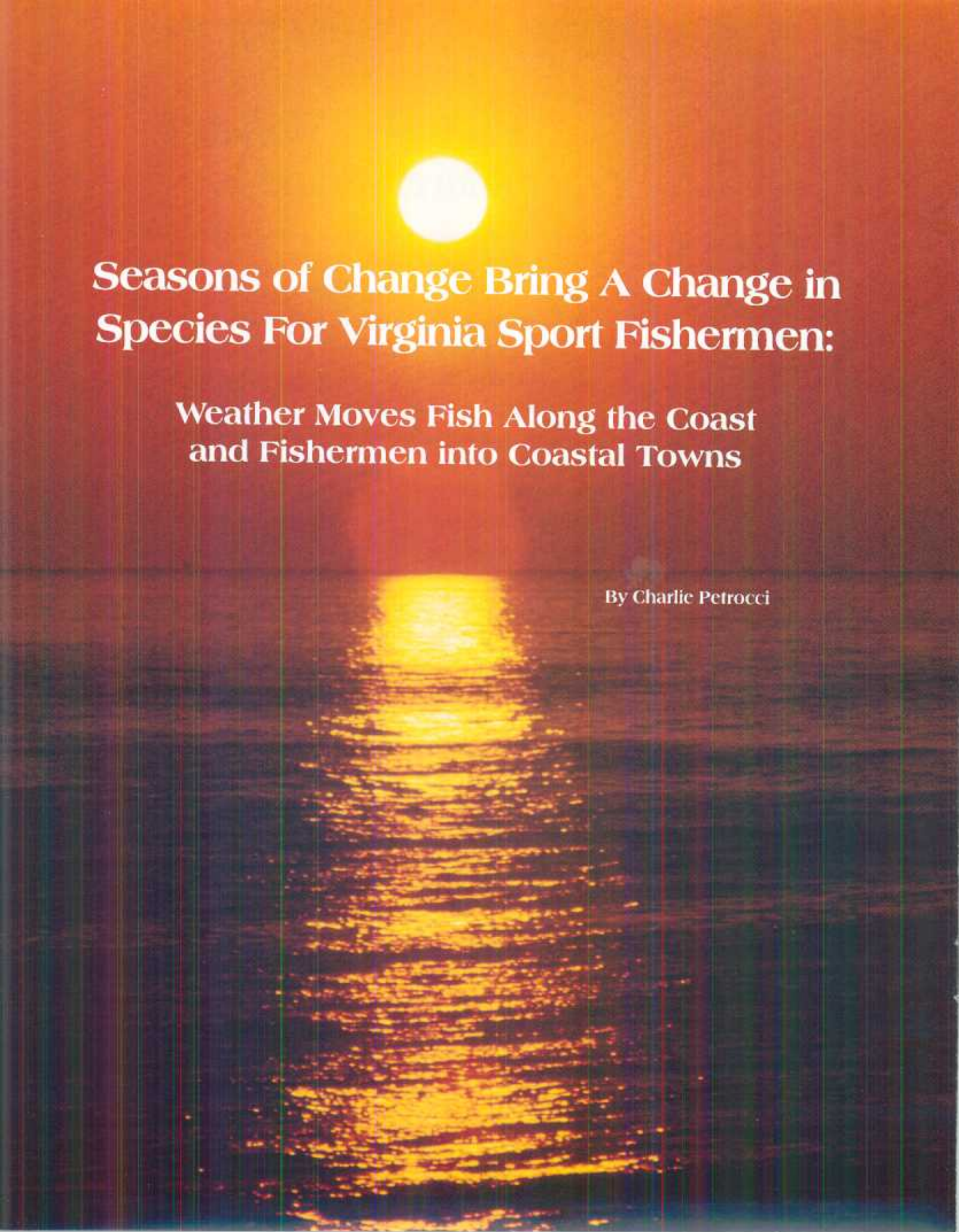
The Bridge is a National Oceanographic Partnership Program project and is sponsored by the National Marine Educators Association and the national network of Sea Grant educators. The Virginia Institute of Marine Science coordinates the project. For more information, contact webkeeper Lisa Ayers Lawrence at ayers@vims.edu at 804/684-7608.

On the left: the categories and resources available on Sea Grant's Bridge.

Seasons of Change Bring A Change in Species For Virginia Sport Fishermen:

Weather Moves Fish Along the Coast and Fishermen into Coastal Towns

By Charlie Petrocci



Depending on geographic location, harbingers of seasonal change come in different forms. For example, people in the Midwest may listen for the distant cry of the geese signaling fall. In the deep South, spring may be the first glimpse of cherry blossoms, while for many across the country, it is seeing Punxsutawney Phil, the celebrity groundhog, look for his shadow. But for those who take species migration and seasonal change seriously, like Virginia sport fishermen, word of the first shad commercial harvest is sign enough that spring is pushing up the coast and coming fast.

No one, it seems, is more in tune with species migration than fishermen, especially sport fishermen. Every angler knows that at certain times of the year, you are apt to catch certain species of fish. Driven by wind, tide, water temperature and the desire to breed, various species of fish have for time unknown made annual migrations along Virginia's inshore coast. The fish fill the Chesapeake Bay and the rivers and tidal creeks. To native Americans, species migration was the heartbeat of nature. Early explorers like John Smith were quick to note and take advantage of the annual schedule. And for many coastal communities around Virginia, seasonal change in fishing means economic change.

Each spring, many small coastal towns shake off the dulls of winter and wait for word of shad or mackerel caught by commercial fishermen, because game fish, such as bluefish and striped bass, will follow. After that will be the visiting, cash-laden fishermen. Early spring is also the time of year when other important recreational species such as sea bass and tautog move back into near shore bottom structures, and flounder make their first appearance off of Wachapreague and Chincoteauge. "Much of my business depends on seasonal species migration," says Greg Savage of Sea Tag Lodge on Chincoteague Island. "We get sports who book spring dates far in advance to take advantage of when the first flounder show up. That's what they come for, because at that time of the year you certainly can't swim on the beach. It kicks off our season and our business depends on them returning for the annual spring flounder run each year," he added. Many of these people are escaping the confines of urban winter living and head for the coast at the first sign of fishing opportunities. There is no doubt that people seek sport fishing as a recreation form to feed the mind and soul. And the arrival of certain species of fish each season is a cause to celebrate.

The coastal waters off Virginia are part of the mid-Atlantic Bight, which begins in Cape Hatteras and extends as far north as New England. The waters of this region are considered temperate, meaning they are neither warm nor cold. Here temperature range may run from a winter low of 35°F., to a summer high of 81°F.—a spread of almost 50 degrees. Thus, this temperature variance creates a tremendous transient population of marine fish in the Virginia coast waters, and a gold mine for anglers.

It is always difficult to pinpoint the dividing line between Atlantic warm water species and cold water species. Warm water species are primarily found in most abundance south of Cape Hatteras, North Carolina. However, many species normally listed as "classic" warm water specie—such as cobia, king mackerel, amberjack, spot, and speckled sea trout—are fairly common in and around Virginia waters and further north. Black drum has a historic spawning area in Delaware Bay. These species and many others more associated with southern waters, tend to range very far north, especially when coastal waters reach up into the 70°F. mark. It makes for a unique opportunity for Virginia fishermen to catch an assortment of species, even in one outing. "One thing about structure fishing is that you never know what's going to come over the rail next," says veteran bottom fisherman Woose Reed of Chincoteague. "I've caught cobia, spadefish and amber jack right along with sea bass, tautog, and bluefish—especially in the early fall when water temperatures begin to mix and you get that overlap of species." Reed, at 90 years old, is probably one of the oldest active charter boat fishermen along the east coast. He still likes to fish the bottom

in the traditional way by using a simple twine hand line.

Many fishermen believe that Virginia coastal waters are becoming warmer every year, thus creating situations where more uncommon southern species, such as pompano and barracuda, are being caught. But this may not be the case if we look at the history books of sport fishing and species habitation. Possibly the most unique phenomenon of southern species moving north is the occurrence of tarpon in Virginia waters. And one place stands out above all the rest: in the back bays surrounding the little seaside Eastern Shore town of Oyster. Here, for decades, tarpon have been hooked and lost. "Every year I go tarpon fishing in these bays and sometimes get hookups. Don't get me wrong. This isn't like Florida, but it's not uncommon to see a tarpon rolling on the surface when the conditions are right," says Barry Truitt of the Nature Conservancy. "I don't know why they are here. More than likely, it's a historic breeding ground for them. I look forward to their return each year." Truitt, for many years, held the state tarpon record, caught, of course, in the unassuming waters around Oyster.

Consequently, just as southern species range north, many cold water species will migrate south. Weakfish, for example, listed as a cool water species, cover an awful lot of geographic area, even as far south as the Gulf of Mexico. Joining this mixture of migration is also the cold water classed bluefish, which ranges from Maine to the Gulf of Mexico. But it is most abundant between Cape Cod and Cape Hatteras. As far as regional fish distribution and migration is concerned, there is probably no one larger influential factor greater than the Chesapeake Bay. With its daily tide exchanges and flush, along with nutrient load and fresh water flow, the Bay's outflow acts as a thermal moderator for many species of fish. In the spring, with warm, abundant fresh water running out into the ocean, it may act as a barrier to some species or an attractant to others. On the other hand, during cold winter months, often warmer, outgoing Bay water "holds" migrating fish coming down from northern waters, offering a boon to Chesapeake Bay Bridge area fishermen. Species which remain in the area year-round often move offshore to deeper waters until spring arrives.

The seasonal distribution of fish is not static. It varies with each season, and, for quite a number of species, the young and juveniles have a different distribution range than they do in their adult stage.

Anadromous species are also another obvious group to consider when looking at seasonal migrations. Some of these fish, which spend most of their lives at sea, only returning to fresh water to spawn, are often treated as fresh water fish. These, for example, include sturgeon and shad. For the sport fisherman, some of these fish are now sacred ground and on the verge of rebound, so harvesting has been limited. But other migratory species fill the recreational void nicely, including striped bass, the darling of the Chesapeake Bay.

Change is part of the seasonal life cycle and is created by different variables. For instance, due to short-term weather phenomena, long-term weather, tides, location and climatic patterns, inevitably fresh and salt water exchange occurs between ocean and Bay waters. When heavy rains on the western Virginia mountains cause floods, they send huge masses of fresh water into tidal creeks and create what are known as "freshets." This fresh water collision with brackish water may create extreme salinity changes and actually shock some marine life. Water temperatures also change quite frequently with the change of seasons, exposing ice in tidal basins during winter and back bay water temperatures creeping into the 90s F during the depths of summer. Sometimes this change in extreme temperatures can have dramatic effects on many types of game fish and should sometimes be taken into account for a lack of species abundance at any give time.

The seasonal distribution of fish is not static. It varies with

each season, and, for quite a number of species, the young and juveniles have a different distribution range than they do in their adult stage. For instance, tropical species with pelagic young may occur in waters of Virginia during the warm months. Some even settle in the warmer, deeper waters off of North Carolina during the winter months. The young of other species live in shallow waters close to shore, while the young of other fish may be found in deep, offshore waters. But as they mature, both species may co-inhabit a middle ground.

The coast of Virginia supports some of the richest marine waters in the world. A reason for this starts with the Chesapeake Bay, the largest and most productive estuarine complex in North America. It is here that several great rivers converge, carrying a vast supply of nutrients into costal waters and provide a huge spawning and nursery ground for many species of sport fish. Forces with seemingly little connection to the Chesapeake have major impact on surrounding waters. For instance, the warm waters of the Gulf Stream flow north along the East Coast until they collide near Cape Hatteras with the cool, plankton rich water of the south flowing Labrador currents. Geographically, this creates a dynamic mix of game fish and brings them within reach of coastal Virginia. This has developed into an area where many temperate species of fish have drawn a southern boundary and subtropical species, a northen boundary.

The coast of Virginia and its adjacent bays and inlets could best be described as a giant corridor for migrating fish. The area is blessed with a mixture of currents which, in turn, create a seasonal myriad of available species for sport fishermen. Thus, sport fishermen are in a unique position to intercept these species as they migrate on a seasonal basis. The rhythm of migration has been going on for thousands of years and hopefully, for the sake of fishermen, coastal communities, and the species themselves, this continuum will not be broken.

New Publications

Laws, Regulations, and Environmental Factors and their Potential Effects on the Stocks and Fisheries for the Blue Crab, Callinectes sapidus, in the Chesapeake Bay Region, 1880-1940

Author: Willard A. Van Engel

Summary

During the period 1880 to 1940, the Chesapeake Bay's blue crab fishery went from a relatively small industry to one with a substantial economic impact on watermen, processors, shippers, and coastal communities. Van Engel examines whether any of several variables had effects on the stocks and the successes or failures of the fisheries. Variables studied include minimum size limits, fishing intensity, the protection of female crabs with extruded eggs, and variations in the physical and chemical conditions of the environment. Little is known of the intensity of fishing of any one gear: licenses were seldom required by the states over the first two-thirds of the period, and federal canvasses of landings and fishing effort were made only occasionally until 1929. New kinds of gear and methods of fishing were seldom introduced. Three legislative changes that could have had a major impact on the stability of the bay's blue crab population were the 3.5 minimum width limit on hard crabs (enacted in Virginia in 1912); the bi-state imposition of the 5-inch minimum width limit on hard crabs in 1916 and 1917, and the seasonal and geographic protection of sponge crabs enacted between 1916 and 1940. Despite those laws, wide and frequent fluctuations in catch and landings have characterized the blue crab fisheries. This does not mean that minimum size and sponge crab protection laws were ineffective, but that other factors could be either counteracting or enhancing them.

Seafood Restructuring Using Cold-set Binding Technology

Author: Bob Fisher

Summary

Food Restructuring is a term used to identify a process where pieces of raw material are bound together to form a single larger food item, typically resembling a natural product form. Market advantage is increased for restructuring if the targeted market form is in high demand. Case in point: of the domestically landed sea scallops, the 20-30 meats per pound size are the most highly marketable; in 1996-1997, landings of that size scallop were drastically reduced, creating a high demand for the larger product. Two cooperating industry members, with assistance from Virginia Sea Grant specialist Bob Fisher, filled that market void by restructuring 80-120 count imported scallops into 20-30 count scallops, and marketing them as "Scallop Medallions." A red-meat industry product, Fibrimex, was utilized in the restructuring.

Fisher's paper details all aspects of the research, including the selection and nature of the raw material, fibrimex and ACTIVA (the binders used), to binder effects on quality parameters.

The development of the scallop medallion has had a tremendous economic impact within the scallop industry in Virginia, and in the nation. Currently, several scallop companies along the East Coast are producing scallop medallions from a variety of raw material sources to supplement their product line. Most of the processors rely on the initial processing parameters identified through the assistance of Virginia Sea Grant.

A Comparison of Size Selectivity and Relative Efficiency of Sea Scallop Trawls and Dredges

Authors: David Rudders, William DuPaul, James Kirkley

During August and September 1997 and May 1998, three comparative fishing experiments were conducted aboard commercial sea scallop trawl and dredge vessels to assess the efficacy of gear restrictions found in Amendment #4 to the Sea Scallop Fishery Management Plan. Restrictions that included minimum mesh and ring sizes and maximum gear widths were assumed to equate sea scallop trawls and dredges with respect to size selectivity and efficiency. Results indicated that the two regulated gear types were not equal in either respect. Absolute gear size selectivity could not be estimated; however, relative size selectivity patterns inferred from other analyses suggest broad yet different size ranges of scallops captured by each gear type. Relative harvest efficiency values demonstrated a shift in at roughly 90 mm shell height. Trawl vessels were more efficient capturing scallops greater than 90 mm. This shift, coupled with a minimum cull size at roughly 70-75 mm shell height, had a profound effect on both relative production rates and catch composition. The differing harvest patterns observed in this study may make equating current trawl and dredge designs difficult.

Ordering Information

To receive a copy of these publications, write Virginia Sea Grant, Virginia Institute of Marine Science, PO Box 1346, Gloucester Point, VA 23062. Each publication costs $5.00. Any checks should be made out to VIMS.

National Catch and Release Symposium Slated for December 1999

A symposium on catch and release in marine recreational fisheries will be conducted December 5-9, 1999 in Virginia Beach, Virginia. The symposium is sponsored by the National Sea Grant Office; Sea Grant Marine Extension Programs from Virginia, New York, North Carolina, Georgia and California; the National Marine Fisheries Service (Intergovernmental and Recreational Fisheries Office), the Atlantic States Marine Fisheries Commission; and the American Fisheries Society.

The symposium will include sessions providing overviews and critiques of catch and release issues in marine recreational fisheries, including one covering the following concepts and subject areas:

- **Current research on hook-release survival**, including new tagging techniques to track released fish over significant periods of time;
- **Catch and release as a management tool**, including concerns of anglers and fishery managers regarding how release mortality impacts stock assessments and size-bag limits;
- **The marine angling community's perceptions and use of catch and release** as a major component of angling ethics and its contribution to effective conservation of marine fish stocks;
- **Critiques of current education and outreach efforts** to promote greater participation in catch and release among marine anglers, including adoption of new techniques or gear;
- **Develop a research and outreach agenda** to more effectively address priority catch and release issues;
- **Posters and displays highlighting research and educational efforts** associated with understanding and promoting catch and release in marine recreational fisheries.

To be added to the symposium mailing list, contact Jon Lucy, Catch and Release Symposium, Virginia institute of Marine Science, P.O. Box 1346, Gloucester Point, Virginia 23062 (phone: 804/684-7166; e-mail: lucy@vims.edu).

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