



Virginia

MARINE RESOURCE

BULLETIN

Virginia Sea Grant College Program
Virginia Institute of Marine Science
College of William and Mary
Volume 31 ▲ Numbers 1 and 2 ▲ Fall 1999



A note of introduction

Day two...

A friend down the hall came into my office, made a 360-degree sweep with her eyes, and declared, "Wow, your office is really . . . stark." We both had a good chuckle over the painful truth. Empty white bookshelves pick up the fluorescent glare from overhead lights and beam it back to me at eye level, while I squint at a rather vacuous monitor over stacks of boxes.

In the boxes rest the results of a readership survey conducted last winter, waiting for some energetic soul to sift and sort them, to find the recurring messages that were carefully scripted by you, our readers (thank you!). Piles of past Bulletins sit atop my desk, dating back to simple black and whites produced in the early 1970s. They were much slimmer then and the stories, more like advisory "snippets" than full-length features. The Bulletin took on a markedly different face in the early '80s, with the advent of longer, in-depth articles devoted to a single subject. Not too many years ago, color was added in the form of the magazine's cover and full-color photographs within. With each of these passages appear distinct trademarks of the editor in charge, a personality peeking between the pages.

So here I sit thumbing through them all, and through dozens of technical papers, educational pieces, advisories, and assorted offerings from the marine industry. I wonder if I'll ever master calling the sea scallop, "*Placopecten magellanicus*," or American shad, "*Alosa sapidissima*," without stumbling. Wonder how long it will take me to get the faces and names connected with the departments and buildings on campus. And wonder if I can do the most important thing of all — translate often complex, brutally technical aspects of the ongoing research projects that both define and glue together this place, and make them clearly accessible to you: researchers, entrepreneurs, educators, fishermen, seafood processors, consumers, concerned citizens.

I am not a marine scientist. But I am a devoted advocate of scientific pursuits that solve practical problems. And with years of working in and writing about environmental concerns, I am—most of all—a generalist. I hope that proves to be an asset as I get up to speed on the critical work going on in Virginia's Sea Grant Program, as I fill up these bookshelves, and as I learn, carefully, how to present that information to you. Along the way, I hope to give the Bulletin a fresh face and suggest a new personality — one whose primary motivation is keeping pace with the demands of a marine world in need of repair. Sitting on the edge of a new millenium, it's a challenge worth pursuing.

Sally Mills

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The *Virginia Marine Resource Bulletin* is a publication of the Marine Advisory Program of the Virginia Sea Grant College Program, which is administered by the Virginia Graduate Marine Science Consortium with members at the College of William and Mary, the Old Dominion University, the University of Virginia, and the Virginia Polytechnic Institute and State University. Subscriptions are available without charge upon written request.

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A New Approach to American Shad Management

By Sally Mills

Marine scientists are often engaged in solving mysteries of one sort or another: transport of an exotic animal or plant, a shift in community dynamics, an apparent new species. But increasingly in the marine science field, scientists are being asked to solve mysteries of another stripe. Working to help others “manage” a particular species can prove a thrilling and complex challenge that generates an entirely new set of questions to answer and clues to uncover. The American shad (*Alosa sapidissima*) presents a perfect case in point.

Background

Shad and herring have supported recreational and commercial fisheries along the East Coast and within the Chesapeake Bay since colonial times. They also play a vital ecological role. Juvenile *Alosa* are an important prey species for striped bass and other recreational species while the shad remain on their freshwater and upper estuarine nursery grounds. In autumn, young shad move to coastal waters, where they are subjected to predation by assorted marine piscivores until they return

to their native streams to spawn for the first time at ages 3 to 5.

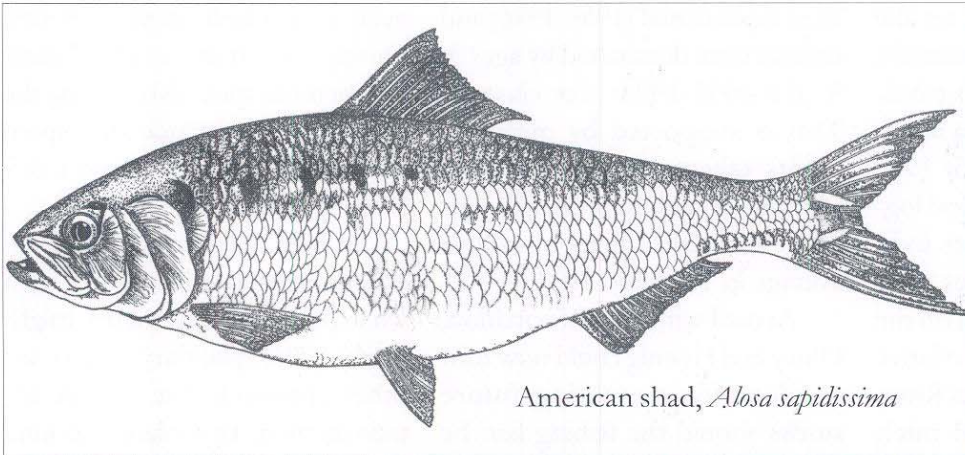
American shad in the Chesapeake were a dietary staple of early colonists and Native Americans before them. But it was not until the late 1800s that the shad fishery in the Bay began to develop rapidly, due to a proliferation of fishing gear — which included haul seines, pound nets, and staked gill nets. Within time, catches began to plummet.

In response, the U.S. Fish Commission and Virginia Commission of Fisheries instituted an artificial hatching program in 1875, and in 1879 the fishery began to improve. The increase in catches led biologists to believe that the shad fishery was largely dependent upon artificial propagation. However, by the early 1900s the decline in shad harvests resumed, despite improved hatching methods and increased numbers of fry released.

Today, many *Alosa* stocks along the eastern seaboard of the United States are depressed, and there is evidence of recent and persistent stock declines of American shad in three of 12 river systems, based on a recently completed stock assessment prepared



Before the moratorium, shad fishermen using nets were a familiar sight on Chesapeake Bay.



American shad, *Alosa sapidissima*

absence of fishing pressure, see if they “hold up” in the field.

Uncovering clues

Drs. Hoenig and Olney first set out to assess the current status of the fishery. They designed a monitoring program to determine current catch rates relative to

for the Atlantic States Marine Fisheries Commission (ASMFC, 1998). Large catches no longer occur as they did at the turn of the century. Commercial American shad landings in Virginia decreased from 11.5 million pounds in 1897 to less than a million pounds in 1982. Over-fishing, dam construction, pollution, and loss of natural spawning grounds are key factors that may be related to this decline.

In the wake of continued declines, a moratorium on the taking of American shad in the Chesapeake Bay and its tributaries was established by the Virginia Marine Resources Commission (VMRC) in January, 1994. The prohibition applies to both recreational and commercial fishers.

A management dilemma

Until 1998, there were no existing monitoring programs that provided direct assessment of stock recovery. The ban on in-river fishing in Virginia remained in effect, creating a dilemma for managers who needed reliable

information in order to make a rational decision on when the in-river ban could safely be lifted.

Specific questions needed to be answered. For example, four years after the imposed moratorium, the current status of the stock was unknown. If the existing moratorium was to be lifted, what should managers do differently to prevent another crash of the fishery? What should be the restoration target for American shad? How should managers balance the use of different gear when establishing harvest limits? What impact does the offshore fishery have on migratory stocks? And perhaps most contentious of all, should the offshore fishery be managed? If so, how?

Helping to unravel this mystery became the challenge of the day for fisheries scientists, Dr. John Olney, Sr. and Dr. John Hoenig. Each piece of the puzzle represents a research project of its own — a daunting task. At the same time, however, the moratorium offers a unique opportunity to try out novel ideas and, in the

those recorded before the prohibition of in-river fishing in 1994. For historic information, the Institute solicited the help of commercial fishermen, who loaned their logbooks of catches during the period 1980 to 1993. The historical data consist of daily records of catch by weight, and the numbers and lengths of staked gill nets set in the York, James, and Rappahannock rivers. In addition, every year the length of the river fished was surveyed and the location of each staked gill net was noted on a map (see next page for 1983 example). These data provided the basis for making comparisons of catch rates in 1998 with historic values.

Fishermen were then hired to fish the same locations, using the same methods, during the spring of 1998 and again in 1999. The 1998 data showed that total numbers (n) of female American shad in staked gill nets were low on the Rappahannock River (n=74), higher on the James River (n=156), and highest on the York River (n=774). Catch rates peaked

on March 21 and April 5 on the York and James rivers, respectively. A seasonal catch index was calculated by estimating the area under the **daily catch curves** for 1998 and each year in the historical log-book data. The time series indicated that 1998 catch rates were comparable to historic data on the Rappahannock River, low relative to historic data on the James River, and higher than recorded catch rates on the York. Additionally, the staked gill net monitoring program in 1998 revealed that a large bycatch of striped bass is taken by this fishery in some rivers.

Next, the age composition of American shad in staked gill nets in the York River was estimated by counting annual growth rings in the **otoliths**. Eight age classes

were represented (1989-1996) and catches were dominated by ages 3-5 (the 1992-1994 year classes). This is supported by measurements taken during the VIMS pushnet survey, in which the juvenile abundance index was above average in 1993 and 1994.

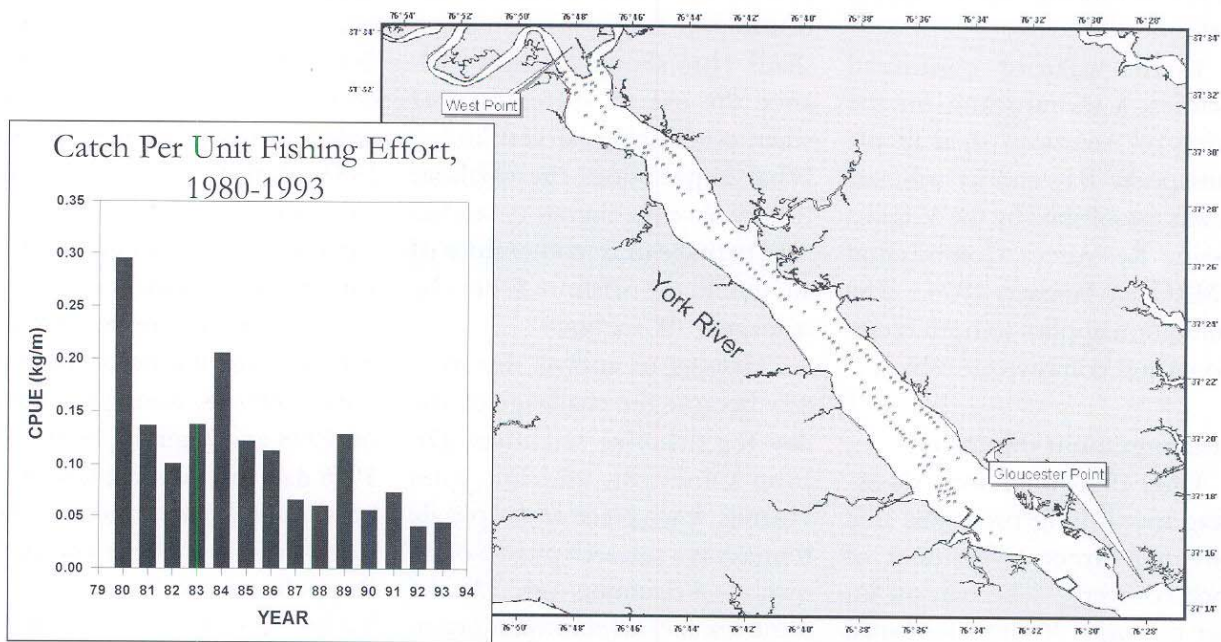
Armed with this information, Olney and Hoenig could now turn to ideas for measuring future stocks should the fishing ban be lifted. One approach involved looking at fish movement in the York River before, during, and after the spring spawning run to establish an index. The index-removal method is built upon the presumption that if 40 fish go up the river and only 20 come back, half of them were harvested. What scientists found out, how-

ever, shot a hole in their theory. During the study period, fishers caught more spent fish, leading the scientists to conclude that spent and ripening fish must have a different "catchability" rate.

If, indeed, catchability is somehow connected to life history, then what other measurements might work? The quandary led to another approach: the change-in-ratio method. By looking at pound net catches (see graph on page 6), researchers established that the sex ratio of both pre-spawning fish and spent fish is about the same. Again, this information can be confirmed only during a moratorium, since an active shad fishery exploits a high percentage of females (approximately 90%).

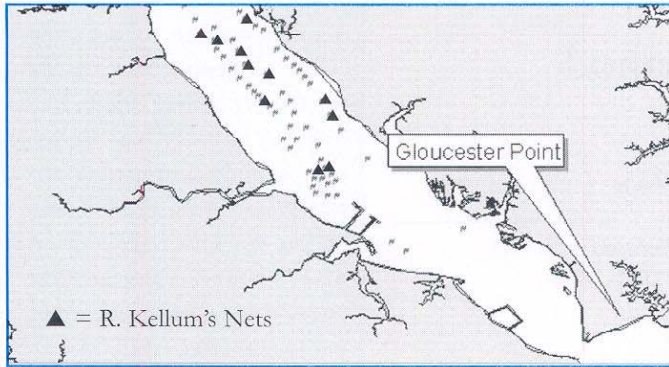
**Words in bold are explained in the glossary on page 5.*

Location of Staked Gill Nets in the York River in 1983

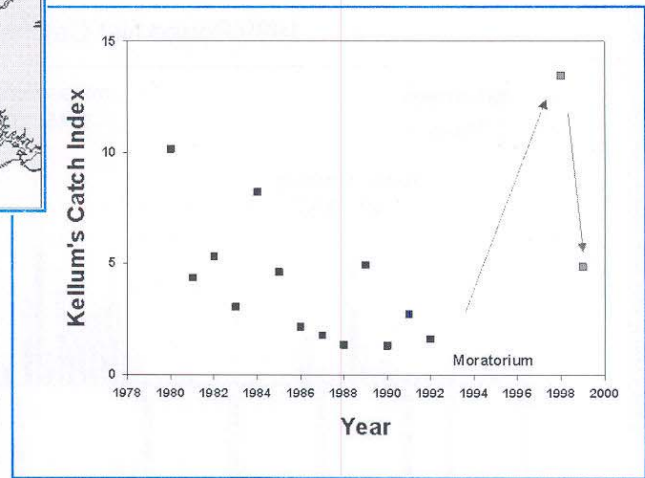


CPUE (kg/m): In this case, catch per unit effort means kilograms of fish caught per meter of gill net.

Location of Raymond Kellum's Gill Nets & Catch Data, 1980-1993



Raymond Kellum kept logs of his daily catches each year until the moratorium was imposed. He has been hired by VIMS to fish in the same locations, using the same methods, in order to compare current catches with those prior to 1994.



Logic predicts that if the fishery is re-opened, the current sex ratio should shift. The change-in-ratio method says that if the fishery is re-opened and the ratio of females to males drops significantly, the change indicates that a large percentage of the total population has been harvested. Conversely, if the ratio of females to males drops very little, the change in ratio signals that only a small fraction of the total population has been harvested. This model could be used in the future by the VMRC and other managers,

should a limited shad fishing season be established.

Hoenig and Olney are now grappling with how to set viable restoration targets. Given what they know, what will the rivers produce? VIMS has been extremely fortunate in picking up key clues. Historical logbook data from the 1950s have been discovered on microfilm, and researchers now know what shad stocks

the rivers were capable of supporting 40 to 50 years ago. At the very least, the information offers a frame of reference in setting restoration goals.

But fishing gear has changed quite a bit in the past 50 years. Today's nets employ synthetic materials of differing mesh sizes. Before scientists can compare 1999 catches with historic numbers, they need to calibrate the different gear used in order to provide a standard of comparison. This coming spring, researchers at the Institute plan to fish the old nets side by side with the new nets to arrive at this conversion factor.

A related research need involves determining an "equivalence" factor for the composite of gear and methods used today. For example, what is the difference between a staked gill net versus a drifting gill net in terms of har-

Glossary of Terms Used

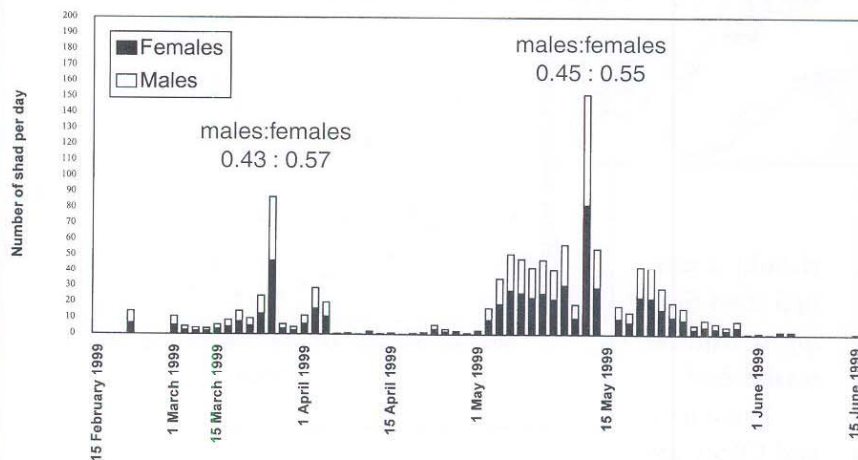
Catch Per Unit Effort - total harvests (or total catch) scaled to the amount of fishing effort; or, how much is being caught per standardized unit of fishing effort

Daily Catch Curve - the curve of data points on a graph; the area under the daily catch curve provides information to examine changes from year to year, or season to season

Otolith - a rock-like deposit in the ear of a fish; of interest because each year a layer of calcified material is deposited here. By sectioning the otolith and counting the layers, one can determine the age of the fish.

Use of the Change-in-Ratio Method

1999 Pound Net Catches



The change-in-ratio method is one approach to assessing American shad stocks, should the fishery be reopened. The method is based on the assumption that during the current moratorium, the sex ratio of pre-spawning shad taken in February-April should equal the sex ratio of spent fish taken after April 15 (see data here). Since the shad fishery targets females, the sex ratio of spent fish should change if the moratorium is lifted. The magnitude of the ratio change will permit researchers to estimate both population size and the fraction of the population being harvested.

vest results? Or, how many drift nets of newer mesh size equal one staked net of traditional mesh size? What combinations of gear will yield the harvest targets? All of these variables need to be identified and quantified in order to propose a management plan that makes sense and distributes fishing access equitably across the spectrum of fishers.

Expected results

Solving the first part of the mystery will provide managers (principally the VMRC and the Atlantic States Marine Fisheries Commission) with contemporary information to assess the status of American shad stocks in Virginia rivers. Specifically, the Institute

expects to report to the VMRC how future catch rates compare to the catch rates recorded during the period 1980 to 1993, before the moratorium was imposed. The comparison should allow managers to assess the state of the current stock relative to historic levels, and possibly support resumption of recreational fishing if stocks are rehabilitated and managed carefully.

By solving other parts of the puzzle, the potential for information of value to recreational fishers also exists. For example, American shad form an important prey group for striped bass and other recreationally important species in Chesapeake Bay. In recent years, there have been shifts

in community structure in major tributaries to the Bay, with striped bass and gizzard shad numbers rising. Monitoring changes in abundance of key species is essential for understanding community dynamics. Also, the bycatch associated with the commercial fishery for shad in Virginia rivers will be studied and characterized, helping to determine the impact of a reopened commercial fishery for shad on other recreationally important species, especially striped bass. And finally, this research provides an opportunity to look for returning, hatchery-reared fish and determine benefits to recreational fishers from those efforts — which have been significant.

Fall Tagging Programs in Full Swing

Striped Bass Survey Continues

The Virginia Institute of Marine Science has been actively monitoring striped bass stocks in Virginia as part of a larger, cooperative study with Maryland. The Chesapeake Bay-wide, “direct enumeration study” began in 1992 and is conducted each fall.

Fish selected must be at least 18 inches long and are taken from pound net catches, haul seine catches, and hook and line catches. On three separate occasions—in late September, late October, and late November—approximately 1,000 fish are tagged and released at sites on the James, York, and Rappahannock rivers. Annually, 6,000 fish are tagged and released by the two states.

The Atlantic States Marine Fisheries Commission requires that fishing mortality of striped bass stay at a prescribed level, and states must prove they are in compliance with the mandate. The tagging study helps identify (and thus quantify) recaptured, tagged fish in an attempt to document that Virginia is complying with mortality limits.



Fisheries technicians Susan Denny (L) and Pat Crewe tag striped bass at the Cheatham Annex pier.

Game Fish Program Producing Results - By Jon Lucy

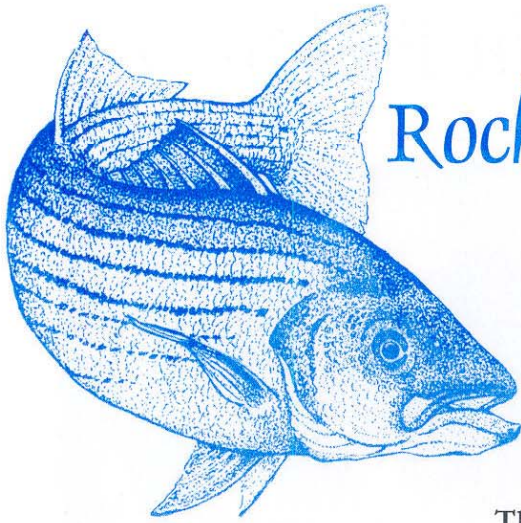
The Virginia Game Fish Tagging Program, nearing the end of its fifth year, targets eight species of fish—red and black drum, gray and speckled trout, black sea bass, tautog, spade fish, and cobia. Useful data are accruing on movement patterns and area/habitat use of fish important to Virginia’s recreational fishery. When significant numbers of a species are tagged in one location and tag return rates are relatively good, the stage is set for gaining insight about the importance of location to a species. The results of red drum tagging efforts in Rudee Inlet during 1999 are a prime example.

From January through early October 1999, trained volunteers tagged and released over 500 red drum inside Rudee Inlet (12- to 20-inch red drum, or approximately 1- and 2-year-old fish). To date, 60 of these fish have been recaptured inside the inlet. The primary tagging period was in April and May. Of the recaptures in Rudee, 92% occurred within two to ten weeks of release (53% recaptured within 2 weeks, 27% at 2-4 weeks, and 12% at 4.6-10 weeks). An additional four fish were recaptured inside the inlet in July/August (2.4-4.1 months post release), indicating that Rudee retained significant numbers of young drum from early spring into mid-summer.

Of the drum tagged in Rudee during April/May 1999, 18 have moved out of the inlet to date. Seven fish were recaptured inside Lynnhaven Inlet waters 37 to 199 days post release, while others moved northward along the Bay’s western shore. Three fish went as far as the Poquoson Flats and Goodwin Islands. Several fish were also recaptured May through August at the Chesapeake Bay Bridge-Tunnel (First Island), Sewells Point, Fort Monroe, and the Hot Ditch (in Elizabeth River).

As in 1998, young reds tagged in the lower Bay during late summer/early fall are demonstrating rapid southward movement to the Carolina beaches. A fish tagged inside Rudee on August 9, for example, was

(cont. on page 13)



Rockfish Return With Vigor

To the delight of Virginia anglers, striped bass have made a great comeback

by Charlie Petrocci

Many regions around the country have a favorite gamefish species, one they can call their own. In New England it's the codfish, and in Gulf Coast states it's the red drum. But here in the mid-Atlantic region along Virginia's Eastern Shore, without a doubt it's the striped bass (*Morone saxatilis*), affectionately known to locals as "rockfish," or "stripers."

A gamefish of unequalled respect, it is enjoyed by the most ardent, dedicated fisherman as well as the family fishing off the dock. Rockfish are the most esteemed coastal species of the Chesapeake Bay region and can be caught under a variety of angling conditions including bay, beach, and near-shore ocean waters. So popular is the fish around Virginia's coastal region that its figure or name can be found on everything from advertising signs and posters to billboards and lapel pins, and even serves as the name of a local rock and roll band (you guessed it, "The Rockfish").

The fish

The "classic" striped bass is the migratory population that ranges from the Outer Banks of North Carolina to as far north as Nova Scotia. An anadromous species that is at home in fresh water as well as salt, hatchery-raised striped bass can now be caught in non-native places such as landlocked Oklahoma, Nebraska, Pennsylvania, Arkansas, Tennessee, and even Arizona. Major spawning grounds for mid-Atlantic migratory stripers include the Chesapeake Bay, Delaware River, and the Hudson River. Stripers are also found as far south as northern Florida and as far west as the coast of California and Oregon.

Identification is usually not difficult for striped bass, whose pronounced black stripes (as many as seven to nine of them) run along silvery sides. The belly is white or off-white, and the back can range in color from steel blue to black, or sometimes hint at green in river fish. Migratory fish usually have a purplish hue on the back, which is more evident in mature, larger fish, while juveniles

can be similar in appearance to the closely related white perch.

For seven consecutive years leading to 1998, around the Chesapeake region young-of-year indexes for striped bass rose steadily. Although annual fluctuations occurred due to weather variables and salinity changes, the index reflects a solid continuum of population growth and juvenile fish recruitment. Spawning stock biomass has increased steadily since 1983, and recruitment of the 1993 and 1996 cohorts in the Chesapeake Bay was the highest since 1954.

The Northeast Stock Assessment Review Committee has concluded that the coastal stock of striped bass is fully exploited, meaning that the fishery has reached a point where yield is either at a maximum sustainable level or at some designated optimum, and the stock cannot undergo higher levels of fishing mortality without adverse effects on stock biomass. In straight-forward language, this means that regional stocks are healthy, and so far, fishery management efforts

have been very successful.

One way to assess striper stocks is through tagging programs, such as the one coordinated by the U.S. Fish and Wildlife Service (USFWS). The USFWS has been placing tubular pink or orange tags into released fish for many years now. Anglers are encouraged to report the tag number, date, location, and length of any of these fish caught. The purpose of this program is to estimate the harvest rates for the fishery. Striped bass in the Chesapeake Bay have also been monitored by several other fishery agencies since the mid-1950s.

The sport tradition

“And what sport doth yeeld a more pleasing comfort and less hurt and change than angling with a booke?” Possibly with those words, 17th-century explorer Captain John Smith launched the first recreational fishery for striped bass throughout the Chesapeake Bay. Today, rock fishing season means big money for waterfront towns and sport fishing related businesses, including tackle shops, motels, food and fuel stores, and camping areas.

The Chesapeake Bay, the largest estuary in North America, is a virtual fish factory for numerous species of anadromous and catadromous fish. It's also the place that the rockfish calls home. But home in the Bay is never the same twice. This giant estuary is influenced as much by river flows as it is by the daily tidal flush of the Atlantic Ocean. Salinity patterns

change constantly and this, in turn, causes significant movement of fish throughout the Chesapeake.

Rockfish are remarkably adaptive to different salinities, especially as juveniles. They tend to spread out all over the Bay, while following loose patterns of migration and feeding. Large females, for example, tend to migrate out of the Bay after they spawn, seeking cooler, deep-water temperatures along the coast, while younger fish in the 10- to 30-inch range tend to feed in rivers and in select, open parts of the Bay. It's during fall migration that anglers tend to focus their energies, since the event presents a good opportunity to tangle with a true trophy class fish.

The bayside

Because of the complexities of species migration and natural stock enhancement programs, harvesting regulations for sport anglers change yearly. Usually the sport fishing season opens in the spring, with anglers using wire lines to deep troll. Preferred lures include parachute tandem rigs, large bucktails, or deep swimming plugs. Rockfish haunts include sun-warmed, open areas of the Bay and the edges of deep-water channels. These are the migration corridors of big fish this time of year. By summer, most fish have scattered and won't be seen in large concentrations until the first cool nights of fall begin to put them back into school feeding patterns.

Fall is when the fishing gets really hot. Stripers begin to “school up” as water temperatures drop. They are getting ready to migrate out of the Chesapeake Bay and they're hungry. As they move down the Bay, they can be found out in open water near deep water holes, sloughs, drop-offs, and especially over oyster bars and other rough bottom structures.

One of the best ways to locate open water stripers is by looking for birds. Stripers love to feed in big schools, and chewed up bait fish floating to the top will attract diving gulls and terns.

When locating a school of feeding fish with birds, approach slowly and try to drift with the school. Bucktails, plugs, and spoons will all work well in this situation. “This is perhaps the most exciting striper fishing to experience, especially if there's bluefish or sea trout mixed in with them,” says charter boat captain Will Laaksonen of Onancock.

Chumming for rockfish is also popular out on the open Bay water, using grass shrimp or ground up menhaden. A circle hook is the way to go with this type of fishing because it cuts down on potential mortality of released fish. And of course trolling—the old stand-by way to catch stripers—is still popular with many anglers, especially along deep-water channels. Popular baits for stripers this time of year are spot, menhaden, and crabs.

Fish are also feeding near river mouths in the fall, especially

around sub-surface structures like old docks, boat hulks, and oyster rocks. In the evening, piers, docks, and bridge pilings are great places to cast bucktails, plugs, or hammered spoons. Some anglers prefer to fish baits, using fresh cut spot or peeler crab.

On high water mornings and evenings, fish will move into the shallows to feed on crabs and silversides. It's pretty amazing just how shallow they can be found, and you don't need a boat to catch one.

The seaside

By far, one of the greatest angling challenges is hooking into a large rockfish just as dusk is settling in and the moon is on the rise. Battling a striper "mano y mano" along the surf line is truly memorable.

Bait fishing in the surf is probably the most consistent way to hook into feeding coastal fish. A fish finder rig on the end of a 10-foot rod with fresh cut spot, menhaden, or clam is the way to go. Watch for sloughs along the beach. You don't have to cast a country mile to find fish, either. Many times they feed in the break line.

For surf fishing, Assateague is the only beach accessible by vehicle. You will need a boat to fish the other barrier islands. "We have been seeing some nice fish come off the barrier islands over the last few years and increased activity by boats fishing the island inlets," said Randy Lewis of Zed's Tackle Shop in Wachapreague.

Also enjoying attention along the seaside inlets in the past few years is live eel fishing, long popular in northern states. One technique is to drift through the inlets dragging a live eel along the bottom. Experienced eelers will work rips and any bottom structures or features. If you decide to anchor your boat, do as veteran angler John Minter does. He says, "Work your bait with some action, casting the eel and then slowly retrieving the bait. When a linesider takes the eel, open the bail, lean forward and let the fish run. Count to three and then set the hook." Stripers love to stun their prey with a body slam, so fishermen must keep this in mind when first getting a hit. Popular inlets that stripers tend to haunt along the shore include Chincoteague, Metomkin, Cedar, and Oyster.

Future outlook

The striped bass management program in Virginia and along the entire East Coast has been nothing short of remarkable. Catch limits on larger stripers could be tightened in the future, however, since it appears that 1998 fishing mortality rates exceeded acceptable levels for age four and older fish.

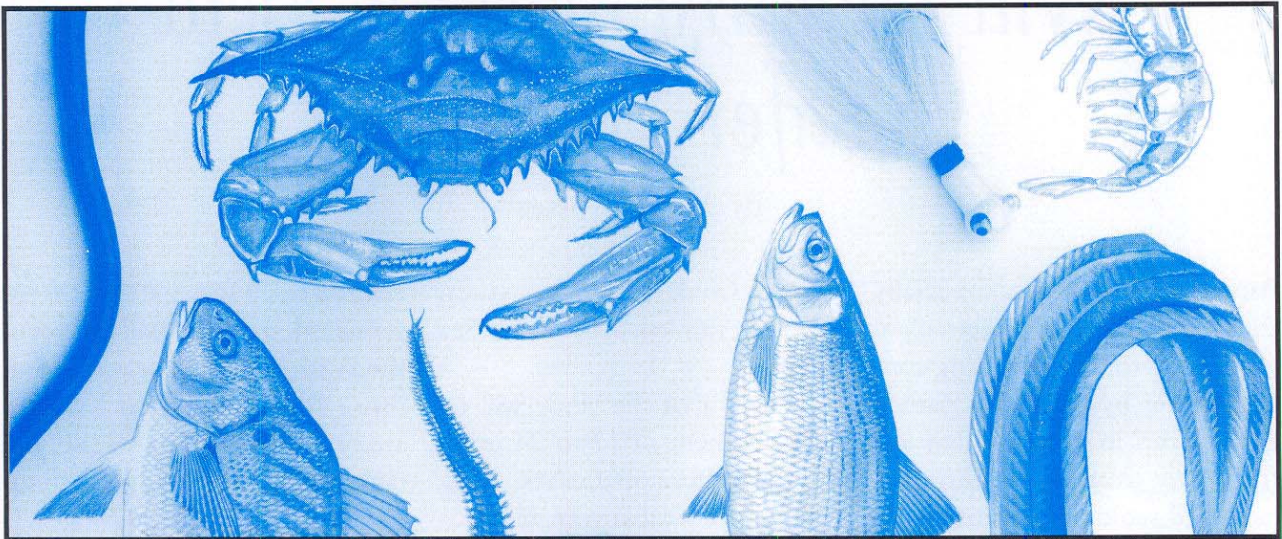
With resurgence of the fishery has come a new socio-economic boom, and the opening of split seasons has become akin to the opening of freshwater trout season for many anglers. A new generation of cottage industries has developed—including lures,

baits, and tackle—all catering to the striper fisherman. Charter boats also have benefitted from a "second wind" in many areas, offering alternative fishing opportunities. "Striped bass have given many charter boats the chance to take up the slack in the late season and also offer fishermen an alternative species along with the old stand-by trout, spot, and croaker fishing. The rockfish return has been great for my business these last two years," mused charter captain Laaksonen of Onancock.

Striped bass fishing should be excellent this fall. It's been a mild winter and stocks are up. First time anglers to the region should talk to local fishermen and tackle shops or patronize area charter boat operations for fishing information. Dress for cool mornings and sunny days, and clean out the freezer before you go — because you shouldn't have any problem filling it back up with fresh striper fillets for the coming winter.



A happy angler holds his catch.



THE BAITS

There are a number of fresh baits available locally that are traditionally used when rock fishing either on the bayside or seaside of Virginia's Eastern Shore. Quite often, recreational anglers spend plenty of money on artificial lures with which to catch stripers, and rightly so. Not much can beat casting a white bucktail or shallow swimming plug around pilings and rocks. But many fishermen, in their eagerness to mimic live baits, forget using *natural* baits themselves.

Menhaden - A favorite prey of migrating rockfish, it also goes by the name of bunker. Its sides are silvery with a large dark spot near the gill plate. An oily fish which imparts a strong attractant scent, it is harvested in huge numbers by purse seine boats. Best used as a cut bait in surf casting or soaking around bridges or pilings but also good as part of a chum slick.

Spot - These little fish are forage prey for rockfish and found throughout the Chesapeake and in coastal surf areas all summer long and into the fall. Live spot are deadly on bass, especially in the evenings.

Grass Shrimp - Actually three separate species that rarely reach beyond 2 inches in length, they primarily inhabit grassy estuaries and bay shallows. Must be caught with a seine or tight mesh cast net. Great for chumming, or put on a few to cover a hook for school-sized stripers.

Peeler Crab - Possibly one of the best all-around baits for striped bass. Unfortunately a lot of other species also like it, including "panfish." A peeler is a local name for a hard blue crab that is about to shed. They give off an attracting odor in this state of metamorphosis. Peelers can be found at bait shops or in crab shanties where watermen shed them. Several baits can be had from a single cut-up crab. Great when fished on the bottom near grass shorelines, creek drainages, and in the surf on a fishfinder rig.

Clam - There's not many fish out there that won't eat a piece of fresh clam, and that includes rockfish. Inexpensive large cherrystone or chowder clams are the best for bait. Put the whole clam on unless it's too big (and then cut into two baits). Change frequently. Good from an anchored boat or in the surf.

Bloodworms - Like clams, there's not much out there that won't eat a bloodworm. Unfortunately these little critters are expensive. Sold by the dozen or in flats, they should be fished alive and threaded on the hook.

Eels - If you want to catch big rockfish, then this is the bait of choice. Fished live in the 6- to 12-inch range, they are great for drifting through coastal inlets, casting in the surf, or fishing while anchored up near a drop-off. Some anglers hook them through the tail to keep the eel from twisting up the line. Use a wire leader and an in-line sinker to keep them on the bottom. There are several eel rigs out there on the market. Most eel fishing success occurs at night or at dawn.

Will Healthy Biofilms Yield a Safer Harvest?

by Angela Correa

Aquaculture systems, especially those that filter and recirculate water, are prone to recurring contamination by microbial pathogens. Even in systems that are frequently treated with disinfectants and sanitizers, harmful bacteria can often find a hiding place somewhere in the system, and re-emerge once system conditions favor proliferation of the pathogen. It is suspected that within these sick systems, one of the places that offers the best protection for these pernicious organisms is the biofilm that forms in aquaculture tanks.

Biofilms are an essential part of a stable system. They provide a substrate for the growth of beneficial flora, necessary for the removal of toxins from the water. Because of these benefits, it is not desirable to completely remove the biofilm through the use of harsh cleansers or frequent scrubbing.

Dr. Robin King is working on a three-phase study that will assess whether biofilms in recirculating aquaculture tanks indeed become harbors for pathogens, and then determine how to eradicate such pathogens without destroying the beneficial properties of the biofilm. George Flick, George Libey, Stephen Smith, Greg Boardman, Merle Pierson, and

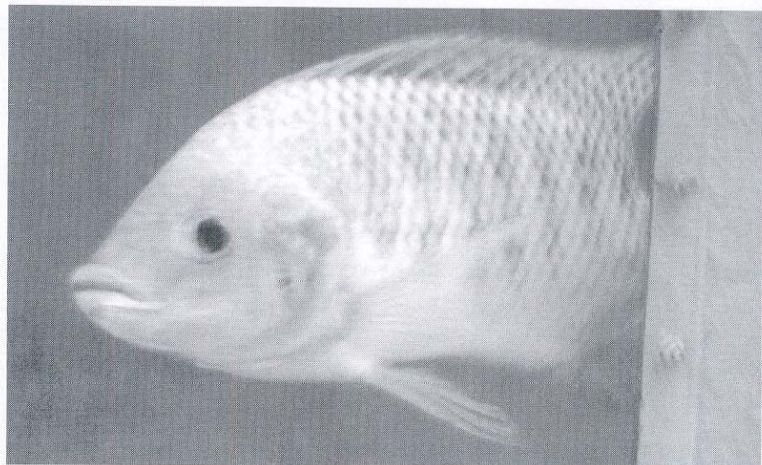
Charlie Coale advise her study, which is funded by Virginia Sea Grant.

Phase I of the study will be an assessment of 12 to 24 existing aquaculture operations. King will culture swabs from biofilms at each facility and identify any potential pathogens found in the biofilm. Phase I will also establish which organisms are most likely to pose a problem for aquaculturists in the region.

In order to understand how best to control the growth of pathogens, it is necessary to understand how they behave within a recirculating system. During Phase II, King will set up small-scale recirculating systems using common substrates. The tanks will contain pathogen-free tilapia, and will be allowed to stabilize for

eight weeks. Once the systems are stabilized, the tanks will be inoculated with pathogens selected from those found in Phase I of the study. The biofilm within the tanks will be sampled at regular intervals to see if the pathogen is present and to determine how long it remains. Further testing will determine whether the pathogens have reemerged in the water. Phases II and III of the study will be conducted in an isolation room in the Aquatic Medicine Laboratory of the College of Veterinary Medicine at Virginia Tech, with access restricted to principal investigators only.

The final phase of the study will provide comparative data on different disinfectants or sanitizers. The same substrates will be used, and tanks will be re-inocu-



Tilapia at maturity

lated with pathogens. After inoculation, the systems will be cleaned and sanitized using various approved chemical treatments.

Following the cleaning and sanitizing treatments, tests will be conducted to determine whether the pathogens have survived by integrating themselves into the biofilm. This will make it possible to determine the effects of different cleaners and sanitizers on the removal of pathogens from the biofilm. The study is expected to increase the knowledge base on biofilm within the aquaculture industry. The information can be

used to improve management practices, and may also spur development of new ways to effectively remove pathogens from tanks and filters in a way that does not destroy the biofilm.

“Aquaculture stocks are a food product that represent a large investment of time and money on the part of the operator. Our goal is to give aquaculturists the tools to respond quickly and effectively to any outbreak of disease that might threaten the health or quality of their stocks,” said King.

Phases I and II of the study began in mid-May and run con-

currently. The entire study should be completed early next year.

Game Fish Tagging

cont. from page 7

recaptured on Sept. 23 (47 days later) at Ocracoke Inlet, North Carolina. A drum tagged north of the Rappahannock River mouth (Fleets Bay) on August 26 was recaptured on Sept. 11 (16 days later) at the Kitty Hawk Pier, NC. Another drum tagged on Sept. 28 inside Lynnhaven Inlet was recaptured 14 days later at Duck, North Carolina. Three drum tagged in the fall of 1998 were recaptured 1-7 days later along Outer Banks beaches.

Young red drum may also be over-wintering in Rudee Inlet, as indicated by some spring 1999 tag returns. Four fish tagged in September-November 1998 in the inlet were recaptured in the same waters in April-June 1999 (5.5-8.8 months post release). Drum are seen inside the inlet during mild winters, and several such fish were tagged from early February to March this year. Rudee Inlet appears to provide favorable fish habitat for the species.

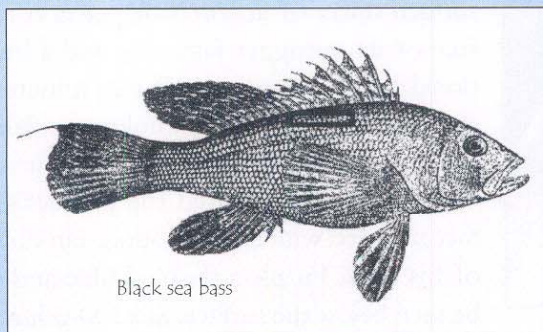
Tagging data are accruing through the dedication of anglers in the Game Fish Tagging Program, a project supported by Virginia anglers' own Recreational Fishing Development Fund under the Virginia Marine Resources Commission.

AQUACULTURE PROGRAMS AT VIMS

The biofilm study at Virginia Tech will benefit aquaculture programs throughout Virginia. VIMS, long known for its shellfish aquaculture programs, has recently expanded into marine finfish aquaculture. Initial research focused on summer flounder grow-out. Since then, the Institute has switched its focus to the spawning and production of juvenile cobia and black sea bass.

Over the past year, researchers have been developing brood stock maturation and larval-rearing capabilities for cobia. A grant has been secured for further reproductive research.

In the area of black sea bass, a cooperative project with a private individual is currently looking at grow-out conditions in a recirculating water system. Future plans include spawning black sea bass and investigating methods for increased larval survival.



Black sea bass

Catch and Release Catches On

New Programs and Studies Support Recreational Catch and Release Activity

by Charlie Petrocci

*“It’s good for business
and great for the
resource. It’s a classic
win-win situation
for everyone.”*

*charter boat captain,
Will Laaksonen*

Decades ago, writer John Buchan wrote something inspirational to fishermen everywhere: “The charm of fishing is that it is the pursuit of what is elusive but attainable, a perpetual series of occasions for hope.” It is this definitive pursuit of the sport that bonds all fishermen, whether fishing for dinner or fishing for sport. And in the last decade, the charm of fishing has evolved beyond pursuit and capture, embracing today the ideals of the *release*.

A day in the life of a fisherman

Standing on the stern of the boat, the men looked dressed more for some unseen battle than out for a pleasurable day of angling on the ocean. Each had on dark shades and long billed hats. They were lathered up with sun block to deflect the intense summer sun. Strapped around their hips were fish fighting belts to help give them leverage for their optimistic stand-up battle with unseen deep sea giants. Beneath them was a quarter million dollar boat, while lining the gunwales were several thousand dollars worth of rods and reels. And dragging behind the boat, in the prop-churned, azure water were an assortment of rigged baits and lures as colorful as anything you’d see in a skirmish at sea.

As the men talked of past deep sea battles, a sudden flurry of action took place. A line snapped free of its outrigger fastening and a huge conventional reel began to sing. For 20 minutes the angler stood and fought with an unknown fish, who took the line at will and gave little in return. Cheers of encouragement followed the pursuer’s every step. Sweat mixed with suntan lotion, ran down the back of his neck. Finally a flash of blue and silver could be seen below the surface, as a 100-pound-plus blue-fin tuna gradually relinquished its strength and spi-



Satisfied angler releases fish.

raled up toward the boat. The leader was grasped, photographs were taken, and the fish was set free with plenty of wishes of good luck. A long battle, high energy, lots of smiles, and a *released* fish: Tonight the anglers would dine on filet mignon to celebrate their efforts.

On another shore

That same day, many miles away, on some back tidal creek of the Chesapeake Bay, a solitary angler has abandoned his old 14-foot aluminum boat. He is wade fishing along the shoreline, methodically casting lead head grubs into the shallows before him. Quietly he shuffles his sneaker-clad feet in the soft sandy bottom. Creeping toward some submerged grasses, he finesses the lures' return so it bumps along the bottom.

There is a swirl, then a pull, and his line tightens and begins to slash across the water. He cannot help but smile at his good fortune. Line peels from his graphite rod and he follows the fish with enthusiasm along the shoreline. Slowly the fish begins to yield and soon it rolls near his feet. Reaching down, the angler lifts by the belly a chunky 6-pound speckled trout and holds it up in the morning sunlight. Talking gently to the fish, he comments on its color and fighting capabilities. The angler is also aware of its succulent taste, but without hesitation, releases it into the clear Bay water. Watching it swim off with admiration, he again methodically casts along the

weed line, tense with anticipation for another close encounter.

The catch and release spirit

These fishermen typify what many others have in common. No matter where or how they go about their fishing, each has a respect for the resource as well as the sport. They have experience in fighting a fish and knowing that the choice to save it or kill it rests within their grip. Catch and release: It's certainly not a new concept, but it has been growing in popularity in the last two decades. And more of the traditional consumptive, or "fillet and release," fishermen are shifting over. No doubt most anglers enjoy eating fish and thus occasionally keep a few, and that is good. Harvesting one's own catch for personal use is a positive experience. But so is catch and release. As dedicated sport angler Jim Kenyon put it, "It's not only good for the resource, but it's good for the soul as well."

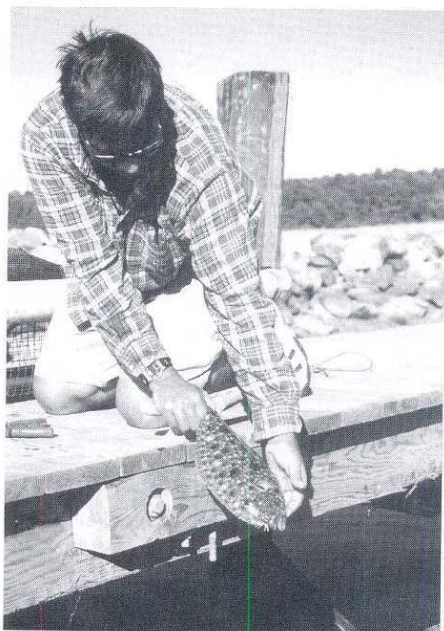
"Many of my customers come specifically for the sport," said charter boat captain Will Laaksonen of Onancock. "Sure I still get the meat fisherman, and that's no problem. But I'm seeing a growing number of anglers who enjoy fishing for striped bass, red drum, and speckled trout, for example, knowing ahead of time they won't keep any. And these guys come back year after year. It's good for business and great for the resource. It's a classic win-win situation for everyone."

Technology steps in

But it takes more than just the values of a sport fisherman to make catch and release work. It also takes technology. Today, with the acceleration of hook and release interest by anglers, one of the most important types of technology comes in the form of the hook—the one piece of equipment that directly connects the fisherman to the fish. And the preferred choice of hooks for avid catch and release fishermen is an age-old, time proven circle hook.

Long used by ancient fishermen in the Pacific Ocean (as evidenced by the discovery of circle hooks made of shell and bone from Polynesia), circle hooks have taken the fishing industry by storm in the last ten years. The principle of the circle hook is simple. It's an extremely short-shanked hook that allows for the fish to be hooked in the jaw, as opposed to the gut—which frequently occurs with traditional long-shanked hooks. On a circle hook, the barb comes entirely back around toward the shank.

Reduced harvest fishing, resulting from regulations and from voluntary measures, has helped enhance fishing opportunities. In response to the growth in catch and release fishing, several state and federal agencies have conducted field research on fish mortality in conjunction with fish release. There have been a number of controlled tests conducted on catch and release for a variety of both inshore and offshore spe-



Summer flounder about to be released

cies, under various conditions. One of the more notable was the work done on bluefin tuna off the coast of North Carolina.

Long prized as a game fish by Virginia recreational anglers and an important economic species for the boats and communities that service those fishermen, bluefin tuna have been heavily regulated because of over-harvesting pressure. Slot limits have been imposed on sport fishermen, and this means lots of release activity for undersized fish. Gut hooking causes tremendous mortality among tuna, and this is especially evident during chunking and chumming (the practice of using ground up baitfish tossed over the stern of an anchored or drifting boat to attract fish into the bait “slick”).

However, Captain Bob Eakes of Buxton, North Carolina, reports that of approximately 450 bluefin tuna caught and released, he was able to achieve a 99% rate of “lip-hooking” the fish. This was accomplished using appropriate heavy tackle with large circle hooks (“Waterfront News,” Summer 1995).

“Circle hooks tend to catch the fish in the mouth and are easier to get out than a traditional J-shaped hook. And jaws heal nicely. A gut-hooked fish usually means the end of story,” says Laaksonen.

Research and program support are key

Nonconsumptive fishing has continued to gain popularity in sport fishing communities around the country. Because of this growth trend, most states have some form of catch and release incorporated into their current fisheries management plans.

High survival of released fish is fundamental to the success of nonconsumptive fishing endeavors. Many studies point out that the location of the hook wound is the most important factor in hook-related mortality. Also, hook-related stress and water quality have been implicated to some degree in hook-related mortality.

In Virginia, there are tremendous recreational fishing opportunities available to the angler. Both offshore and inshore target species continue to benefit from catch

and release activity, primarily because of harvest rules on size.

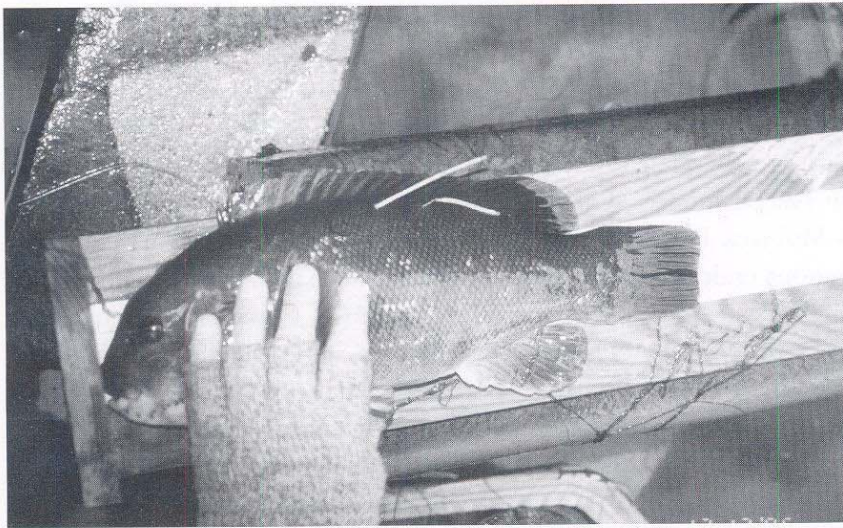
One species that remains the “bread and butter” fish in terms of recreational and economic interests in the region is the summer flounder. Summer flounder angling has consistently remained among the top fisheries in the mid-Atlantic region. Long prized for its meat and angling challenges, the flounder of Virginia remains a resilient game species for anglers young and old.

The summer flounder fishery falls under the Fishery Management Plan, which includes quotas, minimum size limits, and trip bag limits. Estimated hook-release mortality, at 25%, is incorporated into annual recreational catch figures and models. In 1998, a study spearheaded by Jon Lucy of VIMS was undertaken to determine levels of release mortality under recreational fishing conditions.

Using tank experiments, factors associated with mortality were documented. Experiments evaluated the effects of hook wound location, degree of bleeding, and fish size on release mortality. Tank-held fish were systematically caught on hook and line using live bait and then released back into the tank. “The only factor consistently observed to impact release mortality was deep hooking of fish, which included lodging in the esophagus, gills, or deep mouth/tongue area. Deep-hooked fish accounted for 95% of the mortalities in the tank experiments,” reported Lucy.

Summer flounder activity for sport fishermen has improved, if trophy sized fish are any indication. This is supported by the number of large fish being consistently harvested from the waters around the Chesapeake Bay Bridge-Tunnel and the number of flounder entries in the annual Virginia Saltwater Fishing Tournament.

New this year, reports program coordinator Claude Bain, are *release only* citations for red drum, black drum, and sharks. "Our decision to issue awards solely for the release of these species reflects our commitment to conservation and protection of these large individuals, which comprise a large portion of their brood stock," Bain said. There is also a new spe-



Tank studies on double-tagged tautog led the Gamefish Tagging Program managers to use T-bar tags (tag to the right) for fish under 18 inches.

Recognition helps

One of the most popular sportfishing programs in the country, the Virginia Saltwater Fishing Tournament, is now in its 42nd year. This program awards fishermen with a wall plaque for taking eligible species of a specific size or weight. Fishermen are rewarded with citations for fish release as well, using size and weight parameters. Currently there are 32 species eligible for citation awards in the state program.

cial citation award this year called the Chesapeake Bay Grand Slam, which dictates that an angler must catch and release a black drum, cobia, and red drum all in one day. With a minimum of 44 inches for each fish to qualify, it could prove to be a long day.

Gamefish tagging program

Another exciting program getting sport fishermen involved in conservation and management of marine finfish is the Virginia

Gamefish Tagging Program. The program offers anglers the opportunity to help collect scientific information about the movements and biology of various species targeted by the project. Eight species are eligible, including black drum, cobia, red drum, sea bass, spade-fish, speckled trout, gray trout, and tautog.

"Last year was by far the best year we have had in the program, with over 8,500 fish tagged," Bain said. "The fishing community has been very receptive to the tagging program. Fishermen enjoy hearing about recapture reports of their tagged fish, and some data are being used by fisheries managers. It has created a vested interest in the program for them."



Fishing continues to be one of the greatest family-oriented outdoor recreation activities offered in Virginia. Although catching one's dinner remains the primary motive for many anglers working their "beat," releasing fish has increasingly become a legitimate goal. And with various stocks subject to increasing pressures from a variety of sources, the angler contribution to nonconsumptive fishing will extend that past-time to generations of anglers to come.

Don't forget to check the VIMS website (www.vims.edu) for information about the December 5-8 symposium on Catch and Release Fishing (see p. 19).

Something Afloat

Hidden among the pines of Mathews County just a stone's throw from Mobjack Bay, an aquaculture business is in full swing under the diligent care of owners Ken and Kim Kurkowski. Middle Peninsula Aquaculture has been operating for the past five years, raising hard clams (*Mercenaria mercenaria*), soft-shelled clams (*Mya arenaria*), and various strains of oysters (*Crassostrea virginica*) to seed stage. Business customers include a healthy mix of commercial growers and, in the case of oysters, nearby cooperatives such as *Tidewater Oyster Growers Association (TOGA)* and *Restore the Oyster!* in Virginia Beach, who then sell the product to area residents for home consumption or reef restoration projects. The business has benefitted from its proximity to Mobjack Bay, the site of ongoing seeding and grow-out endeavors.

It has also benefitted from a growing breed of nearby residents, many of whom are retired, who've become stewards of the Chesapeake Bay by raising oysters to maturity for transplanting purposes. Through such gardening efforts, oyster reefs from southern Maryland to Hampton to Virginia's Eastern Shore are filling in the landscape of the Bay bottom and sparking hope that the famed oyster will make a comeback.

That is also the hope of VIMS scientist, Stan Allen, who is providing brood oyster stock to the Kurkowskis from the Aquaculture Genetics & Breeding Technology Center on campus. While Middle Peninsula

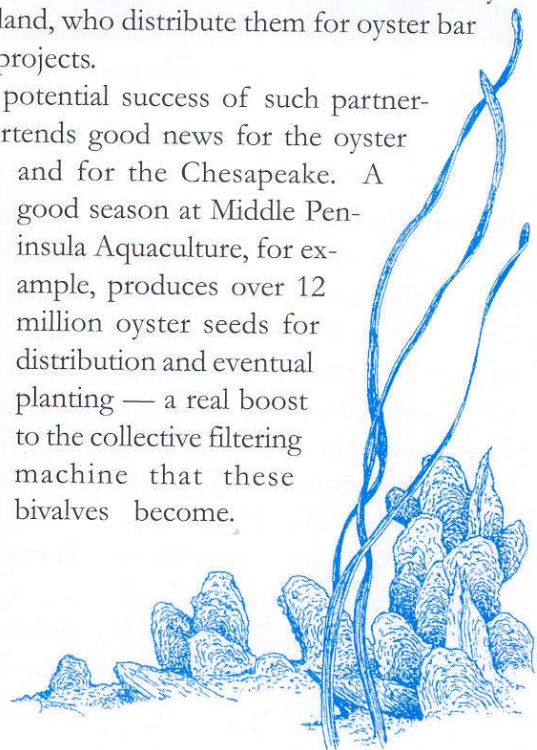


Relative size of oyster seeds when sold to commercial growers as "standard" by Middle Peninsula Aquaculture.

Aquaculture is a client of the center, Stan emphasizes that the relationship is mutually beneficial. In his role as a hatchery operator and marketer of seed, Ken Kurkowski helps the Institute get its product out to a wide customer base throughout the lower Chesapeake Bay region. And Ken benefits by receiving brood stock that he cannot make on his own.

The latest oyster stocks provided to Middle Peninsula Aquaculture by VIMS are the CROSBreed, a collaborative effort among VIMS, Rutgers, the University of Maryland, and the University of Delaware, and the Deby line breed, developed here by Gene Burreson and selected for its disease-resistant qualities. While the program is still in its early stages, Stan hopes to provide Middle Peninsula Aquaculture and other growers with many more oyster strains in the future. A number of workshops have been held for the public to advertise the availability of brood oyster stock from the center, and the word is slowly getting out. The center currently provides a variety of stocks to researchers at the University of Maryland, who distribute them for oyster bar seeding projects.

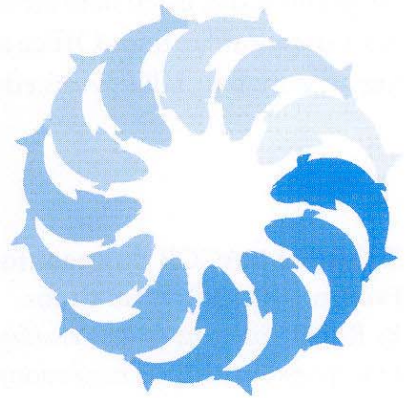
The potential success of such partnerships portends good news for the oyster and for the Chesapeake. A good season at Middle Peninsula Aquaculture, for example, produces over 12 million oyster seeds for distribution and eventual planting — a real boost to the collective filtering machine that these bivalves become.



Announcements

NATIONAL SYMPOSIUM ON CATCH AND RELEASE

In an effort to bring information, technology, and resource impacts to sportfishing professionals, a symposium will be held at the Virginia Beach Resort Hotel and Conference Center, December 5-8, 1999. Sessions will provide overviews and critiques of catch and release issues in marine recreational fisheries, including research on hooks, release mortality, angler education, and catch and release as a viable management tool. Look for detailed information about speaker presentations as well as how to register on the VIMS web-site (www.vims.edu) under Catch & Release Symposium, or contact Jon Lucy (804-684-7166; lucy@vims.edu). **Registration deadline is November 30, 1999.**



FEDERAL CROP INSURANCE FOR HARD CLAM FARMERS

The U.S. Department of Agriculture (USDA) has developed a new program that will offer “crop” insurance to hard clam (quahog) farmers in Virginia and several other states. The insurance protects those insured from crop losses resulting from “unavoidable damage” — most often the result of natural events such as storms and changes in the local environment. Programs vary according to the specific crop being covered, and at this time, quahog growers in Massachusetts are helping the USDA Risk Management Agency assess and develop the risk models needed to initiate the quahog program there. Next year, Virginia growers of hard clams will be able to sign up for the coverage, and we will provide details as the program becomes available here.

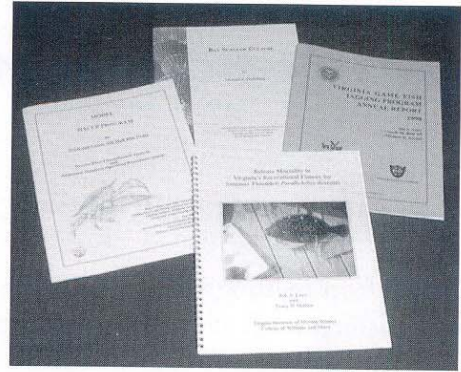


OUTLOOK ON OCEAN SCIENCE

Registration for the popular “Outlook on Ocean Science” program will take place January 3-7 for the Spring 2000 session. This 60-minute program links graduate students at VIMS with area high school students interested in a potential career in marine science. Specialized areas of fisheries biology; resource management and policy; environmental science; and biological, chemical, physical, or geological oceanography are discussed. *Space is limited and program dates are not set until confirmation has been received.* For information, contact Susan Haynes at VIMS at (804) 684-7735, or by e-mail to shaynes@vims.edu, with the following: your name, phone number/e-mail, school name, address, number of programs (maximum of 2 per day), number of students per program (maximum of 30), and class background in marine science.

Publications & Outreach

All publications listed here are available by calling the VIMS Sea Grant Publications Office at 804-684-7170, or by sending an e-mail to bdk@vims.edu.



□ Model HACCP Program for Fresh and Frozen Soft Shell Blue Crabs

By Robert Fisher and Mike Oesterling

In response to seafood regulations issued by the U.S. Food and Drug Administration, a series of preventive measures taken by seafood processors during food production to prevent microbiological, chemical, or physical food safety hazards has been documented under the acronym, HACCP, or Hazard Analysis and Critical Control Point. This report addresses the principles every soft crab producer needs to incorporate into such a program for handling fresh and frozen soft shell blue crabs. (*Ask for Marine Resource Advisory No. 68.*)

□ Release Mortality in Virginia's Recreational Fishery for Summer Flounder, *Paralichthys dentatus*

By Jon A. Lucy and Tracy D. Holton

This report summarizes a study undertaken to determine levels of release mortality under recreational fishing conditions and, through tank experiments, determine what factors might significantly contribute to such mortality. The Fishery Management Plan for the Summer Flounder Fishery has set a 25% mortality rate for this recreational fishery. Results of this study were considerably lower than the 25% release mortality rate currently in use, and suggests that the MAFMC and ASMFC might evaluate the effects of a lower rate as well as size and bag limits on achieving targeted levels of fishing mortality. (*Ask for VMRR No. 97-8; \$4 each.*)

□ Virginia Game Fish Tagging Program, Annual Report 1998

By Jon A. Lucy, Claude M. Bain, III, Michael D. Arendt

The 1998 annual report of the game fish tagging program documents movement patterns of tagged and recaptured game fish in Chesapeake Bay and adjacent coastal waters. Eight species were targeted, including cobia, black sea bass, and red drum. The report is now available on the VIMS website, at www.vims.edu. (*Or when calling, ask for Va. Marine Resource Report No. 99-8.*)

BRIDGE

Ocean Sciences Education
Teacher Resource Center
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Calling All Teachers!

Check out our "Data Tip of the Month," designed to bring real oceanographic data to your classroom. Did you see October's Halloween special on the "Dead Zone in the Gulf of Mexico"? Go on-line to find out what we've got waiting for you in November.

Naturalist's Corner

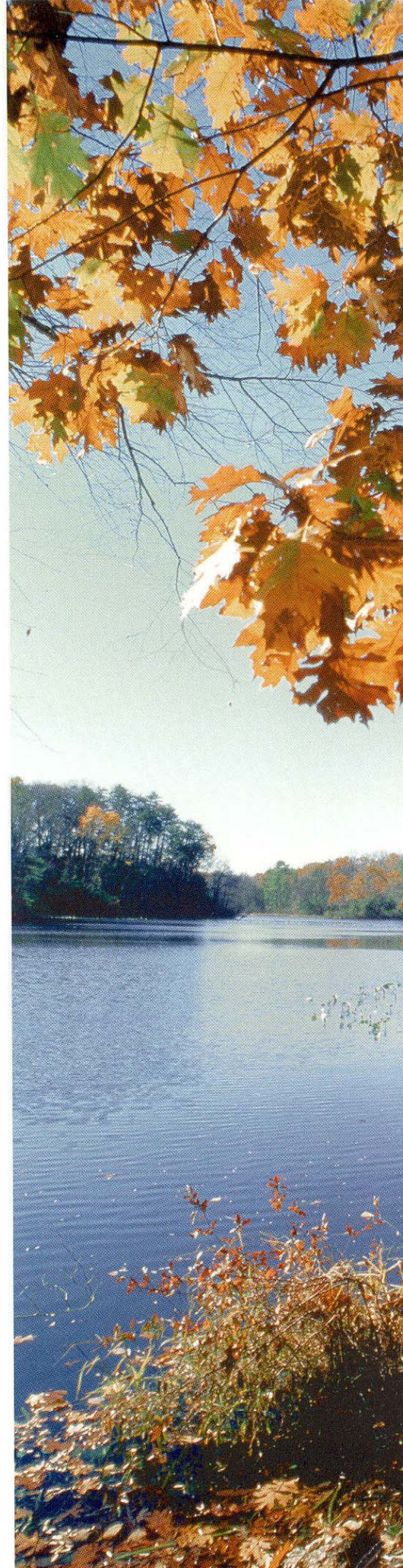
While many of us find autumn a time to perform our own brand of seasonal rituals—last-minute chores like cutting firewood, shoring up windows and doors, and otherwise preparing for colder temperatures—a great number of other life forms are solely transfixed upon getting out of town. Long before cooler nights remind us of fast-approaching winter's grip, shorebirds, seabirds, waterfowl, and marine fishes and mammals have heeded some deeply-embedded signal and begun their arduous journeys south.

Fragile edges where land meets water become their staging areas. Canada geese are the more gregarious and noisy of the travelers overhead, but groups of quieter companions are also on the move. Plovers, sandpipers, and oystercatchers are among those that congregate in wet areas along Virginia's coastline—in wetlands, tidal flats, salt marshes, and beaches—to rest and rebuild body fat. In their quest to replace the fat cells used to get here, migrants forage in the substrate for anything from insects and small crustaceans to worms and mollusks. Varying bill lengths allow different predators to probe to unique depths to capture their next meal: a rather efficient and well-conceived culinary plan. They are joined by over 20 species of waterbirds, such as egrets, herons, gulls, and terns, many of which remain in the region throughout winter's chill.

In nearby coastal waters move an impressive array of fish, some at rather striking speed and focus as the tagging studies are beginning to reveal. The Atlantic croaker, alewife, and red and black drum are among the migrating fish that head to warmer waters along North Carolina beaches and points farther south. Also on the move are small fish, such as silversides and American shad, and juvenile herrings and menhaden. It's a fish-eat-fish world out there, and youngsters making their first dash for the coast often become prey to larger species gathered at the mouth of Chesapeake Bay.

Meanwhile, slithering down inland river channels to some uniquely suited ocean habitat north of the Bahamas is the American eel. Exact travel routes and migratory habits are still unclear, but the species is believed to move through grass beds at night. According to naturalist-writer Jerry Dennis, speculation that this member of the family Anguillidae travels to the Sargasso Sea, presumably to feed upon floating mats of algae and other vegetation to rest and to spawn, has not yielded any confirmed discoveries of mature eels. This squares with scientific theories that American eels die after spawning. Upon their death, adults leave offspring in the form of larvae drifting out in the ocean for 9-12 months, according to scientists Murdy, Birdsong, and Musick in their work, *Fishes of Chesapeake Bay*. The larvae are eventually carried by ocean currents back to coastal waters, where they metamorphose into the transparent glass stage. Once inside the Bay, juvenile American eels acquire pigment and overcome amazing obstacles to swim to upriver reaches, sometimes traversing several hundred kilometers to get there. It's a committed life, to say the least.

During this grueling phenomenon involving constant movement and, in some cases, metamorphosis, migrants face tremendous odds and travel extraordinary distances without rest. In their weakened condition, many succumb to predation and other natural calamities. The entire spectacle should give us pause. Surely, it makes annoying chore lists pale by comparison.





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