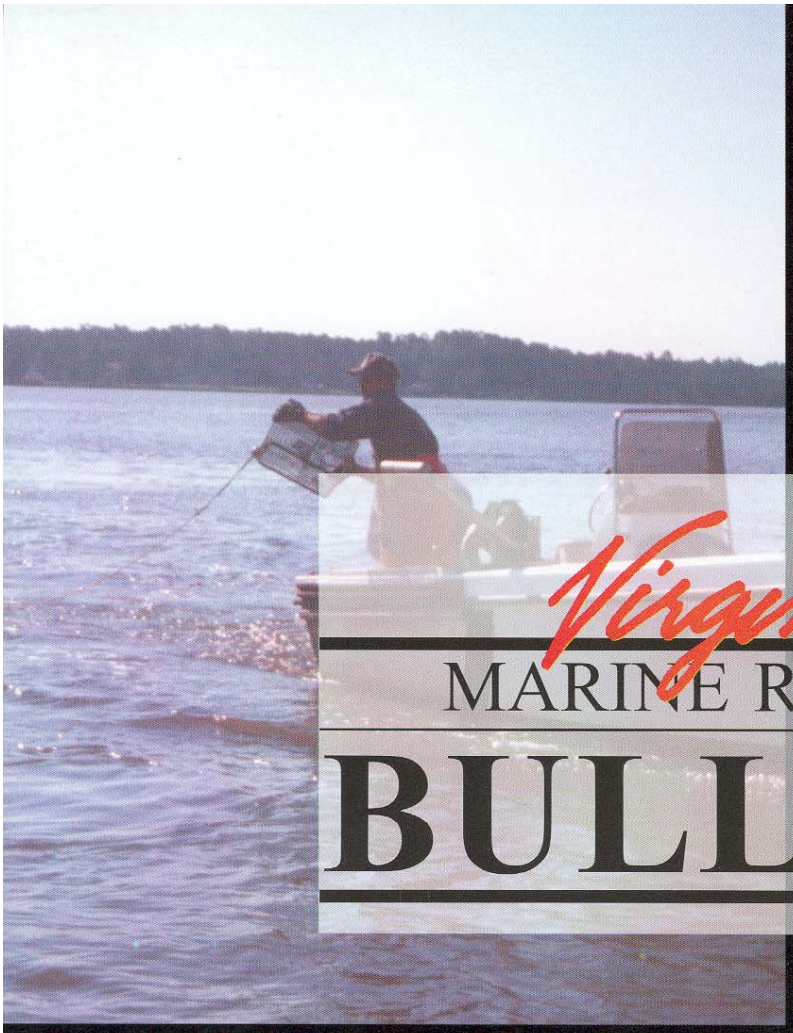

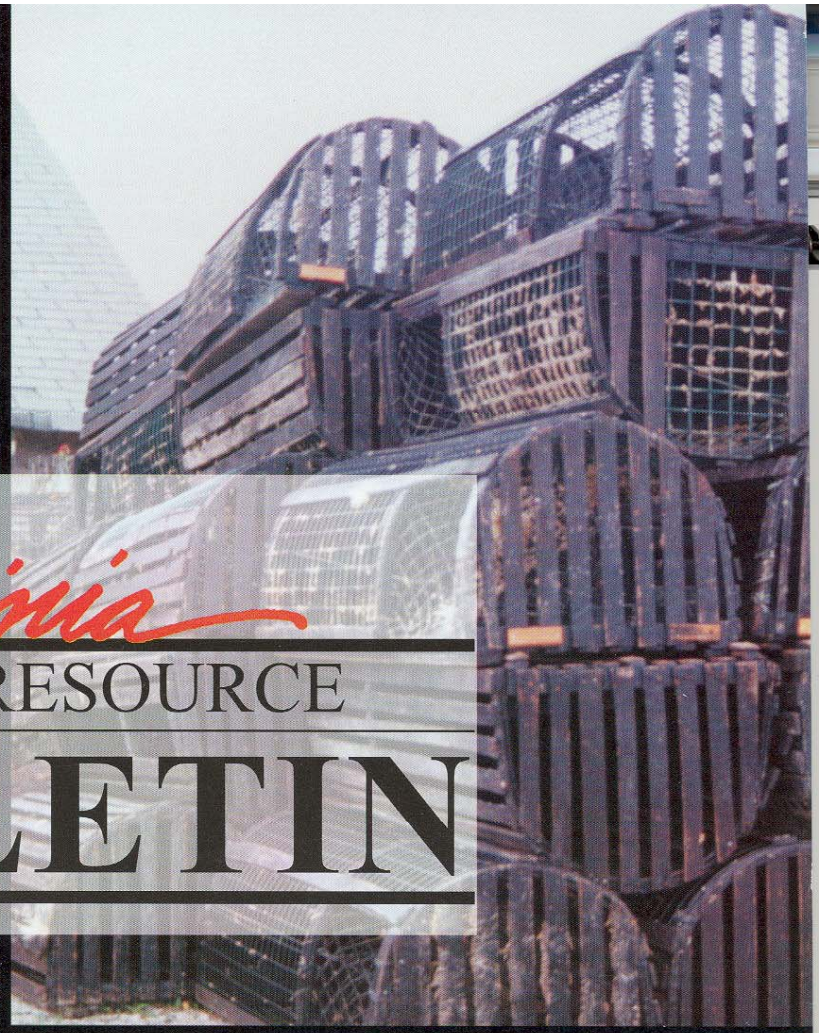

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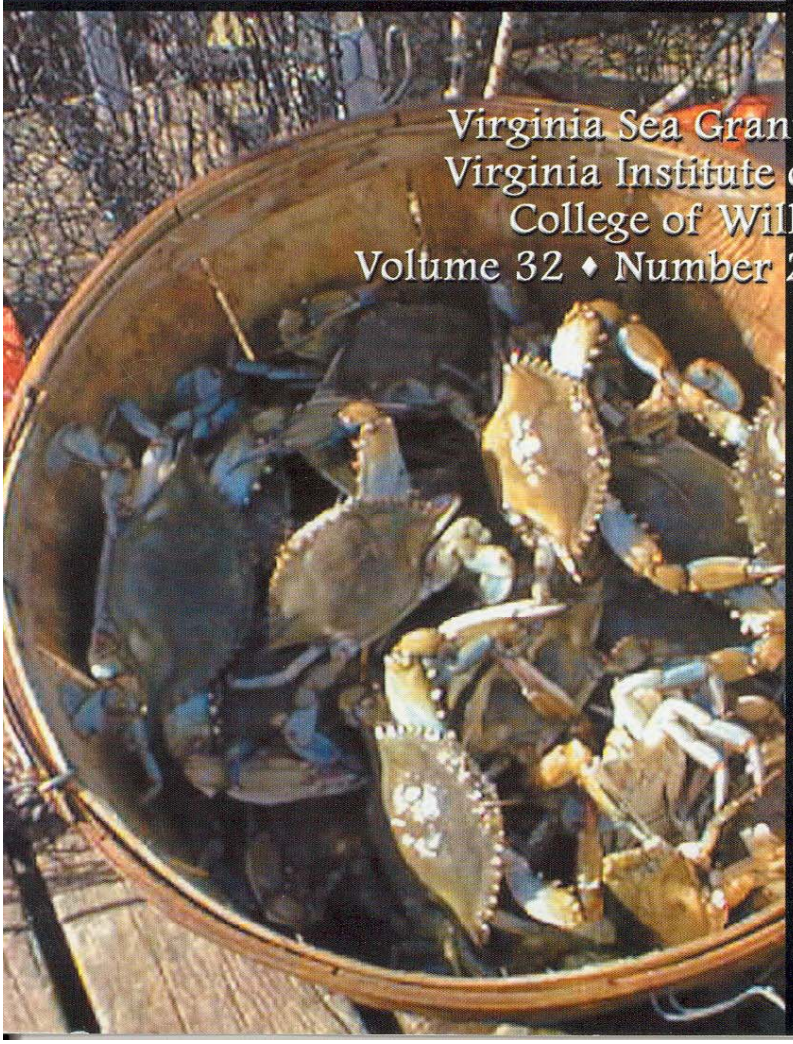

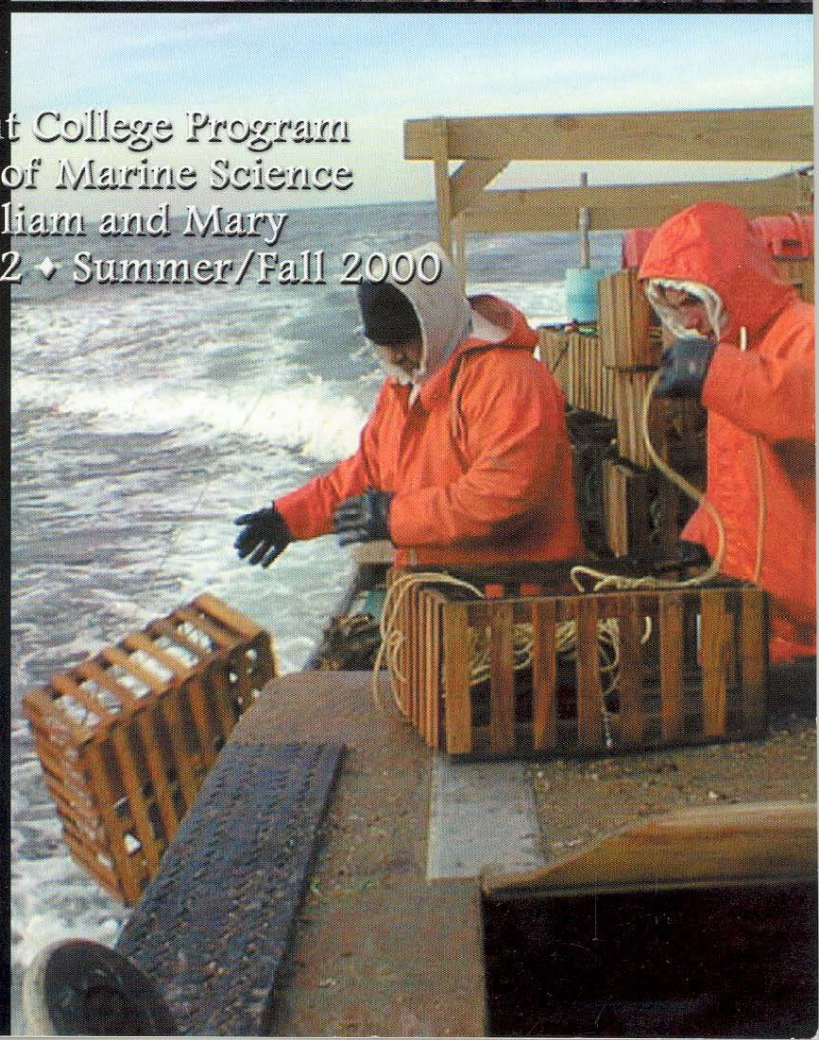

Virginia Sea Grant College Program
Virginia Institute of Marine Science
College of William and Mary
Volume 32 ♦ Number 2 ♦ Summer/Fall 2000

Virginia's commercial pot fisheries are the focus of this issue of the Bulletin. The blue crab, the American eel, and the black sea bass have lured watermen using pots and traps to the Chesapeake for generations. Recently, the channeled whelk has joined the fish so targeted. The pot gear used in these fisheries vary, but all are constructed to take advantage of the peculiar swimming or climbing nature of the animal sought.

Pots are so effective at capturing these species that some quiet grumbling can be heard today among both watermen and fisheries managers that there just may be too many pots and traps in use on the bay. The numbers clearly reveal an upward trend in both license issues and pounds of meat landed at Virginia docks each year. Catch per unit effort – which measures harvests scaled to the amount of fishing effort – is down. While, together, the information might suggest stability, it does not account for other trends that foretell real problems for the commercial fisherman trying to sustain his livelihood.

The challenges faced by a waterman are unique to the particular species of his trade. And each requires a thoughtful, informed management response. A review of fisheries data, coupled with an understanding of the regulations that change from year to year, is every bit as daunting as a review of the tax code. With so many gear types in use – balanced by season and harvest limits – the management end of the equation appears overwhelming at best.

As we head down the road, open debate and reasoning based on accurate data and the best scientific knowledge in place will be the only measured assurance that we can continue to glean economic benefits from Virginia's vast coastal resources while sustaining the essence and lifeblood of her waterways.

— Cover Photographs: upper and lower left by Sally Mills; upper right by Charlie Petrocci; lower right by Bob Fisher —

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Virginia
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Volume 32 • Number 2 • Summer/Fall 2000

CONTENTS

Sea Grant Virginia

William & Mary VIMS
Virginia Institute of Marine Science
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National Oceanic and Atmospheric Administration NOAA U.S. Department of Commerce

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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. Comments and questions about the Bulletin may be directed to the editor at (804) 684-7167, or by e-mail to mills@vims.edu.

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Virginia's Pot Fisheries

By Sally Mills

Going Eeling

Of all the puzzles of the modern marine world, the life and death of the American eel *(Anguilla rostrata)* is one worth marveling. Like other Chesapeake Bay visitors, eels undergo a series of growth stages in which they acquire new colors and physical features. But unlike most travelers here, their migration route is expansive and their metamorphoses, many along the way.

From as far north as Newfoundland to the East Coast of the U.S. to the northern coast of South America, the American eel flanks the coastal Atlantic Ocean and Gulf of Mexico. It is found in freshwater tributaries, coastal estuaries, the open ocean, and even turns up in landlocked lakes from time to time. The American eel is a member of the family, Anguillidae, which includes 14 other species. It is a voracious eater, taking everything from blue crabs and soft clams, to insects and bottom-dwelling fish upriver. In turn, eels are eaten by a host of fresh- and saltwater fishes, and by airborne predators such as bald eagles and shorebirds.

An eel pot resembles a crab pot with a V-shaped central chamber.

After spending a year or more as larvae at sea, young "glass" eels exhibit no exterior pigmentation. Called by some homing device unknown to man, they head to coastal estuaries, darkening along the way. At this point, they are called "elvers" and make their way into freshwater rivers and streams by early spring. After a transition period, they will move even farther upriver, taking advantage of flood tides at night to make their ascent to fresher reaches. This is the stage at which the eel is targeted by eel potters. Called "yellow" eels, they have now become adults.

Adult eels will remain in brackish and freshwater reaches for possibly ten or more years, slowly growing (up to 15 lbs.) and foraging. Then, in what is still one of life's great mysteries, they will move en masse—possibly under cover of a new moon—to a favored spot in the Sargasso Sea. It is believed that the females actually go through a maturation change during this journey. No one has witnessed this mass spawning event; indeed it is suspected to occur at water depths between 550 to 2,200 meters. And no one has witnessed a mature eel leaving the Sargasso Sea, heading back to the Americas. Fecundity is estimated at 10 to 20 million eggs per female—eggs that are tossed about by currents and eventually gathered up by the Gulf Stream, which delivers them to the heart of Chesapeake Bay.

Once in the bay system, eels favor shady areas where they can escape predators, and are usually found in snags and beds of underwater vegetation, or in undisturbed substrate. They are able to withstand tremendous temperature ranges, and this capacity enables eels to be held for long periods of time if provided enough oxygen.

The pot fishery

Eels are a preferred bait in many recreational fisheries and are sold both live and frozen as a food fish. In Virginia, the majority of American eels are caught in wire-mesh pots resembling those used in crabbing (generally 2-feet-square). Though the eel could swim back out, its natural proclivity to settle to the bottom serves to keep it trapped. Brackish to freshwater zones of coastal tributaries are

popular stretches for eel fishermen.

The fishery is conducted mainly during the spring and fall months, but a few potters have made a year-round living of it. One is Bob Caples of West Point, who's been setting out eel pots since 1993. "I watched some guys from Mathews eeling on the river here and got interested. The money was good at the time. It appealed to me because it's a very clean fishery. There's no cutting involved."

Bob Caples started out as a wholesaler, setting large floats made of plywood in the grassy shallows of the upper York River. The float is tied to two poles and can be left in the river for several months. His float will hold up to 1,800 lbs. of eels. Double screening helps to keep river otters—which are serious predators—out.

Wholesaling eels has changed a bit over the past decade. Foreign markets – like Taiwan and Japan – now sell East Coast restaurants pre-cooked, pre-packaged product and, as a result, domestic eel prices are down. Slowly, Bob has gotten out of the wholesale trade and today focuses his energies on retail customers.

Retailing counts on an entirely different approach, one that uses small, weighted wire pots. Bob's pots are somewhat modified from the "typical" design, and feature four small chambers with circular entry points at opposite sides. A central bottom well holds the bait, which, in this case, is a half-horseshoe crab. A pot will hold 2-4 lbs. of eels, or 20-25 individuals.

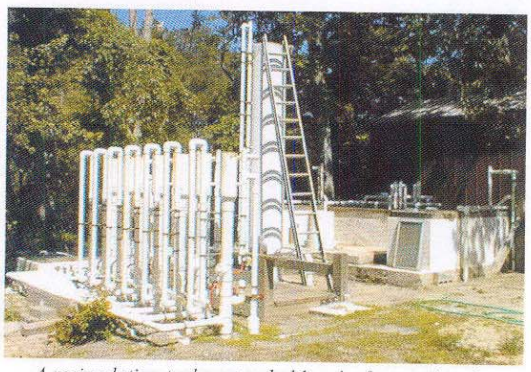
Caples puts his pots out in early morning in several different river segments, starting on the Mattaponi near his home. Lots of intuition is involved, and this eel potter has learned to read the river for signs of likely capture spots. "Grassy areas under shaded cover are inviting locations, if you think like an eel," he says. He strings a half-dozen pots together in an area, then moves a few bends downriver before placing another set. He'll come back daily to check his pots and move them up or downriver a bit if nothing is biting. When he finds a good spot, he's got extras on board to set along with them.

Every eel potter has a distinct style. Bob knows some eel fishermen that work a good five miles of river in one long line of pots. But Caples likes working smaller pot sets, because it gives him the flexibility to easily move them up or down the river, depending on how weather is affecting eel movement. As he proudly beams, "I'm always catching something somewhere."

That's critical to his retail trade, which requires a constant supply of product and a reliable system to hold eels year-round. That thinking led Bob to develop a recirculating system out back – one that capitalizes on common-sense engineering. The recirculating water spends much of its time underground, in large tanks that use oyster shells as a bio-filter, for example, and are fed by gravity. Only one pump is needed for the entire loop to pull water into an above-ground cylinder for the purpose of removing organics such as ammonia and nitrites.

Using well water treated with solar salt, Caples tries to mimic the salinity in the rivers. He tries to accommodate the larger females that tend to migrate to fresher reaches. He culls them in separate tanks according to size. The smaller males (about 18") are sold to bait shops between Deltaville and Richmond. Twenty-four-inch and longer eels tend to be females, which are sold to the restaurant trade and fetch higher prices.

While landings are experiencing a downward trend, this probably reflects a lack of activity in the fishery lately. Duc to stiff competition from abroad, domestic eel prices have dropped in recent years and, as a result, many eel potters are simply not working their traditional grounds. Current fishing regulations require escape holes 4x4.5x1", and this seems to have solved the problem of overharvesting of juveniles.



A recirculating tank system holds eels for retail trade.

The Conch Pot Fishery

Virginia's "conch fishery" is a regional misnomer, referring instead to the whelk species harvested in Virginia waters and primarily offshore: the channeled whelk *(Busycotypus canaliculatus)* and the knobbed whelk *(Busycon carica)*. Of these, the channeled whelk is by far the most sought after, due in part to its attractive, yellow meat. It is the targeted species of conch pot fishermen and commands a higher price in the marketplace.

Whelks are gastropods with an appetite for clams and oysters, as well as algae and other organic matter. A rather large, muscular foot enables the whelk to creep across the ocean bottom and climb structures able to wrap this muscle tightly around. While the whelks resemble each other, the knobbed has distinct points, or knobs, along its upper ridge and a comparatively heavier shell. It is one of the largest northern gastropods. The channeled whelk, by contrast, has a more opaque opening and smooth ridges. A third whelk visitor to the region is the lightning whelk *(Busycon sinistrum)*, distinguishable by an opening on its left side. The lightning whelk is an offshore species and is generally caught as bycatch in the surf clam dredge fishery.

Very little is currently known about the life history of whelks off the Virginia coast. In her study of growth rates of *B. carica* in a lagoon in Beaufort, North Carolina, Magalhaes found that the animal laid eggs from May to June, and again from September to November. Work completed by VIMS graduate student Jane DiCosimo in the mid-1980s focused upon species identification, sex ratios, and size frequencies from commercial landings.

Other research has targeted migration habits. Migration appears to be associated with feeding, predator avoidance, tides, and poor environmental conditions, as well as reproduction.

Whelks tend to move to nearshore waters in the spring and fall, seeking warm water to spawn. During winter, they return offshore to deeper waters.

The harvesting of whelk occurs in Virginia primarily by dredging with a modified crab dredge, or by trapping with baited pots. Conch dredging (targeting the knobbed whelk) has occurred since at least 1940, but potting for channeled whelk did not begin until the early 1990s. Today, the conch pot fishery has picked up momentum, owing in part to the entry of crabbers who are struggling to make a living harvesting crabs. Pots represent virtually all of the reported channeled whelk landings. Until now, the only license required was a dredge license. In 2000, however, the VMRC requires a special license for the harvesting of channeled whelk by pot, based on limited entry.

A channeled whelk wrapping its foot around a lap.

It is estimated that 150 fishermen are actively engaged in Virginia's conch pot fishery today. Another 120-150 people support the fishery by providing bait, or processing and distributing the meat. Much of the processing takes place on Virginia's Eastern Shore.

Mechanics of the fishery

The behavior of conch pot fishermen mimics the movement of

their target. During the months of March through early June, and again between October and December, conch fishermen follow the nearshore waters out to the edge of the continental shelf – a distance of 1 to 50 miles generally – in search of the animals. Conch seasons follow commercial crabbing and shrimp trawling seasons, and thus fill an important niche in the waterman's calendar. A typical fisherman will bait 200-250 pots per trip, placed on a rig of four lines of 50 each. Placement of pots appears to be based on a waterman's instincts, and a "hit or miss" attitude sometimes prevails. A conch potter generally has two rigs going at the same time–one a bit farther offshore or several miles north/south, according to where animals are biting.

Channeled whelks are active at night, and a rig of baited pots is generally checked, and emptied and rebaited if full, daily. A second rig is checked and rebaited, or moved if necessary, on alternate days. The bait of choice is the horseshoe crab. It has readily out-performed all other baits tried thus far, such as sharks, cownose rays, and hard clams. Early studies performed by Copeland on whelk show that the animal is drawn by the smell of the bait.

The conch pot is designed with the channeled whelk in mind. No other whelk in Virginia waters can climb vertically straight up. The knobbed whelk, for example, might master an incline at 45 degrees, but its shell weight and shape prevent it from climbing at a higher angle. The channeled whelk uses its powerful foot muscle to wrap around the laps of the wooden trap and hoist itself up. Upon reaching the top of the trap, it continues toward

A fourth species introduced from its native range in the Sea of Japan is the veined rapa whelk *(Rapana venosa)*, which is generally squatter in shape with a much fatter opening than our native whelks. The rapa whelk is a prolific breeder with the potential to cause great ecological turmoil in the Chesapeake Bay and other non-native waters. A bounty program has been established by VIMS for recovery of rapa whelks, in an effort to learn as much as possible about their habits (see www.vims.edu/fish/oyreef/rapven.html).

A PIONEER IN CONCH POT FISHING

Paul Herrick started "conching" in 1993 when crab harvests plummeted and has never looked back. Like crabbing, everyone has a slightly different technique, and Paul uses the methods that work best for him.

Heading out from the dock in Norfolk aboard his boat *Sunrise*, sometimes as early as 3 a.m., Paul works anywhere from south of Chincoteague to just inside the Carolinas, from one to 40 miles offshore. It's a long, 15-hour stretch most days and as he says with grit, "Being a waterman is hard work. You earn every nickel you make." A full conch pot, for instance, weighs between 70 and 80 lbs., and holds about 100 whelks. He can load his boat with 200 pots comfortably; 300 if he's pushing it.

Paul throws his pots individually attached to a buoy, and says that when he finds a good spot, he puts his pots there, usually within a 200-yard radius. When he first got started seven years ago, it was easier to find whelks. "There were so many conch and few fishermen. You didn't have to go out very far, say two or three miles." Now he sometimes has to search 50 miles offshore.

Conchs are nocturnal creatures and seem to trap best at night. A prudent fisherman checks his pots every morning and re-baits them if necessary or moves them to a new location. "It's a labor-intensive fishery like eeling, and you can't leave your pots for more than a day. If a storm comes up, you can lose all your bait and all your catch, and have to start all over again." Another problem mentioned by several potters: with so many conch fishermen out there now, thievery has become a big problem.

But Paul says he'd rather be conching than just about anything else. He finds the fall to be the best season, up until Christmas. Then the storms come in and cold temperatures cause the animals to move offshore to deeper waters. He notes that if he could continue making a living at conching and dogfishing, he'd stay out of everyone else's hair. He says with a hint of resignation, "I've spent a pile of money to get here. Mother Nature is always up and down. I saw it with my dad. Mother Nature takes care of herself."

He and a buddy of his are experimenting with a new pot design that would allow the pot to be pulled from the bottom and one side through the water column. If successful, pots could be harvested more quickly and reliably, and a more enclosed top would keep animals inside during storm events.

the bait inside. A trip wire within the top perimeter made of rope causes the animal to lose suction and fall inside.

Once inside the 22x22-inch pot, the channeled whelk is prevented by the trip wire from climbing back out, as long as the trap stays upright on the bay or ocean floor. A cement weight keeps the pot anchored.

Conch pots are pulled up mechanically using a winch. A rope attached to a bridle on each side of the pot and fed through the winch pulls it out of the water horizontally level. Use of the pot puller is tricky, and any miscalculations with the bridles would allow the pot to tip over, resulting in lost animals.

Management concerns

The most significant conflict in today's conch pot fishery centers upon use of the horseshoe crab as bait, in light of apparent declines in their stock. In response, the Virginia Marine Resources Commission recently voted to reduce harvest quotas by half, to 355,000 pounds annually, and instituted the use of a bait bag with all horseshoe crab bait. (See related information on page 16.)

A more species-direct management concern has to do with the low survivability of young whelks, coupled with slow growth rates. Also, these animals are bisexual, and females may take up to 12 years to enter the population after starting out as males, according to research performed by Michael Castagna and John Kraeuter in the early '90s. Their research points to the need to closely monitor the harvesting of these animals, given such information and the little that is currently known about their life histories.

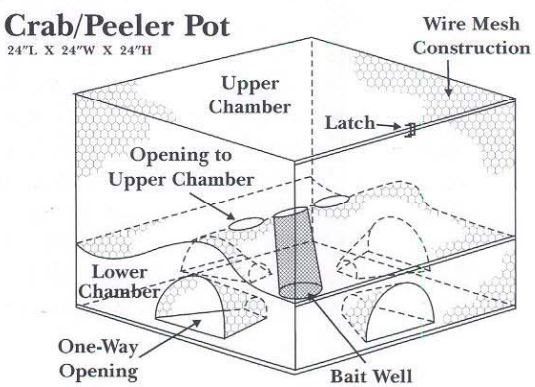
Potting Blue Crabs

No other fishery today claims the stature of a Chesapeake Bay icon than the blue crab *(Callinectes sapidus)*. Over the past 50 years, the blue crab has symbolized the life and toil of the waterman, and has captured the imagination of generations of artists, authors, scientists, conservationists, and visitors from landlocked states. It has often been held up as the last and most visible trophy that must not be lost – propelling us forward in our efforts to restore the once highly productive Chesapeake Bay.

Like the American eel, the blue crab is notorious for its complex life history; one that involves as many as 18 moltings as the crab grows from a juvenile to adult crustacean in a matter of less than a year. At the earliest stage of development, the "zoea," or crab larvae, float near the mouth of the Chesapeake. From here, larvae experience several marked changes in development before becoming "megalopa" with a hard shell and moving into estuarine waters. The megalopa will shed its shell once and become a "first crab" at 2-3 mm wide sometime in August, and begin its ascent to more brackish areas (generally less than 20 ppt) of the bay. At this point the crab is a young juvenile, and will go through a series of moltings—shedding its exoskeleton—before growing to a mature adult. It is during the latter stages of molting, or when it has reached 5 inches as a hard crab, that the blue crab is harvested by fishermen in Virginia and Maryland waters.

Fishing gear

Hard crabs are caught by dredge and by pot. As in other commercial fisheries, watermen often take a basic design and modify it slightly according to their style and particular needs. But the blue crab fishery has gone a step further and capitalized upon the molting process to harvest the crab during the short window of time that its shell is soft. Select gear (including holding pens) have developed accordingly. Indeed, there may be more designs and "tweaks" on the first



crab pot patented in 1928 than any other category of fishing gear. From bank traps to jimmy pots to traditional wire pots, every adaptation is designed to entice that delectable creature to its interior, sometimes with a fellow crab as the tempter.

The majority of blue crabs harvested from the Chesapeake are captured in double-chambered traps constructed of 1-1/4 inch chicken wire mesh attached to a square reinforcing rod frame. The pot is equipped with a weight to assure that it lands right side up, and a line with a cork float is tied to the pot to mark its location. The pot's lower chamber has a cylindrical bait well that is commonly filled with menhaden (called "bunker"), an oily fish that attracts hungry crabs. The lower chamber also has two to four funnel-shaped openings, one on each side, that allow crabs one-way entry. Captured crabs naturally move to the upper chamber seeking an escape route and are trapped by more one-way openings. Small openings called "cull rings" allow crabs that are less than the legal limit to escape from either chamber.

Virginia commercial license holders are currently allotted 100, 300, or 500 pots, according to past fishing practices. In the 1999 license year, a total of 802,500 commercial crab pots were licensed for use in Virginia waters for harvesting hard crabs at least 5 inches in carapace width and softshell crabs at least 3.5 inches in carapace width, measured across the shell from the tips of lateral spines.

Blue crabs are also legally harvested by commercial fishermen as "peeler crabs." Watermen check for signs of impending molting (which is characterized by a color change on the swimming leg, or fin), and crabs that are about to molt are taken to shedding houses where they are held in shallow wooden water-filled trays, called shedding floats. When the peelers molt, they are removed from the float and sold on the soft crab market. They must be a minimum of 3.5 inches at harvest or when they shed out.

Pots stacked at the dock in West Point.

Peeler crabs are caught by several different gear types:

◆ Crab scrapes are used in seagrass beds, where peeler crabs hide during their molt. One or two scrapes are towed from the side of a shallow-drafted boat that can access the shallow waters where seagrasses grow. In Virginia, where scrapes must be retrieved by hand, the scrapes weigh up to 40 pounds each.

◆ Bank traps (also called crab traps or peeler pounds) intercept crabs as they travel along marsh edges seeking hiding places in which to molt. A long section of wire mesh runs like a fence from shore out to deeper water, where it meets a heart-shaped pen equipped with a square box. When the crabs come up against the wire barrier along the shore, they turn and follow it until they are trapped in the pen. Watermen harvest the crabs by periodically removing the box and sorting out the peelers.

◆ Jimmy pots (or peeler pots) are constructed like hard crab pots, but with smaller one-inch mesh. A jimmy pot is baited with a live mature male (jimmy) crab to attract pubertal females (about to enter adulthood) in search of a mate. They have proven extremely effective.

◆ "Crawl in" peeler pots are not baited; they simply attract crabs searching for shelter just before they molt. Far fewer crabs per pot, 2 to 5 on average, are caught this way. Peeler pots are not required to contain cull rings.

Management concerns

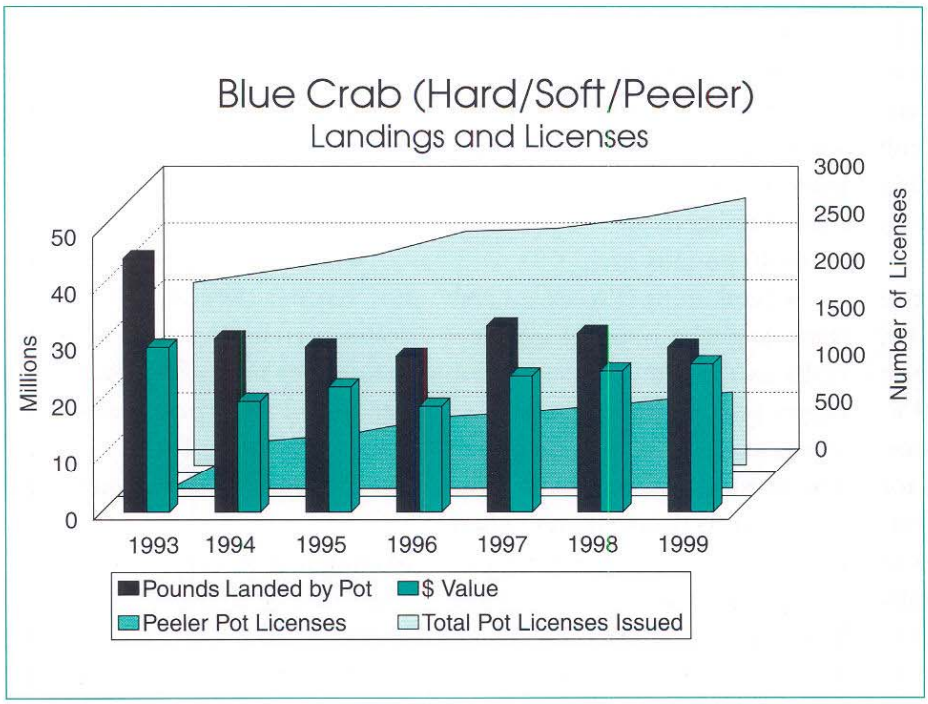
The number of licenses issued in Virginia for both the pot and dredge fishery has increased sig-

nificantly since the 1970s, while the "catch per unit effort" (number of crabs caught in each crab pot or dredge tow, for example) has decreased. Overall landings are down, and real concern centers on the fact that female biomass is down by an estimated 70% since the 1980s. These trends have led many scientists and policymakers to speculate that Virginia waterways are currently "saturated" with crab gear. Of particular concern for managers is the fact that only a portion (perhaps as little as 40%) of licensed crabbers actively pursue the fishery today. The potential for legally stressing the fishery is quite real, should all licensed crabbers begin harvesting at allowable limits.

The majority of crabbers interviewed conceded that they have witnessed great declines in the crab fishery over the past ten years. While no one can agree on the reason, common themes center upon the number of pots currently in use, increased participation in the peeler fishery, and continued harvest of female sponge crabs (with developing eggs attached). A related concern has to do with the number of females taken in the peeler pot fishery—a tactic that denies them the ability to reproduce.

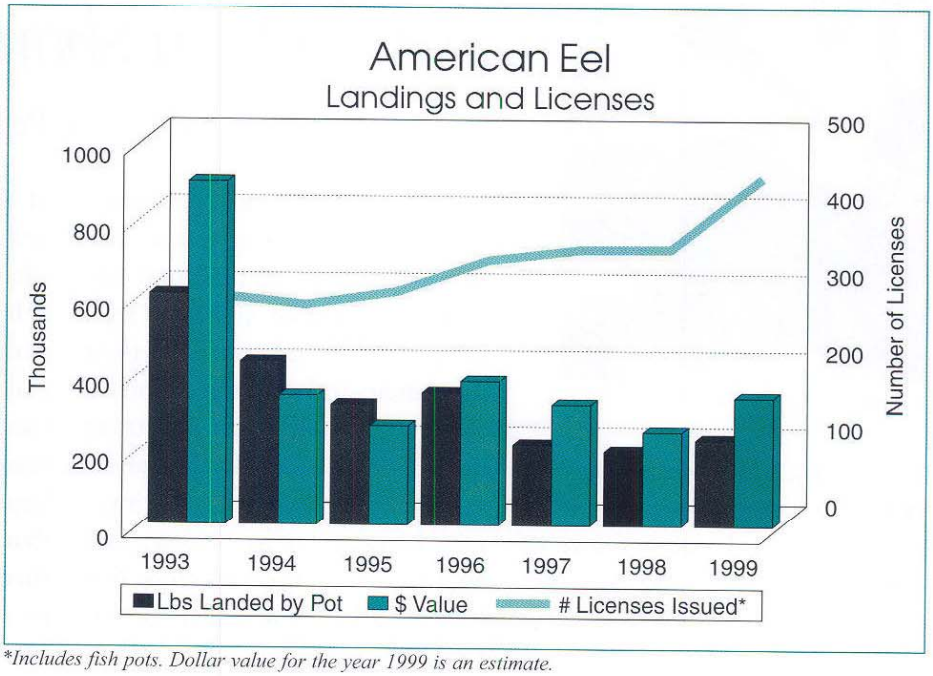
In response to these concerns and others, Virginia recently placed a moratorium on fishing for blue crabs throughout the central corridor of the lower Chesapeake Bay, following the 35-foot-deep contour line. The corridor was established to protect migrating females as they move down the bay to their spawning grounds, and the sanctuary provides protection from June 1 through September 15. There has been discussion recently about the viability of a "rights-based" fishery for the blue crab, modeled after similar approaches used worldwide to manage fisheries in trouble. Such a system would, in effect, allow a license holder to harvest a specific number, volume, or weight of crabs each year. Watermen fear that such a system might concentrate ownership [of licenses] in the hands of too few.

Vicki Clark and Jacques van Montfrans contributed the information on crab gear.

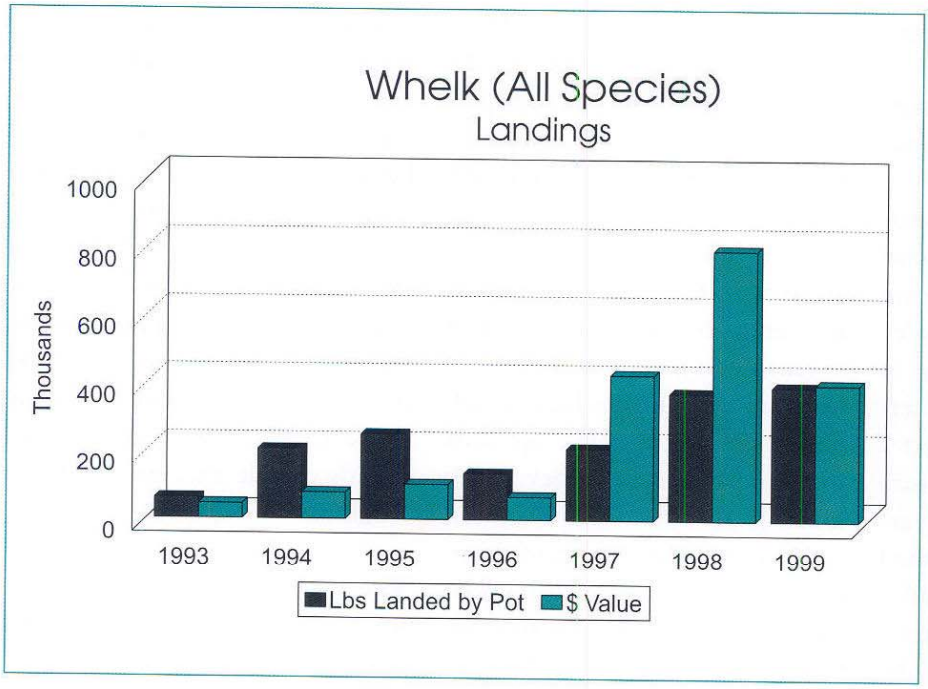


- Landings are intended to report total catch, including mortalities.
- License issues can be confusing. The general trend line is up, but gear categories must be assessed individually. For example, currently the total number of commercial pots that can legally be fished for hard crabs is 429,700; the number for peelers is 372,800.
- All commercial crab pots must be numbered in 2001. This action, along with others implemented since 1994, is aimed at gaining better control over harvesting gear with the intent of helping blue crab spawning stock.

- While the number of licenses is up, the number of active eel fishermen remains low. Less than 35 license holders reported activity in this fishery in 1999.
- Management of this fishery has traditionally focused upon reducing waste, and escape panels that allow small eels out are now mandatory.
- A lengthy migration route and related environmental factors make this a difficult fishery to manage, based upon averages, from year to year.
- Eels must be at least 6 inches long to be harvested.



*Includes fish pots. Dollar value for the year 1999 is an estimate.



- All whelk fisheries were grouped into a dredge gear category until this year.
- Beginning in 2000, a limited entry pot fishery was initiated under a separate license. The pot fishery targets channeled whelk, and all pots must be numbered. A 200-pot limit is in place for fishing in Virginia waters.
- Only a handful of fishermen have actively participated in this fishery until now, but that is changing.
- Most of the channeled whelk activity occurs offshore and is therefore managed in concert with the NMFS.

NOTE: These graphs contain general information intended to show trends since 1993, when mandatory reporting became effective. All data was provided by the Virginia Marine Resources Commission. Landings include all catch brought to Virginia docks (harvested inside and outside Virginia waters).

Potting Black Sea Bass: An Eastern Shore Tradition

By Charlie Petrocci

Captain Kelly displays a recent catch.

Swimming among the tangled, gnarled wrecks and rough bottom found off the Eastern Shore of Virginia is an interesting, commercially valuable fish known as the black sea bass *(Centropristis striata)*. Long known in sport fishing circles as being a scrappy little fighter and excellent table fare, sea bass are a well-established target species for commercial watermen. Yet the number of active commercial sea bass fishermen has dwindled in the past 10 years.

Living in schools in the natural world, sea bass hover around structures and bumpy bottom. Anything from oyster shell piles to sunken WWII ghost ships is called home. The fish are very territorial and may fiercely protect a piece of structure as small as a can. Though harvested almost year-round, sea bass tend to be targeted primarily during spring and fall.

Black sea bass are found naturally from Cape Cod to Florida, with good concentrations in the Mid-Atlantic region. North of Cape Hatteras, sea bass move offshore and south each fall, coinciding with dropping water temperatures. They can be found offshore at depths of 40 to 500 feet. Come spring, they reverse their movement and migrate inshore to shallow coastal habitats. Adults are then found in spawning areas around rough bottom, with juveniles hanging out in estuaries and back bays feeding on anything that looks edible, including crabs, clams, worms, and small fish. Adults will eat barnacles and other benthic organisms.

Sea bass have robust bodies covered with large scales. Their color variation goes from dusky brown, mottled, to black in patterns with definitive longitudinal streaks. They also have the ability to change color, matching their bottom habitat. They are slow growers in the wild, and it takes an average of five years for a fish to reach one pound. Sea bass can reach up to 24 inches long, weigh over 8 pounds, and live upwards to 9 years of age. They reach sexual maturity between 1-4 years.

But probably the most interesting aspect of the natural history of sea bass is that they are protogynous hermaphrodites. In other words, youngsters start out as females, and later, some transform into males. The size and age of the sex reversal varies, but it is believed most fish change sex when they reach about 7-10 inches in length and 2-5 years of age. Females are more abundant than males because they dominate the younger, smaller class of fish. Research has shown that most fish larger than 11 inches and older than 5 years are males. Evidently, there's no fixed rule with regard to sexual reversal, though, and mature males and females can be found in all age classes.

Spawning off the Mid-Atlantic begins in June and peaks around July, depending on water temperatures. Spawning usually takes place in depths between 60 and 150 feet. There, females lay between 30,000 to 120,000 free-floating eggs. After hatching, the young go through a planktonic stage and then begin to migrate toward coastal bays and estuaries. Historic grow-out areas can be found in shallow bays such as those found behind the barrier islands of the Eastern Shore of Virginia.

The fishery

At one time there was an active commercial sea bass fishery throughout the Mid-Atlantic region. Though it still occurs in Virginia, harvesting by offshore trawl

nets and wooden/wire box traps is on the decline. This is due primarily to species movement, small harvest sizes, loss of gear, and a confusing legal season. Trawls are commonly fished up to 300 feet deep, concentrating on hard bottom near rocks, ledges, reefs, and wrecks. Landings occur primarily from September to April.

The predominant gear types used in the commercial sea bass fishery are otter trawls and fish pots, along with a limited amount of hand-line activity. Limited by-catch occurs from lobster pots, trap nets, and pound nets. Otter trawl landings of sea bass are usually a result of by-catch summer flounder and squid fisheries and occur during winter. In contrast, the pot fishery (which occurs, depending on current regulations, from April until November) specifically targets sea bass.

Wooden and wire pots are fished unbaited in depths from 65 to 100 feet. Traps are set in winter and are traditionally fished until November. They are very similar in construction to wooden lobster slot traps. Usually, several hundred pots are set, and only a portion of those is fished on a rotational basis every few days. Traps are set near wrecks, reefs, ledges, and rough open bottom. The sea bass swim inside the dark, unbaited traps seeking shelter and territory and are thus caught. Open slots on the pot allow for undersized fish to escape. By-catch includes starfish, hake, eels, and rock crabs.

One of the few sea bass boats left in Virginia operates out of Chincoteague Island. Captain Joe Kelly of the 50-ft. *Toots* has been fishing for sea bass since the late '80s. "We fish about 500 pots per two-day trip, hauling 250 pots each day. We are limited, though, by weather and quota limits. Limits can stretch from a high of 30 boxes at 100 pounds each down to only 10 boxes per day, depending on the harvest quotas. It's extremely frustrating when we suddenly get a closure, with very little warning. It's a lot of work pulling up those pots and then having to bring them in."

Kelly fishes his wooden slat pots along with a handful of wire pots on open bottom about 30 miles offshore. His pots, many either built locally or in New England, average about 4 feet by 2 feet wide. Bricks or cement liners weight them down. Each pot by law has 2 escape slots for juvenile fish, with the current legal size limit set at 10 inches. The pots are strung out 20 to a line, about 60 feet apart, which is considered standard for the fishery. Pots cost an average of $40 to $60 each. He believes his old wooden pots tend to catch better than today's lighter wire pots.

"The sea bass pot fishery may become a thing of the past someday. Closures are hurting us as well as the draggers, which take a big chunk out of the annual harvest quota. Though I do some lobster pot fishing in between seasons, sea bass fishing is my main business. It's my livelihood," Kelly addded.

A typical sea bass trap has 2 openings and allows young to escape between slatted ends.

The marketplace

In the last 10 years, there has been considerable demand for sea bass in traditional markets like Baltimore, New York, Norfolk, and North Carolina. But now, due to a large growing Asian population that has embraced the sea bass as a favored product, markets have expanded into Philadelphia, Washington, and New Jersey. Sea bass are an excellent eating fish, yielding firm, white flesh. Fish are usually marketed in the round, headed and gutted, or sold as fillets if large enough. They hold up well to Asian cooking techniques — steamed whole, poached, or fried into tempura chunks.

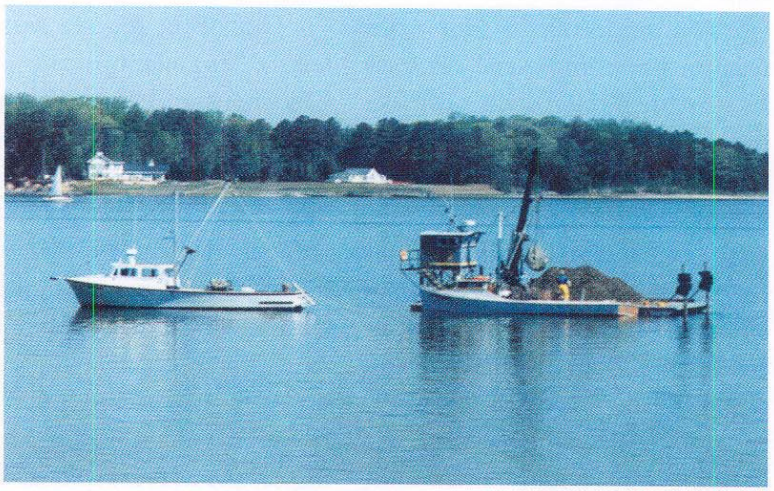
Black sea bass continue to remain a viable commercial species and an economically important recreational species in Virginia. Though harvest quotas are controversial among harvesters, recruitment of young has recently accelerated, hinting at a sustainable fishery with a strong future.

Virginia Fisheries Resource Grants Benefit Oyster Fisheries

By Tom Murray

The Virginia Legislature initiated the Virginia Fishery Resource Grant Program (VFRGP) in 1999 to "protect and enhance the Commonwealth's coastal fishery resource through the awarding of grants in four areas":

- New fisheries equipment or gear;
- Environmental pilot studies on issues including water quality and fisheries habitat;
- Aquaculture or mariculture of marine-dependent species; and
- Seafood technology.



The scale of oyster transportation needed to meet replenishment targets is immense, requiring innovation at all levels of oyster harvesting, transport, and handling.

Funding for the program comes through Virginia Sea Grant, with oversight provided by advisory service specialists and researchers working at VIMS. The VFRGP is based on the simple approach that experienced fishermen come up with ideas to improve their productivity or reduce costs everyday. Typically, attempting such an idea or change entails a cash outlay that is too risky for an individual fisherman to justify, particularly if any benefits of the idea would also be gained by his competition. The VFRGP is there to fund just those costs associated with making an operational change, so that the operator does not bear all of the risk and expense for what ultimately leads to greater industry productivity.

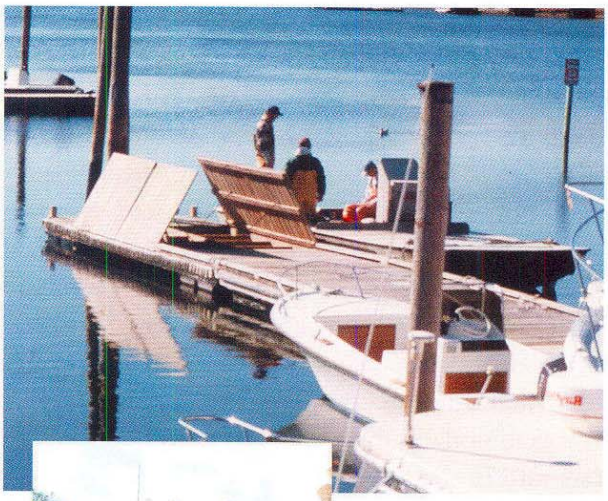
The philosophy of the program lends itself to contribution in many areas important to Virginia fisheries. Perhaps no better example of this link between research and application exists than the current efforts of watermen and fisheries experts funded by the VFRGP to enhance the culture of oysters in Virginia for both the private marketplace and public benefit.

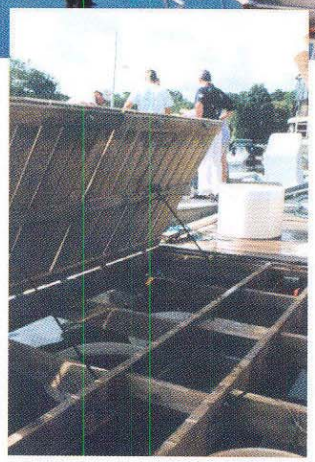
In its first year, the program has funded 11 research projects, five of which deal directly with enhancing Virginia's oyster resources. Looking at two of the oyster redevelopment projects underway will illustrate the potential for using the VFRGP for unique but related projects leading to a common goal.

Whether for the private market or as a part of the commonwealth's growing oyster restoration efforts, the sheer demand for oyster seed continues to grow. The development of efficient and rapid methods to grow these young oysters through the nursery phase of culture is extremely important. Also, investigating technological advances in on-site nursery systems could benefit all by reducing the size of oyster seed needed for grow-out. And it follows that potential decreases in seed cost might encourage more watermen and culturists to become involved in the nursery phase of oyster culture.

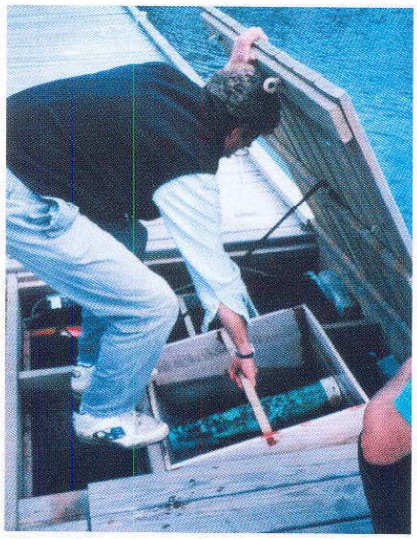
One new VFRGP project along these lines explores a new technique to "jump start" oyster seed using an existing "floating up-weller system" ("flupsy"). The theory behind flupsy use is simple. During the nursery phase, it is critical to protect oyster seed from predators such as fish and crabs while providing ample food. Under forced up-flow conditions, the seed should grow at high densities much faster and more uniformly than passive flow systems. With increased water flow, the oysters pump water faster, and this increases nutrient intake while expediting waste removal.

In this project the flupsy technique is being conducted simultaneously with oyster seed grow-out using a more traditional "bag/float" (a "Taylor Float") system. Initially 150,000 seeds were stocked in the "flupsy" and Taylor floats side by side in a creek on Virginia's seaside. Weekly measurements are made as each float is sieved, measured, and restocked. The seed will be placed in off-bottom trays and floats for final grow-out, then sold as seed to other growers and oyster gardeners.





The upweller is built directly into the dock, allowing for ease of access and transport.



Ease of access to seed silos ensures that seed mortality rates are reduced while growth rates and size consistency are optimized.

If analysis of the flupsy technique proves it successful, the system will offer anyone with a dock and nutrient-rich water the opportunity to raise oyster seed. Interim results are very encouraging, and early indications already promise accelerated seed growth rate, consistency in seed size and survival, and easy monitoring and maintenance. The bottom line: flupsy would contribute significantly to the growth of oyster aquaculture in Virginia, both for private and public purposes.

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A second project concerns an entirely different aspect of oyster restoration. It focuses on improving technology to more efficiently harvest, transport, and plant oyster shell and seed. Many actually consider the bay's ecological health the primary goal of oyster restoration, and public interest in this is considerable. Additional benefits arising from a re-developed oyster industry are also significant. Whatever the motivating force, however, benefits from oyster restoration will accrue only if such restorations continue over the long term, in an economically feasible fashion.

Advances in seed production and nursery grow-out systems are potentially of great use to small-scale aquaculture enterprises. But even if the supply of oyster shell and seed grows, the need for improved handling and transport of shell stock will ultimately have much to do with the success of overall efforts.

The state is also responsible for maintaining and replenishing its public oyster beds. In general, replenishment activities involve the addition of shell "cultch"—which serve as points of attachment for

spat—to these public beds, and the movement of seed oysters between highly reproductive areas to areas of low reproductive activity. Generally, contractors with large boats or barges are hired to plant the shell cultch. For seed oyster harvest and transplant, small boats with private contractors typically harvest the seed oysters by dredge and then off-load them to a large "buy-boat." The buy-boat then transports the oysters to distant locations. Watermen can generally carry between 100 to 300 bushels of seed oysters per boat, while a buy-boat can transport up to ten times that amount.

Traditionally, the watermen must hand shovel the oysters into bushels that are then hauled up by the buy-boat and individually dumped onto the buy-boat's deck. To fill a buy-boat with oysters requires about one hour of strenuous labor for each 150 to 200 bushels that are loaded.

Experimental use of tarps to reduce hand shoveling of oysters resulted in a two- to three-fold increase in efficiency of seed transport from the workboat to the buy-boat.

The VFRGP funded a project investigating an adaptation of this procedure to reduce the extensive labor involved in handling oysters this way. Approximately 8 to 15 bushels of oysters were off-loaded onto a tarp. Layers of tarps and oysters were piled consecutively until the boat was full. When the harvester's boat was alongside the buy-boat, the tarps were secured at 4 or more places and lifted as bags. Using both a telescoping crane and a small excavator to lift the bags of oysters onto the deck of the buy-boat, great strides were made in eliminating back-breaking labor for the watermen.

Early on, the watermen were understandably leery of the technique, but by the end, most reported that they preferred working with buy-boats using tarps to other buy-boats that still relied on shoveling and handling one bushel at a time. The tarp off-loading procedures were found to be two to three times faster than the traditional procedure, with much less physical energy expended. One immediate benefit: watermen have more time to harvest rather than simply unload oysters. In a fixed quota system, such as seed replenishment contract work, the efficiency offered by the tarp system will shorten the amount of seed oyster harvest time, generating a better profit margin per bushel for the waterman. Also, the use of tarps resulted in much less damage to the live oysters.

Refinements are still needed. Experience in handling the tarps and managing the hoisting system led to further insights about protecting the bags, half of which appeared to have been damaged in some way by the off-loading procedure itself.

This experiment took place in the spring, and a total of 60,751 bushels of oysters were moved from the Piankatank River to other areas of the state. Of that total 16,305 bushels were handled with the tarp system. It was determined that the average bushel of Virginia seed oysters weighs 78 pounds. Thus, over 1 million pounds of oysters were handled in less than half the time without a lot of back-breaking shoveling.

Ultimately, oyster recovery will entail a multi-faceted approach involving all aspects of oyster culture, grow-out, transportation, planting, and management. The basic science is underway on such things as optimal reef size and design; introductions of fast growing, disease resistant, genetically selected oyster stocks; and brood stock supplements. Science plays a key role in rebuilding the oyster resource. Through the VFRGP, however, the individual efforts of watermen and related oyster industries can lend a vast fund of experience to the task at hand.

Have Questions?
Workshops for 2001 Grant Applicants:

Monday, September 11th
6:30 - 8:30 p.m.
Rappahannock Community College
Auditorium
Warsaw, VA

Wednesday, September 13th
6:30 - 8:30 p.m.
VIMS, Watermen's Hall Auditorium
Gloucester Point, VA

Monday, September 18th
7:00 - 9:00 p.m.
Eastern Shore Community College, Lecture Hall
Melfa, VA

Wednesday, September 20th
(Tentative - time to be announced)
Tangier School Auditorium
Tangier Island, VA

Cobia Spawn in Captivity

By Mike Oesterling

A milestone in marine finfish aquaculture was achieved on June 15 when cobia *(Rachycentron canadum)* were induced to spawn in a recirculating water system. According to Mike Oesterling, VIMS aquaculture specialist, this is the initial step in the development of cobia aquaculture. Dr. Bill DuPaul, head of the Virginia Sea Grant Marine Advisory Program, explained that, "Cobia are considered prime candidates for aquaculture development because of their fast growth rate as juveniles and an expanding demand for them in the marketplace."

"Cobia are highly prized both as a food fish and a recreational trophy fish," said Oesterling. "We've been investigating the potential for cobia culture for four years now. But, this is our first attempt at spawning." Previous work was conducted on wild-harvested juvenile cobia that were obtained from commercial watermen. Those studies set the stage for the spawning, by providing information on handling and holding cobia in captivity.

Using funding from a National Sea Grant aquaculture initiative grant, researchers from the VIMS finfish aquaculture program arranged for the capture of broodstock fish by recreational cobia fishermen and transferred the fish to holding facilities.

Once at VIMS, the fish were administered a hormonal implant to stimulate the release of eggs and sperm, and were placed within a 7,500-gallon recirculating water system equipped with filtration units and egg collection devices. Within 48 hours of the hormonal implants, the 6 female cobia and 3 male cobia began spawning.

"We began collecting fertilized eggs around 8:30 AM on June 15, and on June 16 at 4:00 PM, the fish were still producing eggs. Literally, the fish have produced millions of eggs," Oesterling noted. "The eggs were then taken to our larval culture facility for hatching and further on-growth."

The overall goal of the cobia culture project is to produce juvenile fish and investigate the requirements for commercial culture. Additionally, vital life history information will be obtained. As the young cobia grow, they will be the subject of different growth studies aimed at providing valuable information for their continued culture.

Update: Horseshoe Crab Research

By Bob Fisher

Horseshoe crabs *(Limulus polyphemis)* inhabit coastal waters from the southern Gulf of Mexico to Maine and are most abundant between Virginia and New Jersey, with high concentrations found in Delaware Bay. Adult crabs spawn within the Chesapeake to Delaware Bay area in late spring (May), where they lay their eggs in the sandy beach habitat in clusters, or nest sites. The eggs have historically served as a vital food source for migrating shorebirds that arrive in the Delaware Bay area each year during the peak of crab spawning.

The horseshoe crab is the preferred and most effective bait in the conch pot fishery, and in the eel and catfish fisheries. It has also evolved as an important resource in the medical field: a blood clotting agent (Limulus amoebocyte lysate, LAL) found in the crab's blood is used to detect certain human pathogens in patients, drugs, and all intravenous equipment.

Background

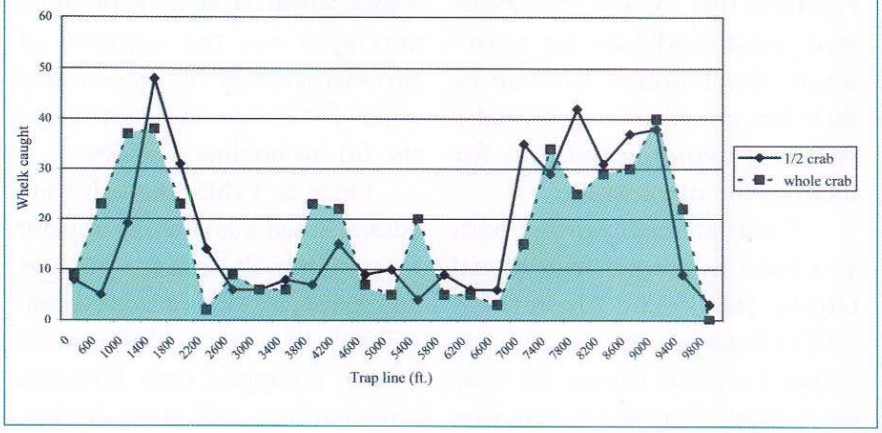
Estimates of crab populations in Delaware indicate a drop from 1.2 million in 1990 and 1991 to less than 400,000 in 1992 and 1993 (Swan et al. 1991). According to aerial surveys conducted by Delaware Bay has also declined from more than 400,000 in 1986, to 200,000 in 1997. Conservation groups headed by the Audubon Society link the bird decline to the decline of horseshoe crabs, citing over-harvesting of the crabs for bait as the primary factor, and have voiced concerns. Within the past two years, the leading producers of horseshoe crabs for bait (in Maryland, New Jersey, and Delaware) have responded by setting limits and establishing harvesting quotas for horseshoe crabs. That has resulted in a 59% decrease in crab landings. Virginia recently decided to cut its annual harvest in half, to 355,000 pounds of meat. The bottom line: Virginia conch fishermen will have a limited supply of bait while the cost per crab continues to rise.

Alternative baits are being researched to sustain commercial fisheries, but currently no bait has been developed that is as effective as the horseshoe crab. Until an alternative is developed, fishermen are limited to the number of crabs they can obtain. Naturally, if fishermen can use less bait per pot without greatly reducing the number of conch caught, less demand for crabs should result.

Research methods

As reported in the last issue of the Bulletin, research was conducted to determine if reducing the amount of horseshoe crab bait placed in a mesh bait bag would affect the number of conch caught per trap. This update provides final research results through June 2000.

Figure 1. Whelk caught along a trap line with pots (N=50) alternately baited with a whole, then a half, female horseshoe crab, and placed within a mesh bait bag. (3 day soak)



Fresh horseshoe crabs were cut on a Hobart vertical food processing band saw (model 5215). Crabs were cut from anterior to posterior resulting in equally symmetrical halves for testing half bait usage, with these halves again cut in half transversely to obtain quarter crab baits. To obtain third sections the abdomen section was first removed followed by a anterior to posterior cut through the thorax section, resulting in two symmetrical halves of the crab thorax and the crabs abdomen section.

The bait bags were made from black, polyethylene plastic quarter inch square aquaculture mesh and measured 28 cm by 30.5 cm. The sides of the bags were closed on three sides with stainless steel hog rings, leaving a long side (30.5 cm) open. The cut crabs were inserted into the mesh bait bags cut-side first, keeping the exposed flesh of the crab away from the open side of bag.

This research was conducted from December 1999 through June 2000 on a commercial conch potting vessel using traditional gear. Fishing occurred within both federal and Virginia state waters extending from the Bay Bridge-Tunnel to the Virginia/North Carolina line. Testing consisted of alternating control traps with treatment traps within a line of traps. Each line fished between 45-55 traps spaced approximately 70 m apart. Soak periods for this study ranged from two to six days. Upon retrieval of traps the number of conch per trap was recorded, while the amount of bait remaining was noted. Statistical analyses were performed using the non-parametric Kruskal-Wallis test for significance.

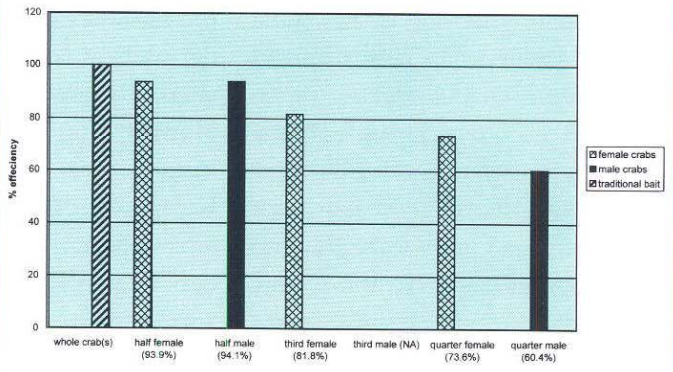
Results

Eighteen lines totaling 346 treatment groups (traps) and 341 control groups were tested. No significant differences were observed in the number of conch caught per pot between using half the amount of bait traditionally used in the commercial conch industry and the traditional amount. Both male and female half-crab test groups showed a slight decrease in total catch (5.9% and 6.1% respectively) from the control groups, but were not statistically different.

Usable bait was observed remaining within the mesh bags of the treatment groups even after the longest soak period (6 days), indicating that the bait was still actively fishing and attracting conch. Throughout the study, the amount of conch caught per pot within a trap line was highly variable; however, variability was high for both test groups. This indicates that both the treatment and the control groups fished equally in areas of both high and low conch densities (Figure 1).

Catch rates began to decline once the bait was reduced to thirds (18.2%), and sharply fell with the reduction to quarters (26.4-39.6%). In areas of high conch densities, the whole crabs consistently caught more conch than the third or quarter crab, but in areas of low conch densities catch was more equal (Figure 2). Female quarters were also observed to work better than male quarters.

Figure 2. Percent efficiency of whelk caught by reducing the amount of horseshoe crab used for bait when compared to the traditional use of one whole female or two whole male crabs per pot.



Editor's Note: The Virginia Marine Resources Commission voted at its July 25th board meeting to cap the annual commercial harvest of the horseshoe crab at 355,000 lbs. and require the use of mesh bait bags whenever horseshoe crab is used as bait. The new rules become effective October 1, 2000.

Tagging Flounder & Red Drum

By Jon Lucy

Starting this year, summer flounder is a new target species for the trained taggers in the Virginia Game Fish Tagging Program. Improvements in summer flounder recreational catches during the past several years, combined with their ranking as one of the most sought after species recreationally, make it an ideal candidate for inclusion in our tagging efforts. Little is known about local movement patterns of adult fish once they arrive in Chesapeake Bay and seaside inlet waters in the spring, and insights into these movements and distribution patterns is a basic program objective.

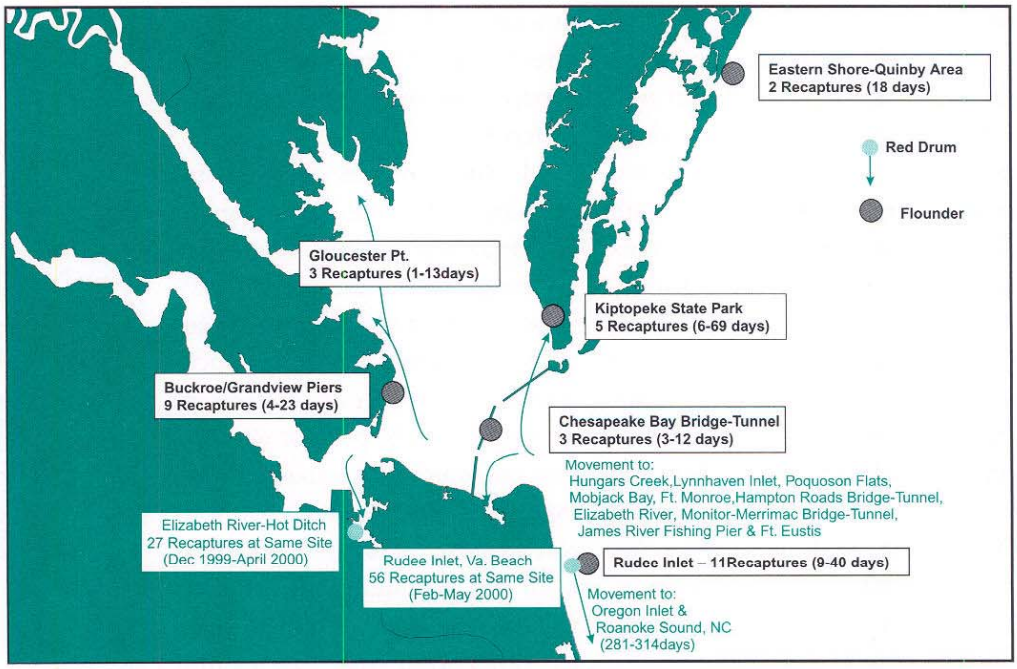
From early May through the end of July, anglers tagged nearly 1,032 flounder. There have already been 52 recaptures reported. Flounder are well known to concentrate in certain areas after moving into the bay and Virginia's ocean inlets. To date, all recaptures have been from virtually the same location where the fish were tagged (see map).

The pattern is particularly noticeable at fishing piers. For example, there have been four to seven flounder recaptures each at Hampton's Buckroe Beach and Grandview piers (about 2.5 miles apart along a continuous stretch of beach) and across the bay at the Kiptopeke State Park pier on the Eastern Shore. Tagged flounder were at large four days to six weeks before recapture at the Hampton piers and for even longer periods (1-10 weeks) at Kiptopeke. At Rudee Inlet, Virginia Beach, 11 recaptured flounder were released at the location approximately 2-5 weeks earlier. Flounder tag returns continue to show little fish movement.

As in 1999, small red drum known locally as "puppy drum" are receiving special tagging efforts at the Elizabeth River "Hot Ditch" (a power plant discharge canal on the river's Southern Branch near Portsmouth) and Rudee Inlet in Virginia Beach. Through July 31st, anglers had tagged 131 drum at the Ditch and 725 at Rudee, revealing numbers ahead of last year's totals (106 and 537 fish, respectively).

Results

The Hot Ditch continues to provide a wintertime haven for small red drum (12 to 16 inches total length). This year's tagging effort at the Ditch, occurring primarily throughout February, has produced 33 recaptures to date. Of



the recaptured fish, 27 (82 %) were re-caught at the same site in February, March, or early April; periods at large generally ranged from 5 to 48 days. A drum tagged at the Ditch in early December 1999 was recaptured again at the site on March 6, 2000 (88 days post release).

Two Ditch drum recaptures from this February were fish tagged at the site more than a year earlier (one tagged November 21, 1998 and the other, January 9, 1999). The fish had grown from 14-15 inches to about 26-27 inches. Possibly the fish remained at the Hot Ditch over the entire period (463 and 403 days, respectively), but they also might have left the site and returned to it again this winter.

Four Hot Ditch recaptures had moved 8-10 miles away from the tagging site, and were recaptured in the Elizabeth River's Western Branch. Tagged and released on January 2, 2000 as well as February 8 and February 13, the fish were recaptured during early April and mid-May (52-96 days at large).

Two other drum tagged at the Ditch (on February 7 and March 21) were recaptured significant distances away from the site. Anglers reported recaptures of one fish at the entrance to Hampton Roads (Norfolk's Willoughby Spit, 48 days post release) and another off the Poquoson River on Plumtree Flats (56 days post release).

In Rudee Inlet, tagging of drum began late this February with the majority of fish tagged during March and April. Fish averaged 15-17 inches in total length. Through July 31st, 66% of the 85 recaptured fish had been caught again inside the inlet, most being at large one to five weeks. However, two drum tagged in Rudee during 1999 (May 26 and August 15) were recaptured again at the site a month apart in March-April of this year. As in 1999, some small red drum likely over-wintered inside the inlet, while other fish probably returned to the site after migrating to the Carolina beaches during the fall. Two additional puppy drum tagged inside Rudee during April 1999 were recaptured in North Carolina waters early this year (Roanoke Sound on February 18th and at Oregon Inlet on April 1st).

Significant numbers of drum have also moved out of Rudee Inlet since being tagged during late winter and early spring 2000. This indicates the importance of the inlet as possibly a feeding area for one- and two-year-old drum before they generally disperse into the Chesapeake Bay for the summer. Tag returns document movement of fish from Rudee to inside Lynnhaven Inlet, Hungar's Creek on the lower bayside of the Eastern Shore, into Hampton Roads, down the Elizabeth River, and up the James River within periods ranging from several weeks to three months (see map).

As an example, five drum tagged on different days in Rudee Inlet between March 4th and May 11th were recaptured at Fort Monroe's fishing pier May 17-18th. Two of the fish were tagged at the inlet May 6 and 11, moving inside the bay to Hampton's Fort Monroe in 7 and 11 days. More extensive movement up the western shore of the bay was documented by tag returns from Poquoson Flats as well as the Ware and Severn rivers, and Winter Harbor (all locations just north of the York River mouth).

While the referenced affinity of small red drum for the Hot Ditch and Rudee Inlet are becoming firmly documented by the Game Fish Tagging Program, surprises still occur which cannot be readily explained. Just before printing, a tagged 17-inch red drum recapture was reported. Tagged on Poquoson Flats on May 7, the drum was recaptured 55 days later, not in Chesapeake Bay, but in the Jacksonville, Florida surf!

The tagging program, coordinated by the Virginia Sea Grant Marine Advisory Program and the Virginia Saltwater Fishing Tournament under VMRC, is primarily funded by saltwater recreational fishing license funds. Persons interested in more information on results of the tagging program can request a copy of the *Virginia Game Fish Tagging Program 1999 Annual Report* (B. Kriete, Sea Grant Publications, VIMS, P.O. Box 1346, Gloucester Pt., VA 23062; 804-684-7170; bdk@vims.edu).

Diving Into Marine Education

By Laura Rose & Lisa Lawrence

Folks have been logging on to the BRIDGE (www.vims.edu/bridge) in record numbers recently. If you haven't been one of them, you might want to know what you're missing.

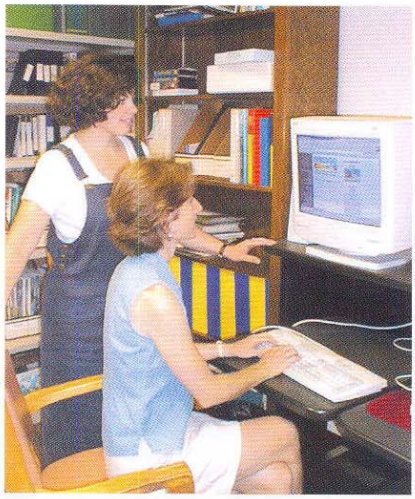
The BRIDGE is a unique clearinghouse of the best ocean science education sites available on-line. It was developed to help teachers wade through the vast oceans of marine related information on the World Wide Web and discern that which is up to date, credible, and useful. On the BRIDGE you can find educator- and scientist-reviewed information on almost any ocean science topic, from aquatic pH to zooplankton, with just a few "clicks" of the mouse. In addition to topical information, the BRIDGE provides educators with links to lesson plans and classroom activities, on-line marine expeditions, ocean science research data, aquariums and research institutes, marine career information, professional development opportunities, and *Scuttlebutt*, a discussion list for marine educators and scientists.

One of the hottest new sections on the BRIDGE is the *Data Tip of the Month*. Created as a special feature of the BRIDGE's On-Line Data section, the *Data Tip of the Month* focuses on an ocean science topic, connects it with current data on the web, and includes questions and often a graphing activity for teachers to use in the classroom. It's a great way to illustrate the "real world" application of data, and all Data Tips are archived for your reference.

Though designed with teachers in mind, the BRIDGE is not just for educators. The general public will find the BRIDGE useful for information on marine science topics, and for regional information like links to their local aquariums and marine science museums. Students can refer to the BRIDGE for background information for homework and to locate student opportunities such as marine science summer camps. And scientists can

-ARCHIVE OF DATA TIPS-

July 2000 - See turtles nest! See turtles hatch! Calculate the hatching success rate of sea turtle nests in Kenya.
June 2000 - Oceanography 101 Use real ocean data from Classroom BATS (Bermuda Atlantic Time-series Study) to conduct inquiry-based learning at the 6-12 grade level.
May 2000 - Coastal Erosion: Where's the Beach? Conduct a beach profiling activity and study some of the natural and not-so-natural factors influencing coastal erosion and accretion.
April 2000 - Submersed in Underwater Technology Use data from an underwater habitat mission to compare coral health.
March 2000 - Discover Galapagos Take a closer look at the unique archipelago and, using a list of marine/brackish fishes of the islands, pretend you're an explorer documenting a newly discovered species.
February 2000 - The Long Journey Learn more about the annual trip some whales make to their breeding grounds and plot current right whale sightings.
January 2000 - Catch & Release Plot catch and release data from the National Marine Fisheries Service to see the influence of weekend anglers.
December 1999 - Tip of the Iceberg Chart the path of two Antarctic icebergs and learn why tracking them is so important to the shipping industry.
November 1999 - Aquaculture: A Cornucopia? Compare aquaculture production rates between Canada and the U.S. for a number of different seafood species.
October 1999 - The Dead Zone: A Marine Horror Story Graph dissolved oxygen levels over depth for the Gulf of Mexico's dead zone.
September 1999 - Taking a Bite Out of the Shark Myth Learn about scientists' concern over sharks' dwindling numbers and graph the annual landings of certain shark species.
August 1999 - Hurricanes! Access real-time coordinates to track a hurricane's path during hurricane season or archived coordinates for tracking previous hurricanes out-of-season.
July 1999 - The Seafloor and Below Create a 3-D representation of a deep sea volcano using NOAA's global relief data.
June 1999 - Be a Bay Investigator Use water quality and other data to assess the health of the Chesapeake Bay, one of the largest and most productive estuaries in the world.
May 1999 - Coral Bleaching Research the conditions of coral reefs worldwide and propose some management recommendations to help save the reef.
April 1999 - Defending Our Coasts from Exotics Help MIT Sea Grant scientists track and contain the spread of a new species of crab and help stop the alien invasions!
March 1999 - The Far-Reaching Effects of Oil Spills Use ocean drifter data to predict where the oil from the New Carissa spill off the coast of Oregon may go.
February 1999 - Swordfish Numbers on the Decline Take a turn in the fisheries management field by plotting commercial fisheries data for swordfish stocks.
January 1999 - Effect of El Niño on Sea Level Learn more about El Niño and its impact on global average sea level.



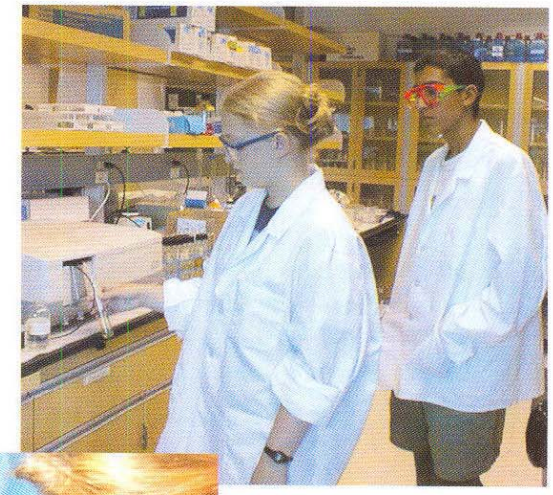
BRIDGE webkeepers Lisa Lawrence and Laura Rose (seated) update the website.

use it as an outreach vehicle, improving communications between the research and education communities. The BRIDGE provides researchers with suggestions on getting involved in education and even offers tips on creating a classroom-friendly website on their research.

The BRIDGE is coordinated by the Virginia Sea Grant Marine Advisory Program at the Virginia Institute of Marine Science, supported by the National Oceanographic Partnership Program, and sponsored by the National Marine Educators Association and the national network of Sea Grant educators. For more information, contact webkeeper Lisa Ayers Lawrence at ayers@vims.edu.

Each summer VIMS faculty and staff dedicate many hours to sharing their expertise with exceptional high school students interested in becoming marine scientists. Six students joined us for the VIMS/NASA Summer Governor's School program, coordinated by the Virginia Department of Education and directed on site by Susan Haynes and the Virginia Sea Grant program.

From marsh mucking to a trip on the VIMS research vessel, *Bay Eagle*, students gained experience with wetland mapping, nutrient analysis, population dynamics and acoustic sediment analysis. The program ended with students formally presenting their research to sponsors and peers.



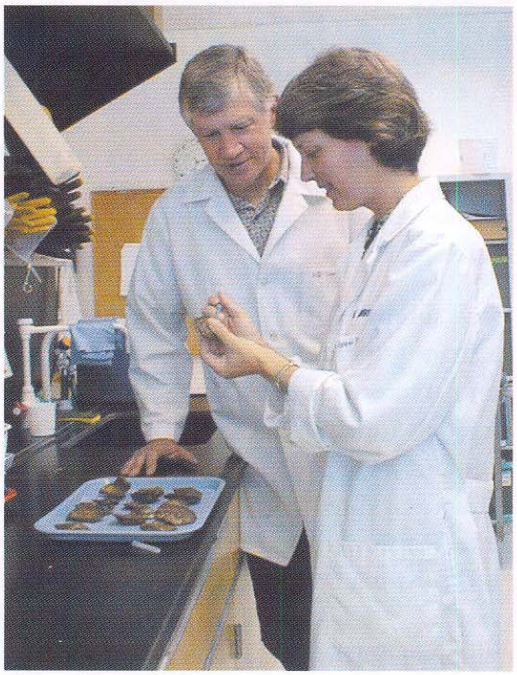
Above, Governor's School students Sarah Bundick and Alan Mehrzad use a spectrophotometer to check nitrogen levels in water collected at the teaching marsh on campus.

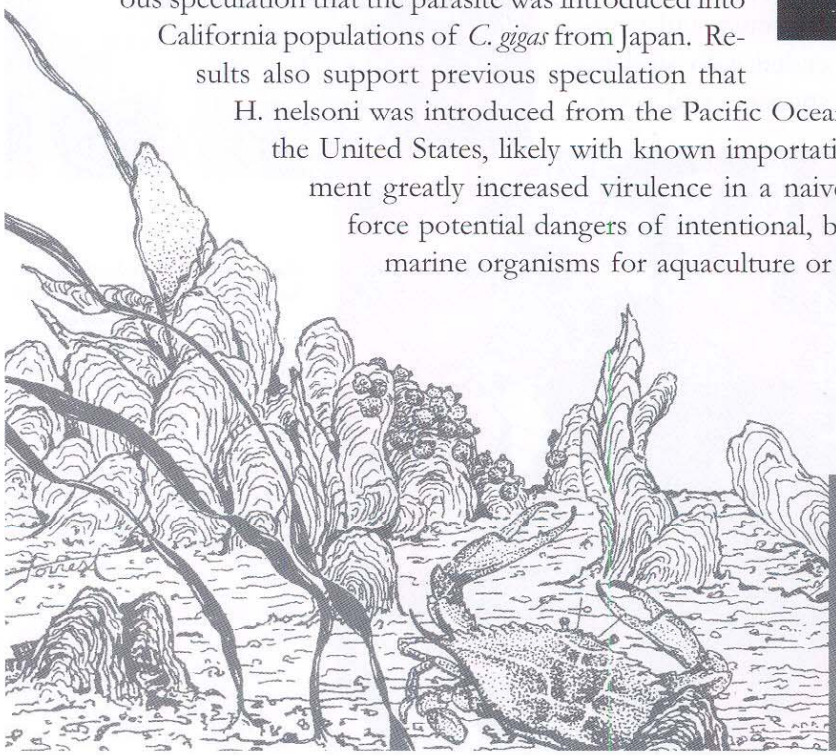
Left, graduate student Landon Ward discusses the diversity of organisms caught in a trawl near the mouth of the York River.

New Publications

E. M. Burreson and N. A. Stokes, "Increased Virulence in an Introduced Pathogen: Haplosporidium nelsoni (MSX) in the Eastern Oyster, *Crassostrea virginica*," *Journal of Aquatic Animal Health,* 12 (2000): 1-8.

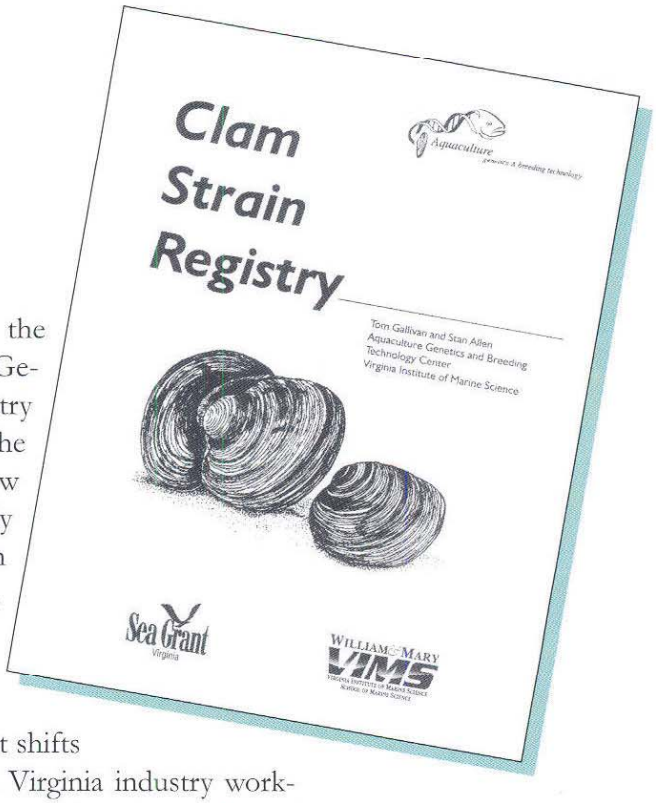
Abstract: The protistan parasite *Haplosporidium nelsoni* has caused extensive mortality in the eastern oyster *Crassostrea virginica* along the Mid-Atlantic coast of the United States since 1957. The origin of *H. nelsoni* has remained unresolved. Molecular diagnostic tools were used to examine the hypothesis that a haplosporidian parasite in the Pacific oyster *C. gigas* is *H. nelsoni.* A DNA probe specific for *H. nelsoni* reacted positively during in situ hybridizations with haplosporidian plasmodia from *C. gigas* collected in Korea, Japan, and California. Primers that specifically amplify *H. nelsoni* DNA in the plymerase chain reaction amplified product from California *C. gigas* infected with the haplosporidian parasite. The DNA sequence of the 565-base pair amplified product was identical to the *H. nelsoni* sequence except for a single nucleotide transition, a similarity of 99.8%. These results are conclusive evidence that the parasite in *C. gigas* is *H. nelsoni* and strongly support previous speculation that the parasite was introduced into California populations of *C. gigas* from Japan. Results also support previous speculation that H. nelsoni was introduced from the Pacific Ocean to *C. virginica* on the East Coast of the United States, likely with known importations of *C. gigas.* These results document greatly increased virulence in a naive host-parasite association and reinforce potential dangers of intentional, but improper, introductions of exotic marine organisms for aquaculture or resource restoration.





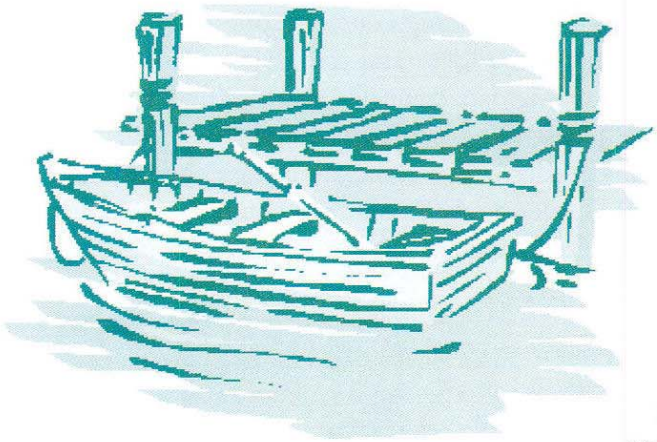
For more information about these publications, call Barbara Kriete in Marine Advisory Services at VIMS at (804) 684-7170.

Clam Strain Registry, Tom Gallivan and Stan Allen, Gloucester Point: Aquaculture Genetics and Breeding Technology Center, Virginia Institute of Marine Science, 2000.



The *Clam Strain Registry* (CSR) is the initial step of the Clam Breeding Project of the VIMS Aquaculture Genetics and Breeding Technology Center. The Registry is a first attempt to catalog sources of clam seed on the East Coast. The CSR sprang from the need to know more about stocks that have been developed already by a number of commercial firms and some research institutions. It is also the prototype for what will, hopefully, one day become a catalog of clam seed with strains developed for specific growing zones and habitats, such as high silt or low salinity.

After identifying available clam strains, the project shifts to broad-scale testing of key strains as defined in a Virginia industry workshop, in "common garden" experiments. The Clam Breeding Project is briefly covered in the CSR, but the bulk of the document describes the stocks encountered during the survey. Eighteen sources of brood stock are described. Those not reported upon were omitted at the request of participating companies.



Marina Guidebook Coming

The Virginia Sea Grant Marine Advisory Program will publish a Virginia marina best management practices guidebook in the fall of 2000. The guide covers such topics as emergencies, marina management, habitat and species, stormwater management, and more. After introducing the subject, each chapter includes a compilation of the laws that affect marinas, a list of information sources and educational materials available, and an extensive list of best management practices, or BMPs.

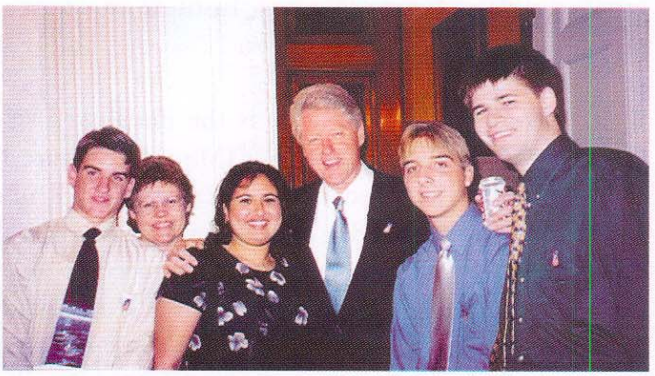
BMPs are ways of running a business in an environmentally sensitive manner while minimizing negative economic impacts. Many BMPs, in fact, create positive economic benefits.

The guidebook is a joint project of a consortium of Virginia natural resource agencies and members of the marina industry.

Announcements

It's not too early to mark your calendars for Blue Crab Bowl 2001! This year's competition will be hosted by VIMS at the College of William and Mary on Saturday, February 10th. Look for more information about this exciting event in the next edition of "The Crest" and in local newspapers.

Pictured here are students with coach Jane Butler from Grafton High School, winner of last year's Blue Crab Bowl, enjoying a moment with the President. The group was one of several from across the country chosen to spend a day at the White House this past June. A luncheon was held in the students' honor to celebrate their interest and accomplishments in the fields of oceanography and space exploration.



Pictured here, from L to R, are: Kevin Ford, coach Jane Butler, Shafaali Nohria, President Clinton, Aaron VanDervort, and Carter Posey. Kevin Ford and Aaron VanDervort were members of the winning team at Blue Crab Bowl 2000.

NOTICE:
Sea Turtle Stranding Center is Taking Patients

Since 1979, the Virginia Institute of Marine Science has served as the Commonwealth's center for the monitoring, study, and conservation of endangered and threatened sea turtles within Virginia waters. The stranding center responds to any reports between the James River and the Maryland state line, and manages stranding data statewide. If you find a live or dead sea turtle, please call one of these numbers:
(804) 684-7313 - turtles between the James River and MD
(757) 437-6159 - turtles on the E. Shore or south of the James

CHEFS, MARK YOUR CALENDARS:

The annual Chef's Seafood Symposium will be held this fall on October 16, 2000 and feature Guest Chef Klaus Friendenreich from the Art Institute of Fort Lauderdale. A special addition this year is a symposium booklet that includes favorite seafood recipes. Send us your submissions by September 15th! Registration information will be sent in early September. Contact marine education specialist Vicki Clark at (804) 684-7169 for more details.

The deadline for Fisheries Resource Grant Program applications is October 15, 2000. See related article on page 12.

Naturalist's Corner

Dance of the dragonfly—
Perhaps no other insects better characterize summertime on the water than damselflies and dragonflies. They are notorious, consummate acrobats, performing dizzying displays of aerial wizardry from a seemingly unlimited well of energy.

At dusk, when the sky's insect population opens to full throttle, they are waiting. Pesky mosquitoes and gnats become dinner fare, as the dance begins. Silently, yet forcefully, a diving dragonfly will capture its prey using both legs, cupped together like a net. Millions of fine combs help the dragonfly hold onto its victim firmly before crushing it with powerful jaw plates. Excellent vision – much more acute than that of a fly, for example – also aids in its predatory skills.

Dragonflies have been around for an estimated 250 million years. More than 400 species live in North America, and more than 4,700, worldwide. At this time of year, they are actively laying eggs. Some eggs will find their way to the stalks of marsh plants; others will become waterbound. Then the female will die, relying upon her progeny to carry on.

Like other nature watching opportunities, spending dusk in a marsh or creek is deeply rewarding. The sounds of hidden peepers, ducks, and other waterborne creatures tucking in for the evening form the backdrop for this atmospheric performance. It is the river's "last call" before darkness settles in, and well worth suffering a few bug bites to experience.

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