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The dog days of late summer are upon us, presenting a great opportunity to escape the heat by spending time at the beach with a good book or magazine. We hope you'll add this edition to your end-of-summer reading list – it can go on top of the mystery books pile.

Plenty of mysteries reside within: a feature article on shark research for one. Summertime sightings of sharks in coastal waters almost always make the news, playing upon our innate fears and anxieties, but the truth is we know very little about them. This article focuses on work by several scientists at the institute to better define shark habitat and behaviors—in an effort to manage those in Virginia waters at sustainable, healthy levels.

Ensuring healthy stocks is a familiar theme when it comes to summer flounder. Size limits have changed this year and quotas have once again been tightened. But what can be vexing – if not an outright mystery – especially if you're a commercial or recreational fisherman, is grappling with how size and catch regulations serve to balance the interests of both camps. Rest assured that, regardless of which side you might favor, the other side will be skeptical of your conclusion.

Electronic waste, or "e-waste," is becoming a high-profile mystery too. Not that we don't know it exists. It's just that we haven't solved the problem of how to carefully deal with computers and other electronics at the end of their useful life. Plenty of options have surfaced in the global debate about keeping electronics out of the waste stream. The real mystery is why we're still waiting for someone to make the first move, to embrace a solution in the wake of its mounting tide.

Finally, the summer course for high school teachers held at VIMS offered plenty of opportunity for mystery solving. Cast against the backdrop of forensics, educators from across Virginia wrestled with the day-to-day puzzles that marine scientists face on a regular basis. There may be, in fact, no better place to hone your investigative prowess and problem-solving skills than in a marine science laboratory.

Whatever your interest in the marine world, we hope you'll find this edition of the *Virginia Marine Resource Bulletin* full of clues and insights that keep your curious side coming back for more.

Cover photo: Carribean reef sharks and blacknose sharks gather off the Bimini coast to feed.

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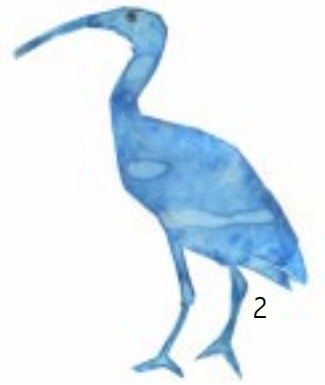

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Fishing for FACTS

by W. Matthew Shipman

SHARK RESEARCH & CONSERVATION IN ACTION

Sharks have long had a hold on our imaginations. From best-selling novels to Hollywood blockbusters, authors and filmmakers have spun fantastic stories about these fish – depicting them as monsters and placing them in a variety of bizarre situations. But for those who are truly fascinated by sharks, the most intriguing tales stem not from our imaginations, but from what we have learned from the animals themselves.

What we have learned about sharks, of course, does not begin with a scientist in a sterile laboratory. Rather, far off-shore under challenging and unpredictable conditions, researchers must first catch these sleek swimmers using a long line of 100 hooks stretching out for over a mile of ocean water. If successful, the often 100-plus-pound creatures may be brought onboard for research purposes using a clever system of winches and pulleys – not a job for the faint of heart!

This sort of fishing, called "longlining," has helped scientists at the Virginia Institute of Marine Science develop one of the most important sources of shark population data in the world. The research data provide fishermen, scientists, and policy-makers with valuable information about just how many sharks remain in coastal Virginia waters, and what that means for the future of these fish.

One of the key findings researchers have been able to tell us is that many shark species are in decline, with populations significantly lower today than they were 30 years ago.

The longline survey

For almost thirty years, VIMS has been collecting information on sharks in the Chesapeake Bay and mid-Atlantic: information about populations, biology, and behavior. In fact, the institute is home to the longest running fisheries-independent shark survey on the East Coast, and possibly in the world.

Being "fisheries independent" means that the survey collects its own data, rather than relying on commercial fishing operators to do so. This is significant because, while commercial fishermen go to sites where they expect to find the maximum number of fish, a fisheries-independent survey draws samples from a random collection of sites in order to get a more accurate picture of overall numbers.

When the VIMS longline shark survey began in 1973, little was known about the age, growth, reproduction, diet, or mating habits of sharks. The survey was designed to collect information on the shark population in our region, particularly seasonal migration and abundance. The program has been funded over the years by various state and federal agencies. Remarkably, in spite of financial challenges, the program has continued every year. In recent years, VIMS has teamed with the Mote Marine Laboratory, the University of Florida, and the Moss Landing Marine Laboratory in California to form the National Shark Research Consortium. The consortium, funded directly by Congress through NOAA, is presently the principal source of funding for the VIMS shark research program.

Photo previous page:
Researchers working in Prince William Sound, Alaska, prepare to bring onboard a 300-pound salmon shark. The female shark will be fitted with a transmitter, allowing tracking via satellite, as part of a cooperative research project between Stanford University and VIMS.

The fact that the shark survey has been run every year is perhaps the program's most important accomplishment – as it has created a long-term database on the abundance of sharks in the Chesapeake and mid-Atlantic region. The program was the first to note a local decline in these fish in the mid-1980s.

"By 1985 the recreational fishery accounted for a 50 percent decline in the shark population," VIMS Professor John A. Musick says. Then the market developed for shark fins, which are considered delicacies in some food markets.

Though commercial fishermen will argue that there has never been a decline in shark numbers, by 1992 the VIMS longline survey showed that populations in the mid-Atlantic were at their lowest level ever. Some species were down by as much as 90 percent from their levels just two decades earlier. While populations have rebounded somewhat since the early 1990s, they remain drastically lower than they were in the 1970s and early 1980s.

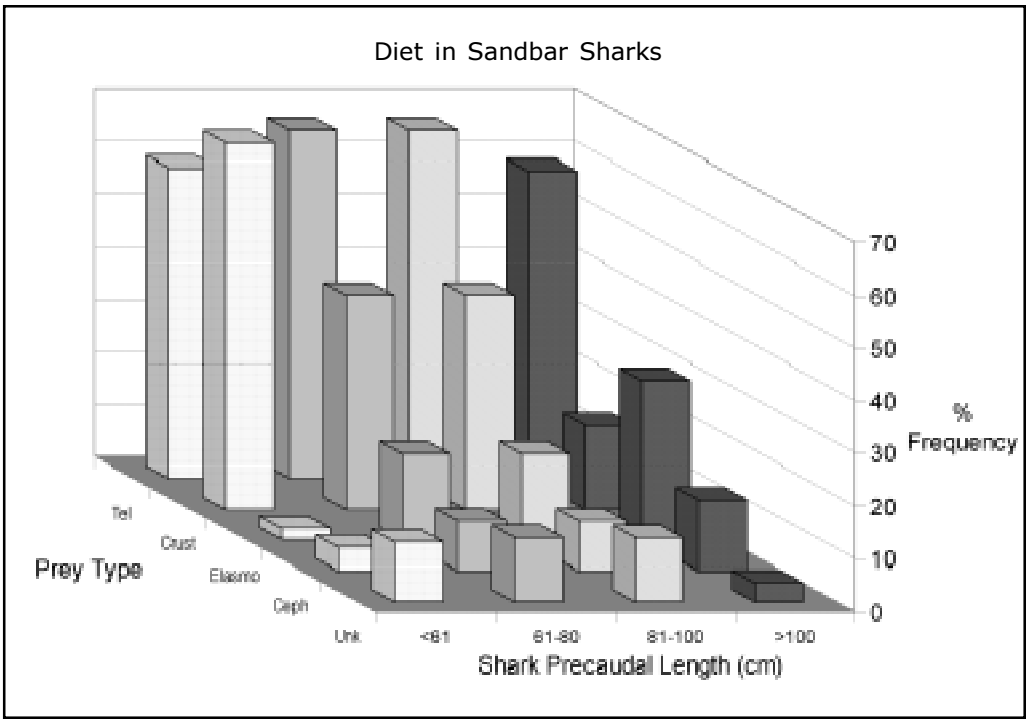
The longline survey provides data to the National Marine Fisheries Service, which uses the information to help determine how many sharks of a given species can be caught annually. As such, it plays a critical role in shark conservation. The efforts are beginning to pay off, and shark populations are slowly rebuilding – though researchers point out that some species are still being overfished.

Overall, commercial fishermen in Virginia brought in over 260,000 pounds of shark during 2002 (excluding dogfish). That same year, recreational anglers are believed to have landed another 27,000 pounds, roughly 10 percent of the commercial landings, according to NOAA's Marine Recreational Fisheries Statistics Survey, though this number cannot be verified.

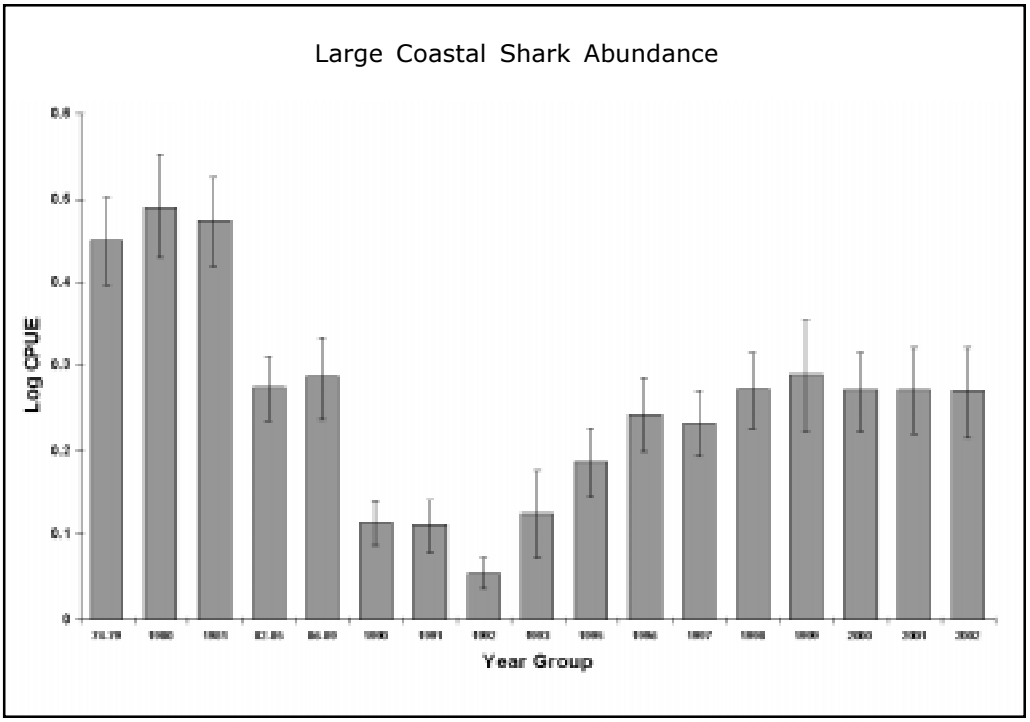
Identifying shark habitat

Besides the longline survey, the shark team at VIMS is engaged in a wide array of other projects designed to learn more about these

(Continued page 6)



Diet in sandbar sharks as measured by the percentage of stomachs (%Frequency) in four size classes that contain the following prey types: Teleost (bony fish); Crustaceans (crabs and shrimp); Elasmobranchs (sharks, skates and rays); Cephalopods (squids); and Unknown. Note the smallest sharks (<61cm) ate crustaceans and bony fishes but the largest sharks concentrated on bony fishes and other clupiforms, with crustaceans making up only a small part of their diet. Graph by Julia Ellis.



Abundance (catch per unit effort (CPUE) of sharks greater than 1.4 meters in total length caught in Virginia coastal waters by the VIMS Longline Project from 1974-2002 (Error bars are standard error of the mean). Note the rapid decline due to overfishing in the 1980s. The stock recovered somewhat after 1993, when a management plan was implemented, and since has stabilized at levels about 50% of those seen in the late 1970s. Graph by Christina Conrath

Studying the MYSTERIOUS Denizens of the Deep

While other VIMS scientists are studying the habits and populations of sharks close to home, one researcher has set his sights farther – and deeper – at sea. PhD student Chip Cotton is trying to learn more about some of the most unusual and mysterious fish in the ocean – the deep-water sharks.

Cotton is collecting data on a host of shark species that flourish at great depths; one he is examining in particular is the gulper shark. Found from 600 feet to greater than 3,000 feet below sea level, these sharks can reach just over five feet in length. Very little is known about them. Cotton's goal is to uncover life history, age, and growth information about gulper sharks.

Gulpers are facing increasing pressure from deep-water fishery operators, such as trawlers and long-liners, Cotton says. Much of this pressure stems from the fact that many deep-water species are caught inadvertently as bycatch in deep-water trawls that are targeting other fish – such as hake or roughy.

The information Cotton hopes to collect and analyze will help fishery managers make educated decisions on what needs to be done to conserve gulpers and other sharks sharing this extreme underworld habitat. Put simply, we do not know how to manage deep-water shark species because we know very little about them. Cotton adds that, while there are no immediate fisheries management implications for these sharks in U.S. waters, the data he collects may be useful in other parts of the world that have more developed deep-water fisheries.

Among other things, Cotton is hoping to confirm whether these sharks are a long-lived species. "All sharks are fairly slow growing," Cotton says, "but gulper sharks live in a harsh environment – low light, cold water, low food availability, etcetera – that likely further slows growth." Cotton explains that the sharks' life expectancy and growth rate are significant because they play a critical role in determining appropriate management responses.

"You need to know how long it will take the population to replace those individuals that are fished out," Cotton says, "and you need to know how long it takes them to grow to maturity so that young individuals are allowed to survive long enough to spawn."

Additional factors that need to be determined are what sort of things gulper sharks eat, how large they get, what the male-to-female ratio is, when they reach sexual maturity, and when and where spawning occurs. The researcher hopes that learning more about the gulper shark will help scientists extrapolate information for similarly behaved species. Since deep-water sharks are infrequently encountered, Cotton is also collecting as much data as possible on other sharks captured in these cavernous settings during his fishing expeditions.

To date, Cotton has collected samples in the Gulf of Mexico and the Northeast Atlantic, working in conjunction with the Florida Institute of Oceanography, the National Marine Fisheries Service, and the Mote Marine Laboratory. And, this summer he's been working aboard Norwegian vessels sampling the mid-Atlantic ridge from the Azores Islands to Iceland – a far cry from Virginia waters. *–W. Matthew Shipman*

fascinating fish, with hopes that the information they collect can help state and federal policy-makers develop means of ensuring stable and healthy stocks for the future.

PhD candidate Christina Conrath, for example, is working to outline the territory on the Eastern Shore of Virginia that is used as a nursery habitat by the sandbar shark.

Conrath's research into sandbar sharks, which can reach over six feet in length, is significant because these are among the more common species found in the Chesapeake and mid-Atlantic. Since its inception, the VIMS longline survey has caught over 4,700 sandbar sharks – as compared to just over 1,000 Atlantic sharpnose sharks, the second most frequently caught species.

However, that also makes them a principal target for commercial fishermen, who harvest them for the seafood and sharkfin soup industries. According to the Virginia Marine Resources Commission's commercial fisheries statistics, 27,901 pounds worth of sandbar sharks were landed by the commercial industry in 2002.

An additional 179,000 pounds of unidentified sharks were also caught by the industry that year, and it is probable that most of these were sandbars. Recreational anglers also take a portion of the sandbar population each year, but estimates on that activity are widely disputed.

Previous studies have shown the Chesapeake Bay to be a key nursery for sandbar sharks, and Conrath's efforts to delineate their habitat as juveniles will contribute much needed life history information. One reason conservation efforts are so critical for sharks is because many of the large coastal species do not reach sexual maturity until they are in their teens. Sandbar sharks, for example, are not able to reproduce until they are 14 or 15 years old. This makes it extremely hard for sandbars to rebound once their numbers are in decline, if any portion of the population is harvested before it has a chance to reproduce.

The information Conrath collects, using old-fashioned fishing and high-tech acoustic tags, will give researchers and policymakers a good general idea of how many juveniles there are in the area and where they go. This, in turn, helps define the sharks' essential habitat and how much geography they may cover in a given season.

Ultimately, the information helps determine how to shape specific conservation measures needed to protect the species.

Focus on a protected species

Graduate student Jason Romine is running another shark-related project at VIMS, focusing on the dusky shark population in the northwest Atlantic. Research on dusky sharks is important because it is currently listed as a "protected" species, meaning that commercial and recreational fishermen cannot keep it. However, few recreational anglers can tell the difference between many shark species and, as a result, may accidentally take duskys while fishing.

The dusky shark population is particularly vulnerable to decline because the sharks have an exceptionally long gestation period and average only eight pups (or baby sharks) per litter every three years. Dusky sharks are also at the far end of the spectrum for reaching sexual maturity, as they are not able to reproduce until they are approximately 21 years old.

Romine's research is targeted at trying to assess, from all available information, whether the dusky population is declining and the possible causes of that decline – such as pressure from the commercial shark fishery. Even though they are protected and cannot be kept, duskys are a common bycatch shark – meaning that fishermen who are trying to catch other species often catch them. This is speculated to be a significant contributor to high mortality rates among duskys.

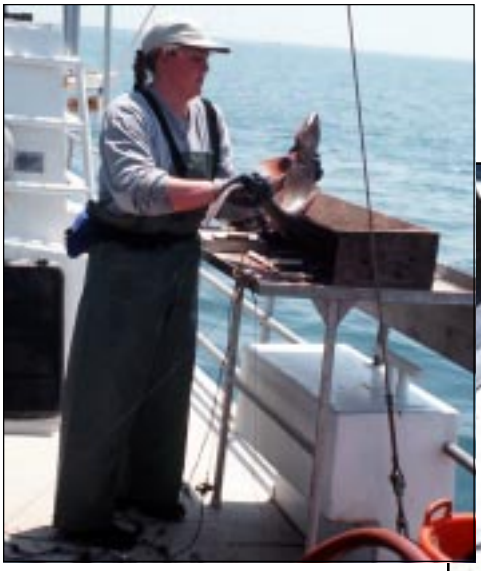
Tagging information is key

Anglers and commercial fishermen can help advance our understanding of shark behavior by keeping an eye out for sharks that have been "tagged" by researchers. By measuring any tagged sharks you catch, and contacting VIMS or the National Marine Fisheries Service with the shark's length and tag number, you are helping scientists determine growth rates and migration and movement patterns. This helps researchers fill in pieces of the puzzle, such as whether mature sharks return to the areas where they were born to give birth to their young.

One species that is part of a federal shark-tagging program VIMS cooperates with is the sandtiger shark. Reaching well over six feet in length, these impressive-looking fish often feed on juvenile sandbar sharks and are notable for their snaggle-toothed appearance. When sandtigers are caught on a longline, scientists must pull the sharks back to the stern of their vessel before tagging and releasing them – a feat of precision in tight quarters, given that the average weight of an adult caught by the longline survey is over 120 pounds.

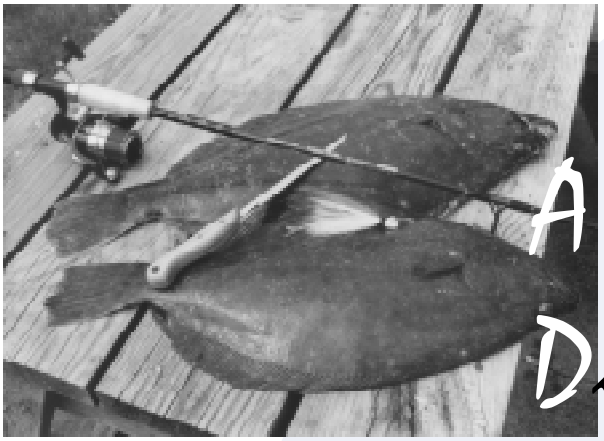
Other sharks that are less common in Virginia waters show up occasionally on the VIMS longline survey as well. Since 1973, the survey has turned up thresher, mako, tiger, and hammerhead sharks, among others.

All of these interactions are recorded, and bit by bit, researchers at VIMS are taking small steps toward helping us understand more about the still largely mysterious world of sharks - and giving us information that can be used to help ensure that world does not disappear. And, best of all, they get to go fishing while they do it!



Clockwise from top:
A marine scientist baits the gangions, a dropper line which will be clipped onto the main line of 100 hooks, kept afloat by a buoy placed every 20 hooks; scientists measure a juvenile sandbar shark along the Virginia coast; and a researcher measures a smooth hound shark aboard the R/V Bay Eagle in the Atlantic Ocean.

–Matt Shipman is a science writer based in Gloucester.–



A Popular Dinner Guest

by Charlie Petrocci

Each spring I like to go down to the fish docks on Chincoteague Island and watch the commercial boats pack out. Lined up along the bulkhead are boats from New Jersey, North Carolina, and Virginia, all waiting their turn to offload. I watch in awe as hundreds of pounds of flounder tumble from boat to culling table to waxed corrugated boxes. Medium, large, jumbo: all are graded, packed, stacked and slid into a waiting tractor trailer destined for hungry northern markets.

As an avid sport fishermen, this scene should have angered me, knowing that the fish were removed from my potential snare. But I was watching a type of traditional fishery that I respect. And I know by seeing all these early spring flounder that the fishery is healthy and the fish are making their way back toward the coast. I also know that commercial boats don't get them all and that they'll be plenty still out there waiting for me to find them.

Recreational fishing for summer flounder *(Paralichthys dentatus)* is possibly the most important sport fishery in Virginia in terms of effort, popularity, and expenditures. For decades anglers from all over the mid-Atlantic have made the pilgrimage to Virginia's waters to partake in the excellent flounder fishing that the state has to offer. For many small towns like Wachapreague and Chincoteague, flounder season is an early, economic shot in the arm.

"About 90% of my annual business depends on flounder fishing and flounder fishermen. My father started this business decades ago and now I'm seeing second and third generations of fishermen. Without good numbers of fish to be caught and agreeable regulations, I would be out of business tomorrow, as would many other sportfishing-related businesses on the Eastern Shore. And it kills me to watch these commercial flounder draggers sail by my dock each winter knowing I'll have to deal with a 17-inch size limit come spring," said Donna Roeske, owner of Captain Bob's Boats in Chincoteague.

The fishery

This year, the Virginia Marine Resources Commission changed the recreational summer flounder regulations for the season, which began in April. The new minimum length is 17 inches, with fishermen allowed to keep 6 fish a day and no mid-season closure. Last year's rules allowed 8 fish a day and a minimum size of 17½ inches.

Many anglers – including those on the Eastern Shore – had hoped for a 16 ½-inch size limit because, they argue, more of their business depends on flounder fishing and they don't get the big fish like those found in the lower Chesapeake. But moving to a 16 ½-inch limit would have meant a short summer closure, something it seemed no one wanted.

The Atlantic States Marine Fisheries Commission (ASMFC) set the 2004 harvest target for anglers at 741,000 flounder. In 2003, Virginia anglers caught 30% less than the prior year's target quota. "It was a terrible year for flounder

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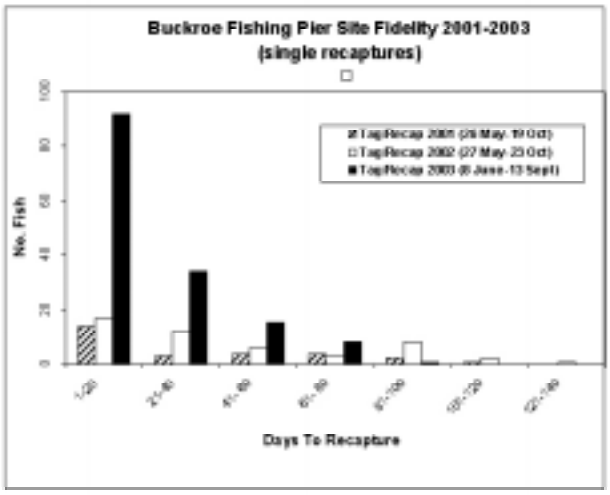
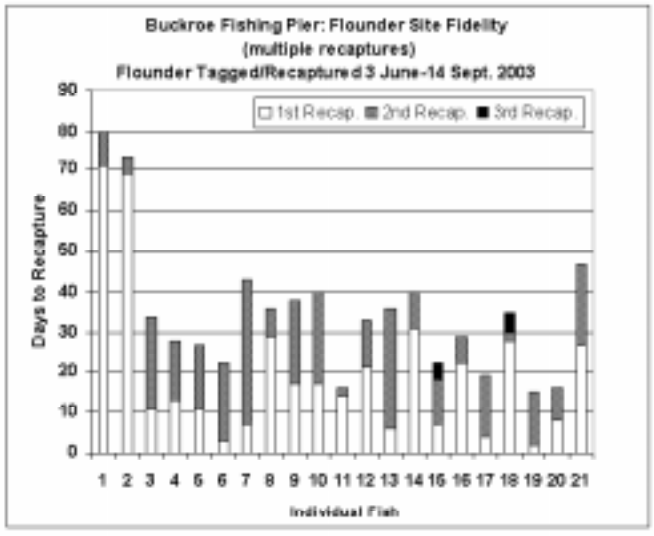
Tagging Program Provides Insight on Flounder

by Jon Lucy



The Virginia Game Fish Tagging Program is documenting a consistent pattern of site fidelity by flounder to specific bay structure sites (piers, bridges, bridge-tunnels, and rock jetties). Buckroe Fishing Pier (sadly, lost during Hurricane Isabel), with its high level of angler tagging and fish reporting effort, best exemplifies the unexpected phenomenon. Tagging data base records for single recapture events from flounder tagged at the pier demonstrate for consecutive years (2001-2003) individual flatfish remained at the structure up to 60 days (about 1-8 weeks), with some still at the pier up to 100-125 days (about 9-18 weeks) after release. Tagging data from other structure sites during the same period have also shown similar patterns during one or more years, i.e., the Hampton Roads Bridge Tunnel, Willoughby Spit Jetty, Harrison's and Grandview Fishing Piers (also both destroyed by Isabel), and Kiptopeke State Park Fishing Pier on Virginia's Eastern Shore.

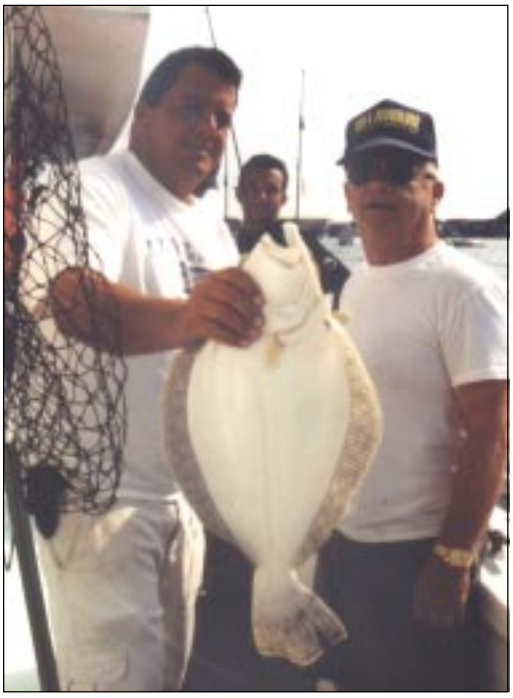


With long-term, single recaptures of flounder tagged at Buckroe Pier (and other structures), it is uncertain whether the fish literally stay around the pier or simply move off to other areas but revisit the pier. Multiple recaptures of pier-tagged flounder (2003 data shown), for similar time spans as single recapture records, indicate that site fidelity for individual fish is either largely continuous, or very frequent pier re-visits occur. As observed in 2001-2002, multiple recaptures of tagged fish in 2003 showed fish holding for long periods to the pier (being re-caught two or three times at the pier after first tagged at the site). Multiple recaptures show individual flounder at the pier for periods of 15-25 days (2-3 weeks), 28-47 days (4-6 weeks), and even 70-80 days (10-11 weeks). As with single recapture records for other structure sites previously referenced, this pattern has also been observed at other bay fishing pier and rock jetty sites.

Multiple recapture data is by far the better way to document fish site fidelity patterns to specific areas. Such valuable data are only obtained when anglers write down and record tag numbers for recaptured fish, quickly release the fish again with its tag in place, then call in their report. Since many tagged fish are undersized when recaptured, this practice is a win-win situation for both the angler and the tagging program.

fishing," said charter captain Nat Atchinson of Wachapreague. Weather and low salinity, due to heavy rain, were blamed for the poor catches. Fisheries officials warn that the objective of the current regulations is not to exceed its 2004 harvest quota. If that happens, the ASMFC would be forced to reduce next year's catch. And this would hurt recreational anglers even more.

So far, the flounder season seems better than it was last year, with increased catches being reported. "We're seeing lots of fish being caught, but most are well under the current legal size. I get disgusted when I hear that these small fish will come back next year, bigger. We'll never see these migrating fish again if North Carolina sport fishermen and Virginia commercial fishermen can continue to keep 14 inch fish. It seems Virginia anglers just can't get a break," said tackle shop owner Randy Lewis of Wachapreague. His father was a charter captain in the late 1920s and then ran a commercial dragger for many years. So he grew up hearing both sides of the fishery story.

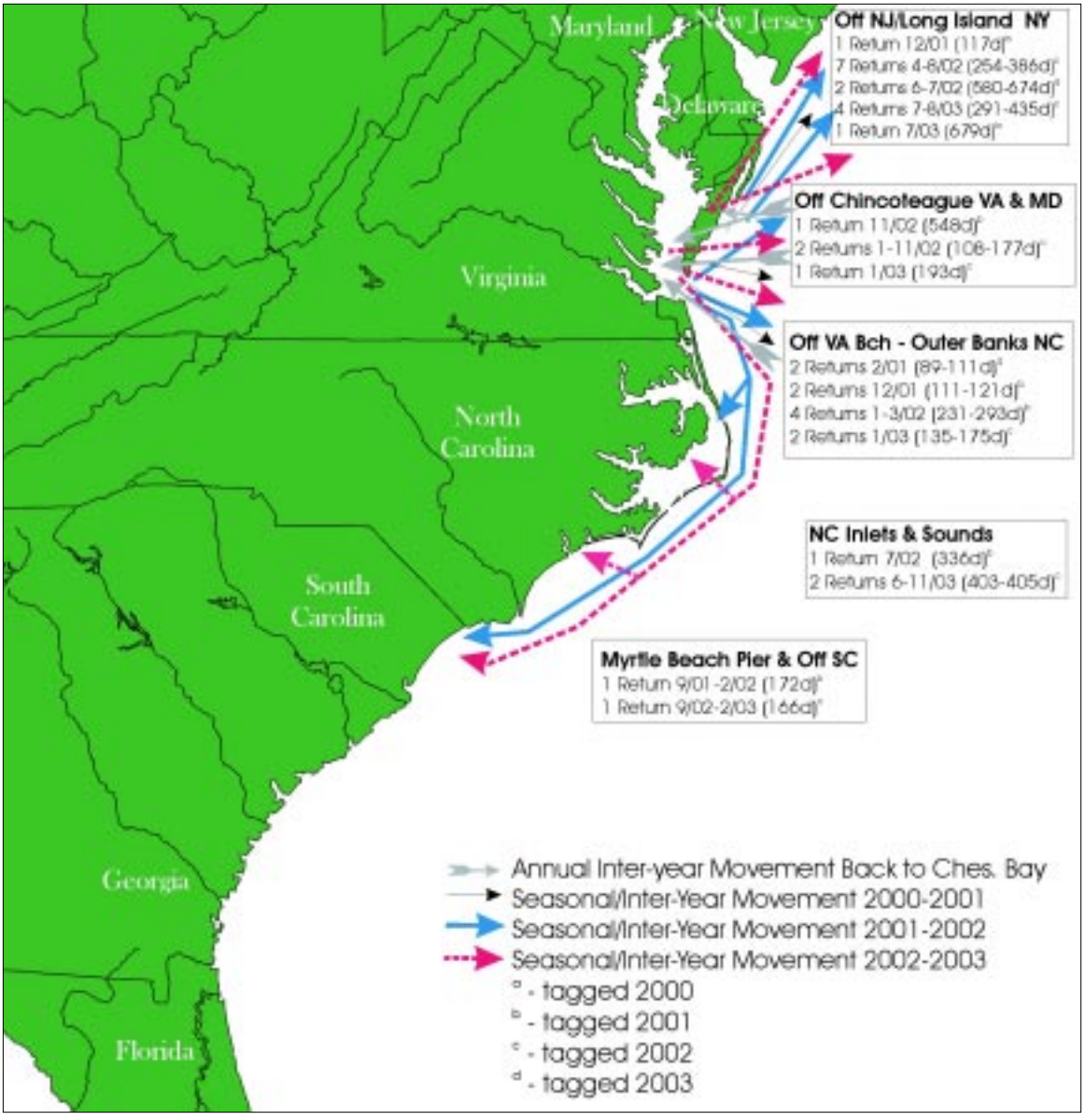


When local recreational flounder catches are down, the blame usually falls to commercial operators. They seem to be the proverbial "smoking gun." Currently, commercial watermen are allowed a harvest of 300,000 pounds of flounder in Virginia waters (up to 3 miles offshore), which is part of the overall state landing allotment of over 3.5 million pounds this year. "During the spring and fall seasons we pack out a number of flounder draggers here and they must fish beyond the three mile limit. Though the fish are landed here, they are often caught in ocean waters off New Jersey, Maryland, and Delaware. A lot of people don't realize this," said Red McDonald, owner of Chincoteague Fisheries. He added, "When people come over that bridge onto this island they see all those fishing boats and it gives them a sense of place. It's keeping Eastern Shore maritime heritage alive in a visual sense." In 2002, there were 2,970,267 pounds of flounder landed in Virginia with a value of over three million dollars. Flounder remain an extremely popular menu item across the country.

So pity the poor flounder. He lies on his belly, trying to be as inconspicuous as possible. Overhead are nets, hooks and natural predators hoping to make a meal of him. His plight and attendance are argued in small rooms across the state by fishermen, researchers and politicians. From white tablecloth restaurants to the backyard fish fry, he will always be on the dinner invitation list. And as demand on his presence continues, stocks will be pressured and his accessibility will continue to be argued by all. Only through the use of prudent regulations, respect for competition, and focused study of his natural history will the summer flounder continue to be a guest of honor.

Coastal Movement of Flounder Tagged in Virginia

2000-2003



(Map and text provided by Jon Lucy)

The Virginia Game Fish Tagging Program first targeted flounder in 2000, and now has over 1,900 tag-recapture records for the species. Flounder tagged in Chesapeake Bay move offshore in fall to the continental shelf to spawn, where some are caught in the winter trawl fishery (red, blue, and black arrows). A few fish move back inshore during spring/early summer to beaches and inlets stretching from Long Island Sound to the North/South Carolina border (red and blue arrows along the coast). Most flounder recaptures (10% rate overall) occur within the same year fish are tagged; however, 1-1.5% also are from fish tagged the previous year (gray arrows). A few additional fish even return again to state waters two years after being tagged. Mostly under size when tagged, the fish grow about one inch per year post-tagging. Tag returns demonstrate that such releases pay dividends 1-2 years down the road for the recreational fishery as more, larger fish become available.

Slowing Down the [e]Waste Stream

by Sally Mills

There's a silent revolution taking place across the countryside: a stockpile of computer electronics is gaining a foothold in the attics and basements, storage sheds and warehouses across America. Virginia claims its fair share of these rectangular mounds of plastic and glass. And we join the rest of the nation in a scramble to find acceptable means of disposal while urging manufacturers to focus upon the root problem of long-term sustain-ability through appropriate product life-cycle planning.

Life cycle planning places the onus of the problem on manufacturers, and entails a long-view approach. The idea is well encapsulated on the Virginia Dept. of Environmental Quality Web site: "The ultimate solution to computer and electronics recycling will come through source reduction and product stewardship such as environmentally friendly design and manufacturers taking responsibility for their product from cradle to grave." That approach, versus blindly sending computer and television monitors, CPUs, printers and other peripherals – not to mention cell phones and related gear – to one of the 50 landfills or transfer stations east of Virginia's fall line, just makes good sense.

Disposal is problematic everywhere, but on the sandy, loamy soils (and relatively high water table) of the Coastal Plain, the issue of landfilling plastic boxes filled with precious metals and hazardous materials where they may one day leach into the ground becomes all the more weighty. Yet, if you live in one of the region's small coastal communities on the Neck or Middle Peninsula or Eastern Shore, finding a suitable outlet for recycling old equipment can be inconvenient and require some research. Many Tidewater communities are refreshingly rural in scale and population, making electronics disposal at the county level a fiscal challenge. And while localities wrestle with the problem, we are left in the near future with a rather perplexing question of what to do with the stuff.

But consider that the National Safety Council estimates some 63 million computers were retired in the U.S. last year alone, and that the average shelf life of a Pentium-era system is 2-3 years – well, you do the math. Just within the multiple campuses of William & Mary, for example, close to 500 computer systems are retired every six months and sent to state auction. While that may not sound like much, the volume regularly fills a 20- by 30-foot room, according to procurement director Linda Orr. A growing appetite for Internet services has also spurred faster and faster operating platforms and sophisticated software, all of which helps to fuel system turnover. With all of these advances, it's a wonder we still have room for family photos and luggage on top of the old 486s and dot-matrix printers in our closets!

What's the big deal?

Of all the materials employed in the building of computer systems, lead and mercury are perhaps the best-known environmental hazards. Once commonly used in a variety of paints, lead found

in the cathode ray tubes of computer and TV screens now tops the list as *the largest source* in the municipal waste stream. Mercury, a heavy metal used commonly in computer switches, has serious consequences for the marine environment.

"When talking metals or toxics," says VIMS environmental chemist Dr. Rob Hale, "one must first consider their bio-availability as well as their ability to bio-accumulate in the environment." Unfortunately, for mercury, that's the rub.

"Mercury is really a global issue," adds Dr. Mike Newman. "Mercury is released from so many sources – through the burning of coal for example – and is very widely dispersed today." Newman specializes in risk assessment and ecotoxicology at VIMS.

Whether mercury is introduced to the environment through landfill leachate or by atmospheric deposition through incineration, its potential impact on sensitive coastal systems can be high. That's because of the active bacterial processes taking place at the land-water interface. Through those processes, mercury in its many forms gets converted to methylmercury. Methylmercury has proven particularly ominous because of its ability to bio-accumulate in the tissue of marine fish and to transfer to predators higher up the food chain, including humans.

"With each trophic exchange, mercury increases in concentration, or bio-magnifies," explains Newman. Like other metals that are introduced, mercury accumulates and remains in sediments for extremely long times, never breaking down. This persistence makes it continually available to bacteria, to benthic organisms, and, ultimately, to the entire food web.

Newman is also concerned about a suite of inorganic substances, also used in manufacturing processes, that have received very little attention. He points to one example: rare earths. Rare-earth phosphors are a class of luminescent material on the rise in the high-tech field – in cathode ray tubes and flat panel displays – and also show up in fluorescent lights, in temperature sensors, and in the making of ceramics. According to Newman, "We just don't have enough information about them toxicologically. They present both production and disposal-related problems."

Other persistent, hazardous materials in computers include: cadmium used in laptop batteries, PCBs in older televisions, and of recent concern, several classes of brominated flame retardants (specifically, polybrominated diphenyl ethers, or PBDEs, and hexabromocyclododecane, or HBCD). Brominated flame retardants have received much press of late, partly because they are found in every nook and cranny of modern-day life—from the foam in cushions to the plastics encasing a CPU, monitor, or related peripheral.

HBCD is used widely in the building industry and, along with PBDE, added to plastics to flame retard casings for computers, TVs, and other electronics. Some PBDE products are used in textiles and carpeting, as well as a variety of plastic furnishings—such as those found in car interiors. Hale notes that brominated flame retardant production has increased widely over the past 20 years, and evidence of these materials is turning up in osprey and falcons and terrestrial animals, including people, in addition to aquatic life. On a positive note, however, two PBDE products

(Continued page 15)

What Can You Do?

REDUCE – Maintain and keep equipment as long as possible. A typical computer's lifespan is 2-3 years, but can be extended by 1-2 years with some upgrading.
·Buy a good monitor; it can last 6-7 years or more. Keep it for use with your next computer.
·Consider leasing a computer so you can trade it in at expiration of the lease.
·Check out more information on manufacturer leasing programs.
·Always use a surge protector power strip with all electronic equipment.
REUSE – A computer of recent vintage can often be refurbished and reused.
RECYCLE – Electronic equipment can be recycled for recovery of metals, plastics, glass and other materials.
.Spent rechargeable Nickel-Cadmium (NiCd) batteries can be recycled through many retail outlets. Find out where you can recycle them using the consumer information at <www.rbrc.org>.

Source: U.S. Environmental Protection Agency Region 3 eCycling Web Site <http://www.epa.gov/reg3wcmd/ecyclingyoudo.htm>

Chris Parkhurst (R) and volunteers repair old computers.

One Man's Hard Drive

For close to six years, Chris Parkhurst of *Computer Recycling of Virginia* has been the first stop along the local, e-waste stream. Parkhurst started his electronics recycling business during the sluggish economy of the late 1990s. He has used his business acumen to help train a cadre of volunteer e-wizards in the recycling trade while providing plenty of capable systems to needy, worthwhile causes. Over the past three years, in fact, he has donated over 3,700 computer components to schools across the Commonwealth. In short, he has found a way to give back to his community many times over.

His 5,000-square-foot warehouse – soon to be accompanied by another 10,000 square feet – sees plenty of activity these days. Everything from the testing, repairing, and storage of refurbished equipment to the tearing down of machines and shipping out of large palleted cartons of parts takes place under roof. Located just outside Tappahannock in Essex County, the company services a wide swath of customers: from south of Richmond to Fredericksburg, northern Virginia, and counties along the Northern Neck and Middle Peninsula. Business has been steadily rising since 2001, and today it is not unusual for the company to handle between 13,000 and 15,000 pounds of steel from computer casings per month. Even with that volume, Parkhurst says he is just breaking even – partly due to rising transportation costs, but also due to the unprofitable nature of handling monitors and TVs. While he charges a modest $5 fee to accept one, that does not cover the cost to handle it according to the state's hazardous materials laws.

It's a sore subject for him, and one he feels deeply about, which is why he continues to accept them at a loss. "You need to pick your battles," Parkhurst concedes. Perhaps in no other segment of electronics production is large-scale recovery so sorely needed, he explains. Estimating that 6-8 pounds of lead are inside each one, he feels fervently that they must be kept out of landfills. And while questions about handling CRTS at their end-of-life point are being debated, the manufacture of such components continues, ironically, largely overseas – in China and elsewhere – where business is booming. A law passed last year by Virginia legislators officially encourages the banning of e-waste from landfills. But it stipulates that counties must have an alternative program in place to handle the waste if they implement a ban. Parkhurst and others predict, however, that Virginia is well on its way to a full-fledged ban on landfilling CRTs.

Another sore point: printers. Most can be repaired, he assures me, but they're made to be disposable. "The truth is, all the parts can be recycled – and some companies like Home Depot are reaping the benefits. Recycled plastics are being made into fences and other products, replacing wood."

Walking through the cavernous building and looking at the stacks of plastic-wrapped CPUs and boxes of skeletal remains, he assures me, "Ninety percent of the material coming through here is donated." When asked how he's been able to keep things running with volunteers, he explains, "This is not rocket science. There's a place for everyone here."

And breaking into a grin, "Anyone can be trained to make functional systems and donate them to a school." And the proof is felt in the carefree atmosphere of the place. Volunteers – especially computer "geeks" – find a path to his door. In Parkhurst's words, "They're like kids in a candy store."

will be removed from production under an agreement between EPA and their manufacturer by the end of 2004.

Fortunately, flame retardants are pretty well self-contained in a computer system and not likely to be released into the environment—until a system gets de-manufactured, that is. During de-manufacturing, precious metals are recovered, but plastic and other scrap materials are usually shredded and, in the process, flame retardants may be released into the atmosphere in the form of dust. This dust, in fact, is beginning to show up in recycling facilities and in households around the globe, although the exact sources and extent of it are currently unknown.

What concerns environmentalists and others following the electronics wave in America is the fact that, at this point in time, no *standards* are in place for the de-manufacturing of computer parts. Virginia, for example, has been waiting for formal guidance from the Environmental Protection Agency for over five years on how to properly handle and dispose of CRTs (cathode ray tubes). Those methods – and all recycling methods – need to be closely watched, according to Hale. "It's through the shredding, burning, and recycling processes that the potential exists for enhanced toxics release into the environment. The resulting, greater bio-availability and exposure are a train wreck waiting to happen," he cautions.

So, what's a consumer to do?

If the picture painted thus far seems rather bleak, hold on. Literally! Hold on to your computer systems and refrain from the temptation to send them off to the local incinerator or landfill. That advice comes from Georgiana Ball, recycling coordinator for state agencies, who has been tracking the issue of computer waste for many years.

"There's tremendous dialogue going on right now, at many different levels of government and within every sector of the electronics industry," she says. "Industry *is* paying attention, but it takes time to build infrastructure. Fifteen years ago, this issue didn't even exist."

And a little research seemed to validate her point. Manufacturers like DELL and Hewlett-Packard are making the recycling of computer systems a bit easier for individual consumers—though not necessarily cheap. You can return

your monitor and PC to DELL for about $30, and individual pieces from any manufacturer to Hewlett-Packard for $13-34 per item, depending on type. Both companies offer curb-side pickup of boxed items. If that's a bit more than you can pay, you may be able to take your system to a local drop-off site for collection by the county – during special events that generally take place once or several times a year. This option may cost you about $15 or more. Locally-sponsored collection days may be rare or even nonexistent in rural markets, however, so it's important to continue to bring attention to the need within your community.

Other options

A new program available for state agencies will take back printer cartridges and toner, and make sure they get re-processed in an environmentally-sound manner. Just for the asking, you can pack up and return these items to the Commonwealth in postage-paid cartons they provide. In addition, Virginia is working with small businesses to connect them to resources for disposal, and through its Pollution Prevention program is developing a set of "EMS" (environmental management system) principles for both private and public sector enterprises to follow.

And, across Virginia, an array of nonprofits and civic-minded entrepreneurs both accept computer parts from those who cannot pay, as well as donate older but functional systems to schools, senior centers, and other worthwhile causes. Visit the Va. Dept. of Environmental Quality Web site at www.deq.state.va.us.ecycling for information. At the commercial level, a number of take-back programs exist among computer manufacturers who recognize the mutual benefit of helping companies steward these important assets.

Businesses have more options today for environmentally-sound computer disposal, and Ball is optimistic about the near future. "Money is being spent on new training, and grants are being awarded for electronics collection. We're not quite there yet, but the messages are getting out."

She suggests that, as a society, Americans are beginning to recognize there's a cost involved with *anything* you dispose of. Computers and other electronics are such visible reminders, however, they make perfect "poster children" for raising consumer awareness and pushing for more sustainable solutions.

But, Ball cautions, "If you educate consumers about the need to do the right thing, you must provide the outlet for them to do so. Otherwise they will become very frustrated." Urging patience, she alludes to a day not too far off when regular local collections, electronics life cycle planning – through up-front handling fees that are built into the product cost – and "green" computers, will represent the norm.

Until that day comes, check out these options:

- DELL Recycling Programs
  (Search on recycling; information provided for individual consumers)
  http://www.dell.com
- Hewlett-Packard Product Recycling
  http://www.hp.com/hpinfo/globalcitizenship/environment/recycle/index.html
- Gateway Product Stewardship
  http://www.gateway.com/about/corp_responsibility/environment.shtml
- Virginia Dept. of Environmental Quality
  (Guidance for small businesses, consumers, and municipalities. See links to e-vendors.)
  www.deq.state.va.us/ecycling/computer.html
- Virginia Dept. of General Services
  (For easy printer and toner cartridge return by state agencies)
  http://dps.dgs.virginia.gov/dps/Surplus/surplus-bottom.htm
- In addition, GOODWILL Industries often accepts older, functional computer systems. Decisions are made at the branch level, however, so check with the store near you.

Many organizations -- both private and public -- are working on the problem of e-waste. Here are some excellent Web sites to check for more indepth coverage of efforts taking place at both the national and international level:

- http://www.electronicsrecycling.org/
- http://www.epa.gov/epaoswer/osw/conserve/plugin/index.htm
- http://www.recyclingtoday.com/

Note to Registrant:
—PREPARE TO GET WET—

by Pauli Hayes & Lisa Lawrence

Getting wet was part of the plan when oyster gardeners teamed up with teachers for the jointly-held Master Oyster Gardener Course / Teacher Oyster Workshop June 28-30 at VIMS. Private citizens came to learn how to grow oysters for their own consumption, and teachers came to learn more about oyster biology and ecology to enhance their curriculum and instill a sense of stewardship in their students. Though their reasons for coming may at first glance seem opposed, it was really a very natural collaboration. Both groups want to encourage a healthy oyster population in the bay, which in the end benefits everyone.

During the three-day course, participants attended lectures by scientists, toured aquaculture facilities, studied oyster anatomy and diseases in the laboratory, and even ate an oyster or two. Eleven of the teachers attending will participate in a year-long oyster restoration project with their school classes. The teachers, who constructed oyster floats during the workshop, will each receive 2,000 juvenile oysters to grow. Their students will monitor growth monthly and upload that data to a VIMS website, enabling them to compare their progress with other schools. At the end of the school year, students will transplant their oysters to a restored reef in the bay.

Workshop participants sample different levels on the oyster reef at Felgates Reef in the York River. In addition to counting the number of live oysters, they are also taking note of wild versus aquacultured animals, recently transplanted by school children.

Those oysters will be in good company. They'll be growing near any number of oyster floats put in place by the more than 2,000 Virginia "gardeners" who now grow oysters both to eat and to repopulate restored reefs in the Chesapeake Bay. Oyster growers have benefited from the Master Oyster Gardener course developed by Virginia Sea Grant Marine Advisory Program staff in conjunction with the Tidewater Oyster Gardeners Association (TOGA). Modeled after the Cooperative Extension Master Gardener Program, the oyster course encourages participants to also spread "seeds of knowledge" within their local communities. This program, begun in 1998, has provided extensive training in all aspects of oyster biology and culture to over 75 individuals.

According to Mike Oesterling, Sea Grant fisheries and aquaculture specialist who coordinates the training program, "This year's course was unique in that it teamed training of both private citizens and public educators." Course coordinators are excited about the collaboration and hope it will foster relationships and projects between the groups.

While the Sea Grant Marine Advisory Program plays a major role in the educational activities associated with oyster gardening, scientists and staff at VIMS and Virginia state agencies provided much of the educational content for the workshop. Participants from both sides had the opportunity to learn first-hand about all facets of oyster culture, restoration, and some of the policy issues currently surrounding the introduction of non-native oysters into the bay.

"A bonus to this training and cooperation," according to Oesterling, "is that oyster gardeners may get to participate in the research being conducted by scientists at VIMS, by actually field testing potentially disease-resistant strains of oysters."

The teacher portion of the workshop was coordinated by Lisa Ayers Lawrence, Virgina Sea Grant marine educator, and Laurie Carroll Sorabella, founder of Oyster Reef Keepers of Virginia. The class restoration projects are made possible by a grant from the NOAA Chesapeake Bay Office B-WET program.

FORENSICS SETS THE STAGE

by Sally Mills

"…[I]magine you've been hired by the U.S. Department of Commerce Forensics Lab and this is your first big assignment. You are on-location at San Francisco's Fisherman's Wharf and you have received a hot tip regarding a suspicious shipment of tuna that was unloaded from a local commercial fishing vessel just this morning. Using your incredible investigative and deductive prowess, you've checked out the catch and tentatively identified four different scombrid (tuna, mackerel) species. …a ban on bluefin tuna has just been passed, making it illegal to harvest or import this species. Are these fishermen breaking the law or are they in the clear?"

Sound like a setup for the season opener to "CSI Miami"? Could be. But fortunately for a group of dedicated high school teachers, it was the opener to an intensive, 3-day summer course, "The Application of Molecular Markers in Marine Science." The course was one of several intended to help teachers keep up with the rapidly changing field of genetics. For some, it represented the first time they had re-visited the subject in depth since earning their college and post-graduate degrees some 15-20 years back.

That's remarkable when you think about it. Many high school science teachers are expected to teach genetics as part of the state's curriculum in environmental science, biology, and advanced placement biology classes. Yet, gaining access to up-to-date, accurate information – in the area of bioinformatics, for example (where computers are used to handle biological information or characterize the molecular components of living things) – is quite challenging for the average teacher.

Stepping in to help: Dr. John Graves, a professor at VIMS with a long-standing connection to York High School in Yorktown. Graves has been working with area high school teachers for over 10 years—helping to bridge the knowledge gap by conducting demonstration labs and other genetics-based courses at the VIMS campus. He took the lead in developing the curriculum for this course, with help from fellow faculty members, Dr. Jan McDowell and Dr. Kim Reece. McDowell performed much of the legwork to find materials that could be adapted into lesson plans for the classroom.

According to Graves, "I think the course makes a difference by improving marine science education in secondary schools. The participants really enjoy the opportunity to use cutting-edge genetics equipment in the lab. They will undoubtedly pass this enthusiasm on to their students when they describe the techniques."

He adds, "I also really enjoy the opportunity to meet the teachers and to get an idea of the challenges they face."

The focus this year was on understanding "PCR," or polymerase chain reaction, and

figuring out how to translate that knowledge into an activity for the classroom. Against the backdrop described, participants learned how to isolate DNA from the tissue of an unknown fish species; then copy and amplify it for identification purposes. The exercise demonstrated one of the very practical applications of DNA analysis in the real world of marine science. Such analysis is often needed, for example, to either identify or confirm a particular species under strict management regulations.

After completing a series of lectures and lab exercises, course participants were dazzled by one more high-tech display. They conducted a "Blast" search online, which enabled them to feed the PCR information into a search engine at the National Center for Biotechnology Information and have the species identified in a matter of mere seconds.

"That's something that any teacher can readily transfer to the classroom," notes Susan Haynes who along with Vicki Clark helped coordinate the summer course.

But what is most appealing to high school teachers about the course structure, according to Haynes and Clark, is the direct access they are given to marine scientists, to experts in the field. VIMS faculty and staff were available throughout the entire time to answer questions and to help guide teachers through the classroom activities.

For some of the teachers, bioinformatics was not yet part of the science curriculum during their college years. This course introduced information that was challenging and brand new to them. Working with their peers and communicating closely with the instructors, the teachers became more comfortable with the subject matter, and most felt confident that they could introduce it to their high school students.

Teachers prepare samples of fish tissue for genetic analysis.

Those sentiments were expressed by many who completed the course survey. Donna Brownlee, a teacher at Gloucester High School, summed it up like this, "I've been to one-day workshops before, but this one really gave me the meat of the matter. It provided enough depth to understand it. It's not that you'll teach it at that level, but you need to understand it at that level to be able to teach it."

The course was made possible through Virginia Sea Grant program funds and matching funds from the Department of Fisheries Science at VIMS.

From left: Lisa Lawrence, Lee Larkin, Vicki Clark, Susanna Musick

CONGRATULATIONS to the Bridge Team!

The Bridge project received the 2004 NMEA President's Award on July 22 at the annual conference of the National Marine Educators Association, held at Eckerd College in St. Petersburg, Florida. The award was presented by NMEA President Jean May-Brett, who recognized the Bridge team for excellence in partnering with NMEA and the 17 regional chapters to help make online ocean sciences education resources available to teachers worldwide. Go to: <www.marine-ed/bridge.org>.

LADIES IN PINK

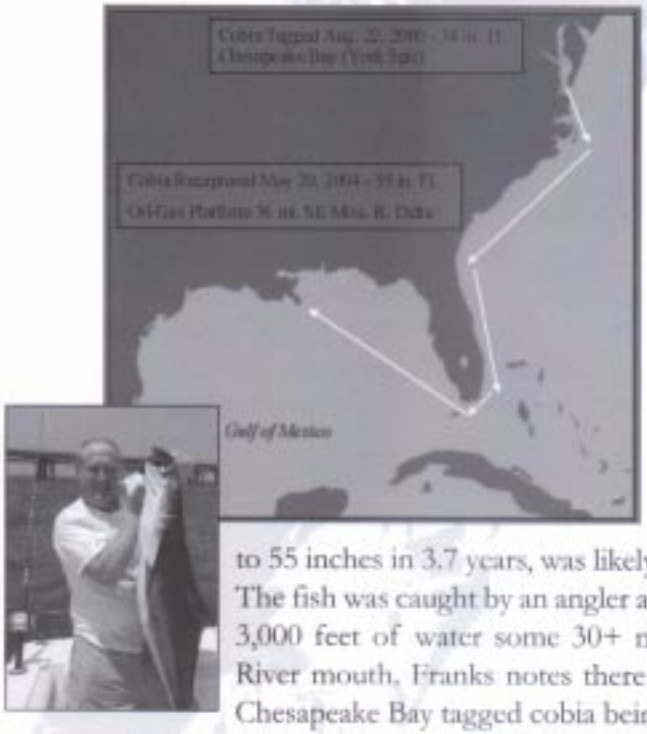
One of the many benefits of living in a temperate zone is exposure to a wide range of flora that find life quite comfortable and well-suited to propagation. Throughout the coastal plain of Virginia, such conditions promote a smorgasboard of native wildflowers that can turn an otherwise dreary wooded understory into a tapestry bursting with vivid color. During spring and through mid-summer, the Pink Lady's Slipper *(Cypripedium acaul)* interrupts the brown decaying leaves and detritus on the forest floor with dazzling shades of pink.

A member of the orchid family, the Pink Lady's Slipper is one of five varieties widely dispersed along the Eastern seaboard. It succeeds not only here, in sandy coastal soils, but also at higher elevations in wooded outcroppings. The orchid grows to 15 inches high and is easily recognized by a front lip, or pouch, that averages about 2.5 inches in length. This lovely pink pouch is marked by reddish-colored veins. A dramatic backdrop is provided by two broad, darkly ribbed leaves that grow up to 8 inches long.

Several species of pine, as well as oak, red maple, sweet gum, and other hardwoods can offer suitable shady habitat for Pink Lady's Slipper. When present, a mycorrhizal fungus provides a medium for seed germination, according to orchid afficionados.

Please don't pick these gorgeous ladies, however tempting, as they do not transplant well.

News from the Point



RECORD COBIA MIGRATION: CHESAPEAKE BAY TO GULF OF MEXICO!

A cobia tagged in Chesapeake Bay during summer 2000 by VIMS-trained tagger Mike Hammond was recaptured in May in the Gulf of Mexico. According to Dr. Jim Franks, who has been tagging cobia at the Gulf Coast Research Lab (Ocean Springs, MI) since the early 1990s, this 1,600+ mile swim is likely the longest fully documented record of such a migration. "The fish, growing from 38 to 55 inches in 3.7 years, was likely a 6-year-old female," said Franks. The fish was caught by an angler around an oil-gas platform in about 3,000 feet of water some 30+ miles southeast of the Mississippi River mouth. Franks notes there is anecdotal information about a Chesapeake Bay tagged cobia being caught off the Mississippi coast during 1988. However, no specific record exists on the date of initial tagging.

CHEFS' SEAFOOD SYMPOSIUM SET

Chefs and scientists will gather at the Virginia Institute of Marine Science on Tuesday, October 12, 2004 for the annual Chefs' Seafood Symposium. Open to all interested culinary professionals, culinary students, and seafood business representatives, this event will feature updates by VIMS scientists on selected Virginia seafood species. The program will be highlighted by cooking demonstrations conducted by renowned chefs, including Ed Daggers from Austin Creek Grill, Hatteras Island, NC. The Chefs' Seafood Symposium is sponsored by Virginia Sea Grant, the Virginia Chefs Assoc., and VIMS. For more information, see <www.vims.edu/adv/seafood/symposium>.

WACHAPREAGUE WORKSHOP DRAWS CROWD

Virginia Sea Grant teamed up with the Eastern Shore Chamber of Commerce and others to host a one-day workshop this spring celebrating the region's maritime and cultural heritage. Speakers offered a glimpse – past and present – of fishing, farming and timbering practices, architecture, maritime transportation, and trade on the Shore. Changing demographics are influencing trends in tourism, and speakers focused on ways that the service industry can market their businesses accordingly. As part of the wrap-up, the *Virginia's Coastal Blueways* map was unveiled, highlighting the many water trails that have been identified (or are taking shape) in Virginia's coastal zone.

SEEKING READER INPUT

The Virginia Sea Grant College Program developed its initial long-range strategic plan in preparation for an overall program review by the National Office of Sea Grant in 1999. The program is scheduled for a similar evaluation in 2004. To prepare for that evaluation, we will conduct a review of our strategic plan during 2003-2004.

The plan identifies program priorities related to the following topical areas: aquaculture, commercial fisheries, seafood technology, coastal economic development, coastal ecosystem health, and fostering an environmentally and scientifically informed citizenry.

We extend our invitation for public comment on the strategic plan, its priorities and its directions until September 1, 2004. If you feel that our plan has overlooked a marine or coastal issue or problem or opportunity, please let us know what you believe should be modified.

We welcome comments from any interested individual, and we will consider all input that is provided to us.

Virginia Sea Grant is on the web at <www.virginia.edu/virginia-sea-grant> and the strategic plan is under "About Us."

Please mail comments to: Director, Virginia Sea Grant College Program, 170 Rugby Road, Charlottesville, VA 22903; or fax to 434-982-3694; or e-mail to <wlr4z@virginia.edu>. Please include your name and address as well as a brief description of your connection to Virginia's coastal and marine resources.

Sea Grant
Virginia

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