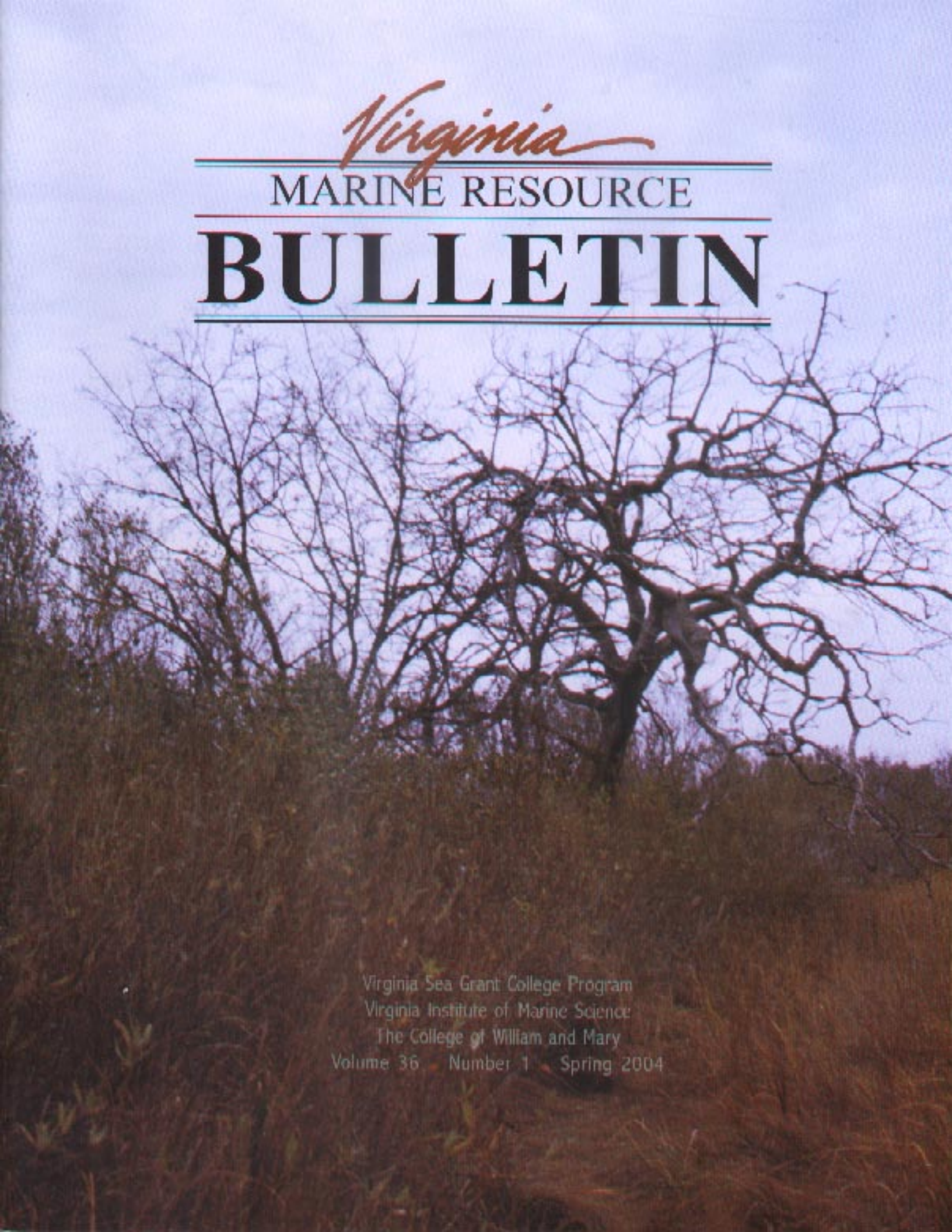

Virginia MARINE RESOURCE BULLETIN

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It's early spring, a period of transition. After a protracted, wet winter that rejuvenated Virginia's groundwater supplies, we celebrate in the first sights and sounds of a new season. Throughout the coastal plain, colorful shadblow trees have blossomed, signaling the first spawning runs of American shad into Virginia's tidal rivers.

As the cover photograph reveals, winter leaves its bold signature behind. Remarkably, this black cherry tree and sweep of marsh grasses beneath it still typify coastal scenes throughout much of Virginia's Northern Neck. Virginia proudly claims this stretch of coast at Dameron Marsh among its growing inventory of natural area preserves.

In Tidewater, spring also holds promise of outdoor celebrations and rituals connected to the water. Seafood festivals are keystone events on both sides of the Chesapeake. They energize waterfront villages with welcomed activity and revenue, while luring a growing wave of tourists to the Commonwealth. See the schedule of events on page 15 and make plans now to visit one of Virginia's picturesque coastal communities.

On the research front, two articles in this edition focus on responses to very different forms of pollution. The first reviews progress made over the past four years in the Chesapeake Ecotox Research Program and the interesting outcomes that speak to the sensitivity of organisms in the estuarine environment.

The second underscores the important services provided by nature in the form of microbes and worms that can help to successfully reduce nutrient loads produced by fish processing activities. Researchers with Virginia Sea Grant look to harness those natural services and direct them toward new products with the potential to help the aquaculture industry improve its bottom line.

By so doing, we strive to help maritime enterprises essential to Virginia's economic vitality succeed, while cooperatively stewarding the coastal resources that make the Commonwealth a superior place to live.

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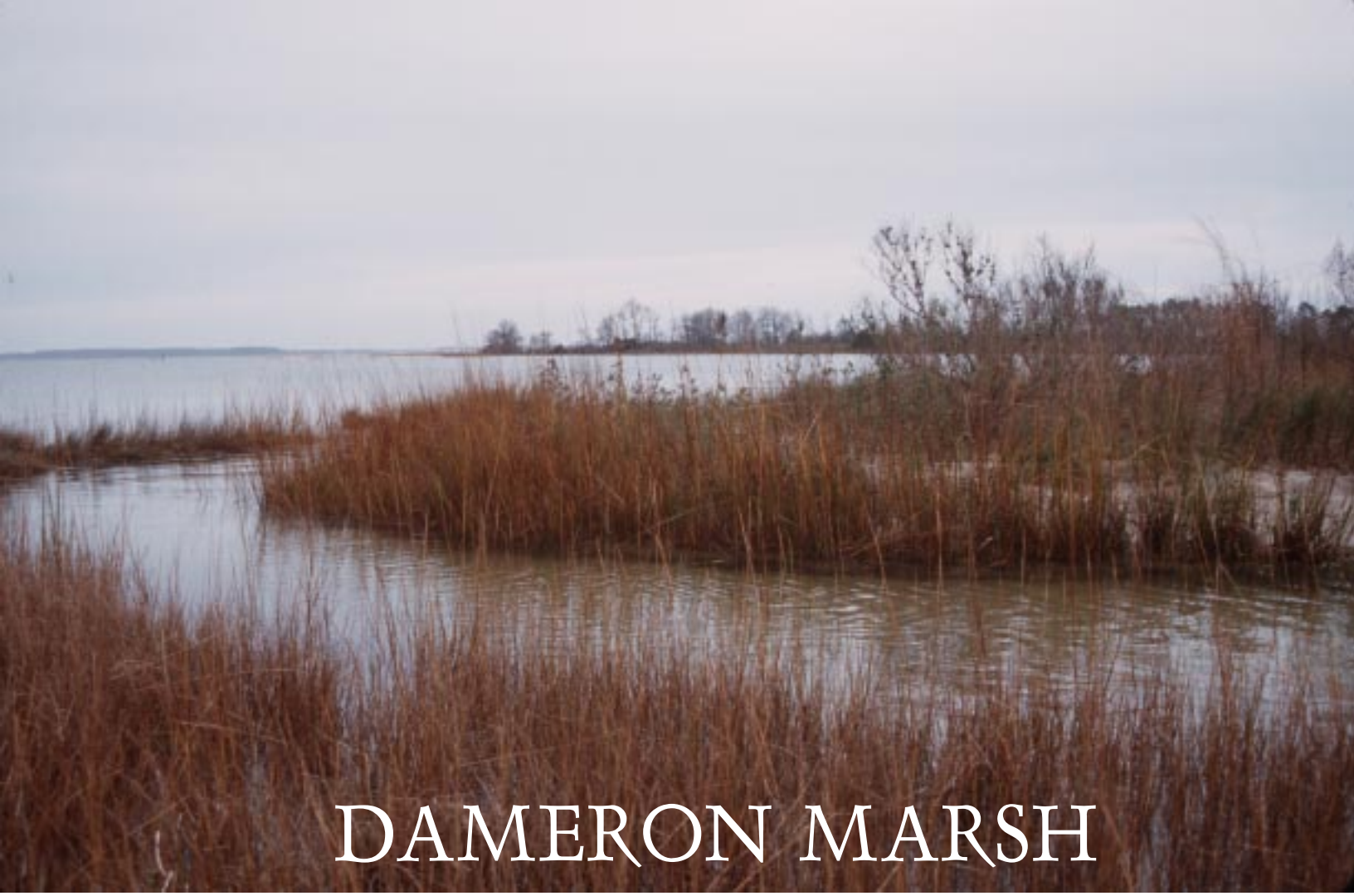

DAMERON MARSH

in the Morning

By Randall Shank

It was dark and the spitting rain felt like ice stinging my cheeks as we crossed Ingram Bay on a cold December day. We were ready for the rain but it was the wind that determined where we spent the morning. We headed to a blind on the sheltered, northwest side of the marsh where we would be out of the wind, and it would be safer to travel across the rough water in the dark.

Having scouted the area in the daytime, we negotiated the trip in the dark based on memory and a sense of direction. It wasn't long before we reached Dameron Marsh and saw the blind. We quickly beached the boat, took the gear into the blind and waded in the shallow water, distributing four dozen duck decoys that we had brought along for the morning hunt. Canada geese honked somewhere in the distance. Quickly, we got situated in the blind and waited for the dawn to break and the birds to fly.

The gray of first light brought the marsh to life. There was a low-shrouded mist across the bay. In the fog, the haunting call of a loon echoed across the water. With our backs to the southwest wind, waterfowl flew over us, riding the wind from the Chesapeake Bay, across Dameron Marsh and into the sheltered water of Ingram Bay. Four Tundra swans glided above me, calling out in the fog. As the morning progressed, they were joined by more than 40 other swans, settling in on the far shore, out of the wind, their white forms gliding like giant snowflakes on the water. The show continued through the morning as flocks of Canada geese moved off the bay and into nearby wheat fields to feed.

Occasionally, the Canadas would be joined by one or two snow geese that had separated themselves from the larger flocks of snows somewhere on the Eastern Shore. We saw large assemblies of mallards and bluebills flying high and out of range of our shotguns, heading for a destination known only to them. After the early morning flight, mergansers, buffleheads, and black ducks flew by. A great blue heron settled effortlessly into the salt pond behind us, oblivious to our presence. A group of late migrating brown pelicans glided in the clouds like ghosts from the past.

Behind us, I could hear the honking of a flock of Canada geese. Turning around and looking back over the marsh, a group of twelve geese were flying in our direction. I asked out loud if they were too high too shoot, and John my hunting partner replied, "I don't think so." As they came over us, we both shot and a single goose landed not far from the blind. Like hunters have been doing for hundreds of years on the Chesapeake Bay, John had harvested his goose for Christmas dinner.

A step back in time

Dameron Marsh is a beautiful coastal peninsula in Northumberland County on the western shore of the Chesapeake Bay that recently became part of Virginia's Natural Area Preserve system. As you leave the urban sprawl of Hampton Roads, Richmond, or northern Virginia, the trip to the Northern Neck is a journey to a place that seems frozen in time. Remnants of old wooden windmills still stand on farms that had no electricity in the 1930s. Shiloh School, a one-room schoolhouse dating back to the turn of the 19th century, sits like a sentinel in a field not far from the waters of the Chesapeake.

Part of a land-grant from the King of England to the Lawrence Dameron family, Dameron Marsh has witnessed very little change in ownership in more than 350 years. At one time, more than 2,000 acres were in the Dameron family. In about 1845 the property was sold to the Harding family. "Brick Walls" replaced the original Dameron house and it is said that pieces of brick from the house are sometimes found when farmers plow the surrounding fields. A description of the area from a long time ago says, "One long tongue of marshy land called afterwards Dameron Marsh, covered for the most part with reeds and marsh grasses, was a cover for wild game and a resting place for waterfowl, and the tidewater rivers and creeks were full of fish and oysters."*

A cottage on the property has been there since the Smith family bought the land more than 50 years ago. The structure was used by the family as a summer cottage and hunting lodge. The Chesapeake Bay is trying to take back part of the peninsula, as erosion continues to eat at the northeast shoreline. From 1937 to the summer of 2003, the distance from the shoreline to the house has eroded from 656 feet to 119 feet. An additional 25 feet of shoreline was lost during Hurricane Isabel's fury. If the present erosion rate continues, it's possible that the remaining 94 feet in front of the house could be lost in the next few years.

Protecting Virginia's natural assets

This unique preserve encompasses more than 316 acres of coastal habitat and natural communities, including: high salt marsh, bayside pine-hardwood forest, tidal mud flats, and high energy beaches. It is a significant marsh in the Chesapeake Bay for shorebirds and marsh nesting birds. The area provides good food and resting habitat for migratory waterfowl and is part of the Virginia Birding and Wildlife Trail. In the shallow waters off-shore is a significant acreage of underwater grass beds, which are critical to the bay's health. The beaches support crucial habitat for the rare Northeastern beach tiger beetle *(Cicindela dorsalis dorsalis)*.

Most Virginians will never encounter a tiger beetle. If they do, they will probably not realize that the tiger beetle has unknowingly helped

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**Helen Foster Snow quoted Mrs. O.A. Keach in "Tyler's Quarterly Historical Genealogical Magazine" by Lyon Gardiner Tyler: Whittet & Shepperson, Printers 1919-1952, p. 117, from material appearing in the, "THE DAMERON-DAMRON GENEALOGY" by Helen Foster Snow.*

protect a vital natural resource along the shore of the Chesapeake Bay. Dameron Marsh in all of its diversity and value will be protected in perpetuity in large part because of this nationally threatened species.

When the property went on the real estate market, the conservation community already knew it to be a significant natural resource in the Chesapeake Bay ecosystem. The Nature Conservancy provided initial funding to purchase Dameron Marsh from the Smith family. The Virginia Department of Conservation and Recreation (DCR) through its Natural Heritage Program then purchased it in 1998 from the Nature Conservancy. Funding assistance was provided by the U.S. Fish & Wildlife Service, the U.S. Army Corps of Engineers, the Northern Neck Audubon Society, and the 1992 Virginia State Park and Natural Area bond funds.

Easements and management agreements are important natural resource protection tools that DCR utilizes with landowners on natural areas across the Commonwealth. The most significant natural areas are often dedicated as state natural area preserves and as open space land by DCR. The natural area and open space designation are perpetual and binding no matter who owns the land. Today, Dameron Marsh is one of 38 Natural Area Preserves in Virginia that total 35,500 acres. While noteworthy, it represents a small portion of the more than 1,400 significant potential natural area sites that the state would like to purchase and add to the Natural Area Preserve System as funds and land become available.

A "Natural Area Preserve" designation provides Virginia lands and waters with the strongest legal protection against activities which might harm the natural communities and rare plants and animals that live there. Because of development pressures, places like Dameron Marsh are disappearing at an alarming rate along the Chesapeake Bay shoreline. There are eight dedicated natural area preserves on Virginia's shores of the great estuary. On the western shore of the Bay along with Dameron are Hughlett Point, Bethel Beach, and New Point Comfort natural area preserves. On the Eastern Shore bayside are the DCR-owned Savage Neck, Parkers Marsh, and the William B. Trower Bayshore Natural Area preserves. The Cape Charles Coastal Habitat Natural Area Preserve is owned by Northampton County.

Dameron Marsh Natural Area Preserve is in good hands. Rebecca Wilson is the Chesapeake Bay region steward responsible for natural resource management of the area. She coordinates a cadre of over 45 volunteers from the Northern Neck who lead hiking tours, birding trips, geology tours and provide public use monitoring of the preserve. Rebecca says, "The volunteers are the eyes that make sure that Dameron Marsh is being well taken care of."

Rebecca works together with Greg Toussaint, who is the eastern Virginia operations steward for DCR. Greg provides law enforcement, maintenance, and works on neighbor relations for

Natural Heritage. He also oversees hunting on the property. Explaining the hunting use philosophy, Greg says, "Managing the waterfowl hunting is a way to allow for the compatibility of uses between hunters and the non-hunting public such as bird watchers." DCR allows a limited number of days for waterfowl hunting each year.

Blinds have been erected that hunters can use through a permit system. By carefully managing the hunting so as not to interfere with other uses and other management goals, DCR allows hunters to enjoy a resource that is becoming increasingly scarce.

An observation deck has been constructed that is a short walk from the parking area. This elevated platform gives birdwatchers the opportunity to see above the vegetation and with binoculars scan the horizon for migrating birds.

Fishing from the shore at Dameron is limited because of the lack of good access to the shore. Mosquitoes in the warm months and shallow water just off the beach add to the challenge. Accessing the area by boat affords the fisherman the best opportunity to fish away from the beach for spot, croaker, trout, and flounder. There is also a private boat launching facility not far away at Ingram Bay marina.

Dameron Marsh not only provides refuge for waterfowl and rare tiger beetles. Many of Virginia's native wildlife species can be found there as well. I saw a raccoon track imprinted in a tidal mudflat. As I followed a deer track down the beach, I heard turkeys calling in the distance. Fox, opossum, quail, and many other animals native to eastern Virginia are present. They survived the effects of Hurricane Isabel, which are quite visible along the shore with flotsam of crab pot buoys, plastic jugs, and boat dock lumber resting in the high tide line deep into the bayberry and wax myrtle on the other side of the maritime dunes.

Cherishing wildness

Returning back to the blind from my walk down the beach and with a goose to take home for eating, we retrieved our decoys and loaded the boat. With an approaching low pressure system moving up the coast, we wanted to be gone before the wind and waves increased. By the time we loaded everything, the fog was as thick as soup. The lure of Dameron Marsh still pulled at us though.

We decided we had time to motor along the shoreline to the eastern tip of land that juts out into the Chesapeake Bay. The maritime loblolly pine forest towered in the distance as we passed a spit of sandy beach. Approaching the eastern point of the marsh, water surrounded us on all sides. Sea ducks, buffleheads, and gulls flushed off the water as we moved along the edge of the Chesapeake.

As the wind blew harder, waves slammed the shore with greater intensity. There was no one else out there. We looked in all directions and felt the sense of wildness as fog enveloped the marsh with a blanket of mist from the Chesapeake Bay.

Randall Shank has worked in the conservation field for many years, most recently as the Chesapeake Bay liaison for the Va. Department of Conservation & Recreation. He is now a consultant and freelance writer/photographer and lives in Walkerton.

NORTHEASTERN BEACH TIGER BEETLE

The tiger beetle is a small, 2/3-inch-long insect that needs broad, undisturbed high energy beaches in order to live. The adults roam the beach in search of prey and will move to other beaches to colonize when possible. Larvae hide in tunnels in the upper tidal zone of the beach. When the tide is low, the larvae open up their burrows and lie in wait for their prey. At high tide the larvae plug their burrows and wait for the water to recede.

Northeastern beach tiger beetles were once abundant from the coast of New England to the Chesapeake Bay and are considered an indicator species for healthy beaches. All but one population in the Northeast has been lost, with sites along the Chesapeake Bay providing the most significant remaining habitat for the subspecies. The most serious threats to the beetle are trampling and loss of habitat to coastal development. The larvae are especially sensitive to disturbance from off-road vehicles. Currently the Northeastern beach tiger beetle is listed as threatened by the U.S. Fish & Wildlife Service and has been recommended for placement on Virginia's endangered species list because of the decline in its range.

▯▯ *Directions to Dameron Marsh:* Take Route 200 north of Kilmarnock for 4.5 miles. Turn right on Route 666 (Shiloh School Rd). Go 2 miles; turn left on Route 605 (Ball Neck Rd). Go about 1 mile to Cloverdale Rd. Turn right and go half a mile to Guarding Point Lane. Bear left and go two-tenths of a mile to a right turn where the road becomes gravel. Follow the road to the parking area.

▯ *For more information on Dameron Marsh:* Contact Ms. Rebecca Wilson in the DCR regional office in Tappahannock at (804) 445-9117.

▯ *For more information on the Virginia Natural Area Preserve System:* Contact the Virginia Department of Conservation & Recreation, Natural Heritage Program at (804) 786-7951 or < www.dcr.state.va.us>.

HOW CLEAN
is clean enough?

By Sally Mills

The players are set. The timekeeper takes position, stopwatch in hand. All's quiet in the room, awaiting the signal that will set everything in motion. And… they're off!

The scenario is played out in many settings for sport and academic competitions, but this time the setting is a small aquarium in a laboratory at VIMS and the contestants are tiny benthic organisms, called amphipods, that form an integral part of the food web in estuaries and tidal mud flats. This particular amphipod, the invertebrate *Leptocheirus plumulosus,* represents any number of creatures that live in these environs, burrowed in the sediment and hidden from most of us. But during this experiment and others conducted over the past few years, this species has taken center stage in a research project designed to measure, among other things, how such organisms behave when exposed to low, sub-lethal levels of contaminants in their habitat.

Sediments in shallow coastal waters often act as sinks, accumulating pollutants and occasionally releasing them into the water column through tidal mixing and wave action, especially during storms. Even the animals living in the sediment can help to release buried pollutants due to their feeding and burrowing activities. Simulating such an environment in the lab presents a challenge, and that is what makes this particular project so unique. The Chesapeake Ecotox Research Program, as it is called, is meeting that challenge by studying toxic compounds as they occur in the "real world" in complex mixtures that affect living organisms through repeated, chronic exposure rather than as single, isolated events.

The work is being carried out by researchers from several institutions and from many different scientific backgrounds, including toxicology, ecology, and biochemistry. The approach indicates an increasing trend toward interdisciplinary studies to understand and help solve problems that plague the environment.

Contaminants in the form of metals and complex organic compounds (polycyclic aromatic hydrocarbons and polychlorinated biphenyls, commonly referred to as PAHs and PCBs) are not uncommon to the sediments found in highly industrialized areas of the Chesapeake Bay watershed, places like the lower Elizabeth River and Baltimore Harbor. Until recently, these contaminants have been studied primarily for their toxic, or lethal, impacts upon natural systems. But this work aims to see what other, more subtle effects they have upon common estuarine species – on biochemistry, on respiratory function, on growth and weight, on reproduction, and on ordinary behaviors such as burrowing – and then infer what such effects might have on populations in nature.

The need to better understand how pollutants are affecting natural systems, especially in low doses over time, is a growing one. Such understanding will help program managers make decisions about how associated, contaminated sites—called "regions of concern" by environmental agencies—should be cleaned up.

A site in the lower Elizabeth River near the former Atlantic Wood creosote plant and two sites in Baltimore Harbor were targeted for

sediment collection because of the known presence of serious pollutants. A location in Fishing Bay—a relatively clean salt marsh located within a wildlife management area—and two similarly healthy creeks of the lower Chesapeake were used for comparative, control sites throughout the experiments. (See map, pg. 8.) The sediments were placed in a series of 50-gallon aquaria-like trays called mesocosms, into which juvenile *Leptocheirus* could be introduced, fed, measured, and observed. During each experiment, mesocosms were flushed continuously with seawater (as they would be in natural settings), and sampling of amphipods generally occurred every 15 days over a 90-day period.

A battery of tests for metals and organic compounds was conducted on the sediments used from each sampling location. The associated sediment profiles helped provide clues about what was later observed among the organisms studied and its possible causes. Exposure to the metal mercury, for example, is known to cause negative effects at relatively low concentrations, based on published research findings. Over time, research results have been tallied and used to establish a value--called the effects range median, or ER-M--that helps scientists draw a "line in the sand" of acceptable risk for a particular contaminant, like mercury. In this study quotient values, representing the *average* of the values measured in the sediment divided by the ER-M, were established for a suite of contaminants identified. (See graphs, pg. 11.)

Mummichog

The players

The *Leptocheirus* is a small crustacean called an amphipod. It is widely distributed in estuaries and coastal systems along the East Coast. In the Chesapeake Bay watershed, *Leptocheirus plumulosus* are predominantly found in lower mesohaline waters of 5-10 parts-per-thousand (ppt) salt content. *Leptocheirus* live in U-shaped tubes within the sediment. They feed by scraping organic material from the soil, or by pumping water through their burrows and filtering out suspended food particles. *Leptocheirus* are a keystone species in the benthic food web in Chesapeake Bay and serve as prey for various species of fish and other predators. The species was chosen to represent any number of organisms typical of this habitat. Similar to many other small benthic creatures, it also exhibits large population increases in spring and fall and population declines in summer and winter—fluctuations that are attributed to seasonal food availability.

During years three and four, experiments shifted focus to a small fish also common to estuaries, called *Fundulus* or "mummichog." These fish form schools that never venture more than a few yards offshore. In Chesapeake Bay, mummichog can be found in tidal fresh to salty bay waters and inhabit a number of highly contaminated sites along the East Coast, including Atlantic Wood. Recent research by Dr. Mike Newman and colleagues at VIMS showed that mummichog have the ability to adapt to contamination, which may explain why they are found in contaminated systems such as the Elizabeth River and Baltimore Harbor. In addition to studying their growth and reproductive responses to contaminants, mummichog were studied in the presence of *Leptocheirus* in experiments designed to better understand predator-prey behaviors in both healthy and contaminated soils.

(Top to bottom) VIMS graduate student Bruce Vogt collects sediment samples from the lower York River which are later placed into test chambers, called mesocosms. Researcher Dawn Davis and Dr. Tom Miller of the Chesapeake Biological Laboratory in Solomons, MD, are shown here checking the mesocosms and measuring growth of the amphipod, Leptocheirus plumulosis.

Early experiments conducted during the research program tested the effects of contaminated sediments at 10%, at 50%, and at full, or 100% concentration. After high levels of amphipod mortality were experienced, subsequent experiments were modified to 7%, 15%, and 30% concentrations. This design provided scientists with the ability to pinpoint contaminant effects over a gradient of exposure and to compare effects between sampling locations.

Results

The research team looked closely at amphipod survival, growth, physiology, and productivity at different levels of contaminant exposure. Immediately evident was the observation that sediments from the selected sites in Baltimore Harbor and Atlantic Wood are highly toxic to *Leptocheirus* and cause significant mortality, even when diluted to half the original concentration. This is consistent with previous studies in the Elizabeth River and Baltimore Harbor, which showed that there have been important changes in the structure of benthic communities of these areas due to mortality of sensitive species and overall reductions in benthic populations. One notable result of this mortality could be a significant decrease in productivity – meaning there might be less food available to fish. In one of the mesocosm experiments, production of *Leptocheirus* in the 50% treatment was reduced by 80% or more relative to production in the 10% treatment, due to high mortality.

But perhaps the most exciting development over the past four years was witnessed in the area of behavioral response, while testing the amphipod's ability to burrow into the sediment. Juvenile *Leptocheirus* were collected from pristine locations in the lower York River system. After acclimating to mesocosms, the amphipod was released into a test chamber of clean or dirty sediment covered in seawater, just below the water's surface. The time required for the amphipod to burrow beneath the sediment-water interface after initial contact with the soil was measured with a stopwatch and recorded in seconds as the "reburial" time. This particular experiment was repeated several times in chambers containing clean and varying concentrations of dirty sediments.

Here, results bore out the hypothesis that contaminants adversely affect fundamental behaviors. At concentrations of just 10% contamination, Dr. Schaffner and graduate student Bruce Vogt observed significant effects on the burrowing behavior of *Leptocheirus*—in some cases, amphipods took twice as long to burrow as in the control sediments. The information has important implications for the amphipods and for many other benthic species, because burrowing is a key defense mechanism used to avoid predation.

Subsequent behavior studies conducted using both amphipods and fish reveal the importance of these subtle changes for predator-prey dynamics. At all contamination levels tested, amphipods had a greater chance of being eaten by a mummichog when compared to control site samples.

Impacts on fish less clear

Researchers did uncover differences in growth rates between fish raised in clean versus dirty samples. During year one of the fish experiments, a marked difference in growth could be seen between those raised in Fishing Bay sediments and those raised in varying concentrations of Elizabeth River sediment, suggesting a dose-dependent response to contamination.

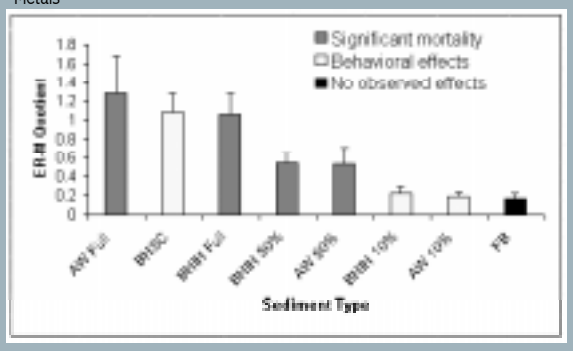
Mummichog were collected during periods of time that would ensure the capture of gravid, or pregnant, females. In looking at contaminant effects upon reproduction, the results were somewhat mixed. Early studies that measured hatching success, egg area (volume) and larval length showed no discernible differences among treatments. During year two of study, however, egg production was significantly *higher* in tanks filled with contaminated sediments.

Related investigation showed that fish larvae growth was significantly slower for those whose mothers were exposed to heavily contaminated Atlantic Wood sediment, even when larvae were subsequently placed in clean sediment after hatch. Such results suggest that mothers provide things other than genetic material that are important for larval growth and survival in the habitat in which they are spawned. Dr. Tom Miller and researcher Dawn Davis at CBL conclude from these tests that sub-lethal effects of contamination were expressed upon the mummichog population in somatic production (related to development of outer body tissue), rather than in processes related to reproduction.

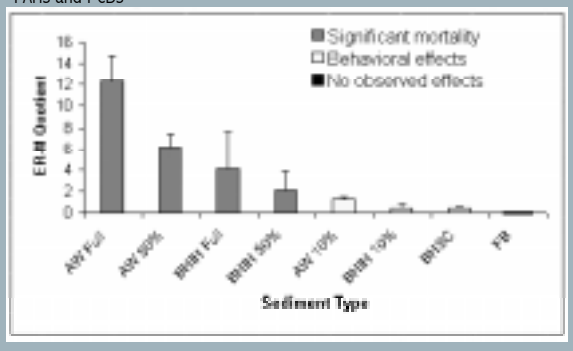
Dr. Peter Van Veld, an environmental toxicologist at VIMS, has been working with the mummichog at the Atlantic Wood and other contaminated sites for years. His research has identified several biochemical and molecular alterations in Atlantic Wood mummichog that appear to be related to the development of

The graphs below show Effects Range - Median quotients for metals and organic compounds found in full and diluted sediment samples collected from the project sites. Mortality and behavioral effects upon the amphipod, Leptocheirus plumulosis, *are clearly distinguishable in the full treatment and 50% dilutions of Atlantic Wood and Baltimore Harbor samples.*

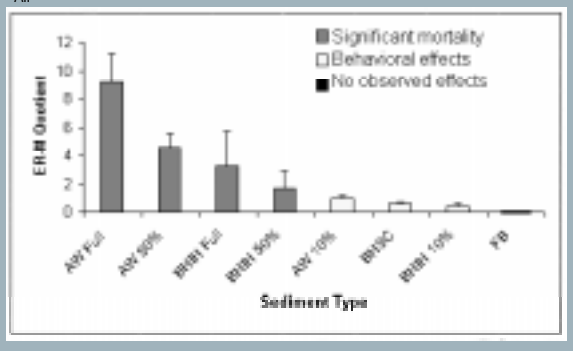
Metals



PAHs and PCBs



All



AW - Atlantic Wood
BHSC - Baltimore Harbor, Stoney Creek
BHIH - Baltimore Harbor, Inner Harbor
FB - Fishing Bay (control)

cancer in this population. One of the protein "biomarkers" under investigation during this study is highly inducible or elevated in mummichog following exposure to PAHs and related contaminants. Evaluation of the levels of this protein in various tissues of the fish can provide important information, not only on the magnitude of exposure but on the routes (the gill, intestine, or skin for example) by which exposure to these carcinogens occurs.

An interesting outgrowth of this research is investigation of other biomarkers – including several of interest to medical researchers probing biomarkers of human diseases, including cancer. In collaboration with scientists at the Eastern Virginia Medical School in Norfolk, Dr. Van Veld has identified several new proteins that could provide a better understanding of the biochemical pathways influenced by carcinogen exposure and the relationship between exposure and the onset of disease.

Implications for management

Results over four years of testing and observation leave researchers with the hope that they can help managers better assess the risks of environmental degradation. For Dr. Schaffner and Bruce Vogt, it all boils down to: "How clean is clean enough?"

There is a project underway, for example, to restore Scuffletown Creek – a degraded tributary in the Elizabeth River across from the old Atlantic Wood plant. The work is ambitious and involves collaboration between the Army Corps of Engineers, the Va. Dept. of Environmental Quality, several federal agencies, and the Elizabeth River Project—a nonprofit grassroots coalition. Plans to clean up sediment in the creek considered many options, including dredging and barging the material to a permanent placement site, or transferring barged material to a regulated landfill after treatment. Schaffner and others hope that, given new information coming out of this study and others, project managers will have a better sense of what they should aim for in determining the final levels of cleanup.

Mark Richards manages the toxics strategy for the Chesapeake Bay restoration effort and acts as an advisor to the CERP project. He acknowledges that one of the best risk assessment tools available to managers working to clean up contaminated sediments – the ER-M quotient discussed earlier – is highly uncertain. Managers, he asserts, are always looking for the best set of tools available, and he welcomes any fine-tuning that may come out of this project once all the data are in.

"As a manager, I would certainly support the use of this kind of information," he notes. "Toxicity testing provides you with only one end point, and the results coming out of this study offer you several end points – information that gives you valuable context for making decisions."

Dr. Walter Priest, a VIMS professor and advisor to the Elizabeth River Project, concurs. But he is quick to add that, in the real world, remediation decisions ultimately boil down to money and hard fought consensus reached among the various parties involved. Early feasibility studies conducted by the Corps of Engineers indicate that a combination of both sediment restoration and wetland restoration at eight targeted sites will yield the best results at Scuffletown Creek.

But for all the other Scuffletown Creeks out there, the CERP work adds new information to be factored into remediation approaches. Clearly, the project has demonstrated that even relatively low levels of sediment contamination can produce significant behavioral and growth impairments in common estuarine species in mesocosm experiments. These sorts of changes have significant implications for the function of estuarine ecosystems because they affect productivity and the food webs that support fisheries.

Researchers from the University of Maryland Center for Environmental Studies, Academy of Natural Sciences Estuarine Research Center, Old Dominion University, and Virginia Institute of Marine Science participated in this long-term study. Funding support was provided by the NOAA Sea Grant programs in Virginia and Maryland and the NOAA Chesapeake Bay Office. Go to: http://www.mdsg.umd.edu/CERP/index.html for more information.

10,000 Years of Feasting

By Charlie Petrocci

SEAFOOD FESTIVALS SHOWCASE VIRGINIA SPECIES

I watched in awe as crab juice ran down the arms of my table partner. I had the tell-tale lines on my own appendages as well. Our lips were burning from unknown spices and had to be quenched with cool libations. Looking around we saw hundreds of others who were indulging in the same methodical rhythm - crack, break, eat, drip, and smile. It was a seafood extravaganza, with napkins serving as the common denominator.

Long lines of people led to other delicacies. Crabs, clams, oysters, fried fish, and steamed corn spilled from plates to table. In the distance, a live band played songs extolling the virtues of the Chesapeake Bay. A small group of colorful dancers gyrated before the stage, oblivious to the simmering heat. Throngs of people moved about - laughing, greeting and eating, many obvious veterans of this type of affair. This was a summer seafood festival, Eastern Shore style: A celebration of the season for some, a rite of passage for most. Seafood festivals around the Chesapeake have evolved as a way of paying homage to the seasonal bounty of Virginia's waters and continuing a culinary tradition that has spanned generations.

Festivals in and around the Chesapeake Bay have been growing in recent years, with seafood at the center of the plate. Most are part fund-raiser, part seasonal celebration, and all fun. They are gatherings of seafood aficionados who come from near and far to partake in their passion and claim the bounty of the water as their common ground. Festivals have grown so much around the Chesapeake shores that, on any

given weekend during the spring, summer, or fall, there are usually several to choose from.

The cultural connection

Feasting on an assortment of indigenous seafood is nothing new here. American Indians have been practitioners of the sport for over ten thousand years. Virginia colonists evidently were turned on to the idea, literally through trial by fire. In early 1607, a group of English explorers came upon several Indians squatting around a fire along the banks of the James River. The startled Indians ran away in fear, leaving behind their anticipated lunch. What the hungry colonists found was an assortment of cooked crabs, clams and oysters being roasted on open flames. The intruders quickly devoured their find and in so doing may have participated in the first non-native seafood feast along the banks of the bay.

From there it was love at first bite and the colonists soon learned to appreciate the many seafood delicacies the bay had to offer. It wasn't long before seafood became a staple of the fledgling colony, helping stave off starvation and destitution. Seafood harvests in Virginia from these utilitarian beginnings eventually rose to become a major export commodity to other emerging American colonies and to Europe as well. Roads, rails, and shipping routes expanded those horizons. Today, Virginia shellfish and finfish continue to command respect in seafood markets throughout the world. Thus, Captain Smith was correct when he tried to convince his backers that the potential wealth in Virginia lay not in her buried gold, but in her obvious, abundant natural resources.

Historically, county fairs, church celebrations, and small town festivals were important social gathering places in small rural communities throughout the area. Many people lived in isolated home sites or villages, and festivals offered them an opportunity to interact with others and escape from the labors of farming, timbering, and fishing. Fairs and festivals allowed folks from far reaches to mingle, to share local news, and to learn of any recent political positioning. It was also an opportunity for young people to meet those of the opposite sex in an informal gathering. Possibly many an early marriage could trace its beginnings from that chance encounter at a community festival or fair. Small town festivals also served as homecomings for families who became separated because of marriage or work. That tradition still holds true today: many families come together each year, using a local festival as the draw. But no matter what the occasion, food—especially local seafood—usually provides the main ingredient of down-home Chesapeake events.

Modern gatherings

Today, seafood festivals can be found from Reedville to Chincoteague and everywhere in between. On the western shore, there is a pile of them held each year from Tidewater north to the Northern Neck. On the Eastern Shore there are several seafood festivals held from spring through fall, and they range in size from small fire company fund-raisers to larger public gatherings. In most cases they represent some type of fund-raiser supporting a local charity or non-profit group. And many have been going on for decades.

They are not only gatherings for the locals, but have become target destinations for tourists and other travelers. Some visitors even build their vacations around seafood festivities each year. For them, a seafood festival is the highlight of their trip.

Seafood festivals come in all shapes, sizes and disguises. Some are celebrations of seasonal harvests, while others trace their roots to political platforms. Many are small community affairs, while others draw thousands of festival fanatics, attracted by food, music, and the camaraderie of the event.

"Most Eastern Shore seafood festivals originally started as a way to showcase local Eastern Shore seafood. Now some have grown into an event with political overtones, especially during an election year. But seafood is, and will always be, the main attraction," says Rose Rulon, director of Virginia's Eastern Shore Chamber of Commerce. Last year's Harvest Fest hosted over 4,000 hungry people from as far away as New England.

Such events provide an economic "shot in the arm" to the host sponsors and small coastal

communities. "In Chincoteague we have several seafood-related festivals, some of which bring in several thousand visitors. They of course also bring in thousands of dollars in revenue for the town," says Susan Taylor, director of the Chincoteague Chamber of Commerce. Money is spent on fuel, lodging, food, and recreation associated with these events. So the trickle down of cash can be significant for area businesses and entrepreneurs.

Seafood festivals also help local watermen and seafood processors, due to a surge of demand just before the event takes place. Watermen and processors are given a list of items needed, months ahead of the scheduled festival. This translates into additional money in their pockets.

"Clams, crabs, oysters, and all the other featured products have to be sourced, purchased and processed, and that's a lot of work," notes Taylor. The Chincoteague Oyster Festival last year served 210 gallons of shucked oysters, 143 bushels of Chesapeake oysters; 73 bushels of seaside oysters; 79 gallons of shucked clams; 30 gallons of clam juice (for stews and fritters); and 60 bushels of blue crabs. All of this, along with several other food items, was consumed in one 5-hour period by almost 3,000 people. The festival generated over $91,000 dollars for the Chincoteague Chamber of Commerce.

Most Eastern Shore seafood festivals are held during the fair weather months and each seems to highlight a seasonal species. For example, in the spring soft crabs may be the center-of-the-plate item, while in the summer many festivals feature steamed blue crabs and clams. The cooler months of fall may offer the adventurer steamed, fried, or raw oysters and various types of finfish abundant during that time of year. Sometimes fish such as black drum, sea trout, and croaker are served, familiar to the locals but perhaps unknown to the visitor. Cultured species such as clams, oysters, crawfish, and catfish represent a growing part of featured food lists. In most cases these items are offered in tandem with other local delicacies—including corn, strawberries, watermelons, and yes, even chicken. But seafood is the main draw for the ticket holder.

SEAFOOD FESTIVALS IN THE REGION

MAY
- Abingdon Ruritans Seafood Festival
  Abingdon Fire Department, Bena
- Chincoteague Seafood Festival
  Toms Cove Campground, Chincoteague

JUNE
- Cape Charles Maritime Festival
  Cape Charles Waterfront
- HarborFest, Norfolk Waterfront

JULY
- Firemens Pony Penning & Carnival, Chincoteague
- Tawes Crab & Clam Bake, Crisfield, Maryland
- Watermens Heritage Celebration
  Yorktown Waterfront

AUGUST
- Harborfest, Onancock
- Wachapreague Fish Fry
  Carnival Grounds, Wachapreague

SEPTEMBER
- Bay Seafood Festival
  Belle Isle State Park, Lancaster
- Chesapeake Skipjack Races & Seafood Festival
  Sandy Point State Park, Maryland
- Hampton Bay Days
  Mill Point Park & Downtown Hampton
- Norfolk Seafood Sampler & Boat Races
  Towne Point Park, Norfolk

OCTOBER
- Abingdon Ruritans Seafood Festival
  Abingdon Fire Department, Bena
- Chincoteague Oyster Festival
  Maddox Campground, Chincoteague
- Crisfield Hard Crab Derby, Crisfield, Maryland
- Harvest Fest, Sunset Beach Hotel, Cape Charles
- Poquoson Seafood Festival, Poquoson Waterfront
- West Point Crab Carnival
  Main Street, West Point

NOVEMBER
- Reedville Oyster Roast
  Reedville Waterfront
- Urbanna Oyster Festival
  Downtown Urbanna

Contact your local Chamber of Commerce for a more complete list and detailed information about events in your area.

Oysters are just one of many delicacies featured at area seafood festivals.

Benefits to the industry

What have seafood festivals done for the regional seafood industry?

"A great deal of publicity," says Randy Lewis of Wachapreague, a long-time festival participant and planner. "People from all over the country go to these traditional festivals, allowing them a chance to try new products, many which they wouldn't find at home. If they like what they eat at a seafood festival, they are more inclined to patronize those dishes when they return home or try one at a local restaurant if they come back on vacation. It's positive mass marketing in a festive atmosphere," he adds. And with all the festivals on tap each year, tens of thousands of consumers are being exposed to Virginia seafood products.

Writer Joseph Conrad once wrote, " The sea I must confess has no generosity." Clearly, Mr. Conrad must not have gone to any seafood festivals in his day. If he were travel around the Chesapeake Bay this spring, he would find an assortment of festivals to prove the sea is indeed very generous. This year an abundance of crabs, clams, oysters and fish will all be the guests of honor at many of these events.

So park the mower, pack the kids, and head out to one of Virginia's great seasonal seafood feasts. They offer a great opportunity to try regional delicacies, to mix with the locals, and to participate in a lively outdoor celebration whose proceeds may benefit a good cause. And if the spices are mixed just right, your senses will go into overdrive, sweat will form just above your lip, juice will run down your arms, and you'll instantly understand why Virginia is so proud of its seafood heritage.

Waste NOT

By Angela Correa

NEW EFFORTS SAFEGUARD THE WATERSHED AND REDUCE COSTS FOR FARMERS, FISHERIES MANAGERS

The seafood industry has traditionally depended on waste management strategies linked to land-based agricultural operations to mitigate a portion of its waste disposal needs. Cropland application of fish processing wastes has been used as an alternative to land filling – an alternative that has at times created as many problems as it has solved. While the nutritional value of the applied waste provides a significant benefit for crops, the practice has occasionally resulted in complaints from neighboring landowners of unpleasant odors or downstream eutrophication. The potential for pathogens or toxins to be introduced to crops, livestock, or the groundwater by the application of untreated wastes is another risk that must be addressed if land application of fish processing waste and aquaculture sludge is to be sustained. Fishery and aquaculture managers and seafood processors are increasingly searching for alternative, benign waste management processes.

A multi-year partnership between researchers at Virginia Tech and Blue Ridge Aquaculture (Martinsville, VA), made possible to Virginia Sea Grant through a grant from the USDA, is exploring new ways to deal with organic wastes from aquaculture operations. Although the project is designed to test alternative treatment options and uses for aquaculture wastewater, the results are applicable to any enterprise that produces a significant volume of organic waste (e.g., traditional livestock farms, fish and shellfish processing operations). Solid waste treatment and disposal fees may be among the heaviest costs borne by farmers; therefore, a company's economic outlook can be significantly improved by reducing waste disposal expenses.

The location chosen for the project, Blue Ridge Aquaculture, Inc., is the largest indoor fishery in the world. Blue Ridge Aquaculture discharges more than 500,000 gallons of wastewater to the municipal wastewater treatment facility daily. Virginia Tech researchers (Greg Boardman, Simonel Sandu) determined that wastewater treatment costs can be significantly reduced by separating and removing from the wastewater stream the solids that typically contribute great expense to treatment cost. A pilot solids separation system was constructed to remove a portion of the solids from the wastewater for further processing.

The dewatered solids, termed "sludge," were then subjected to alternative processes to generate a material that might have economic value. Sludge is typically directly applied to farmland, but this practice can cause problems that range from annoyance to health, safety, and environmental risks. Waste nutrients applied to crops reduce the need for application of commercial fertilizer; however, pollution of surface water may occur if more waste nutrients are applied than the crops can use. The amount of manure generated by concentrated livestock operations often exceeds the capacity of available cropland. Direct application of untreated sludge or manure, if mishandled, may contaminate water supplies with sediments, nitrogen, phosphorus, pesticides, inorganic salts, organic solids, and pathogenic microorganisms, which can, in turn, cause groundwater contamination, fish kills, and disease outbreaks. In response to these potential hazards, new regulations have been promulgated that are increasing the difficulty of applying sludge or manure to fields.

Continuous application of wastes at rates designed to supply crop nitrogen requirements (i.e., agronomic rate) typically raises soil phosphorus to concentrations greater than the ability of the soil to assimilate it. Excessive soil phosphorus concentrations may result in high enough transport of phosphorus to surface water to cause an increase in algal blooms and oxygen depletion following vegetative die-off. The cycling of plant growth and die-off creates wide fluctuations of oxygen in the water that can, in turn, cause fish kills. In addition, the dead plant remains and soil carried in runoff water form bottom sediments. This sediment fills in lakes, reduces water clarity, and destroys the breeding grounds of many aquatic species.

Regulations have been promulgated that reduce the allowable rate of phosphorus to be applied to soil to prevent surface water contamination. A major goal of the Martinsville project is to demonstrate how to develop soil amendments that can profitably be transported from the immediate area of generation and which prevent build-up of excess phosphorus in soils. Virginia Tech researchers Greg Evanylo and Lori Marsh have been evaluating two methods of composting the sludge. Evanylo is using a rotating drum for thermophilic composting, and Marsh is vermicomposting sludge in bioreactor bins.

Thermophilic composting is the microbial decomposition of organic matter in the waste. Microbial respiration results in high temperatures that promote the breakdown and reconstruction of organic matter.

Vermicomposting utilizes organic matter ingestion by worms to stabilize the waste. The worms live and multiply inside the bioreactor bins, using the sludge as a nutrient source. Once digested by the worms, the sludge is converted into fine-grained compost. Both methods result in the production of a stable, disease- and weed-free substrate that can be employed as a beneficial soil amendment or as a horticultural medium. Marsh and Evanylo produced mounds of stable compost that was free of malodors, via these methods.

The overall goal of these efforts is to demonstrate the use of waste management processes that recapture the valuable (and potentially noxious) organic content from the wastewater. This drastically reduces the mass of solids in the wastewater that must be treated, and yields a beneficial product whose sale can improve profitability of the operation. Livestock owners already pay a hefty price for animal feeds, nutrition that passes mostly undigested into the effluent. It makes sense to recover that nutrient-rich portion of the waste stream and redirect it to new and potentially profitable uses.

The project's third component involves testing the composts by using them in the production of a variety of horticultural crops and other plants. Horticulture professor Greg Eaton will utilize the composts to produce

WORM COMPOSTING AT HOME

Enter the search phrases "red wiggler" or "vermicompost" on Google, and you will find over 3,000 sites offering general information and items for the home composter. You can buy worms by the pound (usually between $18-25/lb), as well as a variety of worm composting systems. It is also possible to build your own worm bin. High-end bins utilize the worm's natural tendency to move towards a new food source and away from their castings, resulting in a lower bin that is filled solely with worm-free compost. For the home owner, a simple box is probably adequate. The key thing to remember is to keep the bins from drying out (they typically come with a lid) or becoming waterlogged. The compost should be moist but never soggy when it is harvested. For a relatively small waste stream, such as kitchen scraps, worm composting is generally simpler than traditional composting, because it does not need to be turned to accelerate decomposition. For yard wastes, such as leaves and grass clippings, a traditional compost pile is probably the best solution. As long as the worms receive sufficient scraps, they will produce approximately one pound of compost for each pound of worms in the bin per day.

For more details on how to build your own bin, see "Composting Your Organic Kitchen Wastes with Worms" at <http:/www.ext.vt.edu/pubs/bse/442-005/442-005.html>.

containerized plants suitable for the landscaping industry. Eaton's work is being conducted in a recently erected greenhouse at the Martinsville facility. As the trials progress, Eaton will work to optimize the growing cycle by testing different irrigation methods and plant types. At the same time, Evanylo's team will investigate the compost's capability to enhance drought stress tolerance in turfgrass, and to supply essential plant nutrients.

The waste treatment and re-use loop appears complete at this point, but there is one more addition that will be considered as the project moves forward. The project's final component introduces yet another lucrative product to the mix – Pacific White Shrimp. Researchers Steven Craig, Ewen McLean, and Greg Boardman are exploring the feasibility of using the effluent water from the tilapia facility to raise shrimp in a separate system, before the water is shunted to the solids separator. Shrimp is the number one seafood consumed in the United States, and could be distributed through the same channels that are already well established for the tilapia portion of the business.

The project will help Blue Ridge Aquaculture diversify its product line, adding marketable compost, ornamental plants, and shrimp to its core tilapia culture enterprise, simply by fully utilizing what was once a throw-away byproduct. If a market can be established for the red wigglers used in the vermicomposting, that would add a fourth new product to the overall line. The successful commercialization of any or all of these products will create new revenue sources and new jobs within the company, and serves as an innovative example to livestock and processing operations throughout the region.

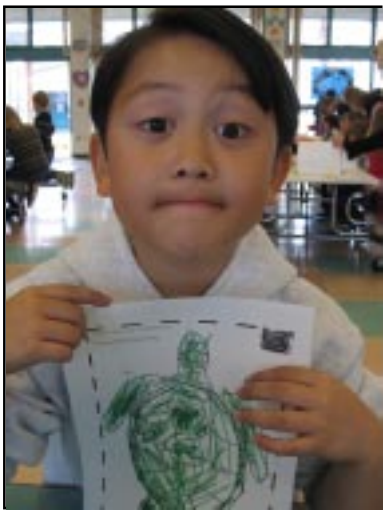
The Blue Ridge Aquaculture waste management model has the potential to help keep businesses operating in the black, hedging their dependency on a single crop while reducing their waste disposal costs. When this model is applied to farms draining into Virginia's coastal waters, it can also reduce nonpoint pollution, helping the bay stay healthy and vital. It's a win-win proposition.

News from the Point

La Vida de la Tortuga—
International Collaboration Using Research Data in the Elementary Classroom

The Bridge (www.vims.edu/bridge), Virginia Sea Grant Marine Advisory Program, and the Baja California conservation and research team, WiLDCOAST, recently finished *La Vida de la Tortuga*.

La Vida de la Tortuga (*The Life of the Turtle*), is an elementary-level curriculum resource that uses research data regarding the Eastern Pacific green turtle. The curriculum contains species-specific information and general biology facts about Pacific sea turtles. In addition, the curriculum is available in Spanish and English and is correlated to both Mexico and the United States' science standards of learning. In the activity, students pretend to be an Eastern Pacific green turtle juvenile in a Baja, California / Mexico coastal foraging area. They face natural and human threats, and calculate their percent survivorship. The student or "turtle" that lives the longest wins the game. The game covers math concepts and addresses bycatch issues and the benefits of sea turtle research and conservation efforts. The activity was presented to Mexican fishermen, scientists, and educators at the 2004 Grupo Tortuguero (Sea Turtle Conservation Network of the Californias) meeting in San Jose del Cabo, Mexico.



The Bridge is grateful for the research and collaboration efforts of WiLDCOAST staff. To download the activity in PDF format in English go to <http://www.vims.edu/bridge/wildcoastenglish1.pdf>, or in Spanish go to <http://www.vims.edu/bridge/wildcoastespanol.pdf>.

Workshop on Fisheries Bycatch

SET FOR JUNE 2004

A workshop to involve all who are interested in bycatch issues is slated for **June 29-July 1** in Boston, Massachusetts. Sea Grant programs from Maine to North Carolina are collaborating with the National Marine Fisheries Service and regional management councils to write an implementation plan for the Northeast, as part of a national initiative to address bycatch concerns in the commercial fishing industry.

Workshop panels will focus on science and research, data and monitoring, resource management, and gear engineering. Details are being formulated right now, but you may visit <www.nero.noaa.gov/ro/doc/nero.html> or contact Hannah Goodale at the Northeast Regional Office of the NMFS, at (978) 281-9101 for additional information.

Virginia Sea Grant and several other organizations partnered with Virginia Dominion Power to sponsor a tagging rodeo in January. Over 70 anglers fished at Dominion's plant on the Elizabeth River and tagged and released close to 40 red and black drum and speckled trout (10-24 inches long). Local anglers are asked to write down the tag and phone numbers printed on the orange tag and release any of these fish caught. By doing so and calling in the catch information, anglers will receive a small reward and contribute to this ongoing program studying fish movements in the lower bay.

OYSTER FOOT DISEASE PROMPTS NEW RESEARCH

An unsightly, though harmless, shell disease is making itself known in the East Coast commercial oyster fishery. Site (but not species) specific, this "oyster foot disease" may create a marketing concern – particularly in the half-shell market.

Commercial fisheries specialist Robert Fisher and Drs. Howard Kator and Jeff Shields of VIMS are working to describe the parameters of the disease.

Gross observations of this shell disease reveal striking similarities to the oyster disease, maladie du pied (foot disease) caused by a marine fungus and reported in oysters from Europe and Canada. This shell-boring fungus enters after another shell-boring animal has provided access from the outside shell surface. The fungus grows within the shell and penetrates into the oyster valves at the site of muscle attachment, where the oyster responds by laying down wart-like lesions and raised calcareous knobs.

The knobs protrude into the adductor muscle. Upon shucking these infected oysters, the knobs routinely break off and remain in the muscle, leaving an unsightly open lesion in the shell.

Though evidence of fungus was found in an infected shell sample, recent findings indicate that *Polydora*, a mudworm, is directly involved by boring holes at the base of the knobs. Though the knobs appear to be the oysters' response to wall-off worms that penetrate to the inside, the role of a marine fungus in stimulating this host response cannot be ruled out, said Fisher. Research on ways to possibly reduce the level of *Polydora* infestation during oyster grow-out is planned. Funding has been provided through the Oyster Disease Research Program, a national Sea Grant initiative.

The Mid-Atlantic Sea Grant programs once again hosted a seminar series and children's program at the annual East Coast Commercial Fishermen's & Aquaculture Trade Expo in Ocean City, Maryland. Shown here is an enthusiastic participant in the Lil' Slippers oyster tonging contest.

WORKFORCE TRAINING SURVEY FOR MARINE TRADES

Marine business specialist Tom Murray is conducting a survey to assess workforce training needs in Virginia and the Mid-Atlantic region. Survey questions are designed to determine the regional market for enhanced marine trades education in an economic sector covering some 2,000 marine-related businesses.

Early returns in Virginia are quite encouraging and should provide information that will help those interested in this type of education develop meaningful programs for the marine industry and tidewater Virginia communities.

Final results of the survey distributed in collaboration with the New Jersey, Maryland, and North Carolina Sea Grant programs are being compiled currently by VIMS. Under a contract with the Northern Neck Planning District Commission, a final plan of action to develop and implement a marine trades education program will be completed over the coming months.

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 invite public comment on the strategic plan, its priorities and its directions until June 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 in the strategic plan.

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 <vsr4z@virginia.edu>. Please include your name and address as well as a brief description of your connection to Virginia's coastal and marine resources and/or environments.

CONGRATULATIONS
to this year's winners
of the
Blue Crab Bowl!

Thomas Jefferson High School in Alexandria once again walked off with first place honors in this academic competition held on Feb. 28th at Old Dominion University.

Pictured here, from left: Coach Lisa Lyle Wu and team members Amy Freitag, Katie Mercer, Cory Pender, Lisa Morrone, and captain Kay Au.

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