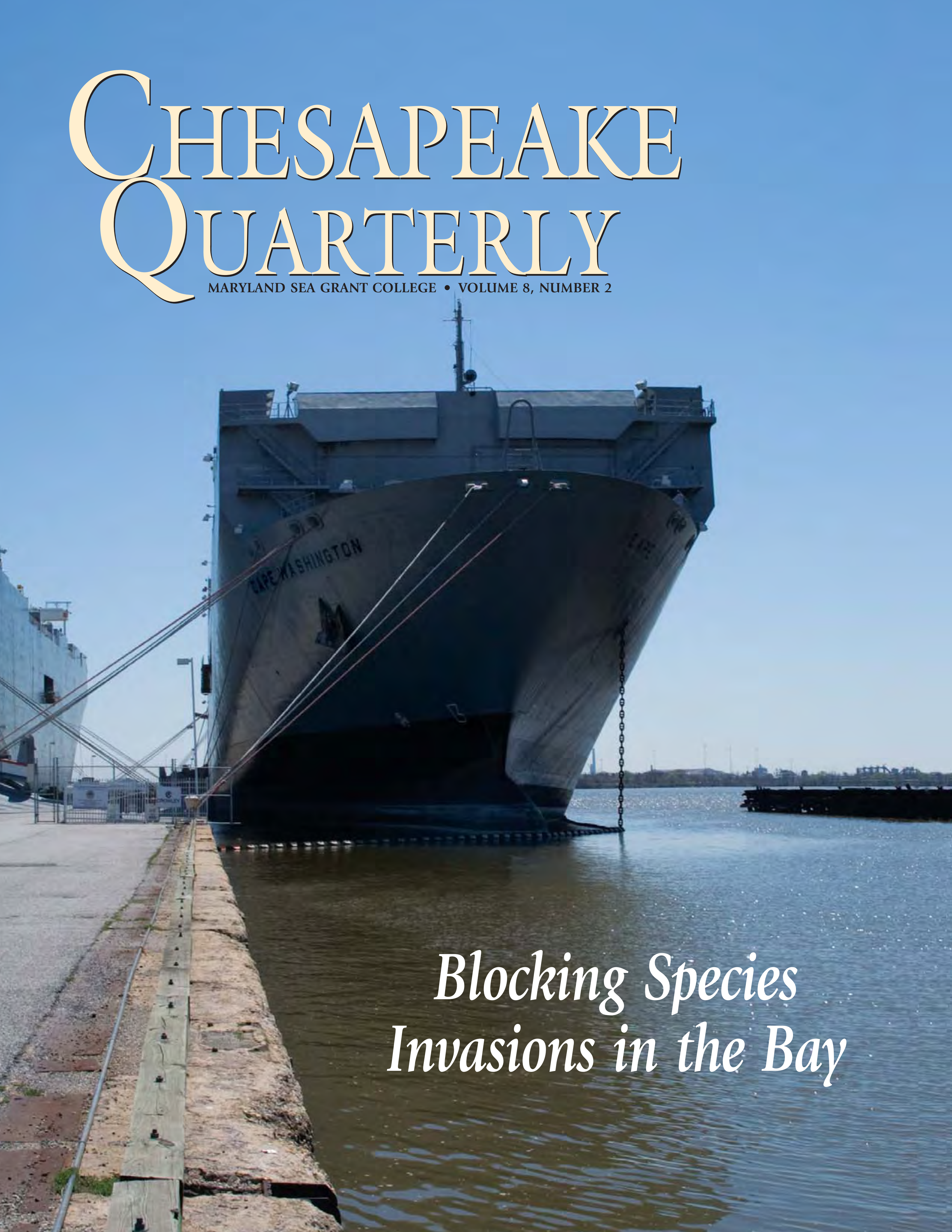
CHESAPEAKE QUARTERLY

MARYLAND SEA GRANT COLLEGE • VOLUME 8, NUMBER 2



Blocking Species Invasions in the Bay

contents

Volume 8, Number 2

CHESAPEAKE QUARTERLY *June 2009*

Chesapeake Quarterly explores scientific, environmental, and cultural issues relevant to the Chesapeake Bay and its watershed.

This magazine is produced and funded by the Maryland Sea Grant College Program, which receives support from the National Oceanic and Atmospheric Administration and the state of Maryland. Editors, Jack Greer and Michael W. Fincham; Managing Editor and Art Director, Sandy Rodgers; Contributing Editor, Erica Goldman; Science Writer, Jessica Smits. Send items for the magazine to:

Maryland Sea Grant College
4321 Hartwick Road, Suite 300
University System of Maryland
College Park, Maryland 20740
301.405.7500, fax 301.314.5780
e-mail: mdsg@mdsg.umd.edu
www.mdsg.umd.edu

NOAA Sea Grant

We gratefully acknowledge support for *Chesapeake Quarterly* from the Chesapeake Bay Trust for 2009.

Cover photo: *Dark sentinel on the Baltimore waterfront, the* MV Cape Washington *keeps watch after its return from the war in Iraq. While it waits in ready reserve, the ship serves as a maritime test facility, helping to defend against invasive species transported in ballast water.* PHOTO BY JESSICA SMITS. ***Opposite page:*** *While the Potomac may be known as "the nation's river," it's now home to several species from far away, including snakehead and hydrilla from Asia.* PHOTO OF POTOMAC RIVER BY MICHAEL W. FINCHAM; INSET PHOTO OF SNAKEHEAD (LEFT) BY THE U.S. GEOLOGICAL SURVEY; INSET OF HYDRILLA (RIGHT) BY MICHAEL NAYLOR.

The Ecological Numbers Game

They called it "the frankenfish." It was the summer of 2002, and an invasion by an air-breathing fish from Asia that could walk on land spurred a media frenzy. Though the most sensational stories proved to be nothing but fish tales, the snakehead soon became a poster species for how easily non-native animals and plants can set up shop in the Chesapeake. No sooner had officials eradicated the toothy invader in a Crofton, Maryland pond than it showed up in the Potomac. The snakehead quickly established what appears to be a firm finhold in the river.

Less able to grab the headlines are scores of other non-native species — plants, animals, and microbes introduced from somewhere else and now in the Bay. Some of these species have taken hold without notice and without apparent harm. Others have killed our oysters, smothered our grasses, degraded our shorelines.

And there are thousands of other non-native species that could yet come to the Chesapeake. That's according to experts like Greg Ruiz, head of the Marine Invasions Research Laboratory at the Smithsonian Environmental Research Center. We don't know which species will come and when, where they will end up, or whether they will cause real harm. It's a numbers game, says Ruiz. An ecological roulette of sorts.

What do we do when we lose the game — when an unwanted species shows up on our doorstep? This past year Maryland Sea Grant helped draft a plan for the Mid-Atlantic states to use when faced with an unintended introduction of a non-native species. The plan outlines necessary steps for a "rapid response" — from deciding whether to take action, to determining control methods, to monitoring results.

The idea was to keep the plan short and simple. It still turned out to be over 40 pages. The plan's unexpected length speaks to the complexity of controlling an invasive species once it's arrived. An effective response effort is, unfortunately, seldom short. Or simple.

While working on the plan, I kept thinking about Ben Franklin's well-worn adage, "An ounce of prevention is worth a pound of cure." Though it's important to respond rapidly to a species invasion, the better goal is to avoid that situation in the first place.

This is where understanding pathways for invasions becomes critical — what scientists call vector ecology. Whether by commercial cargo ship or a weekend warrior's Boston Whaler, bait buckets or fly-fishing gear, how we spread invasive species may be just as important as what we do once they get here.

The Maryland Department of Natural Resources convened a meeting over the winter to discuss the discovery of several zebra mussels near the lower portion of the Susquehanna River. One attendee lamented that the public might grow weary of hearing about another "new" invasive species. Snakeheads. Mitten crabs. Now zebra mussels. Another biologist responded that this march of new invaders shows that focusing on pathways rather than individual species is key. One set of preventive measures — properly cleaning boat hulls, for example — could avoid the introduction of a whole host of organisms.

In this issue of *Chesapeake Quarterly* we explore pathways that invasive species can take to get here, from commercial shipping to the actions of everyday citizens.

We also tell the stories of two non-native species, one that's had devastating consequences for the Chesapeake, and one that hasn't lived up to its initial threat.

Some argue that the introduction of non-native species is a natural turn of events. Plants and animals have been coming and going for millennia. Why should we try to stop them?

The short answer may be, it's a numbers game. Is it worth the gamble?

— *Jessica Smits*

A Question of Ballast

Protecting Ships, Preventing Species Invasions

By Jessica Smits

The wind kicks up over Baltimore Harbor and sends a hard hat flying along the dock. March is going out more lion than lamb. From behind a gritty industrial building come three U.S. Coast Guard inspectors striding along in matching navy-blue jumpsuits. They walk with authority to a black-and-white cargo ship docked in the Patapsco River along the Domino Sugar pier. The ship has come to the refinery to deliver 15,000 metric tons of Mexican sugar. The Coast Guard has come unannounced.

The inspectors walk along the dock checking the condition of the twenty-two year-old ship. Block letters painted white on the black bow spell out its name and origin: *Tamoyo Maiden*. Manila. One officer lifts a tarp on the side of the ship to eyeball the hull's level in the water. It's all part of a Port State Control Inspection to see whether a foreign ship is complying with United States and international maritime laws on safety, security — and the environment.

A bakery-sweet smell spices the air as the inspectors climb to the main deck, the bright orange steps sticky under their black steel-toed boots. At the top, members of the *Tamoyo's* Filipino crew check their identification, then quickly escort them to the captain.

Victorino Escoto aims to please his visitors. The slight captain greets them eagerly and smiles often. Standing by, his burly chief mate offers sodas from the captain's fridge, the familiar red Coca-Cola can accented with Asian characters from a faraway port. Courteous but all business, the Coast Guard inspectors ask to see the ship's documentation.

Captain Escoto gathers several over-stuffed binders and lays them on a table for the Coast Guard to review. Each binder contains sets of meticulously organized documents, mostly pertaining to things like crew lists, emergency procedures, voyage logs. But one of the first binders examined has an environmental purpose: the Ballast Water Management Plan.

While the captain and crew tend to the inspectors, dockworkers operate mechanical claws, grabbing sugar out of

Longtime Baltimore landmark, *the Domino Sugar refinery takes Mexican sugar from the* Tamoyo Maiden*, a freighter flagged in the Philippines (left). Like a kid in an oversized sandbox, a dockworker scrapes raw sugar from massive bins in the ship's hold (above). When the sugar's gone, the* Tamoyo *will take on ballast water from the Patapsco River before heading out to sea.* PHOTOS BY JESSICA SMITS.

the ship's large red bins and dumping it onto a conveyer belt heading into the refinery. When the unloading is complete, the *Tamoyo Maiden* will depart empty. Empty that is, except for water.

To prepare for the ship's next journey, Chief Mate Rodelito Lardizabal will direct crewmembers to fill the ship's ballast tanks with Patapsco River water. Without ballast water and without cargo, Lardizabal says, the ship's propeller and rudder may not even sink below the surface. Water weight provides stability and maneuverability to the *Tamoyo* — and to hundreds of other ships in the global fleet that travel with ballast water every day.

But when the crew of the *Tamoyo Maiden* fills its ballast tanks alongside the Domino pier, they'll bring more aboard than water. Grates on the intake pipes will no doubt keep out large fish, but smaller organisms — larvae, algae, microbes, cysts — will likely slip through as unwitting stowaways. When discharged in another port, hitchhikers like these can cause ecological catastrophe.

In 1982, the comb jelly, *Mnemiopsis leidyi*, arrived in Europe's Black Sea in ballast from North America — perhaps even from the Chesapeake Bay. The comb jelly functions as an important component of the food web in the Chesapeake, but in Europe its insatiable appetite was blamed for decimating fisheries already in decline.

In 1988, the zebra mussel, *Dreissena polymorpha*, a native of the Caspian Sea region, first showed up in the North American Great Lakes. Since then, this colonizing filter feeder has cost billions of dollars in damages by clogging infrastructure at places like water treatment facilities and power plants.

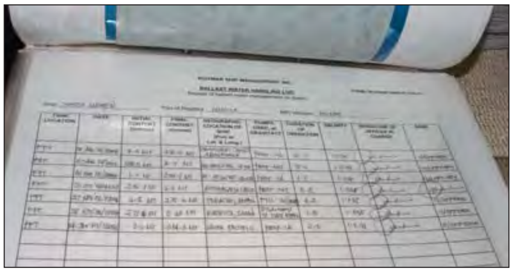
Global shipping is the prime mover behind most aquatic invasions, according to Greg Ruiz, one of the world's leading "invasion ecologists." As the head of the Marine Invasions Research Laboratory at the Smithsonian Environmental Research Center (SERC), Ruiz sits at the hub of invasive species research in the Chesapeake and beyond. Organisms arriving in ports aboard ships — whether in ballast or attached to hulls — often find an ecosystem already degraded by intense human activity. He thinks debarking into a degraded environment may make it easier for a non-native species to establish itself as an invader.

The comb jelly and zebra mussel invasions brought national and international attention to ballast water's role as a pathway for the introduction of non-native species. Decades later, scientists and managers are still asking — how can we protect the environment and keep ships moving safely around the globe?

Fate Hangs in the Ballast

Three months before arriving in the Chesapeake Bay, the *Tamoyo Maiden's* crew filled nine of twelve ballast tanks with water from the port of Onsan, South Korea. Steel products on board provided additional weight. After stopping to offload goods in several countries, the ship arrived in Coatzacoalcos, Mexico, where it picked up sugar bound for Baltimore and emptied its nine tanks. But the water it discharged in Mexico was not from Korea.

Along its route, a little more than halfway between Japan and Hawaii, the



Kevin Bell

***Disaster at sea** can result if ballast tanks fail. That's what happened to the car carrier,* Cougar Ace *(left), during an open-ocean ballast exchange. While such accidents are rare, many see them as one more reason to find an alternative to exchange. Intense scrutiny marks the face of U.S. Coast Guard Ensign Jerome Brown as he studies the* Tamoyo Maiden's *records, with Captain Escoto looking on (above, right). A three-hour port inspection of the ship includes reviewing ballast water management documents and examining the trim of the hull (above, left).* PHOTOS ABOVE BY JESSICA SMITS.

ship opened its valves and turned on its ballast pumps. Seawater from the middle of the Pacific Ocean rushed into the tanks, forcing out Korean coastal water. The entire process — so-called "mid-ocean exchange" — took several hours. This swapping of water was done for one reason: to avoid potential invasion by non-native species.

The theory behind ballast water exchange is that organisms suited to the saltier open ocean will not survive in coastal environments and, in turn, that coastal organisms won't survive the high seas. In 1993, in response to the zebra mussel invasion, the United States first mandated that ships coming from foreign ports to the Great Lakes exchange ballast water offshore. In 1998, they broadened their reach and called for all vessels entering any U.S. port from abroad to voluntarily exchange their ballast water outside the Exclusive Economic Zone (EEZ) — at least 200 nautical miles offshore. After low voluntary compliance, exchange became mandatory in 2004. The United Nations International Maritime Organization (IMO) calls for similar action.

Ruiz finds "very convincing evidence" that these policies have reduced concentrations of coastal organisms in discharged ballast. He believes that ballast water exchange has likely prevented invasions.

He's also quick to point out exchange's shortcomings. Residual coastal water and organisms can stay behind in ballast tanks, even after exchange. Just how many foreign organisms remain, and what they mean for the risk of invasion, is highly variable and subject to debate.

Ruiz also notes that exchange is not always practical for seagoing vessels, and often not required. According to an analysis by the U.S. Coast Guard, about 65 percent of all ships arriving to U.S. ports from outside the EEZ don't have to exchange ballast because they didn't travel more than 200 miles from any shore. This can include ships coming up from South America and passing through the Caribbean, for example. The number of ships not exchanging ballast is even higher when you include coastwise vessels — ships visiting ports along the same coast.

And then there's the issue of safety.

In July 2006, the *Cougar Ace*, a car carrier on its way from Japan to North America, began ballast water exchange off the Aleutian Islands. When its starboard ballast tanks failed to refill properly during the exchange, the huge vessel rolled to the portside, unable to right itself. Tragically, one rescuer died in the salvage effort.

To guard against accidents like this, regulations allow exceptions for safety when — during bad weather, for example — conducting an exchange could jeopardize the ship or crew.

Kathy Metcalf, director of maritime affairs at the Chamber of Shipping of America, thinks ballast water exchange is problematic in any situation. She has strong feelings about the requirement.

"Exchange," she says, "is horrible." She adds that ballast exchange burdens the crew, who should be concentrating on safely operating the vessel, and that it doesn't provide sufficient protection to the marine environment.

Metcalf's opinion matters. An attorney and former ship officer for Sunoco, she now represents the shipping industry before Congress and is a member of the U.S. delegation to the IMO's Marine Environment Protection Committee. But it's not that she thinks ballast water shouldn't be managed. "The environment deserves it," she says.

She just sees another way. "The shipping industry in general would prefer to have economically viable, environmentally beneficial treatment systems."

Don't Exchange It, Treat It

Just around the river bend from the Domino Sugar refinery, the *MV Cape Washington* sits in ready reserve. The slate-gray behemoth serves the Maritime Administration, an agency often tasked with supplying food for humanitarian efforts and bringing resources to the military overseas. If called upon, the *Cape Washington* can ship out in five days. On its last mission, the roll-on roll-off carrier ferried equipment to Iraq — humvees, helicopters, tanks — and returned home with similar items in need of repair. But now the *Cape Washington* is helping with a different sort of mission.

***Maritime Environmental Resource Center** director Mario Tamburri (top) oversees testing of ballast water treatment systems. New technologies come in large containers like the one housing the filter-UV apparatus (bottom left). George Smith tests treated water with a probe, while Tim Mullady records the results. The two Smithsonian Environmental Research Center biologists form part of a multi-institutional team studying how treatment systems affect ballast water.* PHOTOS BY JESSICA SMITS.

Deep in a corner of its cavernous underbelly, a maze of pipes and hoses has replaced military equipment. A team of casually dressed biologists and engineers scurries about, apparently oblivious to the stench of fish and sludge that sours the air. This test facility is part of the Maritime Environmental Resource Center (MERC), an initiative launched by the University of Maryland Center for Environmental Science (UMCES) and the Maryland Port Administration. Their goal? Address environmental issues facing the shipping industry. Priority number one: ballast water.

Mario Tamburri, a researcher at the UMCES Chesapeake Biological Laboratory, directs the Center. He talks fast and exudes enthusiasm. "Ships were not meant to do this," he says, referring to ballast water exchange. "It was an interim solution."

For well over a decade, Tamburri and others have worked on what they think could be a better solution: treating ballast water to eliminate the life within it. Filters, oxygen strippers, UV rays, biocides — no matter the method, the idea is the same. An effective treatment system could remove invasive species while abolishing the need for exchange at sea.

It's an idea that's recently gained significant traction with environmentalists, governments, and the shipping industry alike.

MERC was launched after the Maryland Port Administration and Congressman Elijah Cummings approached UMCES president Don Boesch about tackling the issue of ballast water and invasive species. The Port had funded projects involving treatment technology in the past, but the trend was moving away from individual scientists' academic projects and toward real-world implementation.

In the real world, standardized testing is key. Otherwise systems won't win approval, or certification, from flag states around the globe. As part of an international convention for managing ships' ballast water, the IMO has issued guidelines on testing and a "discharge standard" for treatment systems (see Navigating Ballast Water Management, p. 10). But companies that develop the technology don't necessarily have the expertise to measure biological effects — things like how much life remains in the water and how discharge of treated water may affect surrounding water quality. With experienced biologists from area institutions like the University of Maryland and the Smithsonian Environmental Research Center onboard, Tamburri says, MERC can answer these questions.

MERC solicits applications from technology companies who want to test a system in order to move it along in the approval process. And as an independent third party, Tamburri notes, MERC lends credibility to the test results. "You don't want an infomercial from the company."

With the onset of spring blooms of plankton in the Chesapeake, MERC has just begun its second season of testing. According to Tamburri, the Bay provides ideal conditions to challenge the systems because a mixed bag of phytoplankton and zooplankton abound from spring through fall. The system under review today will use a filter and UV light — a one-two punch to remove organisms from the water.

The *Cape Washington's* ballast tanks are each filling with water from the Patapsco. The turbid water, rich in life, enters the ship and then splits into two separate obstacle courses of piping.

One pipe sends the water straight into the starboard tank — the experimental control. The second pipe includes a detour to a white box, about the size of a small trailer, containing the treatment system. Before entering the portside tank, the water moves through the filter to remove sediment and organisms larger than about the size of a speck of pollen (25 microns). Then the water courses through a stainless steel drum containing bulbs of high intensity UV light. The UV rays pulse the water before it finally enters the portside ballast tank.

While engineers monitor the flow through the treatment system, biologists divert about one cubic meter of untreated ballast water into a large plastic jug. Once the jug is full, they work quickly to collect samples for a whole suite of analyses.

They dip a probe into the tea-colored water to measure physical properties like temperature, acidity, dissolved oxygen, and salinity. This afternoon they'll examine samples under a microscope to identify and count the living organisms.

Additional samples will go back to the lab for chlorophyll analysis and tests for bacteria. All together, this collection of work will show the initial conditions of the untreated water.

The team then does the same for water that's passed through the treatment system. This gives them a read on the conditions of the water soon after it courses through the filter and UV rays.

Water stays in the two ballast tanks for five days, mimicking the length of an average journey at sea.

When they return the next week, the MERC team begins to pump out the tanks. They carry out the exact same protocol as they did days before, gathering data on how life and conditions within the two tanks have changed over the holding period.

As they prepare for sampling, they take a look at treated water running out of blue hoses into a tub. "Looks good enough to drink," one of the biologists quips. Although this quick assessment is not a judgment on the system's success, the contrast is stark between the brown, smelly untreated water that came in the pipes last week and the clear treated water now flowing through the hoses.

Did this filter combined with UV radiation work?

Roadblock to Implementation

MERC can answer only part of that question. They'll compile data from the trials and provide results to the company developing this treatment system and to any governments or organizations it requests. But after they provide the data, it'll be up to others to decide whether this treatment method meets their standards and whether to allow it as an alternative to exchange. And that road gets complicated.

Continued on p. 10

PATHWAYS

Ballast water isn't the only way that non-native species move from place to place. How we work and play and even some of our cultural traditions can all contribute to the spread of potentially invasive animals, plants, and microbes. The study of these pathways — a field called vector ecology — has emerged as a key part of efforts to avoid species invasions. Here's a look at some of the top vectors on the minds of scientists and managers.

Hull Fouling

While organisms transported inside ballast tanks seem to garner the most attention, those attached to the outside of a ship may be equally — or more — to blame. "It's not just about ballast," says invasive species expert Greg Ruiz of the Smithsonian Environmental Research Center (SERC). "There's pretty good evidence, both within the Chesapeake and on a national scale, that hull fouling is really important as well."

Attached to the hulls of commercial ships, fouling organisms like mussels, barnacles, and encrusting algae can spread around the globe. Researchers at the SERC Marine Invasions Research Laboratory study ways to stem fouling through the use of special paints and other physical means. In the coming year the SERC scientists plan to work with the Maritime Environmental Resource Center as it also dives into the hull fouling arena. An added incentive to fix the problem? Biofouling increases drag, which increases travel time and fuel consumption.


Zebra mussels

But commercial ships are not the only culprits for spreading fouling organisms. While ballast water likely brought the zebra mussel to North America, recreational boats have largely contributed to the bivalve's spread — so-called secondary invasions — throughout lakes and rivers of the midwest, south, and northeast. In the fall of 2008, six zebra mussels showed up near the lower Susquehanna River — one on a boat hauled out for the winter. This year, the Maryland Department of Natural Resources (DNR), with additional support from Maryland Sea Grant, sent all boat regis-

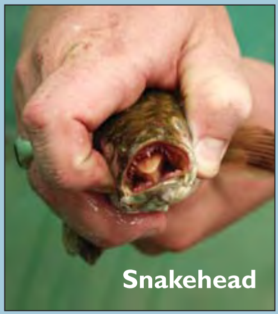
FOR INVASIONS . . . .

tration holders a flyer urging them to take extra steps to clean their boat, trailer, or dive gear.

Live Trade

Global commerce has made it easier than ever to exchange goods — and non-native species. Greg Ruiz thinks the trade of live plants and animals is playing an increasing role in aquatic invasions. But this market is constantly in flux, he says, and scientists don't know enough about it.

Seafood


Snakehead

The discovery of snakeheads, predatory Asian fish, in a Crofton, Maryland pond in 2002 captured significant attention and led to a successful effort to eradicate them in the pond. A local resident ultimately admitted to having released two snakeheads into the pond after purchasing them at a live seafood market in New York. Another introduction in a Virginia creek has led to snakeheads thriving throughout the Potomac River and tributaries in Virginia and Maryland.

Aquarium Pets

Exotic aquarium pets can also wind up in a new environment. Jonathan McKnight, co-chair of Maryland DNR's Invasive Species Matrix Team, notes that pacu fish, a South American species that closely resembles a piranha and is popular with aquarists, have periodically shown up in Maryland waters. Ruiz says such introductions to the wild usually occur when people no longer want to take care of their pets. Working with the Maryland Association of Pet Industries, DNR and Maryland Sea Grant have produced a poster for use in pet stores advising pet owners not to release non-native animals into the environment.

Bait


Rusty crayfish

Unused bait discarded into a waterway at the end of a day's fishing also leads to invasions. McKnight notes that non-native species are widely available in bait shops throughout the area. This is probably how rusty crayfish, native to parts of the midwest, ended up in Maryland. Blamed for displacing native crayfish and preying on plants and invertebrates, "rusties" are now illegal to use as bait.

Fishing Gear

Along with boats, fishing equipment can also serve as a vector for invasion. Wading gear can carry microscopic organisms from one stream to the next. McKnight notes that the tendency of fly fishermen to travel — Montana one weekend, Maryland the next — complicates the problem.


Didymo

In 2008, the discovery of an invasive algae referred to as Didymo (short for *Didymosphenia geminata*) spurred sharper vigilance in Maryland. Also called "rock snot," the algae can form slime-like mats that cover stream bottoms, smothering life. To combat the spread of Didymo and other invasive organisms like it, Maryland DNR asks fishermen to use rubber-soled waders — rather than felt, which can hold more water and more organisms — and to disinfect gear with detergent or salt solution.

Water Gardens

Invasive plants used in aquatic gardens pose a threat as well. Pond owners who dispose of plants improperly or ponds that overflow in heavy rains can introduce non-native species into local streams and rivers. In 2007, officials found water lettuce, an attractive but troublesome weed, in Mattawoman Creek, a tributary of the Potomac River.


Water lettuce

Biologists say non-natives like this can crowd out native plants, block sunlight, deplete oxygen, and even impede boating. Since water lettuce is tropical, its presence here provokes another question. Will rising temperatures allow warm-weather species like this to survive and spread farther north?

Intentional Introductions

Honeybees, cattle, carp. Non-native species don't always appear by accident. Often they're introduced as part of a larger plan — to boost agriculture, the fishing industry, recreational activities, the list goes on. But even species meant to enhance our quality of life have the potential to cause unintended negative consequences.

In the 1950s, semi-aquatic rodents called nutria were introduced to Maryland in an effort to promote the fur industry. The highly prolific animal eventually overran Chesapeake Bay marshes, destroying vegetation and outcompeting native muskrat. Decades later, a multi-agency partnership to control the nutria population through trapping and hunting has successfully cleared over 150,000 acres of nutria. But work remains as managers continue to inspect hundreds of thousands of additional acres.


Nutria

More recently, a proposal to introduce an Asian oyster, *Crassostrea ariakensis*, in the Chesapeake showed how heated the issue of intentional non-native species introductions can get. While some argued that the introduction could help restore oysters to the Bay, others cried foul. They argued that the non-native oyster could bring disease and unforeseen problems to the Bay. In March 2009, after years of studying the issue, state and federal officials announced that they had abandoned the idea of bringing in the non-native oyster — at least for now.

— J.S.

***A grab bag of non-native species** — from repulsive rock snot to attractive water lettuce — lives in the Chesapeake and its tributaries.*

PHOTO CREDITS: ZEBRA MUSSELS, NOAA; SNAKEHEAD, U.S. GEOLOGICAL SURVEY; BAIT, MATTHEW SELL; FISHING GEAR, STEPHEN WITHERDEN; DIDYMO, MARYLAND DEPARTMENT OF NATURAL RESOURCES; WATER LETTUCE, NANCY RYBICKI; AND NUTRIA, CAROL A. HOLKO.

Navigating Ballast Water Management

Over the past two decades, managing the discharge of ballast water has evolved into a complicated tangle of international, federal, and state law — and lawsuits. Here's a glimpse at what's happening now.

International


SERC Marine Invasions Research Laboratory

On the global stage, the International Maritime Organization, a United Nations agency focused on shipping safety and pollution, has developed a legal framework to regulate ballast water. In February 2004, at a diplomatic conference in London, representatives from member countries adopted a treaty with a very long title: the International Convention for the Control and Management of Ships' Ballast Water and Sediments. In addition to a ballast water exchange standard, the convention created discharge standards for treatment methods (for example, the number of living organisms that can remain in the water). The convention allows countries to create their own stricter standards — an important stipulation for the United States, which reportedly lobbied for more stringent discharge standards than those finally adopted. For the convention to enter into force, 30 countries, representing 35 percent of the world's merchant shipping tonnage, must sign on. The U.S. has not yet ratified the treaty.

Federal

In the United States, the Coast Guard regulates ballast water management under the National Aquatic Nuisance Prevention and Control Act of 1990, later reauthorized as the National Invasive Species Act of 1996. Starting in 2009, the Environmental Protection Agency (EPA) is exercising regulatory authority as well.

Why the shift? In 2003, environmental groups brought a lawsuit against the EPA for failing to regulate ballast water as point-source pollution under the Clean Water Act. The EPA had exempted ballast water as a point source and later noted that Congress had directed the Coast Guard, not them, to regulate ballast water. After years of appeal, in 2008, the Ninth Circuit held that the EPA could no longer exempt ballast water or other discharges normal to the operation of a ship.

Forced to enter the ballast water arena, the EPA created a blanket permit that, in effect, called for following the Coast Guard's ballast water regulations. This so-called Vessel General Permit, which went into effect in February 2009, disappointed some states and environmental groups that hoped EPA would use this opportunity to enact stricter ballast protocols. The Coast Guard reports that it's working with the EPA to minimize complications that could arise with two different agencies, working under different statutes, regulating the same thing.

And the situation continues to evolve. The EPA's new administrator, Lisa Jackson, told the Great Lakes Commission that the permit "doesn't begin to address some of the concerns that are out there."

State

Many states have taken ballast water management into their own hands. Fearing that federal (and international) policies don't do enough to protect their waters from invasive species, some states require ships to take additional measures before discharging ballast water in their ports. California, Oregon, and Washington, for example, require coastwise vessels to undergo ballast exchange 50 nautical miles from shore. California has also developed treatment standards that call for zero organisms in discharged ballast water by 2020. Recently, many states took advantage of a provision in the Clean Water Act that allowed them to require vessels to meet more stringent state standards than those included in the EPA's new Vessel General Permit.

The shipping industry largely denounces state measures as patchwork regulations that complicate their ability to do business. "A vessel that goes to New York has to do one thing, but when it goes to Baltimore, it's got to do something else," says Kathy Metcalf of the Chamber of Shipping of America. She says the industry wants a federal ballast water management program that creates one national standard and preempts states from "creating their own and often conflicting programs." "My organization can support the most stringent standard necessary that is technologically achievable," she says. "As long as it's the only standard around the nation." Environmentalists and concerned states want to make sure that any national standard is in fact stringent.

— *J.S.*

Ballast, continued

If the results from the MERC tests look promising — that is, if they meet standards set by the IMO — this filter-UV treatment system will move into the shipboard testing phase. This requires operating on a ship at sea under real-life conditions. Success there means the developer can ask a ship classification society, such as the American Bureau of Shipping, to approve the system as technically sound and safe for use on a ship. From there, the company will approach flag states for certification as a ballast water treatment system that meets IMO standards and requirements.

For now, one thing is certain. The United States will not be approached for certification. The federal government currently does not recognize treatment as a ballast water management tool — exchange is the only option.

Mario Tamburri notes that the first treatment technology to be certified was a deoxygenation system developed by NEI Treatment Systems, based in Los Angeles. Although the system was tested using federal grants from the National Oceanic and Atmospheric Administration (NOAA), NEI could not seek approval for use in the United States because the U.S. does not yet have a procedure in place for approving systems. So, Tamburri says, the U.S.-based company packaged all their information and submitted it to Liberia — commercial shipping's second largest flag state.

According to Coast Guard biologist Rich Everett, the U.S. is moving toward replacing exchange with treatment. Everett has been involved in writing regulations to that end. He acknowledges that the Coast Guard has finished drafting regulations and that they're going through a formal review process with other agencies. How close are they to publishing it as a proposed rule? Everett would not comment except to say that it's impossible to predict because of the many important issues facing the government.

Tamburri is hopeful that publishing the regulations is imminent, within the next year or so. Meanwhile, some states have given up waiting for the federal government and have created treatment regulations of their own (see Navigating Ballast Water Management, at left).

Coastwise Coda

Just a few weeks before MERC's trials began for the season, the *Tamoyo Maiden* took in untreated water — no doubt packed with microscopic life — less than a mile from where the *Cape Washington* sits. Captain Escoto expected that their next port of call would be Lake Charles, Louisiana. As a coastwise voyage the ship would not be required to exchange its ballast water. In order to take on their anticipated cargo, the crew planned to discharge their Baltimore Harbor water into an artery of the Gulf of Mexico — an entirely different ecosystem from the Chesapeake Bay.

Tamburri sees these types of coastal voyages, where exchange is not required, as potential for trouble. He thinks the biggest issue is that once there's an invasion in a place like the Chesapeake Bay, it spreads through coastal routes, resulting in secondary invasions.

The Coast Guard's Rich Everett agrees. He doesn't know of any biological evidence that shows coastwise transport of ballast water poses less of a risk for introducing or spreading an invasive species than transoceanic ballast transport.

West coast states have addressed the issue by requiring most coastwise ships to undergo exchange at 50 nautical miles offshore. Everett says this is considered effective on the west coast because the continental shelf is narrow and a ship can be in deep oceanic water — rather than coastal water — without having to detour too far out of the way. The oceanographic conditions created by the narrow shelf also reduce mixing of offshore and inshore waters. All of this decreases the likelihood that non-native coastal organisms discharged only 50 miles out would wind up reaching inshore habitats.

On the east coast, the continental shelf is much broader, and vessels have to venture farther offshore for effective exchange, an impractical option on coastwise trips.

Tamburri and Everett think that if treatment becomes mainstream it could help solve issues like this. A treatment system could operate without forcing a ship to divert from its course or to carry out a risky exchange. A win for industry. And a treatment system could run in situations where exchange is not required. A win for coastal environments.

The *Tamoyo Maiden* never made it to Louisiana. Before leaving Baltimore, Captain Escoto got different orders — not unusual in an industry whose logistics depend on the dynamic flux in demand for goods around the globe. The change in itinerary sent the cargo ship up the Atlantic coast to the Saint Lawrence River and on to Montreal. The Gulf of Mexico got a reprieve from Baltimore water. At least this time.

Along the way to Montreal, hundreds of miles off Long Island at the edge of the continental shelf, the *Tamoyo* once again opened its valves and turned on its ballast pumps. Water from the Atlantic Ocean flowed into the tanks, and a piece of the Patapsco River flowed out into the sea.

Canadian law called for this exchange. The St. Lawrence has been burned before. Years ago, a ship headed toward the Great Lakes entered here, unaware that it carried the devastating zebra mussel in its ballast tanks. For now, ballast exchange provides some defense again the next invasive mussel or crab or microbe. But it is an imperfect defense, and many hope that there will soon be a better one.

— *smits@mdsg.umd.edu*

Rapid Response Planning

While preventing invasions is key, managers must also be prepared to take action when prevention measures fail. To foster an effective response to aquatic invasive species introductions, Maryland Sea Grant and the Mid-Atlantic Panel on Aquatic Invasive Species worked with their partners to produce *Rapid Response Planning for Aquatic Invasive Species*.

The rapid response plan employs Incident Command System (ICS), a response framework best known for its application to environmental disasters like wildfires and oil spills. ICS provides a common language and a step-by-step approach to organizing response efforts. It aims to help individuals from various agencies and jurisdictions work together as a well-coordinated unit. Use of ICS for invasive species incidents — a relatively new endeavor — is backed by the congressionally mandated Aquatic Nuisance Species Taskforce.

The Rapid Response Plan is available in two formats: (1) A Template and (2) A Maryland Example.

The template is available as a Microsoft Word document to encourage states in the Mid-Atlantic and beyond to adapt the plan to their specific needs while maintaining a common framework across the region. Maryland was the first state to complete the template, and its resulting plan is available for use as an example. Anyone may download both the template and Maryland example at www.mdsg.umd.edu/rapidresponse. The state of Delaware has also used the template and is currently finalizing its plan.

For More Information

Maritime Environmental Resource Center
www.maritime-enviro.org/
Marine Invasions Research Lab
www.serc.si.edu/labs/marine_invasions/
National Ballast Information Clearinghouse
http://invasions.si.edu/nbic/
United States Coast Guard Ballast Water Management
www.uscg.mil/hq/cg5/cg522/cg5224/bwm.asp
Global Ballast Water Management Programme
http://globallast.imo.org/
Mid-Atlantic Panel on Aquatic Invasive Species
www.midatlanticpanel.org/
Maryland Sea Grant
www.mdsg.umd.edu/exotics

Vector Management Workshop

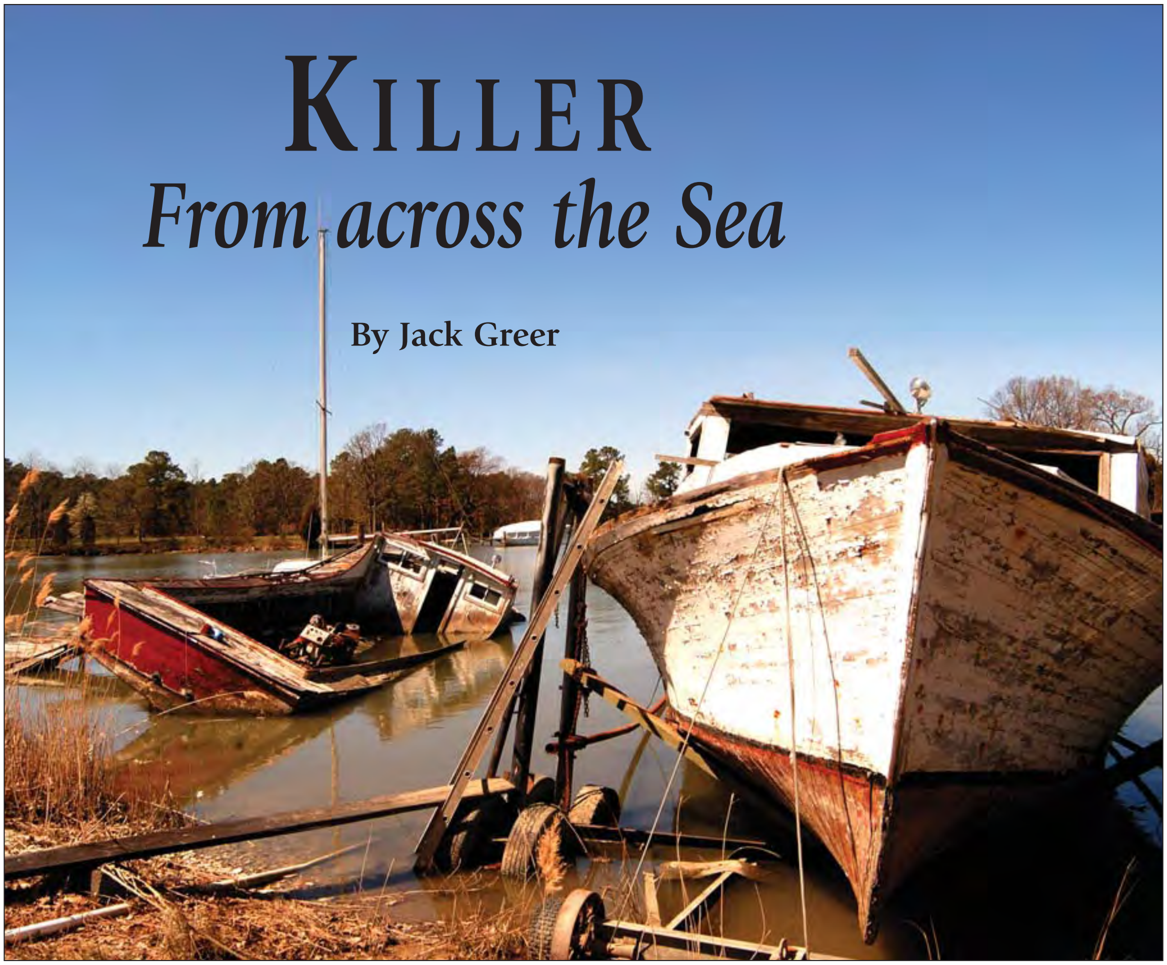
November 17, 2009, Washington D.C. Region


Matthew Sell

Maryland Sea Grant and the Mid-Atlantic Panel on Aquatic Invasive Species will conduct a one-day workshop to bring regional attention to aquatic invasive species introduction pathways. The workshop goal is to develop strategies states can pursue to manage vectors to prevent unwanted introductions of non-native species. For details, visit www.mdsg.umd.edu/vectorworkshop.

KILLER
From across the Sea

By Jack Greer



Skeptics question whether an invasive species has ever really caused significant ecological damage in the Chesapeake Bay. The answer is yes. We called it MSX.

It was like the plague for oysters, and it came from somewhere else. In 1959, when MSX showed up in Virginia's Mobjack Bay, one million oysters died. In a single year. If oysters were once hailed as "white gold," then MSX was the White Death.

More than a nuisance, when this exotic parasite appeared in Chesapeake and Delaware bays in the late 1950s, it destroyed the richest oyster fisheries in the world. It also killed the region's best reef builder and filter feeder.

What about Overharvesting?

Some might argue that the Bay's oystermen had — through decades of aggressive harvesting — already destroyed their golden goose. And there is some truth in that. By knocking down the old bars, watermen not only removed bargeloads of oysters from the Bay, but they left the remaining oysters lying on the bottom. Increasing clouds of sediment covered them. Boring sponges and other predators attacked them.

But it's also true that during the middle of the 20th century the Chesapeake oyster fishery had reached something of an equilibrium. Though down from the reckless white gold rush of the 19th century, for much of the mid-20th century Baywide oyster harvests fluctuated roughly between 20 to 30 to 40 million pounds, year after year. In 1980, in the Maryland portion of the Bay, watermen entering the fishery saw about the same oyster harvest their parents had seen when World War II ended in 1945. About the same harvest Maryland watermen had pulled in as far back as the late 1920s.

Baywide, the oyster harvest — though at a reduced level and constrained by gear restrictions and other rules — found a kind of sustainability. In the 1950s, the Bay was in decent shape. Underwater grasses still lined the shallows. Oysters, crabs, and fish were still in good supply.

Then one day as the 1950s came to a close, a foreign parasite showed up. And that changed everything.

Where Did It Come From?

When oysters began dying in droves in the Delaware and Chesapeake bays, oyster scientists rushed in from around the country. It was not white gold that brought them, but the White Death. They looked at slides beneath their microscopes and found a profusion of round cells (plasmodia), filled with multiple nuclei. They compared these with oyster parasites they'd seen before — but they found no match.

Stumped, they named the unfamiliar organism "Multinucleated Sphere Unknown," or MSX.

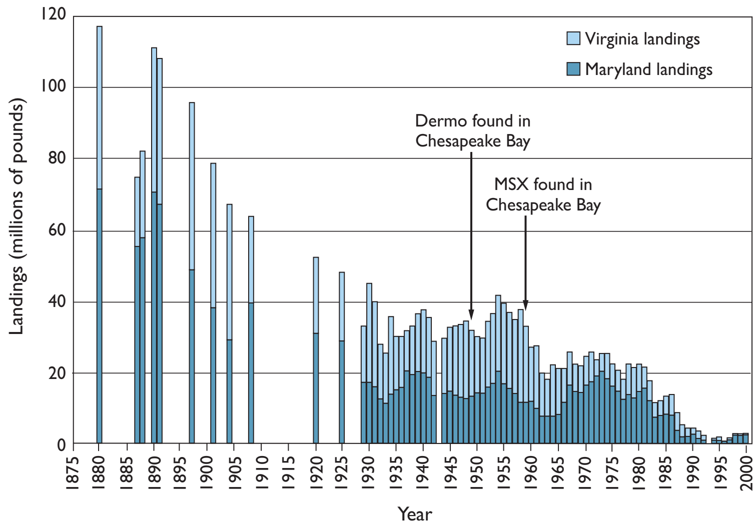
Forty years passed before tools turned up that could pull MSX from a global lineup of oyster parasites. Thanks to genetic detective work by researcher Eugene Burreson and his colleague Nancy Stokes at the Virginia Institute of Marine Science (VIMS), we now know that this oyster killer came from Asia, almost certainly from Japan and Korea, after World War II and the Korean War.

The parasite lives in the Japanese oyster, *Crassostrea gigas*, used for aquaculture in many places around the world, including the northwest U.S. Records show that scientists and oyster growers also brought the Japanese oyster to the east coast, to see how it would do. Ships returning from duty in Japan and Korea may also have unwittingly brought back non-native organisms, including the oyster parasite. Exactly how MSX got here makes for a fascinating story and some intriguing speculation (see Who Killed *Crassostrea Virginica*? on p. 13).

But wouldn't Bay oysters have fought off this foreign invader if decades of overharvesting and habitat destruction hadn't already weakened them?

Burreson doesn't think so. Based on the way MSX swept through healthy oyster bars when it first showed up here, he thinks that oysters would have succumbed anyway. Their immune systems simply had not evolved to handle this invading parasite. Like other diseases — the chestnut blight, Dutch elm disease, small pox — when this parasite from the Old World reached America it found little resistance.

After MSX invaded Delaware, Virginia, and Maryland, it marched up and down the Atlantic coast. In the 1980s, it appeared as far south as Florida and as far north as Maine. In 2000, MSX killed a large number of oysters in Nova Scotia, Canada.



Ghosts of a bygone fishery, *abandoned Bay workboats (opposite page) bear witness to the passing of what was once the world's richest oyster industry. On the oyster landings graph above, the high harvests of the nineteenth century trace the dismantling of the Bay's virgin oyster reefs. Only after the 1920s did Chesapeake oyster harvests stabilize, shoring up a substantial fishery. That changed in 1959 when an exotic parasite called MSX hit. The Virginia oyster harvest plummeted first. Maryland's fishery hung on until the early 1980s, then several years of drought brought disease riding up the Bay on a wedge of saltwater. The Bay's oyster populations have still not recovered.* PHOTO BY MICHAEL W. FINCHAM. GRAPH ADAPTED FROM A NOAA CHESAPEAKE BAY OFFICE GRAPH.

MSX Today

As the Bay moves into the 21st century, MSX is "everywhere" in the saltier reaches, according to Burreson.

But even so, it may be that the shadow of MSX is finally lifting. At least in the lower Bay.

"It's still killing first-year spat [baby oysters]," says Burreson, "but not so much adults." In Virginia, he's seen that once oysters reach their second year, they seem to do okay. It's a similar story in Delaware Bay. Veteran oyster researcher Susan Ford at Rutgers University tells him she's seeing the same pattern.

In both Virginia and Delaware, where MSX has hammered away relentlessly for decades, oysters have developed an apparent resistance.

Says Burreson, "It's taken fifty years."

But the saga of MSX is far from over. In Maryland, where it takes a drought to bring salty water up the Bay, oysters see MSX only at intervals. Burreson thinks they haven't had time to develop the same tolerance as oysters in the lower Bay.

Researcher Chris Dungan agrees. He's at the Cooperative Oxford Laboratory, a research facility on the Eastern Shore created in 1960 expressly to take on the mystery of the new oyster killers. He says that a second oyster disease, known as Dermo (*Perkinsus marinus*), is now more prevalent in Maryland. But ongoing sampling shows that MSX still crops up in dry years when salinity rises.

And it still kills.

And yet Dungan, too, sees a possible ray of hope. The diseases are still out there, but despite dry weather over the last couple of years they haven't killed as many oysters as in the past. Are Maryland's oysters developing some natural resistance? Maybe, he says. We won't know until we have "empirical evidence." The best thing we can do now, he says, is to leave the large survivors in the Bay. He argues that we need sanctuary areas where surviving oysters can reproduce and pass on their ability to resist disease. And then we have to wait.

Still a Mystery

Despite all we've learned about this devastating parasite, there's good reason to keep the X in MSX.

Though scientists long ago characterized the single-celled organism — first naming it *Minchina nelsoni* in 1966 and then *Haplosporidium nelsoni* in 1980 — they still haven't figured out its lifecycle. Or even how it infects its oyster victims.

Burreson still puzzles over this and has devoted endless hours in the search for an intermediate host — an organism that he believes plays a key role in how oysters become infected and how MSX manages to move around so fast and so far. He says it's hard to find continued funding for this work, though, and next year he plans to retire.

"Someone will get lucky one day and just stumble on it," he says. "They'll say, 'Gee, what's this doing here?'" He goes on to say, "I hope this happens before I drop dead. I want to know what it is."

What's the future for oysters and MSX in the Bay? Burreson actually feels "some optimism"— since oysters in high salinity areas now appear to show signs of resistance. The bigger problem now, in Virginia as in Maryland, is that other oyster parasite, Dermo.

This leads Burreson to ask another question. Is there some as-yet-undiscovered connection between Dermo and MSX? Some hidden relationship? We know that Dermo was already in the Bay before MSX showed up. Researchers found it in 1949, the first time they went looking for it. But it wasn't until MSX appeared ten years later that Dermo became a real problem. Cause and effect? Or just coincidence?

That's a hot topic for his younger colleagues to take on, Burreson says. For now he'll have to be satisfied with being part of the team that figured out where MSX came from. That will go down as a pivotal discovery — especially for those who want to know just what kind of damage a non-native parasite can do to a major fishery, and to a national treasure like the Chesapeake Bay.

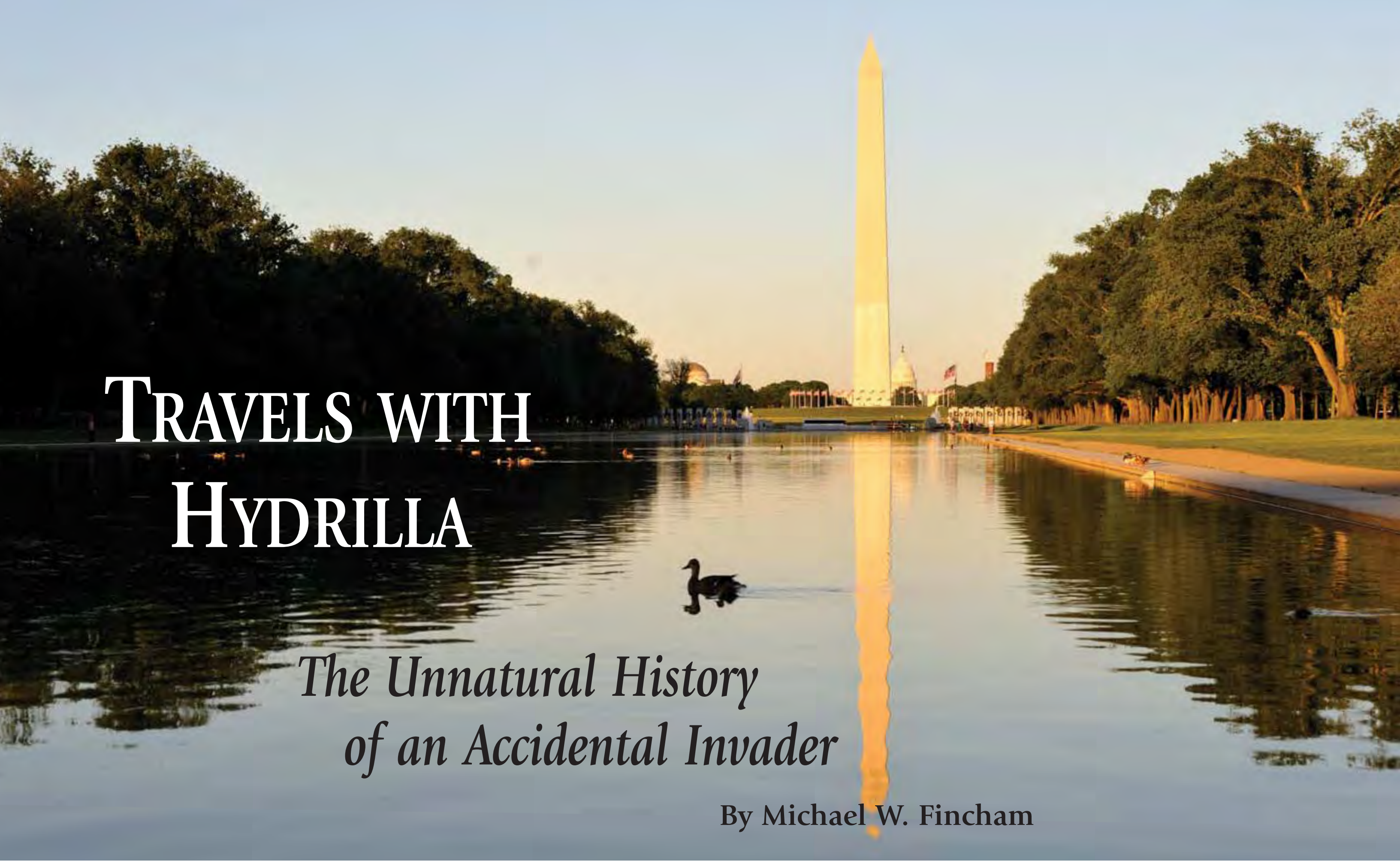
— greer@mdsg.umd.edu

Who Killed *Crassostrea Virginica*?

The remarkable story of how scientists found the origins of MSX and their speculations about how the parasite ended up in the Chesapeake and Delaware bays is now the subject of a new documentary by Maryland Sea Grant, *Who Killed Crassostrea Virginica?* The film traces the decline of the Bay's native oyster and the fatal blow brought by MSX and another prevalent disease, called Dermo.

Produced, written, and directed by veteran filmmaker Michael W. Fincham, the film captures both the poignant destruction of a fabled fishery and the prolonged scientific inquiry into the origins of the killer parasite. Painting a fair picture of the Bay's oyster heritage is a tough assignment. On the one hand the Bay's watermen are its iconographic characters, as native to this region as bullfighters are to Spain. On the other hand, their graceful skipjacks pulled dredges that brought down the Bay's virgin oyster reefs.

The film asks whether we can save both the oyster and the oystermen. And it peers toward a future where the Bay's historic oyster grounds may shrink to areas where disease does not dominate. The film premiered this spring at the Smithsonian Museum of Natural History, as part of the annual Environmental Film Festival, and it will be released for broadcast in September 2009. For more information, visit the web at www.mdsg.umd.edu/oysterfilm.



Travels with Hydrilla

The Unnatural History of an Accidental Invader

By Michael W. Fincham

Early one August morning in 1980, four young scientists from Florida tried to get some sleep on benches near the Washington Monument. Soon enough the Park Police rousted them and they began wandering along the north side of the National Mall. When they reached the lake at Constitution Gardens, the scientists paused, took off their shoes — and waded into the water. When the police caught them this time, they were pulling plants out of the lake and studying their roots.

"This is hydrilla," they told a perplexed policeman with little interest in aquatic plants. It was an accidental discovery but an important one, made by sleep-deprived scientists who had driven all night to make a meeting. Hydrilla, they explained, was a non-native plant found mostly in India, Sri Lanka, Pakistan, and other countries bordering the Indian Ocean. What was it doing on the National Mall?

"We didn't know what hydrilla was," said Richard Hammerschlag, the Park Service scientist who had supervised the plantings. "It wasn't on our radar. It wasn't up here."

Hydrilla was suddenly large on his radar — and not just because it was here on the National Mall. Hammerschlag knew hydrilla had spread through much of Florida, clogging canals and creeks and lakes with thick green mats of vegetation. And he knew Park Service scientists had recently put this same invasive grass out on the Potomac River.

Hydrilla has been confusing scientists ever since it arrived in America. In 1960 two young scientists found hydrilla clogging the Snapper Creek Canal in south Miami, but they had no idea what this mystery plant was or where it came from. Bob Blackburn had been working in Florida for one year. His partner, Lyle Weldon had just arrived. They were the first scientists to study this plant in American waters, but it would take them five years to figure out what it was.

Blackburn and Weldon were part of a group newly organized by the Agricultural Research Service of the U.S. Department of Agriculture. Eastern Florida with its subtropical weather and numerous waterways was ground zero for invasions of aquatic plants from around the world. The new hires were supposed to discover and disable the invaders.

A little detective work turned up the culprit behind the canal invasion. A homeowner told Blackburn she put the plant in the water. Something that looked so pretty in her aquarium would also look nice in the canal. Where did she get the plant? From an aquatic plant dealer who bought plants from overseas and sold them here.

Worried by its rapid spread, Blackburn and Weldon sent plant samples to the University of Florida and the Smithsonian Institution in Washington, D.C. and got the same answer back from scientists at both institutions: this fast-growing plant was probably American elodea.

The second outbreak was 300 miles away in Crystal River, and no detective work was needed to pinpoint the source. An aquatic plant dealer bragged to Blackburn that he had been growing these plants in the river so he could sell them to people with aquariums and backyard water gardens. He knew the plant wasn't American elodea — it was being sold as "Indian Starvine."

When Blackburn and Weldon kept finding tubers and turions, they went looking for a third opinion and got the same answer: this was elodea "with strange growth characteristics." Finally a fourth opinion paid off when they sent samples to Harold St. John, a world authority on aquatic plants. Six months later they got the telegram: this was not elodea. It was hydrilla, a plant native to the Indian Ocean region. At the launch of their careers these young scientists could now take credit for documenting the arrival of a new aquatic plant in North American waters.

They were already driving around Florida observing and photographing new outbreaks. It was work that brought Blackburn and Weldon into a partnership unusual in science. As Blackburn describes it, Weldon was a research partner, then a friend, and finally almost a brother. They worked together, traveled together, and published together.

The famous Reflecting Pool *on the National Mall once held an underwater grass called hydrilla, as did the nearby Constitution Gardens Lake. An invasive species now found in 30 states, hydrilla is native to countries in the Indian Ocean region.* PHOTO BY MICHAEL W. FINCHAM.

And they dove together. Hydrilla, they quickly saw, was "a canopy former," and they wanted to see what lay beneath. To see the underside Blackburn and Weldon began making scuba dives wearing air tanks, weight belts, and regulators. Sinking below the surface, they discovered mats that could grow four to six feet thick, blocking out the sun and sending long vine-like tentacles twisting down to the bottom. It was, Blackburn remembers, like diving into a dark cave.

Hydrilla, they discovered, could snake along the bottom quickly, almost secretly, using vine-like runners. Its long stems then reach upwards toward the surface where they suddenly branch out in all directions, interlacing to form a canopy. It replicates through seeds, buds, and roots, but also through broken shoots that float away, sink, and quickly latch onto the bottom with fine, threadlike roots. By spreading through fragments, the "perfect weed" became a fast traveler. During the 1960s it showed up throughout the state. During the 1970s it would range throughout most of the south.

On February 1, 1970, the partnership ended. Blackburn and Weldon dove into a hydrilla-jammed lake next to a Naval base near Orlando and quickly lost sight of each other under the dark canopy. When Blackburn surfaced he saw no sign of Weldon and dove again. He finally found his partner floating dead under the canopy, tangled in long, twisting hydrilla vines.

Blackburn's guess: "He got under the canopy and got confused." Separation, entanglement, confusion, panic. His mouthpiece lost, his lungs filled with water.

Blackburn never dove again. "I lost my feel for it that day."

As Kerry Steward motored down the Potomac River in the summer of 1982, he was amazed at how far hydrilla had spread along this huge river. A colleague of Blackburn and Weldon, he was a veteran of the hydrilla campaigns in Florida, now come north to consult with the National Park Service. Traveling the Potomac with a team of local scientists, he was finding an invasive species that was first discovered 1,000 miles to the south.

A local scientist riding with him found the scene breathtaking — even frightening. Small bays and coves were covered wall-to-wall with green mats — like golf fairways laid over parts of the river. It was, he thought, an ecological nightmare, an opinion shared by a lot of angry boaters, marina operators, and waterfront homeowners along more than 20 miles of shoreline. The "hydrilla wars," as the locals called them, were well launched by now in the nation's capital. Newspapers were running headlines about a new "monster" seagrass that was invading the river.

Where did the "monster" come from? And how to get rid of it? Those were the questions Steward was hired to solve, according to Richard Hammerschlag, the Park Service scientist who brought him to Washington. Like any good detective, Steward and his team collected samples, sent them off to a lab, and interviewed local witnesses.

Was the National Park Service a culprit? At Dyke Marsh, a cove of the Potomac just south of Alexandria, one of their scientists had been testing a pondweed that looked like American elodea. Looks can be deceiving, as Steward knew. The plants he was pulling out of the Potomac looked to his eye like hydrilla, the same plant that caused so many problems in Florida.

Was there, Steward asked, another, less obvious culprit? Who had sold hydrilla to the National Park Service?

Don Schmitz knows the name of the man who first brought hydrilla to Florida, but he's not telling. The co-author of a history of aquatic invasions, Schmitz did enough detective work to track down the first culprit, agent zero for the hydrilla epidemic. Schmitz not only found his man, he got his confession — but only by promising anonymity.

What Schmitz heard was a tale of mistaken identities and accidents. The mistakes began with a dealer for tropical fish and aquatic plants who imported hydrilla from Sri Lanka (then called Ceylon) to St. Louis, Missouri, thinking he was getting a species of anacharis, a green plant commonly sold for aquariums. Impressed with the plants, he airmailed six bundles to Tampa, Florida, where another dealer, unimpressed, ordered them thrown away.

The accidents began when his son failed to follow orders, first storing the exotics in a Tampa canal near the airport — and then promptly forgetting about them. When the Tampa dealer, let's call him agent zero, later discovered the plant spreading throughout the canal, he promptly changed his mind. Finally impressed, he began marketing his mystery plant to other dealers, calling it "Indian Starvine." And some of those dealers began storing it in canals before selling it for aquariums and ponds.

This roundabout route is fairly typical for invasions of many exotic plants, according to Schmitz. With the expansion of air freight after World War II, the rate of invasions into America picked up dramatically. Plants that used to die on long ship passages now arrived ready for transplanting to new waters.

Much of the transplanting was done by dealers working in the aquarium plant industry. "Dealers deliberately seeded the waterways," says Schmitz. They would import exotics, often storing them in creeks and canals, a tactic that saved them the cost of maintaining so many ponds and tanks. Later they would harvest plants out of the canals and sell them to homeowners for their aquariums and water gardens. Months or years later many of their customers would empty their aquariums into creeks and canals near their home, seeding new waterways.

Once in the water, hydrilla traveled easily to new waters, carried across land as a hitchhiker on boats and boat trailers. Arriving in a new location, any fragment could quickly take root and start snaking along the bottom.

When Schmitz finally tracked down the Tampa dealer, his agent zero, they met in a restaurant for sandwiches. The dealer, now well into his nineties, made his confession but got no absolution from Schmitz, who outlined all the damage done by hydrilla, all the millions spent trying to eradicate it or control it in Florida's waterways.

"I had to ask him, how do you feel about all that," says Schmitz. "He leaned back and said, 'Whoops!'"

As he investigated the hydrilla invasion of the Potomac River, Kerry Steward suspected he was seeing another big whoops: another chain of accidents and mistaken identities that could be a repeat of the Florida invasion pattern. And one possible link in the chain was a local commercial dealer in aquatic plants.

Where, he asked, did Park Service scientists get the mislabeled hydrilla they put in the Potomac River? They told Steward they kept their elodea look-alikes at the Kenilworth Aquatic Gardens, a small riverside park along the Anacostia River — but they originally brought those plants in from Lilypons Water Gardens, a commercial dealer in Adamstown, Maryland. Lilypons in turn often used a supplier in Texas.

Steward sent plants from both Kenilworth Gardens and Lilypons to his Florida lab for culture and analysis. The results showed that plants from both sources were hydrilla, not elodea, and both had identical enzyme patterns, more evidence that Lilypons was the probable source of hydrilla. The chain became clear, says Hammerschlag: "Lillypons to Kenilworth Gardens to Dyke Marsh."

And the last link in the chain was the scientist who put hydrilla in the Potomac at Dyke Marsh.

In the spring of 1980 Horace Wester had a plan. He would put elodea in floating cages, place the cages in the river at Dyke Marsh, and see how the plants fared under different conditions. These cages, five feet long and made of wood, would float, holding the plants above the dark bottom and closer to the light. His hope was to begin restoring underwater grasses to the Potomac. His mistake was using elodea plants that were actually hydrilla.

It was a mistake made by experts around the country, but it carried sad irony for a scientist as experienced and observant as Horace Wester. A native of the Washington, D.C. area, Wester had spent a 40-year career trying to preserve or restore the capital city's endangered natural resources. During the onslaught of Dutch elm disease he helped save Washington's famous shade trees by identifying a single tree that seemed resistant. He discovered it standing in front of the Freer Gallery of Art, and his work led to the cloning of that tree and the cultivation of an American elm species. The "Jefferson" elm became one of the cultivars that the Park Service uses to keep the National Mall lined with large shade trees.

Two rivers run through the nation's capital, and Wester as boy and man spent time on both. He remembered an Anacostia River with marshes full of wild rice and a Potomac River with hundreds of acres of underwater grasses. According to Stephen Syphax who worked with him on both rivers, Wester spent years growing test plots of wild rice in hopes of restoring the Anacostia marshes of his youth. Then he went to work on the underwater grasses of the Potomac.

He carried his passions for these rivers into retirement. By the spring of 1980 he'd been officially retired for three years when he started floating cages of hydrilla in the Potomac.

The monster weed that invaded the Potomac River never went away, but over time hydrilla became hated less, perhaps even loved a little.

Fishermen came to like it first, since they were often catching fish near hydrilla beds. Bird lovers were seeing wading birds walk out on the hydrilla mats where they'd start pecking at the grass and at the fish that emerged along the edges. And scientists were getting high-visibility readings when they dropped their secchi disks, good evidence the beds were trapping floating sediments and helping clear the water.

All of which brought some relief to scientists with the National Park Service who'd taken a lot of heat for releasing this non-native marauder into the Potomac. "What actually happened, essentially to my consternation, was that people like hydrilla," says Richard Hammerschlag. "Hydrilla rapidly filled an ecological void."

Several native species have also reappeared in that void, perhaps helped along by hydrilla. More evidence of that came two years ago when Nancy Rybicki reported her findings from an annual survey she's been running since 1985 for the U.S. Geological Service. While two non-natives, hydrilla and Eurasian watermilfoil, account for 60 to 90 percent of the grass acreage in the upper tidal Potomac, their dominance has decreased over time. As water quality improved in the river, the coverage of several native species, especially wild celery and coontail, increased — slowly, but steadily.

Hydrilla in the Potomac never became the scourge it was in Florida where the campaign to kill it continues. The wide, flowing Potomac is not a Florida canal or creek or lake that can be easily covered over. "We have a different perspective," Rybicki says. "We lost our grasses, so when something came back we were excited about it."

The hydrilla wars abated, but they never ended. Scientists may be pleased, but boaters and sailors and waterside homeowners are still unhappy when hydrilla blocks them off the water. "People are trying to spin it and make a positive out of it," says Jamie Hamilton who owns a dock-building company, "but I don't see it." Watching kids swimming through hydrilla, he even wonders whether someone could drown in the stuff.

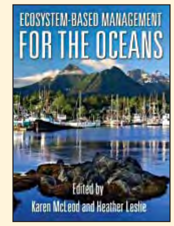
Living with hydrilla means mowing it, so Hamilton also owns a grass-mowing boat now, one of several along the river. In quiet shoreline coves from Dyke Marsh down past Mount Vernon and Mason Neck, marine contractors will fire up heavy, clunky mower boats this summer and begin chomping channels through the thick hydrilla mats. The dead, smelly grasses will probably end up in a landfill.

Fishermen will motor out through these cleared-out channels. In waters where Horace Wester once used the wrong plants to restore a barren river, they will drop anchor along the edge of some large hydrilla beds. And there they will start catching fish.

— *fincham@mdsg.umd.edu*

New Book Includes Bay Case Study

Ecosystem-Based Management for the Oceans, Karen McLeod and Heather Leslie, Editors, Island Press, May 2009, 392 pp.



Nineteen chapters by distinguished experts describe what it means to manage our oceans and coasts as ecosystems. At the book's heart lie the concepts of social and ecological resilience — the extent to which human and natural systems can maintain function in the face of disturbance. The Chesapeake Bay provides one powerful case study, with a chapter by Donald F. Boesch and Erica Goldman, and another by Lisa Wainger and Jim Boyd. For more information, visit www.islandpress.com/bookstore/details.php?prod_id=1750.

Read BayBlog, see the Photo Gallery, and send your comments at *Chesapeake Quarterly Online* at www.mdsg.umd.edu/CQ

Maryland Sea Grant College
4321 Hartwick Road, Suite 300
University System of Maryland
College Park, Maryland 20740

Address Service Requested

Non-Profit Org.
U.S.Postage
PAID
Permit No. 04386
College Park, MD

Recycled Paper
PRINTED WITH SOY INK

Chesapeake Quarterly is printed on recycled paper, processed chlorine free, with soy-based inks

Sea Grant