Smithsonian Environmental Research Center

ON THE EDGE

News from the Smithsonian Environmental Research Center

Winter 2017

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Shark Taggers

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Resurrecting Dormant Orchids

Why Oysters Need Diverse Portfolios Too

Natural Gas Boom Could Spread Invasive Species

THE DIRECTOR'S LETTER

2017: The Year of Earth Optimism

What are your New Year's resolutions? If you're like me, the dawn of 2017 brought a plethora of hopes and goals: to become more active in your daily life, more engaged in your community, or more devoted to your family. This year, the entire Smithsonian came together to make a new resolution. For 2017, we're launching a year of Earth Optimism.

It's part of the Smithsonian's new Conservation Commons initiative. For too long, stories of impending doom have dominated environmental news. Many are true, but they show only part of the truth. Stories of conservation victories—species rescued, habitats saved, solutions uncovered—have often gone unnoticed. It is those stories that will lead us forward, showing us what works in conservation and how we can make those practices more widespread.

Here at the Smithsonian Environmental Research Center, we're bringing the idea closer to home. We've declared 2017 the year of Bay Optimism.

This winter has already brought an influx of hopeful discoveries. Our fish ecologists reported more than a million imperiled river herring swimming up the Choptank, in the first census done in that river since 1973. On land, SERC plant and molecular ecologists found the secret to reviving an endangered orchid from dormancy. SERC's long-term research on the blue crab continues to pay off, as managers and ecologists have rallied to rebuild the fishery.

The Bay Optimism theme isn't limited to the Chesapeake. On the other side of the country, our marine biologists in San Francisco Bay have discovered clues to resurrecting the Olympia oyster, a shellfish that has been hanging on by a thread for decades. Moreover, there are examples of other large complex systems that are recovering with strong, science-based management: places like Monterey Bay in central California (check out "The Death and Life of Monterey Bay" by Stephen Palumbi and Carolyn Sotka) and the city of Portland and surrounding Willamette watershed in Oregon (search for "Willamette Partnership" online). These required sustained efforts from many people and many organizations pressing for science-based approaches over decades. But if this determination is succeeding in these large systems, it can work in the Chesapeake too.

Embracing Earth Optimism does not mean the road ahead will be smooth, or that we are blind to the problems we face. It means we refuse to believe those problems are unconquerable – indeed, there is lots of evidence that we can solve them. It will take scientists, politicians, business leaders, innovators and communities coming together. But it can be done.

Journalist Thomas Friedman, author of the 2008 bestseller "Hot, Flat, and Crowded," put it bluntly: "Pessimists are usually right and optimists are usually wrong but all the great changes have been accomplished by optimists."

In short, pessimism is easy. Optimism takes work—finding the seeds of something good and then laboring to make it grow into something substantial. I choose to be an optimist, because the only way we will reach a healthy future, for ourselves and the planet we call home, is if we first envision it.

—Anson "Tuck" Hines, director

RESEARCH DISCOVERIES

Dormant Orchids Need Fungi to Rise Again

When life aboveground turns harsh, orchids like small whorled pogonias often go dormant, spending years underground sustained by fungi on their roots. But enough fungi can help them reemerge, SERC ecologists discovered in a January study.

Gone in Maryland and endangered in 16 other states, small whorled pogonias are considered the "rarest orchids east of the Mississippi." Ecologists led by Melissa McCormick searched for the orchids' required fungi in soils around them. Orchids were more likely to emerge aboveground if they were in soils with more of those fungi—showing that saving endangered plants often requires looking beneath the surface.

"If you're concerned about a species you're trying to conserve and you're only detecting what's going on aboveground, you're not getting the whole picture," McCormick said.

Research Article Links

Dormant Orchids:
http://dx.doi.org/10.3732/ajb.1600334

Invasive Reed:
http://dx.doi.org/10.1111/gcb.13539

River Herring:
http://dx.doi.org/10.1080/00028487.2016.1235612

*Cover photo: Bull shark (*Carcharhinus leucas*), one of four shark species SERC biologists are tagging for their new migration study. (Credit: Albert Kok)*

Underwater Sonar Gives River Herring Shot at Comeback

For decades, Chesapeake river herring have been floundering. But rescue efforts have struggled in uncertainty, as no one knew exactly how many remained. This winter SERC biologists reported good news, after tracking an entire spawning run up the Choptank River for the first time since 1973: An estimated 1.3 million river herring migrated upstream.

The team used an underwater sonar camera called DIDSON to track fish 24/7, even in murky waters. 1.3 million river herring is worth celebrating, even if different methods make comparing this to 1973 data difficult. It gives managers a baseline to evaluate conservation efforts, said SERC ecologist Matt Ogburn. "We're starting a new count with a new method, and we can track the population from here."

Matt Ogburn

Invasive Reed Releases Deep Carbon from Lockup

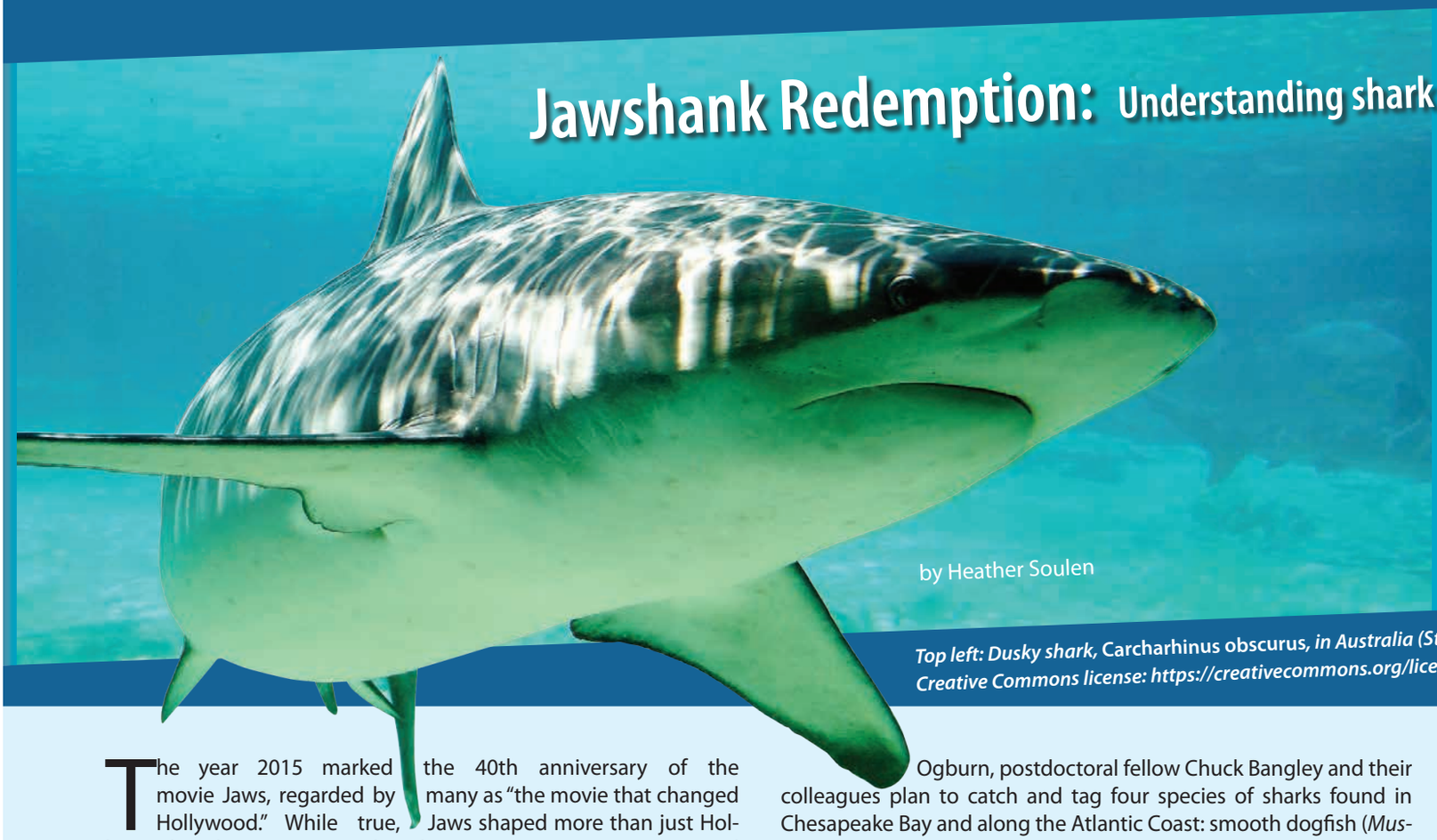
For the first time, ecologists caught the invasive reed *Phragmites australis* releasing carbon from deep soils, where it was once thought to be locked away.

Soils are the Earth's third largest carbon pool. Surface soils routinely release CO_2 as microbes decompose dead plants. But deeper, older soils contain tougher carbon which, undisturbed, can remain buried for millennia.

In a study published in Global Change Biology, SERC ecologists Pat Megonigal and Blanca Bernal, with Bryn Mawr's Tom Mozdzer, grew Phragmites and native plants on SERC's Global Change Research Wetland and calculated the CO_2 microbes emitted from deep and shallow soils. While Phragmites triggered only slightly more soil carbon emissions overall, its deeper-growing roots triggered the release of over five times more deep-soil carbon than native plants.

Jawshank Redemption: Understanding shark

by Heather Soulen



Top left: Dusky shark, Carcharhinus obscurus, in Australia (St
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The year 2015 marked the 40th anniversary of the movie Jaws, regarded by many as "the movie that changed Hollywood." While true, Jaws shaped more than just Hollywood. With its ominous, adrenaline-pumping two-note score and imagery of a bloodthirsty, torpedo-shaped predator with rows of razor-sharp teeth, Spielberg's film shaped our perception of sharks.

After Jaws, fear of the unknown arrested us, and our lack of knowledge helped demonize sharks. But the winds are shifting. New research initiated by the Smithsonian Environmental Research Center's Fish and Invertebrate Ecology Lab aims to investigate habitat use, migration patterns, and species interactions of four underrepresented shark species found in Chesapeake Bay and along the Atlantic Coast.

The Atlantic Coast is a global hotspot for shark biodiversity, and with biodiversity being a vital component of healthy and productive ecosystems, this kind of research is long overdue.

"Sharks are a lot like wolves in Yellowstone National Park or lions in the Serengeti. They can be indicators and drivers of healthy ecosystems because they're likely to be found in places that support large numbers of prey species," said Matt Ogburn, the lab's principal investigator. Ogburn, postdoctoral fellow Chuck Bangley and their colleagues plan to catch and tag four species of sharks found in Chesapeake Bay and along the Atlantic Coast: smooth dogfish (*Mustelus canis*), blacktip sharks (*Carcharhinus limbatus*), dusky sharks (*Carcharhinus obscurus*), and bull sharks (*Carcharhinus leucas*).

"Right now there's a very broad idea that certain sharks are here in the summer, certain sharks are here in the winter," Bangley said. "But nobody's really defined what temperature range they like, what salinity range they like, are they following certain species of prey, things like that."

Their toughest challenge is spending enough time on the water to find, catch and tag 80 sharks, 20 of each species. To get that water time, the team joined forces with the Virginia Institute of Marine Science's (VIMS) Shark Monitoring and Assessment Program and North East Area Monitoring and Assessment Program, East Carolina University, and Florida Atlantic University's Harbor Branch Oceanographic Institute, with other partners expected to join in summer 2017. They began searching for sharks in summer 2016, and have already tagged six. They'll continue tagging through 2017 to reach their goals.

The biologists of SERC's Fish and Invertebrate Lab are aiming to tag 80 sharks—20 each of four different species. Left to right: bull shark (Chuck Bangley), blacktip shark (Valerle), smooth dogfish shark (Chuck Bangley), and dusky shark (VIMS).

Creative Commons permission for blacktip shark photo: https://creativecommons.org/licenses/by-nc-nd/2.0/

k behavior through science

Top right: SERC ecologist Chuck Bangley releases a bull shark in Back Sound, North Carolina. (Cecilia Krahforst)

Steve Garner)
enses/by/2.0/

They're tagging most of the sharks with a special acoustic tag that taps into the Atlantic Cooperative Telemetry Network, a network of scientist-maintained acoustic receivers located along the Atlantic Coast. Whenever a tagged animal comes within about half a mile or less of a receiver, it transmits a signal to the receiver, and a record for the location, tag number, date and time is logged. Ogburn and his team have already participated in the network through their cownose ray and invasive blue catfish studies.

While the information the receivers collect is useful, it's restricted to the stationary location of that receiver. To understand more "day in the life" shark behavior, the team plans to outfit a few sharks with satellite tags that beam up location information when a shark surfaces anywhere in the world for 90 seconds or longer. Some satellite tags on the market can log temperature, salinity, and depth as the shark swims – valuable information for behavior and migration studies.

Social media and the internet are also helping turn the tide of how the public views sharks, in ways many never thought possible after Jaws. Last year, the nonprofit OCEARCH's satellite-tagged great white shark "Mary Lee" became an overnight Twitter star and made news when the organization's website showed her track off the Maryland coast. Because satellite tags make collecting track data and sharing it online relatively easy, Ogburn plans to incorporate shark track maps to engage the public in his research.

"People are fascinated by [sharks] now more than they fear them. So when people hear that a shark's in the area, they're more likely to run to the area with a camera than to flee from it," Bangley said. "Gone are the days when the only good shark was a dead shark."

But beyond the gadgetry and social media, the team's study has real potential to reshape the perception of sharks and their management.

"We hope to excite the public's interest in the positive role of sharks in coastal ecosystems," Ogburn said. "We hope that the data from this study, which will fill a local-regional data gap, will contribute to coast-wide shark fisheries management and conservation efforts."

The shark tagging project is funded by Aramco Services Company. Want the latest updates on sharks and other species the Fish and Invertebrate Ecology Lab tracks? Follow the lab on Twitter at @fishinvertlab, or check their Movement of Life projects at https://serc.si.edu/research/projects/coastal-migrations.

A Diverse Portfolio is Good for Oysters Too

by Kristen Minogue

Olympia oysters (Brian Cheng/UC Davis)

Act local. Diversity pays. Those two phrases could be key to saving young Olympia oysters, the only native oysters on North America's West Coast. They need large networks of adult oyster beds to settle on, and a diverse "environmental portfolio," finds a new study published December in *Ecology*.

The discovery sprang from a collaboration led by Kerstin Wasson of Elkhorn Slough National Estuarine Research Reserve, with Chela Zabin and Andrew Chang of the Smithsonian Environmental Research Center. More than a dozen scientists analyzed estuaries from British Columbia to Los Angeles, to see what conditions help baby oysters settle and grow. Defying expectations, small, local conditions mattered far more than larger, regional ones.

Ecologist Chela Zabin (right) and volunteer Margie Kay in Elkhorn Slough, Calif. (Elkhorn Slough-NERR)

"This is really important for wetland managers to know," Wasson said. "Local management actions have a bigger effect on oysters than the ocean does."

The two biggest influences were winter salinity (some fluctuation helps) and underwater networks of adult oysters for habitat (bigger helps). But there was a third: diversity.

Zabin calls it the "environmental portfolio effect." Like investment portfolios, it's safest to diversify. If one part crashes, all the money isn't lost. Oysters seem to follow the same rule: San Francisco Bay and Newport Bay, with cooler, saltier waters in some spots and warmer, fresher waters in others, had some of the highest oyster recruitment. Meanwhile, Elkhorn Slough—a smaller estuary with extremely low environmental diversity—saw total recruitment failure for three years of the study.

That doesn't mean places like Elkhorn Slough should be abandoned, Zabin says. Even low-diversity estuaries have some good years. The most important thing is to conserve or plant adult oyster reefs in multiple locations. If one spot crashes, a bay's entire population doesn't blink out. "To me that's positive, because that's definitely something that can be done in many locations," Zabin said.

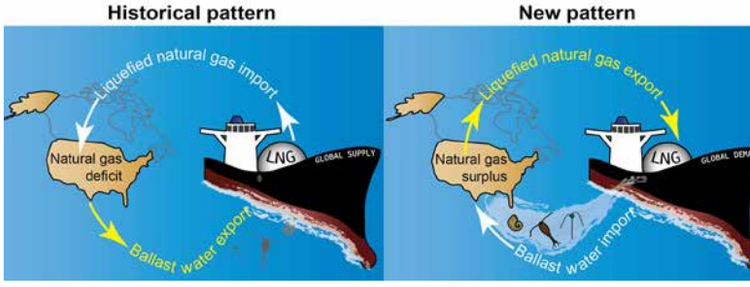
Natural Gas Trade Opens Door for Invasive Species

by Kristen Minogue

The U.S. is on the brink of a natural gas boom—but that could expose its shores to more invasive species, biologists report in a new study published this winter.

Over the last decade, U.S. natural gas imports have dropped as the country tapped into its own resources. Now it's poised to be the third largest exporter of liquefied natural gas by 2020.

The invasive species threat comes from ballast water: water large ships carry in tanks for balance, which can teem with non-native creatures. When vessels bring liquefied natural gas into the U.S., they carry minimal ballast water. However, when vessels with that cargo leave the U.S., they return loaded with ballast water that they discharge in U.S. harbors. One liquefied natural gas tanker can carry enough ballast water to fill 23 Olympic-size swimming pools.



Left: When ships import natural gas, they export ballast water and, potentially, invasive species. Right: When ships export natural gas, they import ballast water and potential invaders. (Kim Holzer)

"When people think about consequences of energy development, they typically focus on infrastructure, like pipelines, and the commodity itself, not the transport process and what may hitchhike inside the ships," said Kim Holzer, lead author and SERC marine biologist.

The amount of ballast water from liquefied natural gas exports could rise 90-fold by 2040 compared to 2015, Holzer and the other biologists estimated.The U.S. Gulf Coast would face the biggest influx, as it houses the most approved or proposed facilities for exporting liquefied natural gas. But similar facilities exist along the Atlantic, including one in Maryland's Cove Point.

There are ways to make ballast water less dangerous. One option is onboard treatment, using chemicals or radiation. As of December 2016, three onboard treatment systems had earned U.S. Coast Guard approval, but it could be years before ships routinely install them. For inventors and ship managers, it's a race against time.

SERC ecologists Kim Holzer (right) and Jenny Carney examine ballast water on a ship in Virginia. (Kim Holzer)

Besides helping at SERC, education volunteers can enjoy other outings, such as nature walks (left) and trips to the National Museum of Natural History (right). Center: Lenore Naranjo with SERC volunteer coordinator Dan Gustafson on her 10-year anniversary with SERC.

Volunteer Spotlight: Lenore Naranjo

by Sara Richmond, communications volunteer

In 2016, approximately 5,000 students and other visitors took part in education programs at SERC, learning firsthand about the Chesapeake Bay ecosystem. They ventured on hikes and canoe trips, hauled in fish and invertebrates with seining nets, and studied the anatomy of blue crabs. SERC's education programs are made possible through the help of dozens of volunteers who lead field trips and assist behind the scenes. In the coming months, we'll highlight the work of some of these volunteers in the newsletter and on the blog.

Lenore Naranjo has been volunteering with SERC for over 13 years. After starting as a volunteer in SERC's canopy labs, she began working with the education program, leading field study groups that give children a hands-on approach to a variety of marine habitats.

"We set up baskets with oysters, and they stay sitting on the bottom of the river through spring, summer, and fall, where they act as a habitat for fish and small critters," she explains. During field trips, she pulls the baskets from the river bed and sets them in a tray of water so children can explore the baskets' contents. "Some kids are very hesitant and don't want to put their hands in something unfamiliar. But then they watch their friends who aren't hesitant, and the next thing you know, they're in there too, pulling out fish and crabs."

For Lenore, the most rewarding part of volunteering is being able to teach children, especially those who have not previously had access to a place like SERC, about their impact on the environment and how they influence the world around them.

It's a lesson she has shared with her own children, too. When her children were four and six years old, her family embarked on a five-and-a-half-year sailing trip around the world. They visited places like Tahiti, New Zealand, Australia, Mauritius, and South Africa, often stopping for several months to live, work, and attend school. "It was during that time that we began to see the interconnection between what people were doing on land and what was happening in the ocean," she says. She hopes she can help visitors to SERC see that connection, too.

"Sailing was a big part of our life, and still is. Now, we also do a lot of kayaking. You see a lot of what's around you—and how it's faring these days—when you're sitting low in the water."

And one of her favorite things to see when she's exploring the Chesapeake Bay by kayak? "The burr marigold," she says. "It's very tall; it almost looks like a daisy or a black-eyed Susan. Go kayaking into any of the river mouths in the late summer or early fall, and they're blooming and beautiful."

Want to join the team? Contact Karen McDonald (mcdonaldk@si.edu) to learn how.

Research Article Links

Oyster Portfolio: http://dx.doi.org/10.1002/ecy.1602
Natural Gas: http://dx.doi.org/10.1016/j.scitotenv.2016.12.125

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You Make Earth Optimism Possible

A big thank you to all our volunteers and donors during 2016! Last year more than 500 citizen scientists spent nearly 6,000 hours assisting SERC research projects. Approximately 50 education volunteers also led hands-on activities for children, devoting over 5,000 volunteer hours to teaching students about Chesapeake Bay and environmental stewardship. You make discoveries and conservation success stories happen on the SERC campus and beyond, and you're a vital part of our mission.

Want to join the team? Contact Alison Cawood (cawooda@si.edu) for citizen science projects and Karen McDonald (mcdonaldk@si.edu) for education opportunities.

Gift Highlights

Wireless Data in the 100-Year Forest Experiment ($350,000) – John C. and Anne Ryan
A new sensor array will monitor soil moisture and temperature in BiodiversiTree, SERC's 100-year forest experiment, enabling SERC to gain a greater understanding of CO_2 storage, tree growth and the value of biodiversity.

Oyster Restoration in San Francisco Bay ($50,000) – Jason Payne
This five-year pledge is funding citizen science projects to identify potential sites for Olympia oyster restoration, and to research the impacts of invasive predatory snails called Atlantic oyster drills.

Want to be part of the Earth Optimism mission in 2017? Visit our Website to donate online at www.serc.si.edu.

Upcoming Events

- **Tuesday, March 21, 7pm**
  First 2017 Evening Lecture
  "Ospreys on the Patuxent" by Greg Kearns (free)
- **Saturday, May 20, 10am – 3pm**
  SERC Open House

The Smithsonian Environmental Research Center is recognized by the IRS as a 501(c)3 nonprofit organization. Contributions to SERC may be tax-deductible.

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On The Edge
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