Ripple Marks

The Story Behind the Story

BY CHERYL LYN DYBAS

Something Wicked This Way Comes, Except the Weed *Hydrilla*

Something wicked this way comes, if it involves invasive species in estuaries such as Chesapeake Bay and their tributary rivers like the Potomac.

But in the exception that proves the rule, the introduced weed *Hydrilla verticillata* has improved water quality in the Potomac River near Washington, DC, and created habitat for species like migrating ducks.

Deemed a severe nuisance when it began to rapidly colonize the Potomac in 1983, *Hydrilla verticillata* has instead benefited the watershed's ecosystem, according to US Geological Survey scientists Nancy Rybicki and Jurate Landwehr. They published results of their study, conducted from 1985 to 2001, in the May 2007, issue of the journal *Limnology & Oceanography*.

The exotic weed *Hydrilla* appeared and started to flourish, said Rybicki, in the freshwater reaches of the tidal Potomac River when efforts to reduce nutrient loads from sewage treatment plants began to work.

Hydrilla produced dense vegetation masses and, in some areas, slowed boat traffic, fouling propellers and impeding water sports.

Submerged aquatic vegetation (SAV) forms an important ecosystem for fish and waterbirds, so it was feared that the explosive growth of *Hydrilla* would impair the health of native species. (One observer referred to the huge rafts of bright green on the river's surface as a floating golf course.) "SAV native to the Potomac is important for waterfowl, including the black duck, a signature species," said Rybicki.

With information from annual field surveys and aerial photographs, Rybicki and Landwehr documented, bed-by-bed, SAV species found in various parts of the Potomac River system. "The methods developed for this study are transferable to any ecological assessment that needs to merge remotely sensed spatial coverage with field observations," said Landwehr.

The scientists recorded the total coverage and biomass of each species. In comparing that information with water quality data, they discovered that, with the reduction of nitrogen in the Potomac, *Hydrilla* growth took off. And so did the diversity of plant species.

In an upset to conventional thinking, *Hydrilla* in fact did not crowd out native species—they increased. *Hydrilla* also proved to be a good winter food source for waterbirds.

Exotic and native species of SAV can provide resources throughout the year, not just during the summer months, said Rybicki. "Some waterfowl eat the benthic invertebrates that are abundant in sediments of SAV beds, and many birds feed directly on below-ground SAV buds and tubers, which are consumed through the winter."

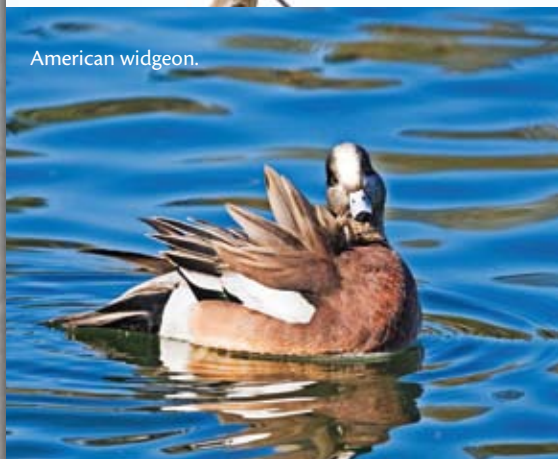
Although most above-ground SAV biomass senesces by December in temperate regions, some live shoots remain standing. Others form floating mats with dormant buds that wash up onto the intertidal zone. They are a feast for waterbirds.

Thanks to *Hydrilla*, mallards, American widgeon, great blue herons, bald eagles, and other SAV- and fish-eating waterbirds along the Potomac River never had it so good.

Great blue heron.

Wood duck.

Bald eagle.



American widgeon.

Photos courtesy of Ilya Raskin, Rutgers University

Largest Marine Protected Area on Earth Created by a Nation that's Among World's Smallest

One raised-coral island and 32 atolls are all it is, but the country of Kiribati, which straddles the equator and borders the International Date Line, has taken a giant leap for humankind, and for marine life: establishing the world's largest marine protected area.

Kiribati is comprised of three distinct island groups: the Phoenix Islands, Gilbert Islands, and Line Islands, with a total of 33 atolls, making it the largest atoll nation in the world.

Dispersed over 3,500,000 square kilometers (1,351,000 square miles), Kiribati has set aside a California-sized ocean wilderness of pristine coral reefs and rich fish populations threatened by overfishing and climate change. Located in the central Pacific between Hawaii and Fiji, the Phoenix Islands form an archipelago several hundred miles long.

The Phoenix Islands Protected Area (PIPA) conserves one of Earth's last intact oceanic coral archipelago ecosystems, made up of eight coral atolls and two submerged reef systems in a nearly uninhabited region of abundant marine and bird life. The 410,500-square-kilometer (158,453-square-mile) area also includes seamounts and other deep-sea habitats.

Scientists in Kiribati and at the New England Aquarium in Boston, Massachusetts, developed PIPA over several years of joint research, with funding and other assistance from Conservation International. "Kiribati has taken an inspirational step," said Greg Stone, New England Aquarium vice-president of global marine programs. "PIPA includes extensive seamount habitat, tuna spawning grounds, and submerged reef systems."

Three New England Aquarium-led research expeditions found high marine biodiversity in the region, including more than 120 species of coral and 520 species of fish, many new to science. Some of the most important seabird nesting populations in the Pacific are found there, in an area that also serves as an important migration route for fish and sea turtles.

"The creation of this amazing marine protected area by a small island nation in the Pacific represents a commitment of historic proportions," said Conservation International president Russell Mittermeier, "and by a country under serious threat from sea-level rise."

Kiribati's one raised-coral island, named Banaba (or Ocean Island), was once a rich source of phosphates, now mined out. The remainder of Kiribati's lands consists of coral and reef rock atolls that rise 6. 5 feet, at most, above sea level. The soil is thin and calcareous, making agriculture almost impossible. Kiritimati (Christmas Island) in the Line Islands is the world's largest atoll. Based on a 1995 realignment of the International Date Line, Kiribati is now the easternmost country in the world, and was the first nation to enter into the year 2000 at Caroline Island, renamed Millennium Island.

Well into this millennium, it is hoped, Kiribati's Phoenix Islands will be protected. Commercial fishing is restricted in PIPA, resulting in a loss of the revenue the Kiribati government would have received from foreign commercial fishing licenses. The New England Aquarium and Conservation International are helping Kiribati design an endowment system that will cover the management costs of PIPA, and compensate the government for its lost fishing licenses. The plan allows for subsistence fishing by resident communities, and other sustainable economic development in designated zones of the protected area.

"If the coral and the reefs are protected," said Kiribati president Anote Tong, "then the fish will grow and bring us benefits. In this way, all species can be protected so none become depleted or extinct."

Through its efforts, the Republic of Kiribati, said Mittermeier, "has set a new standard for countries in the Pacific—and around the world."

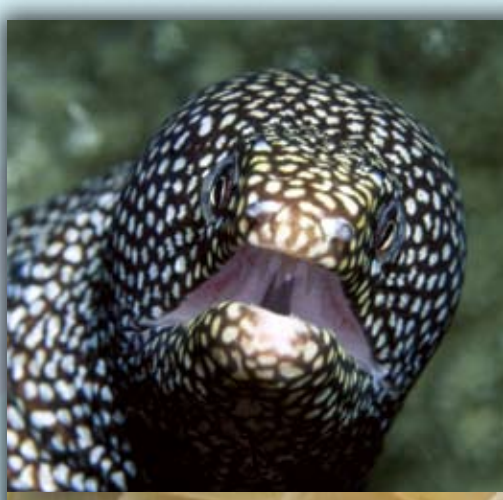


Photo courtesy of Mary Jane Adams

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Photo courtesy of David Obura, New England Aquarium

Photo courtesy of Gregory Stone, New England Aquarium

Background photo courtesy of David Obura, New England Aquarium

Trash in the Ocean: Not A Pretty Picture

Photo courtesy of the Ocean Conservancy

Photo courtesy of Ilya Raskin, Rutgers University

What do cigarette filters, food wrappers, plastic beverage bottles, and cigar tips have in common?

They, along with caps and lids, straws and cans, are among the top 10 ocean debris items collected during the Ocean Conservancy's International Coastal Cleanup (ICC). The ICC is a worldwide, one-day-a-year effort to involve people in removing trash from beaches and waterways, and to identify the sources of debris and change the behaviors that cause pollution.

The 2008 ICC will be held on Saturday, September 20.

Since 1986, when the first such cleanup was held, more than six million volunteers have removed 116,000,000 pounds of debris across 211,460 miles of shoreline in 127 nations.

Last year's "haul"—brought in by more than 378,000 "pickers"—netted 1,971,551 cigarettes and cigarette filters; 693,612 food wrappers and containers; 656,088 caps and lids; 587,827 bags; 494,647 plastic beverage bottles; 376,294 cups, plates, forks, knives and spoons; 349,143 glass beverage bottles; 325,893 cigar tips; 324,680 straws and stirrers; and 308,292 beverage cans, for a grand total worldwide of 6,088,027 "top ten" debris items. In all, cleanup participants picked up 7,238,201 pieces of floating or washed-up trash.

"Our ocean ecosystems can't protect us unless they're healthy and resilient," said Laura Capps, senior vice president of the Ocean Conservancy, headquartered in Washington, DC. "Harmful impacts like trash in the ocean are taking their toll.

"Trash doesn't fall from the sky, it falls from people's hands. Everyone has the opportunity to make a difference, not just on one day, but all year long."

Their efforts come not a moment too soon. Ocean debris kills more than one million seabirds and 100,000 marine mammals and sea turtles each year through ingestion and entanglement. In 2007, 81 birds, 63 fish, 49 invertebrates, 30 mammals, 11 reptiles, and one amphibian were found ensnared by trash.

The refuse in which they are drowning will last far longer than the afflicted ocean animals. A tin can that entered the ocean in 1986 will still be decomposing in 2036. A plastic bottle thrown in the ocean in the same year, 1986, will be with us in 2436. And a glass bottle pitched over the side of a boat in 1986 will be here—in the year 1,001,986.

In 2007, 76 countries held an ICC event. In China, for example, 75 volunteers in Shanghai collected 715 pieces of debris weighing 285 pounds. Thirty-two volunteers in Russia combed nearly 400 feet of shoreline on the coast of the Ussuriysky Gulf in Vladivostok, finding 98 pounds of garbage. The Philippines' coastal cleanup drew 50,526 people on land and 721 underwater, making it the largest such international event. In India, coastal cleanup participants picked up more than 128,000 pounds of trash, 50 percent more than the year before.

While land-based efforts accounted for the majority of activities, cleanups weren't limited to shorelines and beaches. Volunteers also retrieved debris from beneath the water's surface. More than 8,300 divers took part in the effort, and removed some 161,000 pounds of garbage over 1,000 miles of sea bottom.

While cleaning up existing trash is a vital element of the International Coastal Cleanup, the information volunteers collect is just as important, said Vikki Spruill, Ocean Conservancy president. "Data compiled from previous cleanups have been critical to helping us learn about the behaviors that result in marine debris."

Since 1994, more than 50 percent of all debris collected by coastal cleanup volunteers has come from shoreline and recreational activities. Last year was no different, with ocean recreation accounting for 57 percent. Smoking-related activities came in second, making up 33 percent.

International Coastal Cleanup data have been used as the basis for US legislation, including the Marine Debris Research, Prevention, and Reduction Act, which Congress passed in 2006.

Our shorelines certainly need the help. In last year's US coastal cleanup, one state had 963,024 total pieces of trash collected, including 392,771 cigarettes and filters, and 125,038 food wrappers and containers.

The "winner"?

A state many ICC participants least expected: California.

Fish Live in Water, Birds in Trees: Or Do They?

Fish live in water, birds in trees. Or so marine scientists thought. Then they found the mangrove killifish, *Kryptolebias marmoratus*, living in logs, far above the waterline.

Reports of new habitats for a group of organisms are rare, according to biologists Scott Taylor of the Brevard County Environmentally Endangered Lands Program in Melbourne, Florida; Bruce Turner of Virginia Tech; and Ben Chapman of the University of Leeds in the UK.

"Fishes display diverse adaptations for temporary [amphibious] existence on land, but, to anyone's knowledge, none has ever been reported regularly living inside logs," said Taylor. He and colleagues published results of their unusual study of mangrove killifish in the February 2008, issue of the journal *The American Naturalist*.

The mangrove killifish is a western Atlantic marine species with a range overlapping that of the red mangrove, *Rhizophora mangle*. It is found from southern Brazil to central Florida, in the upper reaches of mangrove forests, where it inhabits crab burrows, solution pits, and small ephemeral pools.

"One adaptation the killifish uses for survival in the variable and stressful mangrove habitat is emersion, or leaving the water for a damp terrestrial location," write Taylor et al. in their paper. "Emersed fish move via serpentine wiggling to piles of leaf litter or other damp debris, then become quiescent."

The mangrove killifish was known to emerse, but not to aggregate in large numbers inside decaying mangrove logs that have been hollowed out, or "galleried," by insects. In the first known case of fishes entering terrestrial woody material, this behavior has now been documented in Belize and Florida.

The initial discovery happened in Belize, where Taylor and others located a small drying pool in which several fish were stranded and dying. "We assumed the fish would retreat to adjacent crab burrows when the pool was gone," said Taylor. "It turns out the fish had other housing options."

Taylor removed a 1.5-meter-long log from above the water line, and, upon breaking it open, discovered nearly 100 mangrove killifish inside. The fish were packed "like sardines in a tin can" inside the log, which remained wet in spite of its place well above the water.

Since then, Taylor has documented several cases in which killifish have left drying pools and flipped into rotting mangrove logs, occupying the openings left by termites and beetle larvae.

The behavior has been termed "log packing. "This dense gathering of killfish—in which logs from mangrove trees are lined, fin-to-fin, with the fish—"may imply a novel social context in which aggressive behaviors are reduced," Taylor believes. If 100 fish can coexist in a 1.5-meter-long log, they must be getting along.

How long the fish might be able to live in rotting mangrove logs is unknown. *Kryptolebias marmoratus* is clearly well adapted for emersion, however. In the laboratory, mangrove killifish can survive out of water—for at least 66 days.

Photos courtesy of Scott Taylor

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