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Ripple Marks

The Story Behind the Story

BY CHERYL LYN DYBAS

Messengers from the Arctic

Okpik (snowy owls) bring wisdom. They are the ultimate source of guidance.

—The Inuit of Greenland

The arctic breath of Boreas, god of winter, sweeps in on a frozen wind. It hangs in the air like crystals from the Great White North.

Jagged ice floes creak and groan their way onto Gurnet Road, pushing up and over the street from all sides, making it nearly impassable. The "road" is the only traverse along Duxbury Beach, Massachusetts. The sands of this peninsula, a narrow, 10-kilometer-long barrier beach 65 km southeast of Boston, are nowhere in sight. They're buried under the two meters of snow that have fallen this January.

More ice and snow obscure the entrance to the Powder Point, or Gurnet, Bridge, which crosses Duxbury Bay and leads to the beach. The 1892 bridge is a teeth-rattling washboard as we bump across it in Norman Smith's truck, then crunch-slide down Gurnet Road.

"Who in his or her right mind would be out here on a day like this?" asks Smith, a raptor biologist and director of the Blue Hills Trailside Museum in nearby Milton.

The answer to Smith's question lies in a creature as pure white and soundless as freshly fallen snow. Smith's companion in the truck is a huge, beautiful snowy owl, one he will soon return to the wild along Duxbury Beach's ice-lined shores.

Earlier in the day, Smith captured the owl at Boston's Logan Airport. Owls are caught with a bow trap—a hoop net that holds a live pigeon, starling, or mouse whose movements attract the owl. "The trap is sprung with a hand-held trip wire," explains Smith, "and causes no injury to the owl or the 'bait.'"

After an owl is eased from under the net, Smith carefully weighs and measures it, and checks its overall condition. He then places a metal band on one of its legs. The band is numbered and issued by the US Fish and Wildlife Service. If the owl is recaptured or found dead, the band number will provide information on its movements.

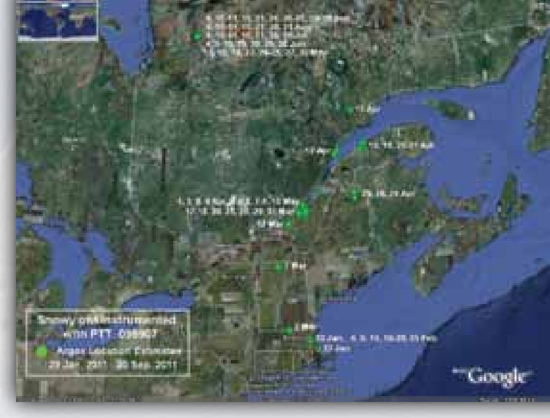
Since 1981, Smith has trapped and relocated almost 400 snowy owls from Logan. "When Logan calls, I go," he says. Owls and aircraft can be a threat to each other. Both might be brought down if an owl were caught in a whirring engine.

Snowy owls, *Bubo scandiacus*, are owls in the "typical owl" family Strigidae. They are the largest owls in North America, and are also known as arctic owls, great white owls, and harfangs, the latter from *The Chronicles of Narnia* by C.S. Lewis. Harfang was the castle of the Gentle Giants, close to the northernmost border of the Wild Lands of the North.

With their one-meter height, two-meter wingspan, yellow eyes, and white feathers, snowy owls are easily identified. Adult males are pure white, but females and young owls have dark barring, with immatures heavily spotted.

Snowy owls nest on the Arctic's vast, open tundra. Their thick plumage and heavily feathered talons allow them to survive summers north of the Arctic Circle. But when their prey, lemmings and other small mammals, go underground in harsh autumn and winter weather, the owls fly south, ultimately settling until spring "anywhere that looks like home," says Smith.

The coastlands around Logan Airport are favored spots. "They're low and relatively flat," Smith says, "with short scruffy grasses and marshy areas. The owls have an abundance of food such as voles, Norway rats, and, we've recently discovered, waterfowl.



Logan attracts more wintering snowy owls than anywhere in the US."

Snowy owls usually start landing at the airport in November; the earliest recorded date is October 22. They leave in April, with July 7 the latest date.

After Smith catches an owl at Logan, he transports it to Duxbury Beach where it's released. Some owls leave with a souvenir of their visit—a "backpack," or transmitter.

Biologists from the Blue Hills Trailside Museum, the Raptor Research Center at Boise State University, the US Geological Survey's Forest and Rangeland Ecosystem Center in Idaho, and The Owl Institute in Montana have started fitting snowy owls with satellite transmitters.

The transmitters track the owls' whereabouts, giving scientists a rare look into the lives of these raptors. The information provides a snapshot of how snowy owls—and their increasingly threatened Arctic nesting habitat—are faring.

The biologists already have gotten more than they bargained for: they're learning the speed and altitude at which snowy owls travel; if and where the owls stop along the way south in winter and north in spring; and the locations they choose during the summer breeding season.

The transmitters periodically send out data such as location, air temperature, and altitude. Satellites pick up the signals and transmit them to Boise State University. Scientists there transfer the information to Smith and colleagues. Because transmitter batteries last for three years, researchers can track an owl's path through several round trips to the Arctic.

Already the effort has changed long-standing lines of thinking.

During "irruption years," when more snowy owls than usual descend on New England and other US regions, it's because lemming populations in the Arctic have crashed and snowy owls head south in search of alternate prey. Or so it was thought.

Smith discovered a twist to the theory. "We actually see the most snowy owls in New England after an Arctic lemming population boom, not bust," he says. More lemmings mean more owls, and so more owls to fly south.

Today, however, we're concerned with one location—Duxbury Beach—and one "airport owl" who would come to be called owl 099907, the number of his satellite transmitter.

Beneath snow-laden skies at Duxbury, it's time to release 099907.

The owl turns its bright yellow eyes in our direction, seeming to ask whether we will keep our promise to protect snowies as a species, and to preserve two coastal habitats—barrier beach and Arctic tundra—linked by an all-white owl.

Halfway down the beach, we skid into an ice bank on the side of Gurnet Road. Smith slides out of the truck and opens the door of a cage in the flatbed. He grasps the owl's talons and gently lifts it out, facing the snowy into the wind. Ice-white sky blends with winter-white plumage. The owl flaps once, turns due north, and disappears.

Transmitter data later revealed that the owl's heading took him back to Logan Airport, where he stayed through February. In spring, he went on to the St. Lawrence Seaway then north to breeding grounds. Between May 10 and May 13, the owl flew more than 650 km northwest to the Opinaca Reservoir east of James Bay in Quebec. There he remained all summer.

As of this writing in October, owl 099907, our owl of January ice floes, is somewhere near Opinaca Reservoir. This winter, will he return to Logan Airport—or perhaps to Duxbury Beach?

Only a snow-white owl that travels on the winds of Boreas can see that far into the future.

Note: The Blue Hills Trailside Museum is the interpretive center for the Blue Hills Reservation, a Massachusetts park that stretches across 28 square kilometers. Massachusetts Audubon manages the museum for the state.

Snowy owl photos courtesy of Ilya Raskin. Satellite transmitter map and airport photo courtesy of Norman Smith.

Whirling Fire in the Sea: New Bioluminescent Bay Discovered in Puerto Rico

Elf luster. Fairy dust. The stuff of a midsummer night's dream.

In some 14 bays around the world, the ocean's waters are suffused with an unearthly glow, best seen on dark nights around the time of the new moon.

Visitors to these lagoons, most of which are found along the mangrove-lined shores of the Caribbean, often notice luminous sparkles in a ship's wake. In locations such as Oyster Bay, Jamaica, tour boats ferry passengers across the bays by dark of night. The destination? The lagoon's center, and a swim amid twinkling dots of light.

What is this otherworldly phenomenon? It's bioluminescence, and in the case of Caribbean bays, is usually—but not always—produced by the dinoflagellate *Pyrodinium bahamense*. *Pyrodinium*, whose scientific name means "whirling fire," is found in Caribbean embayments with narrow openings to the sea, which concentrate the dinoflagellates. When disturbed by motion of any kind, these microscopic organisms release energy in the form of light through a chemical reaction of the enzyme luciferase.

Two of our planet's best-known bioluminescent bays, where the dinoflagellates number in the trillions, are in Puerto Rico: Phosphorescent Bay and Mosquito Bay.

More than a decade ago, however, Phosphorescent Bay's outlet was widened. Now the lagoon's elfish luster—and the larval fish and shellfish that depend on *Pyrodinium* as a food source—have all but disappeared. Like the contents of a genie bottle that's been opened, the bay's important nutrients, such as B-12, have floated out to the open sea. The nutrients are contributed by the mangrove trees that line virtually every bioluminescent bay.

According to a US Navy report, Phosphorescent Bay is one of only 14 bioluminescent bays left on Earth. But there's good news for these rarest of rare bays. Now there are 15.

The newcomer lies in Puerto Rico's Humacao Natural Reserve (HNR). Saltwater from the Caribbean freely flows into HNR coastal lagoons, the result of a recent, man-made channel that links the lagoons with the sea. In 2002 the US Army Corps of Engineers constructed a drainage channel in the main HNR lagoon, connecting it with the Caribbean and altering the hydrology and salinity of the lagoon system. The channel is part of a flood control project to protect the nearby town of Punta Santiago.

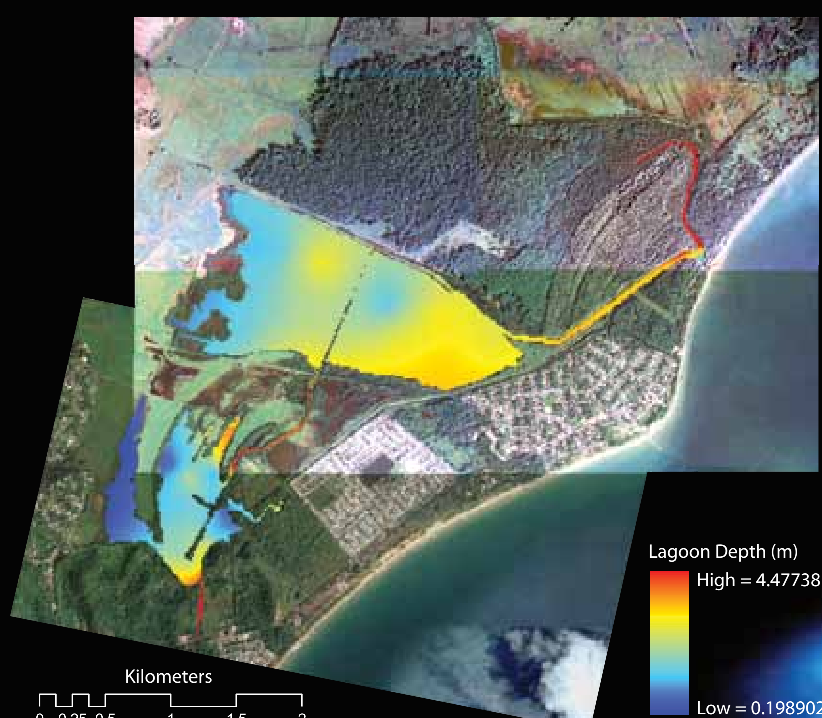
"An unexpected outcome was the introduction of a bioluminescent dinoflagellate," says ecologist Ricardo Colón-Rivera of Texas A&M University. "It's there in such abundance that it's produced a new 'bio-bay.'"

Colón-Rivera and colleagues Carlos Zayas-Santiago of the University of Puerto Rico at Humacao and Rusty Feagin of Texas A&M are working to find out how the salinity of the HNR lagoons has been altered by the channel, and what the relationship is between the amount of bioluminescence and the lagoons' salinity gradients.

Six HNR lagoons—Mandri Lagoons 1, 2, and 3, and Santa Teresa 1 and 2 and Palmas—are divided into two subsystems. Bioluminescence has been observed in one of the subsystems, Mandri 1, 2, and 3, that now has a strong link with the sea via the channel.

"We're comparing water samples from the two subsystems, focusing on their dinoflagellate populations," says Colón-Rivera. The scientists are tracking the dinoflagellates across a 12-month period to determine whether these light producers are more abundant during the dry or wet season.

Photos courtesy of Frank LLosa
Map courtesy of Ricardo J. Colón-Rivera



An early surprise is that the organism responsible for the bioluminescence is likely not *Pyrodinium bahamense*. Salinity averages 24 parts per thousand at all water depths in the HNR lagoons, a low level for *Pyrodinium bahamense*, which usually lives in full-strength seawater at 32 parts per thousand.

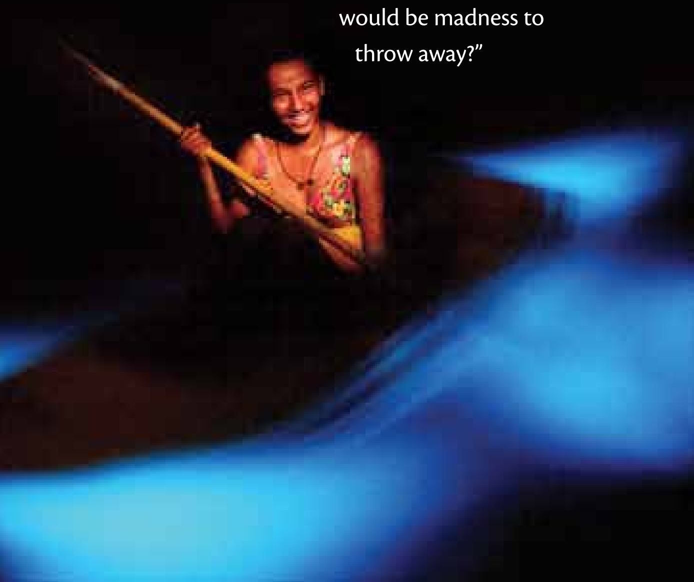
"In our samples, there are only a few *Pyrodinium bahamense*, even when the bioluminescence is very bright," says Zayas-Santiago. "Instead of *Pyrodinium*, there are large concentrations of other dinoflagellates we haven't yet identified."

The researchers' efforts are focused on the taxonomy of the dinoflagellates, and whether they're perhaps from the genus *Gonyaulax* or *Protoperidinium*. These dinoflagellates were the main ones collected in water samples during nights when the bio-bay glowed brightest, says Zayas-Santiago.

"This bio-bay wasn't among the world's known such places," says Colón-Rivera. "The discovery started when we were there working on the effects of sea level rise on coastal wetlands. Local fishers and tour guides started telling us about displays of bioluminescence in the lagoons. When we investigated, we found that they were right."

Along with their research, the scientists hope to develop conservation plans for the bio-bay.

To dive into a bioluminescent bay on a moonless night "is to share universal fires," writes Elizabeth Langhorne in her book *Vieques: History of a Small Island* (Vieques, Puerto Rico, is home to Mosquito Bay). "It is as though a million stars were caught in the sea. Is that not a gift of the Gods, one that would be madness to throw away?"



27 Earths Needed by Year 2050: Protected Areas Not Enough to Stem Biodiversity Loss

Twenty-seven Planet Earths.

The number of Earths it would take in a business-as-usual scenario to meet human demands by the year 2050.

That cumulative overshoot, or excess use of our planet's resources, already has resulted in an "ecological debt" that would require 2.5 Planet Earths to pay.

The debt, including a loss of biodiversity, is unstoppable if we rely on a strategy of setting aside land and ocean territories as protected areas. So found scientists Camilo Mora of the University of Hawaii and Peter Sale of the United Nations University in Ontario, Canada. They published their results in the journal *Marine Ecology Progress Series* on July 28, 2011.

Despite rapid growth of protected land and ocean areas worldwide—totaling more than 100,000 in number and covering 17 million square kilometers of land and two million square kilometers of ocean—biodiversity is in steep decline.

"Biodiversity is humanity's life-support system, delivering everything from food, to clean water and air, to recreation and tourism, to novel chemicals that drive our advanced civilization," says Mora. "Yet there is a sharp global trend in biodiversity loss triggered by a host of human activities."

Those activities include over-harvesting of species, habitat loss due to human encroachment on wilderness areas, introduction of invasive species, and the effects of global warming and pollution.

"Ongoing biodiversity loss and its consequences have prompted strong calls for protected areas as a remedy," says Sale. "While protected areas have helped preserve some species at local scales, use of this strategy as a worldwide solution to biodiversity loss has happened without knowing whether it's meeting its goal."

Mora and Sale warn that long-term failure of protected areas could erode public and political support for biodiversity conservation, and that disproportionate allocation of resources and human capital precludes the development of more effective approaches.

"We need to reassess our heavy reliance on this avenue," says Sale.

The current global network of protected areas has five main limitations, Mora and Sale believe.

Continued next page...

Photo courtesy of National Oceanic and Atmospheric Administration/Department of Commerce, photographer Linda Wade

EXPANSION OF PROTECTED AREA COVERAGE IS TOO SLOW. At current rates, it will take 185 years on land and 80 years in the ocean to cover 30 percent of the world's ecosystems with protected areas—the minimum advocated for effective biodiversity conservation. This slow pace is out of sync with threats that will likely cause the extinction of many species by 2050. In several places, options for a network of protected areas are limited; in Africa, for example, less than 12 percent of the continent is uninhabited by humans.

THE SIZE AND CONNECTIVITY OF PROTECTED AREAS ARE INADEQUATE. To ensure the survival of wild species, protected areas must be large enough to sustain viable populations, and the areas must be close enough together for a healthy exchange of individuals. Globally, however, more than 30 percent of protected areas in the ocean, and 60 percent of those on land, are smaller than one square kilometer—too small for many larger species. "And they tend to be too far apart," says Sale.

PROTECTED AREAS AMELIORATE ONLY CERTAIN THREATS. Protected areas are primarily useful against overexploitation and habitat loss. But other stressors, such as climate change, pollution, and invasive species, are equally harmful, says Mora.

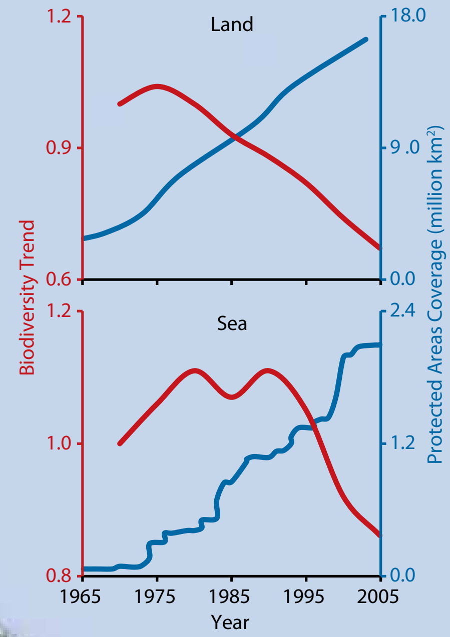
UNDERFUNDING. Protected areas are not well-enough funded for effective management. Mora and Sale estimate that it would require $24 billion per year to meet that goal—four times the current expenditure of $6 billion.

CONFLICTS WITH HUMAN DEVELOPMENT. Humanity's footprint on Earth is ever expanding. Meeting basic needs such as housing and food will become more difficult and exert more pressure on ecosystems. "If it were possible to place the recommended 30 percent of world habitats under protection, intense conflicts with competing human interests would be inevitable," state Mora and Sale. "Forcing a trade-off between human development and sustaining biodiversity is unlikely to lead to a solution with biodiversity preserved."

We are faced with a choice between two paths, says Sale. "One option is to continue a narrow focus on creating more protected areas with little evidence that they curtail biodiversity loss. That path will ultimately fail.

"The other path requires that we get serious about addressing the growth in size and consumption rate of the global human population."

In the end, we have not 27 Earths, but one.



Comparison of the global trend in biodiversity status (red lines) on land (top) and in the sea (bottom), and the global coverage of protected areas (blue lines) from 1965 to 2005. The biodiversity status includes the population trends of nearly 2,000 species monitored worldwide (data from the *World Wildlife Fund 2008 Living Planet Report*). The data on protected areas are from the World Database on Protected Areas. *Figure courtesy of Camilo Mora and Peter Sale*

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