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Ripple Marks

The Story Behind the Story

BY CHERYL LYN DYBAS

And Then There Were None: Shellfish Reefs Most At-Risk Marine Habitats

Tendrils of fog curl above the waters of Chesapeake Bay. Biting winds gusted out of the northwest yesterday, and an early snow is forecast for tomorrow. But for this one afternoon in mid-November, cold winds fetching across slate-gray waves have gone elsewhere. The Chesapeake is holding its breath, granting one last look at autumn on a day that seems suspended in time.

Every fall, the bay's watermen, as oystermen are called here, sail their skipjacks, dredging up Chesapeake oysters. But for how long?

"Once major features in temperate estuaries around the world, declining native oyster reefs are critically important ecologically and economically," states a 2009 report by The Nature Conservancy (TNC): *Shellfish Reefs at Risk: A Global Analysis of Problems and Solutions*. "Centuries of intensive fisheries extraction have put oyster reefs near or past the point of extinction globally, but solutions that could ensure conservation of remaining reefs and even reverse losses are possible."

Worldwide, 85% of shellfish reefs have been lost, making oyster reefs the most severely impacted marine habitat on the planet, the report's authors found. In the study, ecosystem condition was based on the percent of shellfish reefs remaining compared to baselines from 20 to 130 years ago.

Just as coral reefs are critical to tropical marine habitats, bivalve shellfish are the ecosystem engineers of bays and estuaries, creating habitats for countless plants and animals. The surface area of an oyster bed, across its dips and folds and crevices, may be 50 times greater than that of an equally extensive flat mud bottom, according to Alice Jane Lippson and Robert L. Lippson in their book *Life in the Chesapeake Bay*. Many species that live on dock pilings and in seagrass meadows also live on oyster bars, including sea anemones, sea squirts, crabs, and fish like gobies, blennies, and skilletfish.

Shellfish reefs also provide important services to people, according to the TNC report, "by filtering water, and serving as natural coastal buffers from boat wakes, sea-level rise and storms."

Shellfish beds are essential to the health of marine ecosystems, yet are viewed not as habitats but as fisheries. And therein lies the problem.

According to the report, "reef habitats must be managed as just that: habitats, not solely as fisheries."

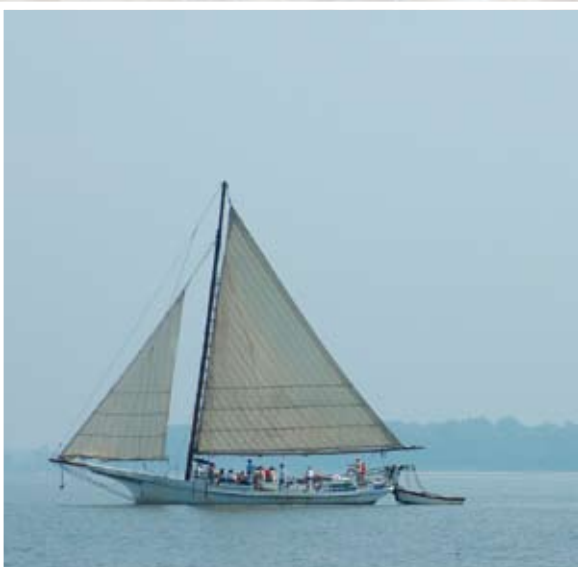
Shellfish have supported civilization for millennia, from the ancient Romans to railroad workers in California in the 1880s. In 1864 alone, 700 million European flat oysters (*Ostrea edulis*) were consumed in London, employing some 120,000 men to dredge oysters. In the 1870s, intertidal reefs of the eastern oyster (*Crassostrea virginica*) extended for miles along the James River in Chesapeake Bay. They had largely disappeared by the 1940s. Roads in many coastal areas, especially around Matagorda Bay, Texas, were often paved with oyster shells.

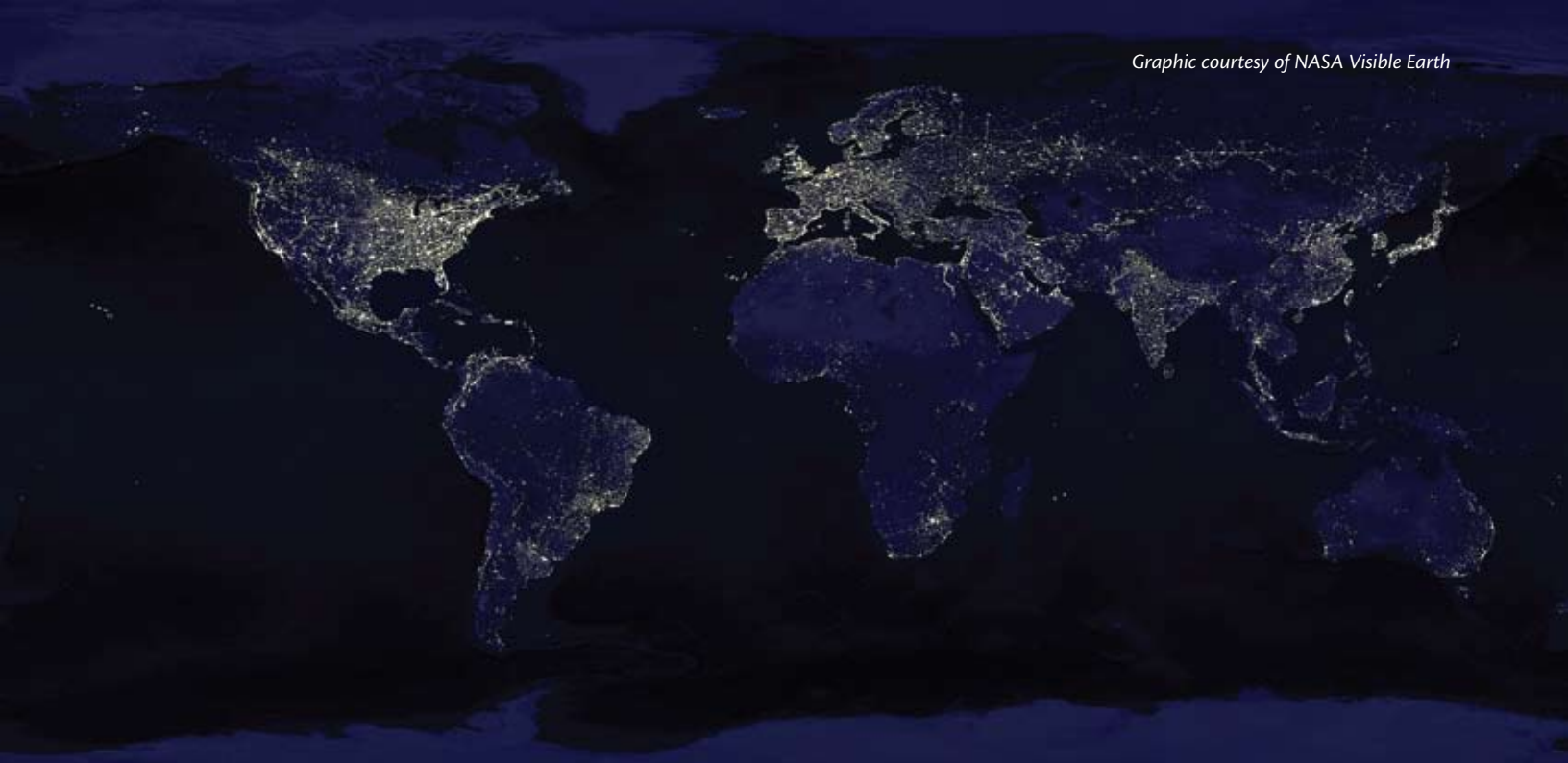
Now, shellfish reefs in some places are at less than 10% of their former abundance, and have gone extinct in many areas, especially in North America, Australia, and Europe. Most of the world's remaining wild capture of shellfish comes from only five ecoregions (of 152 with reported catches), all on the east coast of North America.

What can be done?

According to the report: improve protection for native shellfish reefs; restore reefs to functioning ecosystems that provide multiple services to humans; manage fisheries sustainably for ecosystems and livelihoods; halt the intentional introduction and spread of non-native shellfish; and improve water quality in bays and estuaries.

If the oyster population of the Chesapeake and other areas continues its decline, some autumn soon, skipjacks may make their last voyages, coming to their final resting places in waters strewn long ago with shellfish larger than silver dollars and worth their weight in gold.





Graphic courtesy of NASA Visible Earth

Nightlights Point The Way to Threatened Ocean Regions: "Light Pollution" Affects Corals and Other Organisms

The Boston-to-Washington megalopolis. At night, a sea of lights easily visible by satellites.

Unfortunately, also readily seen in the ocean below—by the denizens of coral reefs and other habitats.

In a paper in the journal *Geocarta International* (December 2008), Christoph Aubrecht of the Austrian Research Centers in Vienna and co-authors report results of a study of the effects of night lights on reefs.

"Artificial night lighting from cities, gas flares, and fishing boats can have direct and indirect effects on marine organisms," says Aubrecht. "Corals are highly photosensitive. Many species synchronize their spawning through detection of low light intensity from moonlight, and coral reef structure is strongly influenced by illumination." For example, seaweeds on coral reefs, signaled by light levels, grow at night to reduce herbivory.

Medical researchers have found that human nighttime shift workers, whose production of the "sleep hormone" melatonin is blocked by exposure to light at night, are at a higher risk of developing breast cancer. Coral health is similarly affected by out-of-sync light.

"The synchrony of coral spawning breaks down under artificially simulated continuous full moon conditions," says Aubrecht. "Corals are sensitive to even minor increases in night light." Nocturnal responses to light in coral reef communities are "set" to levels of light at moonlight intensities and lower, says Aubrecht. "Any artificial alteration of this environment is likely to influence community structure, species interactions and ultimately reduce biodiversity by homogenizing the light environment."

Tracking the effects of light-at-night on reefs is a proxy, Aubrecht and colleagues believe, useful for looking at human impacts on other ecosystems in the sea—and on land.

Three reef stressors were included in their study: cities and towns; gas flares; and heavily lit fishing boats. Aubrecht set a threshold of 5 km for gas flares and heavily lit fishing boats, and 25 km for cities and towns, and added the value of lit pixels within this radius for each reef studied.

Reefs at highest risk from overall light pollution are those off Indonesia, in the Red Sea, and off Japan and Puerto Rico. In a ranking of reefs threatened from lit fishing boats, those off Thailand and China top the list; from gas flares, reefs off Bahrain and in the Persian Gulf are most under fire. Least affected areas are Australia's Great Barrier Reef, and reefs off the Marshall Islands and near Madagascar.

Where is dark still completely dark? In just one tropical place on Earth: the Cargados Carajos Islands near Mauritius. The South China Sea's Spratly Islands and the Solomon Islands east of Papua New Guinea, however, come close: they're almost at "lights out."

Oceans—vast, wide expanses—have no barriers for light but Earth's curvature. "Inasmuch as gas flares, light-induced fisheries, and nearby settlements on land provide illumination that's brighter than the full moon, impacts can be expected in coral reefs," Aubrecht says.

Our millions and millions of night lights are disturbing more creatures than us.

Ghosts of Oceans Past: Sea's Resources Began to Decline in the Stone Age

The ghosts of thousands of right whales are still sounding in the waters off New Zealand.

There, before oil hunters in the early 1800s harpooned whale after whale, the ocean teemed with some 27,000 southern right whales, 30 times as many as exist today.

That's just one of the startling conclusions reported at a Census of Marine Life (COML) conference—"Oceans Past, II"—held in Vancouver, BC, in late May. Scientists affiliated with COML's History of Marine Animal Populations (HMAP) project are reconstructing images of past sea life that boggle the imagination, they say.

When tens of thousands of right whales swam near New Zealand, large pods of blue whales and orcas, blue sharks and thresher sharks, roiled the waters off Cornwall, England.

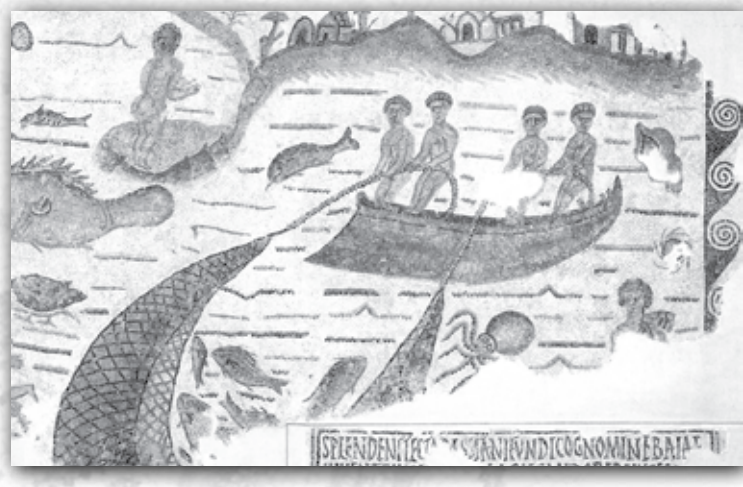
From sources such as old ship logs, literary texts, tax accounts, translated legal documents, fraying restaurant menus, and mounted trophies, COML researchers are fitting together the puzzle pieces of a past ocean world. There, fish of staggering size, abundance, and distribution were found.

Scientists are documenting time lines over which these giant marine populations disappeared. Human fishing and impacts on nearshore and island marine life began in the Stone Age, 300,000 to 30,000 years ago, 10 times earlier than believed. Latin and Greek texts written in the Second Century CE suggest that Romans had already begun trawling with nets.

The size of freshwater fish caught by Europeans started shrinking in medieval times. A shift from locally caught freshwater to marine fish species occurred around 1000 CE, according to James Barrett and Jen Harland of Cambridge University in the UK, Cluny Johnstone of York University, UK, and Mike Richards of the Max Planck Institute in Germany.

Their findings match analyses of scientifically dated fish remains and historical data from England and northwestern Europe showing smaller freshwater fish and fewer species in early medieval times. Exploitation and pollution were the culprits.

New boats and equipment invented in the 1500s made it possible to shift from coastal to deep-sea fishing. According to Maria Lucia De Nicolo of the Universita di Bologna, Italy, a revolution in marine fisheries occurred in the mid 1600s when pairs of boats began dragging nets strung between them.



One of the earliest depictions of trawling. Mosaic from the fifth century, Bizerte, Tunisia. *Source: Yacoub, M., Splendors of Tunisian Mosaics, Tunis, 1995, Fig. 115*

In the early 1800s, years of overfishing followed by extreme weather led to the collapse of the herring fishery in Europe; numbers of jellyfish upon which the herring preyed exploded, completely altering the food web. Periwinkle snails and rockweed migrated from England to Nova Scotia on the rocks ships carried as ballast in the mid 1800s. HMAP scientists call it "the tip of an 'invasion iceberg' of species brought to North America."

Looking at marine life through the narrow window of recent decades "skews perceptions," says Andy Rosenberg of the University of New Hampshire, a leader of the HMAP project and chair of the May conference. "New insights allowed by centuries of information are changing our ideas about 'natural' marine life size, abundance, and vulnerability," he says, "and suggest that we need to revisit baselines."

In many places, human-caused changes in the ocean happened over millennia, but reliable information on those effects is only available for the past few centuries.

In New Zealand, however, first settled by 300 eastern Pacific islanders around 1280 CE, a continuous record of impacts exists, including whaling for southern right whales. Scientists Jennifer Jackson and Scott Baker of Oregon State University, Emma Carroll and Nathalie Patenaude of the University of Auckland in New Zealand, and Tim Smith of the US National Marine Fisheries Service estimated former southern right whale numbers by analyzing more than 150 whaling logbooks and other records. This well-documented history allows researchers to see the scope of change in one place from initial human presence to today. Policymakers are using the results as a baseline against which the current and future status of this marine ecosystem may be measured.

COML scientist Ian Poiner of the Australian Institute of Marine Science refers to a well-known Joni Mitchell song. "'You don't know what you've got 'til it's gone.' When it comes to marine life, we're only starting to realize what our planet once had."

For southern right whales and countless other marine species, we in effect "paved paradise and put up a parking lot."

Ocean News Coverage: Where Have All the Seagrasses Gone? Coral Reefs Darlings of the Media

Long floating grasses turned golden in an autumn sun.

Neon-bright fish darting in and out of tropical shoals.

Which most captures your interest?

If you're a journalist—or a member of the general public—in countries from the United States to Spain, it's the latter, fish in coral reefs, not the former, the seagrasses of the shallows.

Coral reefs receive most of the media attention on threatened coastal ecosystems, according to a paper in the journal *Estuaries and Coasts* (31:233–238). Less charismatic habitats—in the public eye—such as salt marshes and seagrass meadows, get relatively little coverage, say Carlos Duarte of the Mediterranean Institute of Advanced Studies in Spain, the paper's lead author, and colleagues.

(above) Sea urchin in seagrass, Nyali. *Photo by Gabriel Grimsditch, IUCN*

(left) Reef scene with sea rods. *Photo courtesy of Florida Keys National Marine Sanctuary (photographer Mike White)*

"But these habitats, too, are being lost alarmingly fast," says Duarte, "causing severe declines in biodiversity and the loss of ecosystem functions such as nursery areas for fish and protection from storm surges. If the present rates of loss continue for another five decades, the amount of remaining coastal ecosystems will be reduced to less than 15% of the area at the end of World War II."

The scientists searched the electronic archives of several media outlets in the United States, United Kingdom, China, Spain, France, Mexico, and Brazil for coverage on coral reefs, salt marshes, seagrass beds, and mangrove forests. Outlets surveyed included *National Geographic; New York Times; The Economist; International Herald Tribune; People Daily*, China; Google News; *El Pais*, Spain; *El Universal*, Mexico; the Discovery Channel; CNN; *Le Monde*, France; and *Journal do Brasil*.

Seagrass ecosystems received the least media attention of the four coastal ecosystems reviewed—just 1.3%. Salt marshes fared slightly better at 6.5%. Mangroves garnered 20%. The clear winner, however, was coral reefs: 72.5% of media reports on coastal ecosystems covered corals.

On average, Duarte found, 10 media reports existed for each research paper published on seagrasses, compared with 130 to 150 for every paper on mangroves and coral reefs.

The relationship, however, between public awareness and newspaper reports may not be a simple one, Duarte believes. "It involves feedbacks: public awareness triggers interest and leads to news reports, and more news leads to increased awareness. The lack of public knowledge of losses of coastal ecosystems results in the continuation of detrimental practices."

One of the most visible and dramatic services coastal ecosystems provide is protecting shoreline communities from natural disasters. "This was shown in 2004 when the tsunami hit Southeast Asia," says Duarte. "A higher death toll occurred in villages without mangrove protection than in those with preserved pockets of mangroves. Similarly, damage from Hurricane Katrina in 2005 was exacerbated by the extensive losses of salt marshes in the Mississippi River delta."

Coral reefs may be at the top of the news hour, but seagrass meadows have their own charms. They host large organisms that could attract the general public, such as tiger sharks, manatees, dugongs, turtles, seahorses, and giant bivalves. "The comparative lack of appeal of seagrass meadows to the public contrasts with the perception of scientists that these habitats rank among the most valuable ecosystems on Earth," Duarte and colleagues write.

The conservation of coastal ecosystems, they maintain, "ultimately depends on the level of success in building public awareness of their value and of the pressures responsible for their loss, a task that requires more effective communication among scientists, educators, the media, and coastal resource managers."

Duarte and co-authors cite the eye-catching spectacle of "dazzling and colorful fish and invertebrates" as an enticement for the public to know more about coral reefs.

We also need to admire seagrasses, they say, and become fascinated by a marine version of the story of Rapunzel's hair. Draped in the waters, her tresses shelter myriad creatures, each with their own tale to tell.

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