Ode to a Codfish

CHERYL LYN DYBAS

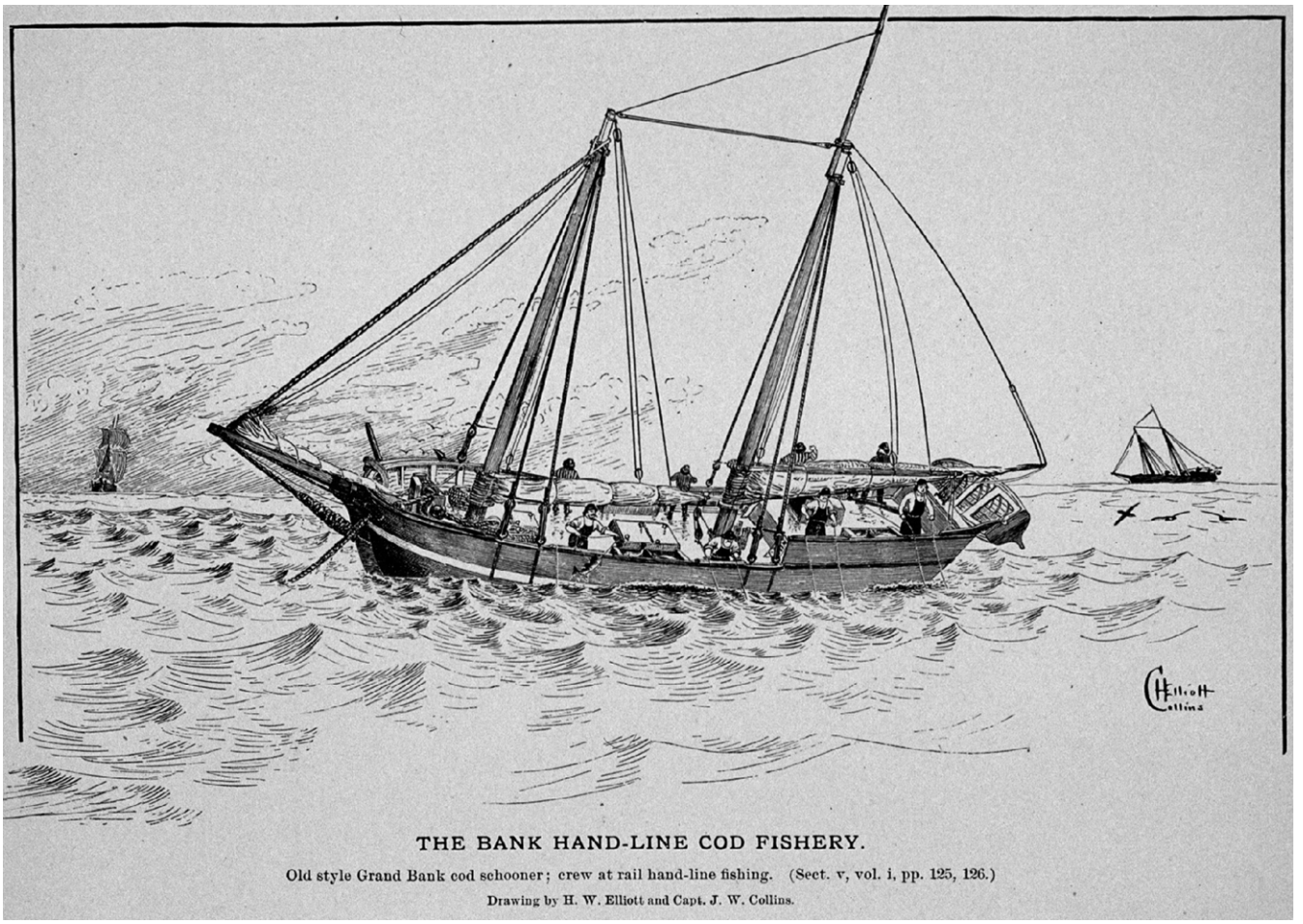
Color illustrations of the New England fishing industry in its prime are rare, but this hand-colored postcard from the early 1900s shows the industry's prominence in the lives of New Englanders. Courtesy of William Leavenworth.

> Cod—A species of fish too well known to require any description. It is amazingly prolific. Leewenhoek counted 9,384,000 eggs in a cod-fish of a middling size—a number that will baffle all the efforts of man to exterminate.
>
> *Cyclopedia of Commerce and Commercial Navigation,* 1858

In the mid-1800s, in the days when fish were fecund, 43 schooners from Beverly, Massachusetts—making up just 18 percent of the US fishing fleet off New England and Eastern Canada—caught more than 7800 metric tons of North Atlantic cod (*Gadus morhua*) on the Scotian Shelf, according to fisheries biologist Andrew Rosenberg of the University of New Hampshire and his colleagues. The shelf is a rich fishing bank south of Nova Scotia.

In 1999, the entire Canadian fishery for cod landed a total of 7200 metric tons—fewer fish from a larger area.

What happened to the millions and millions of tiny cod that should have reached adulthood on this offshore bank? The answer lies beneath a tangled net of international competition, the Industrial Revolution, advances in technology—and human avarice. "If ever there was a fish made to endure," writes Mark



Grand Bank schooners like this one once plied waters off the northeast coast. The schooner's crew is at the rails, handline-fishing for cod, which were abundant in past times, a situation that is radically changed today. Drawing: H. W. Elliott and Captain J. W. Collins, National Marine Fisheries Service Historic Image Collection.

Kurlansky in *Cod: A Biography of the Fish That Changed the World*, "it is the Atlantic cod—the common fish. But it has among its predators man, an open-mouthed species greedier than cod."

A piscine allegory for our times

Once upon a time, historical records show, the Atlantic teemed with cod. It was, says Rosenberg, "a key marine species prior to the industrialization of fishing." Rosenberg and his University of New Hampshire colleagues Jeff Bolster, Karen Alexander, Bill Leavenworth, and others use historical sources to study ecosystem trends and to establish a biomass estimate for cod. Cod was once a dominant fish in northwestern Atlantic waters, but "cod numbers on the Scotian Shelf have dropped 96 percent since the 1850s," says Leavenworth. "In fact, just 16 small schooners of the Civil War era could hold all adult cod currently estimated for an area formerly overflowing with fish."

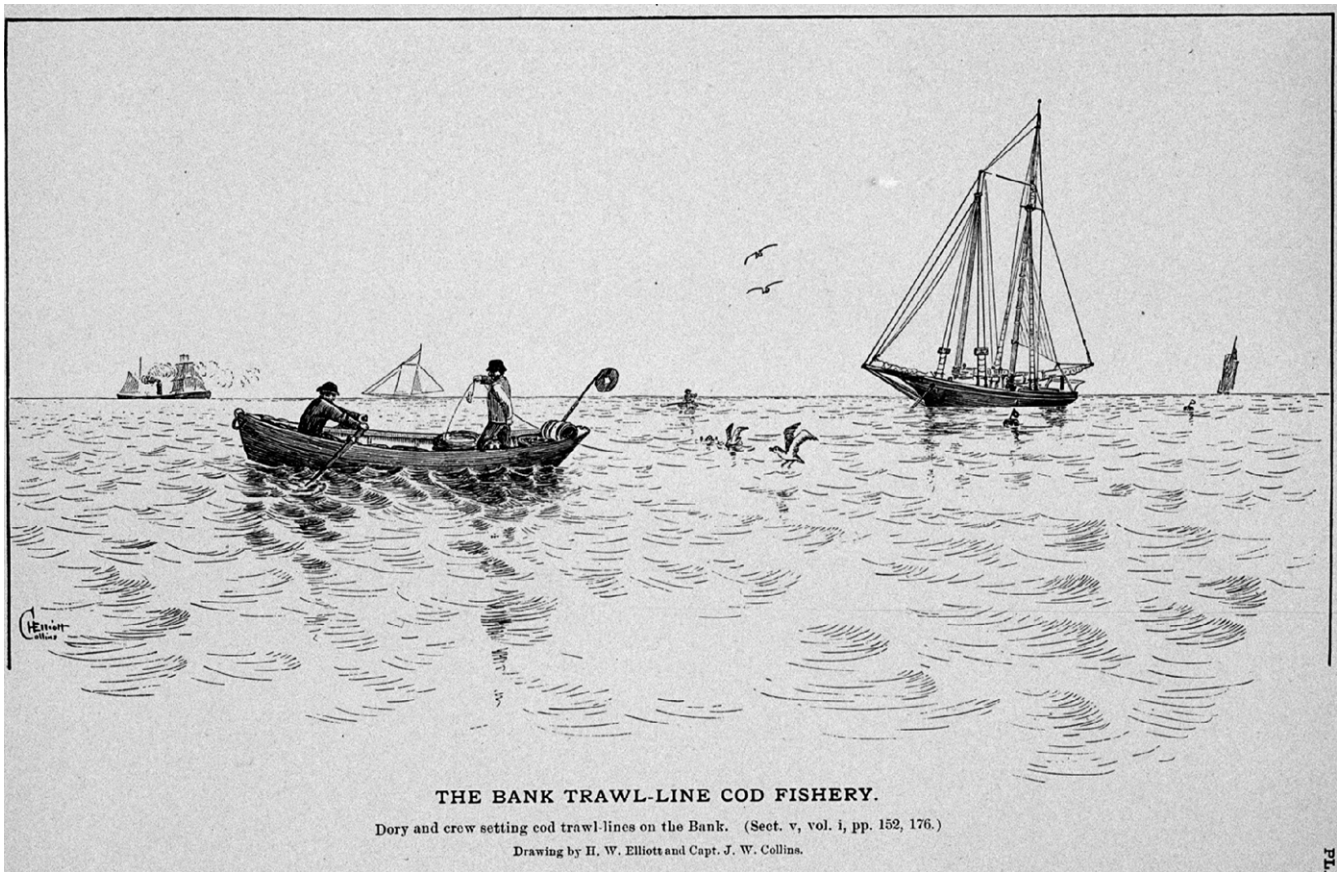
The researchers created the first-ever estimate of cod levels in the 1800s using old schooner catch records and observations, along with modern modeling tools. Their findings, published in the March 2005 issue of *Frontiers in Ecology and the Environment*, have profound implications for policymakers attempting to restore a once thriving fishery.

The Atlantic cod is a cold-water, bottom-dwelling (demersal) fish that inhabits both sides of the North Atlantic. Cod can weigh more than 100 pounds and live more than 20 years. But an average cod caught in the Gulf of Maine now is three or four years old and weighs 5 to 10 pounds. The largest Atlantic cod recently caught in these waters weighed 98 pounds; it was landed in 1969. In contrast, a 180-pound cod was caught in 1838, and a 211-pound cod in 1895. Cod that size have not been seen in more than 100 years.

Adapting to the most readily available food source, cod consume anything in their paths. The fish have a unique "barbell" protruding from their lower jaws, which they use to find prey that may be buried in sand.

Humans have the equivalent to cod barbells: trawlers. If people continue to catch cod in the open-mawed way cod catch small lobsters, shrimp, and other bottom-dwellers, says Rosenberg, we're likely to see the last of these icons of the North Atlantic.

"Managing the remnants of the ocean's resources is a critical issue worldwide, but evidence for what constitutes a



A fishing dory and its crew setting cod trawls on Nova Scotia's Grand Bank, formerly one of the world's most productive fishing grounds for cod and other groundfish. Drawing: H. W. Elliott and Captain J. W. Collins, National Marine Fisheries Service Historic Image Collection.

healthy fish population remains controversial," maintains Rosenberg. "As we attempt to rebuild these fisheries, our decisions should reflect realistic goals for management, not just recently observed catch levels."

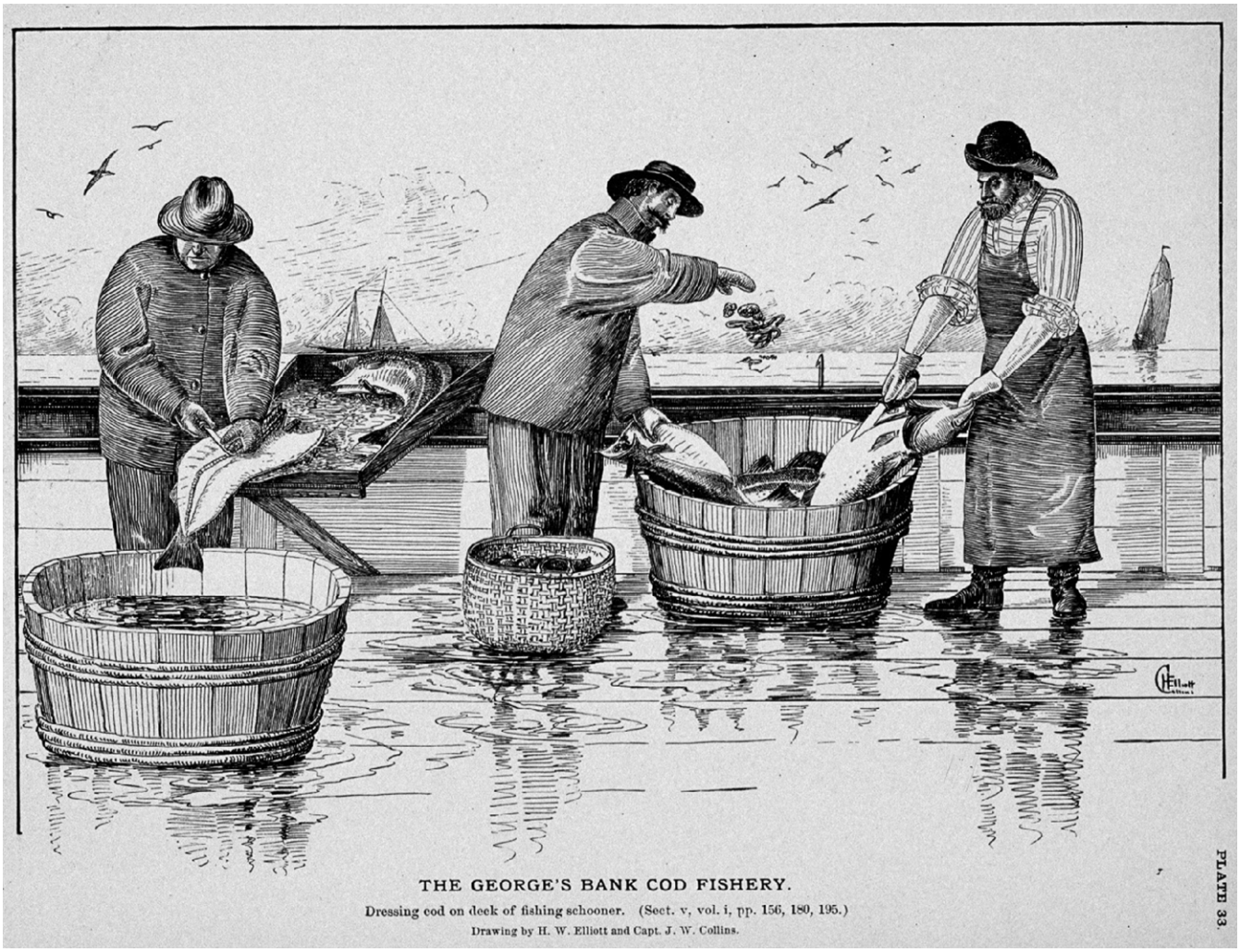
Rosenberg and colleagues' work is part of a Census of Marine Life (COML) project called the History of Marine Animal Populations (HMAP). HMAP is an interdisciplinary research program in which scientists use historical and environmental archives to analyze marine population data before and after human impacts on the ocean became significant. "While ecologists have traditionally tried to identify the current conditions of marine animal populations affected by harvesting," says Rosenberg, "much less focus has been given to the status of these populations in previous times." A historical reference point against which modern populations can be compared is necessary, researchers believe, to determine how ocean ecosystems are changing as a result of human impacts.

"HMAP projects are interpreting changes over the past 200 to 500 years, providing us with a baseline that extends long before the advent of modern technology," says Leavenworth, "and before significant impacts on the ecosystem." Three COML HMAP centers for the study of environmental history have been established: at the University of New Hampshire, the University of Southern Denmark, and the University of Hull in the United Kingdom.

A 150-year perspective challenges conventional wisdom about what constitutes a rebuilt cod stock, Rosenberg believes. "In recent debates in New England over management of cod stocks, for example, many argued that 1980s stock levels should be considered fully rebuilt," he says. "But this contradicts the evidence, which suggests that cod stocks can only be considered rebuilt at much higher levels."

Adds Leavenworth, "Our historical analyses indicate that recent levels of biomass and catch may grossly underrepresent the potential of commercially important species." To date, he says, "declines have not been well described for fish species and marine ecosystems around the world. The importance of determining baseline levels of marine species that existed prior to the industrialization of fishing can't be overemphasized."

To estimate long-ago numbers of cod, the scientists used 1850s schooner records of daily catch locations and fleet activity on the Scotian Shelf fishing grounds. At that time, fishers used handlines to catch fish. With few hooks set, only so many fish could be caught in a day, keeping overall catch numbers relatively low. "Schooner logs," says Leavenworth, "provide a solid,



Cod fishers of the past brought in their fare for sale at various wharves and other open-air waterfront markets. This historical image shows cod for sale at a Gloucester, Massachusetts, wharf in the 1880s. Drawing: H. W. Elliott and Captain J. W. Collins, National Marine Fisheries Service Historic Image Collection.

reliable basis for fish stock assessment at that time."

During the mid-19th century, fishing vessels from New England, Nova Scotia, and, for a time, France fished the productive Scotian Shelf banks from early April to late November. A nearly complete set of detailed, geographically specific logs exists for the period 1852–1859, report the scientists. Their study is based on analysis of logs of 236 Beverly schooners fishing on the Scotian Shelf.

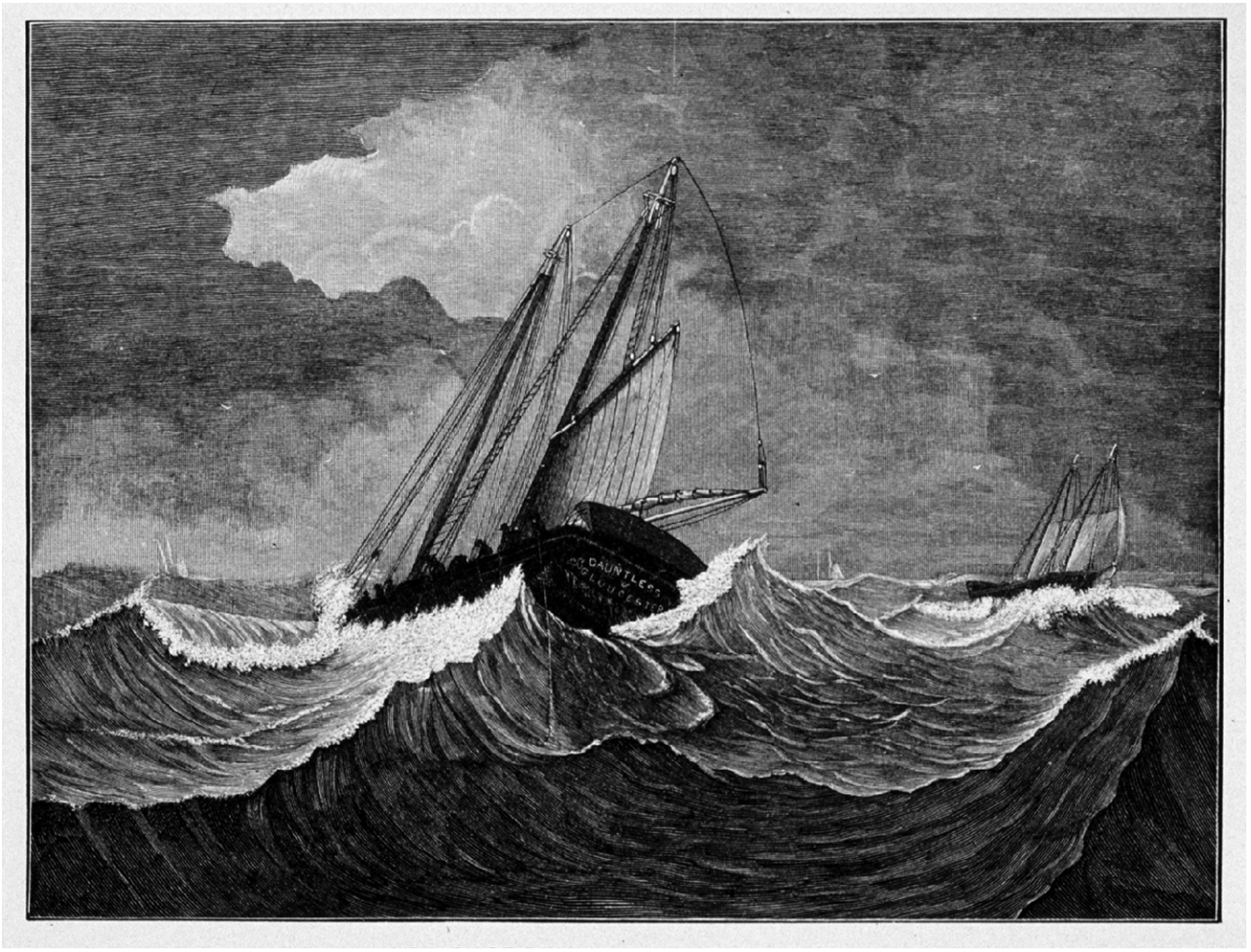
"Vessels usually assembled in groups to fish," says Leavenworth. "Skippers knew that a fleet of vessels at anchor on the horizon was as good an indicator of abundant cod as a flock of seabirds or schooling baitfish." On 4 August 1854, for example, the schooners *Mechanic*, *Pulaski*, *Mayflower*, *WH Lovett*, *Friendship*, *Essex*, *Richmond*, and *Franklin* all swayed in the swells on the Scotian Shelf's "middle ground."

In 1856, the crew of one schooner was washed overboard by a storm. Another vessel came to the fishers' rescue. Upon surveying the scene, the second boat's captain noted that the catch was very good, so good, in fact, that his crew had to pull a drowning man's entire leg out of a large cod to rescue him.

A mere three years later, the scene had changed. On 23 May 1859, Captain Gilbert Weston of the *Dorado*, plying the waters on the Scotian Shelf's Banquereau Bank, wrote in his log that the schooner had "1,000 hooks out and caught only 130 cod fish."

Fishers remembered "the good old days" when lines with two hooks each dropped over a schooner's rail could bring in more than 100 fish apiece. Seven years earlier, in 1852, Captain George Gould's crew on the *Betsy & Eliza* had what they called "golden days," landing more than 1000 cod in one day alone that June.

Fishing patterns, it appears from schooner logs, had begun to change as early as the late 1850s. All was not well on the Banks. There were so many fishing boats that, in 1858, the schooner *Ocean Nymph* of Gloucester was run down by the ship *Sarah Jane* off Cape Cod, though the crew was saved. The handline fishery in sailing schooners apparently depleted regional cod stocks: Between 1852 and



A mid-1800s schooner from Gloucester, Massachusetts, floats at anchor on George's Bank, Massachusetts, in winter. Here the crew fished for cod with handlines. The schooner is rigged without topmasts, in preparation for winter's rougher weather. From a painting by Paul E. Collins, National Marine Fisheries Service Historic Image Collection.

1857, vessels from Beverly, Massachusetts, fished the Scotian Shelf 90 percent of the time. That figure declined to 60 percent in 1859, as captains searched elsewhere for economically profitable catches of cod, says Rosenberg.

One regional folk belief associated cod fishing lines with magic. Their fish-catching magic apparently worked, perhaps too well. "Some vessels left the Beverly fleet, and may have left the cod fishery altogether," Rosenberg says, "a familiar pattern in collapsing fisheries today." Catch declined by more than 50 percent between 1852 and 1859.

Using a mathematical formula, the researchers estimate that cod biomass on the Scotian Shelf was 1.26 million metric tons in 1852, compared with less than 50,000 metric tons today. "Our estimate of 1850 cod biomass is conservative," says Rosenberg, "as old fishing logs record only adult cod. Hook sizes in use at that time, though, made landing smaller juvenile cod very unlikely."

A century later, more knowledge, fewer fish

Despite strict regulations for the last decade or more, says Rosenberg, and a slight rebound of fish stocks during that 10 years, "the best estimate of adult cod biomass on the Scotian Shelf today is a mere 38 percent of the catch brought home by 43 Beverly schooners in 1855."

That estimate is consistent with research by scientist Ransom Myers of Dalhousie University in Halifax, Nova Scotia, which estimated how much cod could be sustained in the North Atlantic ecosystem. "Spectacular collapses such as those of the Eastern Canadian cod stocks, which at first were attributed to climate change, turned out on closer analysis to be solely related to overfishing," says Myers.

"When management delays from political pressure allow continued overfishing, the rebuilding clock keeps ticking and populations decline further," wrote Myers, Rosenberg, and others in *Science* (29 July 2005). "This failure to act early, necessitating deeper fishery cuts to rebuild populations within a time limit, has prompted critics to argue that a longer rebuilding window [longer than 10 years] will be necessary."

It doesn't work that way, these scientists believe. Extending the rebuilding time frame by a decade doesn't change anything. "Human predilection for inaction necessitated the rebuilding time frame in the first place, and deadlines will be needed unless and until human nature changes," they wrote in *Science*.

Populations of New England cod and haddock show the contrast between stepping in to scale back or close down a fishery early, and waiting until it's almost too late. Several years ago, fishing pressure on haddock was abruptly cut back, says Myers, but fisheries managers phased in cod fishing reductions slowly. Haddock rebounded quickly, but cod have barely increased. The lack of early restrictions "is affecting the industry years later, when recovery could be nearing completion."

Gulf of Maine cod have gone missing in almost half of their spawning grounds because many small populations are now extinct. "Overfishing," maintains Myers, "truncates a population's size and age distribution, lowers genetic diversity, and suppresses reproductive and recovery capacity." Prolonged depletion incurs ecosystem cascades—for example, overfishing of blue crabs has contributed to salt marsh grass die-offs. "We need to end, not tolerate, the damage of overfishing."

A look into history's depths

The first colonial industry in America was groundfishing, the catching of fishes that swim close to the bottom, like cod, haddock, and flounder. During the past hundred or more years, changes in the fishers, their methods, and the productivity of the fishery mirror developments in technology and environmental conditions both in the sea and ashore.

Today the numbers of groundfish are lower than ever, and the industry is fading away, struggling to support such historical fishing communities as Gloucester and New Bedford, Massachusetts.

"Increasingly efficient fishing methods, competition among various sectors using different gear, inability to act in harmony with international partners, and a failure to heed scientific advice sound like current themes," according to a document on groundfishing produced by NOAA's Northeast Fisheries Science Center (NEFSC) in Gloucester. "In fact, though, they have been repeatedly echoed since the turn of the century and before."

Once, great fleets of New England and Canadian vessels sailed to the easternmost reaches of North America, the offshore banks. Catches of what was then called salt cod, as it was preserved with salt, supported nearly 400 schooners in each port, as well as shore-based businesses like salt mining, ice harvesting in freshwater ponds, and boat building.

The Industrial Revolution caught up with the fishing industry around the turn of the century, according to the NEFSC. The advent of steam-powered trawlers heralded a sea change in how groundfish were caught. The schooners of old, one by one, rotted away at the dock.

By 1930 there were clear signs that the fleet had grown too efficient for the capacity of fish stocks to sustain growth, says Leavenworth. In 1930, the Massachusetts groundfishery landed 37 million haddock in Boston, with another 70 to 90 million baby haddock discarded at sea. The small mesh size of the nets was the culprit, but not until 1953 did minimum mesh size regulations come into force.

The beginning of the 1960s brought the most grave threat to date. Oceangoing "fish factories," distant-water fleets, discovered groundfish off Georges Bank. Soon such fleets from Russia, East Germany, Poland, Spain, Japan, and other countries competed with those of the United States. It was the 1970s before an international commission brought fishing restrictions to bear, too late to avoid the collapse of groundfish stocks.

Then the US Congress enacted the Magnuson Act of 1976, taking control of the exclusive economic zone—waters out to 200 miles—and mandating regulation of the domestic fishing industry. US fishers began to build steel sterntrawlers, which quickly replaced the former wooden side-trawlers. "But these new trawlers were miniature versions of the factory trawlers used by the former distant water fleets," according to NOAA.

The high-water mark for the groundfish industry in the United States came during the early 1980s, when strong year classes of cod and haddock, spawned in 1975 and 1978, reached harvest size. The fish were scooped up in the maws of modern trawlers. With the cod went the last of the halcyon days of the New England and eastern Canada cod fishery.

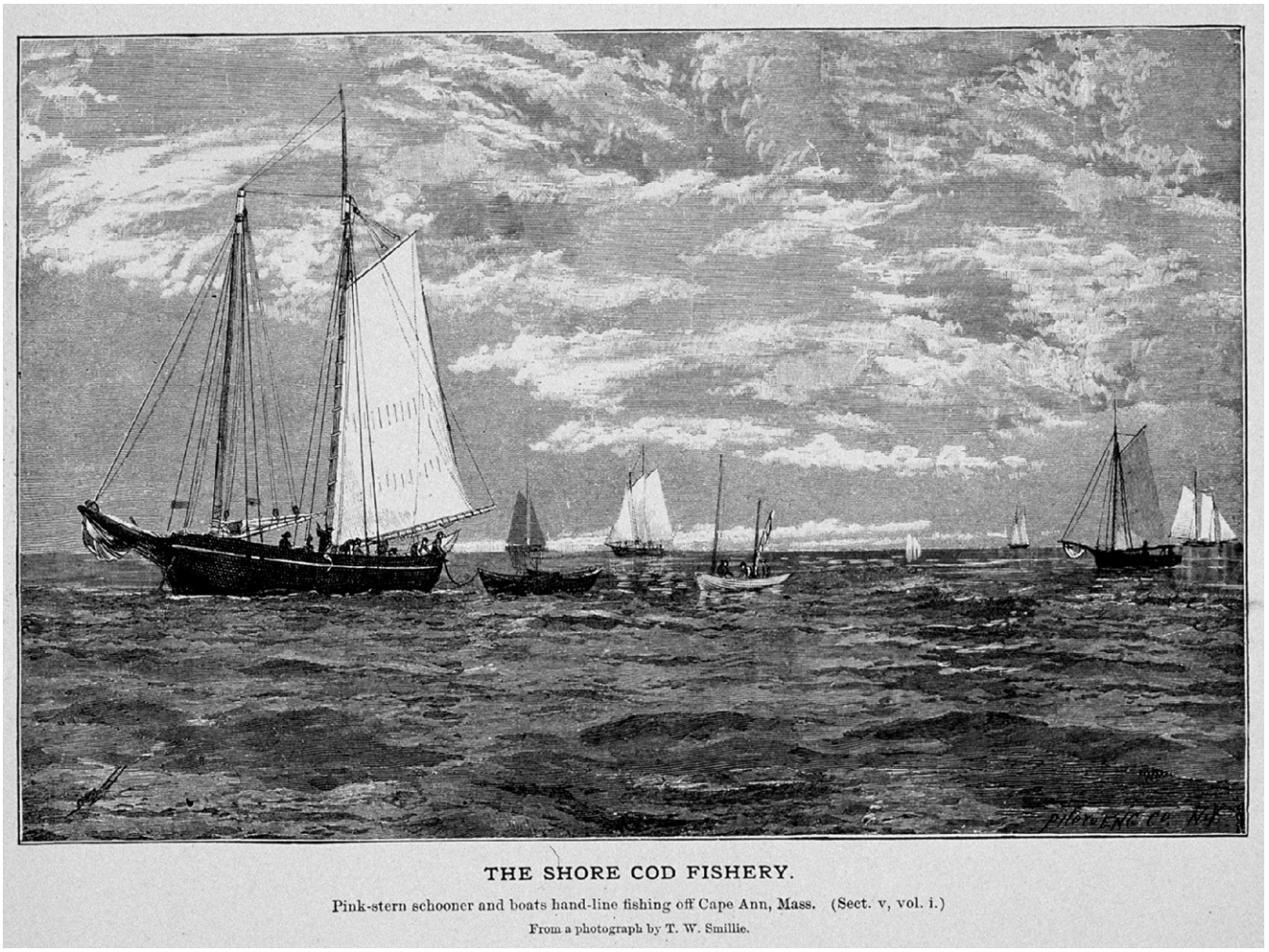
Decades of supporting growth of the fishing industry rendered former federal government policies powerless and led to allegations that these regulations hastened the end of cod. Soon Congress was forced to develop programs to help save not just fish but fishers. Vessel buyouts, job retraining, and subsidized health insurance for fishing families were discussed—more than the fish themselves.

Groundfishing communities ashore began to go the way of groundfish populations in the sea: Some survived, but many were reduced to a fraction of their former extent. Others died a slow death, eventually becoming as diminished as the fish populations they had sought to catch. A fishery that began with a few sailing schooners in the 1800s ended up, more than 100 years later, with too many fishers chasing too few fish.

How do we protect cod and other marine populations?

"From Newfoundland to southern New England, there is a series of shallow banks, the southernmost being Georges Bank off Massachusetts, which is larger than the state," writes Kurlansky in *Cod*. "Several large banks off Newfoundland and Labrador are together called the Grand Banks. The largest of the Grand Banks, known as the Grand Bank, is larger than Newfoundland. These are huge shoals on the edge of the North American continent."

The area is known for its phytoplankton blooms, fueled by nutrients stirred up by cross currents. Zooplankton feed on the phytoplankton. Northern shrimp (*Pandalus borealis*) feed on zooplankton. Cod, in turn, feed on northern shrimp. Since the decline of the cod on the banks, northern shrimp populations have increased significantly, Myers has found. "This suggests that other prey species respond in a similar manner to unprecedented declines in cod stocks," wrote



A schooner and other boats handline-fishing for cod at Cape Ann, Massachusetts, in the late 1800s. From a photograph by T. W. Smillie, National Marine Fisheries Service Historic Image Collection.

Myers and Boris Worm, of Dalhousie University, in 2003 in the journal *Ecology*. "Alterations in predator abundance through overfishing result in strong patterns of community change, and predation appears to be a structuring force in the North Atlantic Ocean."

As cod are declining and shrimp are increasing in response, the effects ripple through other populations that make up the ecosystem of the fishing banks. "The collapse of fish stocks in the Northwest Atlantic is perhaps one of the greatest challenges ever faced by marine scientists, fisheries managers, and resource users," says Myers. Myers and Susanna Fuller, also of Dalhousie University, authored a 2004 report recommending that the southern Grand Bank be considered for designation as a Marine Protected Area (MPA). The purpose of the MPA, they write in the report, *The Southern Grand Bank: A Marine Protected Area for the World*, is "to conserve a representative biodiversity of species and habitat, protect juvenile fish, investigate the effectiveness of a large-scale closure on depleted fish stocks, and establish a precedent for open-ocean high seas protected areas."

Protection of the area with an MPA designation would be politically significant, Myers and Fuller acknowledge, as it would straddle the 200-mile limit, thus requiring international cooperation for implementation. "Should this proposal move forward," says Fuller, "it would be a significant precedent in high seas conservation."

The southern Grand Bank has sustained a web of marine life for centuries. The bank, according to the report, is defined by several distinct physical and geographic characteristics. The most significant, says Myers, is the Southeast Shoal—a shallow, sandy plateau where many species of fish, birds, and marine mammals congregate to spawn and feed.

Pressures of overfishing, especially in the past 50 years, have left the shoal depleted of commercially harvested species, with cod at the top of that list. "Despite fisheries closures and a reduction of fishing effort, commercial fish stocks have not recovered, and many species continue to be exploited as by-catch," says Myers. "A large-scale protected area—with a no-take component—presents us with an opportunity to restore fish stocks

and offers protection of the marine ecosystem."

For people to care about a habitat, Myers believes, it must exist in their imaginations. "When we're concerned about losing something, it becomes much easier to preserve," he maintains. For 500 years, the Grand Banks have been an important source of food for the people of southern Europe and the Caribbean, and they have played a role in many cultural traditions. Dried cod from the Grand Banks, for example, is the traditional Christmas dish in Italy. "The Grand Banks have a strong emotional appeal for the public, so half the battle in gaining international support for protection of this area is already won."

The strongest argument for MPAs as protectors of the Atlantic cod fishery is that they have provided protection in the past, although they were not designated as any kind of conservation zone at the time. Much of the offshore banks area was inaccessible to humans in the days before highly efficient fishing boats and sonar fish finders, says Myers. The banks were protected by natural forces: They were distant from land and covered by ice in winter.

Out of sight, cod indeed were out of mind. According to Rosenberg, Myers, Leavenworth, and many others, to protect besieged cod and other groundfish stocks, whither the fish go, we should not.

Cheryl Lyn Dybas (e-mail: cldybas@nasw.org) is a journalist who specializes in the marine sciences.