



Lobsters fight over a burrow in the sandy seabed off the Isle of Shoals, in the Gulf of Maine. Some believe that overfishing of cod and other fish that prey on lobsters mean that the crustaceans don't necessarily need to hide in rocky crevices and can move out into the open

ANIMALS | NEWS

Maine's having a lobster boom. A bust may be coming.

With warmer waters, the Gulf of Maine's famous crustaceans are flourishing—for now.

PHOTOGRAPHS BY **BRIAN SKERRY**BY **JAMES PROSEK**

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Ask any outsider what Maine brings to mind, and the response might well be: Bone-chilling winters. Forests. Moose. Quaint fishing villages along a rocky coast. Flannel shirts and Bean boots. And lobsters—lots of lobsters.

These cold-water-loving, bottom-feeding crustaceans are top of mind for many Mainers too, including Monique Coombs. She's the director of community programs for the Maine Coast Fisherman's Association, in Brunswick. She's also the wife of Maine lobsterman, Herman Coombs, and the mother of 16-year-old Joceylne, who's going into the family trade. *Homarus americanus*—the American lobster—is what keeps bread on the Coombs' table.

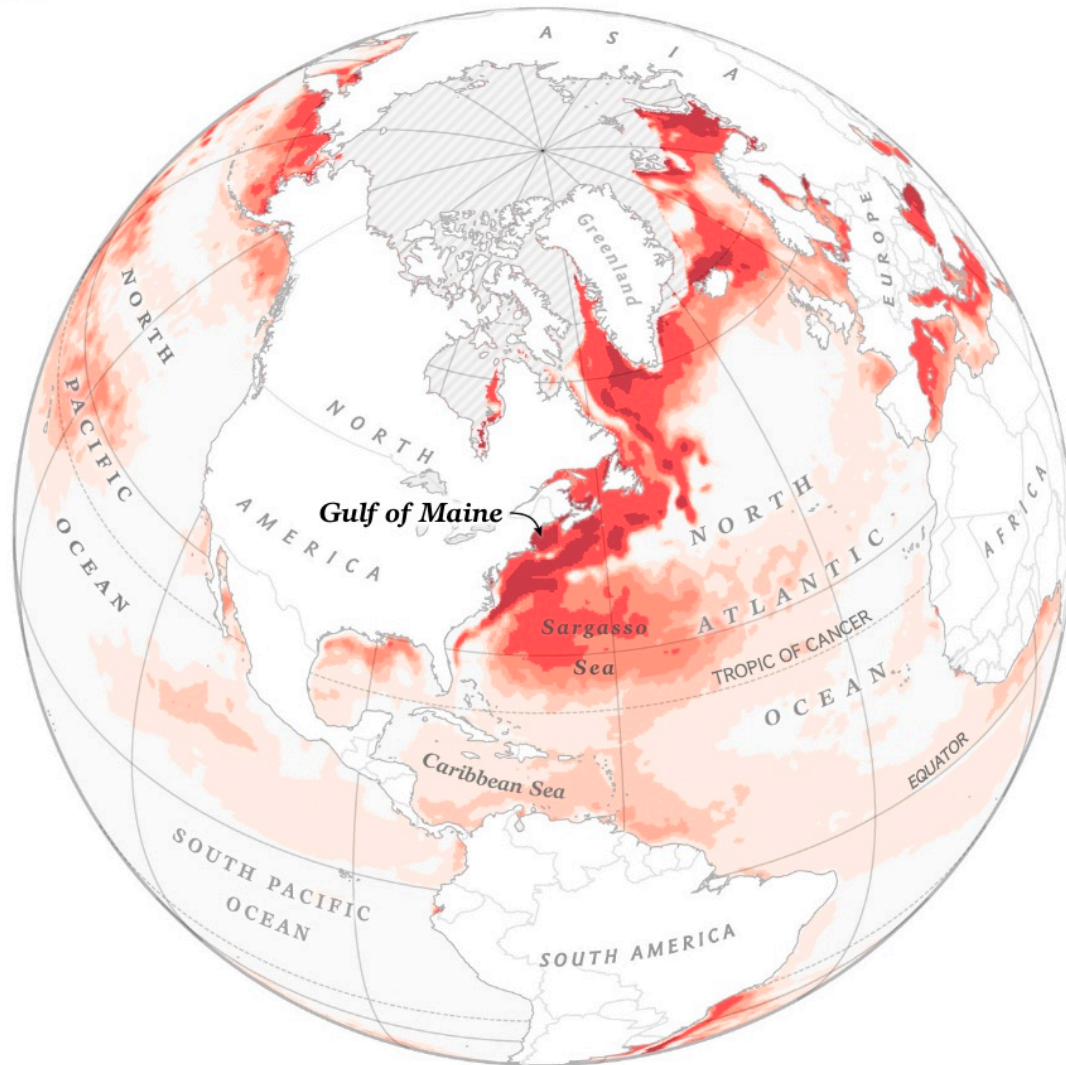
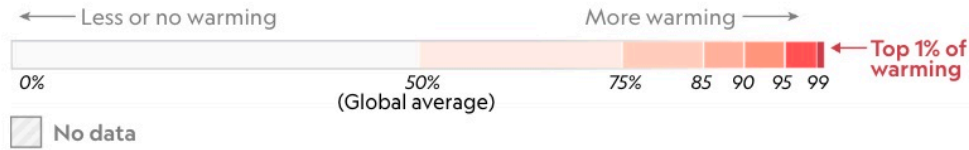
Last year during the pandemic shutdown, Maine didn't get its usual blast of summer visitors, but there were plenty of lobsters. Signs are promising for a revived tourism season in 2021, and Monique expects it to be another good year for lobsters.

But that doesn't stop her from worrying. The waters off Maine's coast are warming, and no one knows what that's going to mean for the state's half-billion-dollar-a-year lobster industry—the largest single-species fishery in North America. Some fear that continued warming could cause the lobster population to collapse.

The Gulf of Maine is experiencing extreme warming

Much of the Northwest Atlantic, especially the Gulf of Maine, has been warming faster than elsewhere in the world's oceans—99 percent faster, according to one study. If warming continues unchecked, it could threaten Maine's lobster fishery.

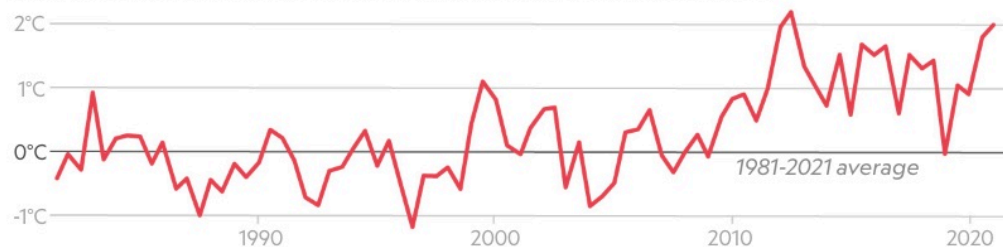
Sea surface temperature warming (1989–2019) Represented as percentile



How the gulf has warmed

For more than a decade, sea surface temperatures in the Gulf of Maine have consistently been higher than what is considered normal.

Biannual Gulf of Maine sea surface temperature anomaly (degrees Celsius)



Soren Walljasper, NGM Staff

Sources: Andrew Pershing, Climate Central Inc; Gulf of Maine Research Institute

The Gulf of Maine—an ocean body brimming with marine life—is cradled by Cape Cod in the south and the Bay of Fundy in the north, and bounded in the east by two underwater shoals, George’s Bank and Brown’s Bank. In 2015, climate scientist Andy Pershing, formerly of the Portland-based nonprofit Gulf of Maine Research Institute, published a paper in *Science* concluding that the gulf was warming faster than “99% of the global ocean.”

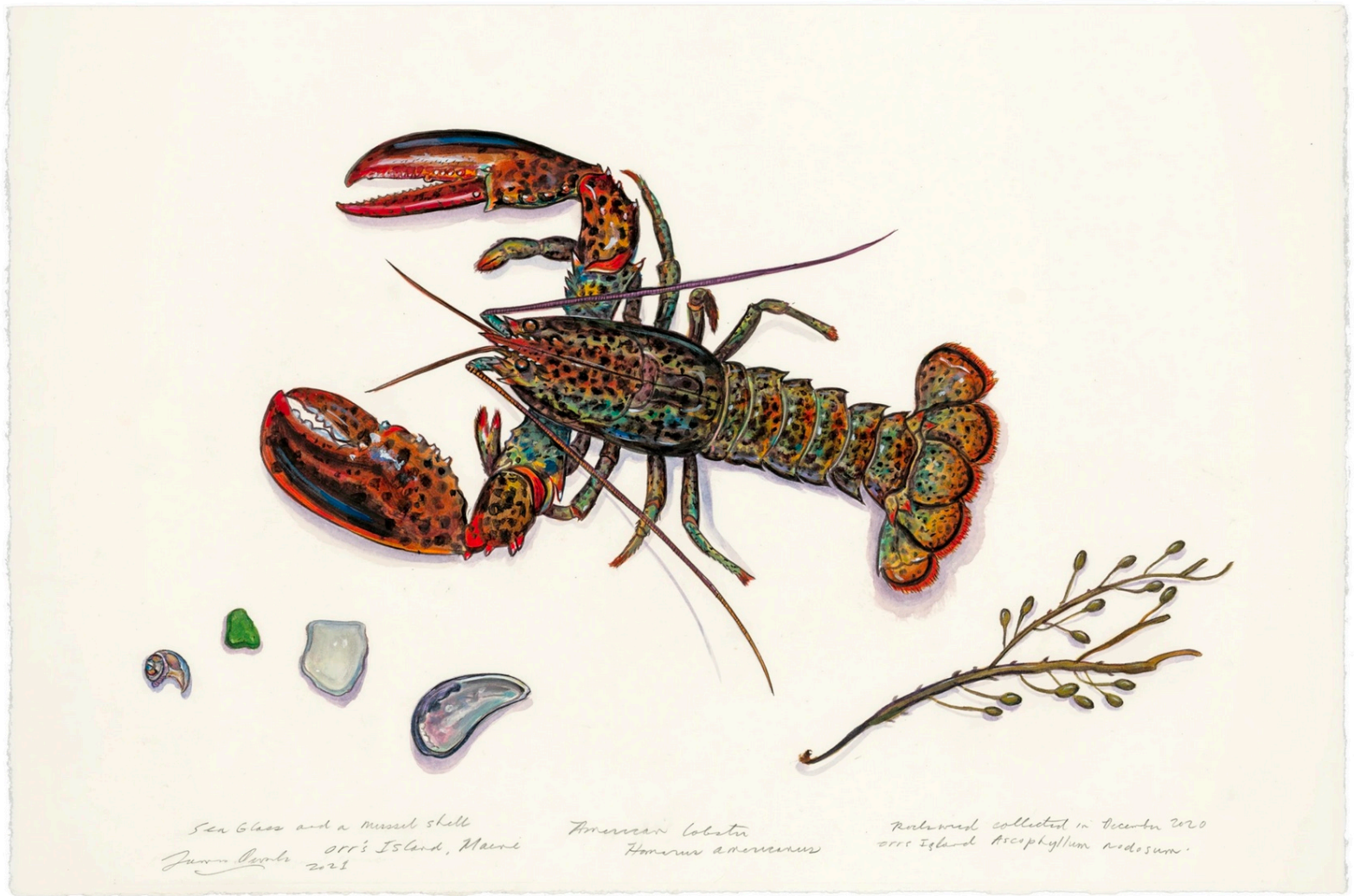
That eye-popping revelation was enough to keep fisheries managers and a whole lot of Mainers awake at night.

Despite professional scrutiny and doubts about Pershing’s claim (some scientists said he cherry-picked data and that only surface water temperatures were factored in, giving an incomplete picture), the Gulf of Maine is warming at least as fast as any other part of the world’s oceans. Between 2004 and 2013, surface waters in the gulf warmed by 5.4° Fahrenheit (3 degrees Celsius).

Climate change, brought on by human activities, is why Arctic ice is melting faster, oceans are becoming more acidic, and the movements of water and air currents such as the Gulf Stream and the polar jet stream are harder to predict. Scientists are scrambling to make sense of the effects of this warming on Maine’s most popular shellfish and other marine life.

There are no clear answers.

To understand what’s happening to the ecosystem of the Gulf of Maine, says Glen Gawarkiewicz, an oceanographer at Woods Hole Oceanographic Institution, in Massachusetts, you have to look beyond it—see how it’s affected by the atmosphere, ocean currents, and rivers that flow into it.



American lobster with sea glass, mussel shell, and rock weed, Orr's Island, Maine
ART BY JAMES PROSEK

Starting in the winter of 2011-2012, the jet stream didn't bring cold air down to the gulf the way it usually does, and the water cooled only half as much as normal. Then a summer marine heat wave hit. After a second marine heat wave, in the summer of 2017, "historical patterns were out the window," Gawarkiewicz says. Fishermen "were catching exotic fish they'd never seen."

Pershing says warming alone wouldn't likely be the cause of a future lobster collapse. Rather, it will be sudden "wild card" secondary events. "The system will get pulled apart, untied in ways we can't anticipate," he says. "Climate is a threat multiplier. It isn't in-and-of-itself the threat—it just makes everything else worse. Pollution is bad, and then you add warming on top of it, and it just makes it harder. It adds stress to the system." Put simply, if warming is too rapid, lobsters in the Gulf of Maine may not have time to adapt. (*Maine's last big lobster crisis? Running out of bait.*)

'We are constantly surprised'

"You would think for a critter that crawls on the seafloor—and you're only dealing with one species, and it's one of the most studied marine resources on the planet Earth—that we'd really know what's going on," says Bob Steneck, a professor of marine biology at University of Maine's Darling Marine Center, in Walpole. "But we don't." Steneck is considered the elder statesman of lobster biology. "We are constantly surprised," he says.



Luck of the haul: Fishermen bait their traps, but lobsters going for a snack can also escape through the way they went in. The lobsters that are caught happen to be in the trap when it's pulled.

For now at least, the warmer waters appear to be causing a lobster boom. It spurred Steneck and colleagues in 2019 to publish a paper in *Global Change Biology* titled [“The Brighter Side of Climate Change.”](#)

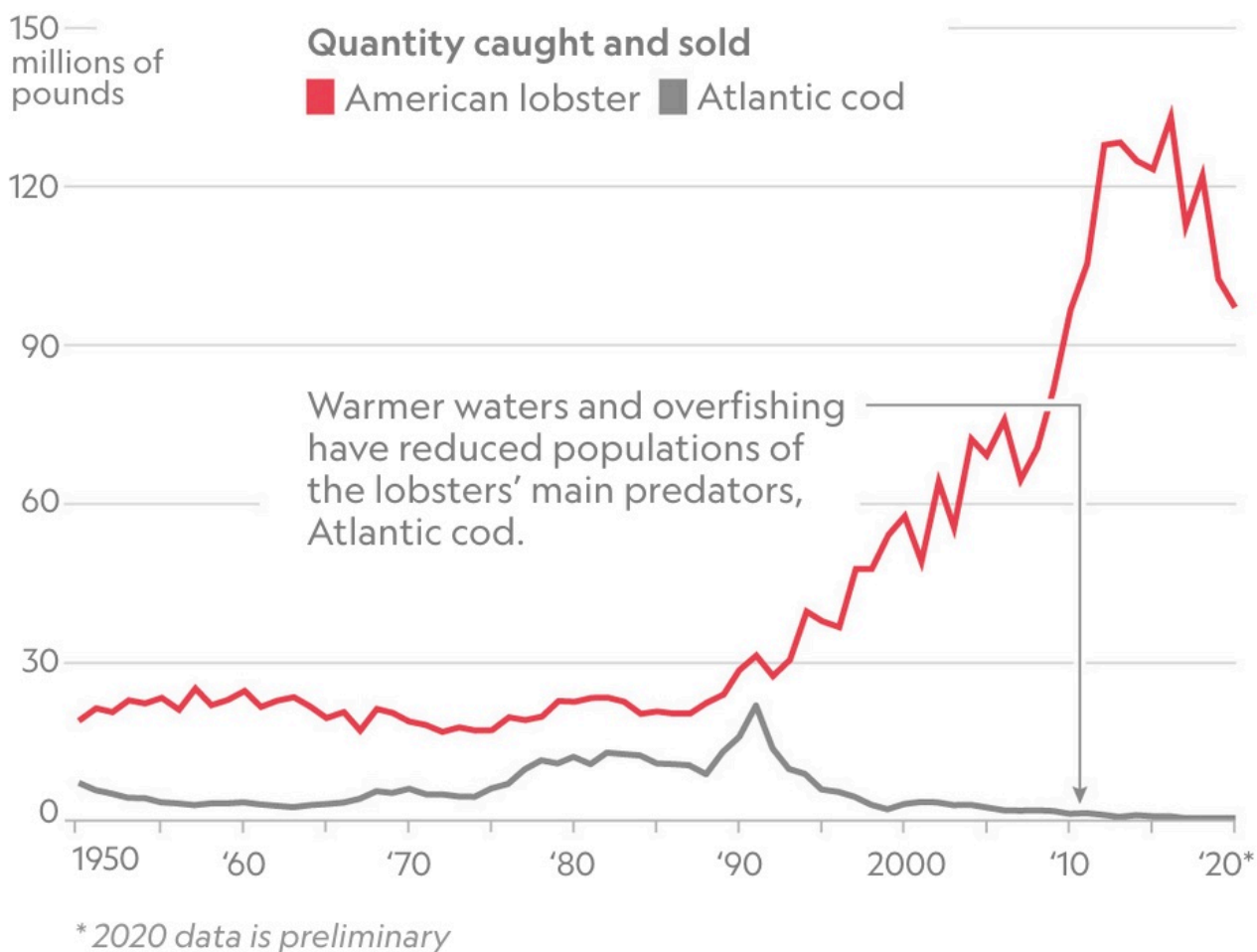
Some effects of the warming are counterintuitive. Steneck says that in the southern and western parts of the gulf, warming near the surface is creating a thermal barrier that keeps deeper waters colder than usual. He doesn't yet know how this might affect the behavior and movements of lobsters.

In the eastern gulf, the more than 40-foot tides, which are among the strongest in the world, help mix the now warmer surface water with cold, deep water, creating higher temperatures at the seafloor. This makes it possible for more juvenile lobsters to settle and thrive where previously it was too cold.

Warming is also helping lobsters in another way—by making the gulf less habitable for cod, a major predator. “It looked like the warming itself was allowing fewer fish to survive,” Pershing says. ([Read about how warming weather may spell the end of cod throughout New England.](#))

The Gulf of Maine's warming waters have created the ideal habitat for lobsters

The American lobster fishery has expanded significantly in the Gulf of Maine, as its waters have warmed during the last three decades. Other contributing factors are the decline of Atlantic cod, and the lobster conservation measures that have been in place since the early 1900s.



Diana Marques, NGM Staff

Sources: Maine Department of Marine Resources; Andrew Pershing, Climate Central Inc. and Gulf of Maine Research Institute

An even bigger factor in the lobster boom, he says, has been decades of overfishing, leaving the cod stock “just a shadow of what it used to be.” With fewer cod and other predators, such as halibut and haddock, lobsters no longer need to hide in rock crevices along the coast. They can flourish in the open in larger numbers on sandy bottoms offshore.

What’s been good for lobsters, however, has been bad for critically endangered North Atlantic right whales. The warming waters are drawing tiny crustaceans called copepods, the whales’ staple food, into the very areas where lobster fishermen are now working. Whales sometimes get tangled in the lines attached to lobster pots, causing injury or death. This has sparked acrimonious debate between conservationists—some have even proposed shutting down the fishery—and lobstermen about what can and should be done.

All in with lobster

“I thought of becoming a tattoo artist or owning a restaurant,” Jocelyne Coombs tells me as we stand with her mother on a dock near their home on Orr’s Island this past December. As we talk, a raft of eider ducks mill about in the rockweed at the edge of the granite-lined shore. She says she’d settled on “lobsterman” because she wants people to have “access to more wild food.” (Maine women in the business, Monique said, prefer to be called lobstermen.)

Jocelyne has her own boat, a 21-foot Privateer named *Orca*, and she fishes a hundred traps all summer with the help of her 12-year-old brother, Riley. “He complains sometimes,” she says with a smile, but “the fresh air is really good, and you get to see a lot of stuff.” She gazes out over the water. “I’ve heard that my generation are the ones that are supposed to save the world, which is kind of scary if I’m being honest.”



With an assist from daughter Jocelyne, 16, and son, Riley, 12, lobsterman Herman Coombs fishes out of Orr's Island. Jocelyne, who has her own boat and commercial license, wants to keep the family tradition going. Maine's lobster fishery is thriving today, but if waters warm too much, it could collapse.

Monique chimes in, rattling off a long list of mounting challenges to the fishing industry: “climate change, increased rules and regulations, quotas, marine closures, modifications to gear to protect endangered species, offshore wind farms, offshore aquaculture, sea level rise, more erratic weather, the next pandemic.” Because of all this, she says she’s encouraged her daughter to try to diversify.

“I say to Jocelyne, if you want to be a fisherman that’s great, but maybe you also learn a trade—maybe learn how to weld, or how to go menhaden fishing. You need to understand some science, to understand how to participate in policy, to learn how to speak and write, and be a contributing member of your industry. It’s like, sure, go lobster fishing, but Maine’s done itself a disservice—we have all our eggs in one basket, and that’s the lobster industry.” (Other industries, such as tourism, earn the state more than lobstering.)

Aside from any future lobster fishing restrictions to protect the right whales, what might happen if the gulf’s waters keep warming up? At what point would that trigger a lobster collapse that could devastate communities up and down the Maine coast, transforming the cultural fabric of the state? That would dash the dreams of Jocelyne Coombs and other young Mainers who have set their sights set on continuing the long-established lobstering tradition.

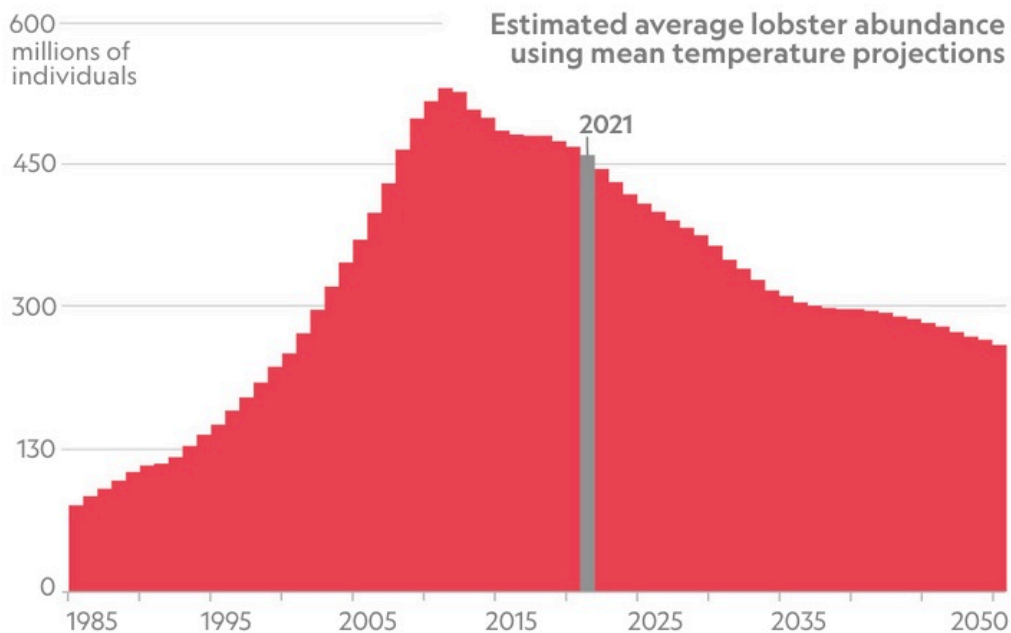
Preview of a collapse

Threat multiplication seems to explain what suddenly befell the lobster fishery a few hundred miles to the south in Long Island Sound.

“A few fishermen friends had called me saying, ‘Hey John you’re not going to believe this, but ... the lobsters are all dying,’” says John Debellas, a lobsterman out of Oyster Bay, at the western end of Long Island Sound, recalling that fateful day just over two decades ago. “I went out to haul the gear I still had in the water, and the lobsters that were in the traps were dead—and the few that were alive were not looking terribly healthy.”

As water temperatures continue to rise, concerns mount over the future of one of the most valuable fisheries in the U.S.

Warming favors lobsters to a point, but when water temperatures exceed 70°F, the lobsters' internal organs start to fail. If warming continues as projected, the fishery could be in jeopardy by 2050.



Diana Marques, NGM Staff

Sources: Andrew Pershing, Climate Central Inc. and Gulf of Maine Research Institute; National Oceanic and Atmospheric Administration

Debellas had started lobster fishing in 1983. By 1999, he was in his early 40s and at the peak of his career. He owned a thousand traps, setting 800 at any given time. He'd just bought a brand-new boat. One day he was running full speed ahead, and the next, his livelihood—and that of hundreds of fellow fishermen, some fourth-generation lobstermen—was gone.

“I haven’t lobstered in 21 years,” he says. “It was terrible. I was in shock. I didn’t want to do anything that had anything to do with the water after that for a long, long time, even recreationally. I got away from it completely.”

Friends of his, no longer able support their families, fell into a deep depression. Marriages broke up. “A lot of people, they didn’t really recover or get back on their feet again. Their entire way of life got pulled out from under them,” he says.

At the time, many people believed that the lobster population would recover. It never did. Debellas, who saw no future for commercial lobstering in the sound, went back to school and became a registered nurse.

What triggered it?

Late in the summer of 1999, a year of record warmth in the region, an outbreak of West Nile virus—a mosquito-borne disease—led authorities around Long Island Sound to undertake widespread spraying of insecticides in freshwater creeks and storm drains to kill mosquito larvae. Soon after that, Hurricane Floyd barreled up the East Coast, dumping more than 10 inches of rain, and flooding rivers and streams, which sluiced the chemicals into the sound. As arthropods, like insects, lobsters are susceptible to insecticides. (*Related: West Nile virus is still here, and it’s spreading among U.S. birds.*)

In hindsight, scientists nearly all agree that Long Island Sound's lobsters succumbed en masse because climate change had warmed the water enough to weaken them, making them vulnerable to pesticides and other threats: parasites that may have affected their nervous systems; organisms at the surface that were killed by the pesticides and sank to the bottom, where they decayed, depleting dissolved oxygen in the water and causing the lobsters to suffocate; sewage discharges from cities along the coast; excessive freshwater runoff from the hurricane that decreased salinity in the sound to the point where lobsters couldn't survive.

Many Rhode Island lobstermen pivoted to catching a previously ignored resource: Jonah crabs. For years, most fishermen who found them in their traps saw them as harbingers of bad luck, like the namesake Biblical preacher who brought storm to his fellow sailors and got swallowed by a whale. But Jonah crabs have new respect now and a place next to lobsters on restaurant menus in Rhode Island and Cape Cod. The meat, though not as chunky as lobster, is sweet and often served chilled.

'The positive side'

Five years after Pershing's nerve-jangling 2015 paper, the Gulf of Maine is still "experiencing warming rates that few other ocean ecosystems have ever experienced," he says.

"I think that climate change has forced the fishing industry and the scientists to interact in ways they hadn't done before," Glen Gawarkiewicz says. Mutual concerns about the oddities they're witnessing (Gulf Stream flounder, for example, normally found in warmer waters) are pushing them to puzzle out what's happening and try to adapt to a new normal. He calls this "the positive side."

But lobster fishing in Maine is so deeply ingrained, and so lucrative (especially right now), that accepting the need for a new normal, let alone adapting to whatever could replace the crustaceans, will be difficult.

Monique Coombs said that lobster fishermen in Maine don't retire. It's not a job, it's their life. "There is a guy on Bailey Island right here named Alfred Johnson who is in his 90s and still fishing," she told me. "I joke with old timers like Al—what are you going to do, when you retire? 'Take a dirt nap, I guess,' they say." (In other words, fish until they die and get buried in the dirt.)

“Many Mainers don’t believe that the demise of lobsters is something they need to worry about,” Monique’s husband, Herman, told me. Cape Cod peninsula, extending east into the Atlantic, helps by being a barrier to warmer waters from the south. Yet lobster deaths from shell disease seem to be increasing in the southern part of the gulf, according to Steneck.

Many argue that the Gulf of Maine is bigger and deeper than Long Island Sound and that even though it’s getting warmer, lobsters can find colder water in deeper areas if they need. But, Pershing and others note, it remains to be seen whether there’s enough light or food in those deeper waters to support lobsters’ life cycles from egg to adult.

The modeling suggests the lobster boom in the Gulf of Maine won’t last. With continued warming, the population will fall off by about 2050, Pershing says. “It will decline back to pre-boom levels—what the fishing was around the year 2000, which was still vibrant and productive.”

The more pressing question is what happens after mid-century. “Beyond 2050, that’s where the choices we make around carbon really start to come into play.” If temperatures keep rising, “you start to see the southern coast of Maine start to look like Rhode Island.” And “by 2080 or so, if CO₂ emissions continue to rise, that’s where we see the Long Island Sound-level collapse happening,” including northeastern Maine, where waters are typically cooler.

With climate change, there are winners and losers, as Steneck’s “brighter side” paper revealed. In Newfoundland, at the northern end of the range of *Homarus americanus*, where it’s still a bit too cold for the crustaceans, fishermen may be rubbing their hands at the prospect of the warming of their waters.

“Newfoundland is an interesting counterpoint, Pershing says. “While Maine could possibly become Rhode Island, Newfoundland is hoping it becomes Maine.” Indeed, more lobsters are starting to show up that far north, he says, “but it’s perhaps too soon for gift shops to start stocking lobster plush toys.”

The lobster collapses in Rhode Island and Long Island Sound can be viewed as a cautionary tale—a Dickensian ghost of a Gulf of Maine future. “I pray for these guys up north that the same thing doesn’t happen to them,” John Debellas says. [Q](#)

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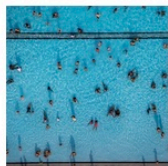
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