

Invasive species exploit a warming Gulf of Maine, sometimes with destructive results

BRUNSWICK

Story by **Colin Woodard**/ Staff Writer
Photos by **Gregory Rec**/ Staff Photographer

Click and drag the slider to compare intertidal flats in Brunswick's Maquoit Bay in June 2001 (left) and in August 2013 (right).

Photos courtesy of Hilary A. Neckles, United States Geological Survey

Until two years ago, if you had walked down to the shore of Maquoit Bay at low tide, you would have seen a meadow of eelgrass stretching nearly as far as the eye could see across the exposed seafloor. Here near the head of the bay, the sea grass stretched for two miles to the opposite shore, creating a vast nursery for the shellfish and forage species of Casco Bay, of which Maquoit is a part.

Now there's only mud.

Green crabs took over the bay in the late fall of 2012 and the spring and summer of 2013, tearing up the eelgrass in their pursuit of prey and devouring almost every clam and mussel from here to Yarmouth. Fueled by record high water temperatures in 2012 and a mild winter in 2013, the green crab population grew so huge that the mudflats of Casco Bay became cratered with their burrowing, and much of the Maquoit and adjacent Middle Bay bottom turned into a lunar landscape.

Eelgrass coverage in Maquoit Bay fell by 83 percent. With nothing rooted to the bottom, the seawater turned far muddier, making life hard on any plants or baby clams that tried to recolonize the bay.

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“We were astounded,” says Hilary Neckles of the U.S. Geological Survey’s Patuxent Wildlife Research Center, who linked the destruction to the green crabs. “The ecological ramifications really reverberate throughout the ecosystem, because sea grass is the preferred habitat of so many fish and shellfish species.”



Chad Coffin, a Freeport clam digger, holds handfuls of green crabs while looking for the invasive species off the coast of Freeport in 2013. **Photo by Gabe Souza/Staff Photographer**

Over the past decade, the Gulf of Maine has been one of the fastest-warming parts of the world’s oceans, allowing warm-water intruders to gain a toehold and earlier invaders such as the green crab to take over. Coupled with declines of the cold-loving species that have dominated the gulf for thousands of years, the ecological effects of even more gradual long-term warming are expected to be serious, even as precise forecasting remains beyond the state of scientific knowledge.

Scientists say the 2012 “ocean heat wave” was an unusual event, and that the 10-year accelerated warming trend is likely part of an oceanographic cycle and unlikely to continue. But the gulf has been consistently warming for more than 30 years, and long-term forecasts project average sea surface temperatures in our region could reach 2012-like levels by mid-century. The events of 2012 and the nearly as warm year that followed likely provide a preview of things to come, of a gulf radically transformed, with major implications for life on the Maine coast.

Genevieve MacDonald, who fishes for lobster out of Stonington, was standing on the dock at Isle au Haut one morning that summer, looked in the water, and couldn’t believe her eyes. There, swimming around the harbor like mackerel, were dozens and dozens of longfin squid, temperate creatures rarely seen in the chill waters of eastern Maine. “If you had a cast net you could have brought in a whole basket full of squid,” she recalls.



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Genevieve McDonald replaces a bait bag in a lobster trap while fishing off the coast of Stonington. In 2012, McDonald saw dozens of longfin squid near Isle au Haut. The squid like warmer water and are rarely seen in the Gulf of Maine but there were numerous sightings of the squid during the “ocean heat wave” of 2012. **Photo by Gregory Rec/Staff Photographer**

Since then, people from Brunswick to Bristol have been encountering gigantic beds of gelatinous, finger-shaped pods in shallow water at low tide, some measuring four feet across. Researchers from the University of Maine’s Darling Marine Center ran across one in the Damariscotta River in August 2014 and, perplexed as to what they were, brought them back to the lab. A colleague recognized it at once: a longfin squid egg mass containing thousands of squirming embryos.

The squid, apparently, are intending to stick around, and MacDonald hopes they do, since they’re the stuff of calamari. “Climate change is real, but it might also provide some new opportunities if we’re careful,” she says. “Lobstering is really lucrative, and I hope it stays that way, but if something happens it would be nice to have a backup plan.”

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Marissa McMahan spent that notoriously warm summer of 2012 lobstering with her father out of Georgetown and encountered a different visitor, a large, stout gray-and-black fish she'd never seen before. The fish, which began turning up in lobster traps up and down the coast, was the black sea bass, a succulent mid-Atlantic species normally unable to tolerate Maine's cold sea.

McMahan is now a doctoral student at Northeastern University and doing her dissertation on how black sea bass are spreading and interacting with lobster and other native species. "I don't see anything to immediately worry about, but I talk to a lot of fishermen south of Cape Cod who think sea bass have played a role in reducing lobster numbers there," she says. "They tend to open up the sea bass they catch, and they do have a lot of lobsters inside them."

"It's a very sought-after and marketable fish, so it could create an economic subsidy where we're pretty much dependent on one single fishery," McMahan adds. "But if there are all these other species moving north, we may have a lot more predators on lobsters."



A juvenile lobster opens its claws as McMahan reaches for it in Lowell's Cove. McMahan is a doctoral student at Northeastern University doing her dissertation on how black sea bass are spreading and interacting with lobster and other native species. **Photo by Gabe Souza/Staff Photographer**

Other invaders appear to have few upsides.

Larry Harris of the University of New Hampshire has been tracking the spread of an unpleasant Asian weed, the pancake batter tunicate, an ugly, bloblike sea squirt that grows in dense colonies that spread in sheets across the seafloor, smothering native creatures. "It can overgrow mussels and sponges and anemones and other species that provide food for predators," he says, noting that nothing here wants to eat it. "It's the

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Brought to New England by shellfish farmers using Asian oysters, the tunicate used to die back each winter, but with the warmer water temperatures, its expanded over large swaths of the bottom from Passamaquoddy Bay to Georges Bank, where Harris thinks its presence may be contributing to the failure of cod stocks.

Green crabs, a European species introduced to the East Coast in the mid-19th century, reached Maine in the late 1940s, when the gulf began experiencing a warming spike second only to the present one. Then, as now, the crabs’ assault on soft-shell clams made newspaper headlines. “Green Killers March On,” the Portland Evening Express warned in January 1952, reporting that “old-timers suggest extreme cold and heavy sheet ice ... were responsible for keeping them under control.”

The gulf has seen cold and warm cycles since, but with an ever warmer background trend, the green crabs appear to be doing more lasting damage.

With its 20-foot tides and miles of sheltered bottom, Cobscook Bay, a multi-chambered estuary in easternmost Maine, is to intertidal ecologists what the Amazon is to rainforest ones, a place where whelks and periwinkles grow to Jurassic proportions. Animals that normally live below the low-tide mark – accessible only by scuba or submarine – live in the intertidal zone here and can be studied with no more than a pair of boots.

Carl Merrill, director of Suffolk University’s field station in Edmunds, on the western end of the bay, has been studying Cobscook’s shores for nearly 40 years. In his surveys, he used to find both the smooth and rough periwinkles in concentrations of hundreds to thousands of individuals per square meter. Now he gets dozens or fewer per square meter. “The decline is substantial and very obvious,” he says. “Sometimes you don’t find one.”

The culprit isn’t harvesters – “wrinklers” collect the larger, non-native common periwinkle, which lives lower down the intertidal zone. “The green crab is the likely explanation,” he says. The crustaceans appear to be picking the shore clean of the little snails, with unknown ecological effects.

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Brian Beal works in the hatchery at the Downeast Institute, where he is the director of research. Beal, also a marine shellfish ecologist at the University of Maine Machias, thinks the disappearance of mussels in the Gulf of Maine is due to warmer water, which makes predators like green crabs, lobsters and the Asian shore crab more active. **Photo by Gregory Rec/Staff Photographer**

The crabs also appear to be stripping much of the coast of mussels. On shorelines that 20 or 30 years ago would be carpeted with the bivalves – taking up half the available space – they now cover less than 10 percent. Water temperature and ocean acidification may be playing a role, but green crabs appear to be a large part of the picture, since wild larvae settle and grow just fine at mussel farms and on the undersides of buoys and other objects the crabs can’t climb to.

Brian Beal, a marine shellfish ecologist at the University of Maine at Machias, says it’s likely not just green crabs but also

lobsters and even Asian shore crabs, another invasive species that’s already become the dominant shore crab in seacoast New Hampshire. Together, he suspects, they’re eating the juvenile mussels, which explains why the bivalve is found only in places crabs can’t easily get to.

Warming is also responsible for the collapse of soft-shell clam populations in Freeport, Brunswick, Penobscot and other communities, Beal says. “As water temperature increases, we get a higher predation rate because most of the predators are invertebrates who are much more active in warm water,” including milky ribbon worms, moon snails and, of course, the green crab, he adds.

To prove his point, in April 2014 Beal oversaw the placement of net-covered plots in Freeport’s Harraseeket River, which were then seeded with juvenile clams. Seven months later, 90 percent of the seeded clams in all plots had survived, plus a staggering 1,400 wild clams per square foot were taking refuge under the nets, designed to stop green crabs from entering. “We estimated that close to 13 million wild clams settled into those 40 netted plots during that seven-month experiment,” Beal said. Just a few feet away from the 40 nets, his team found just 0.4 clams per square foot, suggesting

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“We know that when we have cold water we have more shellfish survival,” says Freeport clammer Chad Coffin, president of the Maine Clammers Association. “The real question is what we are going to do when it gets really warm again.”



Marissa McMahan collects juvenile lobsters in Lowell's Cove in Harpswell. While lobstering with her father off Georgetown in 2012, McMahan discovered black sea bass in the lobster traps, a fish normally found in warmer mid-Atlantic waters. **Photo by Gregory Rec/Staff Photographer**

It's possible the warmer water will bring a solution with it.

At Nova Scotia's Kejimikujik National Park, rangers five years ago decided to take action against marauding green crabs, which had already torn up 88 percent of the eelgrass in the park's two estuaries, which face the open Atlantic near the entrance to the gulf. Their strategy: fish them hard with modified shrimp traps, composting the catch until a market develops. “It looks like we've had phenomenal success,” says Parks Canada ecologist Chris McCarthy.

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By 2013, trapping has helped knock the crab population down to size, with the average haul per trap falling from nearly 50 to fewer than eight. And as they cleaned out the green crabs, eelgrass has returned, along with eels, geese, migrating shorebirds, proper water quality and the stability of the surrounding marsh. Park staff wondered whether the gains would be maintained if they started scaling back trapping.

Then a new invader started showing up in the traps: *Callinectes sapidus*, the Atlantic blue crab, a delicious cousin of the green crabs that is as iconic to the culture of the Chesapeake as lobsters are to Maine. Normally not seen north of Cape Cod, they began showing up at Kejimkujik in 2013 where they were caught by the hundreds last year. “We’ve seen them chasing the green crabs around, so hopefully they’ll have an effect on them without harming the sea grass,” McCarthy says. “The big question will be if they can really establish themselves, given that we get fairly cold waters up here.”

Harris of UNH says they’re likely to do so, as southwestern Nova Scotia has fairly warm water. In fact, he says there’s now a small resident population in the Great Bay and Piscataqua River on the Maine-New Hampshire border. And despite two cold winters, he’s seen the whole crab assemblage continuing to shift eastward, with Bar Harbor lobstermen catching blue crabs last year, Asian shore crabs taking over seacoast New Hampshire, Jonah crabs – which once ranged no further than Casco Bay – established in Eastport, and large numbers of green crabs surviving cold Cobscook Bay winters, an indication that the species may be adapting to colder water.

What the net ecological effect will be is anyone’s guess. Adult Asian shore crabs will eat green crabs and aren’t attracted to muddy areas, but they do enjoy stripping the shore of barnacles. Adult blue crabs will happily munch on green ones, but nobody knows what they’ll do to, say, eelgrass. “Blue crabs are something fishermen can sell, so that’s a good thing, but on the other hand it’s also an indication that the species composition of the intertidal zone is shifting,” Harris says. “In terms of the overall effect, it’s really too early to tell.”

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