

*In Flux: Pondering Penobscot Bay's Future*  
*Article for The Free Press, July 26, 2018*

When asked about changes in Penobscot Bay, Ted Ames, a scientist and former commercial fisherman who has spent 60 years observing the coast, summarizes its history succinctly: “it’s been quite a rollercoaster.” Penobscot Bay is indeed prone to boom-and-bust cycles going back centuries – in its fisheries and in the resources of its watershed, which comprises more than one-quarter of Maine’s land area.

Some booms, such as timber harvesting and granite quarrying, made an obvious imprint on the region’s landscape and islands. Others were more insidious, such as the quest for seabird eggs and plumage and the unrelenting pursuit of groundfish. In more recent memory, the green sea urchin became the poster child for profligate harvesting, followed—predictably—by a plummet with little recovery.

James Wilson, professor emeritus of marine science and economics at the University of Maine, attributes much of the “unraveling” in the bay’s ecosystem to the all-too-human tendency to “take the low-hanging fruit—repeatedly... [aided by] new technology that means you can reach higher in the tree.” This serial harvesting of one species after another has led, over time, to what Wilson calls “a serious disorganization of the system.”

Increasingly, researchers acknowledge that any enduring recovery – getting off the rollercoaster – depends on understanding more fully the depth and breadth of historical disruptions and how dramatically things have changed. When Anne Hayden, fisheries program manager at Manomet, hears people say “we need to protect what we have now,” her response is emphatic: “No! We need a lot better than what we have now!”

*Nesting Ecosystems*

Penobscot Bay is a place of paradox in many ways, one being that it’s a vast embayment within a small sea. “It is not just an irrational regional preference to suggest that Penobscot Bay is Maine’s grandest stretch of water,” Philip Conkling wrote in “Islands in Time.” It is second in size only to the Chesapeake among east coast embayments, 20 miles wide at its mouth. It does not open to the Northwest Atlantic Ocean but to a sea within a sea, the Gulf of Maine, which stretches from Cape Cod, Massachusetts to Cape Sable, Nova Scotia, and eastward to the shallows of Georges Bank.

Most estuaries are defined by the inflow of their tributaries, but a study done between 1996 and 2001 revealed that Penobscot Bay is influenced most by its exchanges with the Gulf of Maine. A strong inflow of Gulf water runs up the western side of the bay, and currents there have particularly distinct layers. Throughout the bay, though, the water column is not uniform in temperature or salinity; it is variable at any given time and changes through the seasons.

That dynamism could get an added boost from climate change. To date, Wilson believes, “what we’ve done to the ecosystem [in terms of harvesting and pollution] has

overpowered the effects of climate change,” but the latter may not remain a bit player for long.

Through a complex series of interactions related to Arctic ice-cap melting, “Gulf Stream waters are penetrating into the Gulf of Maine,” says University of Maine oceanographer David Townsend. Researchers are just beginning to determine how much is coming in and are far from understanding where it will go within the Gulf and what impacts it might have. At this point, he acknowledges, “it’s all very speculative.”

Penobscot Bay waters have warmed noticeably in the past decade, in keeping with a warming of sea-surface temperatures Gulf-wide; the Gulf of Maine Research Institute reports that in the decade leading up to 2015, those temperatures increased faster than 99 percent of the global ocean.

Warmer water and air temperatures represent just two heads of the climate change hydra. Others include more acidic waters, greater temperature variability, accelerating sea-level rise and increased deluges. Each threat could spawn further problems. More runoff from heavy precipitation events, for example, could lead to an overall decline in productivity within the Gulf of Maine (if an inflow of darker brown waters reduces light availability for photosynthesis and growth—as appears to have happened over the past 18 years, according to Bigelow Laboratory researcher William Balch).

Last month, marine ecologist Bob Steneck drew an overflow crowd to Belfast for a presentation entitled “Penobscot Bay: An Ecosystem Colliding with the Anthropocene” (the current geologic epoch in which human activity represents the dominant environmental force). Many of those attending undoubtedly expected a look ahead at how climate might upend the bay. But surprisingly, Steneck invited his audience to look—not forward—but back.

### *Shifting Baselines*

While it might seem counter-intuitive to look to the past for resource management guidance, a growing number of marine scientists acknowledge that the present—and even the recent past—is not a trustworthy guide to the future. “We have lost sight of nature because we ignore historical change and accept the present as natural,” note the editors of the book “Shifting Baselines: The Past and the Future of Ocean Fisheries.”

The term “shifting baselines,” coined in 1995 by marine ecologist Daniel Pauly, describes a widespread tendency to measure change based on a reference point linked to a person (typically how conditions appeared early in a researcher’s life or career) than to past states of the ecosystem. Each successive generation risks taking as its norm lowered population numbers, thus obscuring the full extent of loss over time. Worse still, write Emily Klein and Ruth Thurstan in their article “Acknowledging Long-term Ecological Change,” people can fail to notice the diminution of entire ecosystems, resulting in “simplified food webs or lost relationships and interdependencies.”

That's precisely where we are, Steneck noted in his presentation, facing a bay ecosystem so disrupted that it's hard to fathom the size and diversity of species consumed by prehistoric Americans and left in middens 4,000-plus years ago. Topping that list (see Figure \_\_) at the Turner Farm site on North Haven were cod (which even a thousand years ago still averaged one meter in length), flounder and sea mink (which went extinct in the 1800s).

Between 1800 and 1900, the greatest volume of fish landings gradually edged seaward, shifting from the Penobscot River near Bangor to the lower reaches of the bay. The harvesting of marine resources accelerated further in the last century, fueled by technological advances and by improved access to markets. Fishermen systematically pursued finfish until, in Ames' words, "we succeeded in flattening one species after another."

With groundfish no longer preying on young lobsters, the latter population grew—and grew, aided by a cooperative, locally focused system of management established in the 1970s. Now, says Hayden, "we've flipped the ecosystem from one that's fish-dominated to one that's crustacean-dominated. There's no flipping it back," she adds, "only changing it to something else."

#### *"Socio-economic Time Bomb"*

Right now we're enjoying the fruits of a "lucrative monoculture," Steneck told his audience, in which lobsters represent 80 percent of the value of Maine's fisheries. The lobster industry has been riding high for some time, but Steneck views it as a "socio-economic time bomb." He is not alone in recognizing the great vulnerability—particularly for historic fishing communities—in being so dependent on a single species. Envisioning Penobscot Bay without that fishery conjures up a cultural dislocation so profound that few people interviewed wanted to discuss it. They keep their focus instead on the best insurance against that fearful scenario—diversifying the maritime economy.

Several of them voiced optimism over the prospects of shellfish and seaweed aquaculture, value-added processing of marine products and, potentially, offshore wind facilities. Whatever new fisheries or industries develop, there's an aspect of the lobster-fishing industry that many people hope to see more broadly replicated: the owner-operator model. The underlying idea is that marine harvesting should be done by small-scale operators deeply vested in place, those more likely to have a conservation ethic rather than those seeking a quick return. Maine recently moved to adopt this model in its scallop and sea urchin industries, and could potentially broaden its use still further as a path to more sustainable fisheries.

#### *A Management Mismatch*

There's a struggle underway, in Maine and beyond, to get fisheries management more aligned with the fact that, in Wilson's words, "ecology is actually very localized." That's not news to fishermen who routinely observe how species gravitate to particular spots

year after year and who understand that Penobscot Bay, and the larger Gulf, are inherently patchy. But resource managers have traditionally taken a standardized approach, gauging “average” stock numbers over large areas and setting quotas accordingly. Many regulators now aspire to ecosystem-based management, seeing beyond single species to the complex dynamics that mark marine habitats, but that ideal has proven hard to implement.

Local control is not an option as many marine species are subject to state and/or federal regulations. Increasingly, though, managers and fishermen are navigating a path toward co-management, finding ways to involve those subject to regulations in setting rules and monitoring the resource. Paul Anderson, executive director of Maine Center for Coastal Fisheries (formerly Penobscot East Resources Center), acknowledges the dearth of good information about marine species and sees a critical need for “observing, monitoring, and measuring of the right things. Does government have the capacity to do that observing at the right scale? The answer is no.”

MCCF recently announced a new cooperative agreement, with NOAA’s Northeast Fisheries Center and the Maine Department of Marine Resources, to collaboratively devise a scientific framework for management at a bay scale, Anderson says, that would engage fishermen more in observing, monitoring and policy-making. Many marine ecologists and policy specialists favor a move in this direction. “A combination of owner-operator and co-management focusing on smaller areas; that’s the future,” Anne Hayden believes. But as Wilson observed, even those who support moving in this direction “are wondering ‘how the hell do we do it?’”

They know they need to take a longer historical view, understanding the breadth of diversity and depth of productivity that once characterized Penobscot Bay. And yet, with climate change, those historical data have less and less bearing on contemporary conditions. “We need something besides long-term data sets as those have been compromised and are not as reliable anymore,” Anderson notes. “Even the best available information is now far more uncertain.”

### *Uncertainty*

Another paradox makes any conclusion about Penobscot Bay decidedly inconclusive. Those with decades of professional experience studying the bay’s dynamic ecology have themselves more questions than answers. They know better than to make predictions about how the bay may respond to the hydra of climate change. They realize that disturbed ecosystems are more prone to invasive species moving in, potentially causing cascading changes.

Yet many retain guarded optimism, having witnessed a notable recovery in recent years. Following a monumental effort to restore fish passage in the Penobscot River—a project spanning 17 years and involving dozens of partners, there’s a marked uptick in populations of herring and other species vital to groundfish, seabird populations and seals. “It’s very encouraging,” says Ted Ames; “everywhere you look, the system is

starting to work.” In a wild system, he adds, you can’t predict how it will respond to upsets or fully understand the system’s capacity to right itself.

Will the roller coaster level out? Can restoration efforts, in combination with more localized management, prevent further unraveling? The response from one of those interviewed was echoed by many others: “I don’t know. I don’t think anyone does.”

© Marina Schauffler, 2018