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Lessons for the Future from 50 Years of Maine Fisheries

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by Robin Alden

Somewhere below our house, more than 150 lobster boats swing at mooring each evening in Stonington Harbor, Maine's—and the country's—top lobster port. Lobstering is the state's last major fishery, an indication of the ecological simplification of the Gulf of Maine's ecosystem that has taken place since the early 1970s. The 1970s were when I was first captivated by what fishing means for Stonington and for the state. If done right, fishing is an exceptional human activity: it produces top-quality food, comes from a renewable resource, and can support communities in perpetuity. During the five decades since, I have been both an observer and a participant in Maine's fisheries, innovating and advocating policies that would support that vision, in roles as disparate as journalist, commissioner, and community organizer. I have had the chance to know and work with fishermen in towns from Eastport and Cutler to Kittery, witnessing the differences in their socioeconomic and ecological situations and learning from their knowledge and love of what they do.

The goal of fisheries policy is aspirational: to conduct an important industry within the bounds of a natural system forever. Because the means of production for Maine fishing, the Gulf of Maine, is a natural system, this goal is both more ambitious and also more enduring than those of industries such as wind power or large-scale aquaculture that view the Gulf merely as a place to site a business.

It is important for Maine to get fisheries right. In 2017, the landed value from fishing was estimated at $1.8 billion (Meredith Mendelson, personal communication). This value is particularly significant to the state because it is distributed among 13,000 independent commercial harvesters and 1,200 seafood dealers in communities that span Maine's coast. And, that value would be orders of magnitude greater if many fisheries like groundfish and herring had not followed a centuries-old pattern of steady market-driven expansion of area fished and intensity of fishing. The consequence of this pattern has been overfishing and, more confounding, the failure of species to rebuild to prior abundance after fishing pressure is removed.

Since the 1970s, warming in the Gulf of Maine has produced a population explosion in lobster. This is the type of population explosion that traditionally sets off the geographic expansion and the technological intensification of harvesting. But Maine's lobster management policy interrupted that pattern by confronting the difficult necessity for limits on both technology and geographic fishing boundaries. Maine's lobster science has focused on protecting lobster ecology, monitoring life-stages and behavior rather than simply population size, and it has institutionalized participation by fishermen. Developments in social and ecological science suggest Maine's approach is robust and a way to avoid the pattern of overfishing and system degradation.

Those lobster boats in the harbor, owned by the fishermen who fish from them, back at home each night, and moored in every gunkhole the length of the state's coastline, are more than an iconic symbol of Maine. They are the most impressive example of Maine's unique approach to natural resource management.

But change is a constant. So, what have we learned during the last 50 years about natural and human systems and about the consequences of different regulatory approaches that can help us ensure that the state's fisheries are able to thrive in the next fifty years, in an era of climate change?

TECHNOLOGY

Today's fishing technology and the current regulatory environment would have been unimaginable in the 1970s. In the 1960s, the fish stocks off New England were devastated by foreign fleets. More than 200 foreign vessels 200 to 400 feet long had been working the productive fishing grounds in the Northeast since the early 1950s. They were stern trawlers, midwater trawlers, and purse seiners, these distant water fleets supported by factory ships, hospital ships, and oil tankers. The fleets came and went from other fishing grounds off West Africa, Newfoundland, and Norway, following, on a global scale, the pattern of expanding area and harvesting intensification. They hailed from the Soviet Bloc, Europe, Japan, and Korea and processed everything they caught on board.

Top priority at that time for Maine industry and politicians was to restrict the

foreign fleets—with a 200-mile limit—and use government funds to "modernize" the US fishing industry. The assumption was that once the foreign vessels were gone, stocks of groundfish and herring especially, would rebound.

In Maine in the 1960s and 1970s, most fishing was done by coastal boats, though a few large-vessel, corporate fleets out of Rockland and Portland fished redfish and groundfish (cod, haddock, flounders) offshore. The technology on these boats, the most sophisticated in the fishery and world-leading in the 1930s, was far behind that of the foreign boats. Many US vessels were side trawlers, not stern trawlers and certainly not pair trawlers or midwater trawlers. Though they were landing in Maine then, the redfish boats, following the global pattern, had already fished out redfish populations in the Gulf of Maine and on Georges Bank and were fishing international waters off Canada and east of Newfoundland.

Coastal Maine fishermen then were diversified, not specialists. They switched from lobstering to groundfishing to scallops, shrimp, and herring depending on the season, abundance, markets, and their skills and preferences. Many people dug clams, caught smelts, or dipped alewives for halibut and lobster bait. All but a few of the nearshore groundfish draggers went lobstering part of the year. Lobstering was at a worrying low, however. One pound per pot was considered excellent fishing, a far cry from the current 10 pounds per trap that is considered good fishing now. Annual Maine lobster landings were in the 17–19 million pound range and predictions were that the catch could drop as low as 10–12 million pounds, 10 times less than the >100 million pounds Maine is catching today (Maine DMR 2022).

Reading issues from the first four years of *Commercial Fisheries News* provides documentation of the rapid changes in fishing technology that took place in the 1970s. The first fiberglass lobster boat hulls went on the market in the 1970s and the first wire lobster trap advertisements appeared in 1977. Hydraulic trap haulers were a recent introduction and were widely adopted, manufactured by several Maine companies. Diesels were just entering the lobster boat market, replacing marinized gas engines. Navigation was done with compass, a sounding machine, and skill. Few boats had radars. Herring fishing was done with stop seines, weirs, and a few small, inshore purse seines.

Enter the 200-mile limit in 1977. The Magnuson-Stevens Fishery Conservation and Management Act established a framework to phase out foreign fishing; the Act triggered optimism and a rush of subsidized investment to modernize New England's fishing vessels, fishing methods, gear, and electronics. It also triggered the need to draw a US-Canadian maritime boundary, settled in The Hague in 1984. This boundary caused the large offshore boats to return to New England waters for a few decades before they moved on to Alaska seeking more fish abundance than was left in New England.

During these 50 years, the increase in fishing efficiency has been driven by technology that solves one of the pivotal challenges in fishing: how to get back to a place, any place, in a vast ocean. Suddenly fishermen could easily access any place in the Gulf of Maine, removing much of the need for skill acquired by experimentation and observation. Boats now use GPS (global positioning system), with integrated radars. With sophisticated sonar, fishermen now "see" fish in the water and "see" individual boulders on the bottom. Monitors now show draggers and midwater trawlers how their gear is fishing. Engines are powerful diesels, engineered for speed or pulling, depending on the fishery. Lobster traps are wire. Lobster boats have trap racks and open sterns, changes that may look insignificant to the casual observer, but which facilitate moving large numbers of traps in pursuit of lobsters as they follow water temperature and season.

In 2023, no one can dispute that fishermen have the technology to catch and overwhelm virtually any ocean resource. We may have won the war on fish, but that, of course, is not exactly the goal.

REGULATION

In response to improved technology, regulation is now omnipresent in every fisherman's operations, unlike the early 1970s. Then, virtually all fisheries regulation was done by the state; not by the state agency but through the legislature, a slow, consensus-building process not formally tied to science. The Maine Department of Marine Resources (DMR) was created in 1972 and given regulatory power. That same year, a new law gave the Marine Patrol the right to search a commercial fishing boat and the first aquaculture law passed.

The federal regulatory landscape transformed as well. The National Oceanic and Atmospheric Administration (NOAA) was formed in 1970, the same year the Clean Air Act passed, which was followed by the Clean Water Act, the Coastal Zone Management Act, and the Marine Mammal Protection Act in 1972 and the Endangered Species Act in 1973.

But it was passage of the Magnuson-Stevens Act in 1976 that revolutionized fisheries management. Before its implementation, there had been virtually no regulation of US boats in waters outside three miles. Since then, federal rules have reshaped fishing for groundfish, herring, squid, mackerel, and noncoastal scallops

FISHERIES TECHNOLOGY

Bottom trawler: A fishing vessel, also called a dragger, that tows a funnel-shaped net close to the bottom. The net is towed from two wires off the boat. The wires have "doors," steel or wooden panels that spread the net as it is towed. Modern bottom trawlers are stern trawlers that haul the net on board over the stern.

Dragger: Any fishing boat that tows a net. The principal types are side trawlers, bottom trawlers, and midwater trawlers. Trawler and dragger are words used interchangeably.

Gillnet: A stationary net that hangs vertically in the water, like a tennis net. Usually made of monofilament. Fish swim into the net and get caught in the meshes.

Midwater trawler: A fishing vessel that tows a funnel-shaped net that "flies" off the bottom. These typically have enormous mouths, openings that sweep much of the entire water column, the water between the bottom and the surface of the ocean.

Pair trawlers: Two fishing vessels that tow a funnel-shaped net between them. It can be a bottom trawl or a midwater trawl. Pair trawling allows a larger and wider net to be used than one towed by a single vessel.

Purse seine: A net that encircles a school of fish such as herring or menhaden, with weights on the bottom. The weighted bottom rope is then "pursed," pulled together so that the fish are concentrated and cannot escape through the bottom. They then can be pumped out by a large hydraulic pump.

Side trawler: A fishing vessel that uses an older form of bottom trawling where both wires for the net are deployed off one side of the boat and the net is hauled aboard amidships.

Weir: An enclosure in a cove made by a ring of stakes covered by net or brush. Fish enter the weir and are caught.

and quahogs. Access rights to fish these species in federal waters, outside three miles, have been privatized: to enter a fishery today, a fisherman must buy a permit from an existing permit holder. In some cases, the same is true for quota, which must be purchased or leased on top of the permit, on a species- and area-specific basis.

Whereas in the 1970s both state and federal licenses were simply to fish, today, fishermen must have separate licenses or permits for almost every species they pursue. Unlike federal permits, state-level licenses cannot be sold, but all are limited entry by species, based on apprenticeship and waiting lists depending on the fishery. Many commercial boats now must carry electronic trackers that report their location and activity directly to the National Marine Fisheries Service. Regular reporting requirements now exist in most fisheries. As of 2023, all Maine lobstermen must report online at least monthly, documenting daily activity: catch, time, traps hauled, and location fished. Swipe cards are required to sell in certain state fisheries.

The ecological and social results of federal regulation have been devastating to Maine fisheries. Many spawning areas for groundfish and herring collapsed by the early 1990s and have not recovered. Privatization has resulted in consolidation of fishing rights, so that a Dutch company operating through a private equity firm has controlled much of the New England groundfish fishery, operating out of New Bedford, Massachusetts. Some Maine fishermen, who were originally independent business owners, now fish there as hired captains, their settlement checks docked not only for fuel and supplies but also for leasing the rights to the fish that they are catching. Just 35 boats landed groundfish in Maine last year. They landed one-fifth the groundfish that were landed in the depleted years before the Magnuson-Stevens Act.

SCIENCE

Over the last 50 years, fisheries science developed on two distinct tracks. In the first track, federal fisheries science was shaped by the Magnuson-Stevens Act, which requires the use of "best available science."[1] Best available science is codified as quantitative fisheries science, an approach that emerged in the 1950s and 1960s modeled on mathematical methods used in the physical sciences. The approach was built on the simple—but it turns out erroneous—idea that if we assess the number of fish of a particular species in an area, and choose and enforce the right quota, we will have a predictable impact on the size of the stock. The approach is problematic (Hauser and Carvalho 2008). This may be because behavioral and genetic evidence suggests we have designated very large and inappropriate areas (Ciannelli et al. 2013; Wilson and Giske 2023; and for the Gulf of Maine, see Clucas et al.

2019). When the concept of maximum sustainable yield (MSY) was built into the act, it was already under fire in the scientific community. However, despite the scientific uncertainties, subsequent reauthorizations of the act have hardened the use of quantitative fisheries science, requiring that managers establish fixed-time rebuilding schedules on a single-species and area-specific basis. Within these constraints, science has responded to the growing understanding of fisheries complexity by refining stock assessment methods, adding new streams of data, and developing highly sophisticated modeling to advise managers how much fish can be taken—advice that will stand up in court. Its challenge: timely restraint of fishing using quantitative predictions about individual species over large areas in a highly complex and (increasingly) less organized ecological and economic system.

The second science track developed outside the requirements of management and is poorly integrated into management advice. Through 150 years of research in the Gulf of Maine, we have learned about its bathymetry and currents and their impact on the physical, chemical, and biological aspects of its productivity; about its phytoplankton and zooplankton; about the complex life stages and habitat requirements of its commercial species; and about the interactions of these species. We have learned that many species exist in local populations, more similar to river-specific salmon than the assumption used in most traditional federal fisheries science that fish populations are relatively uniform over large geographic areas. Some species, like cod, home to specific spawning grounds; some cod subpopulations are genetically differentiated so that assessing and setting quotas on a large geographic scale is counterproductive. There is renewed focus on fishermen's knowledge, as was done prior to the emergence of quantitative approaches. We have learned that fish learn, as James Wilson describes in this issue.

Significantly, a new way of looking at complex systems has emerged that better describes natural and human systems using social-ecological systems models. Fisheries are such a system, building upon ideas from Nobel Laureate Elinor Ostrom. Complex systems theory provides a method to integrate the findings from both quantitative fisheries science and Gulf-specific ecological science through governance, an adaptive approach based on ongoing observations taken at multiple scales to adapt human interaction as the system changes.

GOVERNANCE FOR THE FUTURE

How can we learn from the last 50 years to help Maine's fisheries be resilient during the climate-driven changes that are coming in the next fifty? The answer lies in looking seriously at what Maine has already done and at lessons from socio-ecological systems as Anne Hayden does in this issue. Without the independent course the state has already taken for its fisheries, those lobster boats would not be here today in so many harbors and the nearshore scallop fishery would not be a dependable winter's work for many fishermen.

Maine is well-positioned to move further into a deliberate social-ecological systems approach to fisheries. The seeds of such governance already exist in a number of the state's fisheries that enlist local groups' stewardship, nested within state management. Local clam committees can monitor and make decisions about conditions as they change on their flats. Alewife groups can monitor and take constructive action on streams both during the spring run and importantly, as the young make their way downstream in the fall low water. No centralized agency alone could fine-tune actions for the good of these fisheries at that level, yet it is necessary for both commerce and sustainability.

Lobster provides the most ambitious example of governance success in scale and sophistication. Maine's lobster management has tackled the uncomfortable requirement that sustainability requires limits on technology and geographical boundaries on fishing activity. It has built management on the biology of the lobster, enlists participation by fishermen, and has made decisions that prioritize a community-scale business. Unlike federal groundfish rules, Maine's lobster rules are not based on controlling numbers caught. Instead, the approach is intuitively understandable: safeguarding key stages of the lobster's life history by protecting juveniles and proven breeders, the future of the fishery. Lobstermen practice this stewardship every day when they discard any lobster smaller or larger than the limits. Accountability is built in through the owner-operator law, since violations jeopardize their license, their right to participate in the fishery. (The state has extended the owner-operator approach to its urchin and scallop fisheries as well.) And, as lobstering technology intensifies within the existing bounds and as waters warm, lobster management science is vigilant, continuing its focus on all life stages of lobster from egg viability to larval survival and settlement on the bottom, involving fishermen in every zone and reporting back to the industry.

Maine's limits on human activity have been critical: limits on who can fish, their technology, and mobility. This approach is in stark contrast to federal groundfish rules that privatized rights, leaving decisions about entry and scale to the market. The federal approach, however, has done nothing to break the

centuries-old pattern of overfishing and has facilitated concentration of fishing rights in a few companies. The value of the lobster rules can be seen by what might have happened as lobster populations grew exponentially in the last 25 years. Without limits on trap size and number, both would have increased. Without restricting catch to traps-only, basic conservation rules would have lost credibility since most lobsters caught by gillnet or drag cannot be discarded alive. Without the owner-operator law, corporate lobster fleets would have developed, unrestrained by the accountability created through owner-operator. Without limiting the scale of the fishery geographically through the zone boundaries, those fleets could have fished anywhere along the coast, "pulse fishing" the hot spots as lobster abundance shifted location along the coast, the way the foreign fleets did fishing the globe. The fishery would likely have been concentrated in a few towns, undermining the healthy coastal economy that benefits from inputs to the industry, self-employment, and the wholesale and retail trade.

None of this success is forever: the ecosystem is changing and always will. We have learned there is no simple, technocratic answer to sustaining fisheries. But that aspirational, enduring value of conducting an industry within a natural system is within reach by taking an informed approach to governance, governance that empowers ongoing learning on multiple scales and adapts as conditions change. The state and Maine's coastal community fisheries have a strong foundation for doing this, incorporating a wide range of science, local observation, and stewardship into the use of specific geographies as the Gulf of Maine changes, not just for lobster but for all species there. It is worth the effort. An investment in—indeed a commitment to—this type of governance will have lasting value.

NOTES

1 The full text of the Magnuson-Stevens Act is available here: https://media.fisheries.noaa.gov/dam-migration/msa-amended-2007.pdf.

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