Environmental History Spring 2019

The Mortal Sea: Fishing the Atlantic in the Age of Sail

Two

PLUCKING THE LOW-HANGING FRUIT

> No sea but what is vexed by their fisheries.
>
> —Edmund Burke, "Speech on Conciliation with America," 1774

No sixteenth- or seventeenth-century European community relied on the sea as much as the Mi'kmaq and Malecite hunter-gatherers of what are now eastern Maine, New Brunswick, and Nova Scotia. The sea nourished their bodies and souls. Seal hunters, seabird egg collectors, scavengers of drift whales, weir builders, hook fishers, and harpooners, Mi'kmaqs and Malecites studied the tides and remained alert for ecological signals from the neighboring sea. As much as 90 percent of their annual caloric intake came from marine resources. Not only did they know the sea; they felt it. Imagining themselves as descended from animal ancestors, including marine creatures such as eels, Mi'kmaqs and Malecites along the Bay of Fundy and the coast of Nova Scotia inhabited a totemic universe in which humans participated in the natural world without considering themselves separated from it. Likewise, in southern Maine and along Massachusetts Bay, Abenaki agriculturalists were also expert fishermen "experienced in the knowledge of all baits" and "when to fish rivers and when at rocks, when in bays, and when at seas." Before Abenakis acquired iron hooks and manufactured lines from the English, one visitor noted, "they made them of their own hemp more curiously wrought of stronger materials than ours, hooked with bone hooks."[1]

Accomplished Native harvesters understood the ocean differently from European newcomers, but both knew that, like the land, it was biologically productive only in specific places and in its seasons. Natives, however, assumed that the fish, whales, and birds were inextricable from the place; that

its signature productivity would endure in perpetuity. Some English mariners knew otherwise. The weirs that had fished so effectively on the Thames, the Severn, and the Ouse had already depleted anadromous fish there, and hook fishers apparently had removed the largest of the cod, ling, and hake from coastal European ecosystems by the time permanent settlement began in New England.

The calamity facing fishermen, noted Christopher Levett, who sailed Maine's southern coast in 1623 and 1624, was that their "trade is decayed in England." Fish stocks in English waters certainly had not been destroyed. Yet with the simple gear at their disposal English fishermen could not work intensively enough to sustain robust landings in areas traditionally fished. In a pattern that would be repeated throughout the centuries, harvesters confronting that problem saw two alternatives. They could develop better gear to fish familiar grounds more intensively, or fish more extensively by searching for virgin stocks on unknown grounds. Both actions masked the depletion that had already occurred: both shifted downward the baseline of what was considered "normal." Captain John Smith concurred with Levett's assessment. He contrasted the western Atlantic's freshness with exhausted European fisheries. "And whereas it is said, the Hollanders serve the Easterlings themselves, and other parts that want, with Herring, Ling, and wet Cod; the Easterlings a great part of Europe, with Sturgion and Caviare; Cape-blanke, Spaine, Portugale, and the Levant, with Mullet … yet all is so overlaide with fishers, as the fishing decayeth, and many are constrained to return with a small fraught." The sea off New England was different, according to Smith, "her treasures having yet never beene opened, nor her originals wasted, consumed, nor abused."[2]

Francis Higginson, a clergyman from Leicestershire, and one of the first-generation settlers in Massachusetts, testified to that freshness immediately after his arrival. "The abundance of sea fish are almost beyond believing," he wrote home in 1629, with the conviction of a man accustomed to being heard, "and sure I should scarce have believed it except I had seen it with mine own eyes. I saw great store of whales and grampus and such abundance of mackerels that it would astonish one to behold, likewise codfish.… And besides bass we take plenty of skate and thorneback and abundance of lobsters, that the least boy in the plantation may both catch and eat what he will of

them."[3]

Almost without knowing it, staid newcomers of the middling sort who had been landsmen in England, such as Higginson, were forced into the arms of the sea. Once in New England they imitated Native ways, studying the tides to capitalize on the seasonal presence of fish, seabirds, and marine mammals. Missing the orchards, taverns, and roads that defined the reassuring English landscape, the first generation of settlers reoriented themselves to New England's realities. To begin with, the charter generation selected place-names acknowledging the creatures that defined their new world. Within the first decade of the Plymouth Colony religious separatists there named the Smelt River, Eel River, Blue Fish River, First Herring Brook, and "ye creeke called ye Eagls-Nest." Settlers in Salem initially called what is now Beverly the "Bass River." Pioneers on the Piscataqua from the 1620s to the 1640s named that river's tributaries the Lamprey River, Oyster River, Salmon Falls River, and Sturgeon Creek. Newcomers in every locale made powerful associations between the places in which their lives had begun anew and the mind-boggling density of useful organisms found there.

Important decision-making, including selection of town sites, followed from the presence or absence of marine resources. William Wood noted in 1634 that new towns on the bay "reap a greater benefit from the sea in regard of the plenty both of fish and fowl … so that they live more comfortably and at less charges than those … in the inland plantations." At Chelsea, he explained, "The land affordeth the inhabitants as many rarities as any place else, and the sea more." His list of benefits included smelt, frost fish, bass, cod, mackerel, and, at low tides, "flats for two miles together, upon which is great store of muscle banks and clam banks, and lobsters among the rocks and grassy holes."[4] Both Dorchester and Salem, Wood continued, lacked an "alewife river, which is a great inconvenience." Unknown in Europe, alewives were the passenger pigeons of the sea in colonial America. "Experience hath taught them at New Plymouth," wrote one eyewitness, "that in April there is a fish much like a herring that comes up into the small brooks to spawn, and when the water is not knee deep they will presse up through your hands, yea, thow you beat at them with cudgels, and in such abundance as is incredible." Roxbury, on the other hand, according to Wood, had a "clear and fresh brook running through

the town," which, while it lacked alewives, featured "great store of smelts." Smelt are a slender, pale green fish with a silver belly and a broad silvery band along its sides. Smaller than alewives, only six to nine inches long, smelt wintered in brackish estuaries and then—driven by an ancient biological clock—ascended rivers to spawn in the spring. Like alewives they could be seined in vast numbers, or trapped with weirs; like alewives, too, they could be panfried or roasted for immediate consumption, salted or smoked for the future, or used to fertilize fields. Unlike alewives, smelt were well known in Europe.[5]

Promoters' stories had prepared colonists for abundance, but not for the ways in which they would reorient to the sea, or affect it. By 1628, when fewer than 200 men, women, and children lived in Plymouth, settlers there had already built an ingenious trap on a rapid but shallow freshwater river. Reminiscent of the kiddles so effective in English rivers throughout the Middle Ages, their trap caught the eye of a Dutch visitor. In "April and the beginning of May," he wrote, "there come so many shad from the sea which want to ascend that river, that it is quite surprising. This river the English have shut in with planks, and in the middle with a little door, which slides up and down, and at the sides with trellice work, through which the water has its course, but which they can also close with slides … between the two [dams] there is a square pool, into which the fish aforesaid come swimming in such shoals, in order to get up above, where they deposit their spawn, that at one tide there are 10,000 to 12,000 fish in it, which they shut off in the rear at the ebb, and close up the trellices above, so that no more water comes in; then the water runs out through the lower trellices, and they draw out the fish with baskets, each according to the land he cultivates, and carry them to it, depositing in each hill three or four fishes, and in these they plant their maize."[6] Fertilized by fish, even the corn that sustained those colonists had roots to the sea.

Within a generation, in addition to building such clever traps, settlers constructed weirs across virtually every negotiable river on the coast. They stop-seined creeks full of striped bass, gathered seabird eggs from rocky islet rookeries, pursued right whales swimming lazily off the beaches of Cape Cod, built fleets of shallops for the cod fishery, and collected oysters, clams, and lobsters wherever possible. The Puritan historian Edward Johnson regarded

among New England's providential wonders the fact that a "remote, rocky, barren, bushy, wild-woody wilderness, a receptacle for Lions, Wolves, Bears, Foxes, [and] Rockoones" had been transformed within a generation into "a second England for fertilness."[7] Colonists celebrated God's bounty and their own "improvements," but by the inauguration of George Washington marine ecosystems from Cape Cod to Newfoundland had been reshaped by localized depletions, range contraction, extinctions and near extinctions, and diminished estuarine productivity. Some colonists understood that fishing and fowling could have deleterious consequences, even in a sea of plenty. What is most striking about settlers and the sea in seventeenth-century New England is that, although the ocean around them teemed with life, the first two generations of magistrates imposed conservation restrictions on sea fisheries in the midst of that marine dreamscape.

REGULATIONS IN A SEA OF PLENTY

From the perspective of seventeenth-century fishermen the familiar continental shelf on which they plied their trade extended north-northeast from Cape Cod toward Newfoundland as a maze of shallow banks, named basins, submerged ledges, and deep gullies, the jumbled signature of a retreating glacier. The physical features of this underwater landscape were not unlike those ashore, a place at once dangerous and tempting, a place, as the scriptures said, that in its seasons revealed "the blessings of the deep that lieth under."[8] Within a few decades of settlement coastal villagers who had never walked inland a full day in their lives were nonetheless intimately familiar with distant parts of that 100,000 square miles of underwater terrain.

From the middle of the twentieth until early in the twenty-first century oceanographers called this watery territory, which overlaps parts of New England and Atlantic Canada, the Northeast Shelf large marine ecosystem (LME). LMEs are coastal zones extending from the shore to the outer edge of continental shelves or, in some cases, to the outer margins of major coastal currents. Oceanographers characterize LMEs by distinctive "bathymetry, hydrography, and productivity, within which marine populations have adapted reproductive, growth, and feeding strategies," a technical way of saying that

the topography of the seafloor, its water circulation patterns, its normal range of temperatures, and its level of productivity influence the types of organisms found there, along with who eats whom. Scientists, of course, do not assume that the boundaries of such systems are precise. By 2002, after decades of study and as part of a global initiative to isolate coastal ecosystems for research and management, the region between Cape Cod and Newfoundland was redefined into three LMEs—the Northeast U.S. Shelf, the Scotian Shelf, and the Newfoundland-Labrador Shelf. However, from a perspective simultaneously historic and ecological, it makes more sense to imagine the region between Cape Cod and southern Newfoundland as a unified area, as scientists did until 2002, and as Captain John Smith did in 1616, when he wrote of the fishery there "in the deepes, and by the shore" that "stretcheth along the coast from Cape Cod to Newfound-land, which is seaven or eight hundred miles at the least." Throughout the seventeenth century and much of the eighteenth century, that area was crucial to New England's export economy and economic survival.[9]

The first generation of laws in New Plymouth and Massachusetts Bay, like laws and regulations everywhere, were laden with values, assumptions, and inferences about the future. Those early regulations reflected actions taken and stories told. They concerned, among other things, public safety, nuisances, fraud, untimely deaths, idleness, the consolidation of wealth, thefts, wages, fornication, and "the many & extraordinary mercyes wch the Lord hath beene pleased to vouchsafe." They also spoke to the allocation, harvest, and conservation of natural resources. In keeping with seventeenth-century assumptions that the plants and animals of God's creation existed for humans' sake, one of the first laws passed by the freemen and magistrates of Plymouth Colony assured "that fowling, fishing and Hunting be free" to all the inhabitants. A decade later they reaffirmed the principle of free access, but qualified it by reserving to the industrious the fruit of their own labor. The revised law stated that "if any man desire to improve a place and stocke it with fish of any kind for his private use, it shalbe lawful for the court to make such grant, and forbid all others to make use of it." In 1633, shortly after the great migration of Puritans to Massachusetts Bay, Plymouth's magistrates passed a law to reserve local alewives to "such as doe or shall inhabit the town of

Plymouth." Relying on those fish for "the setting of corne," and convinced that stocks were not inexhaustible, they were determined to prevent outsiders from pirating spring spawning runs.[10]

Conserving striped bass stocks was also a concern in seventeenth-century Massachusetts. Bass had providential associations for the first generation of settlers. But for God feeding "them out of the sea," as Governor William Bradford wrote, the Pilgrims would not have survived their starving time. "The best dish they could present" that first year, he noted, "was a lobster or a piece of fish without bread or anything else but a cup of fair spring water." Compared to the bread, beef, and beer dear to the English, the fishy menu seemed hopelessly bleak. Bradford forever associated striped bass with starvation rations. He didn't share the enthusiasm of William Wood, a contemporary who described striped bass admiringly as "a delicate, fine, fat, fast fish … though men are soon wearied with other fish, yet are they never with bass."[11]

Striped bass spawn in brackish water at the heads of estuaries or in freshwater close to the sea. Like all river fish, their propensity to congregate seasonally in rivers and streams made them an easy target. Plentiful in their summer season from Cape Cod to southern Maine, striped bass were less numerous from mid-Maine eastward. According to Wood, "the English at the top of an high water do cross the creeks with long seines or bass nets which stop in the fish." As John Smith had noted farther south in 1622, "there hath beene taken a thousand Bayses [bass] at a draught," that is, in one set of a net.[12]

Striped bass can weigh more than 100 pounds. As Wood observed in 1634, "some be three and some four foot long, some bigger, some lesser." Bigger fish are more solitary. Those that school are typically up to 10 pounds, but sometimes 20 or 25 pounds. Even if the average bass landed in a single set of the net weighed just 10 pounds, the catches were impressive. Small bands of gaunt Pilgrims, such as the ones Wood watched, were landing up to 10,000 pounds of stripers in one haul. The Pilgrims later shipped barrels of pickled bass to Spain, but found no buyers. Bass, when available, was consumed locally.[13]

Such robust landings spelled trouble, even for a Chosen People to whom God had given "dominion over the fish of the sea." By 1639, less than twenty

years after the arrival of the *Mayflower,* when the entire area from Connecticut to southern Maine was inhabited by only 20,000 English settlers, and when silvery shoals of mackerel, menhaden, bass, and cod boggled the minds of observers such as Francis Higginson and William Wood, the gentlemen-magistrates in Massachusetts Bay outlawed using cod or bass as manure in the fields. In what appears to be the first fishery regulation in New England aimed specifically at conservation, the magistrates recognized the specter of waste and the threat of local depletion. No minutes remain from the discussion preceding passage of the law, but the inference is that the gentlemen did not believe that local marine resources were infinite, even when harvested by a tiny human population.[14]

Controversies about the state of bass stocks persisted for decades. During the 1640s the General Court of New Plymouth had granted a lease for bass fishing at Cape Cod to John Stone, of Hull, in the Massachusetts Bay Colony. With his lease Stone was allowed to use "lands, creeks, timber, &c upon the Cape." Stone sailed across Cape Cod Bay from Hull each spring with his assistants, and set up temporary fishing camps along the streams in which bass were known to spawn. The goal would have been to catch, clean, and pack as many bass as they could handle during the spawning runs. Bass, unlike cod, were not air-dried, but were packed in barrels with salt. A successful bass fishery required barrel staves and other cooperage supplies, seine nets or weirs, sufficient salt for the season, a shallop or other vessel for freighting, and provisions for the fishermen. In October 1650, when the total population of the Plymouth Colony numbered only 2,000, the General Court revoked John Stone's lease. Members of the court said explicitly that they wanted to return bass fishing rights to men from towns in their own colony. Yet they did not throw open the fishery to all: far from it. "Wee are informed," they wrote, "y^{t} two companies, with nett, boats, and other craft, is as much as the place can beare." The records do not indicate who informed the court that Cape Cod's rivers and creeks could accommodate only two companies of bass fishers, but it seems reasonable that the court would have been swayed only by individuals conversant with the fishery. In their opinion, at least by 1650, the state of bass stocks did not warrant an open fishery, although numerous rivers in which bass might have spawned emptied into Cape Cod Bay from the Cape's upland

drainage, including Herring River, Blackfish Creek, Fresh Brook, Herring Brook, Bass Creek, Mill Creek, Marasapin Creek, and Scorton Creek. In view of the possibility of overfishing, the court adopted a precautionary approach.[15]

Conservation laws such as the one from 1639 forbidding bass as fertilizer, and the one passed in 1647 requiring that all weirs "be opened from noon of the last day of the week until morning of the second day," reflected not only the magistrates' sense that a well-ordered society was a well-regulated society, but also their appreciation that the marine resources that overwhelmed their senses were finite, and too valuable to squander. Opening weirs over the long sabbath reduced fishing pressure substantially, increasing the likelihood of fish in the future. Another recognition of the seashore's prominent place in their fledgling colony came in 1636, when "Water baylies" (or water bailiffs) were appointed in Boston "to see that noe annoying things eyther by fish, Wood, or stone or other such like things, be left or layd about the sea shore."[16]

Conservation measures notwithstanding, settlers were quick to build permanent weirs, such as those that littered the waterways of Old England. Massachusetts Bay settlers built their first weir within two years of their arrival. Wood reported that there was "a fall of fresh waters which convey themselves into the ocean through the Charles River. A little below this fall of waters the inhabitants of Watertown have built a weir to catch fish, wherein they take great store of shads and alewives. In two tides they have gotten one hundred thousand of those fishes." By the fall of 1632 the Court of Assistants approved construction of another weir in Saugus, and two years after that granted Mr. Israell Stoughton "liberty" to "builde a myll, a ware, & a bridge over the Naponsett Ryver," which flowed into Massachusetts Bay on the southern end of Boston, and "to sell the alewyves hee takes there att 5^{s} the thousand." Roxbury residents had already built a weir without the General Court's permission. The inhabitants of New Town received liberty to erect a weir on the Winotomy River in 1634, and the next year Messrs. Dummer and Spencer petitioned successfully for permission to build a mill and weir at the falls on the river in Newbury. In 1639 Plymouth Colony granted rights for weirs "to take fish at Mortons Hole, Eagles Nest, and Blewfish River," along with a herring weir at Jones River. Several weirs already existed in New Plymouth. Individual farmers and fishermen rapidly came to expect the

presence of vast numbers of fish to use as they saw fit. Refereeing a squabble over rights to alewives in the town of Sandwich, the New Plymouth Court determined in 1655 that "Thomas Burgis shall haue anually ten thousand herrings."[17]

By the 1640s weirs with considerable catching power latticed many of the rivers in the southern third of the Gulf of Maine, an area ranging from Cape Cod to Kittery, Maine. The rash of newly built weirs and milldams inevitably reduced the number of fish seeking to spawn, though precise percentages are unknowable. Native inhabitants, itinerant explorers, and first-generation settlers had all lauded those rivers' spawning runs of shad, alewives, smelt, salmon, sturgeon, bass, and other fish. Such anadromous species formed one piece of the gulf's signature productivity. It is not clear when those fish began to spawn in the Gulf of Maine watershed. We do know that the gulf is one of the youngest arms of the world's oceans. Formed by retreating glaciers some 13,000 years ago, by a landmass that rebounded after being depressed by the weight of that ice, and by rising sea level as a result of glacial melting, its functional age, or time in which its characteristic tidal regime has been similar to that of today, is only several thousand years—"less than the duration of recorded human history," as a team of scientists has written, "and more recent than the arrival of early man in the area we now call the Gulf of Maine watershed." Far from being part of an eternal sea, the gulf's geography, hydrology, and biological productivity were all quite recent when the Vikings arrived in North America. No impact on anadromous fish in the gulf during the preceding 3,000 years had been equivalent to that of the weirs erected between 1621 and the 1640s.[18]

Providentialism and abundance provided foundations for the written history of seventeenth-century New England. As the chroniclers saw it, tracts of unimproved land, virgin forests of pine and hardwoods, and incomprehensibly bountiful fish stocks transformed a hardworking, God-fearing population into a people of plenty in a temperate New World Eden. During the seventeenth and eighteenth centuries Britain's thirteen North American mainland colonies had a rate of economic growth nearly double that of Great Britain itself. By the outbreak of the American Revolution, per-capita gross domestic product in the provinces that would become the United States was substantially higher than

that of every other country in the world, and higher than it would be for the foreseeable future. Such unparalleled prosperity rested on the abundance of natural resources in British North America, and on colonists' work ethic and willingness to exploit both land and dependent laborers.[19]

Yet the dominant narrative of abundance, so valid in many ways, has eclipsed an important back-story. Emigrants carried knowledge of resource depletion in their baggage to the New World. Early settlers were concerned about preserving resources. First-generation emigrants' knowledge of coastal and estuarine overfishing in England and continental Europe became an incentive to conserve resources in America. For several generations, settlers articulated the need for a precautionary approach to their sea fisheries, seeking to balance short-term needs against long-term costs, even as they harvested marine resources with the fervor of men on the make and squabbled over rights of access.

Perpetuating stocks of alewives, which farmers regarded as vital for fertilizer, was always a concern. In May 1664 "the whole town of Taunton," led by Joseph Gray, Samuell Linkhorne, and George Watson, "complained of great wrong" when the owner of the sawmill straddling the herring river in Taunton refused "to leave a sufficient passage for the herrings or alewives." Blocking the river with a milldam prevented access to the fish by upstream farmers, and prevented the fish from reaching their spawning grounds. Everyone understood the implications. By May 1664 much of the spawning season was over and the damage had been done, though the court immediately instructed James Walker, owner of the mill, "to speedily take course that a free passage bee left for the goeing up of the alewives … whiles yet some pte of the season remains." The court also ordered that before the next spawning season the owners of the mill make "a free, full, and sufficient passage" for the fish; otherwise "the said town … is in danger to suffer much damage." Towns took seriously residents' access to marine resources in other ways, as well. In 1659 the towns of Barnstable and Yarmouth, both in the Plymouth Colony, agreed that henceforth their shared town boundary would extend "into the sea one mile," a far-sighted means of preventing disputes over both shellfish and finfish.[20]

Yet officials' concerns regarding depletion extended well beyond

anadromous fish such as striped bass and alewives. While striped bass was not indigenous to the boreal region of the eastern Atlantic, emigrants to New England knew all too well that any anadromous fish stock could be reduced by overfishing. Whether by outlawing its use as fertilizer or limiting the numbers of bass fishers, the magistrates' determination to preserve striped bass made sense in light of their Old World experience.

One of the most striking expressions of concern for the preservation of fish, however, focused on mackerel, literally one of the most numerous fish in the sea. In fact Massachusetts' seventeenth-century fishery regulations were much more concerned with sea fish than with anadromous species. In 1660 the Commissioners of the United Colonies of New England took it upon themselves to prevent the destruction of New England's mackerel stocks. An act that year stated:

> Fforasmuch as diuers of the most experienced ffishermen in seuerall ptes of the Countrey haue complained that the early fishing for Mackerell before they haue spawned doth extreamly wast consume and destroye them; and that the goeing out of some to meet them farr into the sea doth alsoe beat them of the coast; The Comissioners considering that the fish is the most staple commoditie in this Countrey and might bee much more benificiall then yet it hath bine if wisly managed; they doe therefore Recommend vnto the Courts of the seuerall Jurisdictions that they prohibite fishing for Mackerell vntil the fifteenth day of July yearly that soe fish may increase and bee continued.

The United Colonies of New England had been established in 1643 as a "Consociation amongst ourselves for mutual help and strength in all our future concernments." The league of friendship, in which each colony sent two delegates who then elected a president from among themselves, linked Massachusetts Bay, New Plymouth, New Haven, and Connecticut, then centered at Hartford. (Conspicuously missing was Rhode Island, which the others considered theologically schismatic.) The Articles of Confederation specified that the commissioners would not meddle with the government of any

of the independent jurisdictions, but would concern themselves only with issues of consequence to their collective security and friendship. The United Colonies' greatest successes came in the realm of common defense through diplomacy (and threats) directed at regional Natives, the French, and the Dutch, but the commissioners also occasionally directed their attention to other matters, including economic development. Their act in 1660 regarding management of the mackerel fishery is significant not only because it was rooted in the complaints of experienced fishermen, but also because it had support across much of New England. It reflected the concerns of fragile societies dependent on the sea.[21]

The Atlantic mackerel is a sleek, fast-swimming fish. Ivory colored on the belly, mackerel are distinguished by an iridescent greenish-blue back, marked transversely with wavy tiger stripes. Individual fish are generally twelve to eighteen inches long when mature, and weigh between one and two pounds. With rather oily flesh, similar to that of herring and bluefish, mackerel are flavorful and were much sought after. They can be smoked, salted, pickled, or eaten fresh. But the oiliness that makes fresh mackerel so succulent keeps them from preserving as well as white-fleshed fish, such as cod. A staple in Europe from the Bay of Biscay to the Norwegian coast since the Roman era, mackerel were well known to seamen and fishmongers alike, though every winter they disappeared. Fisheries scientists now know that mackerel winter in deeper water offshore. For fishing communities, the mackerel's return provided a welcome sign of spring. But mackerel were fickle, irregular in their migrations, and always restless. Requiring considerable oxygen, they move constantly to increase water flow across their gills. Following the zooplankton, squid, and small fish that they eat, mackerel generally move diurnally, receding into the depths during the day and surfacing at night, although schools also appeared at the surface in daylight. Vast surface-flitting schools were seen routinely by seventeenth-century mariners. A keen-eyed man at the masthead, with the sun behind him, could see schools of mackerel eight to ten fathoms below the surface on a calm summer day. At night submerged schools betrayed themselves by "firing" the water, disturbing bioluminescent microorganisms. On overcast or moonless nights, the eerie bluish trace of bioluminescence enchanted observers, magically revealing shoals of sleek fish darting and

pirouetting in the forbidding depths. During spring and summer mackerel more conveniently closed with the shore. As William Wood noted at Chelsea in 1634, "shoals of bass have driven up shoals of mackerel from one end of the sandy beach to another, which the inhabitants have gathered up in wheelbarrows."[22]

Those shoals were just the tip of the iceberg. Ecologists studying schooling behavior of fish during the late twentieth century reported individual schools of overwintering North Atlantic mackerel that measured five nautical miles long by one-and-a-half nautical miles wide, and twelve meters thick, containing approximately 750 million individual fish. Scientists now know that herring, mackerel, and menhaden are the most numerous species in the North Atlantic. So how could a few seventeenth-century fishermen from New Haven, New London, Duxbury, and Boston, equipped with modest seines and hooks, and sailing in heavy shallops, imagine that they could "consume and destroy" what Francis Higginson had referred to in 1629 as "such abundance of mackerels as it would astonish one to behold"?[23]

The point is that they did. By 1660 enough regional fishermen were concerned about the future of mackerel stocks to convince their elected officials that the fish would "increase and bee continued" only "if wisly managed." They may have felt that mackerel's abundance in 1660 compared poorly with abundance in decades past. They may have observed several seasons of poor year-classes, when recruitment of juveniles to adults lagged the norm. The late 1650s may have been years when mackerel did not come inshore to the extent that had been normal. We don't know exactly what prompted their concern, though it is clear that they believed human activity could affect mackerel stocks.[24]

Fishing continued, however, as did stories about fishing. Ten years later, in October 1670, the General Court of Massachusetts took action after "being informed that the taking of mackerel at vnseasonable times doe greatly diminish their increase, & will, in the issue, tend to the spoyle of the trade thereof." They ordered that "henceforth no mackerel shall be caught, except for spending while fresh"—that is, for immediate consumption—"before the first of July, annually." And the next year, when residents of Hull, in Massachusetts Bay, petitioned the colony of New Plymouth "to haue libertie to employ some

boates and theire companies for the takeing of mackerel with netts, at the season thereof, att Cape Cod," the court granted "libertie only for two boats." Whether the residents of Hull had requested permits for more than two boats ("some boates") is not known. The court may have been simply exercising its prerogative to grant licenses and to collect revenue "due to the collonie from forraigners," rather than acting to preserve fish stocks. At a time when much about nature was unfathomable, especially the mysteries of the sea, New Englanders nevertheless saw the world in certain ways and operated on those assumptions. And by 1670 Massachusetts fishermen and gentlemen were convinced that the seine technology at their disposal had the capacity to affect schooling fish such as mackerel.[25]

In 1684, for instance, an experienced fisherman named William Clarke convinced the General Court at Plymouth to take seriously "the great damage that this collonie and our naighbours is likely to sustaine by the catching of mackerel with netts and saines at Cape Cod, or else where near any shore in this collonie, to the great destruction of fish, and the discurragement of severall fishermen." Clarke put his money where his mouth was. He offered the treasurer of the colony thirty pounds "in currant New England money" for each of the next seven years for the rights to the bass fishing at Cape Cod, provided that the court prohibit mackerel seining. Clark believed that without bountiful supplies of mackerel for forage, striped bass would not frequent inshore waters near Cape Cod, and he was convinced that seining mackerel would deplete them.[26]

From 1660 to 1702 various regulatory bodies of the United Colonies of New England, Massachusetts Bay, and, to a lesser extent, New Plymouth, expressed concerns about the future of mackerel stocks and the possibility of overfishing them. While the words on the tips of fishermen's tongues are lost to time, it is fair to say that the preservationist language of the commissioners and the General Court distilled the essence of numerous conversations by "the most experienced ffishermen," as they put it, conversations about how catching mackerel before they spawned each year could "destroye them," conversations about fishing pressure affecting mackerel's migratory path, and conversations about the importance of beneficial commodities being "wisly managed." By the 1660s some of those fishermen and merchants had been born in the colonies,

but there were also still fishermen such as "Robert Willie, allias Willis, sometimes of Milbrooke in the countey of Cornwall, and sence belonging to Winter Harboure, at Saco, in New England," who was part of the crew of a mackerel fishing trip near Plymouth in 1652. Men like Willie, with firsthand comparisons of coastal ecosystems in Old England and New England, had reason for concern about overfishing.[27]

Massachusetts's most dramatic precautionary restrictions on New England's embryonic commercial fisheries came in 1668. Real earnings from fisheries, as everyone knew, would come not from mackerel, bass, or herring, but from cod. Dried cod became the cornerstone of colonial New England's export economy by the middle of the seventeenth century. Yet with the exception of the settlement at Pemaquid, Maine, attempts to organize a New England-based commercial fishery during the 1620s and 1630s faltered, despite legislative incentives and land grants. While it was common knowledge that the marine ecosystem east-northeast of Cape Cod furnished among the best fishing grounds in the world, few of the Puritan migrants from the south and east of England had the skills or commercial contacts to make the fishery succeed. Rough men from the West Country, who understood the fishery, were not readily welcomed by "the saints," as Puritans called their covenanted communities. And hiring fishing servants for a fixed seasonal wage, as had been the system in Newfoundland for more than a century, generally did not work in Massachusetts or southern Maine, where alternative opportunities abounded. Servant fishermen simply disappeared to seek their own fortunes.[28]

Despite these problems cod-fishing operations commenced in the western section of Massachusetts Bay, immediately adjacent to Boston, during the height of the Puritans' great migration. In 1632 Reverend Thomas Welde optimistically wrote to his former parishioners in England that "The plantation is now set upon fishing for a staple commodity … shallops [are] made and tackling provided to catch it withal and to send it into other countries to fetch in all other commodities." A fishing station at Scituate commenced that year. At Dorchester, Henry Way had two shallops fishing by 1631, one locally and one in waters to the east. By 1634 Matthew Craddock, an absentee capitalist, had a fleet of eight shallops fishing from Marblehead manned by servants under the management of Isaac Allerton, who had been the deputy governor and

commercial agent at New Plymouth before parting ways with other Pilgrim fathers. For a variety of reasons, Allerton's servant fishery never thrived. These false starts and small-scale operations prompted the Massachusetts Bay government to give several gentlemen "power to consulte, advise, & take order for the setting forwards & after manageing of a fisheing trade," and appropriated public money for the task. In 1639, the same year they forbade using cod or bass for manure, the magistrates ordered that a "fishing plantation shalbee begun at Cape Anne," assigning Mr. Morrice Tomson to take charge.[29]

Unlike a seasonal river fishery for striped bass, which could be worked by farmers with nets, or a weir fishery for alewives, which required only the simplest of boats, commercial cod fishing was daunting. It involved arranging substantial credit to procure supplies, as well as catching, processing, storing, shipping, and marketing large volumes of dried fish. As Daniel Vickers, the preeminent historian of the fisheries, explains, "Competing with the highly skilled and well-capitalized fisheries of Western Europe for markets and with the developing rural economy of the Bay Colony itself for labor and capital was not going to be easy."[30]

The English civil war (1642–1651) gave colonial merchants the break they needed. The number of West Country fishing boats working on the coast of Newfoundland fell from 340 in 1634, before the war, to fewer than 200 by 1652. The West Country vessels that had worked the coast of New England disappeared entirely. These disruptions to production, followed by a dwindling supply, elevated the price of cod in southern Europe. All of this provided New England merchants with the incentive to try fishing again, and during the next several decades New England's output of dried cod steadily rose. Initially carried to Spain, Portugal, and the Atlantic islands in English ships, cod was soon being exported in prodigious amounts in American bottoms to Catholic markets in southern Europe and to the Caribbean plantation islands, where an increasingly large population of enslaved workers needed to be fed. Exports of dried, salted cod were on their way to becoming the lynchpin in the New England economy, spurring the shipbuilding and shipping services at the heart of New England's remarkable economic development. Between 1645 and 1675 New England's total output of cod rose between 5 and 6 percent each year, increasing from about 12,000 to 60,000 quintals (one

quintal was 112 pounds of dried cod).[31]

In the midst of this remarkable expansion of the fisheries, in October 1668, the General Court halted open access to stocks of gadoids, ordering "that no man shall henceforth kill any codfish, hake, hadduck, or pollucke, to be drjed up for sale, in the month of December or January, because of their spawning tjme."[32] Why would development-minded authorities limit the cod season, closing the fishery for two months each year?

Northwest Atlantic cod catches—originally in Newfoundland, but later in Nova Scotia and New England—fluctuated significantly throughout the sixteenth, seventeenth, and eighteenth centuries. The year 1592 was an especially poor one for fishermen in Newfoundland, one that "coincided with scarcity in the Cornish and Irish fisheries." And 1621 was a lean year, too. The Dorchester Company failed to develop the fisheries near Cape Ann, Massachusetts, during the 1620s, partly because of a perceived lack of fish. As Christopher Levett wrote in 1624, "the Shippes which fished there this yeare, their boats went twenty miles to take their Fish, and yet they were in great feare of making their Voyages, as one of the Masters confessed unto me who was at my house." At Boston in June 1651 Captain John Leveret was unable to deliver 308 quintals of fish to his assignee, William Stratton. As Leveret explained, Stratton "knoweth that fish hath not been to be pcured for money." One Mrs. Norton stated in her husband's absence that "if her husband could have procured fish he would have done it to his utmost." But fish were scarce near Boston that year. Fishermen could never predict seasonal catches with certainty. And it was more than a matter of luck.[33]

Scientists today attribute fluctuations in historic landings to climate change and other natural factors that influenced the annual size of cod stocks, along with fishing pressure. Female cod laid millions of eggs each year, but the number that hatched, much less lived to become juvenile fish, was quite small. Poor year-classes seem to have affected Newfoundland's southern shore fishery in 1723–1725, and again in 1753–1755. Townsmen in Eastham on Cape Cod complained in 1748 that the "fishery in a great measure has failed of late." Nantucket fishermen lamented in 1751 "that the codfishery round the Island has failed yearly insomuch that there have not been half enough caught … for the Inhabitants to eat fresh, and the fishery on the shoals so fails that it is now

entirely neglected." Natural deviations such as these, which occurred in some years of each century, had real consequences for fishermen.[34]

Assessed over the *longue durée,* from the middle of the seventeenth century to the middle of the nineteenth century, the northwest Atlantic ecosystem seemed able to produce the approximately 150,000 to 250,000 tons per year that fishermen extracted from it. Significant fluctuations year-to-year were common, and are best explained by climate change. Abnormally cold spells, such as the period from about 1660 to 1683, saw marked reductions in cod landings. That overall sustainability, however, may have masked an emerging pattern of localized depletions. As early as the middle of the eighteenth century Newfoundlanders began to shift their fishing effort from areas of declining catch to unexploited places. Resident Newfoundlanders from the southern and southeastern parts of that great island, who were accustomed to fishing from shore in small boats, began to fish eastern Labrador, a distant and inhospitable place that required seasonal migrations. By late in the eighteenth century they increasingly fished Notre Dame and White Bays on the north shore of Newfoundland, which also required a seasonal trek to establish shore-based fishing operations in a wilderness area. While the evidence is far from conclusive, the declining catch rates that Newfoundlanders lamented among certain inshore stocks may have reflected overfished and locally depleted cod populations.[35]

In this light, the decision of the Massachusetts General Court in 1668 to close the commercial cod fishery during December and January of each year may indicate that the court perceived problems with the Massachusetts Bay cod fishery as early as 1668. The historical record is too thin for an absolutely conclusive answer, but examination of the process of farm-building, town-building, and fishing in light of local regions' ecological productivity reveals that as early as the 1660s cod fishing between Cape Ann and Cape Cod, within the confines of Massachusetts Bay, was already on a different path from cod fishing east of Cape Ann, where territories ranged from Essex County, Massachusetts, to the wilds of Maine.

Cod stocks in Massachusetts Bay had a somewhat more fragile foundation for their food chain than did cod stocks east of Cape Ann, a result of the underwater topography of the Gulf of Maine, and the gulf's characteristic

distribution of plankton by its dominant counterclockwise currents. Biologically the Gulf of Maine is a garden, one of the most productive coastal ecosystems in the world. Geologically the gulf is a semienclosed inland sea, a factor that contributes to its productivity. Georges Bank and Brown's Bank, vast shallows that provide a significant barrier to the rest of the Atlantic, prevent the gulf's colder and less saline water from mixing freely with the Atlantic. Cold, well-oxygenated freshwater flows from numerous rivers into the gulf, where it mixes with nutrient-enriched seawater in the presence of sunlight, providing perfect conditions for phytoplankton reproduction. The virtually enclosed topography of the gulf, however, means that its currents circulate in a counterclockwise gyre, with a major current flowing from northeast to southwest along the shore of New Brunswick, Maine, and New Hampshire. Scientists now refer to that current as the Gulf of Maine coastal plume. It carries plankton down the coast as far west as Ipswich Bay, a prime cod spawning area, but is then deflected by Cape Ann so that its plankton-rich waters flow over Georges Bank, but not into Boston harbor or into the inner reaches of Massachusetts Bay from Salem to Plymouth. "Because the deflected Plume bypasses the northwestern bight of Massachusetts Bay in most weather, pelagic plankton feeders, such as herring and menhaden that attract larger predators such as cod, were not drawn in large numbers into that area. But salt marshes and estuaries around the littoral west of Cape Ann were productive enough before European contact to maintain anadromous fish in quantities that supported large local cod populations. In short, Cape Ann ensured that for the demersal fish in Broad and Salem sounds, there was one principal menu: anadromous fish."[36]

By the latter part of the seventeenth century, about the time that the Massachusetts General Court forbade catching cod during their spawning season, two sorts of cod fisheries existed in New England. East of Cape Ann to the midcoast of Maine, shore-based fishermen in relatively small craft pursued cod on inshore grounds, as would their descendents until well into the nineteenth century. West of Cape Ann, however, Marblehead, and then Gloucester and Boston, became home to deep-sea fisheries. Men from those communities did not pursue a mixed fishing, farming, timbering, and coasting economy, but became full-time fishermen earning a living on distant offshore

banks. Cod stocks in coastal waters from Cape Ann to Cape Cod were insufficiently robust to support intensive shore-based fisheries, especially as the process of town-building and farm creation disrupted the habitats necessary to support anadromous fish, such as alewives, shad, and smelt.

Weirs erected across the short rivers that fed Massachusetts Bay compounded the habitat destruction created by siltation from plow agriculture and marsh drainage. Within forty or fifty years of settlement, the Puritans had degraded the forage base for predatory fish such as cod and haddock. While those species continued to thrive farther down east, the small-boat fishery atrophied in Boston harbor and Massachusetts Bay to a large extent, with the exception of trips to Middle Bank (now known as Stellwagen Bank), between Provincetown and Gloucester.

It has long been taken for granted that fishing communities eastward of Cape Ann developed differently from those on Cape Ann and westward, because of sociological factors. Human impacts on the coastal marine environment as early as the 1660s, however, may have influenced the future shape of fishing communities. By the late seventeenth century fishermen based in Massachusetts Bay were sailing to the banks on Nova Scotia's continental shelf in search of cod, because trips made close to home simply were not worthwhile. Simultaneously, fishermen in New Hampshire and Maine continued to find productive grounds on nearshore banks watered by the plankton-rich Gulf of Maine Coastal Plume.

The state of cod stocks in Massachusetts Bay by the late seventeenth century was probably analogous to that of cod stocks in the Irish Sea and the North Sea by the end of the Renaissance. By no means had cod been eradicated. Fishing pressure, however, had already removed the largest fish, which were the most productive spawners. With the simple gear at their disposal, essentially unchanged from the medieval period, fishermen found it more profitable to seek out new grounds than to persist in fishing locally once the cream had been skimmed. Fishing never stopped in the North Sea or the Irish Sea, but many English fishermen took the trouble and risk to sail to Iceland as early as the fifteenth century because catches were better. By the sixteenth century English fishermen, along with those from Spain, France, and Portugal, were sailing to Newfoundland. Likewise, by the final third of seventeenth century, fishermen

based in towns along the shore of Massachusetts Bay preferred to sail hundreds of miles to the east, and fish off Nova Scotia, rather than fish in the bight of Cape Cod—waters whose productivity had astonished early explorers only sixty years before. Settler societies were making an impact on New England's coastal ecosystems.

A few men lamented the deleterious effect of consistent fishing in one place, such as the Englishman who wrote from coastal Newfoundland in 1703 that "the fish grows less, the old store being consumed by our continual fishing." His practical concerns flew in the face of what natural philosophers then assumed about the eternal sea. In the first half of the eighteenth century, for instance, Baron du Montesquieu asserted that oceanic fish were limitless. Such sentiments often prevailed, contradicting fears that sea fish could be depleted by overfishing.[37]

Some New Englanders went a step further. Borrowing the dominant trope of "improvement" as applied to terrestrial ecosystems, whereby a forest wilderness could be "improved" through clear-cutting and the arrangement of orderly fields, or a wetland could be "improved" if drained and transformed into a meadow, coastal New Englanders entertained the notion that they could "improve" the ocean by fishing. This ran counter to the idea that purposeful action might create problems. In 1680 William Hubbard noted, "The first improvement that was ever made to this coast" was that of "the marriner and fisher man." The notion of people improving the sea by fishing it persisted as settler societies picked the coastal ocean's low-hanging fruit. Explaining the calamities that had befallen them during the Revolutionary War, petitioners from New Castle, New Hampshire, a small town that supported itself "almost Intirely" by its cod fishery, wrote to the General Court in 1786 that "they again to hope to improve the Ocean, the only source of their riches," by resuming their fishing. As late as 1832 Lorenzo Sabine reiterated the notion that fisheries could be "improved." By the middle of the eighteenth century such conventions, privileging hard work and the transformation of wild places into orderly zones of civilized production, worked against the likelihood that New Englanders would imagine that their maritime enterprise might be undermining the resources on which it was based.[38]

THE FIRST PERTURBATION

The *Mayflower* anchored at Provincetown, in the bight of Cape Cod, on November 11, 1620. "Every day we saw Whales playing hard by us," observed one of the Pilgrims, "of which in that place, if we had instruments & meanes to take them, we might have made a very rich returne.… Our master and his mate, and others experienced in fishing, professed we might have made three or four thousand pounds worth of Oyle."[39] A few days later a scouting party from the *Mayflower* came across "ten or twelve Indians very busy about something" on the beach. As William Bradford related it, they had been "cutting up a great fish like a grampus," also known as a blackfish or pilot whale. The Pilgrims "found two more of these fishes dead on the sands," according to Bradford, "a thing usual after storms in that place." Blackfish provided welcome meat and oil.[40]

Whales were everywhere, unlike in coastal Europe. There were apparently tens of thousands of great whales in the Gulf of Maine for much of the year at the beginning of the seventeenth century.[41] Even landsmen such as Bradford noticed the difference. Experienced fishermen could not help but observe that the ecosystem in the western Atlantic was structured differently because of the presence of great whales, even if they did not push their conclusions to acknowledge that the paucity of whales in home waters was the result of overharvesting.[42]

Natives from Cape Cod to the Gulf of St. Lawrence may have occasionally hunted large whales during the precontact period, but the archaeological evidence is inconclusive, as are the early ethnographies. Nevertheless, Natives treasured whales. Mi'kmaqs' "greatest liking," according to Nicolas Denys, a fisherman and early settler in Acadia, was "grease [which] they eat … as one does bread." According to Denys, Mi'kmaqs in Acadia relished the blubber from whales "which frequently came ashore on the coast." Along with hunting pilot whales and porpoise, all Native people from Nantucket eastward routinely availed themselves of drift whales—stranded live whales or dead whales that washed up on the beach. Along certain sections of the coast "drift whales were so numerous that no need had arisen to go to sea to kill them."[43] The fact that Natives rarely or never hunted great whales suggests that whale

populations along the coast of New England were virtually unexploited at the time of European contact. Robust whale stocks and relatively low aboriginal population densities meant that Natives' opportunistic reliance on drift whales sufficed for their needs.

Following permanent English settlement, Natives' right to appropriate drift whales was lost rather quickly on Martha's Vineyard and Long Island. On Nantucket, however, that right was codified into law in 1673. "The Court do order that … all the whal fish or Other drift fish belong to the Indian sachems." Purchasing shore frontage from Nantucket sachems in a series of transactions between 1684 and 1701, English buyers always agreed to the caveat, "except drift whales." And on Nantucket and eastern Long Island, at least, because "Indian ownership of drift whales pre-empted the crown's rights … whale oil from Indian drift whales may have been exported tax-free." The exact steps by which settlers proceeded from scavenging beached whales to pursuing whales from the beach are lost to time, but whales' significance is not. In 1635 Governor John Winthrop noted that "Some of our people went to Cape Cod, and made some oil of a whale which was cast on shore." The Plymouth Colony began to tax the enterprise in 1652. Reverend Cotton Mather called whale oil "a staple commodity of the colony."[44] Shore whaling began in Massachusetts during the 1650s or 1660s, but very few human generations were required to deplete the abundant stock of nearshore whales. As early as 1720 the *Boston News-Letter* reported that "We hear from the towns on the Cape that the Whale Fishery among them has failed much this Winter, as it has done for several winters past." Contemporaries claimed that the nearshore whaling grounds had been "fished out" by 1740. The economic consequences were dire: capital equipment sat idle, and expected earnings did not materialize. Minor political consequences followed, too. In 1754 Selectman John Hallet petitioned the province to excuse the town of Yarmouth from sending a representative to the legislature because of the failure of inshore whaling.[45]

According to one conservative study, colonists killed a minimum of 2,459 to 3,025 right whales between 1696 and 1734 in the coastal area between Delaware Bay and Maine, in addition to numerous pilot whales and occasional other great whales. Other informed estimates suggest a much larger harvest. In 1794 the Reverend John Mellen of Barnstable, Massachusetts, noted, "Seventy

or eighty years ago the whale bay fishery was carried on in boats from shore, to great advantage. This business employed nearly two hundred men for three months of the year, the fall and the beginning of winter. But few whales now come into the bay, and this kind of fishery has for a long time (by this town at least) been given up."[46] The killing of northwest Atlantic whales had begun in earnest about a century before the *Mayflower* sailed. Basque whalers killed tens of thousands of right whales and bowheads in the Straits of Belle Isle, between Labrador and Newfoundland, from 1530 to 1620. Then, while coastal New Englanders were exploiting local stocks, Dutch and Basque whalers in the western Arctic harpooned 35,000 to 40,000 whales between 1660 and 1701, reducing stocks considerably and affecting the whales' migratory patterns.[47]

Once inshore stocks were depleted along the Massachusetts coast, sachems' possession of drift whales became a rather hollow "right." Lookout masts, whalemen's taverns, and try yards (the boiling facilities where whale blubber was rendered) were abandoned on Cape Cod and Nantucket. Merchants in towns on the north shore of Massachusetts Bay, such as Ipswich, that formerly had dabbled in shore whaling turned their attention entirely to fishing and sea trading. This transition took time. Whalemen did not give up all at once. But by the early eighteenth century, the number of whales being killed, getting stranded, or washing up dead was decreasing dramatically. By midcentury, shore whaling was no longer a source of reliable seasonal income. An air of desolation hung over facilities that not long before had been bustling and profitable, such as the whalers' tavern on Wellfleet's Great Island, abandoned about 1740 during the denouement of shore whaling. Once inshore stocks of whales had been depleted, whalemen had no call to rest or recuperate in a tavern at Wellfleet. By the 1750s, well-capitalized Cape Cod vessels were voyaging to Labrador and Newfoundland, almost 1,000 miles eastward, to hunt for whales. Meanwhile, as the biomass of the coastal ecosystem shifted to include fewer whales, Nantucket's remnant Indian population sailed as "men before the mast" aboard whaling vessels. Long gone were the days when they could scavenge whales from the beach.[48]

The consequences of shore whaling were not limited to the geographic expansion of deep-sea whaling, much less to the depletion of town coffers, the

abandonment of once-productive whaling installations, or the redefinition of Native life on Nantucket and Long Island. Killing large numbers of whales in a relatively short time removed their qualitative contribution to ecosystem stability. Baleen whales are not apex predators. As large, long-lived creatures, however, whales embody vast biomass in stable form. Mature blue whales routinely weigh 125 metric tons; large ones are often 170 tons. An individual right whale can weigh 100 tons. Before commercial harvesting began, naturally occurring populations of whales concentrated hundreds of thousands of tons of biomass in continental shelf ecosystems. Each animal effectively "locked up" the biological matter of which it consisted throughout its long life. This incorporation of vast biomass in numerous long-lived animals imposed constraints on biological variability in the system, and helped maintain a natural equilibrium. Overharvesting baleen whales liberated considerable prey from capture, and thus may have allowed prey populations to oscillate more dramatically than previously.[49]

Colonial New Englanders referred to one species of North Atlantic whales as "scrags," a name now anachronistic. Obed Macy's *History of Nantucket* claims that the first whale killed in Nantucket was a "scragg." Paul Dudley, a Massachusetts resident who published an essay on the natural history of whales in 1725 in the *Philosophical Transactions of the Royal Society of London,* explained that "The Scrag whale is near-a-kin to the Fin-back, but instead of a Fin on his Back, the Ridge of the After-part of his Back is scragged with a half Dozen Knobs or Knuckes; he is nearest the right Whale in Figure and for Quantity of Oil." A commission from the Muscovy Merchants to Thomas Edge in 1611 referred to a whale called the "otta sotta," whose description—like Dudley's "scrag whale"—corresponds to that of an Atlantic gray whale. Subfossil specimens of gray whales have been found along European shores, and from Florida to eastern Long Island. Radiocarbon dating has established that this species disappeared around 1675. Evidence suggests that a population of Atlantic gray whales lived on both sides of the Atlantic; that those whales, like others, were hunted; and that the population became extinct during the late seventeenth or early eighteenth century. Whether human hunters caused this extinction, accelerated it, or had nothing to do with it is unknowable. Given the rate at which whales were being killed then, however,

it appears likely that this extinction of a North Atlantic marine mammal—the first of the post-Pleistocene era—resulted from the intensified whaling associated with the exploitation of western Atlantic waters and the creation of the Atlantic world.[50]

All marine mammals had value, though whales and walruses were hunted much more regularly than seals and porpoises before the nineteenth century. Walrus hides, ivory, and oil had been a considerable attraction to sixteenth-century European adventurers in the Gulf of St. Lawrence. When killed and rendered each walrus provided one to two barrels of oil. Walruses were historically abundant from Sable Island northward to the Gulf of St. Lawrence and the coast of Labrador. They are gregarious creatures, and despite their great size and unwieldiness 7,000 or 8,000 animals could congregate together at a single terrestrial haul-out, called an "echourie" by fishermen. Echouries were generally at least 80 to 100 yards wide and, whether sand or rock, sloped gradually from the sea to a place sufficiently large for vast assemblies of walruses. Those haul-outs were located in the greater Gulf of St. Lawrence region at the Isle Madame Islands, the Magdalen Islands, the Ramea Islands, and at Miscou Island, among others. The southernmost was at Sable Island, east of Nova Scotia, a treacherous graveyard for ships on account of its constantly shifting sands. Walrus typically spent considerable time on shore during the calving season, between April and June, and when thousands hauled out together, individual animals could go for several weeks without food or water.[51]

Walruses have few predators, but their tendency to cluster together made them vulnerable to humans. The hunters, explained an eighteenth-century writer, "take the advantage of a sea wind, or a breeze blowing rather obliquely on the shore, to prevent the smelling of these animals (who have that sense in great perfection, contributing to their safety), and with the assistance of very good dogs, endeavour in the night time to separate those that are the farthest advanced from those next the water, driving them different ways. This they call making a cut." Once some had been driven up the slope of the echourie, they could be "killed at leisure," sometimes by the hundreds. The crew of one European ship killed 1,500 walruses during the 1591 season at Sable Island. Later, once the art of "cutting" had been perfected, hundreds of walruses were

killed at a time.[52]

During the summer of 1641 Boston merchants sent a vessel with twelve men to Sable Island, off Nova Scotia, to hunt walruses. As John Winthrop explained, they "brought home 400 pair of sea horse teeth [walrus tusks], which were esteemed worth £300," leaving some of the crew and "12 ton of oil and many skins" on the island. Prior to commercial exploitation the largest herds in the world apparently lived near the Magdalen Islands in the Gulf of Saint Lawrence, an archipelago surrounded by shellfish beds, and well supplied with the conveniently sloping haul-outs. The last large-scale walrus hunts of the eighteenth century took place at the Magdalen Islands during the era of the American Revolution. The scale of the slaughter was not sustainable. By the late eighteenth century the great, gregarious herds that had once hauled out on islands and beaches from Sable Island to Labrador had been extirpated. Walruses were not extinct, but they suffered the most dramatic range contraction of any marine animal in the age of sail. By the early nineteenth century that range had been reduced in the western Atlantic to northern Labrador, southeastern Baffin Island, and Hudson Strait and Hudson Bay—in other words to the Arctic and immediate subarctic.[53]

During the eighteenth century seal hunting and porpoise fishing in the Gulf of Maine were occasional pursuits. Porpoises competed with Eastham men for cod and mackerel. During the 1730s the town of Eastham, on Cape Cod, declared porpoises a pest and offered a bounty on porpoise tails. The most successful bounty hunter, Elisha Young, presented about 500 tails between 1740 and 1742. In addition to this sporadic bounty hunting of marine mammals, fishermen killed harbor seals and gray seals as opportunities presented themselves, eradicating competitors and profiting from the oil and skins. In the Gulf of St. Lawrence, however, and along the southern coast of Labrador, eighteenth-century fishermen and market hunters netted seals, including harp seals, in a large-scale commercial operation. Men who fished in the spring and summer turned to sealing during the early winter. Pelts were shipped to furriers in England. And the fat from a single seal could produce anywhere from a few gallons to ten gallons or more of oil, depending on the species and the size. The price of seal oil varied according to the international oil market, determined by the annual success or failure of global whaling fleets.[54]

"There are two modes of catching the seals," explained Edward Chappell, a visiting Royal Navy officer: "the one is, by mooring strong nets at the bottom of the sea; and the other, by constructing what is called a *'frame of nets'* near the shore of some small bay." The typical net used in the first method was forty fathoms long and two deep. It worked on the same principle as a gill net for fish, though with stronger twine. Sealers anchored the foot rope "on a shallop's old rode," as the veteran hunter George Cartwright noted, and moored it with "a couple of killicks" (primitive anchors). The foot of the net was thus kept close to the bottom, while corks on the headrope made it stand perpendicularly. "As the seals dive along near the bottom to fish," explained Cartwright, "they strike into the net and are entangled." The other system was more complicated and required considerably longer nets, more anchors, and capstans ashore to raise and lower specific sides of the pound. Such frames were semipermanent, erected by sealers along shores where seals were known to congregate, often near narrow slots, called "tickles," that helped funnel the seals into the pound.

In December 1770 Cartwright heard with "pleasure" that "Guy and his people had killed near eight hundred seals." A year later, "we have killed nine hundred and seventy-two seals, which is the most I ever heard of." In January 1775 he noted that a "man belonging to Captain Darby came here today; and informed me that one of his master's crews had killed seven hundred seals; the other two, thirty each." The sealing posts were few and far between, and as these relatively modest tallies reveal, the eighteenth-century seal fishery was rather limited. Sealers relied not only on seals coming to them but also on advantageous weather conditions. As Cartwright wrote on December 8, 1775, "The mildness of the weather still keeps the seals back. I do not expect them until hard weather sets in; and as the season is so far advanced, it will freeze so severely that … our nets will all be frozen over." Contrasting with the very limited scale of these passive operations was that of the Newfoundland seal fishery that began in 1795, an active hunt in which schooners carrying from fifteen to forty men each sailed to the ice on which seals were whelping, and moored there as the men fanned out over the ice to club and shoot the listless seals. In those conditions a single crew could kill 3,500 seals in a single week. After 1795 the seal slaughter increased annually by orders of magnitude.[55]

The rapid removal of large numbers of whales and walruses, and some seals and porpoises, affected those populations, their prey populations, and the mariners, too. Shortly before the outbreak of the American Revolution, products from marine mammals—primarily whales—constituted 15 percent of the value of New England's exports.[56] The whale fishery was big business, and, though prosecuted far from home, it was still Atlantic-based: not until the mid-1780s would Yankee whalers round the great capes to kill whales, seals, and sea elephants in high southern latitudes and throughout the Pacific. But the size of Atlantic whale populations, their geographic distribution, their role in stabilizing marine ecosystems, and the nature of New England whaling had all changed significantly during the previous half-century. New Englanders' relatively short-term accumulation of wealth; their knowledge of whales' seasonal migration and feeding habits; and their development of technologies appropriate for pursuing, killing, rendering, and marketing whales all came at the cost of downward trends in biocomplexity and ecosystem resiliency.

RIVER FISH FROM THE SEA

As he sailed up the Kennebec River in 1607 Captain Robert Davies noted "aboundance of great fyshe in ytt Leaping aboue the Watter on eatch Syd of vs," characteristic behavior of sturgeon as they ascend rivers to spawn in freshwater during May, June, and July. Sturgeon were head-turners. Giant, toothless, and armored with rows of bony shields along their sides and back, bottom-feeding Atlantic sturgeon—with peculiar little barbells under their snouts—could be mistaken for no other fish. Archaeological evidence indicates that prehistoric Native inhabitants relied on Atlantic sturgeon in their seasonal eating strategy. Each year as the ice broke, and the annual springtime bloom of phytoplankton turned coastal waters murky brown, the return of spawning fish such as sturgeon, salmon, and alewives signaled Natives' season of plenty. Malecites and Mi'kmaqs relied so much on anadromous fish that they named several months for their return. One Englishman observed that Natives made "very strong sturgeon nets" of "their own hemp." As early as the 1630s, according to William Hammond, Indians were capturing "great store of sturgeon" in the Merrimack River for English buyers. "The sturgeons be all

over the country," noted William Wood, "but the best catching of them is upon the shoals of Cape Cod and in the river of Merrimac, where much is taken, pickled, and brought for England. Some of these be twelve, fourteen, eighteen foot long." A twelve-foot sturgeon could weigh 600 pounds.[57]

John Josselyn, who lived on the midcoast of Maine in 1638–39, and from 1663 to 1671, depicted the Pechipscut River (now the Androscoggin) as "famous for multitudes of mighty large *Sturgeon.*" Settlers in the Piscataqua estuary named one of its tributaries Sturgeon Creek. Few settlers had ever seen sturgeon in Old England, where an 800-year fishing spree had almost eradicated them. Every Englishman, however, shared Thomas Morton's understanding of sturgeon as a "regal fish." In France and England, sturgeon was king's fare. But in New England, as Morton pointed out in 1632, every man "may catch what hee will, there are multitudes of them."[58]

During the mid-seventeenth century, sturgeon linked resourceful Native fishers, colonial settlers, London fishmongers, and highbrow English consumers because of the degraded state of European aquatic ecosystems. By the fourteenth century, chefs in France and England had a recipe "to 'make sturgeon' from veal, a distinct mark of the prestige and favor still attached to an almost extinct food fish."[59] So New England's early settlers knew they would find a seller's market for sturgeon. Captain John Smith noted during the 1620s that one ship returning to England from the Pilgrim settlement at Plymouth carried "fourscore kegs of sturgeon." Samuel Maverick bemoaned the lack of a substantial sturgeon fishery in 1660. The Merrimack River, he noted, "in the Sumer abounds with Sturgeon, Salmon, and other ffresh water fish. Had we the art of takeing and saveing the Sturgeon it would prove a very great advantage, the Country affording Vinager, and all other Materialls to do it withal."[60]

Sturgeon were low-hanging fruit in the arbor of marine resources, and they were plucked quite quickly in all of northern New England's major rivers. They could be trapped in weirs, netted, or lanced—all by part-time shore-based fishermen. Englishmen learned successful techniques from Natives. As Josselyn explained: "in dark evenings when they are upon the fishing grounds near a Bar of Sand (where the *Sturgeon* feeds upon small fishes …) the *Indian* lights a piece of dry *Birch-Bark* which breaks out into flame & holds it over the side of his *Canow,* the *Sturgeon* seeing this glaring light mounts to the

Surface of the water where he is slain and taken with a fis[h]gig."[61]

By 1673, less than fifty years after Morton had written that "every man in New England may catch what hee will," men from the Merrimack River towns determined that insufficient sturgeon existed for an open fishery. William Thomas, of Newbury, then seventy-four years old, petitioned the General Court to prohibit pickling or preserving sturgeon for transport (that is, other than for personal consumption) by anyone "except by such lawful authoritie shall be licensed thereto." Thomas successfully arranged a partial monopoly: henceforth the Merrimack River sturgeon fishery was limited to those "able and fit persons" whom the General Court licensed for "the art of boyling and pickling of sturgeon." Inspectors (each of whom was dubbed a "searcher and sealer of sturgeon") were employed to maintain quality. Licensed townsmen in Newbury and Salisbury then conducted an extensive sturgeon-packing business. An act passed in Boston in 1687 mandated that "all sorts of Greene Dry Salted or Pickled ffish Sturgeon fflesh or Butter That shall be put up for Transportac'on to a fforaigne Market shall be searched and Surveyed." A similar regulation for "Preventing Deceit in Packing," which specifically mentioned sturgeon, passed in New Hampshire in 1719. At that point, when permanent English settlement had existed in New Hampshire and Massachusetts for approximately a century, and when the total population of the two provinces was only about 100,000, roughly the same size as the precontact Native population, the ancient sturgeon stock was headed for trouble. On July 6, 1761, when Matthew Patten caught a six-footer at the Merrimack's Amoskeag Falls, it created a stir. An accomplished fisherman and diarist, Patten had neither caught a sturgeon nor noted anyone else catching one during the previous six years. By then sturgeon were relatively rare in the Merrimack, the Piscataqua, and the other rivers of northern New England, even though as late as 1774 the Merrimac River was labeled the "Merrimak or Sturgeon R." on Thomas Jeffery's "Map of the most inhabited part of New England."[62]

Atlantic sturgeon must grow about four feet long to reach sexual maturity. Their survival as a species was predicated on their longevity: as large armored fish with few natural enemies, they could afford the luxury of low reproductive rates. Throughout the first century and a half of English settlement

in New England, nearly every river and creek was flanked each spring by eager fishermen with weirs, seines, and spears. Towns sold rights for the best places or for annual hauls, and seining companies pooled capital for rope, twine, lead, and boats, betting that they would more than recoup the cost of shares. Immature sturgeon packed and sold as well as older fish, and all were captured indiscriminately. Neither regulation nor custom impeded colonial fishermen from taking all they could. By the end of the eighteenth century the combination of overfishing and sturgeon's naturally low reproductive rate had essentially doomed this "regal fish" in the estuaries of northern New England. In 1793, for instance, when the Massachusetts General Court passed an act "to enable the town of Newbury to regulate and order the taking of Fish called Shad, Bass, and Alewives in the River Parker," sturgeon were already a distant memory, not even mentioned.[63]

Sturgeon would not be virtually exterminated in Chesapeake and Delaware Bays nor in the Hudson River until the caviar craze between 1870 and 1900. But in northern New England, where competitiveness in the emerging Atlantic economy depended on fishing and trade, only two centuries were necessary to accomplish what had taken a millennium in Europe—the severe reduction of a huge fish that in a natural state was likely to die of old age. Ecologically speaking, we do not know the exact qualities or contributions of sturgeon, or how the presence of many year-classes, with individuals of different sizes and ages, functioned in the ecosystem. Yet clearly the ecosystem had been perturbed by sturgeon removal. As the eminent biologist E. O. Wilson reminds us, "The power of living Nature lies in sustainability through complexity." Each reduction in complexity contributes to degradation. It makes the overall system qualitatively different, and less sustainable. As long-living, large animals, sturgeons, like whales, had contributed stability to coastal ecosystems in North America where they were prominent bottom-feeders. Moreover, they had contributed to the cultural and aesthetic values through which Natives and the first generations of English knew themselves and the region. For Natives, the abundance of sturgeon and other marine species affirmed their traditional consciousness of themselves as descendents from the totemic creatures on whom they depended, and with whom they coexisted. For English settlers, the presence of sturgeon conveyed security, prosperity, and upward mobility. By

the outbreak of the American Revolution, sturgeon's contribution to resident identity and ecosystem stability was largely gone in New England, as was the once-thriving fishing and packing industry in old towns like Newbury.[64]

Like sturgeon, striped bass spawned in freshwater beyond the tide. William Hubbard's seventeenth-century *General History of New England* explained that the starving Pilgrims netted "a multitude of bass, which was their livelihood all that [first] summer. It is a fish not inferior to a salmon, that comes upon the coast every summer pressing into most of the great creeks every tide.… Sometimes 1500 of them have been stopped in a creek." Despite the 1639 Massachusetts Bay law forbidding use of bass for fertilizing fields, the pressure on that fine, fat fish persisted. Josselyn noted that settlers in southern Maine were still taking bass "in Rivers where they spawn" and that he had seen "3000 Bass taken" with one set of the net.[65]

Unlike cod or whale oil, the cornerstones of New England's long-distance commerce, bass became part of the local exchange economy. Part-time fishermen put up bass for their own families, exchanged fresh-caught or barreled bass to square their debts, and sold the fish when they could. As town populations swelled in places like Boston and Portsmouth, part-time fishermen peddled fish directly or vended it to consumers through fishmongers. When nets strained to the breaking point, surplus striped bass ended up as "manure" in tilled fields. In the heart of New England, overfishing threatened householders' livelihoods. On the periphery it threatened the peace. During the 1680s Cotton Mather attributed rising tensions between settlers and Abenakis in southern Maine to the newcomers' use of nets that prevented anadromous fish in the Saco River from reaching Native fishers.[66]

By 1770, according to the government of New Hampshire, fishing "hath Almost extirpated the bass and blue fish" in the Piscataqua River. Reverend Jeremy Belknap elaborated during the 1790s: "The bass was formerly taken in great plenty in the river Pascataqua; but by the injudicious use of nets … this fishery was almost destroyed." So, too, in Massachusetts: in 1771 petitioners from Newbury lamented the decline of striped bass in the Parker River, and implored the Massachusetts General Court to preserve them. The court obliged with regulations, but they were ignored or unenforceable, and stocks did not rebound. In 1793 town fathers in Newbury outlawed putting "a seine, hedge,

weir or drag into the river Parker at any season" for "catching Bass." The regulations were too little, too late. By then the providentially abundant fish that had saved William Bradford and the Pilgrims during their starving time teetered on the verge of commercial extinction between Cape Cod and southern Maine. Residents lamented the loss. "Formerly large fish such as salmon, bass and shad came up the river in plenty," wrote Judge Benjamin Chadbourne from South Berwick, Maine, about 1797, "but they have forsook it and now there remains only Tom Cods, or what we call Frost fish which come in the month of December, smelts in the month of April, alewives in the months of June and July, and eels in about all seasons of the year."[67]

Chadbourne revealed how fishing had altered the composition of fish species and, thus, the structure of his estuarine ecosystem. River fish were a crucial piece in most families' livelihoods, too valuable to be stewarded effectively. Striving to secure a "competence," which they defined as financial independence and security for themselves and their dependents, householders targeted spawning runs each spring. Chadbourne ignored sturgeon, which he had never known, even though Sturgeon Creek (named before 1649) was just a few miles south of his home. He personally witnessed the disappearance of salmon, shad, and bass—long-lived, valuable fish—and his plaintive assessment reflected the diminishment of an estuary by human population pressure and ineffectual regulation since its insertion into the Atlantic economy. Both the nature of the place and people's relationship to it had changed significantly.[68]

Chadbourne's lament fingered the ineffectiveness of river fishery regulations during the eighteenth century. Beginning with Massachusetts (1710), and followed by Connecticut (1715) and Rhode Island (1735), most New England provinces passed legislation against "obstructing the passage of fish in rivers." Although New Hampshire never passed such laws in the colonial period, various petitioners approached the governor, council, and assembly in favor of it. The precautionary approach to the regulation of *sea* fisheries had run its course in New England by the first decade of the eighteenth century. Prohibitions on catching mackerel before the first of July, or with seines or nets at any time, had been repealed in 1692, but then briefly reinstated in 1702. By the early eighteenth century legislators' attention had been redirected to the

plight of anadromous fish, notably salmon, shad, and alewives. Massachusetts' first law stipulated that "no wears, hedges, fish-garths, stakes, kiddles, or other disturbance … shall be set … across any river, to the stopping … of fish, in their seasons, or spring of the year" without permission from the general sessions of the justices of the peace in the given county. Subsequent acts noted ongoing depletion, pointing out that "Whereas the river Merrimack hath heretofore abounded with plenty of fish, which hath been of great advantage to the inhabitants of the several towns near the river," excessive fishing led valuable fish to forsake the river. Laws required passageways for the fish to get through dams, and often prohibited seines and dragnets, while allowing low-tech dip nets or scoopnets. Nevertheless, fishermen were convinced that the numbers of alewives, shad, and salmon were decreasing, and that the fish had been diverted from their natural routes. Massachusetts' legislation in 1767 regarding the decay of the Merrimack River fisheries echoed that of 1710.[69]

The Merrimack, like the Connecticut River, flowed through several provinces. Massachusetts controlled the lower portions of the Merrimack through which the fish passed, but New Hampshire controlled the ponds and gravelly streams in which they spawned. People with local knowledge were quite clear about what was happening. "The Shad and Salmon fishery in Merrimack river within this province," explained eighty-two New Hampshire petitioners in 1773, "has in years past been very much decreased by the needless and extravagant methods people have practiced by building dams, fixing weares and drawing long nets or seines, etc. in said river whereby the fish have been so harassed, catched, and destroyed … that we have great reason to fear that the river fishery will be wholly destroyed unless some proper methods are taken to prevent or remove those impediments." A few years later John Goffe of Derryfield, New Hampshire, held out hope of restoration. "For neare twenty years there was not a fish that went up" Cohass Brook, a tributary of the Merrimack River, he explained, "and I thought they had left the Brook intirely but upon a Sabbath day two years ago great numbers appeared." Goffe pulled his dam down, and got his upstream neighbors to do the same, and was gratified the next year when the fish "Increased Abundantly." As he saw it, however, other shortsighted men then fished too hard. "I think that if all fishing were prohibited for at least one year it would

be a means of Great Increase, for it is a free passage that encourages them." Of course Goffe was a miller, and while he was all for fish, he did not want the assembly to require that all dams be pulled down, for then "there can be no grinding."[70]

Goffe's vision and his self-interest encapsulate the issue. The problem was palpable. Enough people commented on it as the eighteenth century progressed that little doubt exists: schools of alewives, shad, and salmon were getting smaller. Most interested parties, however, were in favor of regulating others. Dam owners would prohibit fishing, or dipnet and scoopnet men would come down hard on seiners or weir tenders. While a consensus existed that fish were valuable, that stocks were being depleted, and that a reduction in fishing effort could turn the problem around, insufficient political will existed to impose a workable solution. The bottom line was that river fish were too precious in the short run to be allowed to live. They could be eaten immediately, put up in barrels for the future, sold, traded, and used for fertilizer. Male heads of households not only enjoyed the camaraderie of catching fish during the spring spawning runs, but also depended on river fish from the sea as one piece of their annual livelihood, a way to settle accounts or set up their children. New England's anadromous fisheries were not being conducted sustainably throughout the eighteenth century, certainly not by the end of that century, and river dwellers knew it. Ultimately they were content, however, to push the day of reckoning further into the future.

SEABIRDS IN THE COLONIAL ECONOMY

The cod fishery affected seabird populations quite early, and their depletion triggered ripples throughout human and nonhuman natural communities. At least eighty-five species of birds were likely to have been seen on salt water between Newfoundland and Cape Cod, including wading shorebirds (such as sandpipers); sea ducks (such as eiders); dabbling ducks, geese, and swans (such as teal); and genuine seabirds (such as puffins), which lived on land each year only long enough to nest. Marine birds exhibited a wide variety of ranges, migration patterns, and reproductive strategies. Some, including double-crested cormorants, bred locally and roosted each night on sandbars, rocks, or

trees. Others, including fishermen's favorite avian bait source, the greater shearwater, nested in the remote South Atlantic and appeared on northwest Atlantic waters only during the summer, staying offshore and foraging for squid and fish. Seabirds ranged in size from the northern gannet, a magnificent white plunge-diver with a six-foot wingspan, to the diminutive Wilson's storm petrel, smaller than a robin. Fundamental to the large marine ecosystem of which they were a part, seabirds were not particularly susceptible to its vagaries. Their relatively stable populations consisted of long-lived individuals relying on food supplies that were generally sufficient for reproduction, even in lean years.[71]

Although Natives had long relied on birds for eggs, meat, and feathers, the sheer numbers of birds, especially on offshore island rookeries, flabbergasted the first generations of European seamen. In 1535 Jacques Cartier noted that Newfoundland's Funk Island was "so exceeding full of birds that all the ships of France might load a cargo of them without any one perceiving that any had been removed." This abundance augured well for commercial fisheries. Cod were not fastidious about what they ate, and along with capelin and herring, birds made fine bait. All of the Alcidae family of web-footed diving seabirds, such as guillemots, murres, puffins, razorbills, and auks, nested in vast colonies on remote rocky islands. Those numerous Bird Islands and Egg Rocks between Cape Cod and Newfoundland had been outposts of safety in a cold, dark sea. With the rise of commercial fishing, island sanctuaries became slaughterhouses. Prized for eggs, feathers, oil, and flesh, seabirds were decimated by fishermen and their dependents. From the late 1500s on, most crews fishing in the northwest Atlantic killed vast numbers of birds for bait during at least part of the season. A veteran noted in 1620 that "the Fishermen doe bait their hooks with the quarters of Sea-fowle."[72]

No bird had become better suited to fishermen's needs through 30 million years of evolution than the great auk, which early writers called "penguins." Standing two-and-a-half feet tall, with solid bones and stubby vestigial wings, auks had evolved into superb swimmers and divers. Great auks could not fly away from pursuers because, unlike every other North Atlantic bird species, they had sacrificed flying for underwater swimming as they evolved. They even migrated by paddling, traveling in vast rafts from Newfoundland to Cape

Cod, and occasionally as far south as Carolina, before returning to the relative safety of rocky outposts near Newfoundland to nest. Like Antarctic penguins, auks laid but one egg a year. Anthony Parkhurst recounted in 1578 that sailors at Newfoundland's Funk Island drove "penguins" on "a planke into our ship as many as shall lade her."[73]

Seamen used the birds to navigate. J. Sellar's *English Pilot,* published in 1706, explained that on a westbound voyage sightings of the distinctive flightless bird meant the Grand Banks were not far, and that prudent seamen should take soundings. Mariners routinely noted the presence of auks in their logbooks, as when Captain John Collings, on a voyage from Portsmouth, New Hampshire, to London in March 1733 wrote: "Saw Severall Pengwins & Other Birds at Six of the Clock in ye Evening. Dubell Reef Main Topsail."[74]

Great auks, like passenger pigeons, could thrive only in huge, gregarious groups. Flightless, colonial, and adapted to living in the midst of rich fishing grounds, they collided headlong with commercial fishermen. As late as 1833, John James Audubon was assured by fishermen in Labrador that great auks nested "on a low rocky island to the south-east of Newfoundland, where they [the fishermen] destroy great numbers of the young for bait." Those fishermen were wrong. By then great auks were nearly gone. By the end of the eighteenth century only occasional stragglers were seen in the western Atlantic. Extinction of the species came at Eldey, off Iceland, in 1844.[75]

Most seabirds breed in colonies. With their long wings, webbed feet set far back, and other adaptations for life in the marine environment, seabirds are clumsy on land, and vulnerable to predators. Small offshore islands uninhabited by terrestrial mammals are ideal rookeries if surrounding waters provide ample forage. Breeding birds on remote rocky islets confront avian predators such as eagles, gulls, and skuas. In defense, they tend to clump together in vast numbers. Seabirds that had adapted to incubating their eggs relatively free from molestation on remote islands were nevertheless susceptible to bait-seeking fishermen, who invaded nesting colonies with clubs and sacks. Cliff-nesters like northern gannets were not immune: ladders and lines provided access to hunters who relished the sport, whether seeking eggs or birds. Even birds like the tiny Wilson's storm petrel, which nested in the subantarctic, were not safe from bait-hunters. Fishermen made whips from

lengths of stiff codline. As a fisherman remembered, the petrels were attracted with codfish liver: "when they had gathered in a dense mass, swish went the thongs of the whip cutting their way through the crowded flock and killing or maiming a score or more at a single sweep." Moreover, each spring coastal folk in communities from Massachusetts to Newfoundland sought eggs in the wild. Colossal quantities were gathered: four men from Halifax one year collected nearly 40,000 eggs, and scores of crews were at work. By the 1830s eggers were sailing to Labrador, in part because rookeries between Cape Cod and Newfoundland had already been significantly depleted. John James Audubon then observed, "This war of extermination cannot last many more years. The eggers themselves will be the first to repent the entire disappearance of the myriads of birds."[76]

Gunning probably wreaked less havoc on waterfowl and seabirds before 1800 than baiting and egging, but it also depleted flocks whose numbers had stunned early visitors. Swans, noted Thomas Morton in 1632, could be found in "greate store at the seasons of the yeare." Geese "of three sortes" existed in "great abundance": "I have often had 1000 before the mouth of my gun." Ducks, teals, widgeons, cranes, sanderlings—all were available. As Wood observed of shorebirds, "one may drive them on a heap like so many sheep, and seeing a fit time shoot them." As early as 1710, Massachusetts legislators observed that populations of shorebirds were diminishing as a result of gunners using canoes or floats "disguised with hay, sedge, seaweed" and the like "to shoot them … upon the flatts and feeding ground." An act that year outlawed such methods, but no evidence suggests it was effective.[77]

Natural characteristics made some bird species particularly vulnerable. Eider ducks in the northwest Atlantic, like those in European coastal waters, molt all at once. They typically rafted in great flightless flocks in August while new feathers grew in. Samuel Penhallow reported that in 1717 at Arrowsic, Maine, Abenakis in canoes drove eider ducks "like a flock of sheep before them into the creeks." "Without powder or shot they killed at one time four thousand six hundred," Penhallow noted. Killing eiders with paddles and sticks, Abenakis sold "a great number of them to the English for a penny a dozen, which is their practice yearly." Maine island residents capitalized on this as long as eiders lasted. Each August a flotilla assembled to drive the

ducks into previously selected killing grounds. Duck Harbor, on the southwest side of Isle au Haut, was a choice spot. Its narrow mouth and steep walls trapped the birds. According to naturalist Philip Conkling, "A single drive on Vinalhaven took 2,100 birds, which may have been half the nesting population of eiders for the west [Penobscot] bay that year. After the 1790s, the drives became less and less successful as the eider population declined."[78]

As early as 1770 George Cartwright clearly sensed the pressure imposed on the coastal ecosystem. Cartwright spent years fishing for cod, trapping seals, and hunting birds and game in Newfoundland and southern Labrador. In 1770 he observed that the Native people would be "totally extinct in a few years." As he put it, with "the fishing trade continually increasing, almost every river and brook which receives salmon is already occupied by our people, and the bird islands are so continually robbed, that the poor Indians must now find it much more difficult than before to procure provisions." When Reverend Jonathan Cogswell published his history of coastal Freeport in 1816, he observed "that birds of no kind abound in Maine." The maritime economy had virtually extirpated seabirds and shorebirds in the Gulf of Maine, and had made serious inroads into their populations all the way to Newfoundland.[79]

True seabirds, such as shearwaters, petrels, and gannets, which had baited the cod hooks of several empires, actually share many similarities with marine mammals. As one ecologist explains, both have "long lives, late maturity, low reproductive rates," and "well-developed social behavior." Both are "highly migratory," and neither is "at the top of the food chain." Moreover, the small fish on which birds and most whales prey have high reproductive rates, meaning that birds consume juveniles "surplus to the supply needed to maintain the populations." Seabirds thus may function in an ecosystem similarly to marine mammals, stabilizing it and dampening dramatic oscillations. If that is the case, "an abundance of seabirds could in fact contribute some stability to the fisheries."[80] Ecological interactions are much more complicated than linear cause and effect. The systematic seabird slaughter not only restructured the marine ecosystem by depleting populations of seabirds, but may have destabilized the fisheries that were the cornerstone of the northwest Atlantic economy, in addition to drastically reducing a resource that could have been eternally renewable. The reputations that coastal residents cultivated as skilled

gunners or persistent eggers came at a cost, as did fishermen's opportunistic slaughter of seabirds for bait.

When Edmund Burke rose in the House of Commons in 1775 to salute the not inconsequential accomplishments of His Majesty's subjects in North America, he attested to American whalers' ingenuity and work ethic. As Burke put it, there exists "no sea but what is vexed by their fisheries."[81] It was an apt turn of phrase by a masterful orator. New Englanders not only harvested the sea, Burke suggested; they troubled it. It is unlikely that he intended a point about ecological change. His word choice, however, reveals the link between hard physical labor in extractive industries and the toll that such labor takes on the environment. In retrospect, it is obvious that marine ecosystems could not be assaulted systematically over centuries by people wielding harpoons, hooks, seines, weirs, pots, guns, oyster rakes, and eggers' baskets without consequences, both ecological and cultural.

The notion of "traditional fisheries," often shorthand for preindustrial activity, obscures historical changes in marine ecosystems. It plays to the indefensible but commonplace assumption that the ocean has existed outside of history. Yet just as early modern people modified the terrestrial environments in which they lived, so, too, did they modify the marine ecosystems on which they increasingly relied. An ecosystem is considerably more than a group of isolated units; nevertheless, stocks of marine mammals, anadromous fish, and seabirds, all of which declined precipitously before 1800, serve as indicators of a changing sea. Increasing intimacy with the marine environment during the seventeenth and eighteenth centuries promoted commercial opportunities, curiosity about nature, new cultural forms—and changed ecosystems.

By 1800 the northwest Atlantic was beginning to resemble European seas. Seventeenth-century impacts, in keeping with the small population, were modest. Ironically, seventeenth-century settlers imposed restrictions on sea fishing, turning to closed seasons and limited entry in an effort to perpetuate stocks of cod, mackerel, and striped bass. Even more ironically, restrictions were not imposed on the species that endured the heaviest harvesting pressure, such as whales, sturgeon, and seabirds. In their precautionary approach to

mackerel, cod, and bass fisheries, however, seventeenth-century settlers revealed their beliefs that humans could affect populations of sea fish. During the eighteenth century, when the only restrictions were on harvesting anadromous fish, each human generation confronted fewer whales, walrus, bass, sturgeon, alewives, seabirds, and shellfish. With but few exceptions this diminished ecological capital became regarded as the norm. Ecologists call this the "shifting baseline syndrome"; it appears to have been well under way in the northwest Atlantic by 1800. Despite stories that clearly conveyed some species' localized depletion, and the shrinking range of other species, and despite repeated insistence that fish stocks were "a Great Benefit to the Publick," the pressure persisted. The few attempts to mitigate it failed.[82]