A BLUEPRINT FOR THE PENOBSCOT RIVER WATERSHED

CONNECTING RIVERS

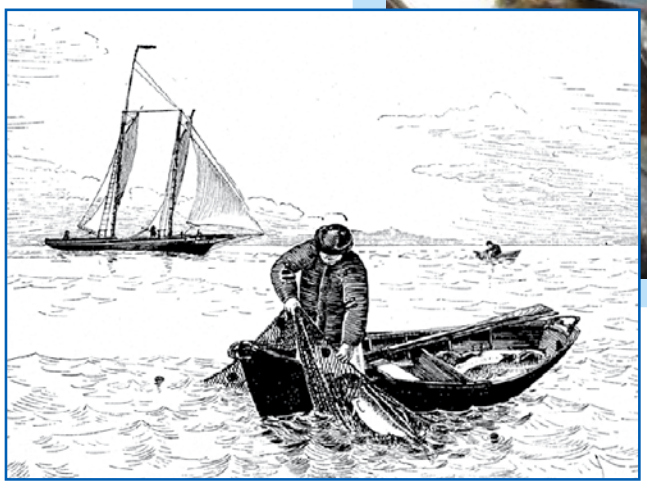
#1 *for healthy ocean fisheries*

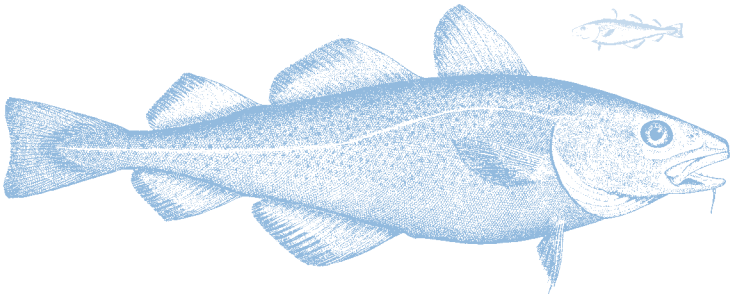
Millions of migratory fish once filled Maine's rivers, swimming upstream from the ocean to spawn in tidal waters, freshwater streams, and lakes. Such migratory fish are called sea-run or anadromous, and include Atlantic salmon, striped bass, sturgeon, smelt, shad, and the "river herring," alewives and blueback herring. The river herring historically were the most abundant migratory fish in Maine rivers, carrying protein rich in ocean nutrients into the nets and traps of hungry humans, and feeding eagles, osprey, other birds and wildlife.

The same situation also occurs in the reverse direction: when river herring (both adults that don't die and their young) swim back downstream, through estuaries and coastal waters to the sea, they are eaten by birds and other wildlife. River herring likely were an important source of food for cod and other groundfish in the Gulf of Maine.

Millions of alewives once swam through Penobscot Bay, where the majority (more than 80%) of Maine's alewife harvest took place. After 1840, dam construction associated with the escalation of timber harvesting throughout the watershed began to block alewife runs, as commercial fishing continued to remove large quantities of fish.

Cod, too, were an important resource for Penobscot Bay fishermen, who traveled to the Grand Banks from home ports in Bucksport, Orland, Castine, and Rockland. But most cod fishing grounds were located within thirty miles of shore. Although cod persisted after most of the alewife runs disappeared, the lack of food fish may have contributed to the later decline of cod in the nearshore area.





About this series

Across Maine, communities and land owners are reconnecting rivers and streams by improving road crossings, fixing broken culverts, and removing dams and other barriers. There are many reasons for doing this work, including preventing costly repairs associated with flooding and washouts, enhancing water quality, increasing wildlife habitat, and restoring fish populations. *Connecting Rivers* explores some of the ways that streams connect inland lakes and forests and the sea.

In his 1873 report to the U.S. Commission of Fish and Fisheries, Spencer Baird documented his conversations with fishermen about the impact of declining forage fish on groundfish populations in eastern Maine: "While the river-fisheries have been depreciated or destroyed by means of dams or by exhaustive fishing, the cod-fish have disappeared in equal ratio… the reduction in the cod and other fisheries, so as to become practically a failure, is due, to the decrease off our coast in the quantity, primarily, of alewives; and, secondarily, of shad and salmon, more than to any other cause."

Baird noted that 30 to 50 years earlier, cod could be taken in abundance at the mouth of Penobscot Bay. Where once the fish came close in to the shore, and were readily captured throughout most of the year, "only stragglers are now to be caught. That period was before the multiplication of mill-dams, cutting off the ascent of the alewives, shad, and salmon, especially the former."

Baird's hope that "the old state of things" would be renewed was not realized.

Dam-building continued, and in the twentieth century pollution in the Penobscot River and its tributaries contributed to the decline of all migratory fish. Today, river herring returns to the Penobscot River represent about 10% of Maine's alewife harvest.

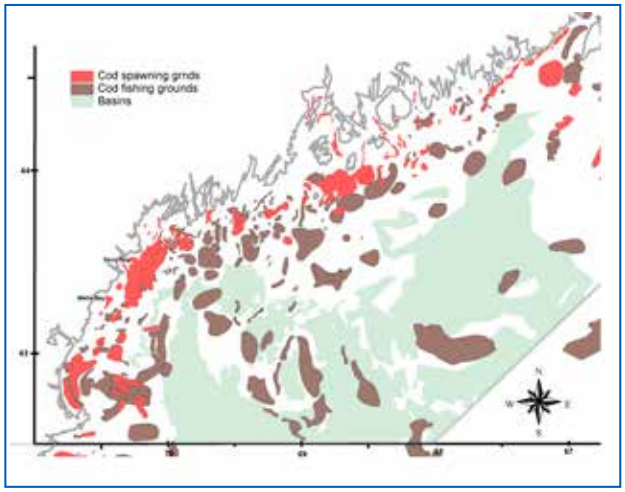
Cod-fishing continued. The introduction of new fishing technology (diesel engines instead of sail power), electronic fish-finders, and trawl gear led to the removal of more cod, with Penobscot Bay fishing grounds empty of cod by the 1980s. Of the more than 1,200 federal groundfish permits issued in the Northeast, only 20 are held by fishermen in eastern Maine, and there is no commercial harvest of groundfish in Penobscot Bay. The situation with cod in the Gulf of Maine has become so dire that resource managers closed the recreational fishery for cod in May 2015, and commercial fishing has been restricted.

"…bear in mind the enormous mass of these anadromous fish one hundred years ago, and even later, to appreciate the influence they can exert in attracting fish from the outer waters to the shores and keeping them there for a considerable part of the year, not only on its own account but also for its influence upon the sea fish. It is well known that while these anadromous fish were present there was an ample supply of cod, haddock, halibut, hake, and various other species close in to the shore."

—U.S. Fish Commissioner Spencer Baird, 1886

Analysis of historic fishing grounds has found a relationship between the collapse of alewife fisheries and cod abandoning inshore fishing grounds.

Historical fishing grounds and spawning areas of Atlantic cod in the Gulf of Maine, from T. Ames (2004).



Cod are omnivores, or what scientists call "generalist predators." They eat small fish like river herring as well as scallops, crabs, baby lobsters, and urchins. As a result, their diets (and movements) reflect the rest of the food web: by studying what cod eat and where, scientists can learn something about the larger marine ecosystem.

Cod will tend to gather where their food is predictable, such as at the mouths of coastal rivers during the alewife run. A recent study of groundfish caught near Maine estuaries, including Penobscot Bay, found river herring made up 5-10% of their diets, especially when juvenile fish were migrating in spring and fall. Cod also are found on Stellwagen Bank, feeding on sand lance which have lately been abundant. Cod, hake, striped bass, bluefish, dogfish, and monkfish all eat alewives.

Reconnecting rivers is just one piece of a larger, complex effort to bring back Maine's coastal fish and local fishing jobs. Several factors are impairing the ability of cod to recover, including too few spawning adults and warming water temperatures. More river fish won't change that, but pulses of river herring entering and exiting the Penobscot and other Maine rivers may help set the stage for recovery, by making sure that if and when cod and other groundfish return in large numbers, they have something to eat.

How do we know? Both fishermen and scientists participate in the following programs to monitor coastal fisheries.

- **The Maine Department of Marine Resources participates in the Maine-New Hampshire Inshore Trawl Survey. Using a commercial fishing vessel, fishermen and scientists survey coastal waters each spring and fall. maine.gov/dmr/rm/trawl/index.htm**
- **Since 2010, Penobscot East Resource Center's Sentinel Survey has monitored the presence of groundfish in the Eastern Gulf of Maine in summer, using both longlines (sinking lines with baited hooks) and jigging gear to sample for cod, cusk, white hake, and halibut, all of which have been found in the region. penobscoteast.org/research/sentinel-survey-fishery/**
- **Since 2012, NOAA Fisheries has been participating in the inshore trawl survey in Merrymeeting and Penobscot bays, monitoring the occurrence of diadromous fish in the diets of commercially important species. Additional NOAA fish surveys in the Penobscot Estuary use acoustics and trawls from May through September. nefsc.noaa.gov/salmon/factsheets/penobscot_estuarine_survey.pdf**

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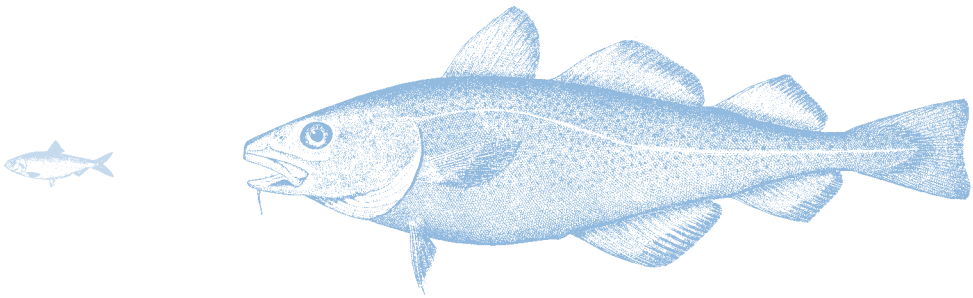

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