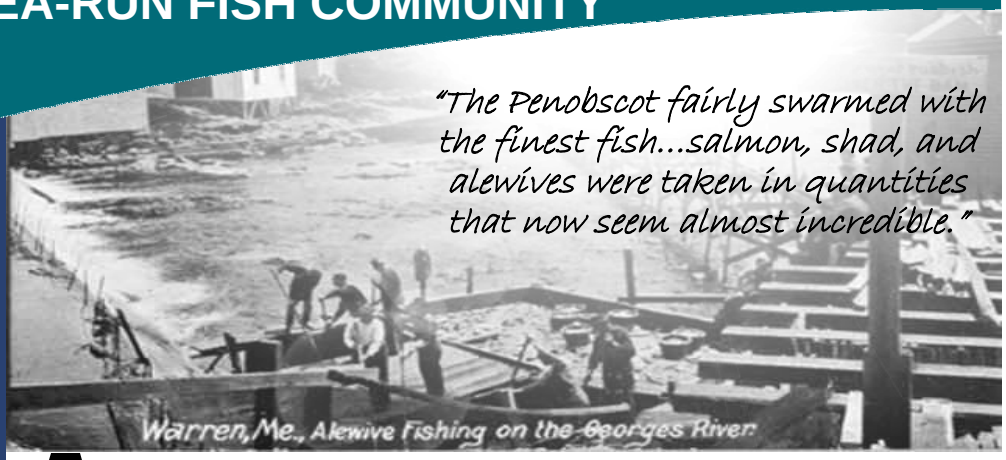
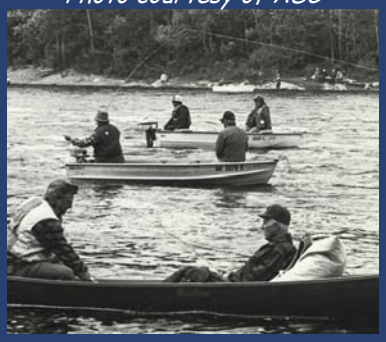
Science, Service, Stewardship

Northeast Salmon Team (NEST) Factsheet Collection

SEA-RUN FISH COMMUNITY



Below: historical salmon fishing on the Penobscot River.
Photo courtesy of ASC



Aquatic ecosystems in the Northeast were once dominated by a unique group of fishes that excelled at exploiting a variety of freshwater, estuarine *and* marine habitat and food sources. Members of this "sea-run" fish community had a huge presence in Maine, from an ecological as well as economic, social and cultural perspective. The upstream migration of some species extended well into the headwaters of Maine's largest rivers and fisheries for species like alewives, shad and Atlantic salmon abounded.

ECOLOGICAL ROLES OF SEA-RUN FISHES

They cycle nutrients between the marine & freshwater environments.

At sea, adults exploit the ocean's rich food sources. When they return to spawn in freshwater, they bring with them "marine-derived" nutrients that have been translated into growth. These nutrients are released into freshwater ecosystems during and after spawning (e.g. in the form of eggs and as carcasses of adults that have died decompose and are eaten by aquatic insects and other organisms).

An adult sea lamprey.

They influence habitat. *In constructing spawning nests, the sea lamprey (right) deposits stones in loose piles and removes silt from stones already at the site; the stones and silt-free habitat is ideal for spawning Atlantic salmon. In addition to creating an attractive spawning area, silt-cleaning activities may improve the "quality" of the surrounding environment with respect to aquatic insect diversity and abundance.*

They provide critical foodweb links. *In addition to providing food for Atlantic salmon, some species likely decreased predation pressure on Atlantic salmon by providing an alternative food source (i.e. a "prey buffer") for native predators. For example, adult alewives migrate upriver to spawn at the same time Atlantic salmon smolts migrate to sea. With greater numbers and a similar body size, alewives would have buffered smolts from predators like river otters, striped bass, ospreys and double-crested cormorants. Juvenile shad and blueback herring may have buffered juvenile Atlantic salmon against opportunistic predators such as mergansers, great blue herons, mink, and fallfish. Likewise, adult shad likely buffered adult salmon against river otters, harbor seals, and perhaps even whales, dolphins, and porpoises.*

Sea-run alewives hold below the Damariscotta Mills fish ladder.

Since sea-run fish evolved under certain environmental conditions and within a specific community of native fishes, completion of their life cycle hinges not only on unimpeded access between freshwater and marine habitats, but also on the presence of those species with which they evolved. As such, NEST is exploring untested hypotheses related to the implications of an intact sea-run fish community, including recovery of endangered species like Atlantic salmon.

SPOTLIGHT ON PENOBSCOT RIVER SMELT

Above: Rainbow smelt are one of twelve sea-run fishes that co-evolved together. Other species include Atlantic and shortnose sturgeon, American eel and shad, alewife and blueback herring, brook trout, Atlantic salmon and tomcod, sea lamprey and striped bass.

Photo courtesy of Kandis Hovland

Every spring, something very special happens in small freshwater streams that flow into the lower Penobscot River. From early April to early June, small, iridescent fish come in at night on the high tide when freshwater temperatures are right. They are not strong swimmers and they use the tide to their advantage. These nighttime visitors are sea-run rainbow smelt, and they are looking to spawn.

The males may arrive first in some locations, flaunting a full body suit of bumpy "nuptial" tubercles and hoping to attract a silky rainbow female. Some are better suited for spawning later in the season, in different locations that are perhaps farther upriver or close to shore in the Penobscot River itself. This diversity in timing and habitat use is common among sea-run fishes. It enables the population as a whole to persist over time and is a species' way of putting its eggs in more than one basket.

Likewise, smelt spend portions of their life in freshwater, estuarine and marine environments. Breeding females that come into freshwater to spawn are chock-full of tiny eggs rich in energy derived from amphipods, shrimps and marine worms. After spawning, these eggs cover the streambed like a sticky mat and provide a highly nutritional food source for freshwater organisms like aquatic insects and other fish that reside in these streams. In effect, as they travel, smelt and other members of the sea-run community link these different environments together by bringing nutrients they obtained from the estuary or ocean into freshwater and vice versa.

Successful or not in their quest, smelt are sensitive to light and temperature; all those looking for a mate must leave as the tide goes out and follow it back to their refuge in the estuary to wait for another night. During the rest of the year, they reside in the Penobscot River's estuary, replenishing their energy reserves and providing another very important source of food for post-spawn Atlantic salmon kelts, striped bass, bluefish and a variety of birds.

Today, access to historical spawning habitat is blocked by even seemingly insignificant obstacles like hanging or "perched" road culverts. Sea-run smelt and several other sea-run community members are "species of concern". Of these, Atlantic sturgeon are actively being considered for listing under the Endangered Species Act (Atlantic salmon and shortnose sturgeon are already listed).

Maine's freshwater ecosystems are very different today...

As early as the 1800s, humans began to alter the aquatic ecosystems in ways that did not favor sea-run fishes. For instance, many of the formerly free-flowing river systems that served as migration corridors to and from spawning habitat and rearing/feeding areas have been subdivided by mainstem and tributary dams and culverts. These systems now favor non-native species (including predators like bass and pike) better suited to slow flowing lake-like reservoirs and warmer water temperatures. In addition to being predators, these species compete with native fishes for food and space. Furthermore, since they do not migrate to and from sea, important sources of nutrients and foodweb links have been lost.

Restoring the native community of diadromous fish and the ecological functions they perform may improve the survival of species like Atlantic salmon at key life history events. Small and large restoration projects (e.g. those that improve fish passage) will lay the foundation for sustaining Atlantic salmon and other native aquatic species into the future, as well as restoring the variety of important ecological linkages that have been lost over time.

...restoration is needed to recover the important ecological roles sea-run fishes play.

The Northeast Salmon Team (NEST) is comprised of Northeast Regional Office (NER) managers and Northeast Fisheries Science Center (NEC) scientists. NER administers NOAA's Programs in the Northeastern United States to manage living marine resources for optimum use while NEC is the research arm of NOAA Fisheries in the region that plans, develops, and manages a multidisciplinary program of basic and applied research. Please visit the NEST website at: http://www.nefsc.noaa.gov/salmon/