EMDC Workshop on Penobscot River Restoration Project
"Natural Setting, Past, Present, and Future" Theme
February 1, 2005, Eddington Salmon Club

Slide – Presentation Agenda

Good evening. I am Clem Fay, Fisheries Program Manager for the Penobscot Indian Nation in Old Town, Maine.

I am here tonight to talk a bit about the historical diversity, range, and abundance of native sea-run fish species in the Penobscot River Basin during the pre-dam-construction era, specifically the late 1700s and early 1800s, as well as the ecological context in which they existed, including connections to the Gulf of Maine.

Then I will talk very briefly about the decline and ultimate demise of these fisheries in the Penobscot, and then finish up by noting some of the legislative, policy, and other initiatives that have occurred beginning about the late 1940s, and which set the stage for a river restoration opportunity such as the Penobscot River Restoration Project.

Slide - Historic Species Diversity and Habitat Range

I will start by showing you the native sea-run fish species of the Penobscot, and then describe their historical range in the Basin.

Slide – List of Species by River Zone

Prior to the construction of dams, the Penobscot River Basin supported large annual runs of at least 11 native sea-run fish species.

As you can see, I have two general groupings on this slide based on where most of their historical freshwater production habitat was located. For the lower river group, most of the historical habitat was below Old Town Falls, which is the site of the present-day Milford Dam.

Slide – Juvenile Striped Bass

However, an eye witness account from 1825, describing the fire that raged for two weeks through the middle portion of the watershed, indicated that at least in that year, adult striped bass occurred considerably further upstream…QUOTE:

"The roaring of the fire was like thunder, and was heard at a distance from twelve to fifteen miles. The islands in the river were burnt over; and the fish in the Piscataquis River were killed by the heat. Twenty bass, weighing from twenty to forty pounds, many young salmon, shad, trout, and other small fish, were found dead in the shoal water and on the shores. The fires were running in Bangor, doing much injury in the woods, and the whole country was filled with smoke." END QUOTE

Slide – Salmon in Situ

For the upriver species group, Atlantic salmon essentially occurred in all but the very uppermost headwater reaches of the Basin, including much of the West Branch Penobscot where sea-run

salmon are now completely absent. Only the most severe of natural obstructions restricted their upstream range in the Basin. Salmon were able to achieve this penetration due by their strong determination to home and their powerful swimming capability.

Slide – Elvers Crawling Over Spillway

The American eel, shown here, and the sea lamprey, also migrated to all but the most upper reaches of the drainage, but not necessarily due to their pure swimming capability. Rather, in the case of eels, their ability to crawl over wetted surfaces such as grassy banks to surmount obstacles they can not swim through is well documented…in this photo, young elver stage eels are trying to surmount a concrete spillway, using wetted cracks in the concrete.

Slide – Lamprey in Situ

Sea lamprey, shown here, are able to use their suction type oral disc to incrementally "spurt and winch" their way along and through high gradient reaches.

Slide – Clem Holding Shad

As to the range of shad and alewives in the Basin, Maine Fisheries Commissioner Charles Atkins reported in 1887…QUOTE:

"Shad traveled up the Penobscot River system to a distance of 170 miles from the sea. There were no insurmountable natural obstructions to the ascent of shad and alewives on the main river for at least 120 miles from the sea, and in some of the tributaries the way was open for nearly as great a distance." END QUOTE

And, in a prior report, Atkins wrote in 1869…QUOTE:

"American shad had once migrated at least as far up the mainstem as Wassataquoik Stream on the East Branch; to Monson Junction on the Piscataquis River; to Silver Lake on the Pleasant River; to Saponic Pond on the Passadumkeag River; and to Mattawamkeag Lake on the Mattawamkeag River. Shad were also known to have reached Grand Falls on the West Branch of the Penobscot, and possibly as far as North Twin Lake." END QUOTE

Slide – Smallmouth Bass

Finally, I will point out that chain pickerel were not present in the drainage prior to 1819, and smallmouth bass, shown here and now the most common and recognized species in the lower and middle Penobscot River Basin, were not introduced until the late 1860s.

Slide - Historic Abundance

Slide – Table with Est. Historical Numbers

Quite honestly, we don't really know the true size of the historical runs of these species because adequate scientific records simply weren't kept at that time. However, using juvenile and adult production estimates from other rivers where runs have not been so severely impacted, and then adjusting to the historical habitat assets for these species in the Penobscot, we think that pre-dam populations of salmon, shad, and alewives were likely in the range illustrated in this slide.

Slide – Blueback Herring Spawning in Situ

For a more anecdotal characterization of historical fish abundance, I am going to read two brief excerpts, the first of which is from Maine Fisheries Commissioner Atkins 1869 report, and which spoke to the pre-dam period leading up to the 1830s, QUOTE:

"In old times the most abundant fish in this river, in terms of bulk was the shad; and this was probably the most valuable. Next came the salmon. Alewives were exceedingly abundant but little esteemed. Bass were not rare. At Old Town Falls as many shad and alewives were taken as would supply the demand, and many fold more might have been taken; the price, one dollar per hundred for shad, was not sufficient inducement to provide beforehand the necessary barrels and salt to take care of them." END QUOTE

Slide – Alewives in Situ

The second excerpt is from an 1882 report by then Atlantic Salmon Commissioner Henry Ford, referring to the period between about 1805 and 1827…QUOTE:

"The Penobscot fairly swarmed with the finest fish...salmon, shad, and alewives were taken in quantities that now seem almost incredible. Some opinion may be formed in regard to these immense quantities of fish in the Penobscot at the head of tide when it is understood that 7,000 shad and 100 barrels of alewives were taken at one haul of the seine, about the middle of May this year of 1827." END QUOTE

Slide - Historical Ecological Roles/Context

Moving on now to the historical ecological connections that these sea-run fish species represented, I am going to present three distinct examples that, in my mind, illustrate the incredible range of possibilities in this realm. And, along that line of thought, I must emphasize that these examples just scratch the surface of what is currently known or hypothesized about these types of complex interspecies relationships, and that there are likely dozens more, perhaps hundreds, that have yet to be discovered.

My examples are:

1. The Role of Sea-Run Fish in Nutrient and Biomass Import, Export, and Cycling
2. The Predator-Prey Relationship between Cod and Alewives
3. The Obligatory Life History Relationship between Alewives and the Alewife Floater Mussel

Slide – Eagle Grabbing Fish

Historical runs of adult sea-run fish in the Penobscot, and especially shad and alewives, provided two major sources of ecosystem enrichment as they migrated through the watershed to spawn.

First, they provided an incredibly rich and abundant prey base for native opportunistic predators of fish, such as eagles, ospreys, cormorants, seals and otters, for example.

Slide – School of Outmigrating Juvenile Alewives

Similarly, these and other predators would utilize the juvenile outmigrants of these sea-run species as additional forage as they made their way back to the ocean. Those juveniles that make it back to the Gulf of Maine would then provide a greatly enhanced forage base for oceanic predators such as cod, halibut, haddock, hake, tuna, striped bass, and bluefish.

Slide – Shad in Situ

Second, these fish provided a conduit for the annual import, export and cycling of trace chemical nutrients, such as N and P, that are essential to aquatic ecosystem productivity, between the rivers and the GOM. This nutrient deposition and cycling occurred in three ways. First, these fish passed urea and feces along the way. These substances contain high concentrations of these nutrients.

Then, on the spawning grounds, these fish release millions of gametes, which are also rich in nutrients as well as fats and oils.

Slide – Lamprey Dying on Spawning Grounds

Finally, depending on the species, anywhere from perhaps 20% to 100% of the adult spawners die on the spawning grounds or along the migration route from natural causes other than by direct predation that I just mentioned. Included here would be losses to disease and parasites, mortality due to rapid changes in environmental conditions during migration, and most significantly, mortality due to migration or spawning exhaustion.

In this photo is a sea lamprey in its last hours of life after spawning. This is significant in that, sea lampreys spawn in the late spring in reaches and habitats very similar to those used by juvenile salmon through the summer and by adult Atlantic salmon the following fall. All lampreys die on or near the spawning grounds, and thus all of the nutrients of marine origin that are in their carcasses are deposited in these habitats and become incorporated into the freshwater food web, including aquatic insects, a primary forage resource for juvenile salmon.

Slide – Alewives in Situ

In my second example, there are numerous references in various historical reports by Federal and State Fisheries Commissioners and Agencies indicating very close ties between seasonal movements, overall oceanic population size, and commercial harvest of cod, and the historical population trends of alewives along the Northeast Atlantic Coast, especially as alewife runs began to decline sharply following the initial construction of full-span dams across many of our larger coastal rivers.

Slide – Mussel in Situ

My third example speaks to the unique life history relationship between fish and freshwater mussels, and in this case, specifically the alewife floater mussel. BTW, this picture is not an alewife floater, but rather a related species…I could not find a good picture of the alewife floater in its environment.

Slide – Mussel Glochidia

In any event, the larval stage of mussels, called a “glochidia” and shaped like a tiny mussel but with a toothy edge, is an obligatory parasite on the gills and fins of host fish. Each mussel species has one or more fish species which can serve as hosts for these glochidia. Some mussels have lots of candidate host fish species, and others are very particular. The alewife floater mussel has been fairly well studied in this area and to date, the only suitable fish host found is the alewife, although there is some evidence that very similar fish species like shad may also be suitable. This exclusive interspecies relationship is clearly evident by examining the consistency of occurrence or absence of both species together. Where there are lots of alewives available, such as in Damariscotta Lake along the Maine coast, there are lots of alewife floaters….where alewives are rare or absent, as in the Penobscot River above Veazie, the alewife floater is also rare or absent, despite strong evidence of robust historical populations throughout the basin, during times when the migration of alewives was unobstructed.

Slide - 2nd Mussel in Situ

Beyond the intrigue of this unique interspecies relationship is the issue of the importance of mussels in general in freshwater ecosystems, as they are efficient little filterers of the water column over where they live and thus provide a critical ecological function with respect to maintaining high water quality, including filtering out contaminants. Just think of the tremendous water filtering services we have lost in a river system as large as the Penobscot when comparing historical populations of these mussels with the current status.

Slide – Initial Declines in Abundance of All Species Following Dam Construction

Having given at least a taste of the historical context that these 11 sea-run fish species existed in, I will now move on to the period of decline, demise, and initial restoration efforts.

Slide – Alewives in Rapids

Maine Commissioner of Fisheries Charles Atkins, in his 1869 report, characterized the initial decline of these fish runs as follows, QUOTE:

“During all these early years the fish found extensive breeding grounds above the occupied portion of the Penobscot valley. Though shut out from some of its tributaries, a circumstance alone sufficient to effect, in time, a decrease in their numbers, the great highway to the many lakes and streams in the wild lands remained open until about the year 1830. It was then nearly closed by Fiske and Bridge's dam at Oldtown Falls.”

Slide – Veazie Dam

“After this the Great Works dam was built, and in 1834 or 1835 the Veazie Dam. The latter dam was closed in the winter. When the fish came in the spring they found an impassable barrier across their way; they gathered in multitudes below the dam and strove in vain to surmount it; many returned down the river, and after the usual time for spawning of shad was past they were taken in weirs in the town of Bucksport, loaded with ripe spawn they could no longer contain; a phenomenon which Mr. John C. Homer who has fished with weirs at that point for forty-three years had never observed at any other time. These were doubtless shad whose natural spawning grounds lay far up the river, and who had, after long contention, given up the attempt to pass the Veazie Dam. A great many shad and alewives lingered about the dam and died there, until the air was loaded with the stench.”

Slide – Leaping Salmon

"For a few years after the construction of these dams, fish were abundant; then a rapid decline set in, and in a few years they were comparatively scarce. In the case of salmon, they reached their lowest point ten years ago, since which time there has been a considerable increase, which may be owing to some increased facilities for passing the dams. We know that the water has made a way for itself around the end of Veazie Dam, so that at the present time, salmon, the most rigorous ones, that come at the right season, and do not get caught in the traps set on the falls, can reach the head waters of some of the upper branches. But the decrease of shad has never ceased. They are growing constantly less, and instead of exporting shad by the cargo, the people of the Penobscot valley are forced to import from other rivers shad for their own consumption." END QUOTE

Slide -Temporary Persistence of Salmon

Slide – Salmon Cars

Despite this era of steep decline, and in contrast to the fact that meaningful runs of shad, alewives and blueback herring had all but disappeared by the turn of the 20th century, salmon persisted in some strength around and after the turn of the century, as you can see from this circa 1890 picture from the Bangor area of the salmon fishing boat St. Agnes with its salmon holding cars.

Slide – Salmon Ad

and from this early 20th century ad for Penobscot Salmon for 4th of July celebrations.

Why did salmon hang on longer than the other species? Well, as was reflected in the excerpt that I just read a moment ago, their strong swimming ability allowed them to use those few rudimentary fishways that were built in the mid and late 1800s, or swim around or over early dams due to the tendency for these earlier dams to include long tapered apron-like structures on at least on one side, or to not be nearly so well engineered in terms of river flow control as our modern day dams are.

Slide - Ultimate Demise of Salmon

However, despite its undying persistence to home to its natal habitat, and their enormous swimming strength, the Penobscot salmon was about to face its ultimate demise over the decades of the 1920s, 1930s, and 1940s.

Slide – Dam and Mill Together

In addition to the migratory obstructions presented by the numerous dams in the basin, the final nail in the Penobscot salmon's coffin was the unregulated explosion of untreated industrial and municipal waste discharge into the river.

While deposits of bark, sawdust, and sediment continued to occur as in previous decades, toxic chemicals, and raw sewage and other oxygen-depleting substances increased dramatically over the first half of the 20th century. As a result, salmon declined precipitously and the commercial

fishery was finally closed in 1948. Few salmon were documented in the Penobscot Basin through the decade of the 1950s.

Slide – Initial Steps Toward Recovery (primarily salmon)

Despite this bleak situation, and beginning in the late 1940s, a series of new laws, mandates and construction initiatives came to pass, and provided the essential foundation for modern, active restoration efforts, especially for salmon, to begin. Some examples, in approximate chronological order, include:

Atlantic Sea-Run Salmon Commission (1947)

Federal Power Act Jurisdiction (1960s)

Anadromous Fish Conservation Act (1965)

Provided funding and other support for fishway construction

USFWS Model River Program (1967)

Designated Penobscot River as a Model Candidate for restoring salmon to a large, industrially developed river system

Expanded/Refurbished Hatcheries at Craig Brook (1955) and Green Lake (1974)

Clean Water Act (1970; 1972)

Modern Version of USFWS/ASRSC Coop Agreement

signed, spelled out commitments of the signatories with respect to salmon restoration in Maine, and formally established Technical Advisory Committee

These various events undoubtedly served to revitalize agency focus on and public awareness of salmon, and as a result, we have more salmon in the Penobscot today than we had prior to these developments. Conversely, the fact that returns to the Penobscot still hover in the dangerously low thousand fish range, and that only about 5 to 10% of the returns are wild fish, indicate that the job of restoring that species is far from done. Furthermore, positive progress on restoring other species such as shad, alewife, and sturgeon is well behind efforts for salmon in the Basin, and will likely require more substantial changes in the overall landscape of the river to have a high chance of success.

Slide – "Welcome to the PRRP"

The opportunity to pursue more substantial changes in the river's landscape was provided when the agencies, Penobscot Nation, and conservation groups were approached in the fall of 1999, by Pennsylvania Power and Light which had recently purchased all of Bangor Hydro's former dams on the river, with an offer to sit down and attempt to reach a negotiated basin-wide settlement for all their hydro projects, addressing both environment and energy. After several years of hard work by all parties, a conceptual agreement was reached in October of 2003, followed by an

implementation agreement in June of 2004, now known as the “Penobscot River Restoration Project”.

Slide – Sturgeon In Situ

This concludes my substantive material, but before I pass the baton on to Gordon, I would like to do two other things. First, I wish to credit Doug Watts of Friends of Kennebec Salmon and his brother Tim for many of the pictures I used today. I also wish to credit Doug for digging out some of the historical anecdotes and Fish Commissioners’ that I used to illustrate the early fisheries in the Penobscot.

Second, I would like to read one last historical excerpt from Captain Jacob Holyoke’s 1860 letter referring to the decade of the 1790s, because it illustrates one example of a more subtle, almost taken for granted, connection between early colonists and these sea-run fish species...QUOTE

"Salmon, shad and alewives were very plenty, and in their season many people came here to catch them -- bass were also plenty, and in the fishing season, we could fill a batteau with fish at Treat's falls in a short time; we would sometimes take forty salmon in a day, and I think as many as five hundred were taken some days, in all. My father had a large seine in the eddy, just above the Bangor bridge, and we had much trouble with the sturgeon. When a large sturgeon was captured, the boys used to tie the painter of the boat to his tail and giving him eight or ten feet length of rope, let him go, and when he grew tired or lazy would poke him up with long sticks and so be carried all around the harbor.” END QUOTE

Now, I recognize that this situation may seem cold and cruel, perhaps even unthinkable, to many of us today. However, thinking back to when I was a boy and how finding a turtle or snake or frog in the woods compelled me to take it home, put it in a cardboard box with some sticks and rocks and grass, and play with it for a while before I let it go, I certainly cannot deny that having a sturgeon that my father caught pull me around in a little boat would not be something I would find interest and fun with as a youngster in that historical time. I just think this illustrates that, while the historical literature often emphasizes the direct economic assets of these pre-dam fish runs, there were also much more subtle, less talked about and more taken for granted, social and cultural connections between these fish and the colonists in the region, many of which have been lost now for well over a century.

I thought this was just such a neat little blurb and I wanted to share it with you and I will end now and turn it over to Gordon.

Thanks for this opportunity and your attention.