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Title: Restoration of ecological continuity: The regulations and actions to preserve Atlantic salmon in the United States

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Casey Bio: Casey is a fisheries biologist with the Maine Department of Marine Resources. Casey works to protect, conserve, restore, and manage diadromous fish and their habitat, in all waters in the state of Maine.

Abstract: Along the Atlantic coast of the United States, the rivers of the State of Maine are the last stronghold for the restoration of Atlantic salmon (*Salmo salar*). Dams and road-stream crossings drastically restrict access to habitat for salmon and the eleven other diadromous fish species found in Maine, but conservation groups and state and federal agencies are working hard to reverse this decline. The largest run of Atlantic salmon is found in the Penobscot River, where an enormous restoration project to improve fish passage and balance hydroelectric power generation along the mainstem took place within the last decade. The tools used in this and other dam removal projects in Maine, were state and federal regulatory mechanisms such as the Federal Powers Act and the Endangered Species Act, along with public safety and other non-regulatory mechanisms. The dam removals and fish passage projects have resulted in returns of millions of fish to these rivers in recent years, but many more restoration projects still need to be complete to restore populations to their historic abundances.

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1) **Who we are**
    a. Hadley Couraud – The Nature Conservancy in Maine
    b. Casey Clark – Department of Marine Resources, State of Maine
    c. Both working in the state of Maine, in the northeast of the United States

2) **Maine Rivers and diadromous fish**

Maine is framed by the eastern United States, Canada, and the Gulf of Maine. This Gulf is interdependent with Maine's network of rivers. This marine and network of freshwater ecosystems are linked by the 12 species of diadromous fish that migrate within Maine each year. These fish transfer valuable nutrients from the ocean to enrich freshwater and terrestrial ecosystems, plants, and animals. These fish include the endangered wild Atlantic salmon, concentrated in 8-10 rivers. Maine's rivers are the last stronghold in the United States for the salmon, presenting the last and best habitat potential for restoration. Historical estimates of fish runs include 14-20 million alewives, 3-5 million American shad, and possibly 100,000 Atlantic salmon. Historic accounts from 1650 noted that "...at certain times, the entire surface of the river for a foot deep was all fish." These fish have co-evolved with each other and depend on the interaction of species for their survival. Beyond fish species, countless other species of plants, animals, and human communities depend on and draw sustenance from these sea-run fish.
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3) Maine cultural, economic, historical ties to diadromous fish

Connections to Maine rivers and diadromous fish begin with the indigenous tribes of Maine, collectively called the Wabanaki. Rivers were, and still are, lifelines for the tribes, providing sustenance and transportation routes, as well as being a part of their identity.

Commercial fishing is a critical part of Maine's economy and long-time livelihood of coastal communities. Maine's top two commercial fisheries, by value in dollars, are 1) lobster and 2) elvers. Typically, the value from lobster landings is around 378,500,000 and 473,000,000 euros annually. The value of elver landings is around 19,000,000 euros today. Critical for the lobster industry are river herring, which are used as lobster bait. Also critically important for livelihoods are the ground fisheries in the Gulf of Maine. "Recent science indicates that coastal commercial ground fisheries will not recover without restoring native sea-run fish, and Atlantic salmon will not survive without restoration of the other sea-run species with which they co-evolved." In addition to commercial fishing, recreational fishing is an important part of the cultural in the State, creating stakeholders and advocates for fish populations.

4) Maine Dams

Since settlers arrived from Europe, rivers have been manipulated – first to transport timber from forests to mills, then with dams to power those saw mills, and eventually, textile and other manufacturing mills, and then hydroelectric dams. In addition to energy, dams generated jobs, and created new opportunities for homes and recreational activity. But as these dams powered Maine's economy in many ways, they do so at the detriment of the rivers and fish. Sediment erosion and water temperature increased, as fish numbers decreased precipitously. In 1948, only 40 salmon were caught in the Penobscot River waterbasin, in the last year of a commercial fishery for Atlantic salmon, and the numbers in this and other major rivers in Maine struggled to improve. Currently, there are 179 hydro-electric dams in Maine, an average of one for every 9km on large rivers in the state.

Penobscot River

Today, we want to share a little bit about the mechanisms and actions taken for the restoration of Atlantic salmon and other species in one particular water basin in Maine.

1) Waterbasin overview

The Penobscot River water basin is Maine's largest, draining nearly 13,800 square kilometers, which is more than a quarter of Maine. Nearly 85% of that is still significantly forested. The water basin contains more than 20,900 kilometers of rivers and streams, with the tides impacting nearly 40 kilometers upstream from the ocean. Importantly, the Penobscot River hosts the largest run of Atlantic salmon in the United States. Restoring habitat and fish passage on the Penobscot is "the last best chance for recovery of Atlantic salmon in the United States". But this river was not spared from the impact of the logging industry or dams. From 1830 – 2013, only 4% of the watershed was accessible below Veazie Dam, the lowermost dam on the Penobscot until 2013.

2) **Penobscot River Restoration Project overview**

To restore the river and its fisheries, a partnership was formed between the Penobscot Nation (one of the Wabanaki Tribes), six conservation groups, two hydropower companies, and state and federal agencies. It evolved into the Penobscot River Restoration Project, which ultimately opened 3200 kilometers of historic mainstem habitat, restored fish passage for all 12 sea-run fish species, and other aquatic life, all while balancing hydroelectric power produced on the river.

3) **Specific Projects:**

This was achieved through a series of key projects. The Great Works dam was removed in 2012. The lowest dam on the mainstem, the Veazie Dam was removed in 2013. A new fish lift was completed at the Milford Dam in 2014. The Howland Dam was decommissioned and a nature-like fish bypass was constructed in 2016. Finally, West Enfield Dam has had existing fish passage since the 1980s. Alongside increasing fish passage at these four sites, power production at four other sites increased (Orono, Stillwater, Milford, West Enfield), resulting in a net zero or net increase in hydropower.

[Mechanisms for Dam removal] - 10 minutes

4) **Enabling conditions for the PRRP**

There are many mechanisms and conditions that allowed the Penobscot Project to move forward. Over the next few slides, I will give details on the two regulations made this project a success. Those two regulations are the federal Power act and the Endangered Species Act

<u>Federal Power Act</u>
The Federal Power Act sets timelines for when a project needs to be relicensed and opens up the opportunity for fish passage and other requirements. This set a timeline when several dams with no fishways or with bad fishways would need to build new fishways. Veazie expired in 1998 and Great Works expired in 2002

<u>Pending and final ESA salmon listing</u>
In the early 2000's it was pretty clear that Atlantic salmon in Maine were going to be added to the Endangered Species list. Listing salmon would mean private dam owners would need be held to a higher standard.

1) **Regulatory mechanisms for dam removals**

<u>Federal Power Act</u>
Enacted in 1920 to coordinate the development of hydroelectric projects. In the early 1900's hydropower dams were being developed and the US Federal government was weighing the benefits of allowing private development of these dams or only allowing the government to develop these projects on waterways. The FPA struck a balance between those two options, where all development would be regulated by a Federal government agency. This allowed for private and government development of hydroelectric projects.

Regulates only hydroelectric dams. Many of the largest dams are hydroelectric dams and are regulated by the FPA. Some hydroelectric dams are exempt from the FPA regulations, but very few. Small dams, for example small historic mill dams, are not regulated by the FPA

FPA grants licenses for a 30-50 year term. The relicensing process documents and considers impacts caused by hydroelectric dams. Requires the consideration of energy generation with other uses of the waterway (for example: as migratory fish habitat or for recreation). Requires measures to reduce avoidable impacts (E.g. fish passage). Measures required are the responsibility of the licensee and measures are intended to be paid back over the term of the license.

For the Penobscot River, additional measures were needed at each of the dams. License expiration requires assessment of environmental measures. This creates a once in 50 year opportunity to improve passage significantly, or require a dam to build a fishway where there wasn't one before. Several licenses were expiring on the Penobscot River. The expirations of the two dams closest to the ocean, and several more in the next decade, created a window of opportunity to pressure the dam owners

Environmental measures outweighed the value of the outdated hydro dams. The cost of improvements at each of the dams outweighed the worth of those dams that did not generate much electricity anyway. While the FPA could not look at the riverbasin as a whole, most of the dams on the river were owned by the same company. That company saw opportunity in getting rid of the worst dams and improving others.

However, the FPA is not a champion for migratory fish. The FPA does not often require a dam to be removed. Dam removal would reduce electricity generation, so it is not compatible with the purpose of the FPA. The only dam removal that FPA has required is the Edwards Dam on the Kennebec River in 1999. This was a terrific succuss, but FPA has not taken this action again in 24 years since Edwards was removed.

Requires a significant amount of time and effort. The FPA relicensing process requires a lot of work on behalf of the natural resources agencies. However the process creates competing, and not overlapping, interests for hydro operators and resource advocates. The process also does not include time for open dialogue between hydro operators and resource advocates

Dams regulated by FPA are not eligible for federal restoration funding. Dam owners that have an FPA license are responsible for operating the dam according to that license, but no more and no less than that. Most funding for restoration in the U.S. comes from federal grants, which are not allowed to be spent on FPA projects. This creates the issue where our biggest problems are unable to be supported by restoration funding. Private owners want to make profit on their dams, not spend money on restoration actions. So fish passage solutions at hydro dams are rarely chosen because they are the right solution, and instead are chosen because they are the least expensive option that might work.

The cost of passage measures cannot be greater than generation of the project. Small projects can have large impacts even if they do not generate very much energy. This creates the scenario where fish passage measures are much more expensive that the project can afford. If a small or inefficient project cannot afford a new fish passage measure over the course of the license term, the FPA will not require

that measure. There are very few opportunities for upgrading efficiency at projects to help both the dam owner and the fish.

Endangered Species Act

The ESA establishes protections for fish, wildlife, and plants that are listed as threatened or endangered. The Gulf of Maine Distinct Population Segment of Atlantic salmon, which is genetically different from other north American populations, collapsed in the second half of the 1900's.

Salmon were formally listed in 2009. This listing included identification of critical habitat, which was also established in 2009. Critical Habitat draws specific boundaries and requires a higher standard for habitat protection within those boundaries

Atlantic Salmon Recovery Plan issued in 2019. The recovery plan for salmon was issued in 2019, which identifies threats to salmon, metrics of recovery, actions to recover the species, and a timeline to complete those actions.

Dams were identified one of the primary threats to salmon. The plan also outlines metrics of recovery which include: Annual return of 6,000 wild origin adult salmon; 900 hectares of accessible instream habitat.

Requires reduction of impacts that could cause the species to go extinct. The listing of salmon defined specific direct impacts to endangered species that must be reduced or avoided. This is especially important if the action, or the cumulative impact of actions, will cause the species to be extirpated from critical habitat. Fish passage is a big piece of this, including specific passage effectiveness standards

ESA and the Penobscot
Cumulative impacts to species (whole riverbasin): Unlike the FPA which looks at dams in isolation, the ESA looks at cumulative impacts to species. For the Penobscot River, too much of the habitat was above too many dams and the fishway at the lower dams were not effective.

Passage effectiveness requirements: For the dams in the Penobscot River, 96% of adult salmon must pass upstream within 48 hours and 95% of smolts and kelts must pass downstream within 24 hours.

Ongoing research to understand threats: Temperature impacts due to delay in passage; Timing of downstream migration of smolts; Predation by invasive species.

ESA is not perfect. Critical habitat excludes important habitat. Critical habitat includes some bad habitat and does not include important habitat. As much as ESA is science driven, the critical habitat listing include economic exclusions or exclusions due to dams. The means that some dams, which are below pristine habitat, are not regulated under ESA.

Public cannot as easily connect to endangered species. Listing species as endangered makes it harder for the public to connect with them. Fishing and other public impacts are banned, which removes the public's ability to interact with the species. Now that salmon have been listed for more than 10 years, many people no longer advocate for salmon recovery. They have forgotten why they are important to them.

Does not amply fund recovery actions. Due to my dysfunctional democracy, the ESA is not funded to achieve the goals or implement the actions to reach recovery for a species. If dams are the primary threat to salmon, then the ESA should fund solutions at dams. Instead, ESA staff provide comments and guidance to dam owners.

Does not act as aggressively as it could. If a species is very close to extinction, ESA can act more aggressively to reduce threats to that species. However, the decision to rule that actions will extirpate the species is very unlikely to be made. In part, because of political/legal pressure, and in part because it would require more certainty than current science can provide. Thus known solutions that would reduce impacts on salmon, but impact businesses are not required. A tiered approach could reduce this hesitant approach to action.

ESA does not adequately fund actions to restore the species. Similar to my comment above, funding is not adequate to reach recovery. Our hatcheries are critical to maintain the species at this time, but they are not fully funded. Research and monitoring are receiving less funding each year.

[Back to the Penobscot River Restoration Project]

In conjunction with the mechanisms Casey described, and many others, there were several key conditions that made this project possible.

First was Tribal Advocacy – before Maine was even a State, the Wabanaki tribes were advocating for fish passage at dams, as well as dam removal. That tireless advocacy of a community connected to their river remained pivotal throughout the project and still is today. The way tribal leaders engaged in negotiations shaped their direction in ways no other partner could have done.

Second, in the mid-1980s, a new dam was proposed on the Penobscot River, the Basin Mills dam. Well before the Atlantic salmon were listed under the Endangered Species Act, the Penobscot tribe and other river advocates knew this dam could ruin their chances of recovery. In 1998, after a lengthy environmental review, the license was denied. This win wasn't just celebrated, it helped spur greater visions of restoring the Penobscot River and its sea-run fish.

- This was the first of series of events that people could not have predicted, but were ready to take advantage of. Remaining flexible – with funding, political changes, weather patterns, with community needs, was shown again and again to be a necessity and opportunity.

Third, were patient negotiations and relationship-building – While it's easy to mark what was over two decades of work by dam removals and improved fish passage projects, each one was made possible by patient negotiations between partner organizations, agencies, and multiple hydropower companies, and tireless relationship-building. This included "kitchen-table conversations" that project leaders shared with people living along the river, to better understand their sentiments around a host of dam-related issues they lived through, as well as inviting local residents to volunteer as project ambassadors in the community.

    - This is how people worked together to identify how dam removal benefited the community and not just the fish. The more we can clearly define the goals of everyone involved, the better we can do to meet those goals with solutions.
    - And, the more community connection there is to fish and the rivers, the more engagement and support can be garnered.

And so, with regulatory tools, partner relationships, community advocates, and flexibility, the project reached key successes.

The first dam to be removed was Great Works in 2012, which you can see here before, and after. The second dam to be removed was the Veazie Dam, in 2013 – note the white house in the background. You can see the scale of the project with these excavators beginning to take apart the wall. And then you can see how the entire dam and all remnants were removed. There's the white house you saw in the first photo. After Veazie Dam, a new fish lift was completed at the upstream Milford Dam in 2014. The Howland Dam was decommissioned and a nature-like fish bypass was constructed in 2016. This dam is on the Piscataquis River, one of the primary tributaries of the Penobscot, and opened access to more inland habitat. In concert with these major projects, electricity production was increased at four other sites along the mainstem and in a side branch of the river, resulting in a net zero or net increase in hydropower.

Altogether, the combination of dam removal, improvements in fish passage at other dams, and a nature-like bypass channel improved access to nearly 3200 kilometers of habitat for endangered Atlantic salmon and the eleven other diadromous fish species.

Today, we are still far from being able to remove Atlantic salmon from the Endangered Species List. We are however, seeing their numbers increase each year. Here you can see the increase in Atlantic salmon numbers in the Penobscot River after the first two dam removals. Other species are rebounding even more impressively, such as the river herring, which you can see here, rapidly increasing, also in the Penobscot River.

In addition to fish numbers, the project has had numerous impressive benefits, including:

- Benefits to terrestrial, avian, and marine wildlife, as well as marine and freshwater ecosystems. For example, seals were seen in Orono (over 50 kilometers from the ocean), and are documented eating river herring instead of only salmon.
- The project began restoring cultural connection of the Penobscot Nation to their river, and
- Revitalized tourism, recreation, and economic opportunities.

The story of the Penobscot River is still being written, but increasingly so by the river and its sea-run fish themselves.