

2024 Report: Experimental Pen-rearing of Atlantic Salmon in Lake Champlain 2021-2025



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2024 REPORT: EXPERIMENTAL PEN-REARING OF ATLANTIC SALMON IN LAKE CHAMPLAIN 2021-2025

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Introduction

The Lake Champlain experimental pen rearing project (Balk 2021) is an effort by the New York State Department of Environmental Conservation (NYSDEC) and the United States Fish and Wildlife Service (USFWS) to determine if pen rearing Atlantic salmon is a viable approach to increase post-stocking survival of juvenile hatchery fish in Lake Champlain and returns of adult fish to their river of stocking origin, in this case, the Saranac River. Background information on pen rearing can be found in the Project Proposal (Balk 2020a). The desired outcomes are increased post stocking survival and recruitment of Atlantic salmon to the rivers as adults and increased Atlantic salmon catches in the Saranac River and Lake Champlain. This report summarizes the fourth year of the five-year project.

The Saranac River provides an excellent location for an experimental pen rearing project due to the depth of the water, existing infrastructure to support the pens and access for volunteer help from the Lake Champlain Chapter Trout Unlimited (TU) members. Another factor influencing our decision to use the Saranac River for this experimental project is the NYSDEC's plan to install a fish ladder at Imperial Mills Dam. Atlantic salmon access to spawning habitat in the Saranac River has been impeded since the construction of dams in the area in the 1880s. Atlantic salmon currently can only access about nine acres of quality spawning habitat from the river mouth upstream to Imperial Mills Dam (Strait and Plosila 1981); this is a limiting factor to how much natural reproduction by salmon is possible in the Saranac River. The NYSDEC is addressing the barrier to Atlantic salmon by installing a fish ladder at Imperial Mills Dam to allow upstream access to historic spawning grounds. Between Imperial Mills Dam and the next impediment, Treadwell Mills Dam, there is another 27 acres of spawning habitat (Strait 1981). Providing access to more spawning habitat will increase the potential for natural reproduction in the Saranac River.

Methods

The Great Lakes Trout and Salmon Cooperative Pen-Rearing Standard Operating Procedures (Legard 2018) was followed for pen design; however, the plan was modified to better fit the Lake Champlain project (Balk 2020b). In partnership with USFWS and TU, NYSDEC Region 5 Fisheries staff completed the fourth year of the experimental pen rearing project in Lake Champlain in April of 2024.

Location of Pens

Pens were installed at the Plattsburgh Boat Basin & Oasis Marina docks inside the marina harbor. This was a slight change in location from past years when the pens were kept at the northernmost docks which were less protected.

Marking/Tagging

In 2021, during the first year of the net-pen project, stocked fish were marked according to study group membership using a combination of fin clips and presence/absence of Coded Wire Tags (CWTs). Starting in 2022, a genetic marking approach called parentage-based tagging (PBT) was implemented and fish were assigned to a study group using genetic analysis (Steele et al. 2019). Therefore, marking with fin clips or CWTs was discontinued. One lot of pre-smolt Atlantic salmon were stocked into the pens in the Saranac River estuary and held for approximately three weeks prior to release. Additionally, an equivalent lot of smolts was stocked directly into the Saranac River estuary the same week that the pen reared smolts were released. Direct stocking is the typical stocking method and serves as the control in this experiment. All Atlantic salmon captured in future sampling efforts will be scanned for Coded Wire Tags, fin clips will be recorded, and tissue samples will be collected for genetic analysis.

Rearing

Pre-smolts were stocked into the pens on April 13th and released on May 2nd, 2024, a span of 20 days. Trout Unlimited volunteers recorded a daily logbook of activities at the pens over the period of the project. Water temperature was recorded using thermometers located within the pens, automatic feeders were filled, mortality counts were conducted, and predatory bird activity was documented.

Results

The duration of holding time in the pen in 2024 was similar to past years. Temperatures remained in the acceptable range throughout the holding time, 45-56 °F. Coordination between the volunteers and Region 5 Fisheries staff was excellent throughout the project. As in previous years, the project was successful in terms of stocking, rearing, and releasing the Atlantic salmon smolts.

Growth

The pen reared pre-smolt average total length at the hatchery on 5-April (pre-stocking) was 151.2 mm ± 13.4 SD. The smolts were measured again on 29-April but did not differ in length (151.7 mm ± 20.6 SD, $t = 0.42$, $p = 0.05$) indicating significant growth did not occur during the 20 day holding period within the pens. Most of the fish (87%) reached the last silvering stage (stage 3) of the smolt assessment index used by Eisenhower National Fish Hatchery, meaning these fish had lost their parr marks and were fully silvered.

Mortalities

Daily counts of mortalities were manually recorded in the data logbook by volunteers. Total mortality was based on the number of dead fish collected from the pens during captivity and

from the bottom of the pens after release. Mortality does not include fish lost to cannibalism or from predators that may have gained access to pens.

A total of about 598 individuals were collected as mortalities in 2024 (Figure 1). This represents 2.2% of the 27,086 fish that were stocked into the pens. Over the 20-day holding time, 101 smolts were collected during the daily feedings and on release day, 497 smolts were collected from the bottom of the pens.

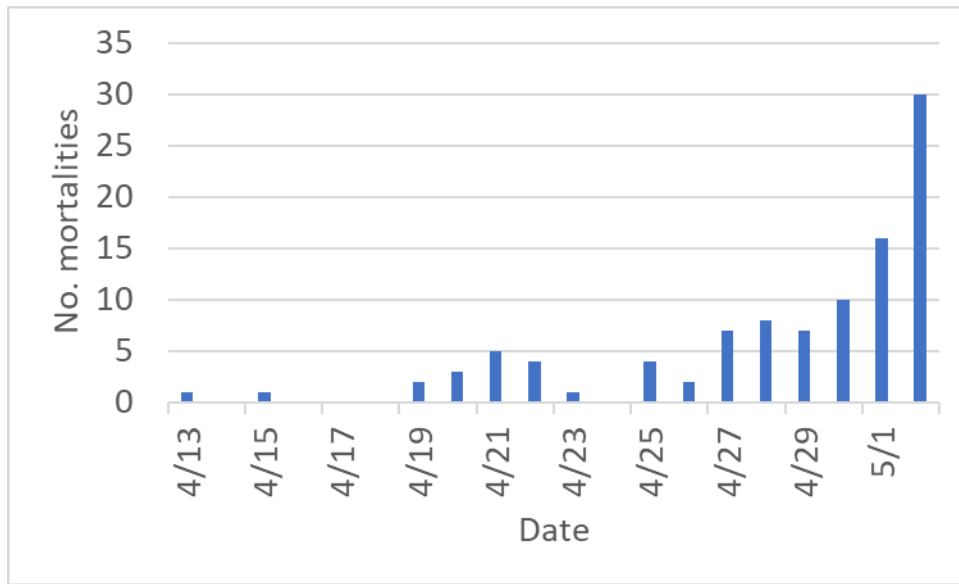


Figure 1. Mortalities collected each day April 13 to May 2, 2024.

Table 1. Annual mortality rates for the experimental pen-rearing of Atlantic salmon in Lake Champlain project.

Year	2021	2022	2023	2024
Percent Mortality	1.4	1.0	2.0	2.2

Water Temperature

Water temperature remained within the range preferred by Atlantic salmon over the entire 20 days of the project (Figure 2). Fish displayed little to no signs of stress due to temperature over the period of the project.

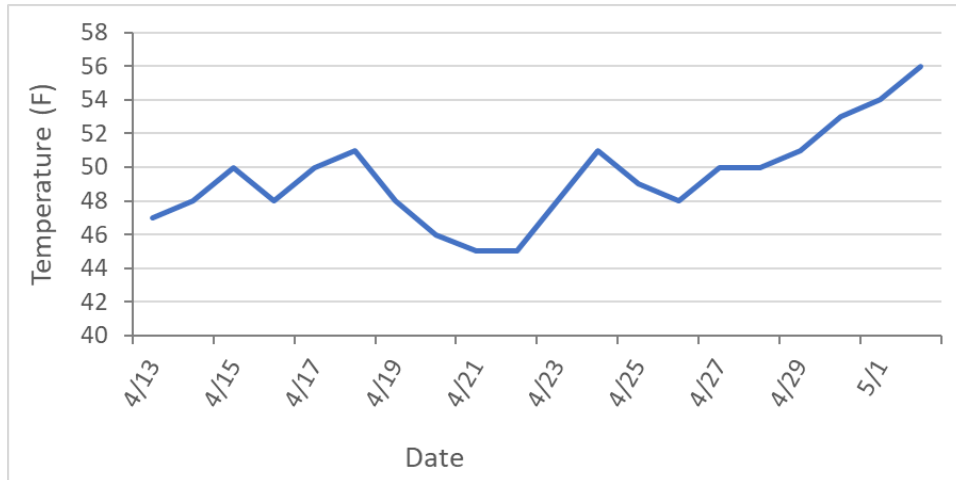


Figure 2. Surface water temperatures at the pen site April 13 to May 2, 2024.

Discussion

The project was once again successful in holding smolts in pens through smoltification.

Growth

The pen reared salmon did not exhibit growth while in the pens, which is acceptable because the intent of the project is to hold salmon while they transition from par to smolts and imprint, and not necessarily to increase their size. Reports from volunteers indicated that the smolts were eating well and appeared healthy throughout the project.

This year's average length of 151.2 mm was significantly less than last year's average length of 176.4 mm ($p < 0.01$). Fish reaching stage 3 of the smolt assessment index used by Eisenhower National Fish Hatchery was the desired state of the smolts. The estimated 87% smoltification is seen as a success and evidence that the holding period was sufficient to achieve the desired response in a majority of the fish; however, there is room for improvement next year. Last year and in 2022, 96% of the smolts were stage 3 upon release, correlating with the larger size at the time of stocking into the pens in those years. The difference in growth and smoltification was likely due to issues at the Eisenhower hatchery in summer 2023 which interrupted the peak growing season for fish (including this year's net pen fish), resulting in reduced growth and smaller than average fish. It is expected that fish for next year will return to average size at the time of stocking.

Mortality

Mortality rates were acceptable again this year. Previous years have had slightly less mortality, but we expect some variation from year to year due to changes in environmental factors. For comparison with a similar project, in 2021 the Lake Ontario pen rearing study average mortality for Atlantic salmon was 4-5% (Scott Prindle, personal communication).

Cormorants appeared to be the most common predator in 2024, but there were only a few observed near the pens. Snow fencing was added to the pen lids this year and appeared to eliminate bird predation from above. One mink was observed near the pens.

Pen Location

The new location near the marina building was more protected than the previous location, resulting in less damage to the pens from wave and wind action. We will continue to work with the marina staff next year. Other benefits of this site included less algae growth on the nets which could be due to greater water depth or flow.

Parental Based Tagging

Adult salmon will continue to be tracked as part of a USFWS project using Parental Based Tagging (PBT). Higher survival, measured by a higher return rate, is expected for the pen reared fish than for the direct stocked fish. The PBT study will determine the contributions of the stocked and wild fish to the fishery and will be reported on in a follow up report. While not an objective of this project, it is an objective of the Strategic Plan for Lake Champlain Fisheries (2020).

Algae

Algae buildup did not appear to be as significant as in past years and there was no associated effect on the health of the smolts. This could have been due to better flow of water through the pens or an increase in shading of the pens at the new location.

Lessons Learned

At the new location this year, there were some changes to the methods of deployment and retrieval. Most of the volunteers are older and there was some concern about potential injury with lifting the heavy pens. The marina manager donated his boat lift operator's time to help with launching the pens and again with retrieval. The boat lift made the process much safer and easier for all involved. The marina manager has already generously agreed to provide the boat lift and operator again in 2025 for continued safe and efficient operation.

With the first net removal using the lift, we learned that leaving the nets attached to the frames trapped some of the fish in the net and was problematic. The fish were removed once the pen was on land, but many of them perished. All subsequent nets were removed at the docks to ensure all the fish were out before the pens were moved. The pens were then ferried to the boat lift, which was much faster without the bulk of the net.

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References

- Ardren, B. 2020. Parental based tagging of Atlantic Salmon in Lake Champlain. USFWS.
- Balk, N. 2021. Experimental pen-rearing of Atlantic salmon in Lake Champlain 2021-2025. New York State Department of Environmental Conservation.
- Balk, N. 2020a. Project Proposal: Experimental pen-rearing of Atlantic salmon in Lake Champlain. NYSDEC. Ray Brook, NY.
- Balk, N. 2020b. Atlantic salmon net pen rearing standard operating procedures, Lake Champlain. NYSDEC. Ray Brook, NY.
- Bishop, D. L. and W. E. Pearsall. 1999. 1998 New York Cooperative Pen Rearing Projects. Section 12 In 1998 NYSDEC Annual Report Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee.
- Connerton, M.J., Balk, C.J., Prindle, S.E., Lantry, J.R., Bowlby, J.N., Yuille, M., Bronte, C. and Holey, M.E. 2016. 2015 Mass Marking of Chinook Salmon in Lake Ontario. Section 3. In NYSDEC Lake Ontario Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Unit.
- Connerton, M. J., Lantry, J. R., Bronte, C. R., & Lapan, S. R. 2022. Origin, Postrelease Survival, and Imprinting of Pen-Acclimated and Direct-Stocked Chinook Salmon in Lake Ontario. *North American Journal of Fisheries Management*, 42(3), 713-740.
- Connor, W. P., Smith, S. G., Andersen, T., Bradbury, S. M., Burum, D. C., Hockersmith, E. E., Schuck, M.L., Mendel, G.W, and Bugert, R. M. (2004). Postrelease performance of hatchery yearling and subyearling fall Chinook salmon released into the Snake River. *North American Journal of Fisheries Management*, 24(2), 545-560.
- Legard, C.D. 2018. Great Lakes Trout and Salmon Cooperative Pen-Rearing Standard Operating Procedures. NYSDEC. Albany, NY.
- Strait, L.E. 1981. Requirements for optimum development of a lake-run salmonid fishery in the lower Saranac River: Stocking, fish passage, access. NYSDEC. Ray Brook, NY.
- Strait, L.E. and D.S. Plosila. 1981. Performance Report for Job 3B Assessments of salmon pre-smolts in streams. NYSDEC. Ray Brook, NY.
- Steele, Craig A., et al. "Parentage-based tagging: Reviewing the implementation of a new tool for an old problem." *Fisheries* 44.9 (2019): 412-422.