Miramichi Salmon Association

Atlantic Salmon Smolt Estimate Report

2021

Introduction

Declining Atlantic salmon (*Salmo salar*) runs in the Miramichi River during the 1970s and early 1980s marked the beginning of increased conservation efforts for this species. Action plans were developed and implemented, including the closure of the commercial fishery and the mandatory release of all large salmon by anglers. From 1984 – 1992 the stocks rebounded, and numbers were on the rise. After 1992, however, stocks began declining again and have continued to do so over the last three decades. In recent years, the Southwest Miramichi River (SW) has outperformed the Northwest Miramichi River (NW) for adult returns. From 1998 – 2014, the Northwest River system only reached conservation requirements of returning adult salmon in two separate years, whereas the Southwest River system met requirements in seven of those years. The average conservation requirement for returning adults from 1998 – 2014 was 103% on the Southwest branch and 51% on the Northwest branch. In 2015, the Department of Fisheries and Oceans (DFO) developed the Limit Reference Point (LRP), which is one of the three components that make up a decision-making framework for fisheries known as the Precautionary Approach (PA). They defined the LRP as "the stock level below which productivity is sufficiently impaired to cause serious harm" (DFO, 2009), and it is measured in the number of eggs per meter squared (m^2) of fluvial wetted area. For the Southwest Miramichi River system, the LRP is 1.52 eggs/m^2; for the Northwest Miramichi River system, it is 1.76 eggs/m^2 (DFO, 2018). The lowest recorded number of adult returns on both the Northwest and Southwest Miramichi Rivers occurred in 2019, with the estimated egg deposition being well below the LRP for both branches; SW LRP was 64%, and NW LRP was 29% (DFO, 2020).

Electrofishing results from the Miramichi River's' Northwest and Southwest branches have typically shown healthy numbers of salmon fry and parr in the past. Currently, smolt production appears stable, but adult returns are not reflecting healthy fry and parr trends (DFO, 2021; DFO,

2022) . In 2011, angling regulations on the Northwest Miramichi River were modified to a catch and release fishery only to reduce human harvesting mortality on grilse, and in 2015, all New Brunswick rivers became mandatory catch and release fisheries of all Atlantic salmon due to the continual decline in stocks (DFO, 2019). The Northwest Miramichi River is also the confirmed site of a striped bass spawning ground, where striped bass spawning coincides with salmon smolt migration to the ocean. This overlap could impact salmon smolt mortality through predation by striped bass. Striped bass are also present in the Southwest Miramichi River but not in highly concentrated numbers like the spawning observed in the Northwest River.

Smolt population estimates have been done on the Northwest and Southwest branches of the Miramichi River system separately and on the entire river system. The Miramichi Salmon Association (MSA) has conducted ten years of estimates on the Southwest branch (2001 - 2010), three years on the Northwest branch (2011 - 2013), and two years on the entire river system (2014 - 2015). Smolt estimates were not completed from 2016 - 2018 as the MSA focused conservation efforts toward the Collaboration for Atlantic Salmon Tomorrow (CAST) program. The smolt estimate program returned in 2019 and 2020 on the Northwest and Little Southwest Miramichi Rivers when the MSA and other like-minded conservation groups were concerned about the increasing striped bass population, the decreasing number of returning adult salmon, and the ongoing impacts of climate change. The focus was initially planned for the Northwest branch, with plans to expand to the Southwest branch in the future. The smolt estimate program then continued in 2021 on the Northwest and Dungarvon Rivers.

An accurate estimate of the total smolt population migrating out of the Northwest and Southwest Branches of the Miramichi River to the ocean is a crucial component to understanding and managing Atlantic salmon in this area. This study aims to assess smolt production on the Northwest Miramichi River and the Dungarvon River (Figure 1) to determine if adequate juvenile production is occurring. Ocean survival rates of smolts can then be observed in subsequent years as adults return as grilse and multi-sea-winter salmon and will help guide management decisions to conserve this critical population of salmon.

Methods

Study Area

The Northwest Miramichi watershed drainage area makes up approximately one-third of the total watershed of the Miramichi River. The Northwest Miramichi basin includes two major river systems: the Little Southwest River (1,345km^2) and the Northwest Miramichi River (2,138km^2), which merge into a delta at the head of tide. The Northwest Miramichi River also includes a large tributary, the Sevogle River (DFO, 2018).

The Southwest Miramichi watershed drainage area makes up approximately two-thirds of the total watershed of the Miramichi River. The Southwest Miramichi basin includes two main river systems: the Southwest Miramichi River (5,840km^2) and the Renous River (1,429km^2). The Dungarvon River is a tributary of the Renous River (DFO, 2018).

Design

Smolt populations in the Northwest branch of the Miramichi River and the Dungarvon River were assessed using a mark-recapture program, with population estimates calculated through corrected Petersen and Bayesian methods. Three rotary screw traps, or smolt wheels, were installed in early May when water levels were accessible and the water warmed to 4-5°C. Two wheels were installed on the Northwest River at the Wayerton Bridge (47.134943°, -65.832723°) and one wheel in a new location on the Dungarvon River (46.816370°, -65.902174°). The wheels were held in place by a large overhead cable that spanned the river's width. A second cable was connected from the overhead line to the wheel. Two pontoons kept the wheel partially afloat and allowed the central trap to rotate fully (the current forces the trap to turn) without hitting the bottom of the river.

Fish entering the wheel were funnelled through the rotating trap into a live box at the back of the wheel. The rotating trap prevented any fish from escaping the box. All fish caught in the live box were collected and sorted. Each species was identified, counted, and released except for the Atlantic salmon smolt, which also had fork length recorded and scale samples taken. Fork lengths (mm) were measured on a maximum of 25 smolts per day, and scale samples were taken from 2 of these 25. The 23 smolts not scale sampled were individually

tagged with a small, numbered streamer tag. Any remaining unmeasured smolts, up to a maximum of 100 per day, were also tagged. After 100 smolts were tagged, all remaining smolts in the box were counted and released untagged. A maximum of 10 scale samples were taken each day, and each sampled fish was released back into the water with no streamer tag. For the purpose of this study, all juvenile Atlantic salmon greater than 100 mm (FL) were considered smolt. All tagged fish were placed in buckets (maximum of 25 fish per bucket) and then transported, in an oxygenated tank on the back of a truck, approximately 5 km upstream for release. The number of tagged smolts recaptured at the smolt wheel allowed us to estimate the number of smolts migrating out of that tributary.

Permits

Scientific Collection Permits from the Department of Fisheries and Oceans (SG-RHQ-22-027 and SG-RHQ-22-020) were obtained prior to starting this project.

Results

The Northwest smolt wheels operated from May 3rd to May 28th, 2021. A total of 1,370 smolts were tagged on the Northwest River, and 109 smolts were recaptured. The peak of the smolt run occurred on May 7th, with a total of 812 smolts captured (Figure 2). Due to lowering water levels, both wheels were readjusted to achieve proper rotations per minute (RPM) and ensure safety protocols were met.

A total of 1,268 smolts were captured through Wheel 1 at Wayerton, and 45 smolts were recaptured with Wheel 1. A total of 1,499 smolts were captured, and 64 smolts were recaptured with Wheel 2.

Applying a 10% mortality rate to our population estimate (using the Bayesian method), it was estimated that 27,900 (95% CI 23,400 – 33,900) smolts migrated from the Northwest River in the spring of 2021 (Figure 3). A similar estimate was obtained through the Corrected Peterson method. Overall, we estimated 0.34 smolts/100m^2.

The smolt wheel on the Southwest River operated from May 4th - May 28th, 2021. A total of 535 Atlantic smolts were captured. Among the captured smolts, 295 smolts were

transported for collection to the hatchery facility at Miramichi Fisheries Management, 236 were tagged with a streamer tag and released upstream, and 4 of those fish were recaptured in the smolt wheel. The peak of the smolt run occurred on May 16th, with 73 smolts captured (Figure 2).

Applying a 10% mortality rate to our population estimate (using the Bayesian method), it was estimated that 27,100 (95% CI 13,600 – 37,300) smolts migrated from the Southwest River in the spring of 2021 (Figure 4). Similar results were obtained through the Corrected Peterson method. Overall, the estimate equated to 1.27 smolts/100m^2.

Discussion

The Northwest River estimate of 27,900 smolts was very low compared to the 600,000 smolts needed annually to maintain population targets. Having a close range of confidence interval of 23,400- 33,900 with only a 10,500 differentiating range leads to a normal distributed result.

Due to the collection of 295 smolts from the Dungarvon wheel for a separate research program, the smolt estimate confidence interval range was wide. The collection data for the Miramichi Fisheries Management could not be excluded from the total estimate data set, creating a skewed result.

Smolt estimates are a key component of understanding and managing Atlantic salmon populations. With the steady decline in returning adult salmon numbers in the Miramichi River, smolt migration numbers can help conservation groups and management/policy administrators determine where our conservation efforts can be best focused. By knowing the smolt numbers migrating out of the Miramichi River system and comparing that figure to adult returns, the at-sea mortality portion of the salmon life cycle can be better quantified, especially in tandem with smolt and kelt tracking programs that MSA participates in with the Atlantic Salmon Federation (ASF). Returning to conduct an annual smolt estimate on the Northwest Miramichi River in 2021 was important to fill the data collection gap that had been missing for over five years.

Acknowledgements

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Appendix

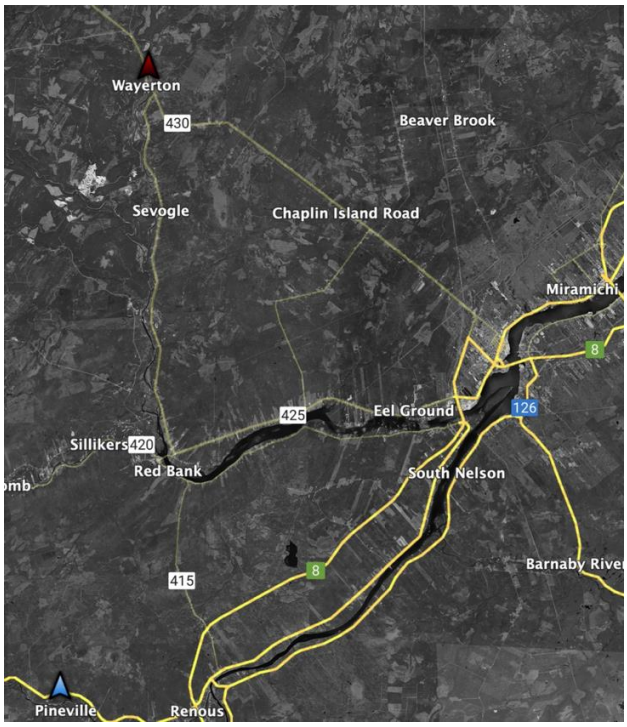

Figure 1. Locations of the three smolt wheels operating in 2021. One wheel at the Dungarvon River location (blue arrow) and two wheels at the Northwest River location (red arrow).

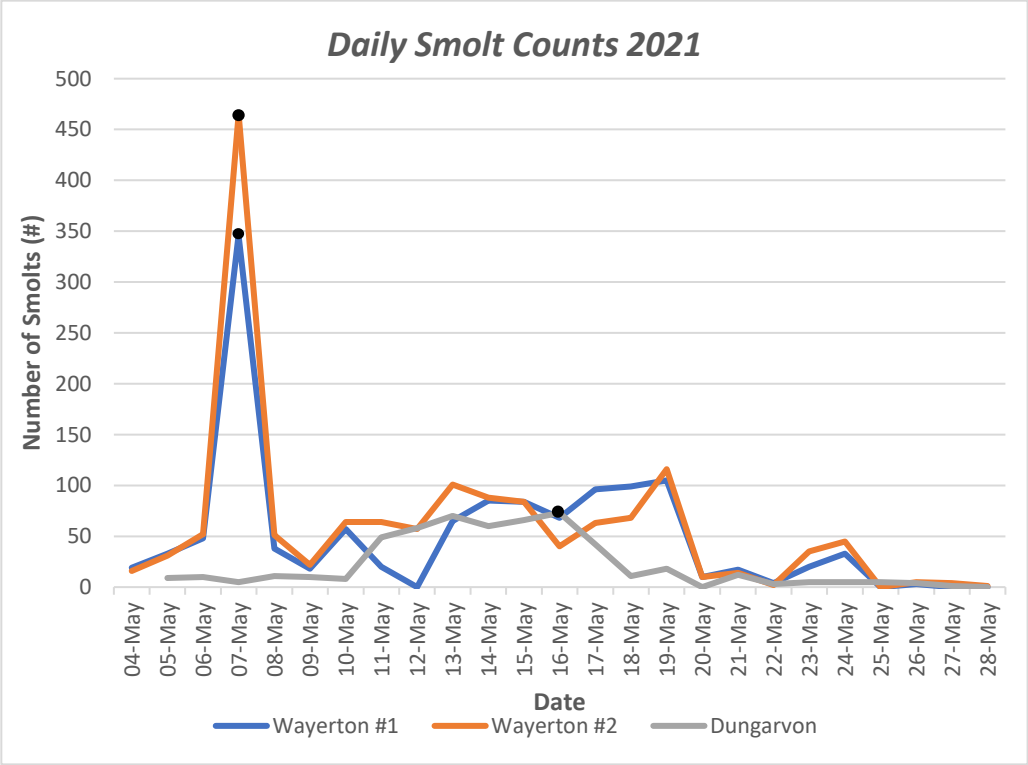

Figure 2. Daily smolt counts at the three wheels operated during May 2021. Peak numbers (black dots) occurred on the Northwest on May 7th, and on the Dungarvon on May 16th.

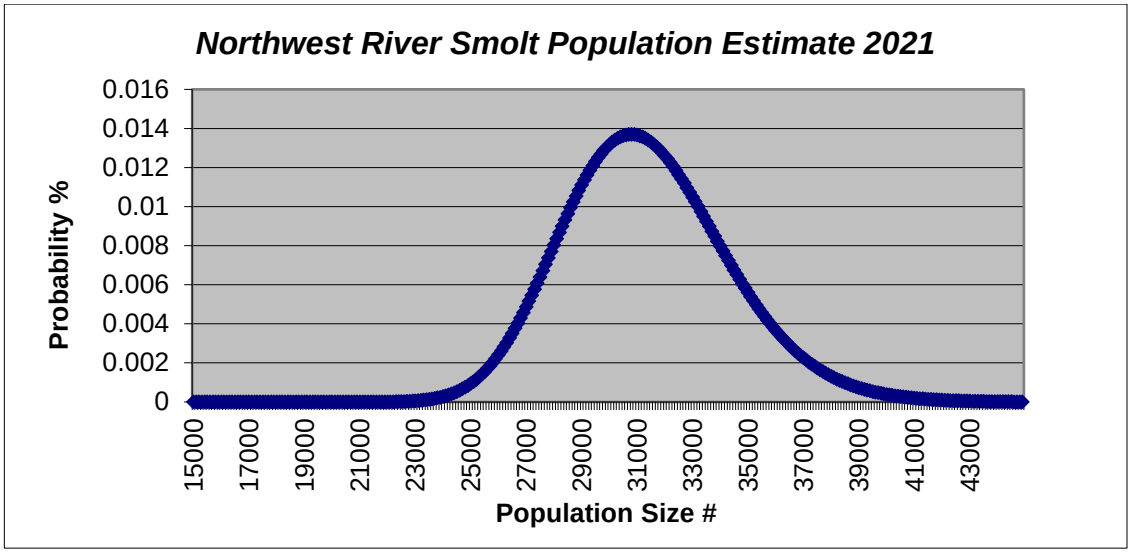

Figure 3. Smolt population estimate for the Northwest River during May 2021. A 10% mortality rate was applied (using the Bayesian method) creating a population estimate of 27,900 (95% CI 23,400 – 33,900) smolts.

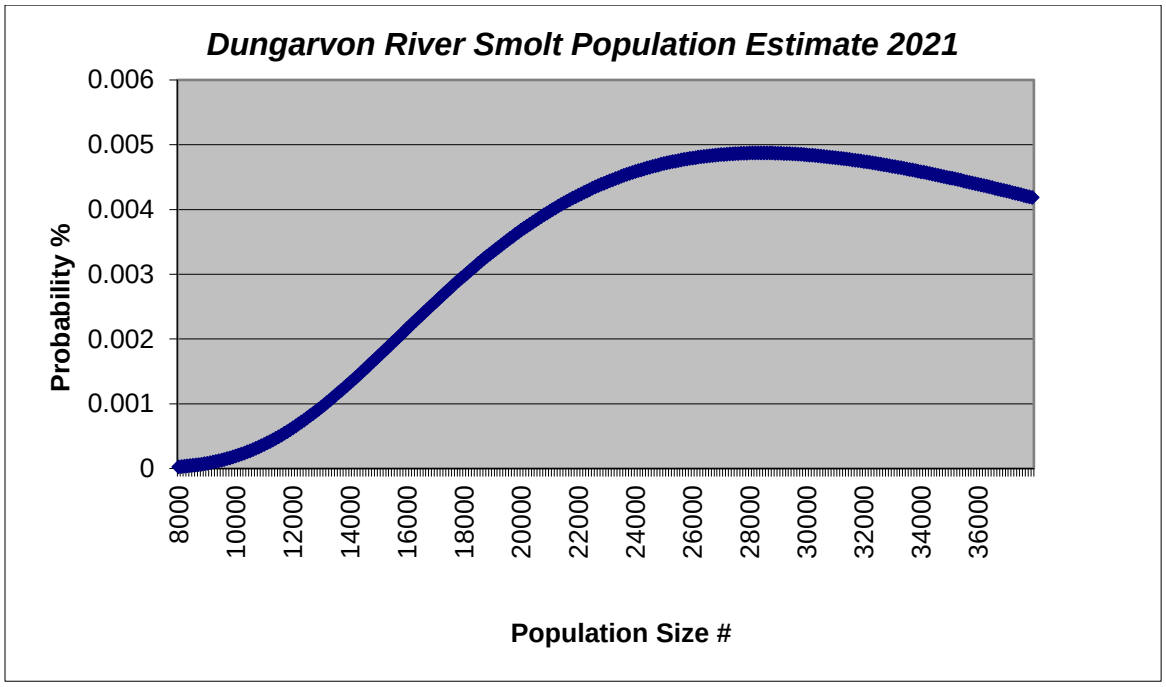

Figure 4. Smolt population estimate for the Dungarvon River during May 2021. A 10% mortality rate was applied (using the Bayesian method) creating a population estimate of 27,100 (95% CI 13,600 – 37,300) smolts.