Smolt Production on the Northwest Miramichi
2011

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Department of Fisheries and Oceans
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By

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Introduction

Over the past three decades there has been a continuing need for conservation efforts to sustain Atlantic salmon stocks in the Miramichi River. While the adult stock assessment has indicated that Southwest Miramichi has averaged 103% (range 77% to 119%) of the conservation requirement (for sustainability) in the years 1998 – 2009, the Northwest Miramichi typically reaches less than 50% (range 26% to 111%) of spawning escapement in a given year.

Although electrofishing studies on the Northwest Miramichi have consistently indicated an abundance of fry and parr in the river, the adult returns have been much lower than should logically be expected. It has been assumed that smolt production would be consistent with the levels of juveniles, however adult returns to the Northwest Miramichi do not seem to reflect this trend. Hence, an accurate estimation of the total smolt population migrating from the Northwest Miramichi River and it's tributaries is an essential component to understanding and managing Atlantic salmon in this watershed and a way to measure at-sea survival of smolts returning as grilse and salmon. This information will also allow us to determine which tributaries contribute the most to smolt production on the Northwest Miramichi since the juvenile densities (fry and parr) vary between tributaries, with the Little Southwest being the lowest, Sevogle moderate and Northwest Miramichi being highest.

The Northwest Miramichi system likely experiences an increased harvest compared to the Southwest Miramichi of grilse and salmon due to the abundance of public pools, crown reserve stretches and First Nation Fisheries Allocations which could reduce the number of salmon available for spawning each year. Additionally the Northwest Miramichi has an increasing striped bass population which contributes to increased mortality of smolts exiting this system on their way to the ocean.
The purpose of this project is to assess smolt production on the Northwest Miramichi system, and it's three major tributaries; the Big Sevogle River, the Northwest Miramichi tributary and the Little Southwest Miramichi (smolt estimate conducted by the Northumberland Salmon Protection Association (NSPA)) to determine if adequate juvenile production is occurring in the Northwest Miramichi River System. The data will be used to allow science based management decisions to be made for the Northwest Miramichi system since the conservation targets of adult salmon have rarely been met. Finally, to determine the at sea-survival from smolt to adult salmon on the Northwest, since it may be higher due to predation by striped bass, as smolts move through the primary spawning area for striped bass in the Gulf of St. Lawrence.

Methods

The method used to obtain the smolt estimates was a mark and recapture experiment. On the Sevogle, Northwest and Little Southwest Rivers (NSPA), rotary screw traps (RST) or smolt wheels were used to capture smolts for tagging. The smolt wheel was strung across the river by an overhead cable and floated on the top of the water by two large pontoons. The current forced the partially submerged wheel to rotate. Any fish that entered the trap were guided into the trap's holding box which is located at the back of the smolt wheel. The rotating wheel prevented the fish from swimming out of the trap. All the fish in the live-box were collected and sorted. Each species caught was identified, counted and

released, except for salmon smolts, which were measured for fork length and then tagged with streamer research tags. Scale samples were also taken from up to five smolts per day for age analysis. After the smolts were tagged they were moved upstream of the smolt wheel. The percent of tagged smolts that are recaptured at the smolt wheel allow us to estimate the number of smolts moving out of that particular tributary.

A single large trapnet was installed in the estuary of the Northwest Miramichi at Cassilis to capture smolts moving from freshwater into the estuary. Tagged smolts captured at the Cassilis trap net allow us to get an estimate of the smolts moving out of the entire Northwest Miramichi. The Cassilis trapnet efficiency is calculated by the total catch of smolts at Cassilis divided by the population estimate. The total smolt run from the Northwest Miramichi is determined by a ratio of the number smolts that are tagged upstream at the Sevogle, Northwest and Little Southwest smolt wheels, the number of tagged smolts that are recaptured at the Cassilis trap and the number of untagged smolts captured at the Cassilis trap. This latter facility was fished daily, generally at low tide, and the smolts were sorted from the rest of the species captured. Each day, sub-samples of up to 100 smolts were measured and 20 were sampled in detail for length, weight, sex and age. All smolts captured were counted and checked for missing adipose fin clips and streamer tags.

Permits

The Navigable Waters Permit from the Department of Transportation, Instream Data Collection Devices Permit from the local Department of Environment and the Scientific Collection Permit from the Department of Fisheries and Oceans were all obtained prior to starting this project.

Results

The Sevogle smolt wheel operated from May 3 to June 2, however was not operating on May 5-9th due to high water conditions and a tree that destroyed the trap of the smolt wheel. The Northwest smolt wheel operated from May 3 to June 4, however did not operate from May 5-8 due to high water conditions. The Little Southwest smolt wheel operated from May 3-June 5, however also did not operate from May 5-9 due to high water conditions. The estuary trap net at Cassilis operated from May 18 to June 10, 2011, was late being put in due to high water conditions.

The peak of the smolt run for the Sevogle River was May 21 and 182 smolts were captured that day. The peak of the smolt run on the Northwest River was May 22 with 307 smolts being captured that day. The peak of the smolt run on the Little Southwest River was May 30 with 250 smolts being captured that day. This year we tagged 812 smolts on the Sevogle and 1055 smolts on the Northwest Miramichi, and 1036 on the Little Southwest Miramichi. We were able to capture 909 smolts in the Sevogle smolt wheel and 1153 smolts on the Northwest smolt wheel, and 1898 smolts on the Little Southwest smolt wheel over the entire season. The capture efficiency of the Sevogle smolt wheel was the lowest at 1.6%, however the Northwest Miramichi (3.0%) and Little Southwest Miramichi (2.8%) smolt wheels had good capture efficiencies.

At the Cassilis estuary trap, we captured 9,958 smolts, 42,000 smelts, 861 striped bass and 250 gaspereau as well as many other species throughout the season. We were

able to recapture 34 smolts with streamer tags at the Cassilis trap net which were tagged at the Sevogle, Northwest or Little Southwest smolt wheels upstream. Smolt production on the Northwest Miramichi in 2011 was estimated at 765,000 smolts (4.6 smolts per $100m^2$) assuming a 10% mortality of tagged smolts due to handling and predation.

The smolt estimate for the Sevogle River in 2011 was 56,800 (CI 37,000 to 114,000), which worked out to be 2.0 smolts per $100m^2$. The smolt estimate for the Northwest River in 2011 was 38,000 (CI 28,000 to 57,000), which worked out to be 1.0 smolts per $100m^2$. The smolt estimate for the Little Southwest River in 2011 was 70,000 (CI 50,000 to 104,000), which worked out to be 1.8 smolts per $100m^2$. Therefore according to our smolt estimates none of the major tributaries of the Northwest Miramichi met the target of 3.0 smolts per $100m^2$.

Our objective to reach the 3.0 smolts per $100m^2$ smolt production target for the Miramichi was exceeded on the Northwest Miramichi River as a whole, however smolt production on the Sevogle, Northwest and Little Southwest Miramichi was were much lower than expected in 2011 with none of the rivers seemingly meeting the production target of 3.0 smolts per $100m^2$.

Discussion

The Northwest Miramichi River as a whole, exceeded the smolt production target for the Miramichi River in 2011. We were surprised by this result as the numbers of adults returning to the river each year has generally been below the conservation requirements for the river.

We were very surprised that the smolt production on the Sevogle, Northwest and Little Southwest Miramichi was low in 2011 with none of the rivers seemingly meeting the production targets, particularly since there were very high parr numbers on the Northwest and Sevogle Rivers, especially in the headwater areas. The largest problem we encountered was with the analysis of the smolt estimates. When the branch estimates were added, (Little Southwest, Sevogle, Northwest combined produce an estimated 164,000 smolts), however they do not add to near the estimates produced from the Northwest Miramichi system (trap at Cassilis 765,000 smolts), even assuming a 20% mortality due to predation.

One problem that we had with this project was that the water was extremely high on the Miramichi early in spring and all of the smolt wheels had to be tied up for 5 days so they would not be lost by the high water. Even so, the trap box of the Sevogle smolt wheel was destroyed when a tree hit the raised wheel. The wheel was replaced and the study continued.

We feel that the Northwest system estuary trap net estimate best represents the number of smolts produced by the Northwest Miramichi System. There are two reasons for this, firstly because the capture efficiencies for the fish tagged in each tributary are very similar which indicates that adequate mixing of marked individuals is occurring (Table 1), and secondly if we use only the number of tags put on at each smolt wheel and the recaptures at the trap from the different wheels, for the mark-recapture experiment, they give similar estimates to the Northwest System estuary trap (Table 1).

It is possible that high discharge in spring flushed smolts from the tributaries or some smolts were moving during the time when the wheels were up due to high water and therefore underestimated. However it is unlikely that hundred of thousands of smolts

were moving when the wheels were up due to high water because the water temperature was still low (<8°C).

It was very surprising that the Northwest Miramichi tributary and Sevogle had such low smolt production. Especially considering the very high numbers of parr (1-2+) found in the Northwest Miramichi tributary by electrofishing the previous year (6 out of 9 sites had greater than 30 parr per $100m^2$) and Sevogle (3 out of 6 sites had greater than 30 parr per $100m^2$).

Alternately, smolt production may be lower than expected due to the movement of presmolts from the Northwest Miramichi tributary and possibly the Sevogle. It is speculated that Rocky Brook on the Southwest Miramichi does not contain enough over-winter habitat for the high numbers of parr that live there. On average, a minimum of 72% of a smolts produced by Rocky Brook leave as presmolts in fall. These large numbers of parr destined to become smolts exit the brook in late fall to seek suitable over-wintering habitat downstream. We speculate that the low smolt estimate on the Northwest Miramichi may result from pre-smolt movements since there are very high numbers of parr in the headwaters of the Northwest tributary. If this is the case it is surprising that the presmolts seemed to move much lower than the Northwest smolt wheel at Trout Brook to overwinter, since they were not picked up at the smolt wheel which is approximately 14 km upstream from the head of tide.

Another explanation for such low smolt numbers from the tributaries (smolt wheels) is due to gear bias. Assuming that 765,000 smolts were produced from the Northwest Miramichi system the number of smolts captured in the smolt wheels should be much higher (Table 2). It may be that the method of recycling smolts in the smolt wheels over-inflates the trap efficiency, resulting in lower than expected smolt estimates.

Based on one year of data, it appears as though the current management actions on the Northwest Miramichi may be capable of sustaining salmon on the Northwest Miramichi system as a whole. However more years are required to determine if this is a one year event or if the Northwest Miramichi meets smolt production targets regularly. It is unclear as to which tributaries contribute the most to juvenile production as the target of 3.0 smolts per $100m^2$ was not met in any of the tributaries and the tributaries with the highest juvenile densities did not produce the highest number of smolts. Due to this it is also difficult to determine which tributaries may be over-exploited or under-seeded.

The recommendations we have for future work is to continue counting smolts on the Northwest system and its tributaries to determine if smolt production is being met in more than one year. Other projects that would give insight into the smolt dynamics on the Northwest Miramichi would be to install a smolt wheel in the fall to determine if presmolts are moving out of the Northwest Miramichi and the Sevogle, which is resulting in underestimated smolt counts in spring. Install acoustic tags to determine where these presmolts may be over-wintering and if they are over-wintering below the smolt trap at Trout Brook and capture smolts with a different method at the smolt wheels (ie. fyke net, counting fence) to determine if the recycling method isn't over estimating the wheel efficiencies and resulting in lower than expected estimates on our river.

The data from this project will be used in the Northwest Miramichi Management Plan, developed by the Miramichi Watershed Management Committee (MWMC) to determine the stock status of Atlantic on the Northwest Miramichi and aid in future regulation changes for the grilse fishery. The results of this study will be discussed at the MWMC Science Committee meeting and presented to the Miramichi Salmon Association board. The data collected from this project will be sent to the New Brunswick Data Warehouse. Data from this project is also being used to assess the survival of salmon parr (1-2+) to the smolt stage by comparing electrofishing densities the previous year and to assess the survival to the grilse and two sea-winter maiden salmon stage by comparing smolt estimates to the returns of grilse and salmon the following years.

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Table 1. Smolt estimates for the **Northwest System**, based on the tags applied at the Little Southwest, Sevogle, Northwest smolt wheels and recaptures at the Northwest trap net at Cassilis. Upper and lower confidence intervals (CI) are given.

Tagging Location	Estimate	Lower (CI)	Upper (CI)	Smolts per unit	Recapture Efficiency
Little Southwest	640,000	420,000	1,295,000	3.8	1.3%
Sevogle	724,000	444,000	1,732,000	4.3	1.1%
Northwest	777,200	492,000	1,457,200	4.6	1.0%
Combined	**765,000**	**570,000**	**1,047,500**	**4.6**	1.2%

Table 2. Number of smolts needed to be captured in the Little Southwest, Sevogle and Northwest smolt wheels, assuming measured trap efficiency and Northwest System smolt estimate of 765,000 smolts.

Variable	Little Southwest	Sevogle	Northwest	Below wheels
Habitat units (m2)	79,289	28,936	37,716	21,946
Trap Efficiency	2.8%	1.6%	2.7%	2.4%
Smolt per unit	4.5	4.5	4.5	4.9
Population Size	359,550	130,050	168,000	107,100
Estimated Catch	**10,067**	**2,081**	**4,536**	

Promotion

The New Brunswick Wildlife Trust Fund was promoted through the Northwest Smolt Production Study by the use of the pencils and stickers, on the gear used at the smolt wheels, as well the logo was on the overhanging cable signs above the smolt wheels. Through the MSA website under Programs, the NB WTF will be acknowledged, as well as in the report from this project to be circulated at the Miramichi Watershed

Management Committee Science Committee meetings and at MSA board meetings in Boston, MA and Freeport, ME as well as acknowledged at the joint MWMC/MSA Science Workshop in April 2012.