Miramichi Salmon Association
Conservation Field Program Report 2012

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1 Overview

This report is a review of the 2012 Miramichi Salmon Association (MSA) field and research programs implemented in the Miramichi River watershed. The MSA was started in 1953 as a non-profit conservation group dedicated to protecting the Miramichi River system. The MSA has acted as a conservation advocate on behalf of anglers, outfitters, guides, and all others with economic, environmental, and recreational interests in the river. Managed by volunteers from Canada, the USA and abroad, as officers and directors, the MSA remains cooperative with, but independent of, government or special interests influence. It responds only to its growing conservation membership. The MSA employs four full-time staff as well as one seasonal field technician.

The MSA has evolved from primarily a conservation advocate group to non-profit conservation group whose work focuses on research and field programs. Through partnerships with government organizations and other non-profit groups, the MSA has been crucial in increasing the amount that is known about Atlantic salmon on this river, assessing the current status of many life stages of Atlantic salmon, and providing funding to other important programs that would not be able to take place. In addition the MSA oversees the Miramichi Salmon Conservation Centre, located in South Esk, NB, which is used to produce Atlantic salmon and brook trout fry for enhancement activities.

2 Atlantic Salmon Kelt Tracking using Acoustic and Satellite Tags

Introduction

Spring salmon, or “kelt”, is an Atlantic salmon (*Salmo salar*) that has spawned in the previous fall, remained in the river over winter, and is migrating back towards the ocean in the spring to feed and recondition. Kelt survival in the Miramichi River has been estimated between 15-20% based on the life history characteristics salmon captured in the DFO index trap-nets. Kelt that manage to exit the river, recondition at sea, and return to the river for spawning are termed repeat spawners. Repeat spawning kelt are important for juvenile production in the Miramichi River system as they tend to be larger, produce larger eggs, and have more eggs than maiden salmon. Furthermore, it is estimated that repeat spawning salmon produce between 25-40% of the salmon eggs laid in the Miramichi River each year. A kelt that leaves the river in spring, reconditions in the Gulf of St. Lawrence, and returns to the river to spawn in the same year is termed a consecutive spawner. A kelt that leaves the river in spring, reconditions in the gulf or Atlantic Ocean, and returns to spawn in the river the following year are termed alternate spawners. The ratio of kelt that return to the river as alternate spawners or consecutive spawners is roughly 1:1, depending on the year. Based on previous year’s results from the acoustic tagging kelt study, the largest loss of Atlantic salmon kelt appears to be at sea, although prior to the use of satellite tags, identifying these mortalities areas has not been possible.

The purpose of this project is to further our understanding of the migration paths and timing of kelt movements through the Miramichi River, Miramichi Bay, and Gulf of St. Lawrence using both acoustic and satellite tags. We will determine how long individual kelt spend in the ocean before returning to spawn as well as the fine-scale locations and potential sources of mortality for kelt while they are reconditioning in the gulf and ocean.

Methods

To track both freshwater and marine movement patterns, Atlantic salmon kelt were tagged with either external acoustic transmitters (= “acoustic tagged”) or kelt were tagged with small external acoustic tags and satellite tags (= “satellite tagged”). Vemco VR2 receivers were deployed to detect within river movements with the most upstream receivers located just below the head-of-tide in the Northwest Miramichi River (Cassilis trap-net) and Southwest Miramichi River (Millerton trap-net) (Fig. 1). Other receivers were spread throughout the Northwest branch, Southwest branch, and main stem Miramichi River (Fig. 1). The most downstream Miramichi River receiver was located at river mouth in Loggieville (Fig. 1). Receivers were also located at the Miramichi Bay exits between the barrier islands near Neguac, Portage Island Channel, and Huckleberry Gully (Fig. 1). Finally, the acoustic receivers were deployed at the Gulf of St. Lawrence exits to the Atlantic Ocean in the Strait of Belle Isle between Newfoundland and Labrador and in the Cabot Strait between Newfoundland and Cape Breton. This is the second year that Cabot Strait had receivers and these were put in place through the Ocean Tracking Network.

Kelt were captured by angling on the Miramichi River near the Northwest Miramichi River head-of-tide at the Red Bank Bridge on April 20-21, 2012. Fish were anesthetized and held upside down in a holding box with a wet sponge over the fishes’ head to keep the gills moist. Acoustic tagged fish had transmitter surgically inserted into the abdominal cavity by making a small incision in the abdominal wall and sliding the transmitter into the cavity. The incision was then closed with 2-3 sutures depending on the size of the incision taking between 1-3 minutes. Satellite tagged kelt the acoustic receiver implanted in the abdominal cavity as well as a satellite tags that was attached into the dorsal fin cartilage using a specialized thin wire. After surgery the fish was placed in a wooden recovery box with river water flowing through it and after the fish had fully recovered it was released back into the river. The acoustic tags gave each fish an individual code and these codes were used to identify the fish when they passed by receivers. Each time a tag passed by one of the receivers, the receiver recorded the tag number, date, and time. The satellite tags were pre-programmed to pop-off, half of the tags on September 1 and half on September 30, or to prematurely detach from the fish if the depth profile doesn’t change for three days (assuming mortality).

Results

Overall 35 kelt were angled and tagged (25 acoustic and 10 satellite) over the two-day period on the Northwest Miramichi River (Table 1). A range of fish sizes were tagged with the smallest at 60.2 centimeters (cm) and the largest at 98.5cm (Table 1). Of the tagged kelt there was one male grilse, one male salmon, and 33 female salmon.

Kelt survival out of Miramichi River was very high as 94.3% (33/35) of the tagged kelt were detected exiting the mouth of the river (Table 2). The two kelt, one acoustic and one satellite (ID-117455), that died within the river were last detected swimming between the Cassilis and Millstream receivers, just below the head-of-tide. A handheld acoustic receiver was used to actively search for the satellite tagged kelt in order to retrieve the tag in the river, but neither tag was detected. Kelt survival through the inner Miramichi Bay barrier island receivers was also high as 88.6% of the tags were detected (Table 2). Kelt moved through Miramichi Bay between April 26 and May 18, 2012 (Fig. 2). Of the 31 kelt exiting the Miramichi Bay, two kelt went through the Neguac bay exit, 28 went through receivers at Portage Island Channel, and one kelt was detected at the Huckleberry Gully receivers.

For acoustic tagged kelt, after exiting Miramichi Bay only four of these were detected at the Strait of Belle Isle receivers, while none of the kelt passed through Cabot Strait receivers. Kelt that were detected on the Strait of Belle Isle receivers passed through the area between June 24 and July 3, 2012. All kelt that went through the Strait of Belle Isle were expected to be on their way to Greenland and will potentially return to the Miramichi River in 2013 as alternate spawners. One acoustic kelt returned back to the Northwest Miramichi River to spawn in 2012 as a consecutive spawner. Any kelt that exited the Miramichi Bay but were not detected by the receivers at the Strait of Belle Isle or Cabot Strait are either reconditioning the Gulf of Saint Lawrence or may have died at sea.

For the satellite tagged kelt, six of the tags (IDs- 117454, 117458, 117460, 117461, 117462, and 117463) prematurely popped-off from the fish in the Gulf of St. Lawrence but were still able to transmit their data to the satellites (Fig. 3). One satellite tagged kelt (ID- 117456) exited to the gulf but returned to the Northwest Miramichi River and was tracked using the acoustic handheld receiver to Big Hole Pool (Fig. 3). Unfortunately, after spending only two months reconditioning in the marine environment the fish died in Big Hold Pool, although we were able to retrieve the satellite tag and data. One kelt (ID- 117459) was detected in the Strait of Belle Isle, leaving the gulf towards the Atlantic Ocean but did not transmit its satellite data. The remaining kelt (ID- 117457) was detected entering the gulf but no satellite data was transmitted from this tag. A biologist from the ASF is currently analyzing GPS locations to determine the exact pathways for each of the recovered satellite tag data. The satellite tags also provided daily depth and temperature profiles which will also be analyzed by the ASF this winter before final results can be prepared. However, an example of the depth and temperature data revealed that two individuals revealed similar patterns that suggested they may have been eaten by a predator as sharp increases in temperature were detected, potentially from the stomach of the predator, followed by the immediate surfacing of the tag, likely after the predator excreted the tag (Fig. 4).

Results over the past five years have shown that the kelt survival out of the Miramichi River and Miramichi Bay are high; however, survival to the Strait of Belle Isle and back into the river is variable indicating there may be environmental issues, predator concerns, or problems finding adequate prey after entering the marine environment. The proportion of kelt that pass through the Strait of Belle Isle traveling towards Greenland is highly variable, ranging from a high of 45.8% in 2008 to a low of 15.5% in 2010 (Cabot Strait not included because of incomplete receiver coverage between 2008-2011). A possible explanation for the low number of kelt passing through the Strait of Belle Isle in 2010 may be explained by the high number of kelt that returned as consecutive spawners that year. However, in 2012 there was a low proportion of salmon detected at the Strait of Belle Isle receivers (16.1%) and a very low proportion of the kelt returned to the river as consecutive spawners suggesting that either the kelt are reconditioning in the Gulf of St. Lawrence or have experienced a high rate of mortality in the gulf.

Table 2.1: Summary of the kelt collected and tagged at the Red Bank bridge in the Northwest Miramichi River on April 20-21, 2012. Acoustic and satellite tag identification numbers, fork length (cm), weight (kg), and sex for each kelt are shown.

Date	Acoustic tag	Satellite tag	Fork length	Weight	Sex
20-Apr-12	15427		75.0	2.85	F
20-Apr-12	11108	117454	87.0	4.90	F
20-Apr-12	11109	117455	76.0	3.10	F
20-Apr-12	No tag		77.5	3.15	F
20-Apr-12	15428		77.9	3.10	F
20-Apr-12	11111	117457	92.3	6.05	F
20-Apr-12	15429		78.0	3.30	F
20-Apr-12	15430		79.5	3.05	F
20-Apr-12	No tag		74.2	2.90	F
20-Apr-12	15431		74.8	3.00	F
20-Apr-12	11112	117458	78.6	3.20	F
20-Apr-12	No tag		64.5	-	F
20-Apr-12	15432		98.5	6.90	F
20-Apr-12	11113	117459	80.3	3.80	F
20-Apr-12	15433		88.1	4.15	M
20-Apr-12	11114	117460	78.0	3.45	F
20-Apr-12	15434		75.3	3.10	F
20-Apr-12	11115	117461	75.5	2.65	F
20-Apr-12	11116	117462	76.0	3.05	F
20-Apr-12	11117	117463	78.6	3.50	F
20-Apr-12	15435		72.6	2.65	F
20-Apr-12	11110	117456	80.5	4.40	F
20-Apr-12	15436		80.5	4.00	F
20-Apr-12	15437		77.6	3.50	F
20-Apr-12	15438		79.4	3.70	F
20-Apr-12	15439		85.0	4.65	F
21-Apr-12	15440		82.9	4.10	F
21-Apr-12	15441		88.8	5.35	F
21-Apr-12	15442		77.5	3.50	F
21-Apr-12	15443		80.2	3.07	F
21-Apr-12	15444		97.4	7.00	F
21-Apr-12	15445		78.1	3.15	F
21-Apr-12	15446		91.0	5.65	F
21-Apr-12	15447		60.2	1.40	M
21-Apr-12	15448		67.1	2.45	F
21-Apr-12	15449		78.2	3.65	F
21-Apr-12	15450		79.2	4.00	F
21-Apr-12	15451		74.5	2.85	F

Table 2.2: Number of kelt surviving to the different receiver arrays by year.

Location	2008	2009	2010	2011	2012
Head of tide	50	50	50	50	35
River mouth	48	46	45	47	33
Miramichi Bay	48	46	45	47	31
Strait of Belle Isle	22	9	7	15	5
Returned to river as consecutive	3	4	9	5	2
Returned to river as alternate	4	0	5	2	*

* denotes that an unknown number of alternate spawning kelt that will return in 2013.

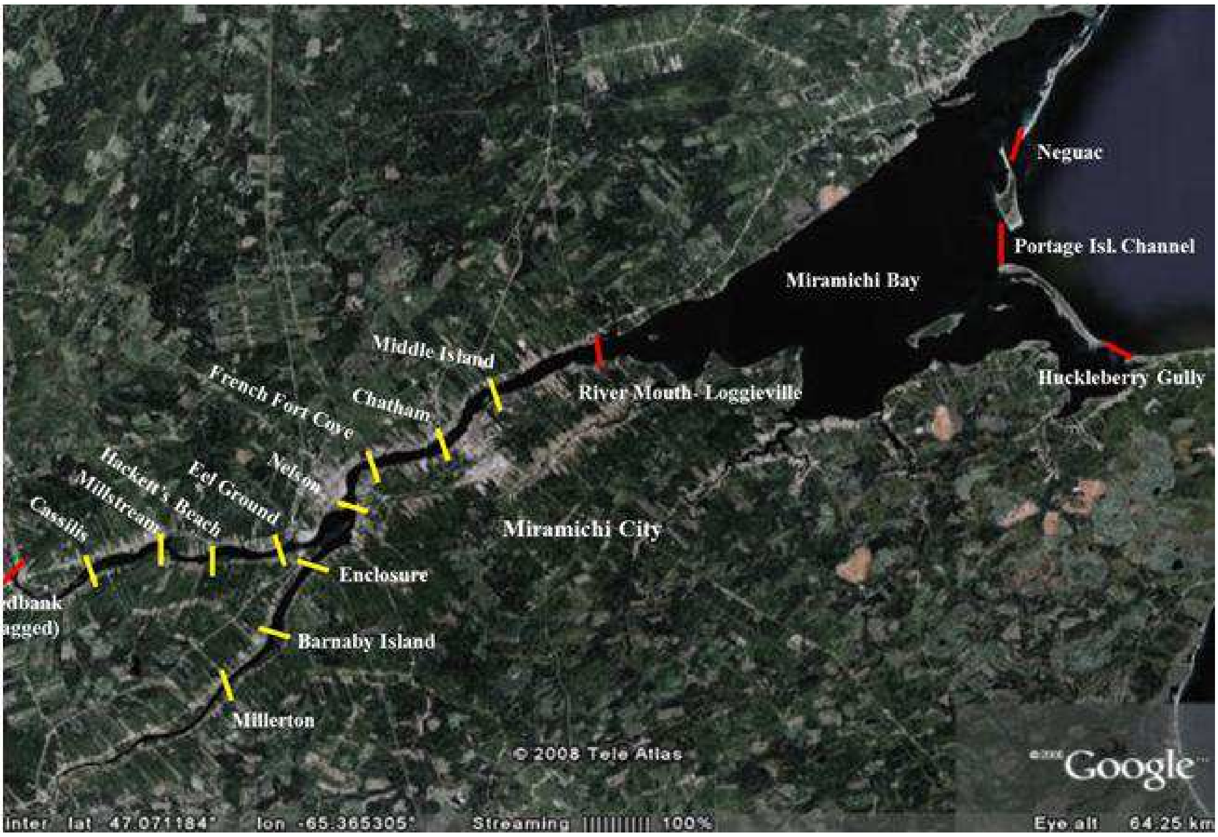


Figure 2.1: Map showing the receiver locations throughout the Miramichi River and the array of receivers in the Miramichi Bay exits at Neguac, Portage Island Channel, and Huckleberry Gully.

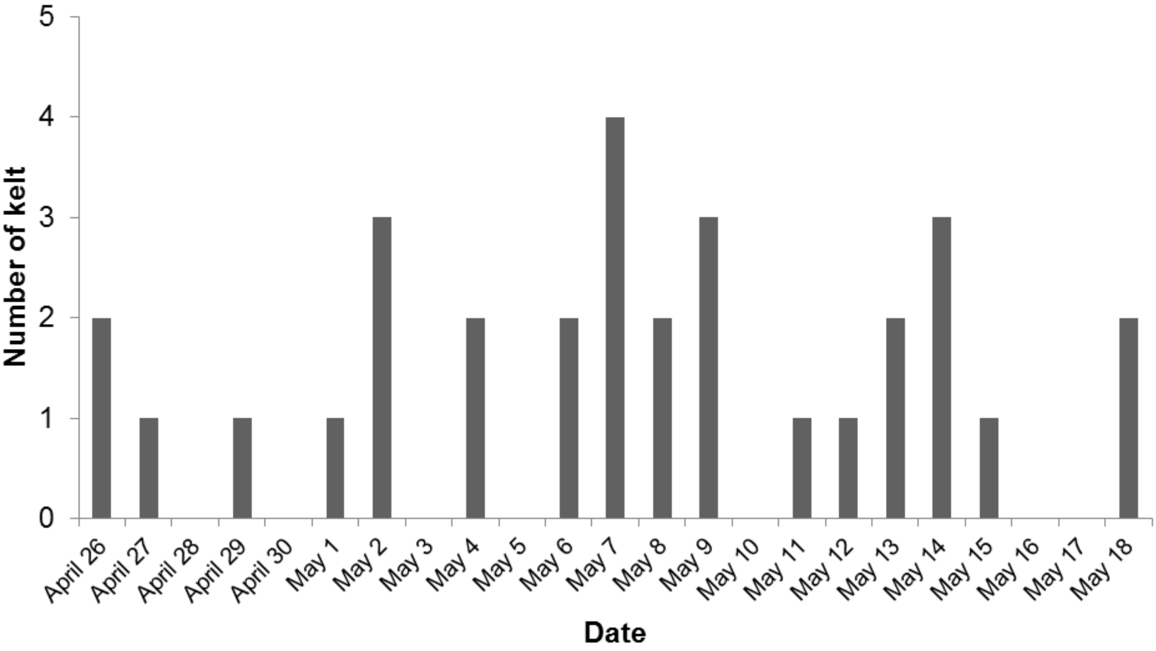


Figure 2.2: Timing of kelt movements through the receivers at the barrier islands of the inner Miramichi Bay, exiting to the Gulf of St. Lawrence.

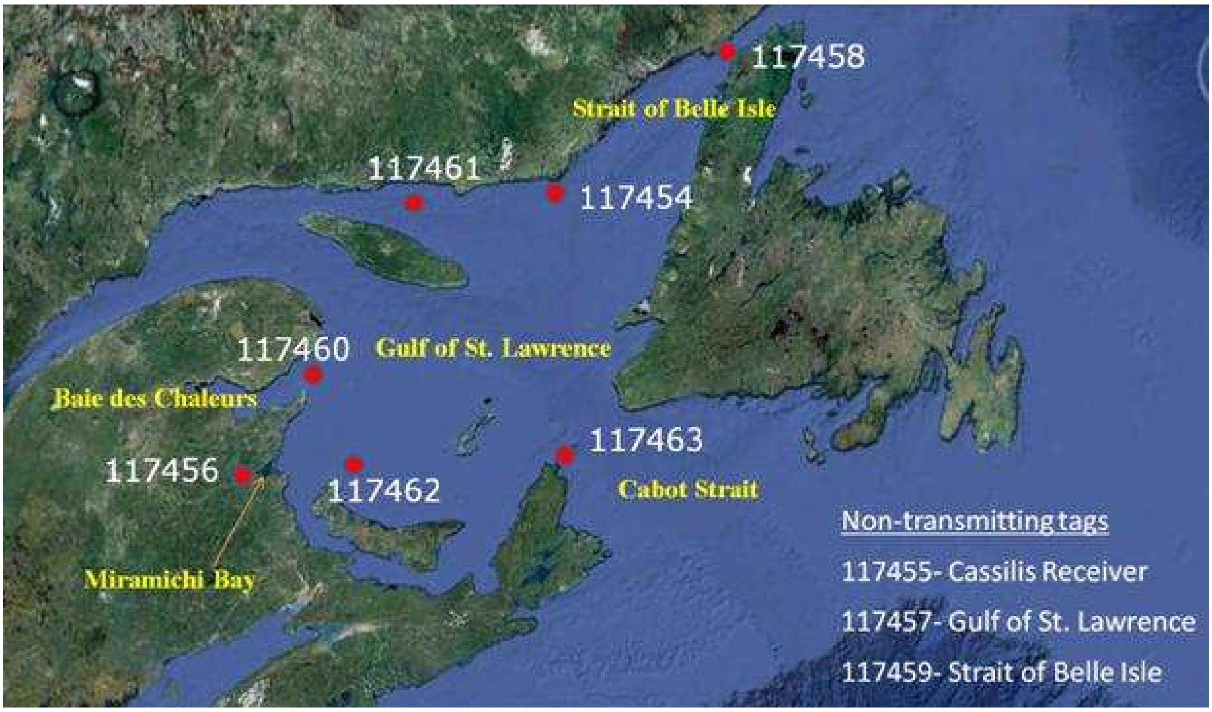


Figure 2.3: Map showing the locations of where the seven satellite tags transmitted their data to the satellites. Three of the tags (117455, 117457, and 117459) did not transmit their data but their last known locations are described.

3 Warm Water Temperatures and Thermal Refuge of Atlantic Salmon

Introduction

Over the past few years a large portion of the Southwest Miramichi River salmon run has returned in July and August and because of the run-timing, fish are subjected to warm water temperatures on the main stem of the river. Therefore, adult Atlantic salmon must seek suitable thermal refuge as they migrate upstream to minimize the physical stress associated with warm water temperatures. For events that are moderately stressful (i.e. 23-24°C), there may be enough cool-water habitat for fish to access; however, during periods that are very stressful (i.e. 26-27°C) cold-water habitat may be limited, particularly in the lower sections of the river where the water is warmer. The Warm Water Protocol developed by DFO is based on temperatures in the main stem Southwest Miramichi River at Doaktown, NB, and currently has three classes of proposed regulation changes: 1) Closure of the 12 major holding pools that are important for thermal refuge, 2) Morning only angling and live release reduced to one fish, and 3) Complete angling closure. To improve the warm water protocol, there is a need to identify the temperatures that fish are actually experiencing during periods of warm water temperatures. The use of miniature thermal loggers will allow us to determine the actual temperatures that fish experience as they make their way upstream and will also reveal if fish are able to find adequate thermal refuge during warm water periods. Climate changes are projected to increase water temperatures in the future; therefore, we can expect an increased frequency of the warm-water temperature events to occur in the Miramichi River watershed. More frequent warm water events could have negative consequences for Atlantic salmon so enhancing the warm water protocol may help prevent declines in this fisheries resource from the environmental changes.

In this study we aim to determine the relative temperature of Atlantic salmon cold-water holding pools to the water temperature station in Doaktown. Comparing the temperatures measured in the holding pools will allow us to determine at what temperature measured in Doaktown constitutes a stressful warm water event. Secondly, we will tag fish externally with miniature thermal loggers so that we can determine the actual temperature that these salmon experience during warm water periods and whether or not they are actually able to seek out cooler water temperatures.

Methods

Five VEMCO temperature loggers were successfully placed in major coldwater holding pools on the Southwest Miramichi on July 18, 2012. Salmon pools included in the study were: Betts Mills Brook, Doak Brook, Mill Brook, Big Hole Brook, and Donnelly Brook. The thermal recorders were anchored near the deepest part of the holding pool to get a temperature profile of where the fish would lay during warm water periods. We outfitted ten adult Atlantic salmon, captured at the trap-net in Millerton, NB, with individual miniature thermal loggers. The miniature loggers were attached externally to the fish in a similar method to the attachment protocol of the Carlin tags, which are put on adult salmon annually at the Millerton trap-net. Since we could not track the location of the tagged fish, temperature loggers had waterproof stickers attached to them indicating a 50 dollar reward and the MSA contact phone number with the hopes that any angler catching one of these fish could return the tag to the MSA and get the reward.

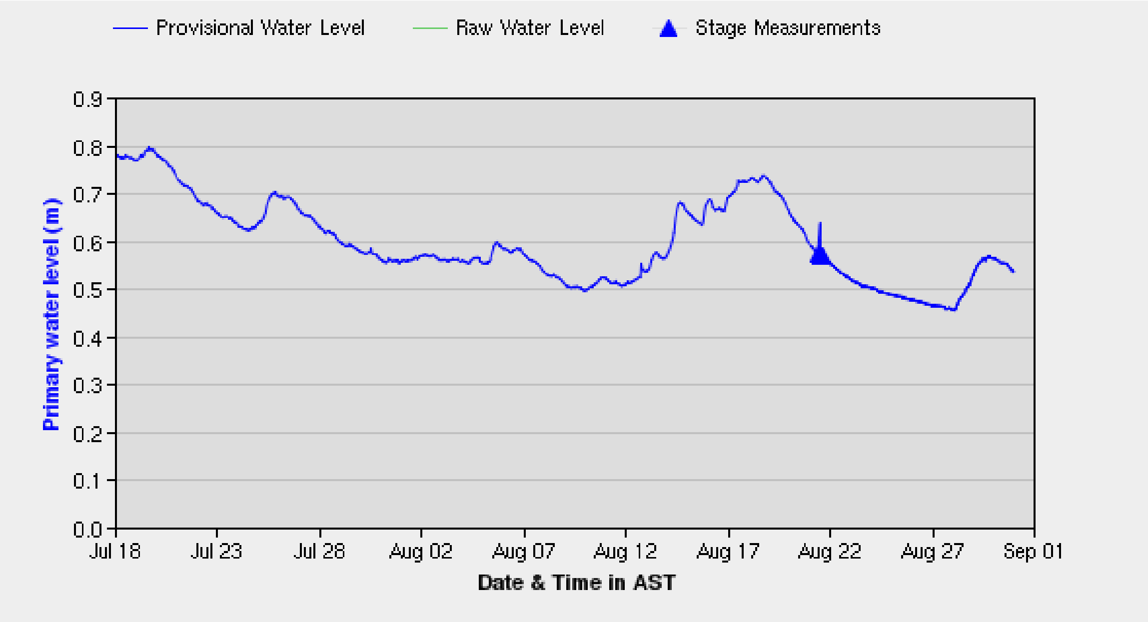
Results

The MSA field-crew successfully anchored the temperature loggers in the five major holding pools in July; however, were unable to retrieve any of the data loggers from the pools in the fall because of high water and poor visibility. The water levels in the holding pools were low when the temperature loggers were put in but when the MSA field-crew went to retrieve the data loggers in October, water levels were much higher. For reference, Figure 1 shows the water levels in the main stem of the Southwest Miramichi River at Blackville in the summer when levels ranged between 0.45-0.8m whereas at the same location in the fall, water levels ranged between 0.6-1.6m. As the temperature loggers were placed in smaller tributaries than the main stem of the river the differences in water levels may have been greater at the salmon pools than the Blackville location and this could further explain the lack of success retrieving the data loggers. However, the loggers will continue to record water temperatures and next summer in 2013, when water levels are low again, we will be able to recover them and get the 2012 water temperatures. The salmon tagging project was also not able to recover any of the 10 miniature temperature loggers that had been placed on adult Atlantic salmon at the Millerton trap-net (Table 1). We relied on anglers to return any tags that were captured and unfortunately, no tags were reported. However, the tags will continue to record temperatures over-winter and may be reported next spring if any of the tagged salmon are caught in the spring fishery while migrating back to sea. If returned next spring, we will still be able to recover the 2012 temperature data from these tags and determine if the salmon were able to locate coldwater temperatures in this past summer.

Table 3.1: Summary of the 10 adult Atlantic salmon that had been tagged at the Millerton trap-net on the Southwest Miramichi River. Date, life-stage, sex, and length of the salmon that had been tagged were all recorded.

Month	Day	Year	Life Stage	Sex	Length (cm)	Tag #
July	16	2012	Salmon	Female	72.5	284
July	17	2012	Grilse	Unknown	54.3	285
July	18	2012	Salmon	Female	88.2	286
July	19	2012	Salmon	Female	94.5	287
July	20	2012	Grilse	Male	61.1	288
July	21	2012	Salmon	Female	95.5	289
July	24	2012	Grilse	Unknown	55.7	290
July	24	2012	Salmon	Female	82.8	283
July	25	2012	Salmon	Female	83.9	292
July	25	2012	Grilse	Unknown	54.1	291

A.



B.

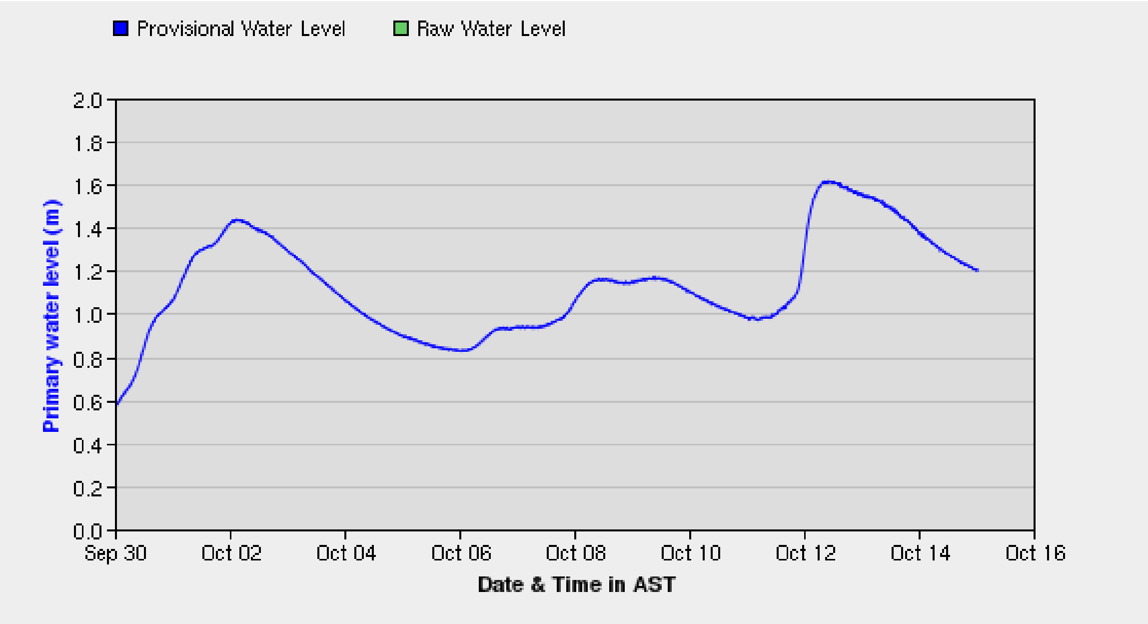


Figure 3.1: Water levels for the main Southwest Miramichi River in Blackville comparing the water levels in (A) July, when the data loggers were installed, to the water levels in the (B) September, when the data loggers were unable to be found. No direct data was found for the holding pools used in the study but the figure shows the relative water levels in the main stem of the Miramichi River. Data was retrieved from www.wateroffice.ec.gc.ca.

4 Juvenile Electrofishing Assessment

Introduction

The Miramichi Salmon Association (MSA) continued its electrofishing program in 2012 to assess juvenile Atlantic salmon populations in the headwater areas of the Miramichi River watershed. The MSA also worked co-operatively with the Department of Fisheries and Oceans (DFO) Science Branch on another survey using targeted sites that are monitored on a yearly basis to assess Atlantic salmon juvenile abundances on the Miramichi River system. Both electro-fishing surveys target Atlantic salmon and brook trout juveniles but other fish species are often collected as by-catch. In this report, Atlantic salmon juveniles are listed as fry and parr, with the parr consisting of 1+ and 2+ age classes. Wild salmon fry (0+) are typically less than 60mm in length in late summer and wild parr (1+, 2+) vary in size by site; however, parr are grouped together in length by year class and generally do not exceed 120mm. There is typically a higher abundance of fry than parr as fewer salmon are present in successive age classes due to mortality and predation. If this trend is not observed, it could be viewed as an indication that fry survival is low and should be investigated.

Electrofishing sites in both surveys are generally 3rd or 4th order streams and are tributaries to major rivers where salmon historically spawn; however, sites may also include some main river locations. The headwater tributary streams are of major focus to the MSA electrofishing as they are considered feeder streams to the major rivers and are typically under-seeded with juvenile salmon. Generally, swift moving water less than 60cm in depth with gravel, rocky substrate characterize juvenile salmon habitat. Adult salmon migrate as far upstream as possible to spawn but juveniles in their first, second or third year can move around quite extensively in search of food, avoiding predation, and identifying suitable over-wintering habitat. During the warm water periods in the summer months, juveniles (parr more often than fry) also move throughout the river seeking cold-water refuge.

The main objectives of the annual electrofishing program are to:

1. Assess proper stocking distribution of spring first-feeding fry. Broodstock are collected from individual rivers and their progeny must return to their native river system. Determining wild densities allows us to avoid overstocking and target naturally under-stocked streams in each

river system. In terms of stocking, any site containing more than 50 fry per 100m^2 is not considered for stocking as it appears to reflect a healthy natural population.

2. Identify areas absent of fry as this indicates adult salmon were not able to spawn in that area last fall. No fry present could mean that adults were unable to access the spawning grounds. That is, the river or stream may be barricaded in some way (e.g. beaver dams) as to limit upstream migration of adults. Not only will these areas be targeted to stock but efforts may be made to identify and remove any obstacles to natural spawning.
3. Evaluate the success of spring stocking activities by comparing juvenile densities at stocked sites to sites that were not stocked that year.
4. Estimate the number of juvenile salmon in the river. The juvenile Atlantic salmon survey conducted in partnership between DFO and MSA determines the number of juvenile salmon relative to other years, dating back to 1970, at the same sites each year. Fry to parr survival can be calculated to aid in determining where bottlenecks to juvenile salmon production may be.

Methods

Electrofishing is the use of electricity for the active capture of fish. Electricity is generated by a battery located on the back-pack of the electrofisher with an anode (positive) wand and the cathode (negative) tail placed in the water to pass the electric current through the water. The charged particles moving between the anode and cathode produce an electric field that is used to promote involuntary swimming action in fish, causing them to move toward the anode. When a site has been identified, a crew of three people wearing leak-proof waders and rubber gloves enter the site facing upstream. With one person carrying the backpack electrofisher, the two other crew members collect the fish with a dip-net and a small seine net as they are drawn up to the water surface by the electrical current. The fish are placed in a bucket of water and held until the site is completed.

There are two methods for measuring density in a given area: Catch per Unit Effort (CPUE) and closed-site depletion. The MSA survey for assessing headwater areas for stocking uses the CPUE method exclusively. CPUE sweeps are continued back and forth along the stream from bank to bank, until 500 seconds has elapsed on the electrofisher. The crew then samples the captured fish on shore for length and abundance counts for each species. The fish are then released back into the stream. The depletion method, only performed during the MSA/DFO juvenile assessment, is done by capturing all fish from a measured section of stream rather than the timed CPUE method. A 200 square meter section of stream is measured off and barricaded with fine nets at the upper and lower ends of the site. This 'closed site' is then swept three to four times removing all fish or until an acceptable reduction in fish occurs (often four sweeps). This method produces an actual density for a known area and is used to calibrate the formula for the timed CPUE method. All fish are identified to species and lengths and weights are recorded. Substrate type (rocky, gravel, etc.), stream type (riffle, run, etc.), water and air temperature, and site dimensions are all recorded along with a diagram of the site. The DFO uses both the closed site and CPUE techniques to get juvenile estimates for sites that are sampled annually.

Assessment of Stocking First-Feeding Fry

Starting in 2010, the MSA shifted the focus from stocking young of the year Atlantic salmon fingerlings in fall to stocking first-feeding young of the year salmon in late spring. First-feeding fry are at the life-stage when they would normally being feeding for the first time in the wild. Stocking sites are selected based on electrofishing results from the previous year as well as some additional headwater sites expected to have low levels of fry. Sites are stocked with approximately 5000 first-feeding fry and then electrofished later in the summer to determine if first-feeding fry successfully remained at the site. The stocked sites were all headwater tributary sites with moderate to high quality Atlantic salmon habitat. We compared the average first-feeding fry density of the sites stocked to those not stocked.

Results

Electrofishing assessment of stocking first-feeding salmon fry in late spring

A total of thirty electrofishing sites were assessed between July 30 and August 29, 2012 in the Miramichi River (Table 1). Of the sites electrofished, 18 sites had been stocked with first-feeding fry from the Miramichi Salmon Conservation Centre between June 18 and July 5, 2012 (Table

1). The average fry density at the sites that were not stocked with first-feeding fry in 2012 was 57 fry per 100m^2 while the sites that were stocked had a significantly higher average density of 121 fry per 100m^2, which is considered well above the minimum sustainable fry density (50 fry per 100m^2) for the river (Fig. 1). Variable results were found in the non-stocked sites as five sites had no fry and one site had less than five fry per 100m^2 whereas one site (Bill Gray Mountain) had an extremely high density of 454 fry per 100m^2 and this site likely over-inflated the non-stocked sites average. All of the sites that were stocked had fry present, ranging from 3-422 fry per 100m^2. The MSA identified 14 sites as having fry densities lower than the target number and of these, nine of the sites had not been stocked this spring compared to only five that had been stocked (Table 1). The high survival of first-feeding fry at stocked sites can help to increase the overall juvenile salmon production in the river. Therefore, the MSCC will continue its stocking of first-feeding fry in the future.

Juvenile population assessment survey (MSA/DFO)

The DFO/MSA collaboration resulted in 55 of the annual sites being electrofished in 2012. Preliminary results from the assessment revealed high fry densities at many sites in both the Northwest and Southwest Miramichi Rivers as 60% (33/50) of all sites contained greater than 50 fry per 100m^2 (Fig. 2). No site contained zero fry and only 11% (6/55) had fewer than 30 fry per 100m^2. Parr results revealed high densities, greater than 20 parr per 100m^2, at 33% (18/55) of the sites but also found that five sites contained zero parr. However, some sites were electrofished in relatively warm water conditions and parr, which do not tolerate warm water as well as fry, may have moved away from the sites seeking out cold-water refuge. However, the DFO continues to verify age classes using the scale samples they had collected to confirm these results.

Table 4.1: Juvenile abundance assessments calculated using the CPUE method for the 30 sites electrofished by the MSA to identify potential future stocking sites. Sites with less than 50 fry per $100m^2$ are candidate sites for future stocking efforts while sites that had been stocked in 2012 are also identified.

		Catch per $100m^2$		
River	Site	Fry	Parr	Stocked 2012
Main Southwest	Betts Mills Brook	0.0	6.1	N
Main Southwest	Doak Brook	30.5	29.5	N
Main Southwest	Big Hole brook	3.8	14.5	N
Main Southwest	Crooked Bridge Brook	0.0	23.3	N
Northwest	South Branch- road crossing	207.3	11.6	Y
Northwest	Bill Gray Mountain	454.3	13.0	N
Northwest	South Branch - Goodwin Lake	419.9	47.0	Y
Northwest	North Branch Tomogonops	287.3	68.3	Y
Sevogle	Johnstone Brook	132.8	5.2	Y
Sevogle	South Branch - above old e-fish	51.3	38.8	Y
Sevogle	Sheephouse Brook	77.7	28.2	N
Sevogle	Bear Brook	18.5	15.6	N
Sevogle	North Branch-bridge crossing	162.7	9.1	Y
Sevogle	North Branch- above bridge	129.7	51.6	Y
Sevogle	Little Sheephouse Brook	0.0	0.0	N
Sevogle	Travis Brook	46.8	30.7	Y
Little Southwest	Upper West Branch	60.5	40.5	Y
Little Southwest	West Branch- lower e-fish site	34.6	12.5	N
Little Southwest	Upper Libby's Brook	107.6	19.4	Y
Little Southwest	Devils Brook	31.3	19.1	Y
Little Southwest	Upper Saddlers Brook	189.7	17.0	Y
Little Southwest	Squaw Barron Brook	54.8	34.7	Y
Little Southwest	Crooked Brook Tuadook	209.5	42.2	Y
Little Southwest	County Line Brook	2.3	3.2	Y
Cains	McKenzie Brook	19.5	3.4	Y
Cains	Salmon Brook	0.0	1.4	N
Cains	Mahoney Brook	8.8	0.0	Y
Cains	West Branch Sabbies	74.7	36.4	N
Cains	East Branch 6 Mile Brook	0.0	27.7	N
Cains	West Branch 6 Mile Brook	70.3	9.7	Y

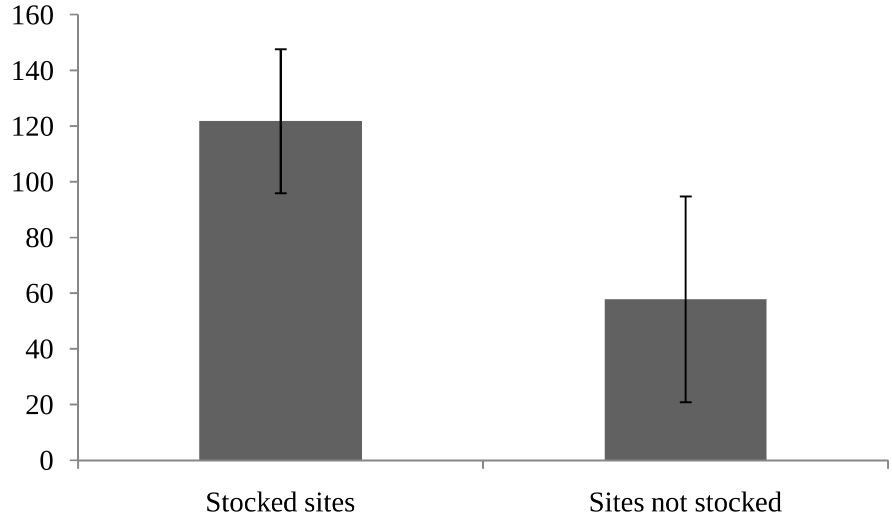
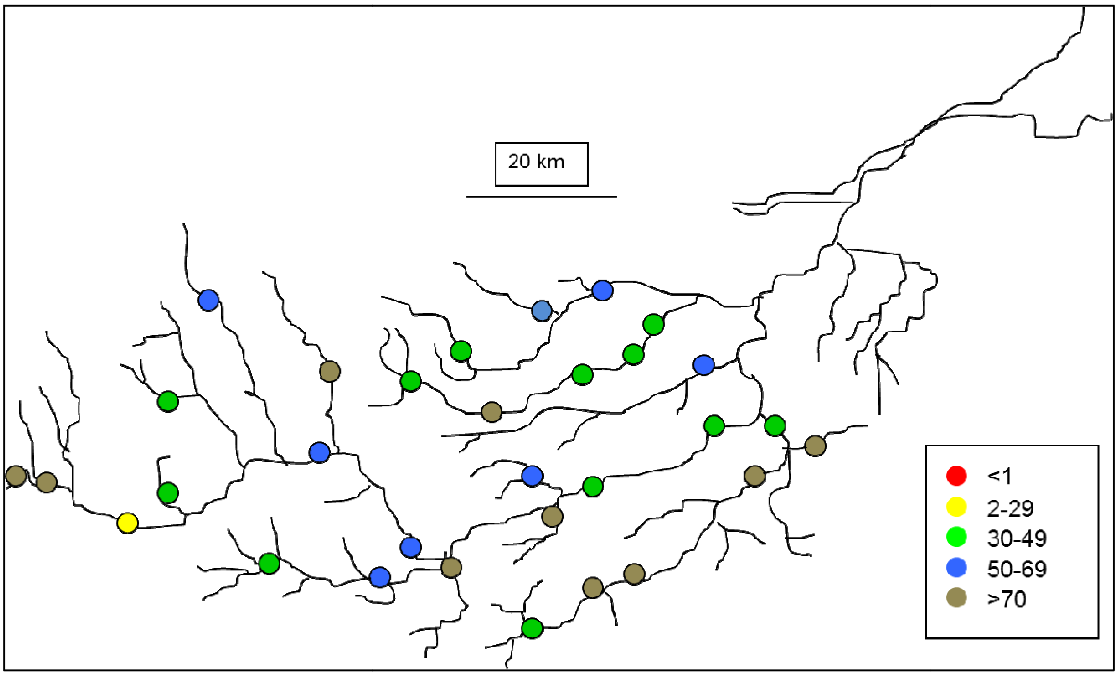


Figure 4.1: Comparing the number of fry collected at sites that had been stocked by the Miramichi Salmon Conservation Center in 2012 to the number of fry collected at sites that had not been stocked.

A.



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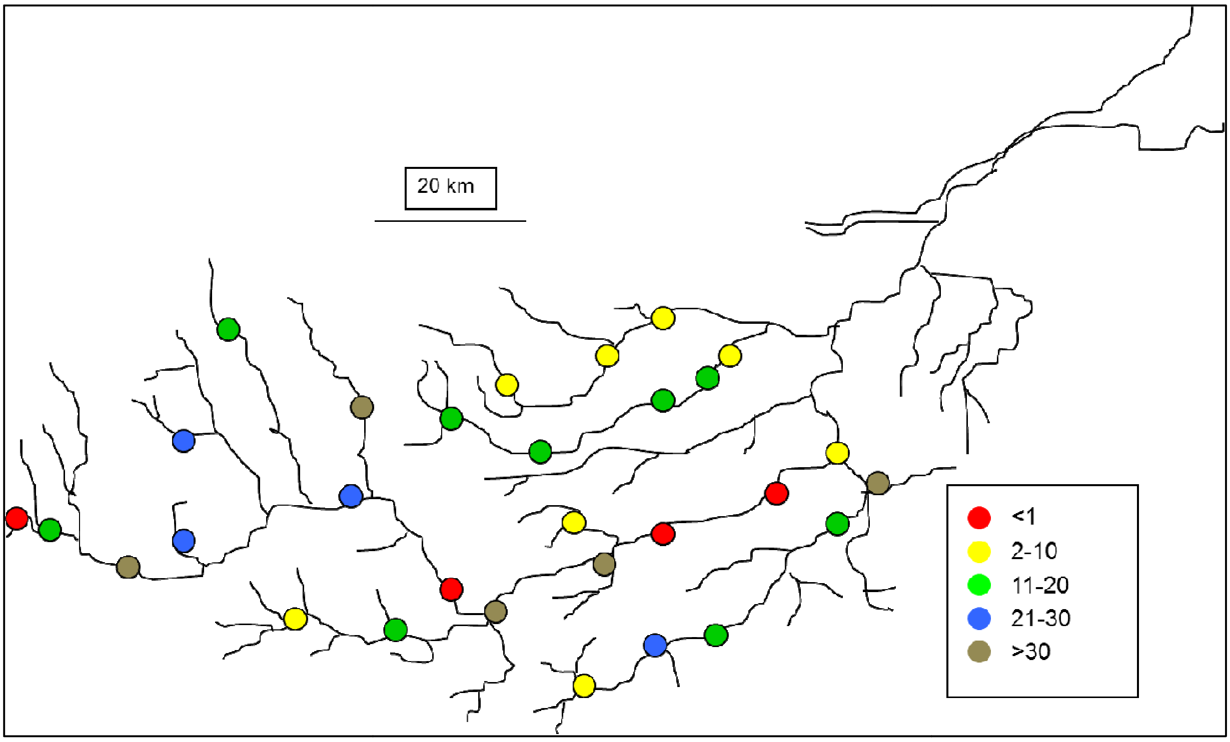

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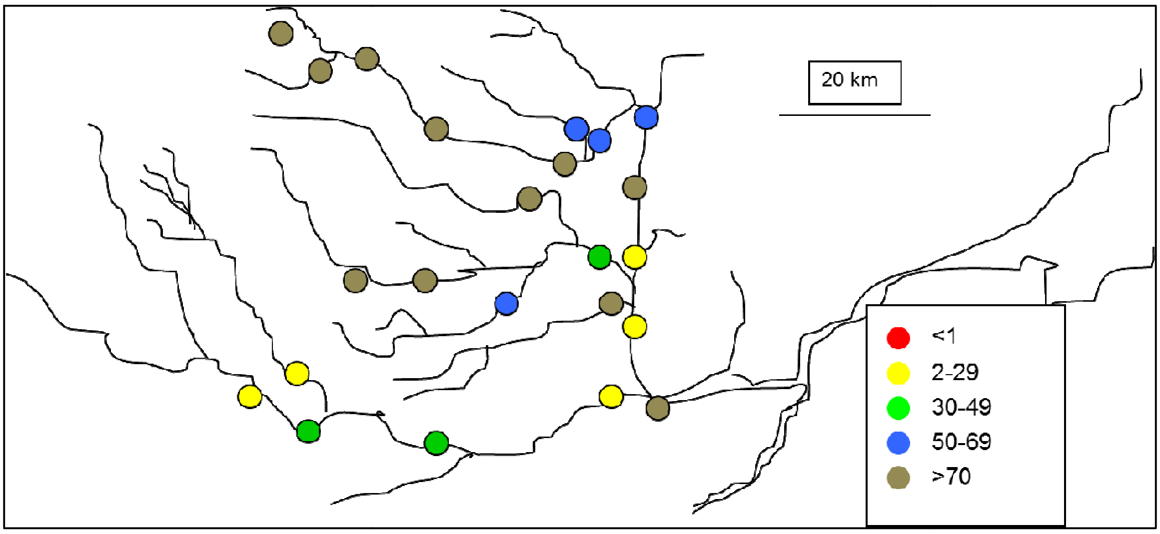

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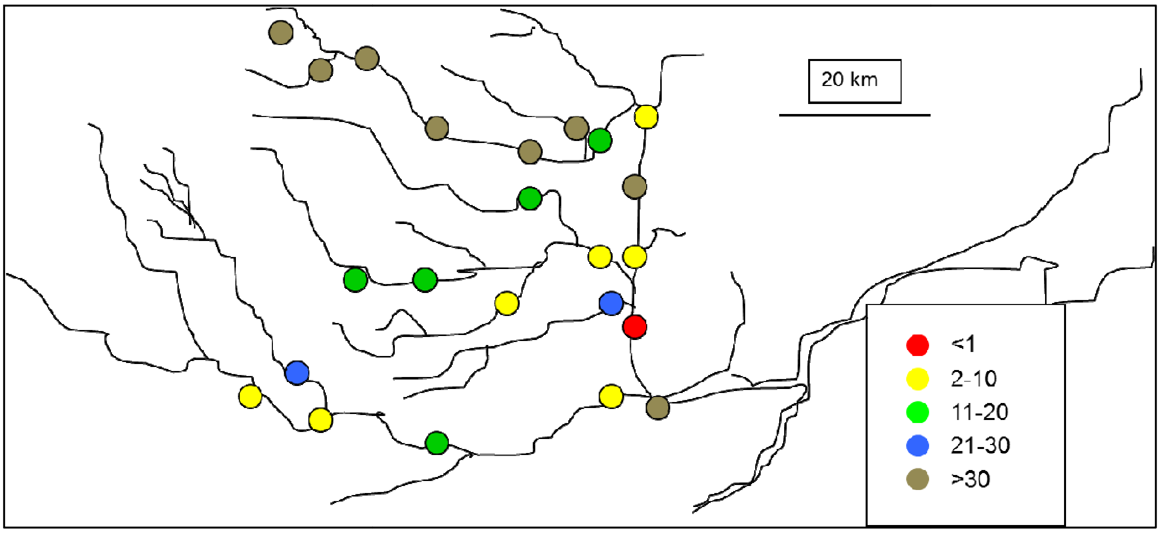


Figure 4.2: Preliminary juvenile density results from the 2012 MSA/DFO annual electrofishing program with: (A) showing the fry densities at sites in the Southwest Miramichi River tributaries, (B) showing parr densities at sites in the Southwest Miramichi River tributaries, (C) showing fry densities at sites in the Northwest Miramichi River tributaries, and (D) parr densities at sites in the Northwest Miramichi River tributaries. Fry density classifications range from < 1, 2-29, 30-49, 50-69, and > 70 fry per 100m^2. Parr density classifications range from < 1, 2-10, 11-20, 21-30, and > 30 parr per 100m^2.

5 Smolt Production on the Northwest Miramichi River

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 the Southwest Miramichi River has averaged 103% (range 77% to 119%) of the conservation requirement for sustainability from 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. Thus, an accurate estimation of the total smolt population migrating from the Northwest Miramichi River is an essential component to understanding and managing Atlantic salmon in this watershed and a way to measure at-sea survival of smolt that return as grilse and salmon.

The Northwest Miramichi system likely experiences an increased harvest of grilse and salmon compared to the Southwest Miramichi due to the high abundance of public pools, crown reserve stretches, and First Nation Fisheries allocations which could all reduce the number of salmon annually available for spawning. Additionally, the Northwest Miramichi has an increasing striped bass population which likely contributes to an increased mortality of smolt exiting this system on their way to the marine environment.

The smolt population estimates from this study represent the second year of the multi-year Northwest Miramichi River Smolt Production Project. The purpose of this project is to assess smolt production on the Northwest Miramichi system using its 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). The data will enable scientific based management decisions to be made for the Northwest Miramichi system since the conservation targets of adult salmon have rarely been met. We will also be able to estimate the at sea-survival from smolt to adult salmon on the Northwest River by looking at the number of smolt exiting the river compared to the number of adults coming back to the river as grilse and first-year spawning salmon.

Methods

The method used to obtain the smolt estimates was a mark and recapture experiment. On the Sevogle, Northwest and Little Southwest Rivers, rotary screw traps (RST), or "smolt wheels," were used to capture smolt 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 river 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. All fish in the live-box were collected and sorted with each fish identified to species, counted, and released except for salmon smolt, which were measured for fork length and then tagged with streamer research tags. Scale samples were also taken from every 5th salmon smolt for age verification. After the smolt were tagged they were taken back upstream of the smolt wheel so they could be recaptured again by the smolt wheel. The percent of tagged smolt that are recaptured at the smolt wheel should allow us to estimate the number of smolt moving out of that particular tributary. Upon recapture, the already tagged smolt were all released directly in to the river so they can move downstream and be recaptured in the main stem of the Northwest Miramichi. A single large trap-net was installed in the Northwest Miramichi River at Cassilis to capture smolt moving from freshwater into Miramichi Bay. Tagged smolt captured at the Cassilis trap-net allow us to get an estimate of the smolt population moving out of the entire Northwest Miramichi watershed. The Cassilis trap-net efficiency is calculated by the total catch of smolt at Cassilis divided by the population estimate. The total smolt run from the Northwest Miramichi is determined by a ratio of the number smolt that are tagged upstream at the Sevogle, Northwest, and Little Southwest smolt wheels, and the number of tagged smolt that are recaptured at the Cassilis trap comparing to the total number of untagged smolt captured at the Cassilis trap. The trap-net was fished daily, generally at low tide, and the smolt were sorted from the rest of the species captured. Each day, sub-samples of up to 100 smolt were measured and 20 smolt were sampled in detail for length, weight, sex, and age.

Results

The Sevogle smolt wheel operated from May 1 to May 26, the Little Southwest smolt wheel operated from May 1 to May 25, and the Northwest Miramichi smolt wheel operated from May 1 to May 26 although this wheel was not operational on May 11. The trap-net at Cassilis operated from May 8 to May 31 although the trap-net leader was washed out on May 12 due to high water conditions and did not operate again until May 16.

The peak daily smolt runs for each tributary were: on May 11 on the Sevogle River with 1026 smolt, May 12 on the Northwest River was on with 195 smolt, and on May on the Little Southwest River with 117 smolt. In 2012, 1212 smolt were tagged on the Sevogle, 818 smolt tagged on the Northwest Miramichi, and 667 smolt tagged on the Little Southwest Miramichi. The recapture efficiency of smolt moving downstream for each tributary was: 1.65% on Sevogle, 5.75% on the Northwest, and 1.47% on the Little Southwest.

At the Cassilis trap, we captured 6392 total smolt and we were able to recapture 47 smolt with the streamer tags that had been put on at the tributary smolt wheels. Smolt production on the entire Northwest Miramichi River system in 2012 was estimated at 328,000 smolt (95% CI 255,000 to 452,000) (Fig. 1), which worked to 2.0 smolt per $100m^2$ assuming a 10% mortality of tagged smolt due to handling and predation.

Discussion

Our objective to reach the 3.0 smolt per $100m^2$ smolt production target for the Miramichi was not exceeded on the Northwest Miramichi River system, as it had been done in 2011. However, in 2012 the Cassilis trap-net was washed-out and was therefore not operational from May 12 to May 15. The Cassilis trap-net wash-out occurred a day after the peak smolt run in both the Sevogle and Little Southwest Rivers (May 11 for each tributary), as well as the peak smolt run of the Northwest Miramichi River (May 12); therefore, this likely had a large impact on the total smolt production estimate for the Northwest Miramichi River system. Another potential reason that the smolt estimate may be low for the system is that the Northwest smolt wheel was not operational on May 11, which was the peak smolt movement date for the other two tributaries; therefore, none of the smolt that left the tributary during this time period received a tag. Although many of the un-tagged Northwest smolt may have passed by the Cassilis trap-net when it was washed out, there were likely many collected in the trap-net after it was re-installed.

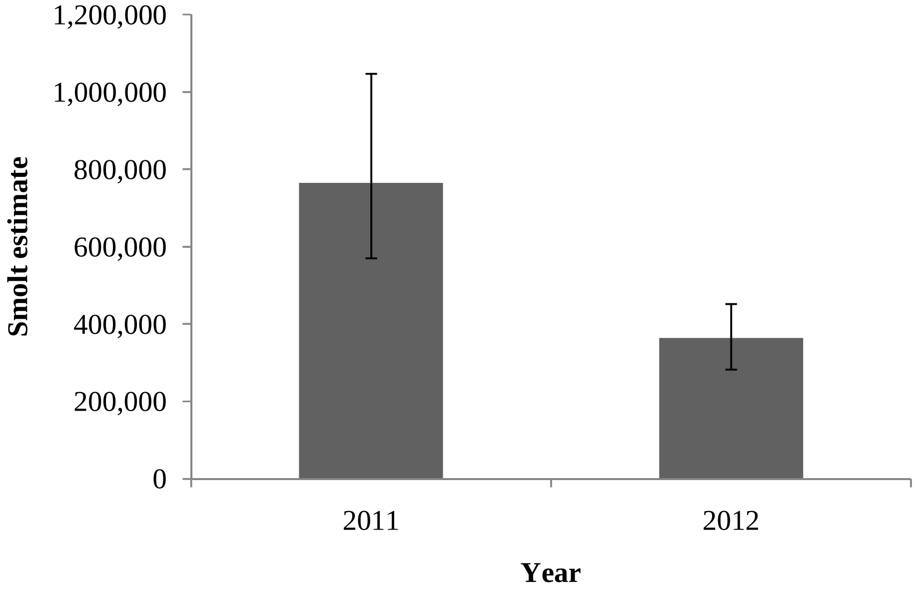


Figure 5.1: Estimated smolt production for the Northwest Miramichi River in 2012 compared to the smolt estimate from 2011.

6 Beaver Dam Management

Introduction

Beavers can block off access to spawning areas by building large dams in brooks, culverts, or fish ladders. Beaver dams can impede Atlantic salmon upstream migrations to spawning habitat when water levels are low and salmon are unable to swim or jump over the impoundments. When their migrations are blocked, salmon will congregate below the dams and lay their eggs in redds; however, with so many females laying eggs in a small area, redds become crowded and overlapping with egg survivability reduced. Beavers also typically build dams on small streams and these areas generally contain: excellent juvenile salmon habitat quality, fewer numbers of large predators, and cooler stream temperatures. Low egg survivability and reduced habitat quality below the dams, as well as lack of spawning above the dams, results in these areas becoming devoid of juveniles. Lack on salmon juvenile production not only negatively impacts total salmon production on the river but also reduces prey availability for other wildlife (i.e. eagles, otters).

Beaver numbers, and consequently beaver dams and blockages, have recently increased due to the decrease in people trapping beaver. Historically, people trapped beaver to supplement their income; however, over the past few years beaver pelt prices have been at the lowest point since the 1993/1994 season resulting in lower annual beaver harvests over the past 5 years.

Beaver dam notching during the critical salmon run time period has had recent success as prior to 2006 few salmon fry were found on Betts Mills Brook near Doaktown NB despite the building of a new fish ladder near its mouth. In 2006, a major beaver dam that had been blocking the fish ladder was removed, as well as 21 additional beaver dams were notched or removed, and this resulted in adult salmon access to more than 50,000m^2 of spawning habitat. Electrofishing results by the DFO and MSA revealed the presence of fry in Betts Mills Brook the following year. Additionally, Porter Brook and Big Hole Brook each have high quality salmon habitat and when salmon were able to access spawning habitat upstream of their respective beaver dams, high densities of salmon fry were present during electrofishing.

Providing access to spawning habitat for adult Atlantic salmon will ensure that the Miramichi River maintains a strong juvenile output. High numbers of juvenile will hopefully increase adult salmon returns and provide the Miramichi outfitters, guides, and local fishermen the highest quality Atlantic salmon fishing in the province.

Methods

In the late-summer and fall of 2012, the Miramichi Salmon Association staff surveyed brooks on the Cains River and targeted brooks of the main Southwest Miramichi River. The MSA field crew was made up of Tyler Storey (MSA technician) and Tyler Coughlan. Many of the brooks are inaccessible by roads; therefore, the project requires the field-crew to canoe downstream brooks to locate dams. Brooks that were surveyed throughout the summer in the main Southwest Miramichi River were: Porter Brook, Betts Mills Brook, and Big Hole Brook and in the Cains River were: McKenzie Brook, Six Mile Brook, Muzroll Brook, Salmon Brook, Little Otter Brook, Upper Cains River, and Sabbies River. During the mid-summer/early fall, beaver dams were removed and the GPS locations of these were given to a "nuisance wildlife trapper" to have the beavers removed. A nuisance trapper possesses a special permit to remove beavers out of season, since the furbearer season is from October 30 to January 1st, after the majority of salmon have spawned. Later in the fall (from Oct. 1- Oct. 26), while salmon were migrating upstream in brooks of the Cains River, the beaver dams were simply notched to provide access to the salmon spawning habitat.

Results

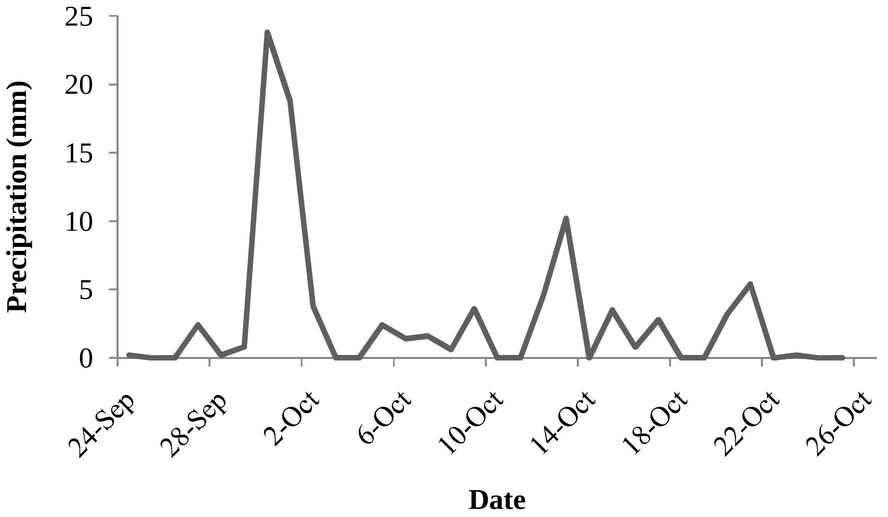
The 2012 beaver dam removal and notching project commenced on September 24 and ran through October 26; although, two beaver dams at the mouth of McKenzie Brook had been identified, removed, and reported to a nuisance trapper earlier in the summer. From Sept 24-Sept 30, two beaver dams in Porter Brook, ten beaver dams in Betts Mills Brook, and six beaver dams in Big Hole Brook had been removed and the dam locations were reported to a nuisance trapper. However, during the beaver dam notching time period in the Cains River (Oct 1-26), the field-crew lost many days because of high water levels (Fig. 1). On days that the field-crew were able to canoe through the brooks, water levels had either washed-out many of the beaver dams or made the beaver dam difficult to locate due to high water. Nevertheless, on the days that the water levels were too high for canoeing, or when high water masked the presence of a dam, adult Atlantic salmon that would be migrating upstream in these brooks could potentially swim, or jump, over the beaver dams which would provide them access to upstream spawning habitat. Although only two dams on McKenzie Brook (Cains River) were cleared earlier in the summer, we were able to remove successfully 15 beaver from the watershed. It was hoped that more beaver dams would be trapped but due to uncooperative weather and time constraints we were unable to do so, although the high water levels likely allowed salmon to naturally access spawning habitat.

Table 6.1: The major river, tributary, and GPS location of each beaver dam removed during the project.

River	Tributary	GPS	
Southwest Miramichi River	Porter Brook Dam 1	46.5018	-66.4501
Southwest Miramichi River	Porter Brook Dam 2	46.4975	-66.4533
Southwest Miramichi River	Big Hole Brook Dam 1	46.5584	-66.2710
Southwest Miramichi River	Big Hole Brook Dam 2	46.5561	-66.2297
Southwest Miramichi River	Big Hole Brook Dam 3	46.5566	-66.2266
Southwest Miramichi River	Big Hole Brook Dam 4	46.5572	-66.2201
Southwest Miramichi River	Big Hole Brook Dam 5	46.5609	-66.1996
Southwest Miramichi River	Big Hole Brook Dam 6	46.5545	-66.1868
Southwest Miramichi River	Bett's Mills Brook Dam 1	46.4963	-66.1964
Southwest Miramichi River	Bett's Mills Brook Dam 2	46.4974	-66.1937
Southwest Miramichi River	Bett's Mills Brook Dam 3	46.4982	-66.1924
Southwest Miramichi River	Bett's Mills Brook Dam 4	46.5002	-66.1897
Southwest Miramichi River	Bett's Mills Brook Dam 5	46.5086	-66.1916
Southwest Miramichi River	Bett's Mills Brook Dam 6	46.5115	-66.1927
Southwest Miramichi River	Bett's Mills Brook Dam 7	46.5288	-66.1795
Southwest Miramichi River	Bett's Mills Brook Dam 8	46.5343	-66.1826
Southwest Miramichi River	Bett's Mills Brook Dam 9	46.5389	-66.1845
Southwest Miramichi River	Bett's Mills Brook Dam 10	46.5389	-66.1845
Cains River	Upper Cains River*	46.2801	-66.2940
Cains River	MacKenzie Brook1	46.4413	-66.0104
Cains River	MacKenzie Brook2	46.4419	-66.0155

* = water too high to remove

A.



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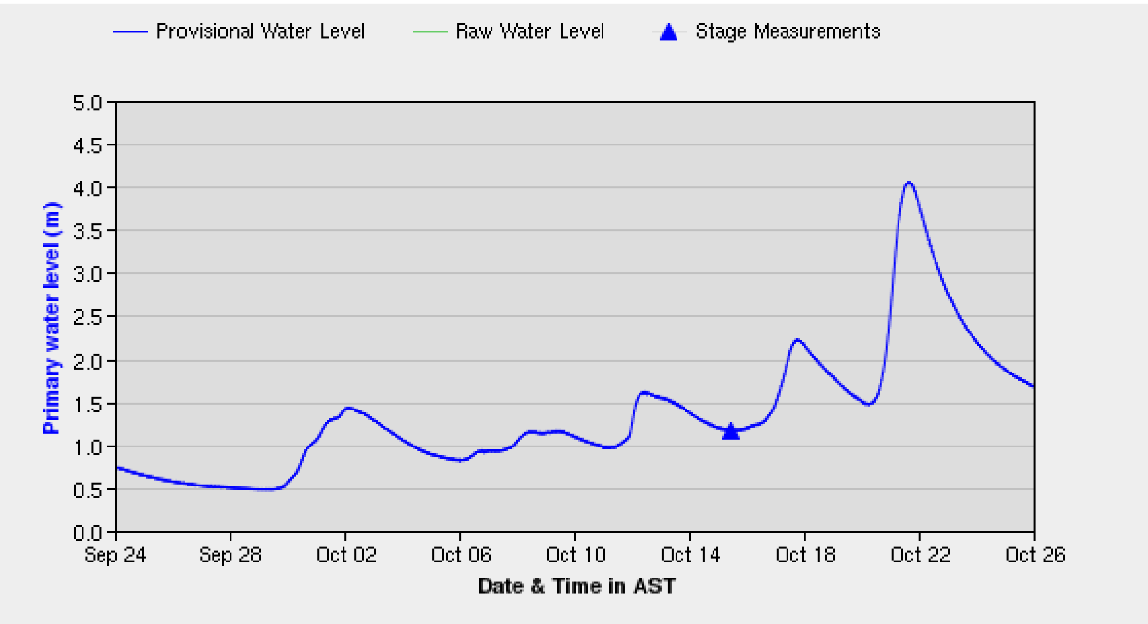

Figure 6.1: (A) Precipitation in Miramichi during the beaver dam removal time period, historical data accessed from www.farmzone.com (B) Rain resulted in high water levels in the main Southwest Miramichi River, and its tributaries, causing unsafe sampling conditions, beaver dam wash-outs, or dams to be overtopped by water. Data for the SW Miramichi River at Blackville (01BO001) is accessible from www.wateroffice.gc.com.