Miramichi Salmon Association
Conservation Field Program Report
2010

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1. OVERVIEW

This report is a review of the 2010 Miramichi Salmon Association (MSA) field and research programs for rivers and streams in the Miramichi Watershed. A large focus of the field programs for the MSA is on the Cains and Dungarvon Rivers looking at juvenile (fry and parr) and smolt production, as well as focusing on headwater areas that can be used to enhance juvenile salmon production due to habitat quality, less competition and typically fewer predators than lower reaches.

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 in the end only to its growing conservation membership. The MSA employs four full-time staff as well as one seasonal field technician.

The MSA has evolved since 1953 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 and assessing the current status of many life stages of Atlantic salmon on the Miramichi, and providing funding to other important programs that would not be able to take place.

In addition the MSA also 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.

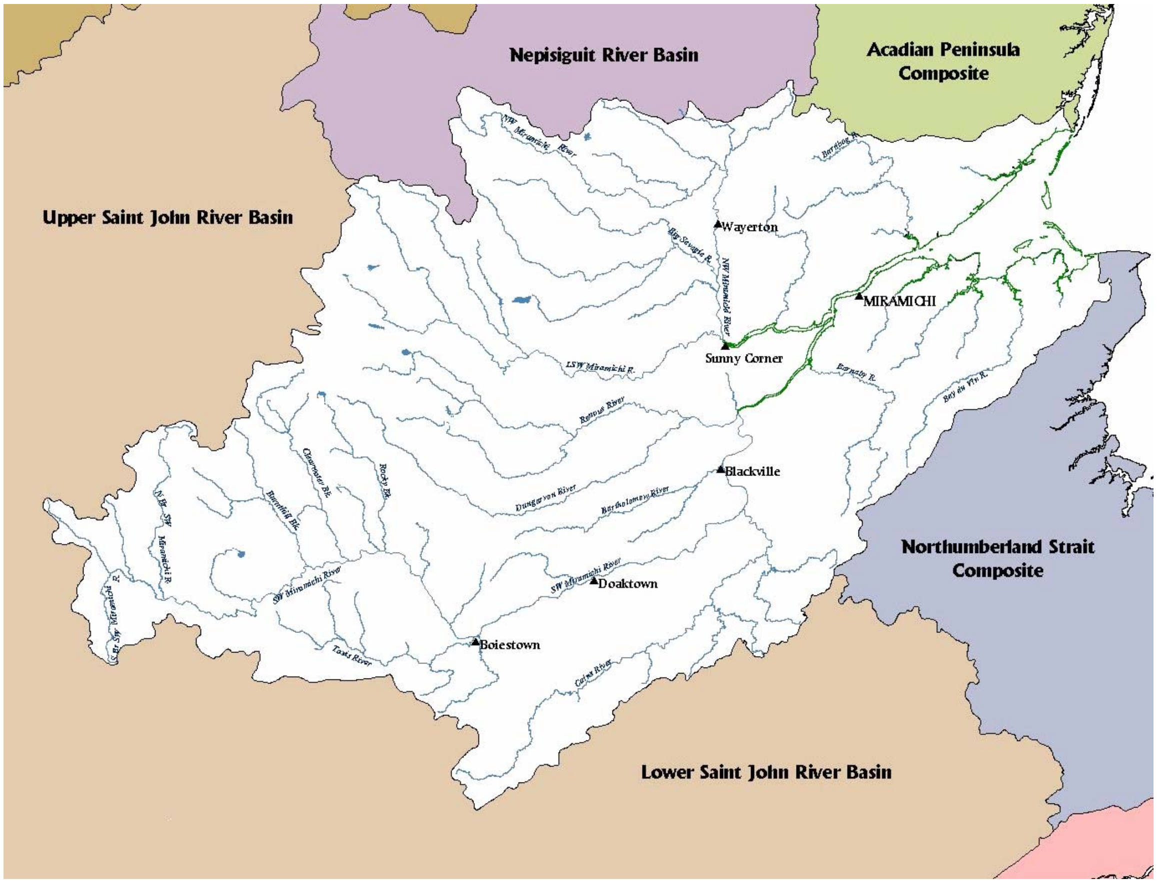


Figure 1. A map showing the Miramichi River basin.

2. KELT TRACKING THROUGH THE MIRAMICHI RIVER AND ESTUARY

Introduction

Kelts are salmon that have spawned the previous fall and are migrating out of the river towards the ocean in spring to feed and recondition. Kelt survival on the Miramichi River is currently estimated between 15-20%, based on the life history characteristics of the fish captured in the DFO index trap nets. Fish that return to spawn in subsequent years are termed repeat spawners and they make up an increasing amount of the spawning run each year. Since they are older, these fish tend to be larger and produce larger eggs and more eggs than maiden fish (grilse and 2 sea-winter maiden salmon). It is estimated that they produce between 25-40% of the eggs laid each year in the river. Repeat spawning salmon can either come back the subsequent year they left the river or the same year they left the river. Kelts that leave the river in spring and come back that same year are termed consecutive spawners. Kelts that leave the river in spring and come back the next year to spawn are termed alternate spawners. Approximately half of the repeat spawning salmon come back as alternate spawners and half as consecutive spawners, depending on the year. There is a large loss of Atlantic salmon at sea and this project will give insight into where the losses of some of these adults may be occurring.

The purpose of this project is to determine the migrations paths and timing of kelts movements through the Miramichi River, estuary and Gulf of Saint Lawrence. It will give us information on the temperature and depths kelts prefer to migrate through and how long individual kelts spend in the ocean before returning to spawn. This project will also give us the locations and possible sources of mortality for some of the kelts.

Methods

Vemco VR2 receivers were deployed at the head of tide, Cassilis and Millerton, NB, at Loggieville at the river mouth and between the barrier islands in Miramichi Bay near Neguac, Portage Channel and Huckleberry Gully. Receivers were also deployed in the Strait of Belle Isle between Newfoundland and Labrador and in the Cabot Strait between Newfoundland and Cape Breton. This is the first year that Cabot Strait had receivers in it which were put in place through the Ocean Tracking Network.

The spring salmon, or kelts were captured by angling on the Miramichi River below the head of tide. Fish were anesthsitized using MS-222 in an oxygenated holding box. The fish was held upside down by another holding box with a wet sponge over the fishes' head to keep the gills moist. A transmitter was 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. The surgery took between 1-3 minutes. After surgery the fish was placed in a wooden holding box with river water flowing through it to recover. Each transmitter (tag) gave each fish an individual code, which was be used to identify it when it passed by receivers located at the head of tide, at the mouth of the river, at the barrier islands at Miramichi Bay or through the Strait of Belle Isle. After the fish had fully recovered the fish was released back into the river.

Receivers recorded the tag number, date and time of kelts each time the fish and tag passed the receiver.

Results

Overall 50 kelts were angled and tagged over a three day period, from April 26-28, 2010 on the Northwest and Southwest Miramichi. Twenty nine kelts were tagged on the Northwest Miramichi, at Red Bank, and twenty one kelts were tagged on the Southwest Miramichi at Quarryville. The surgery typically took around two minutes and all fish recovered fully. A range of fish sizes were tagged, with the smallest being 21 inches (2.8 lbs) and the largest being 40.6 inches (14.4 lbs). Two were female grilse, 14 were male grilse, 26 were female salmon and eight were male salmon.

Kelt survival out of the river was very high, 90% of the tagged kelts made it to the mouth of the river at Loggieville. The kelts that made it to Loggieville passed by the island between May 2- 14th, between four and eighteen days after they had been angled at Quarryville or Redbank. The kelts moved through Miramichi Bay between May 2 and May 21st, 2010. Twelve kelts went through the Neguac exit, 31 went through receivers in Portage Channel, the main river channel exiting Miramichi Bay and two kelts were not picked up by the receivers in Miramichi Bay. No fish exited near Huckleberry Gully near Bay du Vin, NB. Of the 45 kelts that made it through the outer array, seven kelts passed through the Strait of Belle Isle on their way to Greenland. The kelts that went through the Strait of Belle Isle are making their way to Greenland and are alternate spawners These kelts will recondition in the ocean in 2010 and may return to spawn in 2011.

The kelts that exited the estuary but were not picked up by the receivers at the Strait of Belle Isle may have exited through the part of Cabot Strait not covered by receivers, may be reconditioning the Gulf of Saint Lawrence or may have died at sea.

Nine kelts returned back to the Miramichi River, to spawn in 2010. The kelts that returned back to the Miramichi in 2010 are consecutive spawners, which recondition in the ocean for part of the summer and return in the summer or fall of 2010 to spawn again. This is the highest number of kelts returning that we have had in the three years this project has taken place. Most of the kelts that came back to the river moved through the bottom section of the river within two to three days of entering. All of the kelts that returned to the Miramichi River went up the respective branches where they were tagged this spring. Eight of the kelts that returned were female salmon and one was a male salmon. All of the kelts returned to the river between June 22 and July 14th, 2010.

Most of the returning kelts entered the river and traveled fairly quickly through the lower tidal section of the river. However there were three kelts that made some interesting movements prior to or while in the river. One kelt passed by a receiver at Chatham on July 12 and was captured at the DFO Millerton trap net on the Southwest Miramichi on July 13th, 2010. This kelt was noticed by DFO staff since it still had stitch marks on the belly where the tag had been inserted. Another kelt was also picked up in the Bay du Chaleur on a receiver for a smolt tracking study on July 12, 2010, moved into the Miramichi River the same day and made it's way to Millerton by July 14. Another kelt entered the river at Chatham on July 6th, went up the Northwest Miramichi on July 9th (last known hit was Cassilis) held for the summer on the Northwest then on September

26th moved downstream and up the Southwest Miramichi, past Millerton. This kelt was originally tagged on the Southwest Miramichi.

We will not know entirely how many kelts successfully returned until 2011 when the kelts that went to feed off the coast of Greenland return.

Table 1. Locations of kelts moving through the Northwest and Southwest Miramichi River and Miramichi Bay estuary.

Date Tagged	Location Tagged	Sex	Size	River Mouth Receiver	Receiver in Miramichi Bay
April 28, 2010	Southwest	female	salmon	French Fort Cove	Dead
April 28, 2010	Southwest	female	salmon	French Fort Cove	Dead
April 28, 2010	Southwest	male	grilse	French Fort Cove	Dead
April 28, 2010	Southwest	female	salmon	French Fort Cove	Dead
April 26, 2010	Northwest	male	salmon	Loggieville	Dead
April 27, 2010	Northwest	male	grilse	Loggieville	Neguac
April 28, 2010	Southwest	male	salmon	Loggieville	Neguac
April 28, 2010	Southwest	male	grilse	Loggieville	Neguac
April 28, 2010	Southwest	male	grilse	No Hit	Neguac
April 28, 2010	Southwest	male	grilse	French Fort Cove	Neguac
April 26, 2010	Northwest	female	salmon	Loggieville	Neguac
April 26, 2010	Northwest	female	grilse	Loggieville	Neguac
April 26, 2010	Northwest	male	grilse	Loggieville	Neguac
April 26, 2010	Northwest	male	grilse	Loggieville	Neguac
April 27, 2010	Northwest	female	salmon	French Fort Cove	Neguac
April 27, 2010	Northwest	male	grilse	French Fort Cove	Neguac
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 28, 2010	Southwest	male	grilse	Loggieville	Portage Channel
April 28, 2010	Southwest	female	salmon	French Fort Cove	Portage Channel
April 28, 2010	Southwest	female	grilse	Loggieville	Portage Channel
April 28, 2010	Southwest	female	salmon	Loggieville	Portage Channel
April 28, 2010	Southwest	male	salmon	Loggieville	Portage Channel
April 28, 2010	Southwest	male	grilse	Loggieville	Portage Channel
April 26, 2010	Northwest	male	salmon	Loggieville	Portage Channel
April 26, 2010	Northwest	male	grilse	Loggieville	Portage Channel
April 26, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 26, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	male	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel

April 27, 2010	Northwest	male	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel
April 27, 2010	Northwest	male	grilse	Loggieville	Portage Channel

Table 2. Locations of kelts moving into the Gulf of Saint Lawrence, Strait of Belle Isle or returning to the Miramichi River in 2010.

Date Tagged	Location Tagged	Sex	Size	River Mouth Receiver	Receiver in Miramichi Bay	Location in Gulf	Date of receiver hit
April 27, 2010	Northwest	male	salmon	French Fort Cove	Portage Channel	returned 2010	2-Jul
April 26, 2010	Northwest	female	salmon	Loggieville	Portage Channel	returned 2010	2-Jul
April 26, 2010	Northwest	female	salmon	Loggieville	Portage Channel	returned 2010	29-Jun
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel	returned 2010	22-Jun
April 28, 2010	Southwest	female	salmon	Loggieville	Neguac	returned 2010	29-Jun
April 28, 2010	Southwest	female	salmon	Loggieville	Portage Channel	returned 2010	13-Jul
April 28, 2010	Southwest	female	salmon	Loggieville	Portage Channel	returned 2010	13-Jul
April 28, 2010	Southwest	female	salmon	French Fort Cove	Portage Channel	returned 2010	14-Jul
April 28, 2010	Southwest	female	salmon	Loggieville	Portage Channel	returned 2010	8-Jul
April 28, 2010	Southwest	male	grilse	Loggieville	no hit	Strait of Belle Isle	2-Jul
April 28, 2010	Southwest	female	salmon	French Fort Cove	Portage Channel	Strait of Belle Isle	11-Jul
April 26, 2010	Northwest	male	grilse	Loggieville	Portage Channel	Strait of Belle Isle	28-Jun
April 26, 2010	Northwest	male	grilse	Loggieville	Portage Channel	Strait of Belle Isle	1-Jul
April 26, 2010	Northwest	female	salmon	Eel Ground	Portage Channel	Strait of Belle Isle	29-Jun
April 26, 2010	Northwest	female	salmon	French Fort Cove	no hit	Strait of Belle Isle	30-Jul
April 27, 2010	Northwest	female	salmon	Loggieville	Portage Channel	Strait of Belle Isle	27-Jun

b)

a)

Figure 2. a) Biologist Jenny Reid implants a kelt with an acoustic tag for tracking its movements through the Miramichi River and Gulf of Saint Lawrence. b) President Mark Hambrook releases a kelt that has undergone surgery.

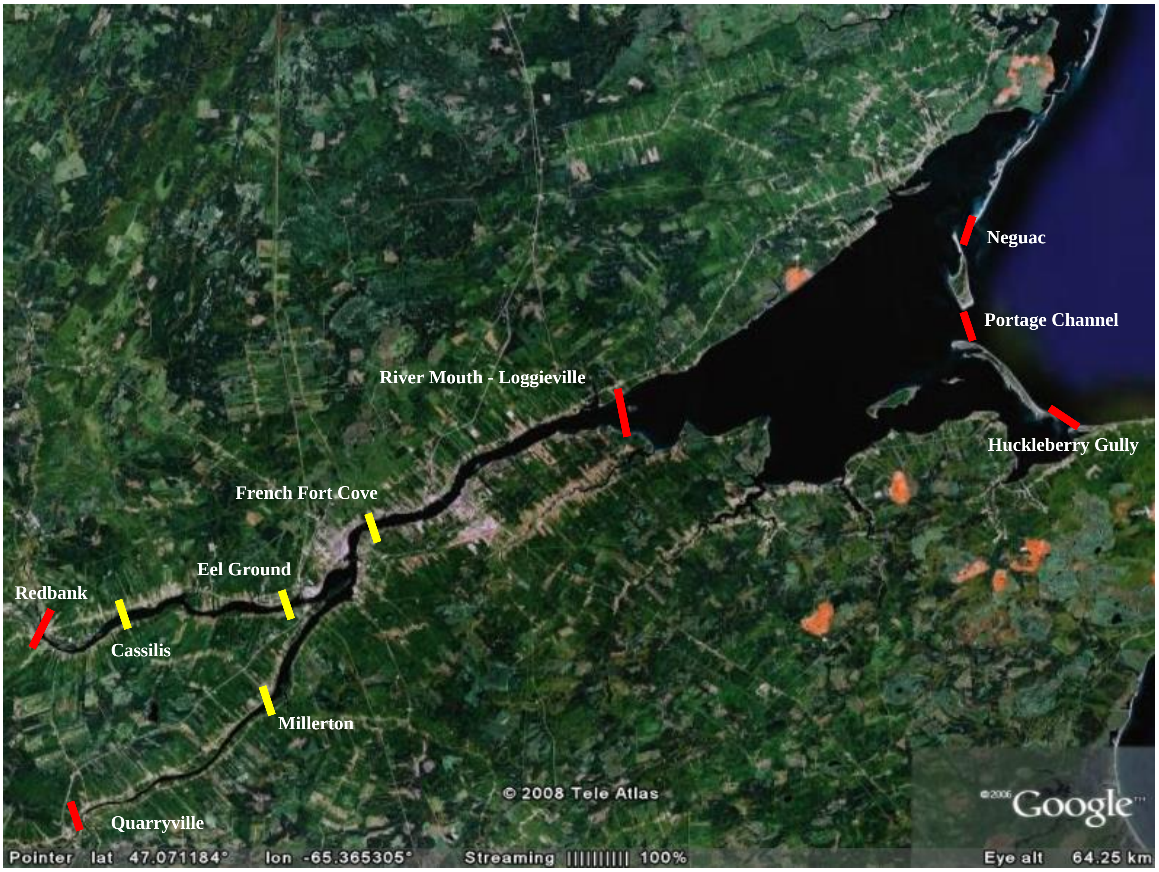


Figure 3. Location of receivers in Miramichi River and Miramichi Bay. Red lines are receivers located at head of tide, river mouth and exits of barrier islands, yellow lines are additional receivers which may have extra information about a kelt's movements.

Figure 4. Location of receivers in the Gulf of Saint Lawrence. Red lines are receivers arrays.

Acknowledgements

The Miramichi Salmon Association acknowledges the financial contributions of the Atlantic Salmon Federation, New Brunswick Wildlife Trust Fund, Youth Experience Internship Program (YEIP), MSA kelt sponsors and volunteers, and in kind-help provided by the Department of Fisheries and Oceans for this project in 2010.

3. Juvenile Production – Fry and Parr

Introduction

The Miramichi Salmon Association (MSA) continued its electro-fishing program in 2009 to assess juvenile Atlantic salmon populations in the headwater areas Miramichi River watershed. The MSA worked co-operatively with the Department of Fisheries and Oceans (DFO) Science Branch on another survey to target sites being monitored on a yearly basis to assess Atlantic salmon on the Miramichi watershed.

The electro-fishing survey targets Atlantic salmon fry and parr in the river. All other fish species captured are recorded and fork lengths are taken. Wild fry (0+) are typically less than 60mm in length in late summer and wild parr (1+, 2+) vary in size by site but are grouped together in length by year class and generally don't exceed 120mm. Fish that are reared at the Miramichi Salmon Conservation Centre and in the MSA Satellite Rearing tanks are marked by the removal of the adipose fin (adipose clipped – AC). In many cases these fish have experienced accelerated growth due to feeding and being reared in optimal water temperatures that are conducive to growth. Generally the fish are larger than wild fish of the same age class.

There is typically a higher abundance of 0+ fish than 1+ or 2+ salmon, with fewer salmon being present in the next subsequent age class due to mortality and predation from year to year. If this trend is not observed, it could be viewed as an indication that fry survival is low and should be investigated. In this report, juveniles are listed as fry and parr, with the parr consisting of 1+ and 2+ age classes.

Sites

MSA/DFO electro-fishing sites are generally 3rd or 4th order streams which are tributaries to major rivers where salmon are historically present and spawn but also include some main river sites. Generally, swift moving water less than 60cm in depth with gravel, rocky substrate characterize juvenile salmon habitat. It is important to note that juveniles do not remain in one place. While adult salmon migrate upstream as far as possible to spawn, juveniles in their first, second or third year do move around quite extensively in search of food, avoiding predation and searching for suitable over-wintering habitat. During the warm summer months, juveniles will generally seek colder water refuge.

The tributary streams are of major focus to the MSA electrofishing as they are considered feeder streams to the major rivers. The selection of a specific stream is made to:

1. Estimate the number of juvenile salmon in the river. Work is currently being conducted collaboratively through the MSA/DFO to estimate the numbers of smolts that are produced from the Southwest Miramichi and the Cains and Dungarvon tributaries. The estimate developed for parr through electrofishing can give us an indication of the number of smolts that could be expected for the subsequent year.

Additionally the fry to parr survival, and parr to smolt survival, can be calculated to aid in determining where bottlenecks to salmon production may be.

2. Assess proper distribution of fall fingerlings. Broodstock are collected from specific rivers and their progeny must return to their native river system. Determining densities allows us to avoid overstocking and target naturally under-stocked streams in each individual river system. In terms of stocking, any site containing more than 100 fry / 100m^2 is not considered for stocking as it appears to reflect a healthy natural population. Sites with less than 50 fry / 100m^2 are first considered candidates for fall stocking.

3. Identify problem areas. Evidence of fry indicates evidence of adult salmon present 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 (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 impediments to natural spawning.

4. Evaluate the success or failure of past stocking activities by identifying and recording any adipose clipped parr found at the site. In many cases areas which have been stocked in the past couple years will show a presence of adipose clipped parr identifying that area as a successful stocking site.

Methods

Electrofishing is the use of electricity for the capture and control of fish. Electricity is generated by a battery located on the back-pack of the electrofisher. An anode wand (positive) and the cathode tail are placed in the water. The current moving between them produces an electric field that is used to stun and capture fish. When a site has been identified, a crew of three people wearing leak proof waders and rubber gloves enter the site facing upstream. The other crew members collect the fish with dip-nets 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 Removal. The MSA survey for assessing headwater areas for stocking uses the CPUE method exclusively. This process is continued back and forth along the stream from bank to bank, until 500 seconds has elapsed on the electro-fisher. The crew then samples the captured fish on shore for length by species. All salmon are checked for the presence of the adipose clip. The fish are then released back into the stream.

The removal method, which is done on the juvenile assessment survey done in collaboration with DFO is done by capturing all fish from a given section of stream rather than a timed sample as in the 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 (usually four sweeps). This produces an actual density for an 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.

Assessment of Stocking First Feeding Fry

In 2010 the Miramichi Salmon Association shifted the focus from stocking young of the year Atlantic salmon fingerlings in fall to stocking first feeding young of the year salmon in early spring when they would normally being feeding for the first time in the wild. Stocking sites were selected based on the previous years electrofishing results as well as some additional headwater sites that were thought to likely have low levels of fry. Twenty stocking sites were selected and electrofished later in the summer to determine if the first feeding fry stocking was successful. These sites were all headwater tributary sites with moderate to high Atlantic salmon habitat qualities. We compared the average density of the sites stocked with first feeding fry to those not stocked with first feeding fry as well as compared the fry numbers in 2010 when first feeding fry were stocked with the fry numbers in 2006-2009 when those sites were not stocked with first feeding fry.

Figure 5. Technician Tyler Storey captures juvenile salmon by electrofishing with Pius Marshall on the dip net and Matt Ward on the seine.

Results

Juvenile population assessment survey (MSA/DFO)

In 2010 the Southwest Miramichi experienced high densities of fry in most tributaries, except that low densities of fry were found in the Taxis, parts of Renous and Cains (Figure 1). Moderate parr densities were found in most parts of the Southwest Miramichi, except for the Cains, Renous and South Branch of the SW Miramichi which generally had low parr densities (Figure 2). The Northwest Miramichi had high fry densities on the upper reaches of the Northwest Miramichi, upper reaches of the Sevogle and a few sites on the upper Little Southwest (Table 2). However low fry densities were moderate to low on the lower reaches of mainstem Northwest Miramichi, lower reaches of Sevogle and parts of Little Southwest (Figure 3). The Northwest Miramichi had high fry densities on the upper reaches of the Northwest Miramichi, North Branch Sevogle and moderate to low densities the Little Southwest. Low fry densities were found on the lower reaches of mainstem Northwest Miramichi, parts of the South Branch Sevogle and Little Sevogle (Figure 4).

Juvenile assessment of headwater areas for stocking/adult salmon access
The Little Southwest tends to have relatively lower fry and parr abundances than the Sevogle or Northwest Miramichi based on the juvenile population assessment survey. We electrofished eleven sites in the headwaters of Little Southwest to provide a broader picture of the abundance of juvenile salmon in that tributary. Six of these were new sites that would be considered for stocking in 2011, however only four of the six sites were suitable and contained no fry or parr. Eight additional sites were surveyed on tributaries of the main Northwest Miramichi where fry and parr densities are typically lower than the headwater areas. Four of these sites were found to be too small or had very poor salmon habitat and would not be candidates for stocking. Two of the sites were found to have high fry densities and the other two contained no fry or parr which would make them suitable candidates for spring stocking in 2011 (Table 1).

Electrofishing assessment of stocking first feeding salmon fry in spring
Twenty sites were stocked with first feeding fry from the Miramichi Salmon Conservation Centre in spring of 2010 on the Miramichi River. We compared the average density of the sites stocked with first feeding fry to those not stocked with first feeding fry (Figure 5). The average fry density at the sites that were not stocked with first feeding fry was 27.2 fry per $100m^2$ which is considered a moderate fry density, while the sites that were stocked with first feeding fry had average densities of 69 fry per $100m^2$, which is considered the optimum fry density. Within the group of sites that were not stocked nine had no fry at the sites and the additional six sites had between (3.4-227.2 fry per $100m^2$). Of the group of sites that were stocked two did not have any fry present, however the additional 17 had between 15.8 and 140.7 fry per $100m^2$. To ensure that the increase in fry seen at these sites was not due to yearly changes in fry density we compared the densities of the stocked sites in 2010 to those in previous years (Figure 6). Eleven of these sites had been electrofished in at least two years between 2006-2009. On average the sites stocked with first feeding fry in 2010 had higher fry densities (62.2 fry per $100m^2$) in August than the sites that were previously stocked with fall fingerlings in October (32.8 fry per $100m^2$). This indicates that the survival of first feeding fry is good and can help to increase the overall juvenile salmon production in the river.

Table 3. Predicted abundance of Atlantic salmon fry and parr/100m^2, calculated by CPUE method, from headwater sites located on the Miramichi River.

Sub-basin	Major Tributary	Site #	Site	Fry	Parr
Northwest	Little Southwest	332	Crooked Brook Tuadook	66.9	31.1
Northwest	Little Southwest	457	Libby Brook	124.9	1.2
Northwest	Little Southwest	205	Little North Pole Stream	15.8	8.5
Northwest	Little Southwest	334	Squaw Barren brook	44.0	9.0
Northwest	Little Southwest	337	West Branch Little Southwest	30.0	56.4
Northwest	Little Southwest		Left Lower N. Br. Little Southwest	0	0.0
Northwest	Little Southwest		Fish Brook	0	0.0
Northwest	Little Southwest		Upper Sadlers Brook	0	0.0
Northwest	Little Southwest		Freeze Brook	0	0.0
Northwest	Little Southwest		Upper West Br Little Southwest	Beaver Dammed	
Northwest	Little Southwest		Sadlers Brook	Beaver Dammed	
Northwest	Northwest Miramichi	302	South Branch Northwest	19.0	2.4
Northwest	Northwest Miramichi	135	NW Millstream CI Road	64.4	6.7
Northwest	Northwest Miramichi		NW Millstream Bellefond	31.7	14.6
Northwest	Northwest Miramichi		Smoker Brook	62.4	11.8
Northwest	Northwest Miramichi		South Tomogonops	0	0.0
Northwest	Northwest Miramichi		Lower N Br. Tomogonops	0	0.0
Northwest	Northwest Miramichi	581	Trout Brook	Very small brook	
Northwest	Northwest Miramichi		McLaughlin Brook	Very small brook	
Northwest	Northwest Miramichi		Portage River	Very poor salmon habitat	
Northwest	Northwest Miramichi		Pats Brook	Very poor salmon habitat	
Northwest	Sevogle	465	North Branch Sevogle	81.4	2.4
Northwest	Sevogle		Travis BK	103.5	26.2
Southwest	Burnthill		Greenbank Brook	75.5	18.5
Southwest	Burnthill		South Branch Burnthill	140.7	19.4
Southwest	Cains	403	Alderson Brook	50.7	0.0
Southwest	Cains	347	Cains Below Mckinley Brook	91.7	1.2
Southwest	Cains		Sutherland Brook	0	0.0
Southwest	Cains		Cains River Headwaters @ Zionville	Water levels too deep	
Southwest	Cains	404	McKinley Brook	122.8	14.9
Southwest	Clearwater		Clearwater Brook	127.3	49.2
Southwest	South Branch Southwest	447	Foreston brook	136.5	56.0
Southwest	South Branch Southwest	254	Juniper Brook	46.3	6.7
Southwest	South Branch Southwest	312	Little Teague	34.1	10.1
Southwest	South Branch Southwest	445	Simpson Brook	0.0	7.3
Southwest	Southwest Miramichi	318	Betts Mills Brook @ fork	18.3	17.2
Southwest	Southwest Miramichi	338	Moores Donally	0.0	1.2
Southwest	Southwest Miramichi	90	Porter Brook 2	227.2	15.9
Southwest	Southwest Miramichi		W. Br. Burntland BK	3.4	12.9
Southwest	Southwest Miramichi	417	Porter Brook 4	0	0.0
Southwest	Southwest Miramichi	330	Salmon Brook	0	0.0
Southwest	Southwest Miramichi		Cross Creek	Water levels to low	
Southwest	Southwest Miramichi	418	Porter Brook 5	Road undrivable	

Table 4. Predicted abundance of Atlantic salmon fry and parr per 100m^2, calculated by CPUE method, from juvenile abundance survey located on the Miramichi River.

Site	Watershed	Major Tributary	Site Location	Fry	Parr
107	Northwest	Little Southwest	Little Southwest	11.8	5.1
43	Northwest	Little Southwest	Little Southwest	14.3	2.2
46	Northwest	Little Southwest	Little Southwest	18.2	26.9
145	Northwest	Little Southwest	North Pole Brook	19.4	21.2
217	Northwest	Little Southwest	Little Southwest	32.1	15.8
44	Northwest	Little Southwest	Little Southwest	34.7	15.1
218	Northwest	Little Southwest	Little Southwest	67.5	24.5
147	Northwest	Little Southwest	Little Southwest	74.7	24.6
45	Northwest	Little Southwest	Little Southwest	81.1	5.4
20	Northwest	Northwest Miramichi	Little River	77.7	27.4
23	Northwest	Northwest Miramichi	Northwest Miramichi	13.2	46.7
26	Northwest	Northwest Miramichi	Northwest Miramichi	15.1	2.1
135	Northwest	Northwest Miramichi	Northwest Millstream	16.1	8.6
216	Northwest	Northwest Miramichi	Northwest Miramichi	20.3	2.3
113	Northwest	Northwest Miramichi	Tomogonops River	35.6	30.2
215	Northwest	Northwest Miramichi	Northwest Miramichi	40.8	20.1
115	Northwest	Northwest Miramichi	Northwest Miramichi	58.2	54.6
30	Northwest	Northwest Miramichi	Northwest Miramichi	62.4	16.3
34	Northwest	Northwest Miramichi	Northwest Miramichi	67.3	64.1
33	Northwest	Northwest Miramichi	Northwest Miramichi	74.2	36.3
35	Northwest	Northwest Miramichi	Northwest Miramichi	97.3	30.6
31	Northwest	Northwest Miramichi	Northwest Miramichi	112.9	38.9
103	Northwest	Sevogle	Mullin Stream	12.5	16.1
190	Northwest	Sevogle	Big Sevogle	19.4	3.7
104	Northwest	Sevogle	North Branch Sevogle	43.6	42.6
40	Northwest	Sevogle	Little Sevogle	115.6	15.8
153	Northwest	Sevogle	South Branch Sevogle	120.7	18.2
38	Northwest	Sevogle	North Branch Sevogle	129.9	49.6
39	Northwest	Sevogle	South Branch Sevogle	192.9	32.5
75	Southwest	Cains River	Cains River	11.2	0.0
77	Southwest	Cains River	Cains River	42.2	10.4
213	Southwest	Cains River	Cains River	59.8	1.2
78	Southwest	Cains River	Cains River	70.3	15.2
74	Southwest	Cains River	Cains River	125.6	99.7
121	Southwest	Clearwater Brook	Clearwater Brook	85.1	10.4
55	Southwest	Dungarvon	Dungarvon	37.8	8.7
117	Southwest	Dungarvon	Dungarvon	54.5	21.3
210	Southwest	Dungarvon	Dungarvon	63.1	34.1
57	Southwest	Dungarvon	Dungarvon	86.3	20.2

221	Southwest	Dungarvon	Dungarvon	89.3	23.7
186	Southwest	Dungarvon	Dungarvon	95.6	22.4
214	Southwest	Renous	Renous	22.6	6.7
48	Southwest	Renous	Renous	28.5	5.5
54	Southwest	Renous	Renous	76.0	10.3
92	Southwest	Rocky Brook	Rocky Brook	172.2	70.0
95	Southwest	South Branch Southwest Miramichi	Teague Brook	80.1	3.7
61	Southwest	Southwest Miramichi	Southwest Miramichi	17.4	0.0
129	Southwest	Southwest Miramichi	McKiel Brook	30.2	12.0
69	Southwest	Southwest Miramichi	Southwest Miramichi	50.0	26.2
62	Southwest	Southwest Miramichi	Southwest Miramichi	52.2	2.2
206	Southwest	Southwest Miramichi	Southwest Miramichi	61.1	9.6
79	Southwest	Southwest Miramichi	Big Hole Brook	72.4	22.1
120	Southwest	Southwest Miramichi	Burnthill Brook	74.8	20.9
65	Southwest	Southwest Miramichi	Southwest Miramichi	91.8	3.3
60	Southwest	Southwest Miramichi	Southwest Miramichi	101.6	59.9
58	Southwest	Southwest Miramichi	Southwest Miramichi	104.3	6.2
82	Southwest	Southwest Miramichi	Bett's Mills Brook	142.7	27.2
84	Southwest	Southwest Miramichi	Burntland Brook	192.4	127.3
88	Southwest	Taxis River	Taxis River	16.1	17.8
86	Southwest	Taxis River	Taxis River	44.9	34.4

Table 5. Yearly fry densities per 100m^2 for sites that were stocked with first feeding fry in 2010 by the Miramichi Salmon Association.

Sub-basin	**Major Tributary**	**Site #**	**Site**	**2006**	**2007**	**2008**	**2009**	**2010**
Northwest	Little Southwest	334	Squaw Barren Brook (LSW)	9.4	1.7	0.0	0.0	44.0
Northwest	Little Southwest	337	West Branch Little Southwest	8.9	1.8	13.2	19.4	30.0
Northwest	Little Southwest	332	Crooked Brook Tuadook (LSW)	214.0	8.2	23.8	131.5	66.9
Northwest	Northwest Miramichi	302	South Branch Northwest	6.9	0.0	0.0	0.0	19.0
Northwest	Sevogle	465	North Branch Sevogle			0.0	0.0	81.4
Northwest	Sevogle		Travis Brook (SEV)		19.3	43.7		103.5
Southwest	Cains	404	McKinley Brook (CAI)	14.9	NA	4.8	5.3	122.8
Southwest	South Branch Southwest	254	Juniper Brook (SBM)	7.0	15.8		10.9	46.3
Southwest	South Branch Southwest	445	Simpson Brook (SBM)	7.4	0.0		12.2	0.0
Southwest	South Branch Southwest	312	Little Teague (SBM)	52.6	26.4		21.1	34.1
Southwest	South Branch Southwest	447	Foreston brook (SBM)	86.1	154.8		239.9	136.5

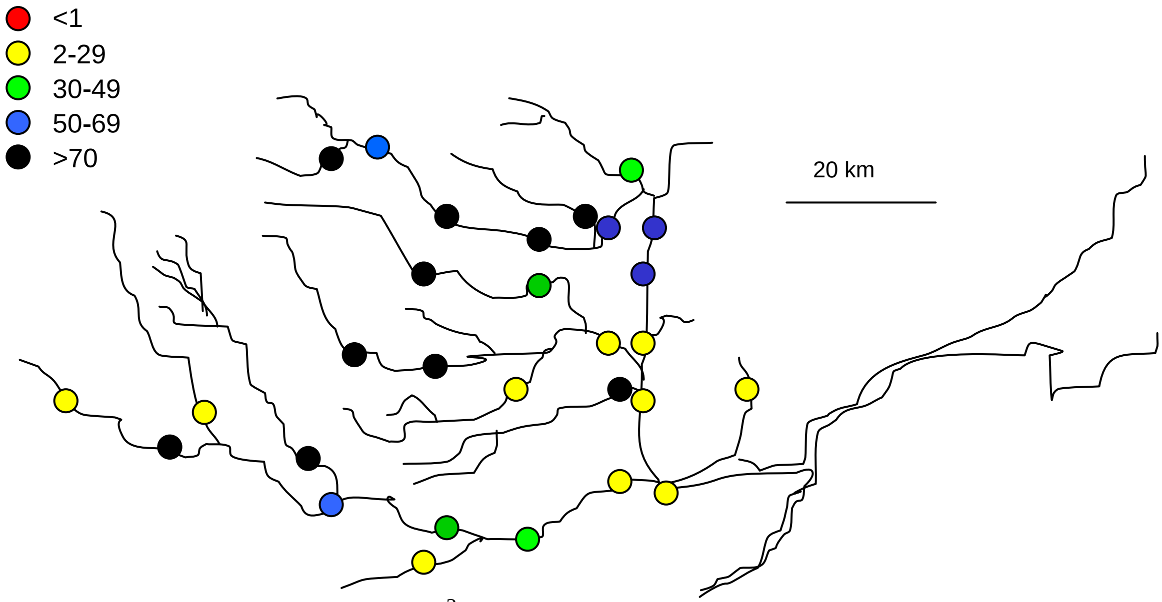


Figure 6. Density of fry per 100m^2 on the Northwest Miramichi based on the juvenile abundance survey.

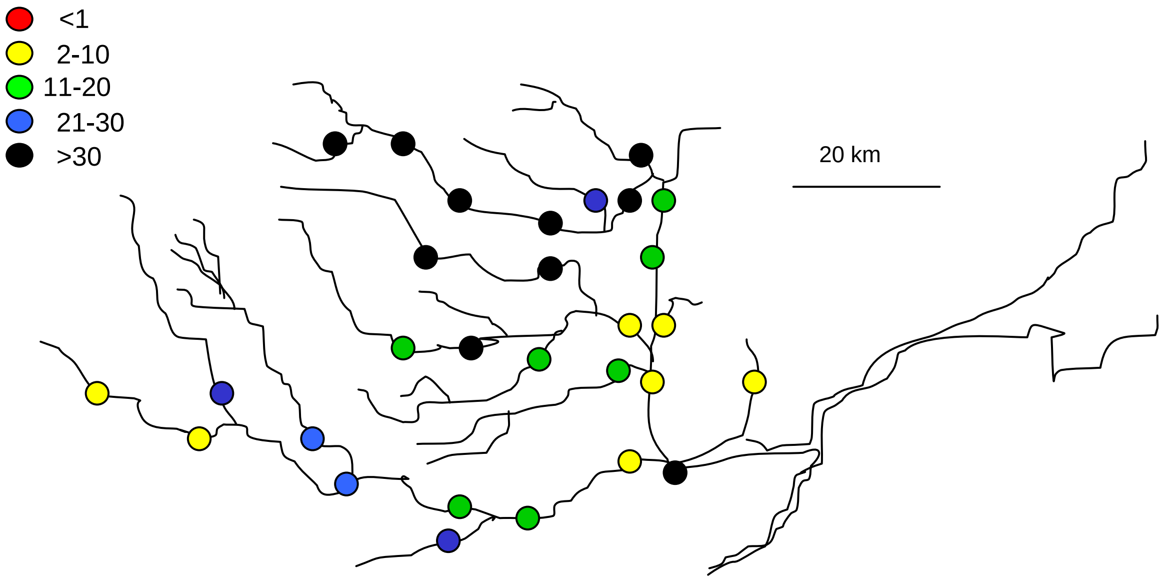


Figure 7. Density of parr (1+ 2+) per 100m^2 on the Northwest Miramichi based on the juvenile abundance survey.

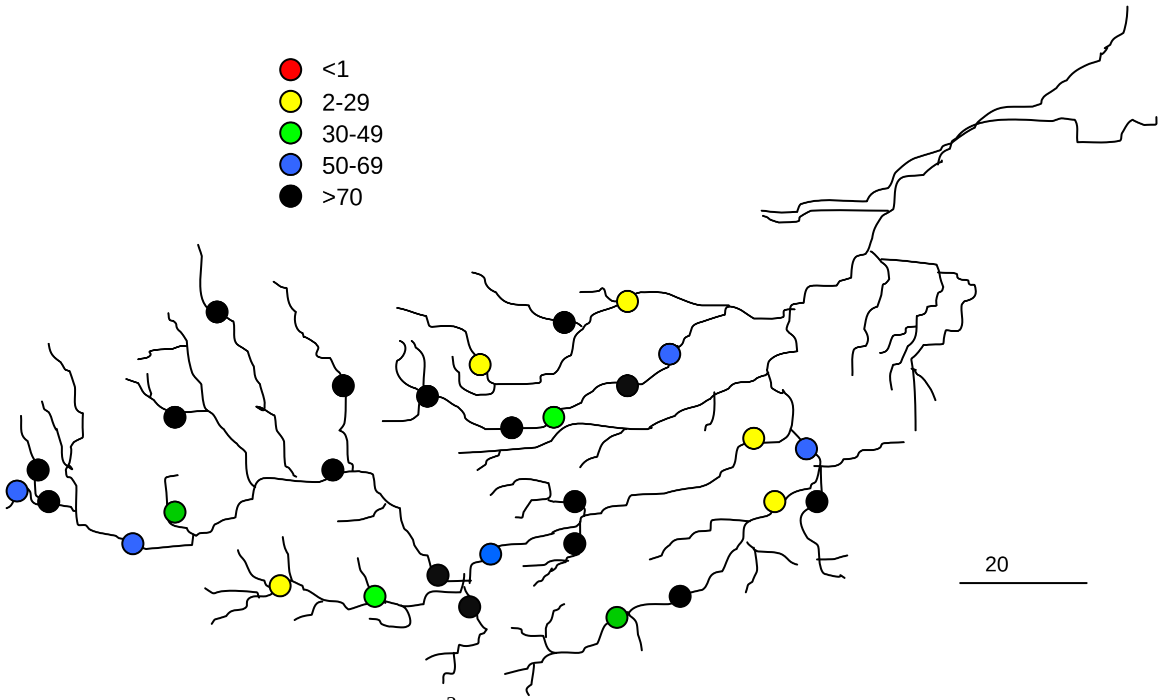


Figure 8. Density of fry per 100m^2 on the Southwest Miramichi based on the juvenile abundance survey.

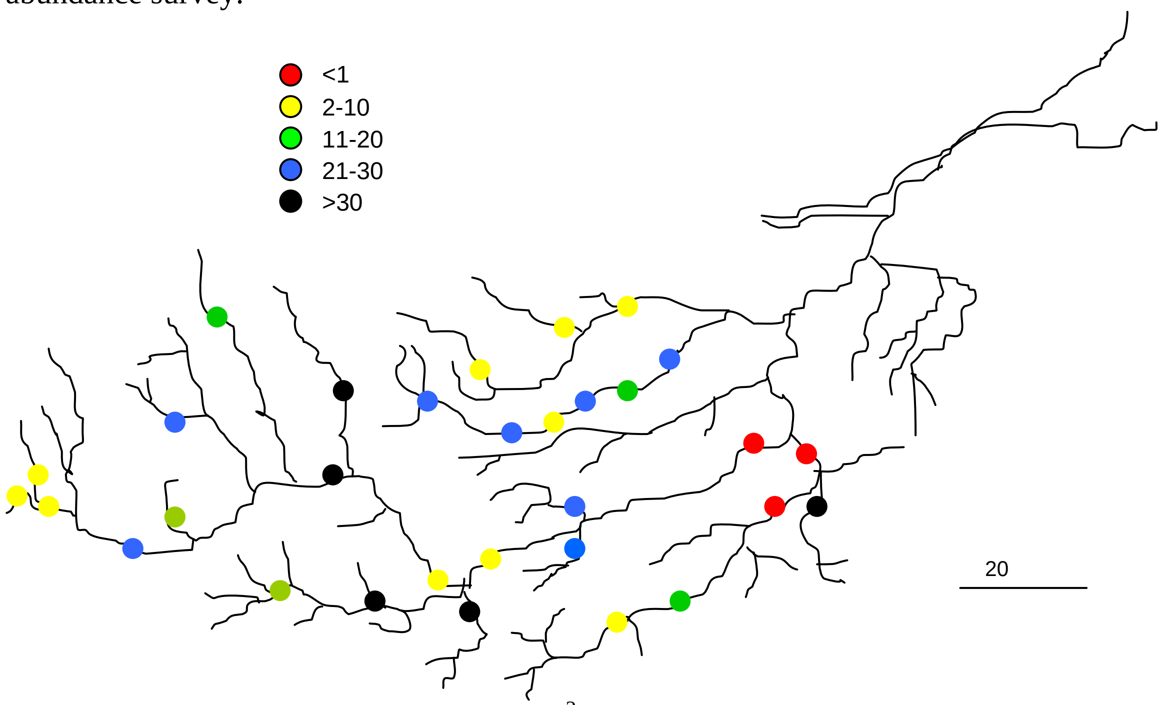


Figure 9. Density of parr (1+ 2+) per 100m^2 on the Southwest Miramichi based on the juvenile abundance survey.

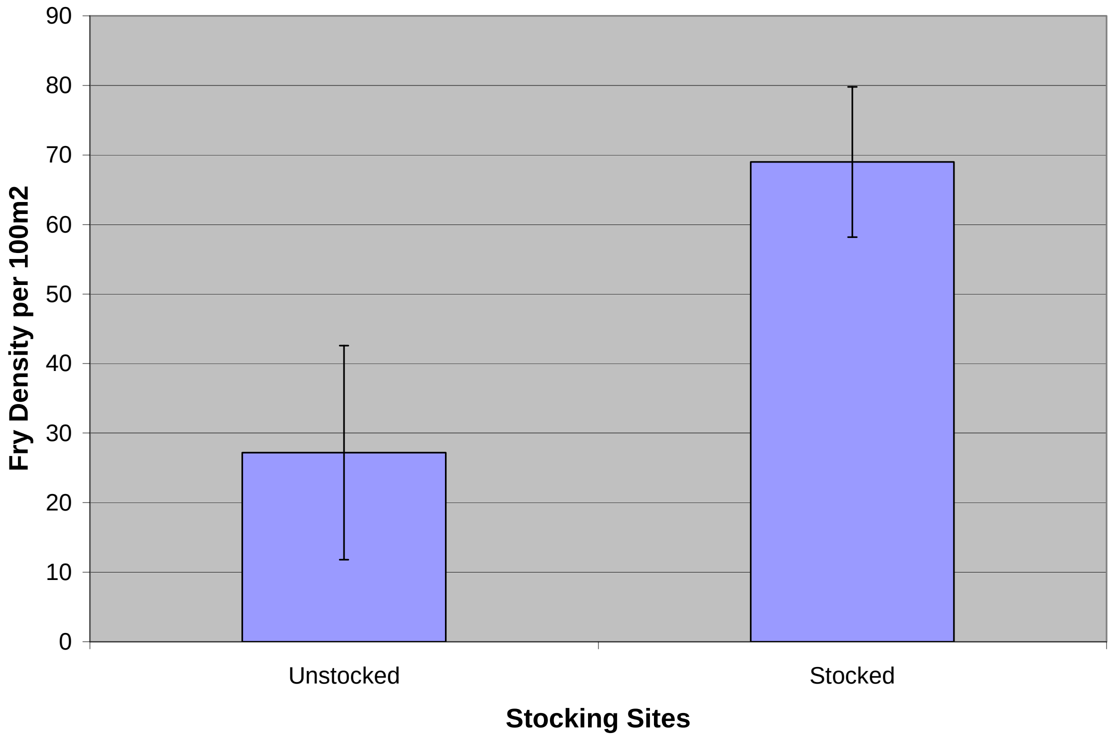


Figure 10. Average density of electrofishing sites in 2010 stocked with first feeding fry compared to sites that were not stocked with first feeding fry in 2010.

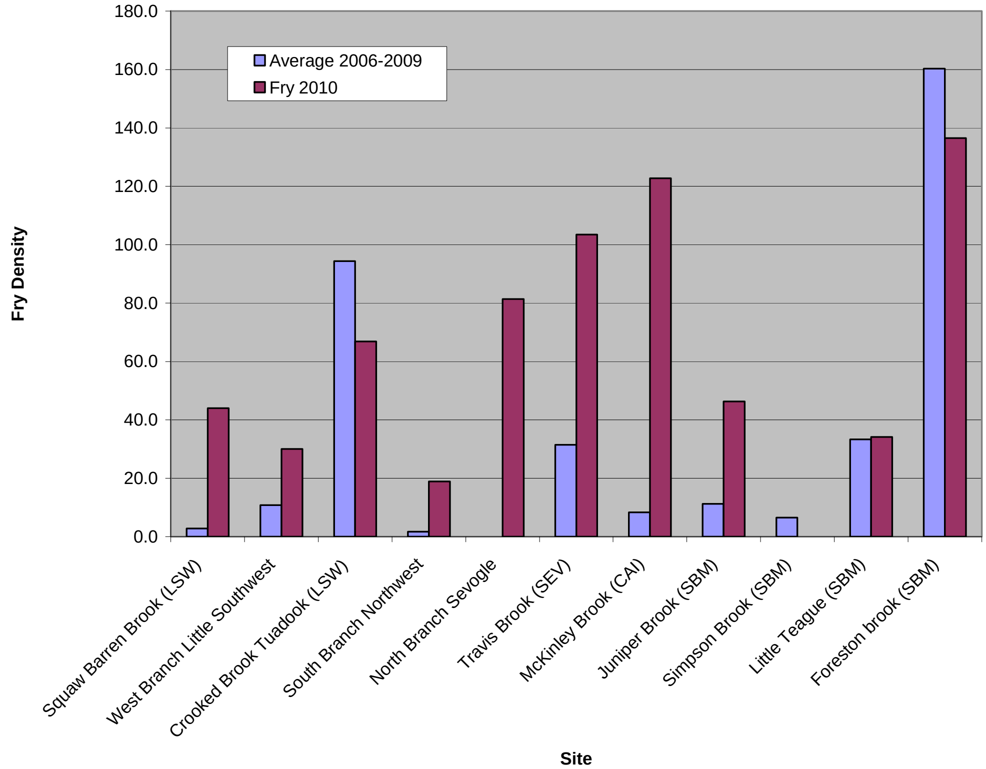


Figure 11. Average fry density of sites stocked with first feeding fry in 2010 compared to the average fry densities from those sites from 2006-2009 when data was available. (LSW- Little Southwest, SEV – Sevogle, CAI – Cains, SBM – South Branch of the Southwest Miramichi)

4. SMOLT PRODUCTION

Smolt Production Study on the Southwest Miramichi River

Introduction

Over the past three decades, there has been a continuing and recognizable need for conservation efforts to sustain Atlantic salmon stocks in the Miramichi River. Over that time, despite major management actions such as the closing of commercial fisheries in both the Maritimes and Newfoundland, annual returns have fallen below expectations. In very recent years, minimum spawning requirements for Atlantic salmon have just been met in the Miramichi River system.

An accurate estimation of the total smolt population migrating from the Miramichi River is an essential component to understanding and managing the Atlantic salmon in this watershed. Currently, work is being conducted to estimate the population of fry, 1+ and 2+ parr in the watershed using electrofishing; smolt wheels are used to estimate the number of smolts migrating from the Miramichi River; and trap nets are used to estimate an adult population. By having a population estimate for all of the different life stages it allows us to look at trends in the production of salmon between the various life stages and to pin point areas in the life cycle of Atlantic salmon where the most mortality is occurring.

Methods

The method used to obtain the smolt estimates was a mark and recapture experiment. On the Cains and Dungarvon Rivers, 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 Southwest Miramichi at Millerton to capture smolts moving from freshwater into the estuary. Tagged smolts captured at the Millerton trap net allow us to get an estimate of the smolts moving out of the entire Southwest Miramichi. The Millerton trapnet efficiency is calculated by the total catch of smolts at Millerton divided by the population estimate. The total smolt run from the Southwest Miramichi is determined by a ratio of the number smolts that are tagged upstream at the Cains, Dungarvon and Rocky Brook smolt wheels, the number of tagged smolts that are recaptured at the Millerton trap and the number of untagged smolts captured at the Millerton 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.

Results

The Cains smolt wheel operated from April 25 to May 27 and Dungarvon smolt wheel operated from April 25 to May 27, 2010, because of early ice out within the tributaries and warmer than normal water temperatures early in the season. The estuary trap net at Millerton fished much earlier than previous years, from May 3 to May 30, 2010, due to early ice out and warm spring temperatures.

The peak of the smolt run for the Cains River was May 4 and 87 smolts were captured. The peak of the smolt run on the Dungarvon River was May 7 with 153 smolts being captured that day. The peak of the smolt run in 2010 was more than a week earlier than 2009, likely due to the warm spring air temperatures and low snow accumulation over the winter that facilitated the warming of the rivers and movement of smolts. This year we tagged 635 smolts on the Cains and 1569 smolts on the Dungarvon River and were able to capture approximately 749 smolts in the Cains smolt wheel and 1722 smolts on the Dungarvon smolt wheel over the entire season, which was less than in 2009. This was likely due to reduced efficiency of the smolt wheels due to the low water conditions, as both the Cains and Dungarvon smolt wheels had lower capture efficiencies than in previous years.

The smolt estimate for the Dungarvon River in 2010 was 71,000 (CI 54,000 to 103,000), which worked out to be 3.2 smolts per $100m^2$, exceeding the target of 3.0 smolts per $100m^2$. There was no smolt estimate for 2010 on the Cains River due to the low number of recaptures (n=4) due to the low efficiency of the smolt wheel. The efficiency of the smolt wheel on the Cains River is typically between 1-2%, however due to the extremely low water conditions experienced in 2010 the trap efficiency was 0.6%. The water conditions were so low in 2010 that the Cains smolt wheel hit bottom from the first day it was put in, and each day had to be raised a bit higher to prevent it from hitting the river bottom more. With low discharges the smolt wheels do not rotate quickly and it may be that some fish were able to swim out of the wheel.

At the Millerton trap, we captured 65,785 smolts, 158,000 smelts, 1000 striped bass and 500 gaspereau as well as many other species throughout the season. In 2010 we processed the most number of fish through the trap as in any of the other years, and had double the amount of smolts in the trap compared with the highest number of the previous 9 years. We were able to recapture 82 smolts with streamer tags at the Millerton trap net which were tagged at the Cains, Dungarvon or Rocky Brook smolt wheels upstream. Smolt production on the Southwest Miramichi in 2010 was estimated at 2.18 millions smolts (6.2 smolts per $100m^2$). This is the highest smolt production for the Southwest Miramichi on record. The Southwest Miramichi greatly exceeded the desired smolt production in 2010 of 3.0 smolts per $100m^2$, which it has in the 5 of the last 6 years (not including 2005 in which there was no estimate as the trap was washed out). In addition, 0.2% of the Southwest Miramichi smolt run was comprised of salmon smolts with clipped adipose fins which were stocked by MSA a few years earlier.

Overall smolt production on the Dungarvon and Southwest Miramichi was good in 2010 with all rivers exceeding their production targets. It is likely that the Cains River had higher production than average, as the Dungarvon, Southwest Miramichi and Rocky Brook had higher smolt production than usual. Additionally the Dungarvon also experienced reduced efficiency like the Cains, likely due to lower water levels, however adequate numbers of fish were able to be recaptured on the Dungarvon.

Discussion

Smolt production on the Southwest Miramichi and its tributaries may have been higher than previous years due to a relatively mild winter and early spring. The ice on the river this winter was not as thick as usual, and there was a minimal spring freshet during ice out due to low snowfall this winter. This may have translated to smolts experiencing less harsh conditions during the spring ice out, such as fewer ice jams and reduced discharges ect. Therefore smolt survival through the spring may have been higher than in previous years, hence the higher smolt production observed this spring compared to previous years.

The data collected from this project over the past nine years has indicated that over the past five out of six years smolt production of 3.0 smolts per $100m^2$ from the Southwest Miramichi has been achieved or very close to being achieved. This indicates that the Southwest Miramichi River should be producing enough smolts to allow adequate numbers of adults to return. However on the Cains River smolt production over the past nine years is typically around 1-2 smolts per $100m^2$, which indicates that the Cains River has relatively low smolt production relative to other rivers on the Miramichi River. The Dungarvon River tends to have moderate smolt production with typically between 2-3 smolts per $100m^2$. These trends indicate that not all tributaries produce the same number of smolts and that while some tributaries produce large numbers of smolts, (ie. greater than 3 smolts per $100m^2$), other tributaries fall below that target.

In addition to determining differences in smolt production between the different tributaries this project has also given insight into the factors why adult returns have been lower than expected. Over the past twenty years the at sea return rates for smolt returning as grilse or two sea-winter maiden salmon has decreased, and reached a record low at sea survival in 2009 as grilse returns were the lowest seen since the 70's despite good smolt production from the Southwest Miramichi in 2008.

The data collected from this project will be published in the Canadian Technical Report of Fisheries and Aquatic Sciences as part of two publications documenting the movements and population characteristics of Atlantic salmon smolts from two Southwest Miramichi River tributaries (Cains and Dungarvon) and the Southwest Miramichi River (attached). 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.

Acknowledgements
The Miramichi Salmon Association acknowledges the financial contributions of the New Brunswick Wildlife Trust Fund, Canada Summer Jobs (CSJ), the Student Employment Experience Development (SEED), MSA members, and in kind-help provided by the Department of Fisheries and Oceans for this project in 2010.

Figure 12. Two MSA staff count smolts and other fish species that are captured in the smolt wheel daily.

Figure 13. Andrew Haddad and Sean Losier tag smolts that are captured in the smolt wheels and release them upstream.

Figure 14. The estuary smolt trap used to capture smolts from the Southwest Miramichi system.

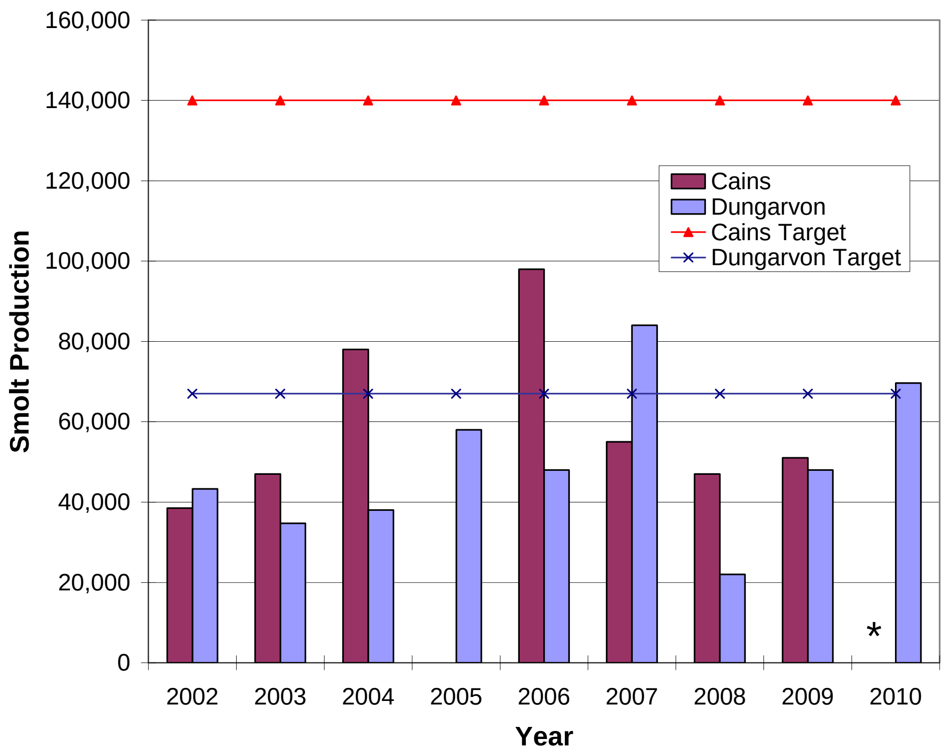


Figure 15. Smolt production from 2002 to 2010 for the Cains and Dungarvon Rivers. * indicates that smolt estimate was not available due to low trap efficiency and very low number of recaptures.

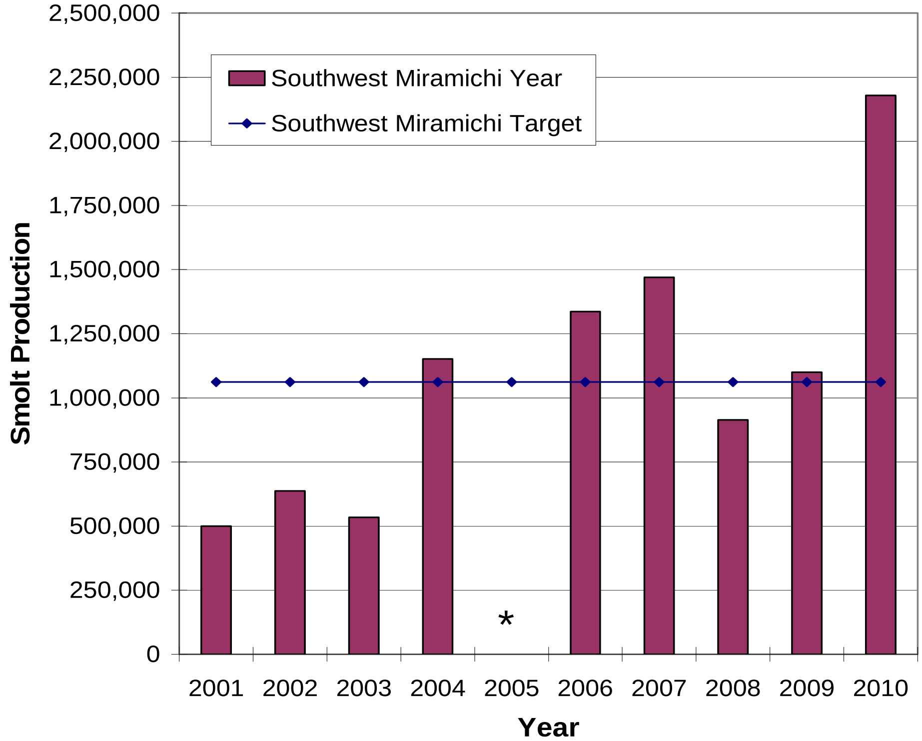


Figure 16. Smolt production from 2001-2010 for the Southwest Miramichi River. * indicates smolt estimate was not available due to trap wash out and high water conditions.

5. ADULT SALMON

Introduction

The current adult assessment for Atlantic salmon on the Miramichi River is based on a mark recapture experiment. Typically the assessment is adequate for the Miramichi River as a whole, but when the assessment is broken down into two different rivers, the Northwest and Southwest Miramichi, there is less reliability in the estimates.

Currently the adult assessment for the Southwest Miramichi is done by tagging Atlantic salmon at a trap run by Eel Ground First Nation near the Enclosure, and recapturing them at the DFO Millerton trap net upstream. On the Northwest Miramichi, Atlantic salmon are tagged at the DFO trapnet at Cassilis and recaptured at the food fishery traps at Redbank First Nation. The number of fish tagged, the number of fish recaptured and the total number of fish captured are used in an equation to estimate the population. In order to get a relatively accurate estimate of the population a certain number of fish must be recaptured. One of the problems is in the assessment is that the food fishery traps are not fished on the weekends, are not in place for the entire year and that the trap nets must be raised during high water events or may be washed out by high water. This could mean that during periods of high water fish could move past the traps without being tagged or recaptured. In addition, many fish come in on a high tide and start going up one branch of the river, then change their mind and go up the other. For example, a fish may be tagged at Cassilis and then later recaptured at Millerton.

In order to attempt to improve the stock assessment, other methods of recapturing tagged fish have been contemplated. Seining is a good method because many different tributaries on the Miramichi could be sampled and it would allow fish to be recaptured, as well as capture a number of unmarked fish, which is required in order to achieve the estimate. There also would be no exchange of fish moving from one tributary to the next because fish would be recaptured higher in the system and fish could be recaptured when high water conditions had receded.

The objectives of this study were to increase the number of salmon and grilse that are recaptured with Carlin tags and adipose punches, increase the confidence in the separate adult branch estimates (NW/SW) by recapturing large numbers of tagged and untagged adult salmon and grilse (~1000 grilse and ~500 salmon per branch), determine Carlin tag loss by anglers removing tags and to determine the percentage of adult adipose clipped salmon or grilse returning to the river from the MSA's stocking efforts.
To manage the Atlantic salmon resource appropriately, decisions must be made based on good scientific data.

Methods

Fish captured at the DFO adult traps at Cassilis and Millerton, on the Miramichi River, NB, were marked with blue carlin tags and an adipose punch (Figure 1). This punch allowed us to identify any fish that had previously been tagged, if the tag had been removed by an angler. If a fish was adipose clipped then it received a carlin tag and caudal punch to mark it as being tagged. In days when large amounts of grilse were caught in the trap (typically greater than 30 per day), the first 30 would receive a carlin tag and adipose punch but any additional fish would receive a caudal punch to mark them as having moved through the trap. Fish moving through the Millerton trap received an upper caudal punch and those moving through the Cassilis trap received a lower caudal punch.

Pools were selected all over the watershed based on their ability to hold fish during the seining period and their ease at being seined. Fish were scared down into the pool and the pool was surrounded by a fine meshed net. Divers worked in deep water and lifted the net over large rocks or when it got caught on debris. The fish were corralled into a given area and sorted. Fish were identified as grilse or salmon, male or female and checked for tags, punches and adipose clips. Other species captured were also identified and counted. All fish were released except those taken for spawning at the Miramichi Salmon Conservation Centre.

The adult estimate was derived from a mark-recapture experiment where the fish were marked downstream at the Millerton or Cassilis DFO index trap nets and recaptured upstream in holding pools as they made their way upstream to spawn. Tag loss is normally estimated at 10% however it was likely much higher in 2010 due to high water temperatures and poaching and for the purpose of this report we will estimate it at 20%. The estimates are based on the formula:
Population Estimate = Number of fish marked x Total catch / Number of fish recaptured

Results

In total 1047 grilse and 370 salmon at the Cassilis trap and 1033 grilse and 529 salmon at the Millerton trap were tagged and received an adipose punch in 2010 as of September 30, 2010. However due to the warm water conditions fish experienced this summer there were higher mortality levels than in previous years which would reduce the number of available tags.

We seined a larger number of pools this year despite the water levels. Seining did not start until the first week of September because water temperatures were too warm to be handling the fish. Initially water levels were extremely low which meant that pools could still be seined despite the rain. We attempted to seine pools higher up in the systems when water levels were higher because they would drop quicker than lower sites.

In total we seined 18 pools, 8 on the Northwest Miramichi and 10 on the Southwest Miramichi, with only the Dungarvon barrier being seined more than one time because the first time we didn't catch many fish due to high water conditions.

The majority of pools seined on the Northwest system were on the Little Southwest and Northwest Miramichi. The Sevogle is relatively inaccessible by truck and requires ATV's to access the majority of the angling pools. Additionally due to the rocky features such as bedrock or cliffs, the pools on the Sevogle are generally very difficult to seine. We seined Stillwater pool on the Big Sevogle but due to the large amount boulders and current the chain ripped off the net and any fish that may have been captured escaped. We also assessed Limekiln pool that day but due to the large boulder bottom and width of the pool decided we were not able to seine it. Cruickshank pool on the North Branch of Sevogle was not seined in 2010 because of warm water conditions in early September and rainfall caused the fish in that pool to move upstream after the river had cooled.

In total from both tributaries we were able to capture 572 salmon and 1245 grilse. This is below the anticipated number of 1000 grilse and 500 salmon from each branch that was desired. However time constraints, such as a one month to seine, fall rains and changes in water levels and warm water temperatures, the amount of effort required to seine a pool and the lack of suitable holding pools which hold very large numbers of fish (>200 fish per pool), made achieving these numbers of fish impossible, particularly for the Northwest Miramichi where there are large numbers of fish spread throughout small pools, such as in the Crown Reserve sections. We were able to capture good numbers of fish from each branch despite not capturing 1500 fish from both branches. In total we were able to capture 459 grilse and 380 salmon on the Northwest Miramichi and 786 grilse and 292 salmon on the Southwest Miramichi (Table 1). Included in those numbers we captured 2 marked grilse on the Northwest Miramichi, and 13 grilse and 15 salmon on the Southwest Miramichi that were tagged and/or punched (Table 2). In addition we captured 205 white sucker and 32 brook trout. The number of tagged fish recaptured on the Southwest Miramichi was good, however few tagged fish were captured on the Northwest Miramichi despite large numbers of fish being tagged at the DFO index traps and good numbers of salmon captured by seining.

Carlin tag loss from anglers (adipose punch only) was estimated at 8% for grilse and 33% for salmon based on the fish that were recaptured with marks. The number of adult salmon returning that were stocked in previous years by MSA (adipose clipped) were 0.4% of the grilse and 0% salmon seined on the Northwest Miramichi and 4.4% of grilse and 2% of salmon seined on the Southwest Miramichi. The majority of these fish were from the Northwest (1) and Little Southwest Miramichi (1) on the Northwest system and from the Dungarvon (32), Rocky Brook (7), Clearwater (1), South Branch of the Southwest Miramichi (1) and Cains (1) Rivers on the Southwest Miramichi where we had satellite rearing sites in previous years.

When DFO determines the number of returning salmon to the Miramichi, the adult seining program data will be used in the model, as well as the barrier counts and the mark and recapture at the trap nets.

Table 6. Adult Atlantic salmon captured at holding pools in the Miramichi River

Sub-Basin	Tributary	Pools	Grilse	Salmon
Northwest	Little Southwest	4	122	67
	Northwest	3	337	213
	Sevogle	1	0	0
Southwest	Cains	2	87	20
	Clearwater	1	92	84
	Rocky Brook	4	123	57
	Dungarvon	3	455	116
	S Br SW Miramichi	1	17	14
	Burnthill	1	12	1

Table 7. Number and location of marked Atlantic salmon captured during adult seining program.

Tributary	Size	Origin	Sex	Tag	Tag number	Adipose punch
Cains	Grilse	Wild	Male	Carlin	YY27025	None
Cains	Salmon	Wild	Male	Carlin	YY25506	Adipose punch
Cains	Salmon	Wild	Male	Carlin	YY25649	Adipose punch
Clearwater	Grilse	Wild	Male	Carlin	YY24145	Adipose punch
Dungarvon	Grilse	Wild	Female	Carlin	YY28351	Adipose punch
Dungarvon	Grilse	Wild	Female	Carlin	YY24657	Adipose punch
Dungarvon	Grilse	Wild	Male	Carlin	YY28163	Adipose punch
Dungarvon	Grilse	Wild	Male	Carlin	YY24777	Adipose punch
Dungarvon	Grilse	Wild	Male	Carlin	YY24670	Adipose punch
Dungarvon	Grilse	Wild	Male	Carlin	YY26214	Adipose punch
Dungarvon	Grilse	Wild	Male	Carlin	YY26097	Adipose punch
Dungarvon	Grilse	Wild	Female	No tag		Adipose punch
Dungarvon	Salmon	Wild	Female	Carlin	YY25596	Adipose punch
Dungarvon	Salmon	Wild	Female	Carlin	YY25367	Adipose punch
Dungarvon	Salmon	Wild	Male	No tag		Adipose punch
Dungarvon	Salmon	Wild	Female	Tag scar		Adipose punch
Dungarvon	Salmon	Wild	Female	Carlin	YY29835	None
Dungarvon	Salmon	Wild	Female	Carlin	YY25367	None
Rocky Brook	Grilse	Wild	Male	Carlin	YY24652	Adipose punch

Rocky Brook	Grilse	Wild	Female	No tag		Adipose punch
Rocky Brook	Grilse	Wild	Male	Tag scar		Adipose punch
Rocky Brook	Salmon	Wild	Female	Carlin	YY25410	Adipose punch
Rocky Brook	Salmon	Wild	Female	Carlin	YY25376	Adipose punch
Rocky Brook	Salmon	Wild	Male	Carlin	YY25443	Adipose punch
Rocky Brook	Salmon	Wild	Female	Carlin	YY24462	None
Rocky Brook	Salmon	Wild	Female	Carlin	YY24480	None
Rocky Brook	Salmon	AC	Female	Carlin	YY24418	NA
S Br SW	Salmon	Wild	Female	Carlin	YY25737	None
Little Southwest	Grilse	Wild	Male	No tag		Adipose punch
Northwest	Grilse	Wild	Male	Carlin	YY26116	Adipose punch

Figure 17. Grilse showing location of carlin tag and adipose punch.

6. STOCKING OF JUVENILE ATLANTIC SALMON AND SEA-RUN BROOK TROUT

Introduction

Stocking Atlantic salmon juveniles can improve the production capacity of a river by targeting areas that are under seeded or not accessible to spawning adults. An electrofishing survey is carried out each year by the MSA to assess areas of the river that are lacking adequate numbers of fry or parr. If lots of fry are found it indicates that adult salmon were able to spawn in that area the previous fall. If no fry were present it could mean that adults were unable to access that spawning area. In most cases the river or stream may be barricaded in some way (eg. 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 impediments to natural spawning. The majority of these areas are located in headwater areas or small tributaries of the main stem. These brooks often have good quality habitat and lower numbers of predators compared to lower stream sites however are often inaccessible to adult salmon due to blockages by beaver dams or due to the small size of the brook, especially in years with low flow conditions.

The Miramichi Salmon Association uses information from the wild juvenile abundance survey and smolt information to aid in determining specific tributaries that may need additional stocking. In the past both the Little Southwest and the Cains River have had low to moderate fry and parr densities as well as low smolt production. Therefore additional stocking areas have been identified on these tributaries by electrofishing. This is important because if fish are stocked into an area with an already high density of fry or parr then there will be increased competition and will likely not result in an increase in production for that area. Determining juvenile densities allows us to avoid overstocking and target naturally under-stocked streams in each individual river system. In terms of stocking, any site containing more than 100 fry / 100m^2 is not considered for stocking as it appears to reflect a healthy natural population. Sites with less than 50 fry / 100m^2 are considered candidates for fall stocking.

Stocking efforts should also be evaluated so that we can determine how good the stocking site is for increasing salmon production. If stocked fry are not present at stocking sites it may indicate that the site does not contain the appropriate habitat or it may have too many predators. Prior to 2010 fall fingerlings were stocked and were identified by an adipose clip (removal of the adipose fin). In 2010 the Miramichi Salmon Association 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 when they would normally being feeding for the first time in the wild. These fry are stocked in late May or June, instead of October. However due to the size of the fish it is not possible to mark them in anyway. Additional fall fingerlings were raised by the satellite rearing program run through the MSA, NSPA, JD Irving Ltd and MHSF.

The objectives of this program were to improve Atlantic salmon production in the headwater areas of the Miramichi River and to assess the practice of stocking first feeding salmon fry in headwater sites.

Methods

Stocking sites were identified based on the juvenile densities found at the headwater sites by electrofishing and tributaries that typically have low juvenile production (ie. Cains and Little Southwest). Wild Atlantic salmon adults were collected for broodstock in the fall of 2009 and their eggs were incubated over the course of the winter. Atlantic salmon fry were ready to start feeding during the last week in May and early June and were stocked out during this time. Additional salmon fry were taken in to satellite rearing sites for rearing at the camps over the course of the summer.

Twenty stocking sites were selected and then electrofished later in the summer to determine if the first feeding fry stocking was successful. These sites were all headwater tributary sites with moderate to high Atlantic salmon habitat qualities. We compared the average density of the sites stocked with first feeding fry to those not stocked with first feeding fry as well as compared the fry numbers in 2010 when first feeding fry were stocked with the fry numbers in 2006-2009 when those sites were not stocked with first feeding fry to determine if the first feeding fry stocking was effective.

Results

In 2010 139,276 first feeding salmon fry (Table 1) and 177,800 sea-run brook trout were released into the Miramichi River in the spring of the year (Table 2). In 2010 76,000 salmon fry were distributed to the satellite rearing sites in mid-June (Table 3). Of those 29,773 fall fingerling salmon fry were released into the Miramichi River that fall from the satellite rearing sites (Table 4). In total twenty four sites were stocked with first feeding fry from the Miramichi Salmon Conservation Centre in June of 2010 on the Miramichi River. We compared the average density of the sites stocked with first feeding fry to those not stocked with first feeding fry (Figure 1). The average fry density at the sites that were not stocked with first feeding fry was 27.2 fry per $100m^2$ which is considered a moderate fry density, while the sites that were stocked with first feeding fry had average densities of 69 fry per $100m^2$, which is considered the optimum fry density. Within the group of sites that were not stocked, nine had no fry at the sites and the additional six sites had between (3.4-227.2 fry per $100m^2$). Of the group of sites that were stocked, two did not have any fry present, however the additional 17 had between 15.8 and 140.7 fry per $100m^2$. To ensure that the increase in fry seen at these sites was not due to yearly changes in fry density we compared the densities of the stocked sites in 2010 to those in previous years (Figure 2). Eleven of these sites had been electrofished in at least two years between 2006-2009 (Table 5). On average the sites stocked with first feeding fry in 2010 had higher fry densities (62.2 fry per $100m^2$) in August than the sites that were previously stocked with fall fingerlings in October (32.8 fry per $100m^2$). This indicates that the survival of first feeding fry is good and can help to increase the overall juvenile salmon production in the river. Therefore the objectives of this project were met. Due to the success stocking first feeding fry we will continue to stock first feeding fry in 2011.

Table 8. Distribution of Atlantic salmon first feeding fry from the Miramichi Salmon Conservation Centre.

Release Date	Stock Origin	Number Released	Length (mm)	Weight (g)	Release Location	Lat	Long
26-May	Sevogle	4,737	30mm	0.217	Sevogle- Travis Brook	N47.047982	W66.230471
26-May	Sevogle	4,737	30mm	0.217	Sevogle - N Br Sevogle	N47.20343	W66.32045
27-May	Cains	8,000	30mm	0.173	Cains- Sutherland Brook	N46.208593	W66.350358
27-May	Cains	9,000	30mm	0.173	Cains Headwaters @ Zionville	N46.206785	W66.1671137
27-May	Cains	5,000	30mm	0.173	Alderson Brook	46.30612	66.28274
27-May	Cains	5,000	30mm	0.173	McKinley Brook	46.29327	66.28049
27-May	Cains	4,872	30mm	0.173	Cains River below McKinley Bk	46.29397	66.28274
2-Jun	Richibucto	4,278	30mm	0.18	Richibucto R1	N46.491007	W65.266250
2-Jun	Richibucto	4,278	30mm	0.18	Richibucto	N46.485194	W65.277111
2-Jun	Richibucto	4,278	30mm	0.18	Richibucto R1A	N46.512568	W65.180744
2-Jun	Richibucto	4,278	30mm	0.18	Bass River BR1	N46.549586	W65.109666
2-Jun	Juniper	4351	30mm	0.227	Foreston Brook	N46.527816	W67.307898
2-Jun	Juniper	4351	30mm	0.227	Simpson Brook	N46.544995	W67.228034
2-Jun	Juniper	4351	30mm	0.227	Little Teague	N46.260786	W67.260786
2-Jun	Juniper	4351	30mm	0.227	Juniper Brook	N46.539150	W67.184470
3-Jun	Rocky Brook	18934	30mm	0.23	Rocky Brook LL Bridge	N46.779	W66.725
3-Jun	Burnthill	3315	30mm	0.19	S Br Burnthill	N46.680897	W67.000969
3-Jun	Burnthill	3315	30mm	0.19	Greenbank Brook	N46.680897	W67.006868
10-Jun	Clearwater	4803	30mm	0.222	Salmon Falls	N46.663309	W66.75907
11-Jun	Clearwater	4803	30mm	0.222	North East Branch Clearwater	N46.82142	W66.84908
12-Jun	Clearwater	4803	30mm	0.222	Clearwater	N46.75841	W66.84100
13-Jun	Clearwater	4803	30mm	0.222	Clearwater	N46.76438	W66.84291
8-Jun	Northwest	8640	30mm	0.195	South Branch Northwest	47.2492	66.3932
3-Jun	Little Southwest	5422	30mm	0.256	Libby Brook	46.8936	66.3937
3-Jun	Little Southwest	5422	30mm	0.256	Crooked Brook Tuadook	46.9154	66.7770
3-Jun	Little Southwest	5422	30mm	0.256	Squaw Barren	46.9725	66.7009
3-Jun	Little Southwest	5422	30mm	0.256	West Br LSW	47.0045	66.7083
3-Jun	Little Southwest	5422	30mm	0.256	Little North Pole Stream	46.9843	66.5189

Table 9. Distribution of sea-run brook trout first feeding fry from the Miramichi Salmon Conservation Centre.

Release Date	Stock Origin	Number Released	Length (mm)	Weight (g)	Release Location	Lat	Long
25-May	Beadle Brook Sea-run	44,450	20	0.15	McKiel Brook	N46.55466	W67.04826
25-May	Beadle Brook Sea-run	48,895	20	0.15	McKiel Brook	N46.550119	W67.04420
25-May	Beadle Brook Sea-run	35,560	20	0.15	Bundy Bank- N Br SW Miramichi	N46.60641	W67.18679
25-May	Beadle Brook Sea-run	48,895	20	0.15	White Birch Bridge - N Br SW Miramichi	N46.68321	W67.17559
TOTAL		**177,800**					

Table 10. Distribution of Atlantic salmon fry to the satellite rearing tanks.

LOCATION	#FRY	STRAIN
Rocky Brook Camp	7000	Clearwater
JD Irving Ltd	12000	Clearwater
Clearwater Subtotal	**19,000**	
Rocky Brook Camp	10500	Rocky Brook
Rocky Brook Subtotal	**10,500**	
Salmon Palace	2500	Rocky Brook Dom
Slate Island	5000	Rocky Brook Dom
Salmon Brook	5000	Rocky Brook Dom
Black Brook	12000	Rocky Brook Dom
Rocky Brook Dom Subtotal	**24,500**	
NSPA	5000	Little Southwest
Little Southwest Subtotal	**5,000**	
MHSF	12000	South Branch Southwest Miramichi
Juniper Subtotal	**12000**	
Miramichi Fish and Game	5000	Northwest
Northwest Subtotal	**5000**	
TOTAL	**76,000**	

Table 11. Distribution of Atlantic salmon fingerlings from the satellite rearing tanks for fall stocking.

LOCATION	#FRY	WEIGHT (g)	RELEASE DATE	LOCATION	COORDINATES	
Rocky Brook Camp	1096	5	7-Oct	Gravel Pit	N46.638739	W66.764765
	3289	5	7-Oct	North East Branch Clearwater	N46.82142	W66.84908
	1096	5	7-Oct	Bridge	N46.654034	W66.768937
	1096	5	7-Oct	Salmon Falls	N46.663309	W66.75907
JD Irving Ltd	2000	5.5	19-Oct	Clearwater headwaters	46.853408	66.935663
	1500	5.5	19-Oct	Clearwater headwaters	46.85189	66.935826
	1000	5.5	19-Oct	North East Branch Clearwater	46.821078	66.849256
	1000	5.5	19-Oct	North East Branch Clearwater	46.798927	66.860594
	500	5.5	19-Oct	North East Branch Clearwater	46.795945	66.891131
	2000	5.5	19-Oct	Pond Brook	46.769199	66.861428
Clearwater Subtotal	**14,577**					
Rocky Brook Camp	2086	5	8-Oct	LL Bridge	N46.779	W66.725
Rocky Brook Subtotal	**2,086**					
Salmon Palace	500	2	15-Aug	Southwest Miramichi	N	W
Slate Island	500	2	1-Oct	Slate Island	N46.5374	W66.8797
Salmon Brook	4475	1.5	13-Aug	Salmon Brook	N46.5579	W66.5476
Black Brook	50	5.5	7-Oct	Black Brook	N46.670	W65.773
Rocky Brook Dom Subtotal	**5,525**					
NSPA	150	5	27-Oct	Johnson Brook	N46.9313	W65.80273
Little Southwest Subtotal	**150**					
MHSF	1087	8	28-Oct	Juniper Brook	N46.55	W 67.19
	1087	8	28-Oct	Teague	N46.59	W67.25
	1087	8	28-Oct	Beaufort	N46.57	W67.28
	1087	8	28-Oct	Elliot Brook	N46.5824	W67.3066
	1087	8	28-Oct	Lake Brook	N46.525	W67.340
Juniper Subtotal	**5435**					
Miramichi Fish and Game	2000	1.5	13-Aug	Camp Adam NW	N47.1836	W66.1163
Northwest Subtotal	**2000**					
TOTAL	**29,773**					

7. BEAVER DAM BREACHING AND MANAGEMENT

Introduction

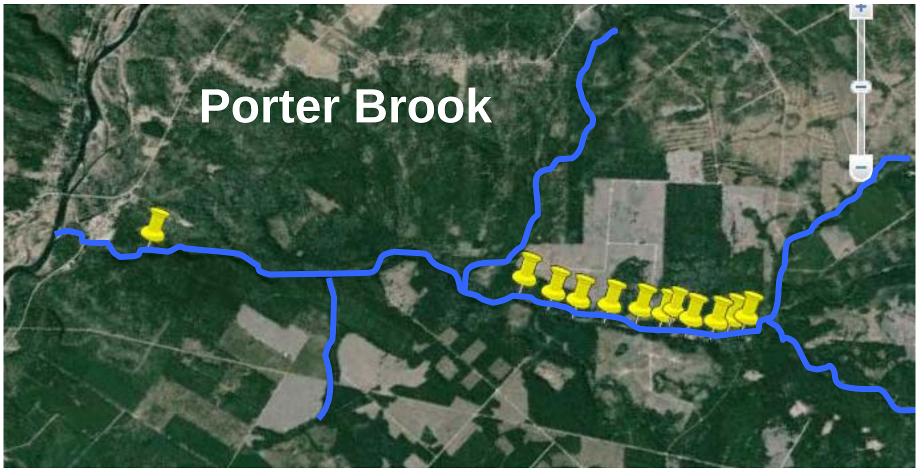
In the fall of each year the Miramichi Salmon Association breaches beaver dams on certain stretches of the river in order to allow adult salmon to access areas above beaver dams for spawning. In some cases beaver dams may be build so large that they prevent hundreds of fish from spawning above and therefore spawning is congregated in an area or redds are dug up by later spawning fish seeking good quality habitat. Allowing adult salmon to access areas above beaver dams during spawning, allows fry and parr to access habitat that may not be otherwise accessed and access good quality habitat and have less competition when the eggs hatch. This program is not externally funded and takes place over a one to two week period prior to the peak of spawning on the Miramichi River. Brooks are selected based on electrofishing surveys which indicate salmon cannot or have difficulty accessing these areas (due to low fry or parr densities) and that removing beaver dams from these areas in the past has lead to increased fry and parr densities from wild adults.

Methods

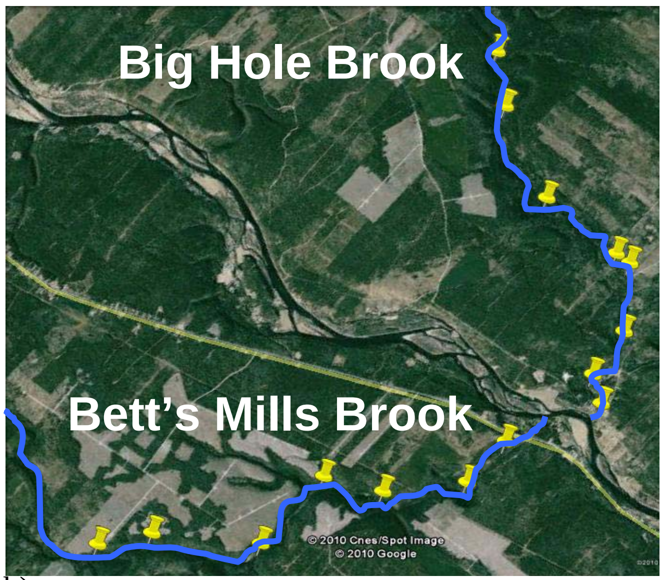
Sections of river are canoed or accessed by trails and active beaver dams are notched with a pick axe or hedge clippers. This allows salmon to move through the dams, however the dams are repaired later by the beaver. It is important that dams in the lower sections of the brooks are removed first so that salmon are not blocked by downstream dams which would prevent them from accessing upstream habitat.

Results

In 2010 the beaver dam removal program took place over a one week period. Beaver dams were removed from Bett’s Mills Brook, Big Hole Brook, Porter Brook and the Bartholomew River. Seven dams were removed from Bett’s Mills Brook, eight were removed from Big Hole Brook, twelve were removed from Porter Brook and one was removed from the Bartholomew River.



a)



b)

Figure 18. Location of beaver dams removed from Porter Brook, Big Hole Brook and Betts Mills Brook.