Electrofishing Program Summary 2016

Prepared by:
Holly Labadie
Biologist
Miramichi Salmon Association
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Introduction

The Miramichi Salmon Association (MSA) continued its electrofishing program in 2016 to assess juvenile Atlantic salmon populations in the smaller tributaries 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 historic baseline sites that are monitored on an annual basis to assess Atlantic salmon juvenile abundance on the Miramichi River system. Both electrofishing 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. Wild parr vary in size by site, but 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 tributary streams are the major focus of the MSA electrofishing program as they are considered feeder streams to the major rivers and can be under-seeded with juvenile salmon in the event adults were unable to access these areas to spawn (i.e.: barriers, low water levels). Generally, swift moving water less than 60cm deep with gravel or rocky substrate is characterized as 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, to avoid predation, or to seek out 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 for the 2016 annual electrofishing program were to:

1. *Evaluate previous year's beaver dam removal success:*

   The Miramichi beaver dam management program resulted in 55 dams breached in 2015 over the entire Miramichi watershed (35 by MSA staff and 20 by heavy rains that washed them away). Upstream locations from where some of these dams were removed were part of the focus for electrofishing crews in 2016 to determine if adult salmon were able to access these areas for spawning.

2. *Evaluate spring stocking success:*

   Electrofishing surveys were conducted on stream stretches stocked with first-feeding fry in late June and early July of 2015 and 2016 to assess fry survival rates. Stocked location densities that are higher than unstocked locations are considered to reflect successful survival of hatchery fry following stocking.

3. *Determine future stocking sites of spring first-feeding fry:*

   Broodstock are collected annually from major rivers/streams in the Miramichi watershed and spawned at the Miramichi Salmon Conservation Centre (MSCC). The fry produced are returned to their native river system. In order to achieve effective stocking results in 2017, electrofishing surveys were carried out during the summer of 2016 to identify high quality juvenile habitat (gravel, or rocky substrate) with low fry and parr densities. Determining wild densities allows for avoidance of overstocking areas with healthy juvenile densities and for the targeting of tributaries that are naturally under-seeded or devoid of juvenile salmon. Any site containing more than 50 fry/100m^2 is not considered for stocking as it appears to reflect a healthy natural population, where sites with densities below this value are considered for stocking.

4. *Estimate juvenile abundance using baseline locations:*

   Juvenile Atlantic salmon abundance surveys were conducted in partnership with DFO. These surveys monitor baseline sites, some of which have been electrofished for over 40 years, and allow for the estimation of absolute juvenile abundance in these areas.

Methods

Electrofishing is the use of electricity for the active capture of fish; electricity is generated by a battery located on the backpack of the electrofisher. An anode wand (positive) and cathode tail (negative) are placed in the water. The electric current moving between the wand and tail produce an electric field which can render fish immobile (galvanonarcosis) or cause them to move towards the electrofisher (galvanotaxis). A crew of three people wearing water tight chest waders and rubber gloves enter the site facing upstream. While the electrofisher stuns the fish, the other crew members collect the fish with dip nets and a small seine net as the fish 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 in completed.

There are two methods for measuring density in a given area: catch-per-unit-effort (CPUE) and closed-site depletion (or removal). 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 a predetermined amount of time has elapsed on the electrofisher, approximately 200-500 seconds depending on the site. CPUE calculations are standardized so all densities reflect a 500 second sampling time and 100m^2 area to allow for comparisons. 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 200m^2 section of stream is measured 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 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, site dimensions, and GPS locations are recorded.

Results

A total of 90 electrofishing sites were assessed by MSA and DFO field crews between August 2nd and October 3rd, 2016 on the Miramichi River system. MSA alone surveyed 37 sites, while MSA and DFO worked together on 56 sites.

Beaver dam removal success from previous year

In total, 38% (14/37) of the sites electrofished in 2016 focused on areas upstream of beaver dams removed in 2015 (13 on the Southwest and 1 on the Northwest). Twelve of these sites had fry present, with fry densities ranging from 0 to 163.1 fry/100m^2 (Table 1). Sites with fry present were in lower to midstream reaches of the tributaries, suggesting adult salmon did make it past dams that were breached in the lower sections, but were not able to access the more upstream habitat. Beavers can repair active dams within a 24 hour time frame, so the timing of notching/removing dams is crucial in helping the fish access ideal spawning habitat. Field crews can only access and remove so many dams per day and the efficiency of the beavers in repairing them can still pose problems for adult salmon migrating upstream to spawn.

Evaluating spring stocking success

Twenty three of 37 sites (62%) were surveyed to assess the previous two year's stocking success. In 2015 beaver dam numbers were low, as heavy rains washed many of them out, so in 2016 crews spent more time assessing stocking success. Of these 23 sites, fifteen were stocked in 2016 (eight on the Northwest and seven on the Southwest) and eight in 2015 (four on each of the Northwest and Southwest Rivers). Fry were found in all sites stocked in 2016 and parr were found in all sites stocked in 2015. Fry densities ranged from 5.5 to 259.3/100m^2 and parr densities ranged from 2.4 to 41.2/100m^2 (Table 2 & 3). The high survival of first-feeding fry at stocked sites can help to increase the overall juvenile salmon production in the river, therefore the MSA will continue to stock first-feeding fry in the future.

Determine future stocking sites of spring first-feeding fry:

Many of the sites surveyed in 2016 were good quality habitat for juvenile Atlantic salmon and contained <50 fry/100m^2. This leaves many areas to consider for future stocking sites (Tables 1 – 3).

Table 1. Salmon fry abundance assessments calculated using the CPUE method for 14 sites electrofished in 2016 by the MSA upstream of beaver dams removed in 2015.

River Branch	Site	Fry/100m^2
Southwest	Junction of North and South Bartholomew River	31.6
Southwest	Bartholomew River 2	88.8
Southwest	Bartholomew River 3	13.9
Southwest	Betts Mill Brook 1	23.5
Southwest	Betts Mill Brook 2	3.3
Southwest	Porter Brook 1	11.6
Southwest	Porter Brook 2	39.2
Southwest	Sabbies Brook	163.1
Southwest	East Sabbies Brook	34.4
Southwest	Otter Brook	27.4
Southwest	Big Hole Brook 1	7.9
Southwest	Big Hole Brook 2	45.6
Southwest	Elliot Brook (Upper by bridge)	0.0
Northwest	Little River	0.0

Table 2. Juvenile abundance assessments calculated using the CPUE method for 12 sites electrofished by the MSA to identify stocking success from 2016.

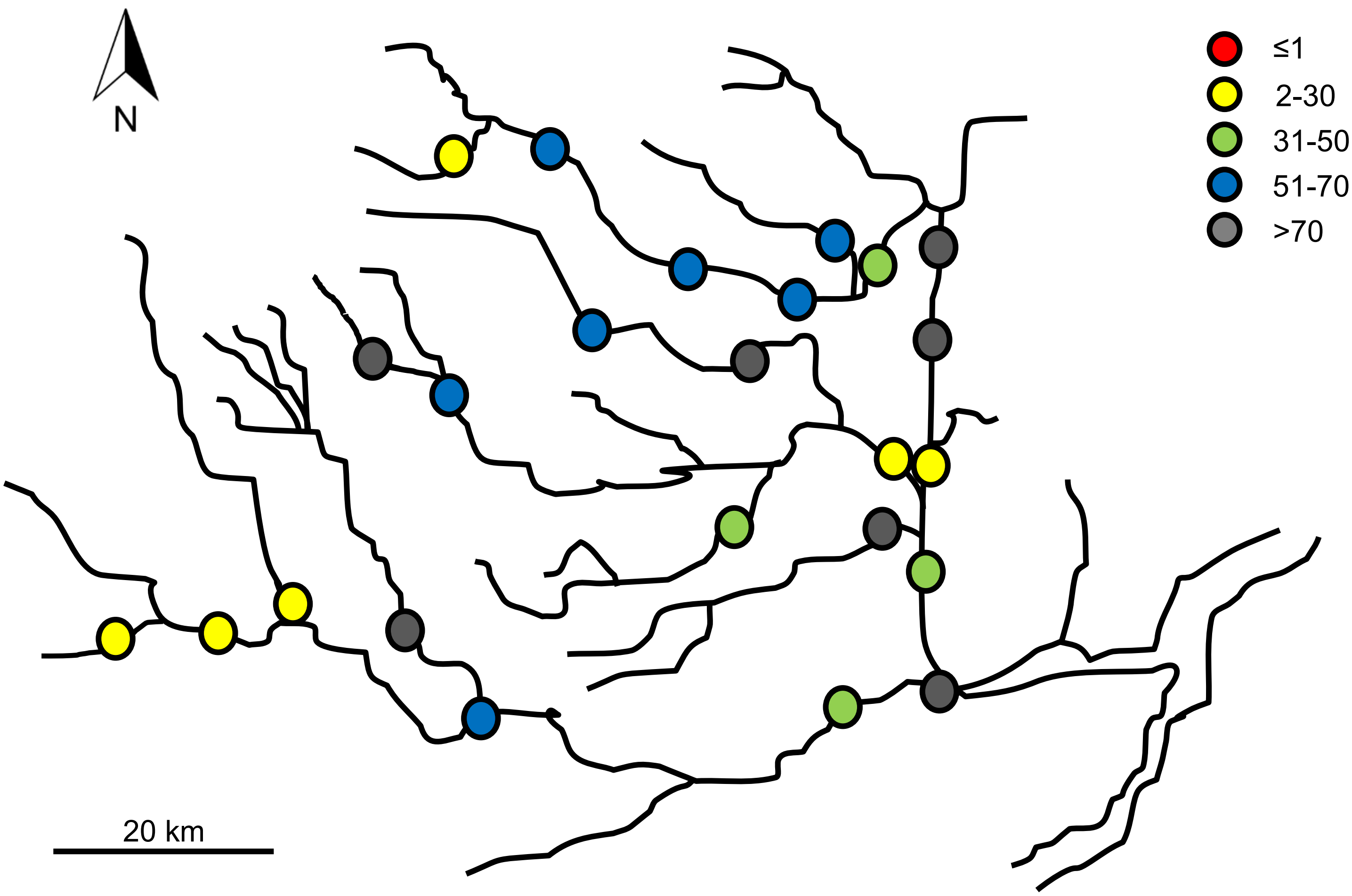
River Branch	Site	Fry/100m^2
Northwest	North Branch Sevogle River	22.1
Northwest	South Branch Sevogle River	5.5
Northwest	South Branch Tomogonops River	23.4
Northwest	Mountain Brook Stream	39.3
Northwest	Gill Brook	17.7
Northwest	South Branch of NW Miramichi River	15.2
Northwest	Devil's Brook	57.3
Northwest	Travis Brook	17.6
Southwest	Elliott Brook 2 (Gallaway Bridge)	83.4
Southwest	Elliott Brook 3	64.7
Southwest	Clearwater Brook 1	259.3
Southwest	Clearwater Brook 2	56.2
Southwest	Fairly Brook	29.4
Southwest	North East Branch Clearwater Brook 1	8.0
Southwest	North East Branch Clearwater Brook 2	16.7

Table 3. Juvenile abundance assessments calculated using the CPUE method for 8 sites electrofished by the MSA to identify stocking success from 2015.

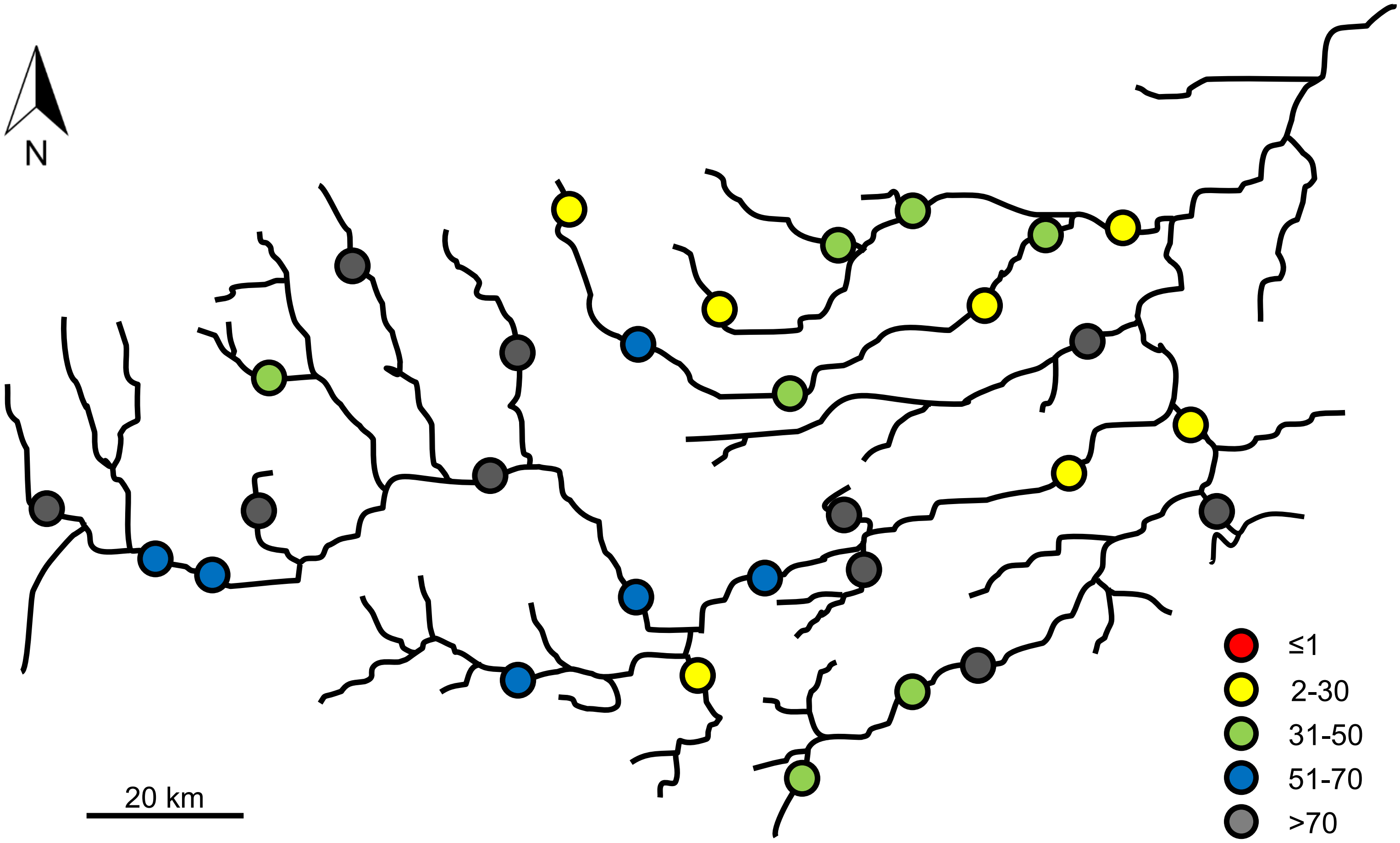
River Branch	Site	Parr/100m^2
Southwest	North Cains River	8.8
Southwest	West Six Mile Brook	11.9
Southwest	West Branch Six Mile Brook	19.0
Southwest	Middle Branch Six Mile Brook	6.0
Northwest	Johnson Brook	7.4
Northwest	Trout Brook	14.3
Northwest	Pats Brook	2.4
Northwest	Stoney Brook	41.2

Juvenile abundance using baseline locations (MSA/DFO)

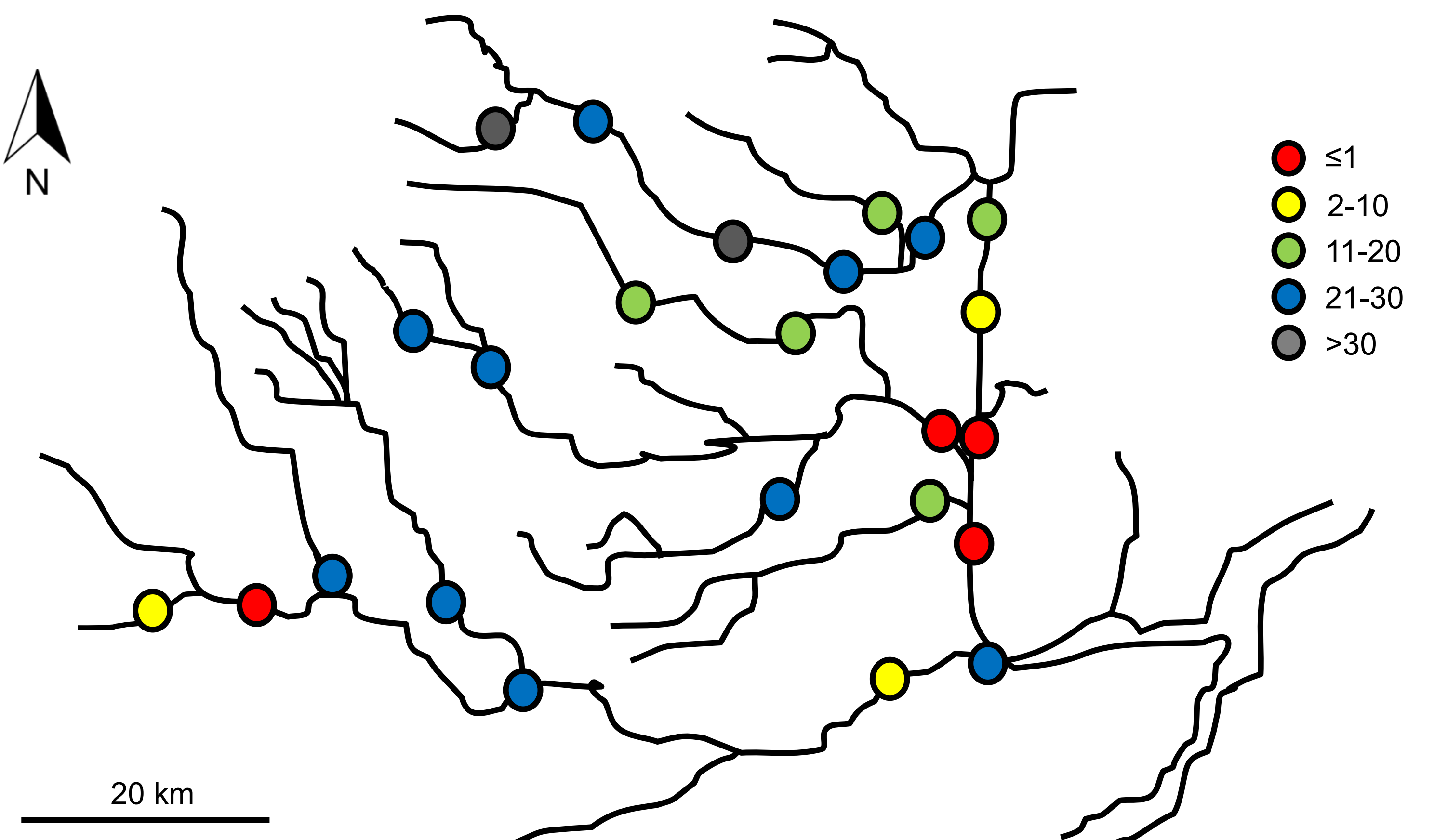
From August 29th to October 3rd 2016, a total of 56 baseline sites were electrofished in several tributaries as part of the MSA/DFO cooperative program. Preliminary results from the assessment revealed high fry densities at many sites in both the Northwest and Southwest Miramichi Rivers, as 77% (43/56) of all sites contained greater than 30 fry/100m^2, 20% (11/56) of sites contained between 30 and 50 fry/100m^2, and no site contained zero fry (Figure 1a&b). Parr densities were high (>20 parr/100m^2) at 39% (22/56) of sites, and only 9% (5/56) of sites contained zero parr (Fig 1c&d).



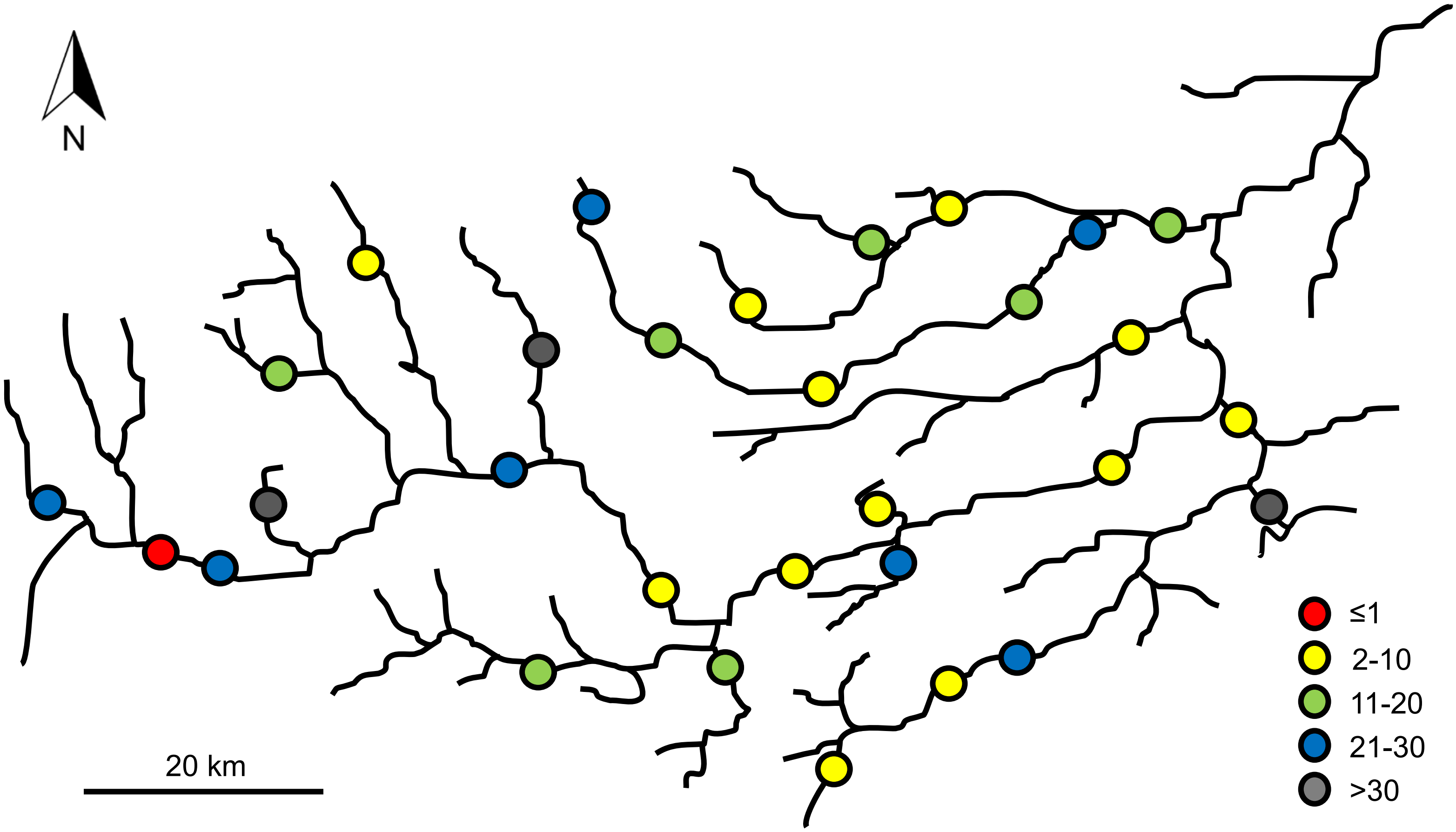
1(a). Northwest Miramichi fry densities 2016.



1(b). Southwest Miramichi fry densities 2016.



1(c). Northwest Miramichi parr densities 2016.



1(d). Southwest Miramichi parr densities 2016.

Figure 1: Preliminary juvenile density results from the 2016 DFO/MSA annual electrofishing program – (a) fry densities at sites on the Northwest Miramichi River system, (b) fry densities at sites on the Southwest Miramichi River system, (c) parr densities on the Northwest Miramichi River system, (d) parr densities on the Southwest Miramichi River system. Fry densities range from ≤1, 2-30, 31-50, 51-70, and >70 per 100m^2. Parr densities range from ≤1, 2-10, 11-20, 21-30, and >30 per 100m^2.

Juvenile population assessment data trends from the last five years (2012 – 2016) are presented in Table 4. DFO has been surveying baseline sites over the last 40 years, however not all sites are surveyed each year due to weather conditions (i.e.: water levels) and site access/suitability. The data presented in Table 4 is summarized, by tributary, over these five years and represents a very general picture of juveniles over this time. Juvenile population numbers show no strong correlation to adult returns over the last five years (Table 5).

DFO Salmon Stock Assessment Reports focus on four summarized tributaries of the Miramichi River with regards to juvenile population data – the Northwest River, the Little Southwest River, the Renous River, and the Southwest River. General trends from these tributaries, since the data began being collected in the 1970's, show that juvenile population numbers have increased since the mid 1980's, but vary substantially from year to year (Chaput *et al*., 2016). DFO's Stock Assessment Reports are available online at http://www.isdm-gdsi.gc.ca/csas-sccs/applications/Publications/index-eng.asp.

Guillaume Dauphin, a post-doctoral fellow with the Canadian Rivers Institute at the University of New Brunswick, is currently working with DFO's long term electrofishing datasets to answer questions related to population dynamics of Atlantic salmon in the Miramichi and Restigouche Rivers. He has developed a calibration model using statistical methods and new covariates (i.e.: type of electrofishing gear used, sampling day, water discharge rates, etc.) to produce reliable density estimates. The next stage of his work is to bring all salmon life stage data together and develop a life stage model to better understand regulatory mechanisms occurring in these populations.

Table 4: Preliminary juvenile density results from the DFO/MSA annual electrofishing program. Densities were averaged over 5 years (2012-2016) for each tributary on the Northwest (a) and Southwest (b) Rivers. Fry densities range from ≤1, 2-30, 31-50, 51-70, and >70 per $100m^2$. Parr densities range from ≤1, 2-10, 11-20, 21-30, and >30 per $100m^2$.

Fry density ranges (# of fry/$100m^2$)	**≤ 1**	**2 - 30**	**31 - 50**	**51 - 70**	**>70**
Parr density ranges (# of parr/$100m^2$)	**≤ 1**	**2 - 10**	**11 - 20**	**21 - 30**	**>30**

4(a). Five year average fry and parr densities for electrofishing sites on the Northwest branch of the Miramichi River. Five tributaries on the Northwest contain sites surveyed by MSA/DFO at least once between 2012 and 2016.

Basin	**Fry**	**Parr**
Northwest	Northwest River	Northwest River
	Little River	Little River
	Tomogonops River	Tomogonops River
	Sevogle River	Sevogle River
	Little Southwest River	Little Southwest River

4(b). Five year average fry and parr densities for electrofishing sites on the Southwest branch of the Miramichi River. Thirteen tributaries on the Southwest contain sites surveyed by MSA/DFO at least once between 2012 and 2016.

Basin	**Fry**	**Parr**
Southwest	Southwest River	Southwest River
	McKiel Brook	McKiel Brook
	Burnthill Brook	Burnthill Brook
	Clearwater Brook	Clearwater Brook
	Rocky Brook	Rocky Brook
	Taxis River	Taxis River
	Burntland Brook	Burntland Brook
	Big Hole Brook	Big Hole Brook
	Betts Mills Brook	Betts Mills Brook
	Cains River	Cains River
	Bartholomew River	Bartholomew River
	Dungarvon River	Dungarvon River
	Renous River	Renous River

Table 5: Adult Atlantic salmon returns to the Northwest (a) and Southwest (b) Miramichi Rivers from 2011 – 2015 based on DFO's stock assessment data. Summarized fry densities for sites on each branch, based on DFO electrofishing surveys the following year (2012 – 2016), are presented underneath the adult return numbers. The most common fry density range for each year is highlighted in **bold.**

Fry density ranges (# of fry/100m^2)	**≤ 1**	**2 - 30**	**31 - 50**	**51 - 70**	**>70**

5(a). Adult returns from 2011 to 2015 and fry densities for the following year (2012-2016) on the Northwest River.

NORTHWEST RIVER	**2011**	**2012**	**2013**	**2014**	**2015**
salmon	5147	2635	2342	1235	4171
grlise	13550	2623	4094	1240	11980
TOTAL	20708	7270	8449	4489	18166
	0	1	0	0	0
	5	**11**	7	**14**	6
	3	5	4	5	4
	4	3	5	2	**7**
	11	1	**9**	5	**7**

5(b). Adult returns from 2011 to 2015 and fry densities for the following year (2012-2016) on the Southwest River.

SOUTHWEST RIVER	**2011**	**2012**	**2013**	**2014**	**2015**
salmon	27870	10780	10120	8940	11490
grlise	30320	5586	7537	6180	13980
TOTAL	60201	18378	19670	17134	27485
	0	0	0	0	0
	1	**7**	6	9	7
	13	1	4	4	7
	6	1	4	8	7
	12	0	**17**	**11**	**11**

References

Chaput,G., Douglas, S.G., and Hayward, J. 2016. Biological Characteristics and Population Dynamics of Atlantic Salmon (*Salmo salar*) from the Miramichi River, New Brunswick, Canada. DFO Can. Sci. Advis. Sec. Doc. 2016/029. v + 53 p.