Juvenile Assessment Report
2022

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Introduction

The Miramichi Salmon Association (MSA) continued its juvenile assessment program using electrofishing in 2022 to measure juvenile Atlantic salmon populations in the smaller tributaries of the Miramichi River watershed. The MSA also worked cooperatively with the Department of Fisheries and Oceans (DFO) Science Branch on another survey using historic baseline sites that are monitored annually 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 60 mm 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 120 mm. 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 primary 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 60 cm deep with gravel or rocky substrate is characterized as juvenile salmon habitat. Adult salmon migrate as far upstream as possible to spawn. Still, juveniles in their first, second, or third year can move around extensively in search of food, to avoid predation, or seek out an 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 2022 annual electrofishing program were to:

1. *Evaluate previous years' beaver dam removal success:*
   The Miramichi beaver dam management program resulted in 48 dams breached in 2021 over the entire Miramichi watershed. Upstream locations from where some of these dams were notched were part of the focus for electrofishing crews in 2022 to determine if adult salmon could access these areas for spawning without the help of our beaver dam management program.

2. *Evaluate spring stocking success from previous years:*
   Our project assessed the previous two years' fry stocking success. Due to COVID-19, no broodstock were collected in 2020, and no fry stocking occurred in 2021. Therefore, we were only able to evaluate 2022 fry stocking success and the continued survival of 2020

stocked fry. Electrofishing surveys were only conducted on stream stretches stocked with first-feeding fry in late June of 2022 to evaluate fry survival rates (0+ juveniles). Higher fish densities at stocked locations compared to unstocked locations reflect the successful survival of fry, incubated and raised at the Miramichi Salmon Conservation Centre (MSCC), 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 MSCC. The fry produced are returned to their native river system. To achieve effective stocking results in 2023, electrofishing surveys were carried out during the summer of 2022 to identify high-quality juvenile habitats (gravel or rocky substrate) with low fry and parr densities. Determining wild densities allows us to avoid overstocking areas with healthy juvenile densities and instead target tributaries that are naturally under-seeded or devoid of juvenile salmon. Any site containing more than 50 fry/100 m^2 is not considered for stocking as it appears to reflect a healthy natural population. In contrast, sites with densities below this value are considered for stocking.

4. *Estimate juvenile abundance using baseline sites:*
   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 estimating 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 produces 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 is 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 100 m^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, captures all fish from a measured section of the stream rather than the timed CPUE method. A 200 m^2 section of stream is measured and barricaded with fine nets at the upper and lower ends of the site. This “closed site” is 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.

Permits
A Scientific Permit from the Department of Fisheries and Oceans (SG-RHQ-22-116) was obtained prior to starting this project.

Results/Discussion
A total of 86 electrofishing sites were assessed by MSA and DFO field crews on the Miramichi River system between August 22nd and October 13th, 2022. MSA alone surveyed 32 sites, MSA and DFO worked together on 48 sites, and DFO alone surveyed an additional 6 sites due to high water.

Beaver dam removal success from previous years:

In total, 37.5% (12/32) of the sites electrofished in 2022 focused on areas upstream of beaver dams removed in 2021 on the SW Miramichi River. Few of these sites had fry present, but almost all did contain parr (Table 1). Sites with parr present were in lower to midstream reaches of the tributaries, suggesting that in 2021, adult salmon did make it past dams that were breached in the lower sections but were not able to access the habitat further upstream. These findings support using dam breaching techniques during peak spawning season to facilitate fish migration. Beavers can repair active dams within a 24-48 hour time frame, so the timing of notching/breaching dams is crucial in helping the fish access the 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 from previous years:

19 of 32 sites (59.37%) were surveyed to assess the fry stocking success of 2022 on the SW Miramichi River. Fry were found in half of the sites stocked in 2022, and parr were found in all sites. Fry densities ranged from 0 to 93.3/100 m^2, and parr densities ranged from 0 to

218.7/100 m^2(Table 2). The high survival of first-feeding fry at stocked sites can help increase the overall juvenile salmon production in the river; therefore, the MSA plans to continue to stock first-feeding fry in the future.

2 of 32 sites (6.25%) were surveyed to assess the continued success of stocking that occurred in 2020 on the SW Miramichi River. Fry were only present in one site. Obstruction from beaver dams or overall Atlantic salmon population declines may account for these low findings, however, parr densities ranged from 18.4 to 218.7/100 m^2 (Table 3). If the fry stocked in 2020 survived, they would be parr in 2022, correlating with the results of parr densities at these sites.

Determine future stocking sites of spring first-feeding fry:

In 2022, 6 out of 32 sites (18.75%) were surveyed to assess suitable habitats for later stocking. All sites contained less than 50 fry/100 m^2, making all six sites ideal for future stocking (Table 4).

Many sites surveyed in 2022 provided high quality habitats for juvenile Atlantic salmon and contained <50 fry/100 m^2, showing a decreased natural population. Our results identify numerous areas that should be considered for future stocking sites (Tables 1 – 4).

Juvenile abundance using baseline sites (MSA/DFO):

From August 29th to October 13th, 2022, a total of 52 baseline sites were electrofished using the open-site depletion method, and 2 sites using the closed-site depletion method in several tributaries as part of the MSA/DFO cooperative program (DFO, 2023). Preliminary results from the assessment revealed average fry densities at many sites in both the NW and SW Miramichi Rivers. Fry were present at 98% (53/54) sites and parr at 91% (49/54) sites. Fry densities ranged from <1 to >70 per 100 m^2 and parr densities ranged from <1 to >30 per 100 m^2 (Figure 1a,b).

Electrofishing, whether conducted individually or collaboratively by organizations, provides on-the-ground data to inform management practices and should be continued on the Miramichi River.

Acknowledgements
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References
DFO. 2023. Update of indicators of Atlantic Salmon (*Salmo salar*) in DFO Gulf Region Salmon Fishing Areas 15 - 18 for 2022. Unpublished manuscript.

Appendix

Table 1. Juvenile abundance assessments calculated using the catch-per-unit-effort (CPUE) method for 12 sites on the Miramichi River electrofished by the MSA upstream of beaver dams removed in 2021.

River Branch	Site	Fry/100m^2	Parr/ 100m^2
Southwest	Otter Brook 1	0	0
Southwest	Otter Brook 2	77.1	135.0
Southwest	Sabbies Brook 3	2.4	8.1
Southwest	Salmon Brook 1	0.9	13.9
Southwest	Salmon Brook 2	0	10.1
Southwest	Six Mile Brook 1	0	7.6
Southwest	Six Mile Brook 2	7.7	9.6
Southwest	Betts Mills Brook 1	0	0
Southwest	Betts Mills Brook 2	2.4	13.5
Southwest	Big Hole Brook 1	159.0	409.0
Southwest	Big Hole Brook 2	0	0
Southwest	Doak Brook 1	1.4	12.9

Table 2. Juvenile abundance assessments calculated using the catch-per-unit-effort (CPUE) method for 19 sites on the Miramichi River electrofished by the MSA to assess stocking success from 2022.

River Branch	Site	Fry/100m^2	Parr/ 100m^2
Southwest	North Cains Branch 1	0	17.3
Southwest	Otter Brook 2	77.1	135.0
Southwest	Sabbies Brook 3	2.4	8.1
Southwest	Salmon Brook 1	0.9	13.9
Southwest	Salmon Brook 2	0	10.1
Southwest	Six Mile Brook 1	0	7.6
Southwest	Big Teague Brook 1	0	28.0
Southwest	Big Teague Brook 2	0	14.9
Southwest	Big Teague Brook 3	5.1	30.8

Southwest	Clearwater Brook	93.3	218.7
Southwest	Elliott Brook 2	0	40.5
Southwest	Elliott Brook 3	0	22.3
Southwest	Juniper Brook 1	0	18.4
Southwest	Lake Brook 1	4.7	84.6
Southwest	Lake Brook 2	2.8	74.5
Southwest	Lake Brook 3	0	11.0
Southwest	Lake Brook 4	0	9.5
Southwest	Lake Brook 5	9.3	65.4
Southwest	Miramichi Southwest South Branch 1	1.6	16.2

Table 3. Juvenile abundance assessments calculated using the catch-per-unit-effort (CPUE) method for 2 sites electrofished on the Miramich River by the MSA to assess stocking success from 2020.

River Branch	Site	Fry/100m^2	Parr/ 100^2
Southwest	Clearwater Brook 1	93.3	218.7
Southwest	Juniper Brook 1	0	18.4

Table 4. Juvenile abundance assessments calculated using the catch-per-unit-effort (CPUE) method for 6 sites electrofished on the Miramichi River by the MSA to assess suitable habitat for future stocking.

River Branch	Site	Fry/100m^2	Parr/ 100m^2
Southwest	Muzzeroll Brook 1	0	12.7
Southwest	Muzzeroll Brook 2	27.0	114.9
Southwest	Dungarvon Main 1	1.9	11.8
Southwest	Dungarvon North Branch 1	4.6	7.7
Southwest	Dungarvon North Branch 2	0	2.0
Southwest	Porter Cove Brook 1	0	72.0

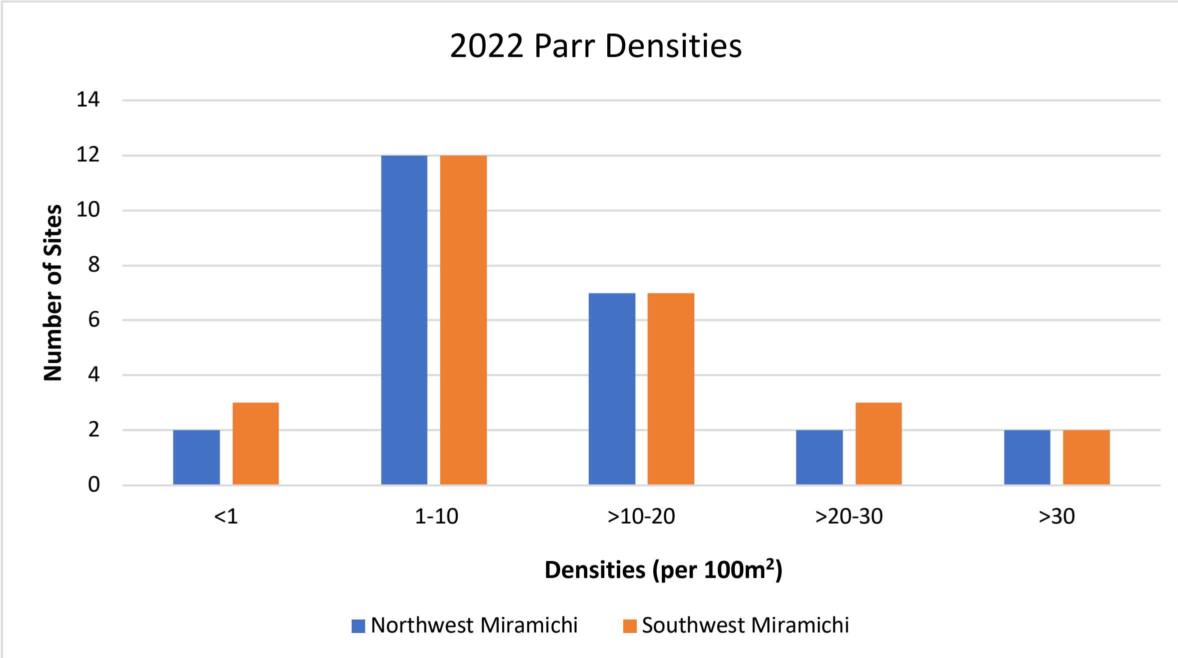

Figure 1(a). Northwest and Southwest Miramichi 2022 fry densities (DFO/MSA).

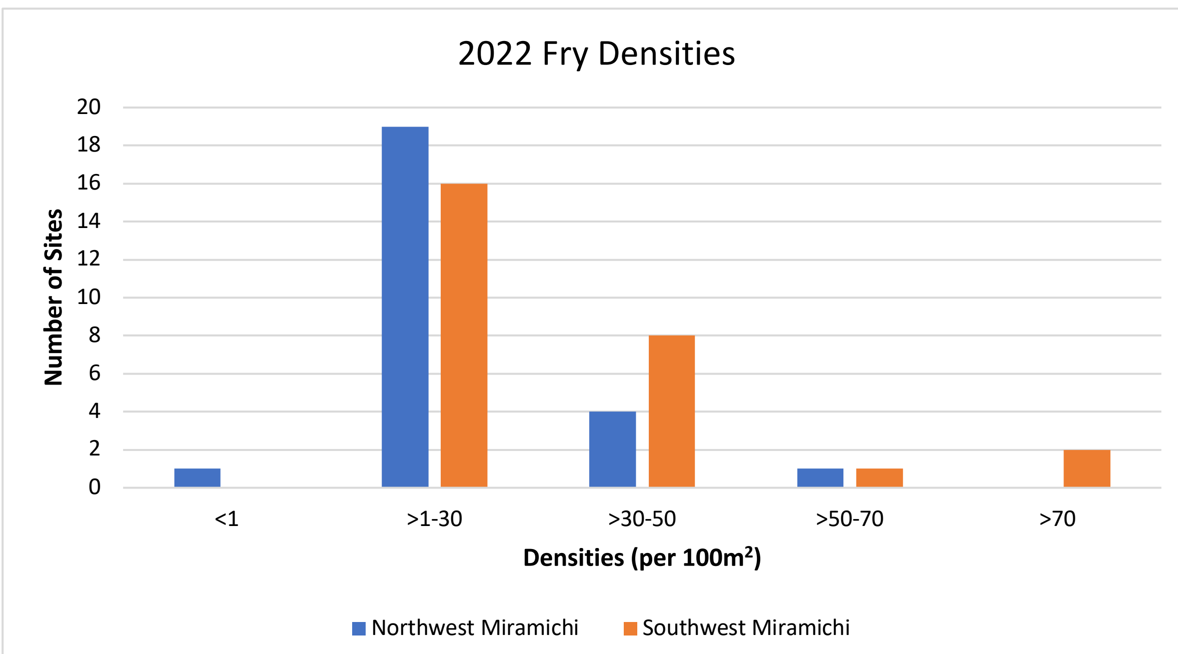

Figure 1(b). Northwest and Southwest Miramichi 2022 parr densities (DFO/MSA).

Figure 1. Preliminary juvenile density results from the 2022 DFO/MSA annual electrofishing program – (a) fry densities at sites on the Northwest and Southwest Miramichi River systems, (b) parr densities at sites on the Northwest and Southwest Miramichi River system. Fry densities range from <1, >1-30, >30-50, >50-70, and >70 per $100m^2$. Parr densities range from <1, >1-10, >10-20, >20- 30, and >30 per $100m^2$.