

‘Rearing Magaguadavic Broodstock at Huntsman Marine Science Center’

Final Report

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Wild Atlantic salmon populations in rivers draining into the Bay of Fundy region have precipitously declined, to that point that the species is facing biological extinction at many sites. The salmon population of the Magaguadavic River has been chosen for a pilot recovery program, and as a place to evaluate novel recovery methods. Wild Atlantic salmon were collected from this river and spawned in 1998, with the intention of rearing the offspring in captivity to the adult stage, and then releasing the adults to the river to reproduce naturally. Work by DFO had found that the release of mature spawners was the quickest, most effective, and cheapest way to increase Atlantic salmon populations. However, these studies used wild-caught adults. We do not know if mature adults reared in hatcheries would show the same success.

For the Magaguadavic fish, egg incubation and rearing of juveniles to the smolt stage occurred at Heritage Salmon’s Lake Utopia facility. Smolt were moved (in 2000) to both a commercial sea cage site and a freshwater facility for growth to the adult stage. This design permitted us to evaluate whether or not fish reared in freshwater would perform as well as a sea water group. However, as a result of complications with the ISA virus in the sea cage region, and also the need to fallow cage sites in accordance with the newly imposed Bay of Fundy Management Strategy, the Magaguadavic salmon at the sea cage site (operated by Cookes Aquaculture, Limited) had to be moved. This precipitated an emergency for the Magaguadavic Recovery program, as an alternate holding facility had to be located, then the funding found to pay for it. Following the approval of a Wildlife Trust Fund emergency grant, in January 2002, a total of 178 Magaguadavic origin salmon, weighing on average four to five kilograms, were relocated to sea water tanks at the Huntsman Marine Science Center (HMSC), St. Andrews, NB.

The fish were reared in six tanks. During the initial 60 days at HMSC, 71 salmon died. It is believed that these mortalities were related to the stress of transfer from the sea cages to HMSC (fish handling and near lethal water temperatures). Water temperature had dipped as low as 0.4 °C during the initial rearing stage at HMSC. Most moribund fish had high scale loss. Following the initial losses, mortality rates declined to low levels and in total, 85 fish died at HMSC before the completion of rearing. All moribund fish were sent to the Federal Department of Fisheries and Oceans lab in Moncton, NB, for viral and bacteriology screening. All tests were

negative for viral and bacterial pathogens. The remaining fish were more than sufficient for the projects needs, and maintained the genetic diversity found in the original parents.

In May 2002, all fish were tissue sampled for DNA pedigree analysis, and PIT (Passive Integrated Transponder) -tagged for individual identification. The DNA pedigree analysis was conducted at the Department of Fisheries and Oceans Bedford Institute of Oceanography, Dartmouth, NS. The pedigree analysis ensured that the genetic integrity of the existing Magaguadavic salmon stock would be maintained through a proper mating plan and release strategy for the program's fish.

Tissue sampling and pedigree analysis was also completed for the Magaguadavic origin broodstock reared at the Mactaquac Biodiversity Center (freshwater rearing facility). The DNA analysis showed that family (sibling) representation was similar between Mactaquac and HMSC. Thus, the Magaguadavic River Recovery Group decided to use the Magaguadavic origin broodstock at Mactaquac for the continuation of the captive breeding program, as well as for release to the river along with the sea water reared fish.

Thirty fish (15 each from HMSC and Mactaquac) were acoustically tagged (between August to October 2002 to document their movements in the Magaguadavic River and to assess spawning site selection of first generation captive reared broodstock released into the river to spawn naturally (see Appendix 1 for specific release dates per fish grouping).

Figure 1. Jim Martin (MRSA) releases acoustic tagged salmon into Magaguadavic River. Participants left to right include Nell Halse (NB Salmon Growers Assoc.), Dean Guest (Stolts Sea Farm), James Mariner (NBWTF), Tony Huntjens (MLA), and Sheldon Lee (MLA). Additional pictures are available upon request.



Photo T. Moffatt

In addition to the acoustic tagged releases, 69 fish were released at selected spawning sites chosen by a breeding committee composed of trained geneticists and research scientists. The sites and individuals released to them were chosen to minimize the potential for inbreeding. Releases of the fish that were not acoustically tagged occurred from 22 October to 7 November 2002 (see Table 1). The remaining nine salmon were selected for an inbreeding experiment to test the survival rates of eggs stemming from sibling matings. These eggs were to be incubated in egg baskets in the Magaguadavic River. However, the remaining fish did not mature, or died for unknown reasons. The four surviving fish were released into the river (Table 1).

The tanks and other rearing equipment were removed from HMSC at the end of October 2002.

Table 1. Groupings and release sites for the Magaguadavic salmon reared at HMSC.

Magaguadavic River	Female	Male	Total	Total	Total	Release
Release sites	Mature	Mature	Immature	Mature	Released	Date
Millpond	1	4	5	5	10	23-Oct
Thomaston Corner	2	1	8	3	11	22-Oct
Turnover Island	2	7	1	9	10	23-Oct
Graveyard Pool	1	3	4	4	8	23-Oct
Longlookem	3	1	2	4	6	23-Oct
Flume Falls	1	4	0	5	5	23-Oct
MacDougall Inlet	3	5	2	8	10	24-Oct
Upper Trout	4	3	0	7	7	24-Oct
Mag Hpond	0	1	1	1	2	7-Nov
egg basket study (Mag fishway)	3	6	0	9*	4	8-Dec

Total released: 73

** 5 fish died*

Appendix 1.

Magaguadavic Captive Broodstock Tracking Experiment

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Goal: Recovery of wild Magaguadavic River origin Atlantic Salmon

Objective: The objective of the tracking experiment is to evaluate the effectiveness of rearing F1 progeny (from wild Magaguadavic Atlantic salmon broodstock) to the adult stage in captivity, and then releasing them into the Magaguadavic River for natural spawning.

Specifically we wish to assess:

1. Early season (mimic early run fish) versus late season (mimic late run fish) releases. The movements and survival of fish will be assessed.
2. Compare movement and behavior of salt water versus freshwater reared fish. In each set of releases, equal distributions of saltwater reared (HMSC) and freshwater reared (Mactaquac) will be released.
3. Lower versus upper river releases. The movements and survival of fish will be assessed.

Experimental Design/Methodology

Tags and tagging Procedures

V16-4H-R04K coded ultrasonic pingers (15 mm diameter X 65 mm length; weight 10 g in water, produced by Vemco Limited, Shad Bay, Nova Scotia) will be used to tag Atlantic salmon broodstock. Each pinger will have an individual identification on frequency 69.0 kHz, with a minimum and maximum delay of 20 to 69 seconds between transmissions. This delay period will prevent tag collisions (which prevents tag decodes) if multiple tagged fish are within range of a receiver at the same time. This will increase the probability of fish being identified by the receivers. Each tag has an expected life of 570 days. Pingers will be surgically implanted in the peritoneal cavity of the fish. Approximate fish size will range from 770mm to 950mm and weigh from 4 kg to 6 kg.

Protocol for selecting broodstock for tag application

Geneticists from the Magaguadavic breeding committee will determine what level of kin versus non-kin individuals should be released into the river so that the potential for inbreeding is minimized. Once the 30 fish are selected, kin versus non-kin individuals will be randomized in the releases. The frequency of association will be measured for kin versus non-kin individually tagged fish. Sexes will evenly be distributed in the sample (15 male, 15 female). If the average fish size were 5 kg, then expected egg deposition (@1500 eggs/kg of fish) would be about 112,500 eggs.

Fish will be tagged at their respective rearing facilities (Mactaquac and HMSC).

Anaesthetized fish (Clove oil: [40 mg/L]) will be placed ventral side up in a V-shaped trough with moist paper toweling for support. Germex will be used to sterilize all surgical tools, sutures, and pingers. Furacin will be used to clean the ventral surface of the fish prior to making a 2-cm mid-ventral incision beginning 2 cm anterior to the pelvic fins. The pinger will be inserted into the peritoneal cavity under the incision. Three to four sutures (4-0 Ethilon black monofilament nylon with FSL circular cutting needle) will be applied to close the incision and a tissue cement

(Vetbond) will be used to seal the incision and stitches. Furacin will be sprayed on the closed incision. Fish recover in under 10 minutes from the anesthesia. The tagged broodstock will be monitored for a minimum of 7 days following surgery to allow for a recovery period. The fish will then be moved to the St. George fishway trap (Magaguadavic River) to allow river acclimation for a minimum of 24 hours.

Release Times and Locations

Early Release

From 8 to 14 August 2002, 10 ultrasonically tagged fish will be released. All early releases will occur in the lower river (Magaguadavic River headpond, St. George). Release days for saltwater and freshwater reared fish was randomly chosen. Release dates will be 48 hours apart and are as follows:

Date	# Tagged fish	Location	Rearing Source
8 August	4	Day Adventure Center, St. George	Salt water (HMSC)
10 August	4	Day Adventure Center, St. George	Freshwater
12 August	1	Day Adventure Center, St. George	Salt water (HMSC)
14 August	1	Day Adventure Center, St. George	Freshwater

Late Release (lower headpond)

From 14 to 20 September 2002, 10 ultrasonically tagged fish will be released. All releases will occur in the lower river (Magaguadavic River headpond, St. George). Release days for saltwater and freshwater reared fish was randomly chosen. Release dates will be 48 hours apart and are as follows:

Date	# Tagged fish	Location	Rearing Source
14 September	1	Upstream of St. George Fishway	Salt water (HMSC)
16 September	1	Upstream of St. George Fishway	Freshwater
18 September	4	Upstream of St. George Fishway	Freshwater
20 September	4	Upstream of St. George Fishway	Salt water (HMSC)

Late Release (near spawning grounds)

On 22 October, 10 ultrasonically tagged fish will be released in holding pools near spawning grounds. This approach will assess whether fish remain near the site of release at the onset of spawning.

Release sites are as follows:

Date	# Tagged fish	Location	Rearing Source
22 October	5	Longlookem, near Brockway	Freshwater
22 October	5	Graveyard Pool, Pomeroy	Salt water (HMSC)

Tracking

Movements of tagged fish will be monitored by positioning submersible receivers (VEMCO VR2 single channel receiver) at strategic locations in the river. Each unit has a built-in omni directional hydrophone with data logging components programmed to decode pinger tag number and date/time of each detection. Weekly active searches for tagged fish will also be performed using boats equipped with VR60 receivers having either directional or omnidirectional hydrophones. As the onset of spawning approaches, onsite riverbank observations will be made to assess spawning activity.