

**Maquac Aquatic Ecosystem Study
Report Series 2019-061**



**Passage Efficiency of the
Tobique-Narrows Smolt
By-Pass Facility: 2017-8
Results**

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1. Introduction

The Saint John River (SJR) flows almost 700 km from the Maine North Woods and Eastern Quebec downstream to the Bay of Fundy at the City of Saint John. Once world renowned for its Atlantic Salmon (*Salmo salar*), the stock steadily declined over the last few decades. The Tobique River was and continues to be, the largest contributor to the SJR Atlantic Salmon population above the Mactaquac Generating Station (MGS) (Figure 1; Jones et al. 2010). At age 2-4, juvenile salmon begin to make the migration to the ocean, generally in the spring months. In the Tobique River, about 70 % of smolt begin their downstream migration in the fall, typically late October to early November. These fish are commonly referred to as pre-smolts. These fish will migrate out of Tobique River to the main stem of the SJR where they overwinter, resuming their seaward migration in the spring. At the Tobique Narrows Generating Station (TNGS) located ~ 1.6 km from the confluence with the SJR, there were only two modes of passage through the facility for downward migrating fish, over the spillway or through the turbines. Studies have assessed pre-smolt/smolt mortality rate at the TNGS which ranges from 10.0 to 23.7% (MacEachern 1960, Bell 1981, Carr 2000, Jones and Flanagan 2007, AMEC 2005 and 2013). In 2017, a by-pass facility was constructed to intercept smolts at the upstream approach to the TNGS and divert them to a collection facility. This bypass system guides fish into a plunge pool where they enter a rectangular holding tank. Here, fish can be assessed for biological characteristics. A screen at the end of the tank can be opened and fish crowded into a pipe, which empties near the upstream passage entrance in the tailrace. If fish are to be retained (e.g., broodstock collection), a separate screen allows fish to swim into a circular holding tank, upon which they are sent down a pipe and into a holding tank of a transportation truck. The purpose of this study was to continue to investigate the smolt migration from the Tobique River and begin assessing the capture efficiency of the TNGS smolt by-pass facility.

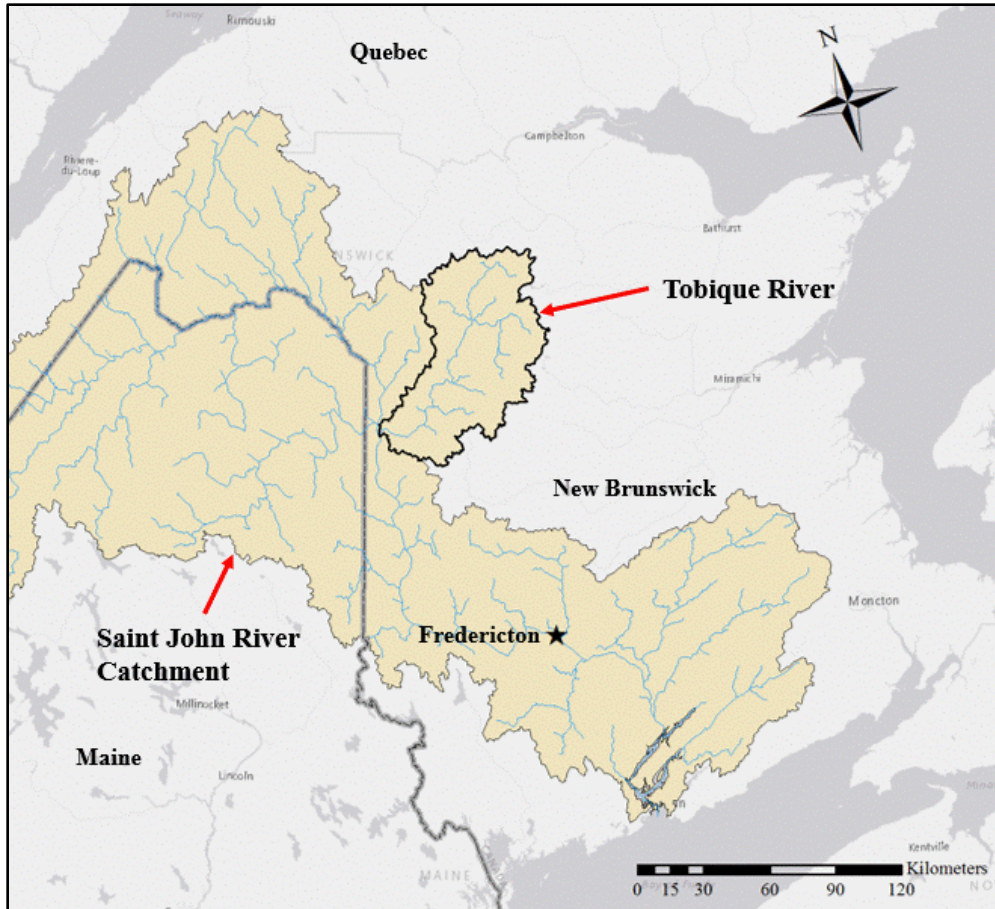


Figure 1: Saint John River catchment with the Tobique River highlighted.

2. Methodology

Atlantic Salmon pre-smolts were captured at Fisheries and Oceans Canada (DFO) rotary screw traps located at Three Brooks (Figure 2). Fish collected in the traps were sorted and fish for tagging were held in a live well placed in the Tobique River.

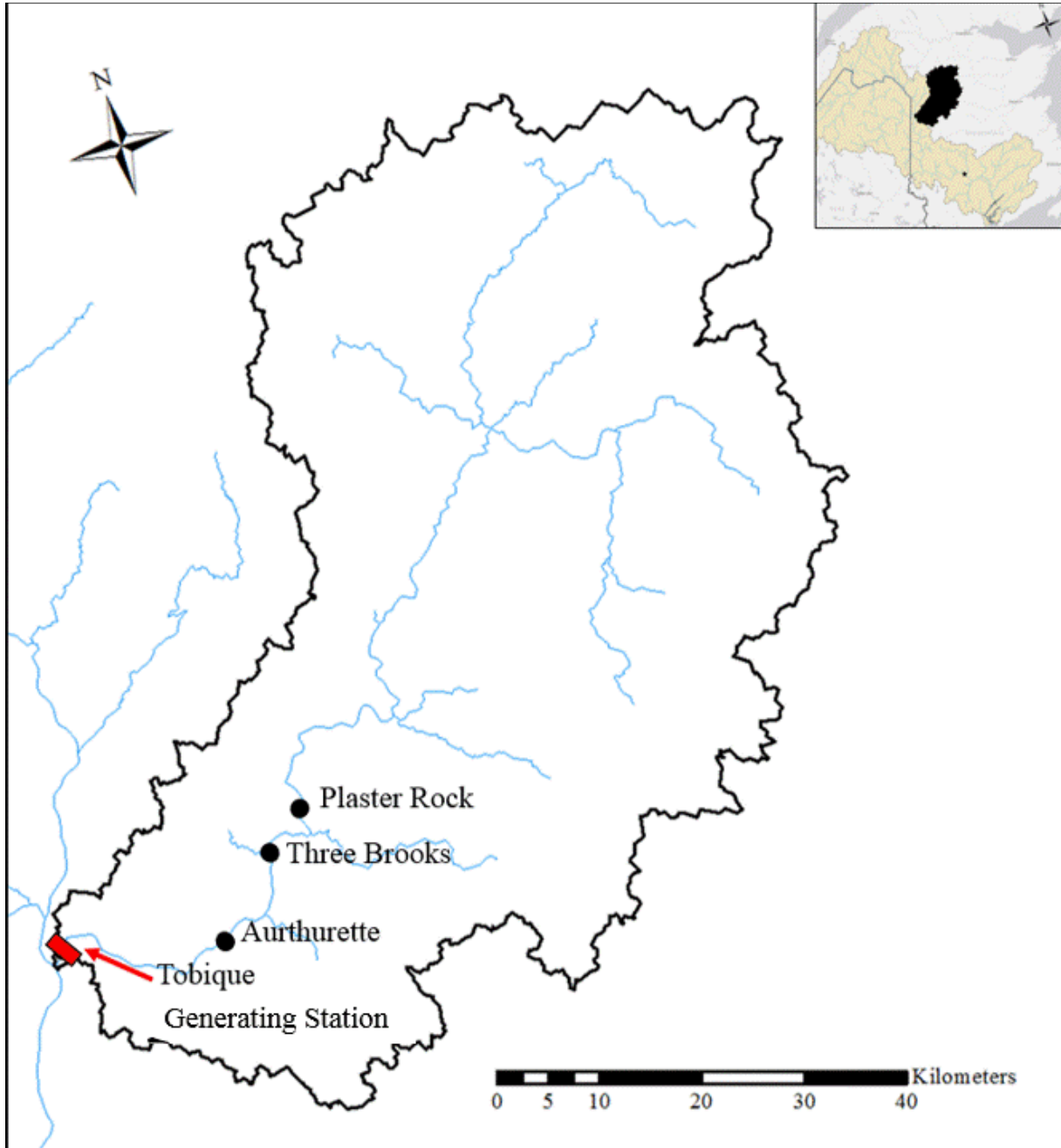


Figure 2: Tobique River Catchment and the key locations for the study (see text).

2.1 Tagging

Pre-smolt were surgically implanted with Vemco V7-2x acoustic telemetry tags. The tags were custom programmed to emit a ping at random intervals of 30-90 seconds for 45 days after activation in order to catch autumn movements. After the first 45

days, the tags went dormant for 131 days during the winter to conserve battery life, after which, the tags resumed pinging for an additional 57 days during the spring migration out of the river (Table 1). Pre-smolt were tagged following procedures outlined by Gautreau *et al.* (2015). Pre-smolt large enough for a tag (i.e., greater than 35 g), were anesthetized using a clove oil (60 ppm) bath. A small incision was made in the abdomen of the fish, just left of the ventral mid line and ahead of the pelvic girdle (Figure 3). The acoustic tag was inserted through incision, which was closed using two small sutures held by surgeon’s knot (6-0, Ethicon monofilament, reverse cutting suture) (Figure 4). Fish were allowed to recover in an aerated holding tank and released below the rotary screw traps once recovered from the effects of the anesthetic. All instruments and materials used were sterilized using Betadine. At the Mactaquac Biodiversity Facility (MBF), a sample of 50 smolts were tagged with “dummy” tags (tags with the exact dimensions and weight of the acoustic tags) and held at the MBF to assess tag retention and fish mortality. All tagged pre-smolt and hatchery smolt were measured for fork length, total length, and weight. Body condition (K) was calculated using the Fulton Condition Factor formula, $K = \text{Weight} / \text{Length}^3 * 100$ (Anderson and Neumann 1996). All procedures were approved by the UNB Animal Care Committee: protocol numbers 17046 and 18046.

Table 1: Acoustic tag specifications and programming details for Atlantic Salmon pre-smolt tagged in the Fall 2017 and Spring 2018 in the Tobique River, New Brunswick. Power output L (low), to extend the battery life.

Tag Model	Diameter (mm)	Length (mm)	Weight in Water (g)	Weight in Air (g)
V7-2x	7	18	0.75	1.6

Custom Programming				
Interval	Status	Time (days)	Power	Ping Rate
Step 1	ON	45	L	30-90
Step 2	OFF	131		
Step 3	ON	57	L	30-90



Figure 3: Incision in the abdomen of an Atlantic Salmon pre-smolt for insertion of the V7 acoustic tag.



Figure 4: Sutures closing the incision.

2.2 Tracking

Movements of tagged pre-smolt were monitored using a network of Vemco VR2W acoustic receivers strategically placed in the Tobique reservoir (n=5), below the TNGS (n=2), and locations along the Saint John River (n=6) (Figure 5). An additional 55 receivers are located along the lower SJR, from MGS downstream to the City of Saint John (Figure 6). Receivers were attached to a concrete deck block, which was

connected to a second concrete brick with a length of rope ~30m in length (Figure 7). At each location the receiver was lowered to the substrate with the rope, the boat was then reversed to separate the receiver from the second brick, which was then lowered. The VR2W receivers were retrieved using a grapple that was dragged between the two concrete bricks to catch the extended rope, then manually raised to the boat. The data from the receivers was downloaded using a Bluetooth dongle and the Vemco Vue program (version 2.4.2) (Figure 7). Pre-smolt collected at the bypass facility were visually accessed for an incision, and released downstream of the Tobique Generating Station. The VR2W receiver latitude and longitude, the deployment and retrieval dates are tabulated in Table 2.

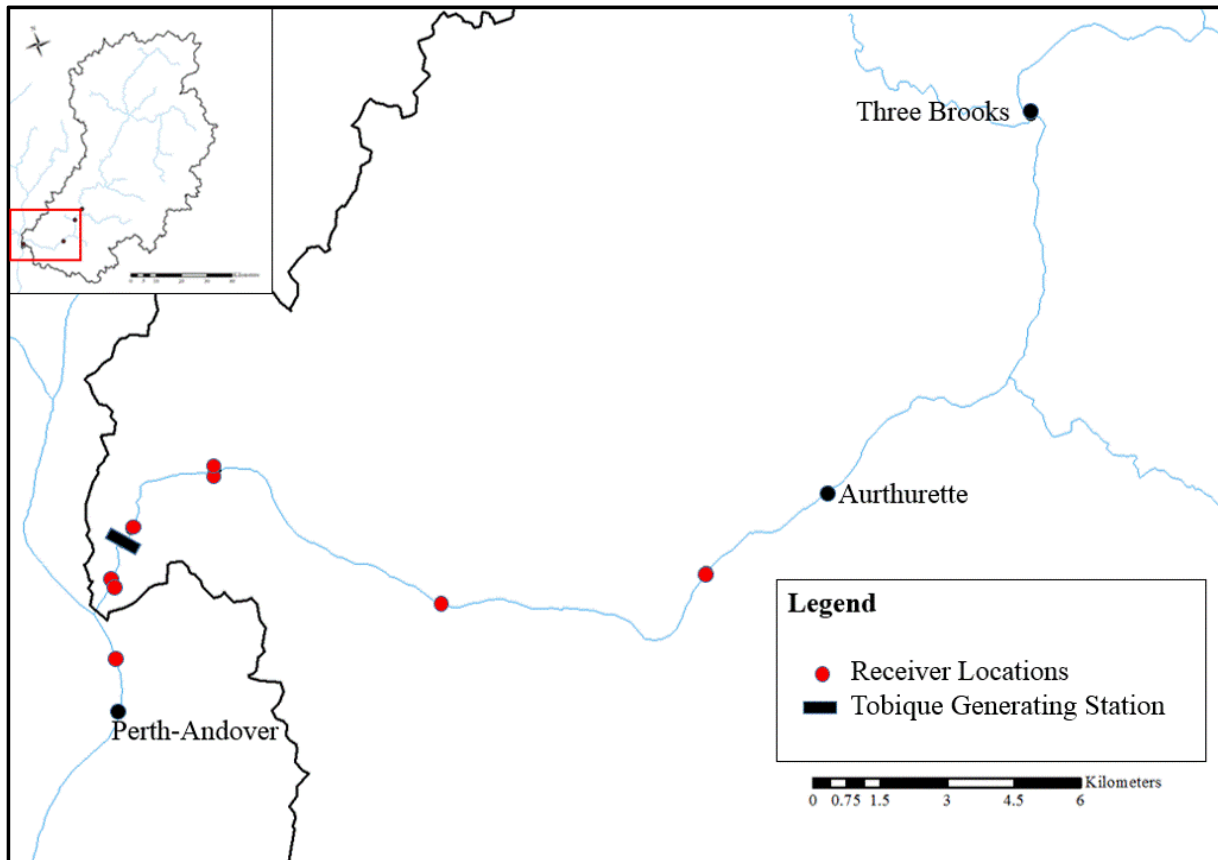


Figure 5: Receiver locations in the Tobique River Reservoir and downstream of the Tobique-Narrows Generating Station.

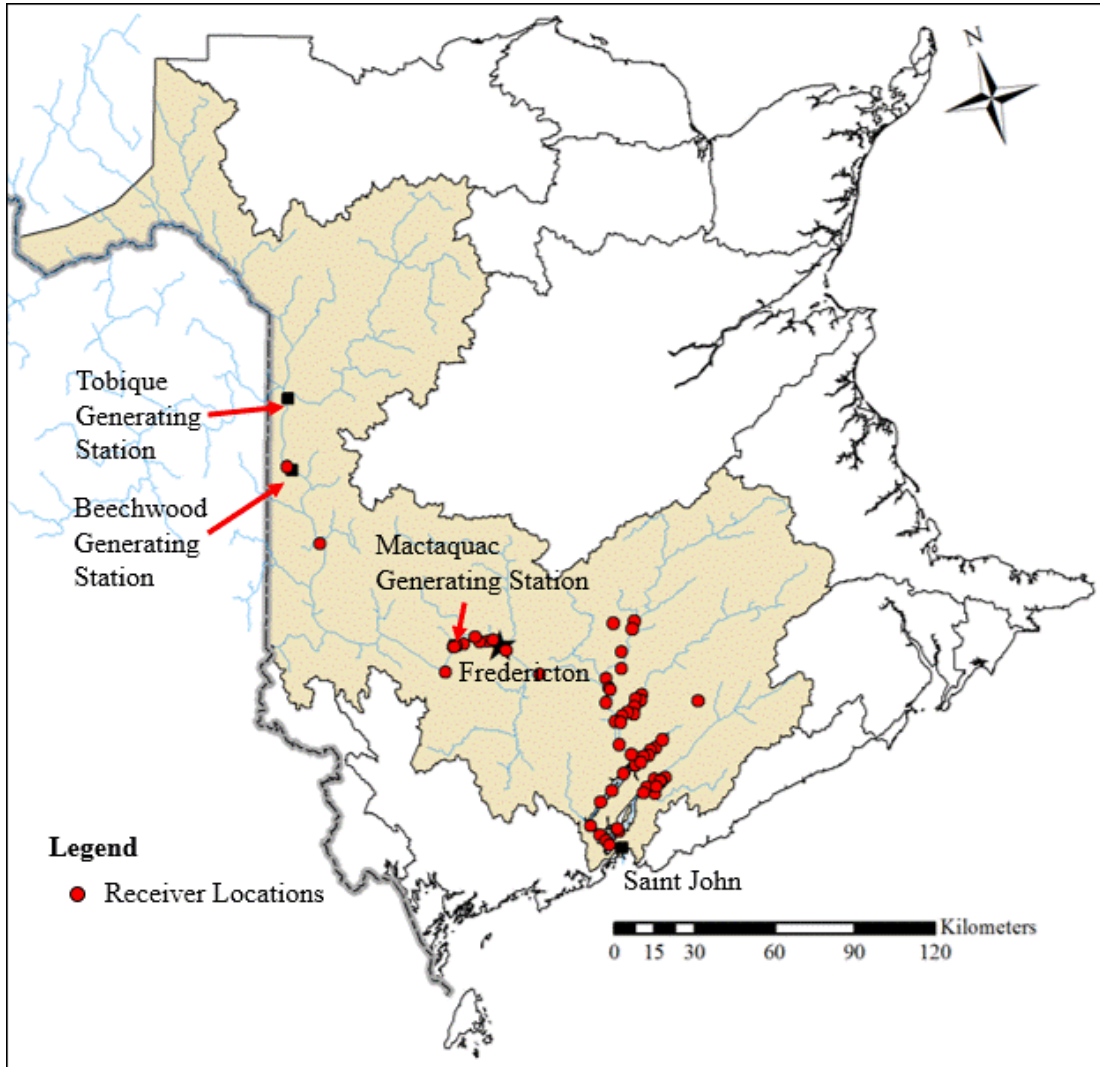


Figure 6: Receiver locations in the Saint John River from above the Beechwood Generating Station to the river mouth in the Bay of Fundy.



Figure 7: VR2W deployment setup (left) and data downloading (right).

Table 2: Name and coordinates of receiver deployments for the smolt by-pass study.

Station	River Km	Latitude	Longitude	Serial Number	Date Deployed	Date Retrieved
Below Odellach River	18.4	46.77623	-67.52353	100676	13-Oct-17	20-Nov-17
Quaker Brook	11.3	46.76928	-67.60155	127639	13-Oct-17	9-Aug-18
U/S Tobique Narrows (1)	5.4	46.79539	-67.66840	100660	13-Oct-17	9-Aug-18
U/S Tobique Narrows (2)	5.4	46.79435	-67.66879	124894	13-Oct-17	9-Aug-18
U/S Tobique TGS	2.3	46.78348	-67.69251	124864	13-Oct-17	9-Aug-18
Downstream TGS (1)	0.9	46.77314	-67.69832	128205	13-Oct-17	9-Aug-18
Downstream TGS (2)	0.9	46.77231	-67.69791	Unknown	13-Oct-17	Lost
SJR-Perth-Andover	312.6	46.75695	-67.69677	127618	13-Oct-17	20-Nov-17
Beechwood	287.4	46.55155	-67.69135	124863	24-Oct-17	Not retrieved
Hartland	250.4	46.29376	-67.52750	102964	01-Nov-17	Lost
Longs Creek	161.7	45.86596	-66.91248	124962	24-Oct-17	Not retrieved
Mactaquac Earthen Dam	151.0	45.95050	-66.97643	124960	01-Nov-17	20-Nov-18
Mactaquac Park	151.0	45.94967	-66.87234	100658	01-Nov-17	20-Nov-18

3. Results

Tobique River receivers (n=7) and one in the main SJR above Perth-Andover were deployed on October 13th, 2017. The remaining receivers above MGS were deployed on October 24th and November 1st, 2017. The receiver below the Odellach River and the one above Perth-Andover were retrieved on November 20th, 2017 due to the high likelihood of being lost due to spring ice flows. The remaining receivers were retrieved on August 9th, 2018. The receiver below the TNGS and one in the SJR at Hartland are presumed lost and no new receivers were not re-deployed. The receivers in the Beachwood Reservoir and in Longs Creek are yet to be retrieved, but not presumed lost. The bypass was operational November 7 - December 7, 2017. The guidance system component of the bypass was dislodged overwinter and was not operational. The bypass was operated for seven days, June 4-11th, 2018. DFO observed three tagged fish in the bypass collection facility in the fall and two in the spring, one of which was a mortality (Leroy Anderson, pers. comm.). The exact dates of operation are not known, as the operation schedule was not made available at the time of the report.

Pre-smolt (n=62) were tagged at Three Brooks between the November, 2nd and 13th, 2017 (Figure 2). Pre-smolts had an average fork length of 16.0 ± 0.8 cm (1 SD) and weighed 40.6 ± 6.3 g. The body condition of pre-smolts tagged averaged 1.0 ± 0.1 , and the acoustic tag weight to body weight ratio averaged $4.0 \pm 0.5\%$. Measurements of tagged pre-smolts are tabulated in Appendix 1. Of the 62 pre-smolt tagged, 52 (84%) were detected by the VR2W receivers in the Tobique Reservoir. The number of pre-smolt were detected immediately upstream of the TNGS was 17; 29 pre-smolt were detected downstream of the TNGS. At the MGS, 17 of the November tagged fish were detected in the reservoir immediately upstream of the facility and only 12 were detected at the McKinley Ferry receiver, 1 km downstream of MGS. All 18 of the November tagged fish were detected by receivers below the MGS and 5 were detected downstream at the Reversing Falls receiver (Figure 8).

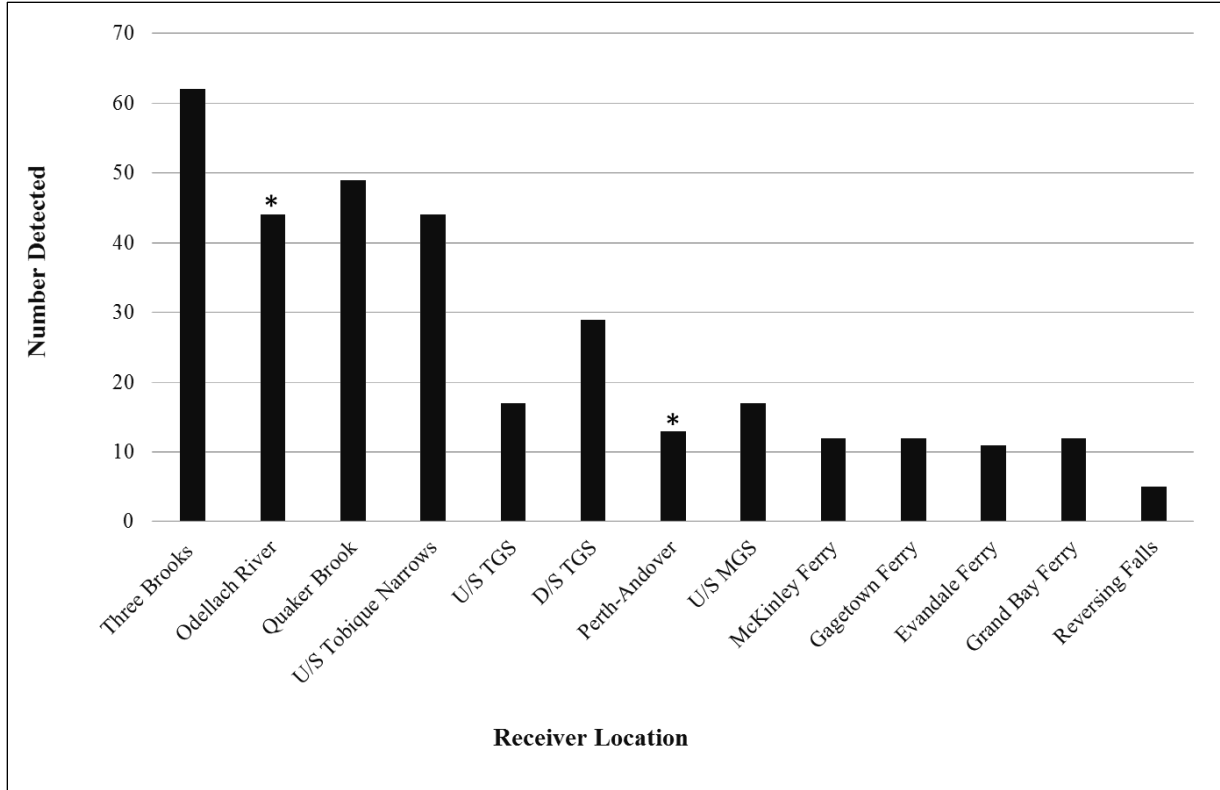


Figure 8: Number of wild pre-smolts released and detected during their downstream migrations. * Receiver was pulled late fall due to ice conditions and was unable to be redeployed in spring.

An additional 38 hatchery smolts were tagged and released below the Authurette Bridge on May 30th, 2018. These fish had an average fork length of 16.4±0.5 cm and weighed 39.7±3.8 g. The body condition of pre-smolts tagged averaged 0.9±0.1, and the acoustic tag weight to body weight ratio averaged 4.1±0.4%. Individual measurements for tagged pre-smolts are tabulated in Appendix 1. Of the 38 tagged hatchery smolts, only 28 (74%) were detected by the Tobique River receivers. All 28 fish were detected immediately upstream of the TNGS, with only 11 detected immediately downstream and only five of which were detected at the MGS reservoir receivers. None of the tagged hatchery fish were detected below the MGS (Figure 9). See Appendix 2 for a list of all detections at all receivers.

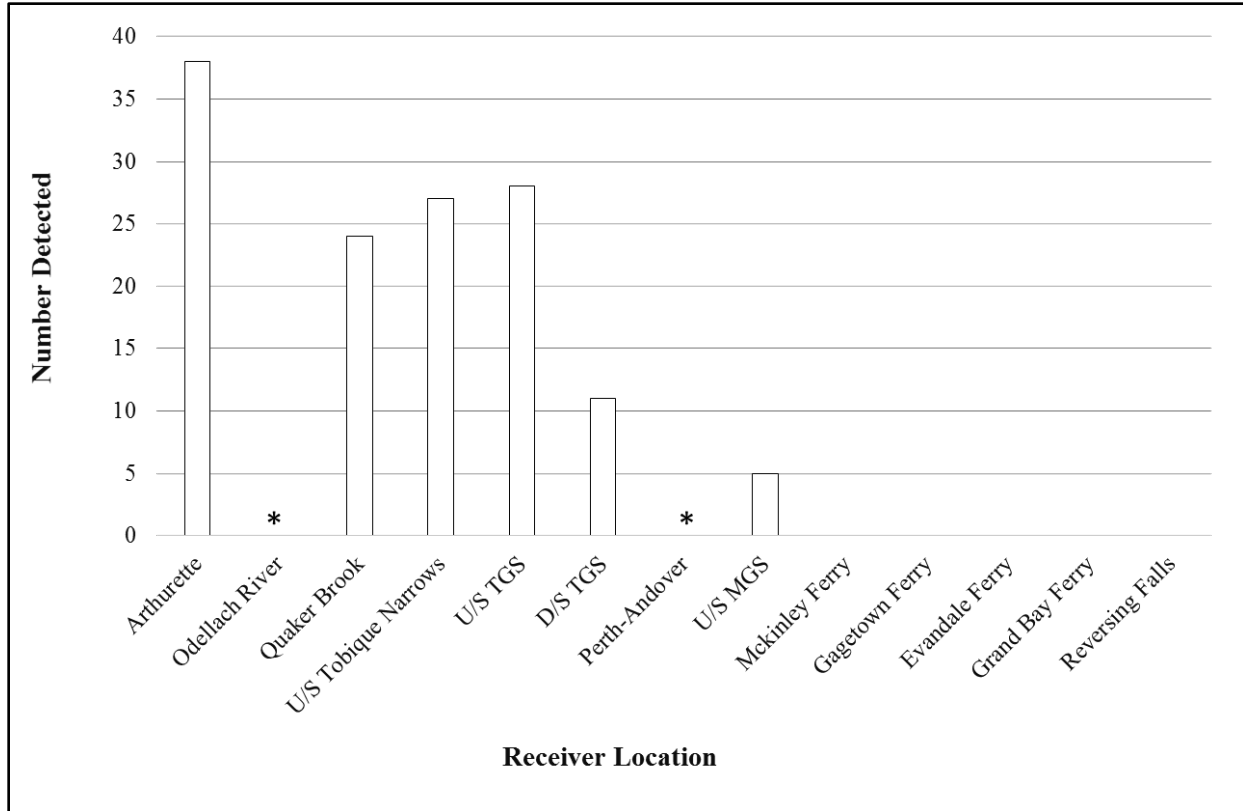


Figure 9: Number of hatchery smolts released and detected during their downstream migrations. *Receiver was pulled late fall due to ice concerns and was unable to be redeployed in spring.

Tagged pre-smolts were detected in the Tobique River November 3rd through December 27th. The earliest tagged fish passed through the TNGS on November 5th and the last fish detected downstream of the TNGS was on December 10th, 2017. None of the tagged pre-smolts were detected in the Tobique River in the spring. The hatchery smolt tagged in on May 30th, 2018, were detected in the Tobique River May 30th – July 5th, 2018. Of the fish that migrated downstream past the TNGS, seven were detected downstream of the TNGS on May 31st, three between Jun 2-6th, and one on July 3rd (Figure 10).

The first tagged pre-smolt were detected at the MGS reservoir receivers on May 10th, 2018. Most fish detected upstream and then immediately downstream of the MGS, passed (n=7) 1-4 days after arrival at the facility. One tagged fish passed the MGS the same day, while another passed after an apparent delay of 19 days. The fish that did not pass the MGS, were detected 2-37 days in the reservoir before all detections ended (Figure 11).

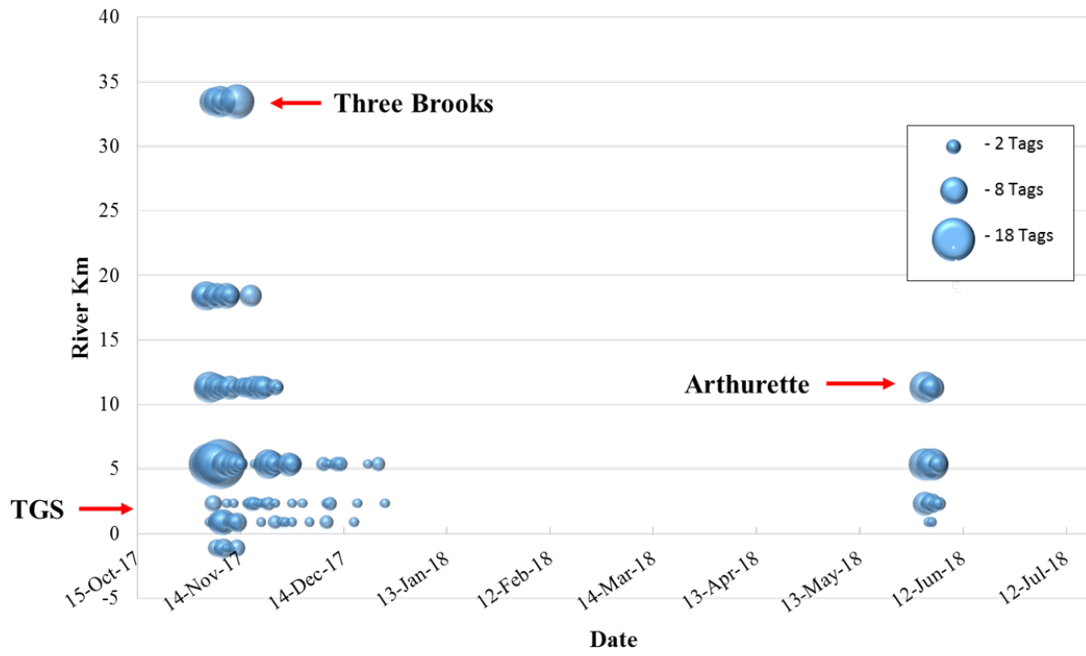


Figure 10: Tagged pre-smolt (Fall) and hatchery (Spring) detections by river km up to the Tobique-Narrows Generating Station (TNGS).

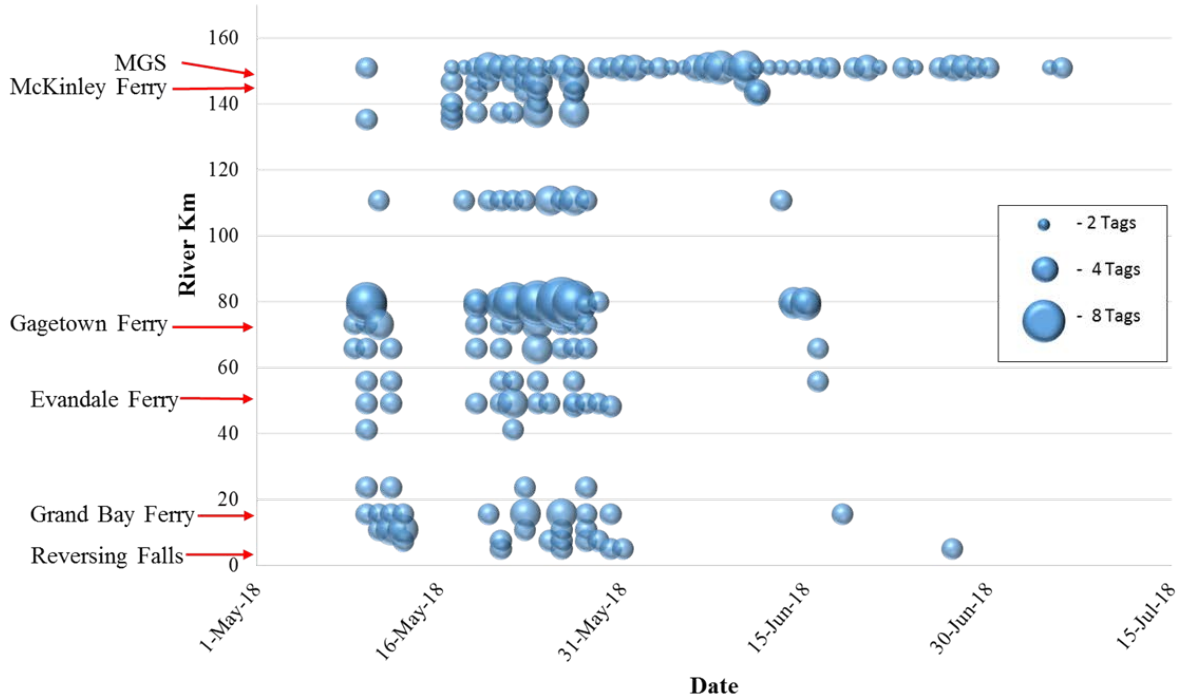


Figure 11: Tagged pre-smolt (Fall) and hatchery (Spring) detections by river km below the Mactaquac Generating Station (MGS).

At least three of the tagged pre-smolts appear to have been predated below the Evandale Ferry. These fish appear to have travelled upstream into Belleisle Bay and back several times (Figure 12). These movements are not indicative to downstream migrations of smolts and are likely movements of a predator like Striped Bass or Brown Trout, both of which frequent inhabitants in this section of water.

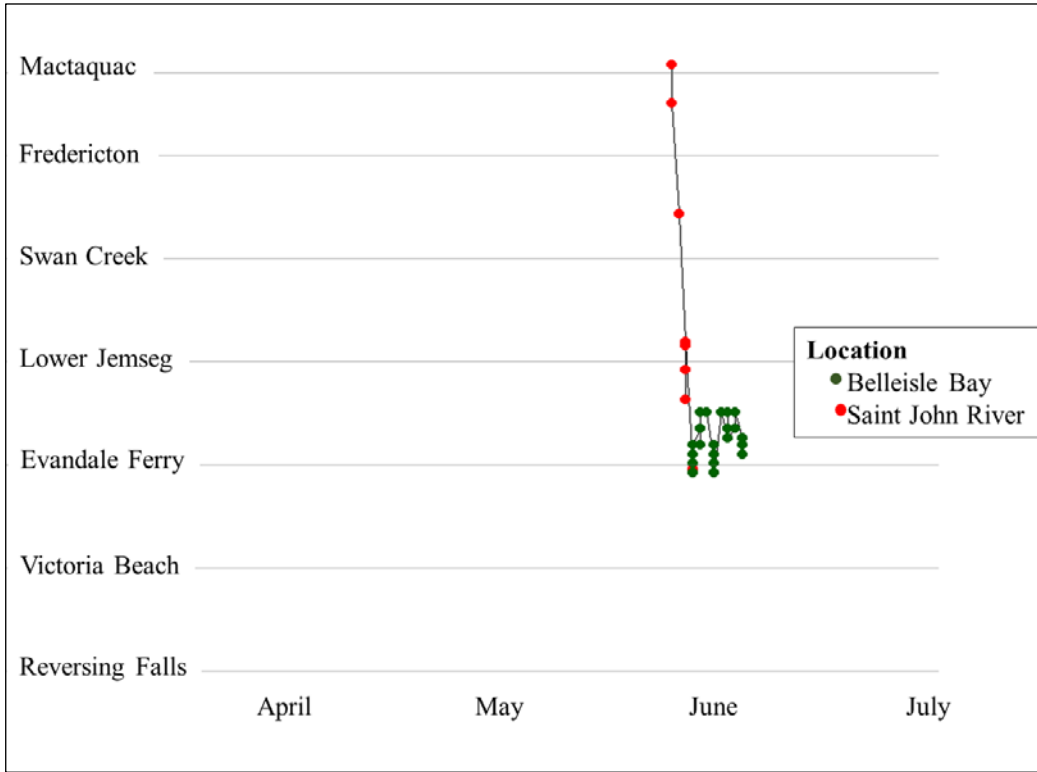


Figure 12: Movement track of a pre-smolt suspected to have been predated upon in the lower Saint John River.

On November 30th, 2017, smolts (n=50) were tagged with “dummy” tags at the MBF. The smolts had an average fork length of 15.1±0.6cm, weighed 37.8±4.9g, with an average body condition of 1.1±0.05. The smolts were held until March 12th (103 days), at which time, 100% tag retention and 100% survival was observed. All fish appeared to be in good health and the incisions healed (Figure 13, Table 3).

Table 3: Mean (standard deviation) length and weight of dummy tagged fish held at the Mactaquac Biodiversity Facility.

Date	Fork Length (cm)	Total Length (cm)	Weight (g) - with tag	Weight (g) - without tag	Condition
30-Nov-18	15.1 (0.6)	16.4 (0.7)	N/A	37.8 (4.9)	1.09
12-Mar-08	15.8 (0.7)	17.1 (0.7)	41.9 (5.6)	40.4 (5.6)	1.03



Figure 13: Photo of a pre-smolt implanted with a dummy tag on day 103 of being held at the Mactaquac Biodiversity Facility.

4. Discussion

This study is an ongoing assessment of smolt migrations from the Tobique River and the efficiency of the new by-pass facility at the Tobique-Narrows Generating Station. Of the 100 pre-smolts and smolts tagged, only 5 were detected in the by-pass facility. There were 5 fish detected making it to the Reversing Falls, and at least 3 pre-smolts appear to have been predated upon.

Having detected only 5 fish out of 100 using the by-pass facility rather than passing through the turbines or spillway, suggests that the new structure is inefficient. However, there are many confounding factors that may have contributed to apparent inefficiency. Although the by-pass was operational November 7 - December 7, 2017, it was not in operation everyday during that period. The days that no one was there to operate it, the screen to hold the smolts was removed, allowing the smolts to pass through undetected. Therefore, more smolts may have used the by-pass than was observed. Without the operations schedule, a more accurate assessment of the fall cannot be made. In the spring, the by-pass was operated for seven days, June 4-11th, 2018 where 2 fish (5%) were observed in the by-pass. Additionally, the guidance system that is supposed to direct the surface migrating smolts into the facility was damaged by ice and was not operational. Having nothing to direct smolts into the by-pass means that they had an

equal chance to enter the TGS through the turbines, spillway, or by-pass. This greatly decreases the efficiency of the by-pass. In general, fish detections above the TNGS were fewer than below. This suggests that fish may have been able to pass without detection or before the next ping of the tag. More studies on the acoustic environment of TNGS are required.

Many of the pre-smolts were already detected at or downstream of the MGS when the hatchery fish were being released at Arthurette and none of the hatchery fish were detected at the MGS. Not being able to acquire all the individuals needed in the fall required the use of hatchery smolts to be tagged in the spring. The first exposure to the wild was upon their release and being placed into a novel environment may have caused a prolonged acclimation period before initiating migration. This delay, combined with the delay in release due to floodwaters, may have resulted in the tag batteries dying before the smolts made it downstream (tag battery life is ~100 days).

Of the 100 fish tagged (62 pre-smolts and 38 smolts), 76 were detected at least once post-release. The fate of these individuals is unknown. The dummy tagged control group at MBF had no mortalities, i.e., the tagging procedure had no effect on tag loss and/or mortality.

This is the first year of study of the by-pass facility and operations. For future studies to accurately assess efficiency, details of operation of the by-pass are essential, e.g., it is critical that the by-pass be staffed everyday of operation during both the fall pre-smolt and spring smolt runs to properly assess that the detections downstream of the TNGS are fish that used the by-pass. References

5. References

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Appendix 1 – Summary of measurements of tagged pre-smolts and hatchery smolts.

Tag ID	Date	Location	Fork length (cm)	Total Length (cm)	Weight (g)
3238	13-Nov-17	Three Brooks	16.9	18.4	44.9
3239	13-Nov-17	Three Brooks	18.4	20.0	60.4
3240	13-Nov-17	Three Brooks	16.0	17.4	39.5
3241	13-Nov-17	Three Brooks	16.8	18.8	47.4
3242	13-Nov-17	Three Brooks	15.8	17.4	40.8
3243	13-Nov-17	Three Brooks	15.2	16.6	35.0
3244	13-Nov-17	Three Brooks	15.9	17.2	43.2
3245	13-Nov-17	Three Brooks	16.8	18.0	44.0
3246	13-Nov-17	Three Brooks	16.2	17.7	41.3
3247	13-Nov-17	Three Brooks	16.7	18.2	46.8
3248	13-Nov-17	Three Brooks	15.3	16.5	35.3
3249	13-Nov-17	Three Brooks	15.2	16.5	36.2
3250	30-May-18	Aurthurette	16.3	17.7	38.2
3251	30-May-18	Aurthurette	16.4	17.8	37
3252	30-May-18	Aurthurette	15.9	17.3	35.4
3253	30-May-18	Aurthurette	17.1	18.7	44
3254	30-May-18	Aurthurette	16.2	17.5	39.1
3255	30-May-18	Aurthurette	15.3	16.6	34
3256	30-May-18	Aurthurette	16.5	17.8	39.8
3257	30-May-18	Aurthurette	16.8	17.9	42.1
3258	30-May-18	Aurthurette	17	18.5	47.6
3259	30-May-18	Aurthurette	16.7	17.8	42.4
3260	30-May-18	Aurthurette	16.4	17.7	40
3261	30-May-18	Aurthurette	16.1	17.4	39.5
3262	30-May-18	Aurthurette	16.8	18	42.5
3263	30-May-18	Aurthurette	17.4	18.8	47.7
3264	30-May-18	Aurthurette	16.6	17.9	41.4
3265	30-May-18	Aurthurette	16.1	17.3	36.8
3266	30-May-18	Aurthurette	16.2	17.6	39.5
3267	30-May-18	Aurthurette	15.9	17.1	37.5
3268	30-May-18	Aurthurette	15.8	16.8	336.7
3269	30-May-18	Aurthurette	16.1	17.4	34.6
3270	30-May-18	Aurthurette	15.8	17.2	35.9
3271	30-May-18	Aurthurette	16	17.3	37
3272	30-May-18	Aurthurette	16.8	18.3	45.9
3273	30-May-18	Aurthurette	15.7	17	33.9
3274	30-May-18	Aurthurette	15.6	17	34.4
3275	30-May-18	Aurthurette	16.3	17.6	38.2
3276	30-May-18	Aurthurette	16.6	17.8	37.8
3277	30-May-18	Aurthurette	16.8	18.2	44.4

3278	30-May-18	Aurthurette	16.7	18	44.9
3279	30-May-18	Aurthurette	16.4	17.8	40.6
3280	30-May-18	Aurthurette	16.1	18	43
3281	30-May-18	Aurthurette	16.2	17.4	36.3
3282	30-May-18	Aurthurette	16.4	17.6	36.9
3283	30-May-18	Aurthurette	16.6	17.6	38.8
3284	30-May-18	Aurthurette	16.3	17.6	38.7
3285	30-May-18	Aurthurette	16.7	18.2	39
3286	30-May-18	Aurthurette	15.8	17.2	38.8
3287	30-May-18	Aurthurette	17.4	18.7	46.9
3425	02-Nov-17	Three Brooks	15.5	16.7	35.3
3426	02-Nov-17	Three Brooks	15.4	16.8	35.4
3427	02-Nov-17	Three Brooks	15.7	17.1	37.7
3428	02-Nov-17	Three Brooks	15.9	17.2	38
3429	02-Nov-17	Three Brooks	15.4	16.8	35.7
3430	02-Nov-17	Three Brooks	15.5	17	35.6
3431	02-Nov-17	Three Brooks	15.8	17.1	38
3432	02-Nov-17	Three Brooks	15.4	16.8	36.4
3433	02-Nov-17	Three Brooks	17	18.5	45.9
3434	02-Nov-17	Three Brooks	16.1	17.5	37.5
3435	02-Nov-17	Three Brooks	16.2	17.6	41.3
3436	02-Nov-17	Three Brooks	16.8	18.2	44.1
3437	02-Nov-17	Three Brooks	15.8	17.2	38.8
3438	02-Nov-17	Three Brooks	16.6	18	43.7
3439	02-Nov-17	Three Brooks	16.3	17.7	37.8
3440	02-Nov-17	Three Brooks	15.6	16.9	38
3441	02-Nov-17	Three Brooks	15.1	16.5	34.4
3442	02-Nov-17	Three Brooks	15.3	16.6	36.7
3443	06-Nov-17	Three Brooks	16.1	17.8	39.6
3444	06-Nov-17	Three Brooks	16.8	18.3	47.2
3445	06-Nov-17	Three Brooks	16.3	17.7	37.7
3446	06-Nov-17	Three Brooks	16.3	17.8	40.2
3447	06-Nov-17	Three Brooks	15.2	16.6	37.1
3448	06-Nov-17	Three Brooks	16.3	17.9	43.1
3449	08-Nov-17	Three Brooks	16.6	18.3	47.7
3450	06-Nov-17	Three Brooks	17	18.6	48.5
3451	06-Nov-17	Three Brooks	16.4	17.8	45.1
3452	06-Nov-17	Three Brooks	16.1	17.7	38
3453	06-Nov-17	Three Brooks	15.7	17.3	38.8
3454	06-Nov-17	Three Brooks	15.3	16.6	34.5
3455	06-Nov-17	Three Brooks	16.6	18	45.5
3456	06-Nov-17	Three Brooks	16.4	17.9	44
3457	06-Nov-17	Three Brooks	15.5	16.9	35.7
3458	08-Nov-17	Three Brooks	15.8	17.2	38.2
3459	08-Nov-17	Three Brooks	15.9	17.2	39.9
3460	08-Nov-17	Three Brooks	17.5	18.9	50.1

3461	08-Nov-17	Three Brooks	16.1	17.5	39.2
3462	08-Nov-17	Three Brooks	15.9	17.2	38.4
3463	08-Nov-17	Three Brooks	15.3	16.7	34.5
3464	08-Nov-17	Three Brooks	15.3	16.7	35.1
3465	08-Nov-17	Three Brooks	15.6	17	37.2
3466	08-Nov-17	Three Brooks	17.9	19.5	60.1
3467	08-Nov-17	Three Brooks	15.3	16.9	33.8
3468	09-Nov-17	Three Brooks	15.9	17.2	40.4
3469	09-Nov-17	Three Brooks	15.7	17.1	35.2
3470	09-Nov-17	Three Brooks	15.1	16.3	35.2
3471	09-Nov-17	Three Brooks	15.6	17.2	49.3
3472	09-Nov-17	Three Brooks	14.9	16.2	32.3
3473	09-Nov-17	Three Brooks	15.8	17.4	39.9
3474	13-Nov-17	Three Brooks	18.4	20.2	61.3

Appendix 2 – Summary of smolt detections and river km’s on the Saint John River

Site (Rkm)	Three Brooks	Arthurette	Odellach River	Quaker Brook	U/S Tobique Narrows	U/S Tobique	D/S Tobique	Perth-Andover	Maқтаquac	Below MGS	Total
Tag ID	34.45 km	21.8 km	18.43 km	11.33 km	5.38 km	2.34 km	0.88 km	312.55 km	151 km		
3250		Release									0
3251		Release		10	24	4					38
3252		Release		16	6	1					23
3253		Release		1	2	6	10				19
3254		Release		7	11	6	1				25
3255		Release		10	15	13	12				50
3256		Release									0
3257		Release		22	84	4					110
3258		Release		3	1	7	6				17
3259		Release									0
3260		Release		2	33	15			210		260
3261		Release		6	130	2					138
3262		Release		16	55	33					104
3263		Release		2		20					22
3264		Release			32	3					35
3265		Release		3	19	5	1				28
3266		Release		42	1	1	3				47
3267		Release		40	3	5					48
3268		Release		3	32	7			8		50
3269		Release									0
3270		Release			31	7					38
3271		Release		1	10	2	13				26
3272		Release									0
3273		Release		68	49	21					138
3274		Release			2	5					7

3275	Release			13	4						17
3276	Release		7	10	1		3				21
3277	Release		3	10	17				165		195
3278	Release										0
3279	Release		24	36	3		28				91
3280	Release		5	14	8				53		80
3281	Release		12	16	4				14		46
3282	Release										0
3283	Release		24	16	5		4				49
3284	Release										0
3285	Release		7	22	9		2				40
3286	Release										0
3287	Release										0

Tag ID	Three Brooks 34.45 km	Arthurette 21.8 km	Odellach River 18.43 km	Quaker Brook 11.33 km	U/S Tobique Narrows 5.38 km	U/S Tobique 2.34 km	D/S Tobique 0.88 km	Perth-Andover 312.55 km	Mactaquac 151 km	Below MGS	Total
3425	Release		6	65	750		37		40	305	1203
3426	Release		7	52	76						135
3427	Release		4	41	164		45	2			256
3428	Release		7	17	942		48		6	92	1112
3429	Release		3	53	162		44	1	2	24	289
3430	Release		2	64	1737		142				1945
3431	Release		7	22	588						617
3432	Release		11	56	494		20			1	582
3433	Release		3	11	257						271
3434	Release		3	25	72	22	3	1			126
3435	Release										0
3436	Release		31	138	105		78	1			353
3437	Release		16	62	281		27		9	62	457
3438	Release		3	130	186	3	21	4		27	374
3439	Release		3	132	66					1	202

3440	Release	5	100	113	75					293
3441	Release	5	43	36		1		23		108
3442	Release	8	133						69	210
3443	Release	9	29	70		40	2			150
3444	Release		15	769		4		8	178	974
3445	Release									0
3446	Release	5	143	180		620				948
3447	Release	2	142	206						350
3448	Release	6	69	109		34	2			220
3449	Release	4	120	1094		47	1	392	118	1776
3450	Release	10	279	78						367
3451	Release	7	78	512		954	5	283		1839
3452	Release	6	79					306		391
3453	Release	3	94	54		38	1	3	87	280
3454	Release	7	92	96	290	7				492
3455	Release	3	1565					28	152	1748
3456	Release	4	170	1058		231				1463
3457	Release	4	123	58		246	4	118		553
3458	Release	12	2136					37		2185
3459	Release	36	42	846	4	41		35	62	1066
3460	Release	3	60	67	18	10				158
3461	Release		316	56	17	13				402
3462	Release	4	40	81	18					143
3463	Release	138	47	975	4	6		64	146	1380
3464	Release	2	215	181	56	6		52	39	551
3465	Release									0
3466	Release	8	24	81	1	22	2			138
3467	Release		275	194	47				1	517
3468	Release	4	50	161	23					238
3469	Release	2	17	308	2					329
3470	Release	5	144	94	3	64	2			312
3471	Release	120	3001							3121

3472	Release	49						49
3473	Release	6	45	290	99			440
3474	Release							0
3238	Release		5	9183				9188
3239	Release					17	72	89
3240	Release							0
3241	Release							0
3242	Release		17	80		4		101
3243	Release		57	116	14		91	278
3244	Release							0
3245	Release							0
3246	Release							0
3247	Release							0
3248	Release		26	318				344
3249	Release	1						1