Evaluation of Habitat Expansion Outcomes on Upper Terra Nova River

Project Report, December 2015

Submitted by:
Freshwater-Alexander Bays Ecosystem Corporation (FABEC)

Introduction

Terra Nova River is the fourth largest river on Newfoundland Island. Since the 1950's a number of projects have been undertaken to stimulate growth of the river's Atlantic salmon population. This included construction of three fishways to open up new habitat at Grant Falls (11 km. from ocean), Terra Nova River Falls (22 km. from ocean), and Mollyguajeck Falls (56 km. from the ocean), as well as a salmon enhancement program aimed at establishing a population in the watershed above Mollyguajeck Falls.

Habitat upstream from Mollyguajeck is estimated to have 60 percent of the river's salmon production capacity above Grant Falls (Bourgeois, 2002). The enhancement program initially involved the transfer of 1,412 spawners from the lower river between 1985 and 1989, and beginning in 1995 the stocking of 2.5 million salmon fry incubated at a hatchery in Terra Nova.

The most recent salmon investment was the construction in 2010 of a new fishway at Terra Nova River Falls at a cost of $2 million.

The river has seen a significant rise in salmon returns in recent years. In 2015 the salmon count at Grant Falls was 5,168, seven fewer than the record of 5,175 in 2011. The 5-year average for 2011-15 was 4,506 salmon, 58 percent higher than the average of 2,854 for the preceding ten years (2001-10).

Despite this encouraging growth, returns remain significantly below the estimated conservation requirement of 8,937 spawners for the river above Grant Falls (Bourgeois, 2002). Habitat above Mollyguajeck Falls is estimated to have 60 percent of this capacity, or about 5,400 spawners.

In 2015 FABEC was successful in obtaining assistance from a number of partners to monitor fishway performance and salmon returns at Mollyguajeck Falls. The partners included the Atlantic Salmon Conservation Foundation, Department of Fisheries and Oceans, Terra Nova National Park, and the Towns of Glovertown, Traytown and Terra Nova.

The project had two main goals:

(1) To assess the effectiveness of the Mollyguajeck fishway in accommodating the passage of salmon around Mollyguajeck Falls.

(2) To determine the proportion of total returns through the Grant Falls fishway that was destined to the upper watershed. Realization of this goal would provide an indication of how strongly the population is growing in the upper watershed and its contribution to the overall population in the river.

Fishway Performance

Mollyguajeck is a rustic fishway, which, unlike the river's other two fishways, does not include built infrastructure requiring ongoing maintenance. It was developed by using explosives to blast a channel through bedrock to divert water from above the falls to a natural channel located below the falls. This created a complete route around the falls that salmon are able to navigate.

The photograph below shows the location and flow direction of the fishway. The inflow channel receives water from the main river and then turns 90 degrees toward the bottom of the falls. The box in the photo shows where the fish trap was installed for this year's project.

For the 2015 project, when the fish trap was installed on July 30, the water depth immediately outside the trap measured 59 cm. By August 23, after 283 salmon had been counted through the trap, the depth measured 48 cm. After August 23 water levels continued to fall and did not recover for the remainder of the project. Only 14 salmon entered the trap over the next 45 days. Of these there were four mortalities caused when a short downpour resulted in a rapid overnight rise and fall of water in the trap. When the staff checked the trap in the morning, there were four dead fish and three live ones that were released.

In the latter part of August and during September, stranded salmon were frequently observed in pools below the falls and in the fishway. They were also observed attempting to jump the falls.

The project clearly demonstrated that the fishway does not perform well for salmon passage when water levels are as low as they were in 2015. To determine if 2015 was an abnormal year, the table below provides water discharge rates from the Environment Canada monitoring station in Terra Nova River near Glovertown. The data compares 2015 with the years 1992 and 2001, when the previous Mollyguajeck counts were undertaken, as well as the four years prior to 2015. It shows discharge rates on selected dates one week apart.

WATER DISCHARGE RATES - TERRA NOVA RIVER							
	1992 (m3/s)	2001 (m3/s)	2011 (m3/s)	2012 (m3/s)	2013 (m3/s)	2014 (m3/s)	2015 (m3/s)
26-Jul	30.6	30.9	53.6	13.2	27.2	14.1	14.7
02-Aug	35.2	21.9	78.7	14.5	29.5	14.0	20.1
09-Aug	37.1	15.2	63.1	14.6	32.4	10.5	18.0
16-Aug	29.3	10.4	38.3	15.1	28.9	22.2	18.7
23-Aug	25.8	8.2	28.6	21.5	21.8	38.3	14.5
30-Aug	22.7	11.3	24.5	29.0	15.6	59.3	10.6
06-Sep	23.6	9.9	16.6	28.0	130.0	45.4	9.2
13-Sep	38.0	7.7	13.4	38.3	74.5	38.4	5.9
20-Sep	52.1	22.9	13.3	47.5	86.8	26.3	10.7
27-Sep	44.9	28.2	14.9	46.1	125.0	16.4	7.8
04-Oct	37.0	28.3	35.0	44.4	95.3	13.7	6.1
11-Oct	40.4	25.8	58.5	42.0	49.7	14.1	6.6
18-Oct	63.2	19.9	55.8	41.7	34.9	10.3	5.6
25-Oct	75.0	16.3	52.9	40.9	51.5	13.0	6.3
01-Nov	77.2	23.5	98.6	42.6	60.0	55.7	8.3
AVERAGE	42.1	18.7	43.1	32.0	57.5	26.1	10.9

Source – Real Time discharge data for Water Station 02YS005, Glovertown

The data leaves no doubt that 2015 was much dryer than average. The snapshot of weekly discharge rates from July 28 to November 1 shows that the average runoff of 10.9 m3/second was equal to 58% of the average in second driest year, 2001, and 19% of the wettest year, 2013. It was one-third of the average for all seven years combined.

As a result of the unusually low water, FABEC is confident that the number of counted salmon in 2015 significantly understates the actual number that were destined to the upper watershed. These salmon either were permanently

stranded below Mollyguajeck Falls or managed to navigate over the falls when the force of water dropped to manageable level.

As a result 2015 was not a good year to get a representative record of salmon returns to the upper watershed. It was, however, an excellent year to identify the fishway's structural deficiencies. Based on FABEC's findings, DFO Real Properties is undertaking an engineering assessment to identify how to correct the problem of low water inflow during dry periods.

Assessment of Salmon Returns

The following table shows weekly salmon returns in 2015 compared to the previous counts in 2001 and 1992. The 2015 returns of 297 spawners compared to 329 in 2001 and 108 in 1992. According to Bourgeois (2002), the 2001 count was adjusted to 436 to account for brood stock removed from the lower section of the river as part of the enhancement program.

Mollyguajeck Fishway Weekly Counts- 2015, 2001 & 1992

	Fish Count 2015			Fish Count 2001			Fish Count 1992		
Week	≤63 cm	>63 cm	Total	≤63 cm	>63 cm	Total	≤63 cm	>63 cm	Total
July 28-Aug 3	46	1	47	9	1	10	15	3	18
Aug 4-10	53	8	61	1	1	2	18	2	20
Aug 11-17	131	22	153	0	0	0	16	1	17
Aug 18-24	21	1	22	0	0	0	5	0	5
Aug 25-31	0	0	0	0	0	0	6	0	6
Sep 1-7	3	0	3	0	0	0	13	3	16
Sep 8-14	0	0	0	0	0	0	17	0	17
Sep 15-21	7	0	7	46	17	63	1	1	2
Sep 22-28	4	0	4	47	4	51	1	0	1
Sep 29-Oct 5	0	0	0	16	0	16	6	0	6
Oct 6-12	0	0	0	109	9	118			
Oct 13-19				63	3	66			
Oct 20-26				2	0	2			
Oct 27-Nov 2				2	0	2			
Total	265	32	297	294	35	329	98	10	108

The 2015 count was significantly lower than expected. Based on the higher general returns in recent years, along with anecdotal evidence (e.g. high presence of parr in the upper watershed), the expectation had been that returns to the upper watershed would be much higher.

Initial returns in the first 3 weeks seemed to confirm that this would be the case. But returns dropped off quickly after mid-August corresponding with the decline in water flow. By August 26, when the water depth outside the trap measured 44

cm, the level inside the trap was only 7.5 cm. By September 8 the trap floor was completely dry. Salmon were observed in pools below the fishway and trying to jump the falls. No remedial action was taken as it was expected that normal rainfall would soon fix the problem.

By late September it was decided something had to be done. On September 26, the elevator was removed from the trap and a makeshift dam was put in place to direct more water into the fishway. This added a few centimeters in the trap but did little to alleviate the problem. River levels continued to fall and only four additional fish passed through the trap over the remainder of the project.

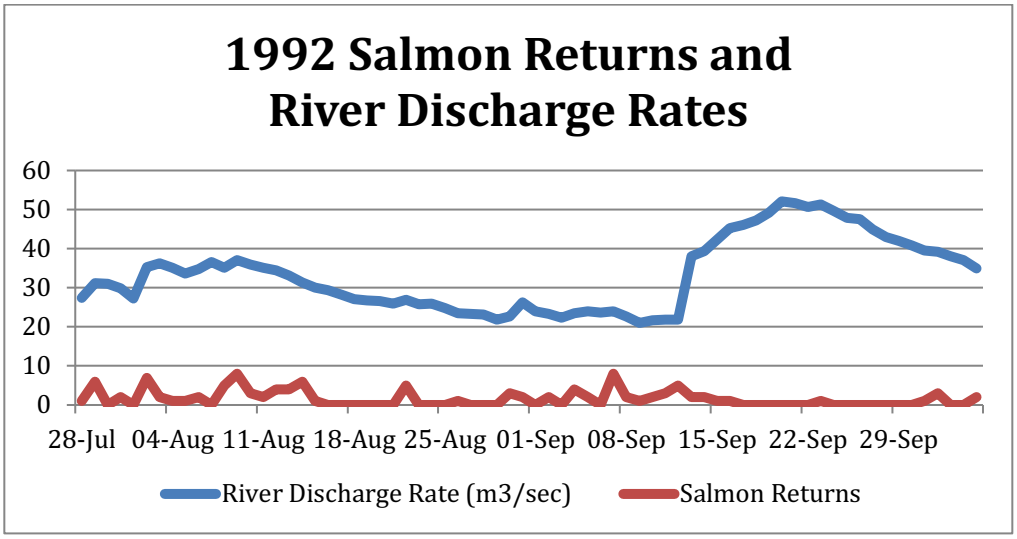
The three graphs below show salmon returns at Mollyguajeck Fishway in 1992, 2001, and 2015 in relation to recorded water discharge rates at the monitoring station in Glovertown. These comparisons were an attempt to ascertain the nature of the relationship between river flow conditions and salmon movement through the fishway. More to the point, it was to estimate at what water flow rate salmon are prevented from moving through the fishway.

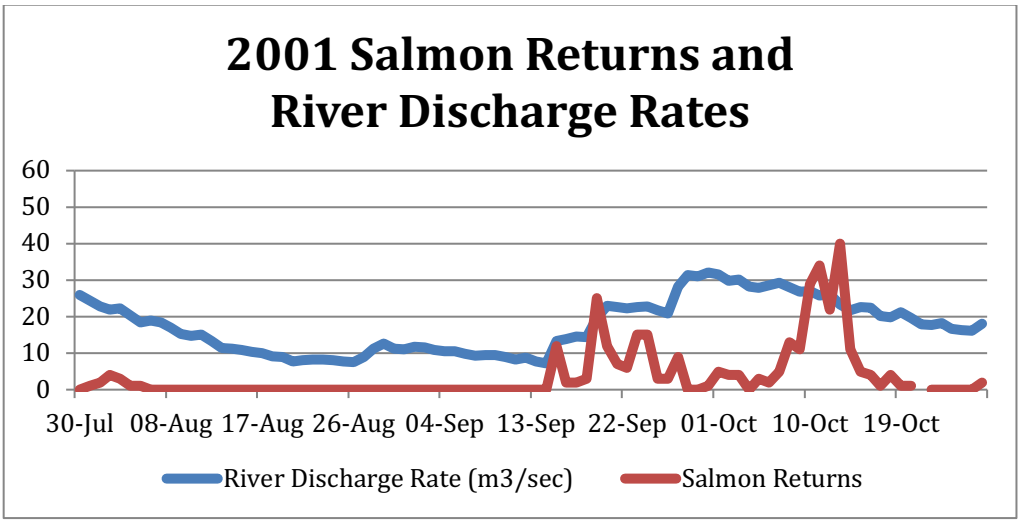
In 1992, 108 salmon passed through the fishway over a period of 70 days. During that period the discharge rate at the monitoring station never fell below 21.0 m3/second. As shown in the 1992 graph, the lowest salmon returns did not correspond to the periods of lowest water flow. The lowest returns actually occurred after mid-September when flow rates rose to their highest level.

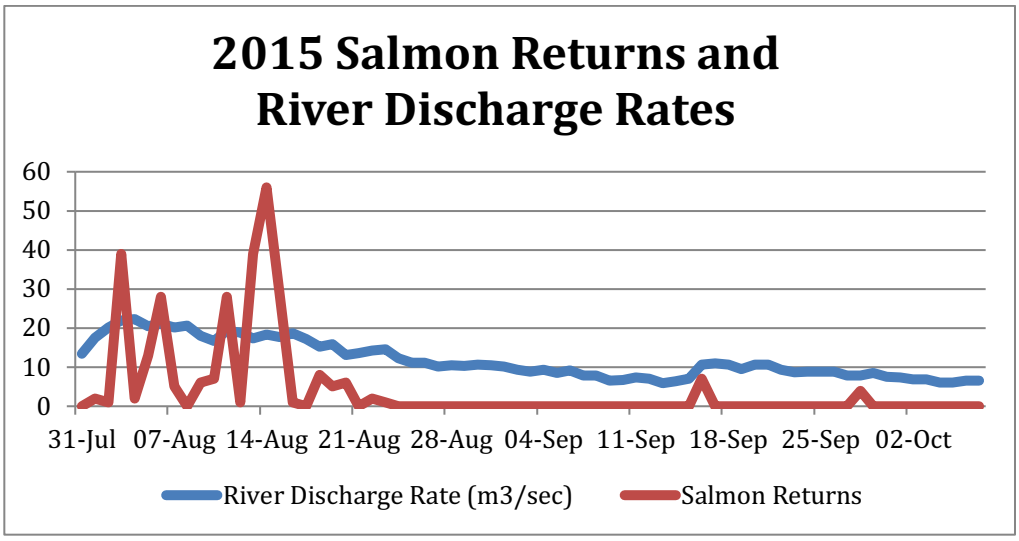
The salmon count in 2001 took place over a period of 90 days from July 30 to October 27. The 2001 graph shows the correlation of salmon returns through the fishway to river discharge rates. Returns were zero for a period of 40 days (August 6 to September 14) during which the average river discharge rate was 10.7 m3/second. Discharge rates began to rise on September 15 and over the next 36 days averaged 24.0 m3/second. During this period 313 salmon migrated through the fishway for an average of 8.7 per day.

The count lasted for 70 days in 2015. As shown in the 2015 graph, 276 salmon passed in the first 20 days of August for an average of 13.8 per day. This corresponded to an average discharge rate of 19.0 m3/second at the Glovertown monitoring station. In the other 50 days, when the average discharge was 9.2 m3/second, only 21 salmon entered the fishway.

It appears that the Mollyguajeck fishway's effectiveness declines after discharge rates drop below 19 or 20 m3/second. This in itself is not unusual but in most years rainfall fixes the problem after a short period. Nevertheless in eight of the past 24 years, discharge rates remained below 20 m3/second for more than forty days between July 30 and October 31. The driest years were 2002 (94 days), 2015 (86 days), 2003 (68 days), and 2001 (57 days).


1992 Salmon Returns and River Discharge Rates
60
50
40
30
20
10
0
28-Jul 04-Aug 11-Aug 18-Aug 25-Aug 01-Sep 08-Sep 15-Sep 22-Sep 29-Sep
River Discharge Rate (m3/sec)
Salmon Returns


2001 Salmon Returns and River Discharge Rates
60
50
40
30
20
10
0
30-Jul 08-Aug 17-Aug 26-Aug 04-Sep 13-Sep 22-Sep 01-Oct 10-Oct 19-Oct
River Discharge Rate (m3/sec)
Salmon Returns


2015 Salmon Returns and River Discharge Rates
60
50
40
30
20
10
0
31-Jul 07-Aug 14-Aug 21-Aug 28-Aug 04-Sep 11-Sep 18-Sep 25-Sep 02-Oct
River Discharge Rate (m3/sec)
Salmon Returns

Conclusion

It is FABEC's conclusion is that the 2015 Mollyguajeck fish count cannot be relied on as valid indicator of spawner returns to the upper watershed. Unusually low water levels were an impediment to fish passage through the fishway. Although some salmon may have been able to navigate over the falls due to low water force, there is no way to estimate what the number may have been.

FABEC's second conclusion is that the Mollyguajeck Fishway is deficient in its ability to facilitate salmon passage in below average water flow conditions. Dry conditions also occurred during the last count in 2001, when a temporary dam was also used in an attempt to increase water flow in the fishway. While 2015 was one of the driest years in recent times, river discharge data indicates there are likely many periods when the fishway's performance is constrained by low water flow. The difference in 2015 was that flow conditions never did return to a level necessary for salmon passage before the project ended.

Based on the results of the 2015 project, FABEC has two recommendations:

(1) It is recommended that structural modifications be made to the Mollyguajeck fishway to increase water inflow during below average river levels. In our opinion, a permanent solution would be to deepen the channel leading from the main river to the fishway.

(2) It is recommended that another fish count be undertaken in 2016. In order to guard against the possibility of another dry year, this should include preparations so that an effective temporary diversion dam can be constructed quickly in the event of low water levels.

APPENDIX

FISHWAY DAILY LOG SHEET

Mollyguajeck Fishway Daily Log Sheet - 2015

Day	Date	Fishway Environmental Conditions				Water Discharge Rate Stn. 02YS005 (m3/second)	Salmon Count		
		Temperature		Water Level at Trap					
		Air	Water	Inside	Outside		≤ 63 cm	> 63 cm	Total
1	30-Jul	n/a	n/a	n/a	n/a	15.6	5	0	5
2	31-Jul	n/a	n/a	n/a	n/a	13.4	0	0	0
3	01-Aug	n/a	n/a	n/a	n/a	17.5	2	0	2
4	02-Aug	28°	n/a	30 cm	59 cm	20.1	1	0	1
5	03-Aug	n/a	n/a	27 cm	n/a	21.9	38	1	39
6	04-Aug	11°	17°	n/a	60 cm	22.3	2	0	2
7	05-Aug	n/a	18°	n/a	60 cm	20.5	10	3	13
8	06-Aug	24°	19°	n/a	58 cm	21.1	25	3	28
9	07-Aug	20°	20°	n/a	57 cm	20.1	4	1	5
10	08-Aug	n/a	19°	n/a	56 cm	20.6	0	0	0
11	09-Aug	18°	18°	n/a	58 cm	18.0	5	1	6
12	10-Aug	18°	18°	20 cm	56 cm	16.7	7	0	7
13	11-Aug	23°	19°	n/a	57 cm	19.3	25	3	28
14	12-Aug	10°	18°	n/a	57 cm	18.9	1	0	1
15	13-Aug	21°	21°	n/a	58 cm	17.4	36	3	39
16	14-Aug	n/a	20°	n/a	57 cm	18.3	45	11	56
17	15-Aug	n/a	20.5°	n/a	57 cm	17.7	23	5	28
18	16-Aug	15°	20°	n/a	55 cm	18.7	1	0	1
19	17-Aug	26°	22	n/a	54 cm	17.2	0	0	0
20	18-Aug	29°	23°	16 cm	54 cm	15.3	7	1	8
21	19-Aug	23°	22°	n/a	51 cm	15.9	5	0	5
22	20-Aug	14°	20°	n/a	51 cm	13.1	6	0	6
23	21-Aug	28°	21°	n/a	50 cm	13.6	`	0	0
24	22-Aug	25°	21°	n/a	49 cm	14.3	2	0	2
25	23-Aug	29°	22°	n/a	48 cm	14.5	1	0	1
26	24-Aug	16°	21°	n/a	47 cm	12.3	0	0	0
27	25-Aug	19°	21°	9 cm	45 cm	11.2	0	0	0
28	26-Aug	21°	21°	7.5 cm	44 cm	11.2	0	0	0
29	27-Aug	20°	22°	7 cm	43 cm	10.2	0	0	0
30	28-Aug	13°	21°	6.5 cm	43 cm	10.5	0	0	0
31	29-Aug	28°	21°	n/a	43 cm	10.3	0	0	0
32	30-Aug	20°	21°	n/a	43 cm	10.6	0	0	0
33	31-Aug	22°	21°	n/a	42 cm	10.5	0	0	0
34	01-Sep	16°	20°	n/a	42 cm	10.2	0	0	0
35	02-Sep	12°	18°	4 cm	40 cm	9.4	2	0	2
36	03-Sep	20°	19°	3 cm	39 cm	8.9	1	0	1

Mollyguajeck Fishway Daily Log Sheet – 2015 (continued)

Day	Date	Fishway Environmental Conditions				Water Discharge Rate (m3/second)	Salmon Count		
		Temperature		Water Level at Trap					
		Air	Water	Inside	Outside		≤ 63 cm	> 63 cm	Total
37	04-Sep	15°	18°	2.8 cm	37.5 cm	9.3	0	0	0
38	05-Sep	9°	16°	2.5 cm	37.5 cm	8.6	0	0	0
39	06-Sep	15°	15°	1 cm	36 cm	9.2	0	0	0
40	07-Sep	18°	17°	1 cm	36 cm	7.8	0	0	0
41	08-Sep	17°	12°	0 cm	34.5 cm	7.9	0	0	0
42	09-Sep	4°	11°	0 cm	34 cm	6.6	0	0	0
43	10-Sep	23°	18°	0 cm	35 cm	6.7	0	0	0
44	11-Sep	19°	18°	0 cm	33 cm	7.3	0	0	0
45	12-Sep	17°	16°	0 cm	32.5 cm	7.0	0	0	0
46	13-Sep	14°	16°	0 cm	32.5 cm	5.9	0	0	0
47	14-Sep	14°	15°	o cm	31 cm	6.4	0	0	0
48	15-Sep	18°	17°	2 cm	37 cm	7.0	0	0	0
49	16-Sep	13°	13°	3 cm	37 cm	10.7	7	0	7
50	17-Sep	6°	10°	3 cm	37 cm	11.0	0	0	0
51	18-Sep	11°	16°	1.5 cm	36 cm	10.6	0	0	0
52	19-Sep	16°	15°	2 cm	37.5 cm	9.5	0	0	0
53	20-Sep	20°	14°	2 cm	36 cm	10.7	0	0	0
54	21-Sep	13°	17°	2 cm	36 cm	10.7	0	0	0
55	22-Sep	18°	16°	0 cm	35 cm	9.3	0	0	0
56	23-Sep	29°	16°	0 cm	35 cm	8.7	0	0	0
57	24-Sep	18°	14°	0 cm	34 cm	8.9	0	0	0
58	25-Sep	1°	13°	0 cm	34 cm	8.9	0	0	0
59	26-Sep	7°	13°	10 cm	37 cm	8.8	0	0	0
60	27-Sep	7°	13°	7 cm	35 cm	7.8	0	0	0
61	28-Sep	19°	13°	8 cm	36 cm	7.9	4	0	4
62	29-Sep	9°	13°	6 cm	34 cm	8.6	0	0	0
63	30-Sep	27°	17°	3 cm	33 cm	7.6	0	0	0
64	01-Oct	19°	17°	2 cm	32 cm	7.4	0	0	0
65	02-Oct	7°	13°	2 cm	32 cm	6.9	0	0	0
66	03-Oct	4°	13°	n/a	n/a	6.9	0	0	0
67	04-Oct	13°	14°	3 cm	31 cm	6.1	0	0	0
68	05-Oct	17°	13°	2 cm	30 cm	6.1	0	0	0
69	06-Oct	18°	13°	1 cm	30 cm	6.6	0	0	0
70	07-Oct	6°	12°	0 cm	28 cm	6.6	0	0	0
						Total	265	32	297

References

Bourgeois, C. E., J. Murray and G. Clarke. *A review of Atlantic salmon enhancement activities on the Terra Nova River (SFA 5), Newfoundland.* DFO, St. John's, 2002.

Environment Canada. *Hydrometric Data for TERRA NOVA RIVER AT GLOVERTOWN (02YS005).* www.wateroffice.ec.gc.ca.