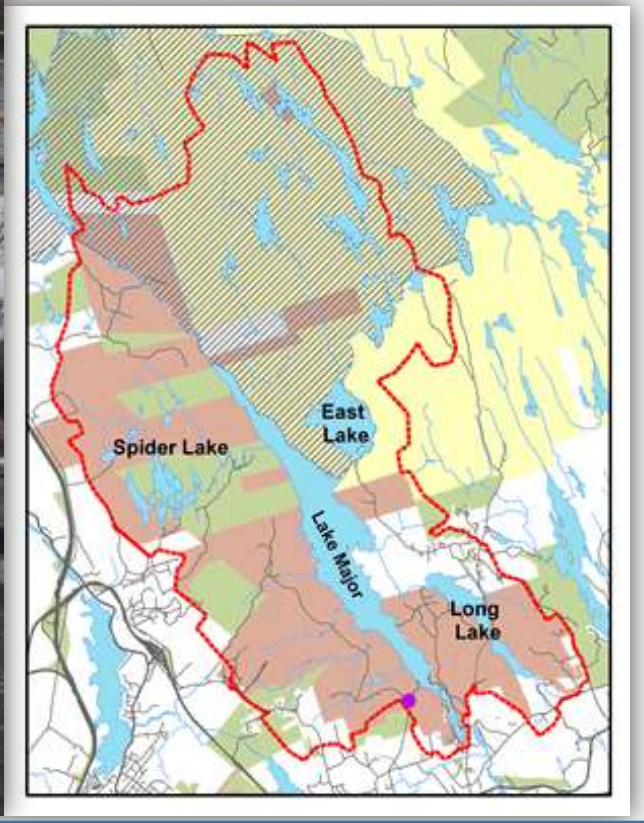
Lake Major Dam—Fish Passage

A Project for Halifax Water



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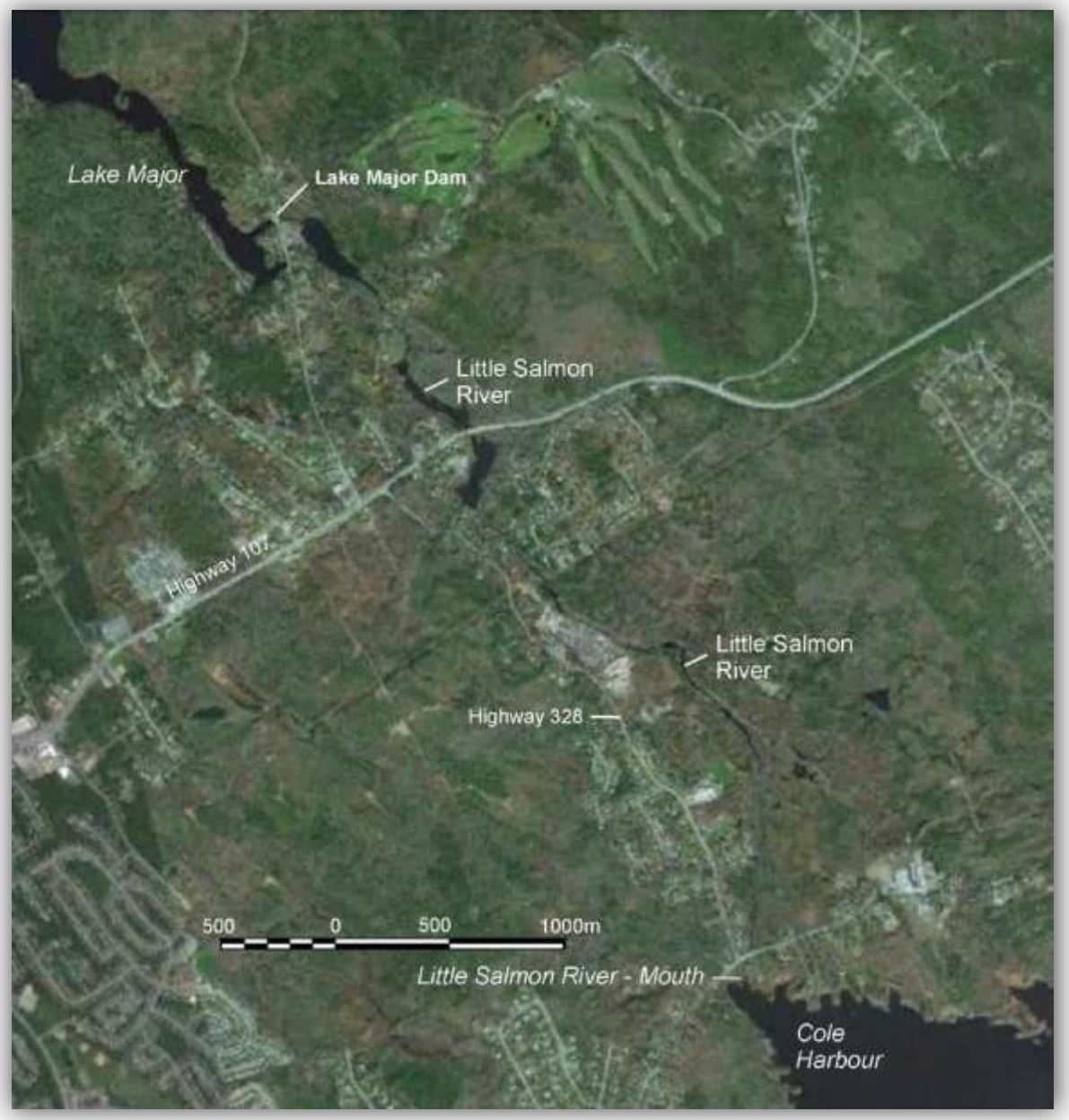
Executive Summary

- Emergency decommissioning of a fishway (filled in with rock) on a water supply reservoir lake (Lake Major, Nova Scotia) in January 2015. No provision for DFO required fish passage.
- Requirement for the manual capture and transfer of migratory gaspereau (*Alosa pseudoharengus*) and sea run brook trout (*Salvelinus fontinalis*) over the dam to fulfill their upstream and downstream spawning runs until the dam could be reconstructed and a permanent fish ladder installed.
- A modified fish pump (CanaVac) designed for moving sea-farmed fish was used successfully to transfer the run of 30,000+ gaspereau & sea run brook trout, as well as other species.
- Negligible mortality occurred when the fish pump was in full operation and video observations of fish released on the upstream side suggested no side effects of the transfer.
- This is a novel use of such system to meet fisheries management requirements in a flowing river system. Although with a high relative cost, the fish pump worked in a situation with a short time frame where construction or deployment of a temporary fish ladder was not possible because of concern of dam integrity.

Introduction

- Halifax Water is responsible for providing drinking water to the cities of Halifax and Dartmouth, NS, and surrounding urban communities.
- Its Lake Major reservoir is located in the North Preston area, on the east side of the urban area.
- Reservoir levels are maintained by a rock-filled dam (Lake Major Dam) near the outlet on the Little Salmon River, which exits Lake Major & reaches tidal waters of the Atlantic Ocean about 5 km downstream.
- The reservoir supports migratory & non-migratory fish populations, including: Gaspereau, Brook Trout, White Sucker, American eel, and probably Atlantic salmon, Shad, & American smelt.



- Emergency decommissioning (filled in with rock) of the Lake Major Dam fishway occurred in January 2015.
- Requirement for the manual capture and transfer of migratory gaspereau and sea run brook trout over the dam to fulfill their upstream and downstream spawning runs until the dam could be reconstructed and a permanent fish ladder installed.
- A modified fish pump (CanaVac, Inventive Marine Products Ltd., Bedford, Nova Scotia) designed for moving sea-farmed fish was installed to pass migrating gaspereau and sea run brook trout, as well as other species over the dam.
- Numbers of fish passing through the Lake Major fishway on the Little Salmon River had not been documented prior to this work.

Background Information

Fish Studies

- Department of Fisheries and Oceans

Historical data suggests…..(waiting for a response).

- Dillon Consulting

In past, electrofishing was conducted in Little Salmon River and salmon parr were caught.

- Clean Foundation:

In 2012 & 2013, electrofishing & water quality monitoring was conducted in the Little Salmon River Watershed (i.e. Cherry Brook). Brook trout, American eel, White Sucker & Brown Bullhead were found.

Species to occur in Little Salmon River

- Gaspereau- Alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*) are anadromous clupeids that frequent the rivers of the Maritimes (DFO 2001). They are collectively referred to as gaspereau. Spawning migrations of gaspereau typically move upstream in the spring to spawn in the lake with juveniles moving downstream in the fall.
- Sea run trout-Sea trout move up into the lake in the spring and fall, spawn primarily in streams in the fall, and move downstream in the fall and spring. The migrations of sea-run trout are variable.
- Brook trout-live primarily in streams year-round.
- Atlantic salmon-move upstream after trout in early November, spawn, and return to the sea immediately after spawning. Young salmon may remain in freshwater for up to five years before returning to the ocean in the spring.
- The American eel is catadromous, living as an adult in freshwater and returning to the ocean to reproduce and also needs passage.
- Other fish-White sucker are prevalent and chub & sticklebacks are likely to occur in the river as well.

Methodology

Objective:

- To provide fish passage;

i. Trial & error process to get the fish pump working in a manner that could pass sufficient fish to be considered successful;
ii. pass fish over the dam as necessary by whatever means available (including dip netting, purse net and/or use of a seine);
iii. consider effort and species seasonally; and
iv. consider that the seasonality of upstream migration of adults to spawn, and downstream migration of juveniles & adults to feed varies seasonally.

- To provide documentation;

i. Data records-fish counts by species
ii. Wildlife observations
iii. Underwater video
iv. Photos
v. Additional information (water quality measurements, weather, anecdotal information & activities by local residents)

- To report to Halifax Water

Considerations

Fish Pump—Trial & Error

Fish pump used for the first time to aid in fish passage.

- Suction;

Hose diameter (10 vs 8 inch)
Hose length

- Placement of fish pump intake;
- Check valve (hard vs soft valve);
- How to attract, 'gather' & direct the fish to below the fish intake; and
- Use of other methods to pass fish over the dam in the interim of fish pump operation.

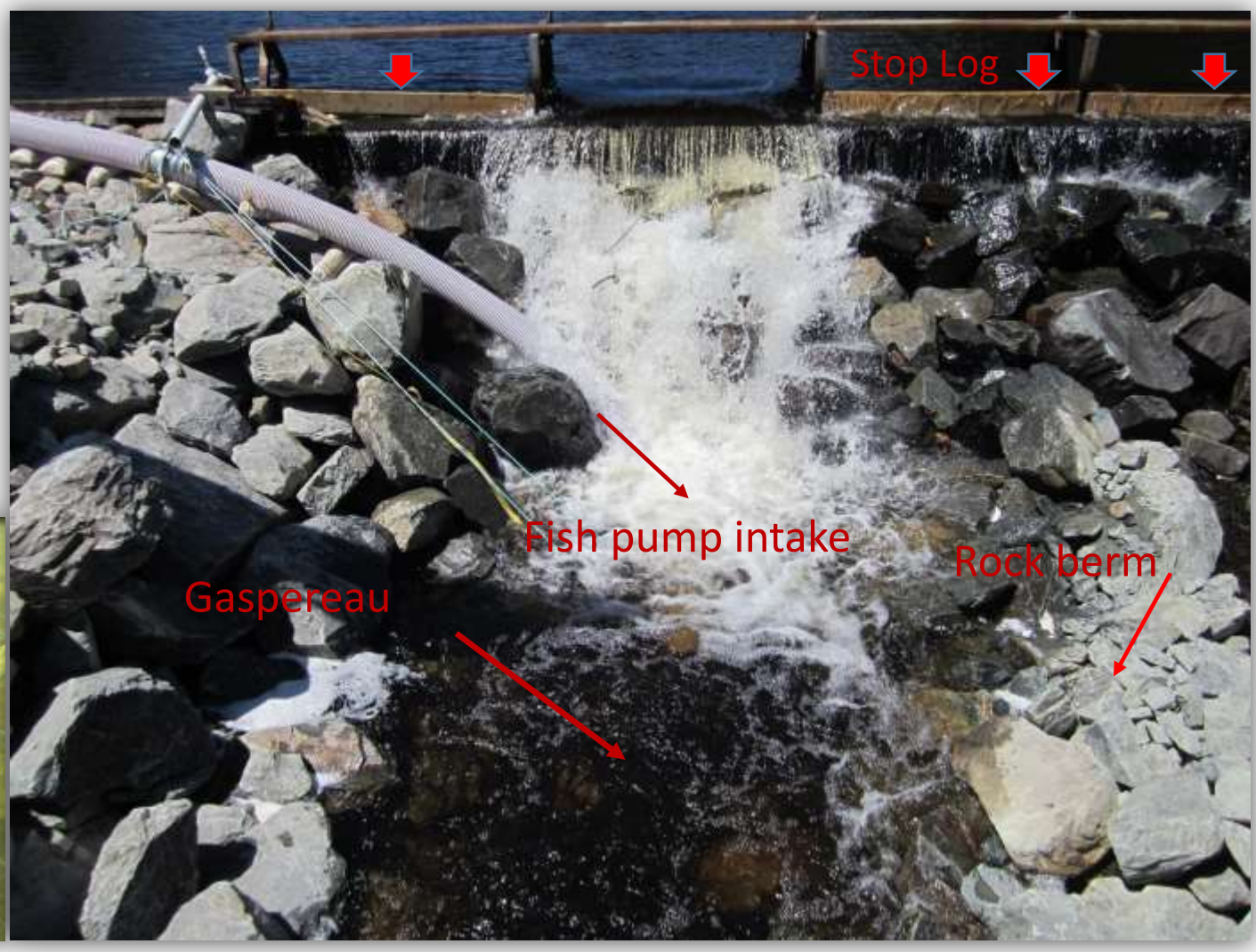
Other

- Local 'input' or knowledge concerning timing & seasonality of fish.
- Environmental cues, i.e. wildlife in area (osprey, duck, gulls, raptors arrive when fish arrive).

Fish Passage

Fish Pump-Set-up

- Stop logs placed across the dam-one ‘open spot’ with directed flow to attract fish.
- Rock berm to ‘channel’ flow & aid in containment of fish with sufficient area for fish to line up with laminar flow.
- Fish pump intake was located in center of main flow and in deeper pool section but opening slightly upwards to collect & transport fish over the dam.
- Reduced length & diameter of hosing & addition of a ‘soft’ check valve.



Fish Passage

Fish Pump-Operation

- 8 inch diameter hose & soft check valve worked the best (10 inch hose-fish were being drawn in by leaving the hose between cycles).
- Pumping cycle of 36 seconds from beginning to end of cycle (i.e. orange test).
- Herding techniques were important to gather & direct fish toward fish pump intake when fish density was low to moderate (e.g. low density of fish + herding= 2.8 fish/cycle).

i. Walk the fish up from downstream.

ii. Use long sticks to stretch across the width of the stream to startle fish upstream.

iii. Herd fish into channel & toward the fish pump intake.

- Fish pump was more effective with larger numbers of fish in the channel (e.g. herding not needed with high density of fish—~500 fish passed over the dam via fish pump in 1 hr).

Fish Passage

Fish Pump in Action—Peak run, June 4 2015.

Results

Observations

- Over 100 observation days between May 6 & November 26, 2015.
- May 12-16 fish were *first* noted below the dam (water temperature ~9 degrees C).
- Loons, gulls, cormorants & osprey were also observed in area.
- May 16-25, fish pump trial & error process. Other methods were used to move fish in interim:

i. Seine

ii. Dip Net

iii. Purse Net

- Fish congregated along the shoreline, mainly along the left side (facing upstream & below the dam) in deeper water & in the main channel (centre) below the bridge.
- Density of fish increased in the afternoon & as the temperature increased throughout the month.

Osprey

Dip Net

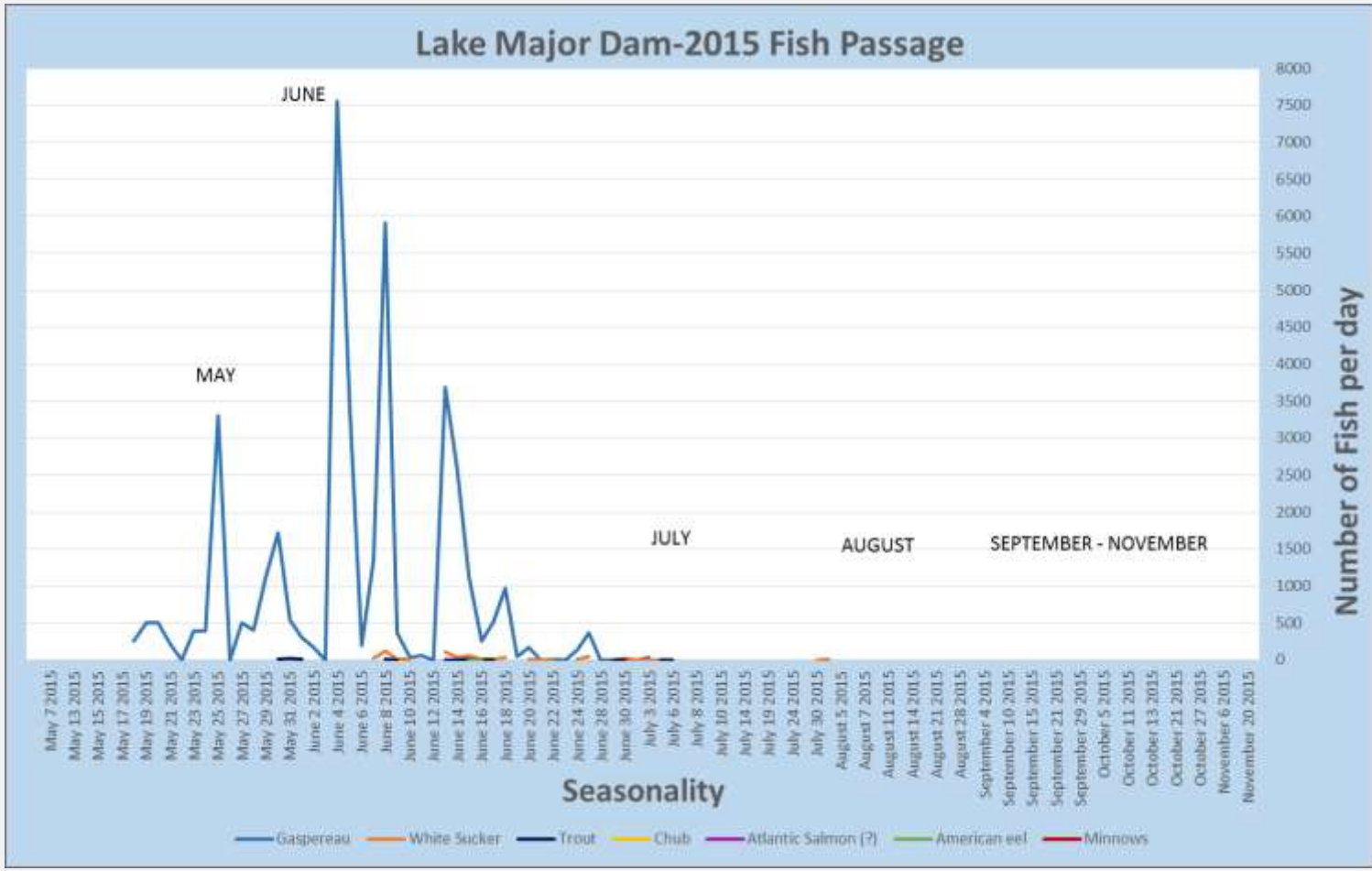
Purse Net

Results

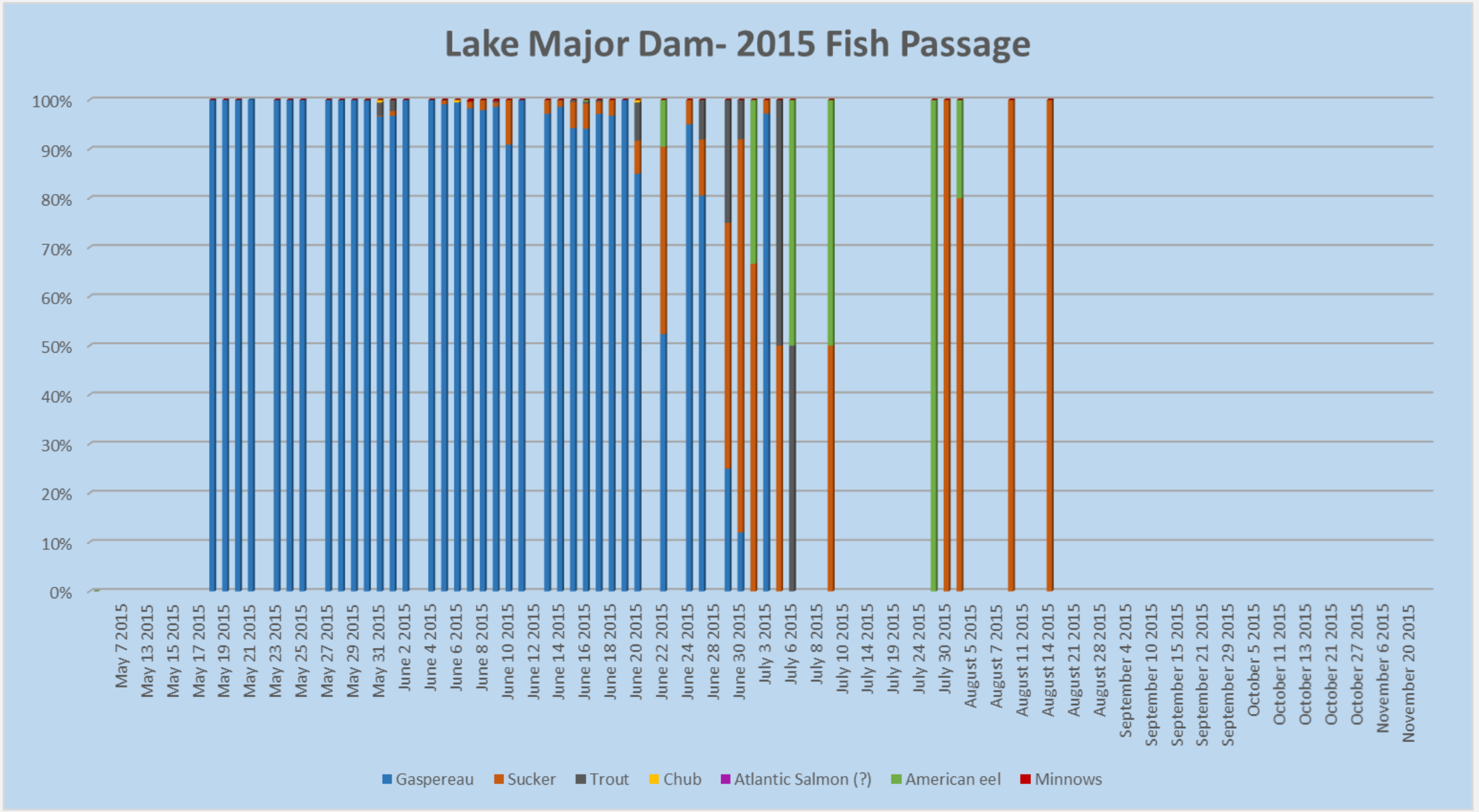
- May 26-August 14, fish pump in full operation.
- Gaspereau observed from mid May – early July.
- Peak run, late May to early June.

Example: June 4- 7556 fish counted between 11 am – 7 pm; a peak fish density occurred between 2:45-4:45 pm (~5696 fish); 48 fish/cycle.

- Sucker run occurred from the end of May to August; peak in June.
- Occasionally other species were noted such as chub, eel, minnows, trout. One unconfirmed salmon sighting.
- A fall sea run trout migration was not observed though was expected.
- Fish numbers decline in mid-June & onward.
- The fish pump was turned off & drained on August 17 and fish observations only were noted from here onward.



Results


Lake Major Dam- 2015 Fish Passage
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
May 7 2015
May 13 2015
May 15 2015
May 17 2015
May 19 2015
May 21 2015
May 23 2015
May 25 2015
May 27 2015
May 29 2015
May 31 2015
June 2 2015
June 4 2015
June 6 2015
June 8 2015
June 10 2015
June 12 2015
June 14 2015
June 16 2015
June 18 2015
June 20 2015
June 22 2015
June 24 2015
June 28 2015
June 30 2015
July 3 2015
July 6 2015
July 8 2015
July 10 2015
July 14 2015
July 19 2015
July 24 2015
July 30 2015
August 5 2015
August 7 2015
August 11 2015
August 14 2015
August 21 2015
August 28 2015
September 4 2015
September 10 2015
September 15 2015
September 21 2015
September 29 2015
October 5 2015
October 11 2015
October 13 2015
October 21 2015
October 27 2015
November 6 2015
November 20 2015
Gaspereau
Sucker
Trout
Chub
Atlantic Salmon (?)
American eel
Minnows

Results

- Estimated counts of fish, based on visual observation, were documented from May to November 2015.
- Fish identification was at times difficult (uncertain) because fish passed through a translucent hose quickly.
- The fish pump was used successfully to transfer the run of 30,000+ gaspereau, a small sucker run and minor numbers of other species.
- An estimated 39,693 fish were passed over the dam.
- Negligible mortality occurred when the fish pump was in full operation. There were periods where small amounts of fish died in the method development process. Some dead fish noted below the dam were assumed to be due to wildlife (birds) and the occasional fish left behind by locals who were harvesting them.
- Fish were not observed in the immediate area below the dam after August 31, 2015.
- Monitoring continued until the end of November.

Lake Major Dam—Fish Passage, an estimation of number of fish passed over the dam based on visual observations from May-November 2015.

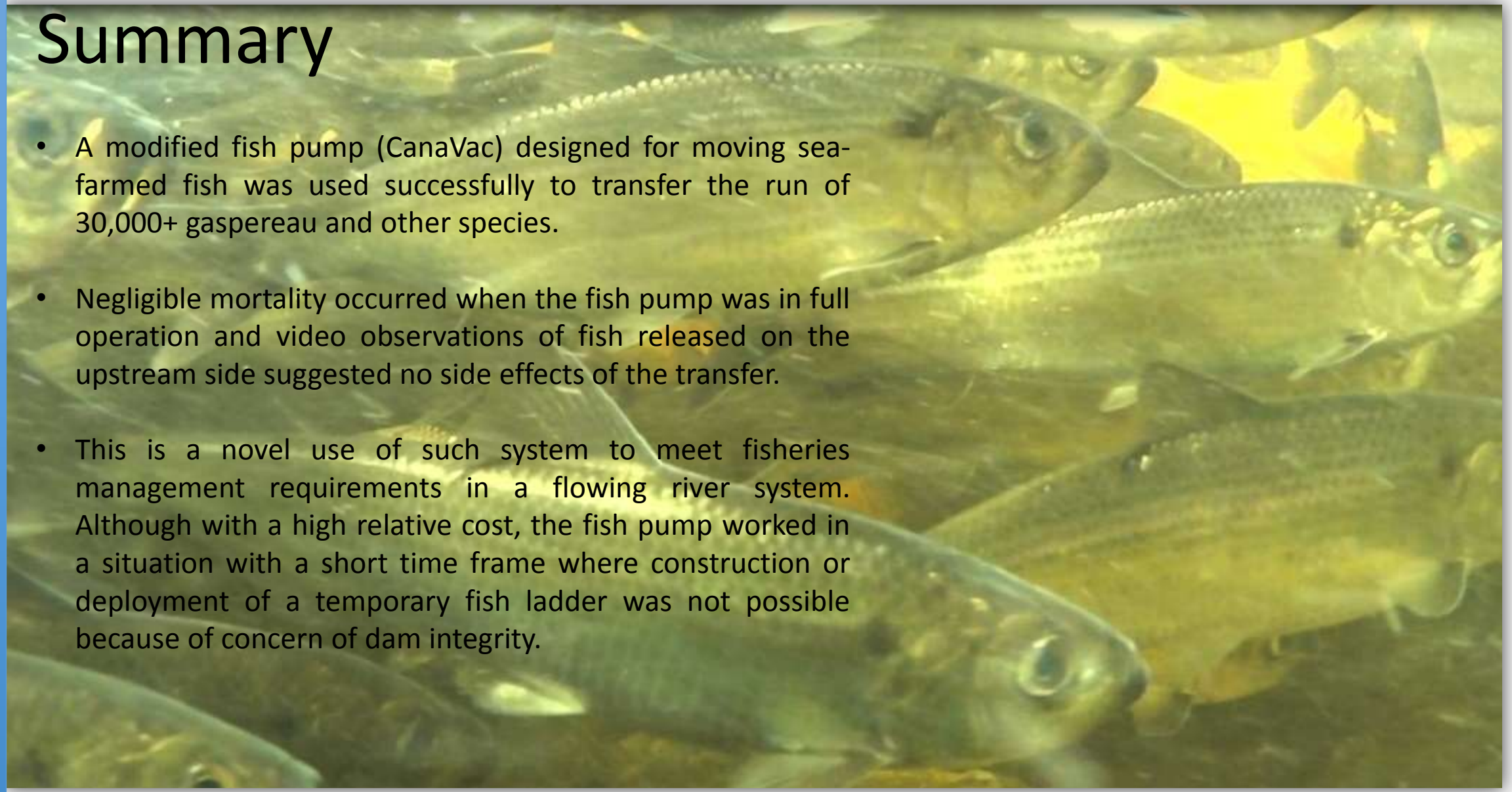
Date	Gaspereau	Sucker	Trout	Chub	Atlantic Salmon	American eel	Minnows
Observations only							
May 6-17							
Dip Netting, Minor use of Fish Pump & Purse Netting							
May 18 – 25	5553						
Fish Pump							
May 26-August 14	33466	554	97	5	1	9	8
Fish Pump Drained & Turned off-Observations only							
August 14-November 27							
Total	39019	554	97	5	1	9	8
Estimate # of fish passed over the dam = 39,693							

Results

Downstream migration

- Larger sea-run trout could have passed over (leapt) the dam without easily being observed.
- A chute was designed, constructed and put in place in late July to aid in downstream migration of young gaspereau.
- Young fish were observed schooling above the top of the dam in early August (e.g. August 6, 2015, 50-100 fry ~2-4 cm in length).
- It is assumed that the chute was used for downstream migration in the fall. Counts were not determined.
- The chute was left in place for the remainder of the year.

Summary



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Acknowledgements

- This project was a collaborative effort and would not have been possible without the input, technical support and expertise of many individuals. I would like to sincerely thank the following for their significant contribution.

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  & our fish crew (Mitch, Anna, Christena, Joy, Valerie, Jackie (Sprytech) & Tim (Pario)).