Final Year Review of Fisheries Activities for HSP8148 Atlantic Whitefish Recovery Project

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Prepared for:
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Table of Contents

List of Tables

List of Figures

Executive Summary

This report details activities performed by Coastal Action for the 2020-21 Atlantic Whitefish Recovery Project field season, the 3rd year of a three-year project designed to contribute to and complement Fisheries and Oceans Canada (DFO) activities to recover the endangered Atlantic whitefish (*Coregonus huntsmani*). These activities were funded by the Habitat Stewardship Program for Aquatic Species at Risk. Activities were conducted within the critical habitat of the Atlantic whitefish, in the upper lakes of the Petite Rivière watershed in Lunenburg County, Nova Scotia, and additional data was collected from the LaHave River watershed. Activities included the monitoring of upstream gaspereau (*Alosa pseudoharengus)* migration into Hebb Lake, smallmouth bass (*Micropterus dolomieu*) nesting surveys and nest destruction, bathymetry mapping on Fancy Lake, zooplankton hauls and depth profiling on Minamkeak Lake, the monitoring of a rotary screw trap to remove invasive fishes, as well as outreach and education activities.

1. Introduction

1.1. Background

The Atlantic whitefish is an anadromous fish species currently restricted to the three upper lakes (Minamkeak, Milipsigate, and Hebb) of the Petite Rivière watershed in southwestern Nova Scotia, Canada (Figure 1). Under Schedule 1 of the *Species at Risk Act*, the Atlantic whitefish is listed as Endangered, and as such, recovery actions are required. These activities in the Petite Rivière watershed are a continuation of Coastal Action's ongoing Atlantic Whitefish Recovery Project (AWRP) that serves to promote the species' recovery.

The activities outlined within this report were performed in addition to activities directly contracted to Coastal Action by DFO that included the collection of juvenile Atlantic whitefish from the wild in the spring for rearing and husbandry, removal of invasive smallmouth bass and chain pickerel (*Esox niger)* through angling and boat electrofishing, as well as monitoring of the Hebb Dam Fish Passage Facility from October to December for the potential upstream migration of Atlantic whitefish. These activities have been reported on separately and submitted to DFO-Science as a data report.

In working towards the recovery of the species, Coastal Action works to remove invasive fish species from Atlantic whitefish habitat, maintain the dataset of gaspereau entering Atlantic whitefish habitat in the spring, address knowledge gaps relating to habitat and food sources of the Atlantic whitefish, and finally spread awareness within the local community and beyond.

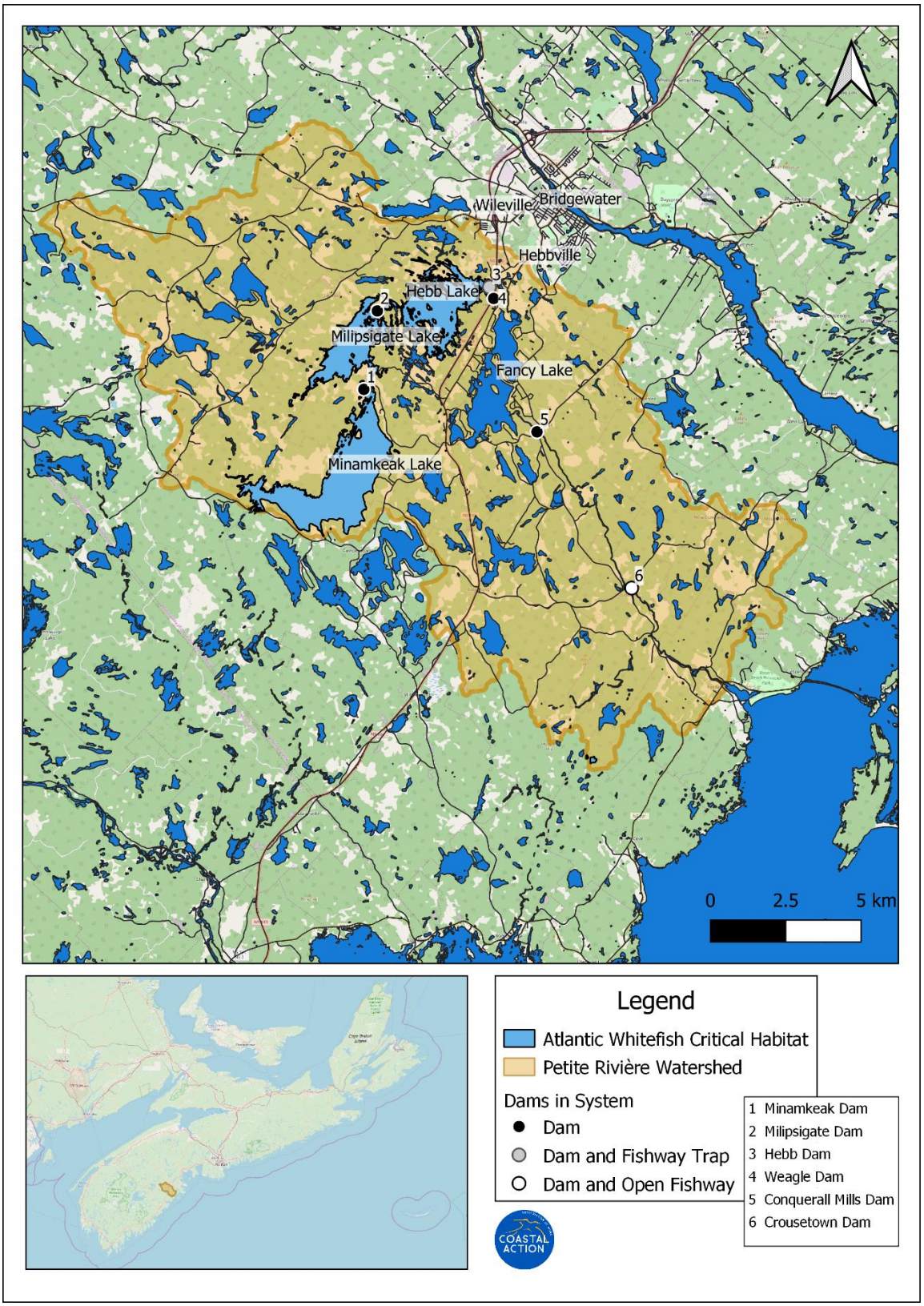

Figure 1. Map of the Petite Rivière watershed showing the three lakes (Minamkeak, Milipsigate, and Hebb) which contain the existing wild Atlantic whitefish population, as well as the dams and fishways present in the system.

1.2. Project Objectives

Coastal Action's Atlantic Whitefish Recovery Project (AWRP) had several goals and objectives for the 2020 field season, outlined as follows:

1. To operate and monitor the Hebb Lake Dam Fish Passage Facility and fishway trap in the spring.
2. To continue to remove invasive smallmouth bass and chain pickerel from Atlantic whitefish habitat.
3. To continue to address knowledge gaps surrounding the habitat and food sources of the Atlantic whitefish.
4. To contribute to DFO's investigation of candidate Atlantic whitefish translocation lakes.
5. To spread awareness about Atlantic whitefish in the local community and beyond.

1.3. Report Objectives

This report provides a detailed account of Coastal Action's activities in support of the recovery of the Atlantic whitefish, as funded by the Habitat Stewardship Program for Aquatic Species at Risk. This report reviews the fieldwork activities and results from AWRP, conducted between April 29 and December 10, 2020. These activities were conducted in the three upper lakes of the Petite Rivière watershed, Minamkeak, Hebb, and Milipsigate Lakes, as well as the main branch of the Petite Rivière. Additional data was collected from Lonesome Lake, LaHave River, and Dauphinees Mill Lake, Hubbards.

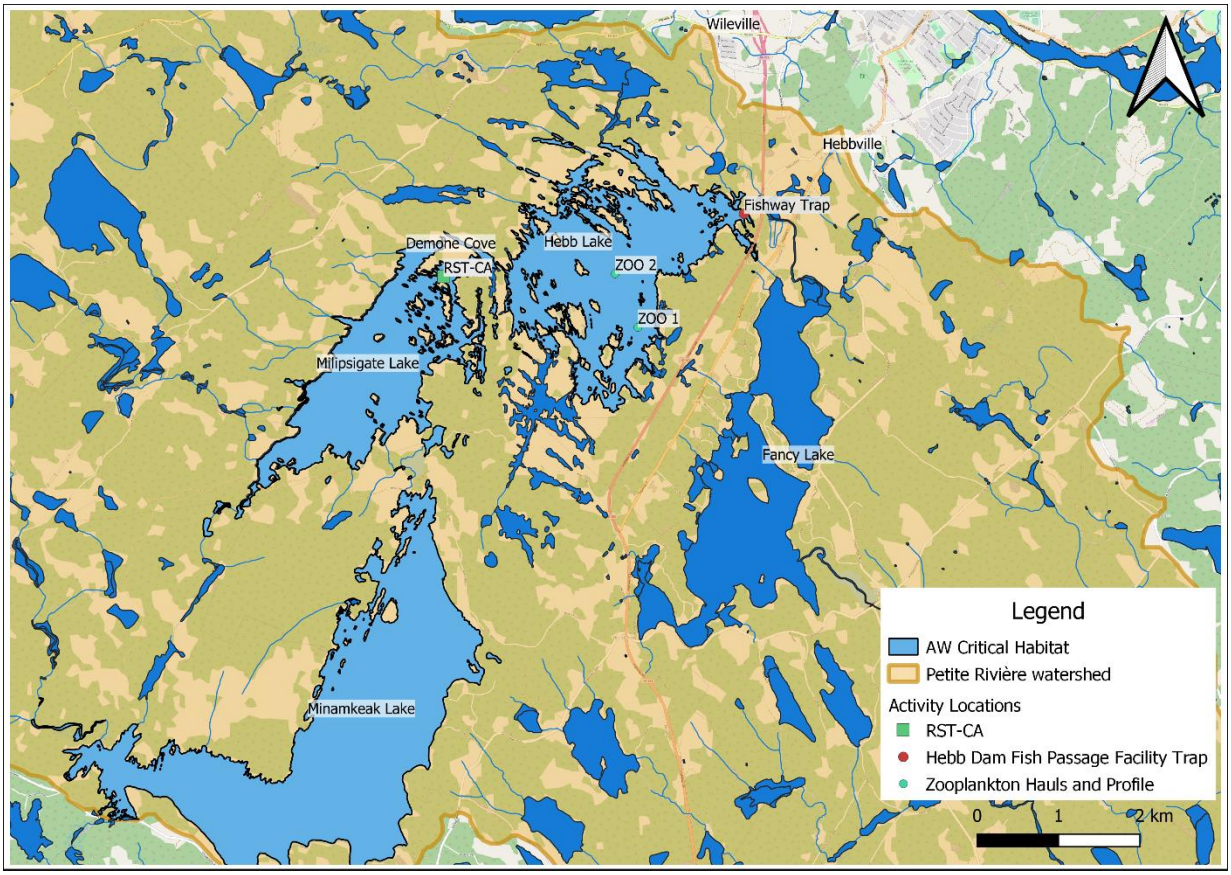

Figure 2. Map showing study area locations in the Petite Rivière watershed used during the 2019-20 field season.

2. Methods

2.1. Spring Monitoring at the Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility (Figure 3) was opened by Coastal Action staff on April 29, 2020 and was operated until July 2, 2020, to allow for the upstream migration of gaspereau. The fish passage trap consists of a suspended 6'0" x 6'8" x 7'8" aluminum box that is deployed in the fishway passage to intercept any fish that are migrating upstream into Hebb Lake.

Each day, staff lifted the trap using its chain block and pulley system. The trap was opened using its front sliding door and each native captured fish (excluding sea lamprey) was netted and transferred into the upper section of the fishway, above the trap, where they would be free to continue upstream into Hebb Lake. Sea lamprey (*Petromyzon marinus*) were released downstream.

Figure 3. Left: Hebb Dam Fish Passage Facility trap lifted out of the fishway with door open. Right: Hebb Dam lake level gauge by fishway exit.

In addition to the manual counting of fish, an underwater camera (Biotactic Bravo Generation 2) and solar panel for power were installed in the upper section of the fishway on May 1, 2019 and remained installed until winter of 2020 (Figure 4). This camera (provided by DFO-Science) was used intermittently to record fish as they swim upstream through the fishway to determine the feasibility of using a camera instead of the manual count.

Figure 4. The upper section of the Hebb Dam Fish Passage Facility showing the placement of the camera and accessories. Left: the camera is placed underwater, adjacent to the first concrete baffle. The case contains the control panel for the camera. Right: the solar panel used to power the Biotactic Bravo Generation 2 camera.

All fish were sampled and released as per DFO protocol. The following species were permitted to pass upstream: white sucker (*Catostomus commersonii*), brown bullhead (*Ameiurus nebulosus*), gaspereau, brook trout (*Salvelinus fontinalis*), and American eel (*Anguilla rostrata*). Smallmouth bass and chain pickerel were sacrificed for the biological study. Sea lamprey were released downstream of Hebb Dam as the monitoring protocols ensured that any fish entering Hebb Lake would not pose a risk to Atlantic whitefish. Gaspereau were counted as they were transferred from the fishway trap to the fishway itself. All other native fish were measured to fork length (cm) and then allowed to pass upstream. In addition, the relative water level of Hebb Lake was recorded (inches) daily using a gauge attached to the fishway (Figure 3); along with water temperature (°C) which was measured using a digital thermometer.

2.2. Smallmouth Bass Nest Survey

Nest surveys were conducted in summer 2018 and 2019 that evaluated smallmouth bass nests in Demone Cove in Milipsigate Lake. In 2020, staff returned to the same study area (Figures 2 and 5) to determine if nest destruction and removal of male smallmouth bass nest guards in 2018 and 2019 decreased the number of nests created this year. Bass nest surveys began on June 1, 2020, once the spring larval Atlantic whitefish collections had concluded.

Using Coastal Action's fishing boat, a team of two visually surveyed the shoreline of Demone Cove and used a Garmin eTrex 10 handheld GPS unit to record nest locations. Individual nests were surveyed using a Rickly Hydrological Co. AquaScope II viewer, and the nest class was determined according to Table 1. Approximate depth of nest, bottom substrate, and presence or absence of a male smallmouth bass nest guard were recorded. Once nest details were recorded, the male nest guard was angled off the nest (if present), and the nest was destroyed using a paddle. Nest assessment was limited to sunny days with minimal wind to ensure ideal viewing conditions. Bass nest surveying was attempted three times during June 2020.

Table 1. Smallmouth bass nest classifications and descriptions.

Nest Classification	Description
Class A	Newly excavated
Class B	Eggs present
Class C	Fry present but not dispersed
Class D	Fry dispersed
F1	Nest abandoned after being Class A
F2	Nest abandoned after being Class B
NE	No eggs visible
CF	Couldn't find nest
N	Too late to assess

Figure 5. The rocky shoreline characteristic of Demone Cove in Milipsigate Lake as shown in a picture from June 2018.

Figure 6. Underwater photograph of a smallmouth bass nest with eggs present (May 2020).

2.3. Bathymetry Survey on Fancy Lake

In September of 2020, Coastal Action staff began to map the bathymetry of Fancy Lake. Using a Hummingbird Helix 9 SI and its AutoChart Live function unit provided by DFO and mounted to the boat using clamps, staff surveyed the entire lake to record the bathymetry. Staff completed this work over eight visits to the lake and completed it on October 6, 2020.

2.4. Zooplankton Hauls and Depth Profiling

Vertical zooplankton hauls were conducted monthly from June to September of 2020 in Minamkeak Lake. At the same site, a Secchi disk depth was recorded, followed by a water quality depth profile using a ProDSS Digital Professional Series YSI sonde (model # 18A104818). The YSI sonde was used to collect several parameters: temperature (°C), dissolved oxygen (% and mg/L), conductivity (µs/cm), TDS (mg/L), and pH readings from the surface (0.25-m depth) to the bottom at 1-m intervals.

The vertical zooplankton hauls were conducted using a CABIN kick net (mesh size 355 µm) that had been modified for use in this study. The wooden handle was removed, and rope was tied onto the metal ring of the net at three points and then tied together to make a single line to be used for vertical hauling. Prior to performing the zooplankton hauls, the net was rinsed three times in the lake, without allowing lake water to spill over the top of the net. The sample jars (250 mL Mason jars) were then rinsed three times

within the net while the net remained in the water with its ring above the surface. This was done to prevent any material from entering the sample jars that would not be excluded by the net's mesh size. Lake depth at each sample site was determined using a Humminbird Helix 9 SI unit and the net was lowered to 1 m off the bottom of the lake. The net was then hauled back up by hand at a constant speed of approximately 0.5 m/s and rinsed with lake water using a squeeze bottle to ensure all net contents were flushed to the bottom of the basket. The basket was detached from the net, and the mesh filter was removed using tweezers and then rinsed off with 95% ethanol (EtOH) into a sample jar.

After emptying all basket contents into the sample jar, additional ethanol was added to ensure the preservation of the sample. Samples were later analyzed using a dissecting microscope and a compound microscope and specimens were identified to species level whenever possible.

2.5. Lake Surveys to Assess Candidate Atlantic Whitefish Translocation Sites

Coastal Action staff surveyed three lakes in Nova Scotia to assess their suitability for the translocation of Atlantic whitefish. The three lakes were selected by DFO to be assessed by Coastal Action. Lonesome Lake was surveyed on August 13, 2020. Dauphinees Mill Lake was surveyed on August 14, 2020. DFO's preliminary criteria for selection included the absence of both smallmouth bass and chain pickerel, absence of lake whitefish (*Coregonus clupeaformis*) due to potential hybridization concerns, access to the ocean, and a minimum depth of 15 m such that there is adequate summertime cold-water refugia available.

All lake survey activities were conducted from a 14-ft Lone Star aluminum fishing vessel with a 4HP or 6HP Yamaha motor. Following a protocol developed by DFO, Coastal Action staff angled for a minimum of 30 minutes in locations where invasive fish would most likely have been introduced, had an introduction occurred. Areas of the lake adjacent to roadways, boat launches, inlets, and outlet streams were focused on, as well as other likely habitat areas such as weed beds and rocky drops. In the case of smallmouth bass or chain pickerel detection, the lake survey would not proceed to the following steps.

Using the DFO-provided Humminbird Helix 9 SI unit and its AutoChart Live function, Coastal Action staff performed a coarse grid survey of the lake to identify the spot with the deepest water in the lake, as well as identify the locations of inlet and outlet streams. The deep-water spot was then used as the site for the following described survey activities. Trolling with angling gear occurred during the bathymetry survey as well.

First, using a ProDSS Digital Professional Series YSI sonde (model # 18A104818), a water profile was performed to collect temperature (°C), dissolved oxygen (% and mg/L), conductivity (µs/cm), and pH at 1-m increments from the surface to the bottom at the deep-water station. A Secchi disk depth measurement was also collected.

Next, to collect water samples to be tested for nutrients and metals at the surface and 1 m above the bottom, a Van Dorn (Wildco, Part # 1120 H45) was rinsed three times with lake water and submerged with both plungers open to the relevant depth to collect a water sample. The Van Dorn was sealed at the required depth, then pulled out of the water. The water sample was poured into bottles and labeled with the date, site location, and depth of the sample. Prior to adding the sample water, nutrient bottles were rinsed three times with lake water; the metals bottles were not rinsed due to the nitric acid already in the bottle that would act as a preservative. Samples were kept in a cooler on ice and provided to DFO.

Finally, two identical vertical zooplankton hauls were done at the deep-water station using a Birge closing

net with 153 µm mesh (Wildco Part # 3-21-A35). A rinse bottle filled with lake water was used to rinse all material down the sides of the net's basket and a second wash bottle filled with 95% EtOH was used to rinse contents into a pre-rinsed sample jar. Both hauls were rinsed into a single sample jar.

2.6. Fall Monitoring of RST-CA at Milipsigate Dam

The rotary screw trap (RST-CA) at Milipsigate Outlet (Figure 7) was deployed for the fall monitoring session on November 10, 2020, and was checked daily until December 10, 2020. The trap was deployed for the primary purpose of removing invasive fishes from the watershed, as well as for the secondary purpose of monitoring native fish populations. All native fishes captured were counted, measured to fork length, and released except for gaspereau, which were counted and then released. Captured invasive fish were measured to fork length, weighed, and then sacrificed to determine stomach contents and sex of fish.

Figure 7. Rotary screw trap at Milipsigate Outlet, November 2020.

3. Results and Discussion

3.1. Spring Monitoring at Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility trap fished from April 29, 2020 to July 2, 2020 and was monitored for captured fish daily. A total of 7867 fish were intercepted, comprising seven different species (Table 2). In 2013, gaspereau were permitted to access the upper watershed for the first time in over 40 years and 2018 was the largest return of 20,350 fish (Table 2). Of the seven species captured in 2020, gaspereau, white sucker, American eel, and brook trout were transferred to the upper section of the fishway to continue into Hebb Lake. All captured smallmouth bass and chain pickerel were removed and sampled as part of the stomach content survey. The six sea lamprey captured in the trap were released below Hebb Dam. The Biotactic Bravo Generation 2 camera footage was provided to DFO-Science such that it could be analyzed using a software program to determine the effectiveness of using this camera. This software can identify sections of the footage where fish have passed by and then the fish in these identified sections would have to be manually counted.

Table 2. Total spring capture results (counts) of fishes from the Hebb Dam Fish Passage Facility from 2013-2020.

Species	2013	2014	2015	2016	2017	2018	2019	2020
American eel	3	1	1	2	4	3	0	5
Brook trout	1	10	2	2	1	1	1	1
Chain pickerel	0	1	0	1	4	4	0	1
Chub Spp.	5	0	0	0	0	0	0	0
Gaspereau	2120	2924	4793	2333	11 738	20 350	6449	7823
Shad	1	0	0	0	0	1	0	0
Sea lamprey	1	1	70	11	8	0	6	6
Smallmouth bass	18	35	59	43	25	19	10	27
White sucker	174	37	61	26	79	39	6	4
Total	**2323**	**3009**	**4986**	**2418**	**11 859**	**20 417**	**6472**	**7867**

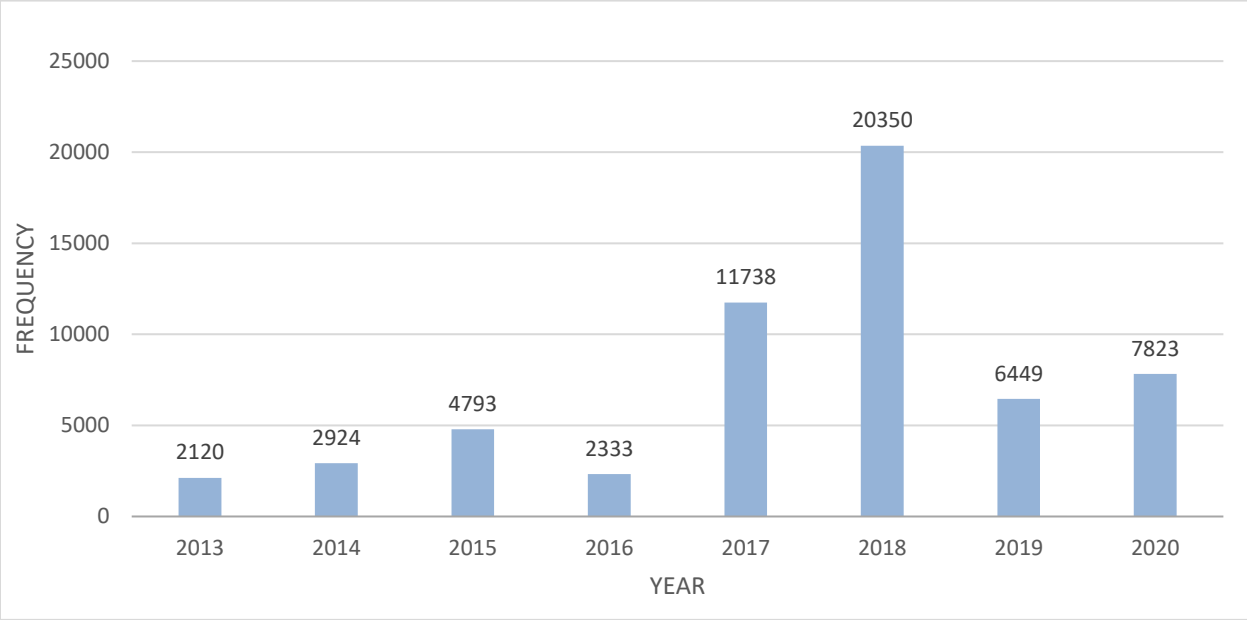

Figure 8. Adult gaspereau captures at Hebb Dam Fish Passage Facility in Spring 2013-2020.

3.2. Smallmouth Bass Nest Survey

Demone Cove was surveyed three times between June 1, 2020 and June 17, 2020. During this time, 13 nests were identified (Table 3). One nest was class B in the initial survey and was raked. The nest was noted to have eggs present on the second survey and was raked again. During the final survey, a total of seven nests contained fry and had male bass guarding the nest. These males were angled off the nest. All 13 nests were raked as of June 17, 2020. In 2018, 25 nests were found in Demone Cove between June 4 and June 21, and in 2019, 16 nests were found between June 1 and July 5. This is a decrease of 12 nests since 2018 and three nests since 2019 visible in Demone Cove. Substrate for all nests was found to be pebble and cobble, and nests were found at depths of approximately 0.3 to 1.5 m.

Table 3. Smallmouth bass nest classification at each sampling event in 2020.

Nest Number	01-Jun-20	10-Jun-20	17-Jun-20
29	Class B	Class B	Class C
30	Class A	Class A	Class C
31	Class A	Class A	Class B
32	Class A	Class A	Class C
33	Class A	Class A	Class C
34	Class A	Class A	Class C
35	Class A	Class A	F1
36	Class A	Class A	F1
37	Class A	Class A	Class C
38	Class A	Class A	Class C
39	Class A	Class A	F1
40	Class A	Class A	F1
41	Class A	Class A	F1

3.3. Bathymetry Survey on Fancy Lake

The bathymetry of Fancy Lake, in its entirety, was surveyed using the Humminbird Helix SI 9 unit over eight visits to the lake in 2020. This data has been provided to DFO to create an updated bathymetric map of Fancy Lake.

3.4. Zooplankton Hauls and Depth Profiling

Profiles taken at the deep-water station on Minamkeak Lake using a ProDSS Digital Professional Series YSI sonde were graphed to determine the stratification of the lake during the 2020 field season. Profiles indicated that conductivity remained stable across each sample date while dissolved oxygen and total dissolved solids were more variable. The thermocline was apparent in June at a depth of 5 meters and in July at around 8 meters from the lake surface (Figures 9 and 10). In September, no thermocline was observed.

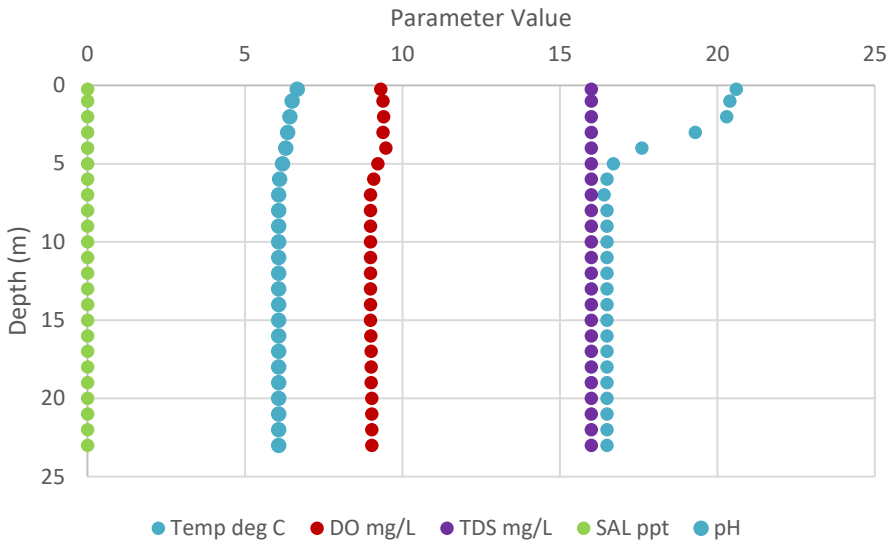

Figure 9. A profile of Minamkeak Lake, conducted on June 19, 2020.

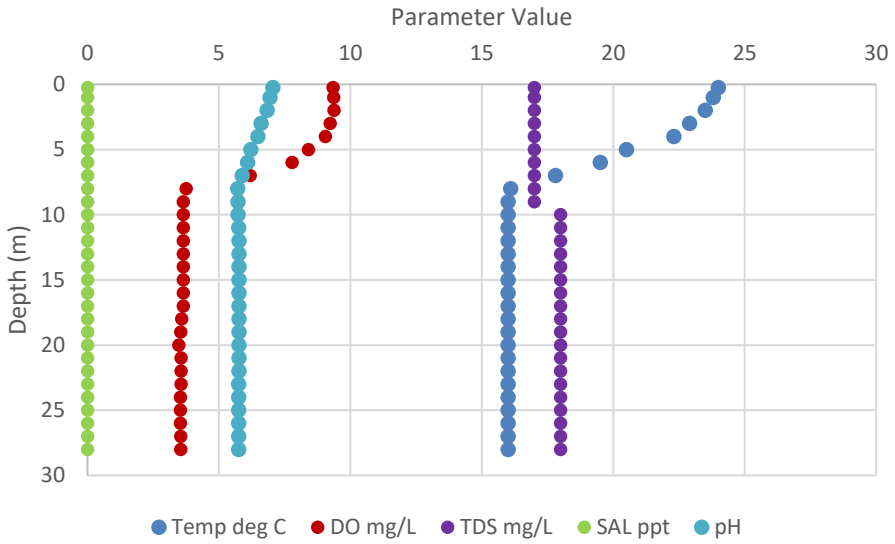

Figure 10. A profile of Minamkeak Lake, conducted on July 28, 2020.

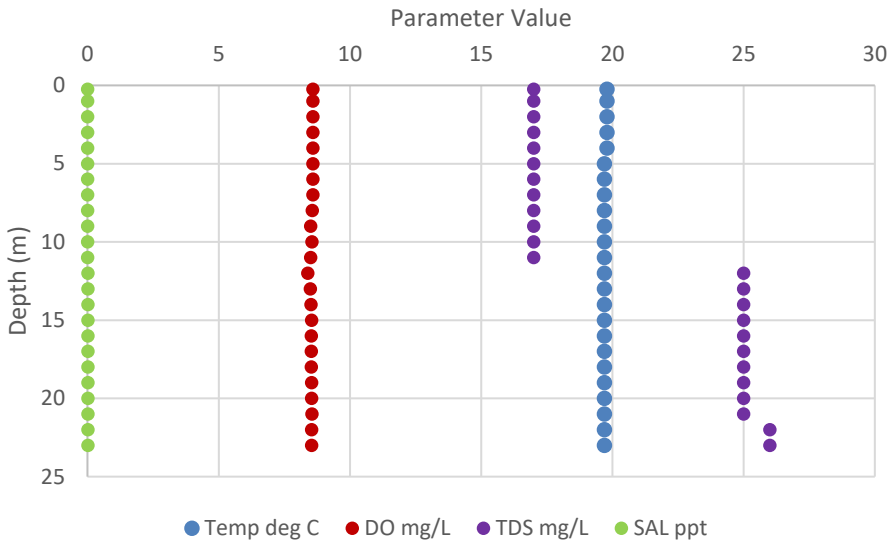

*Figure 11. A profile of Minamkeak Lake, conducted on September 15, 2020 (*pH probe malfunctioned during sampling).*

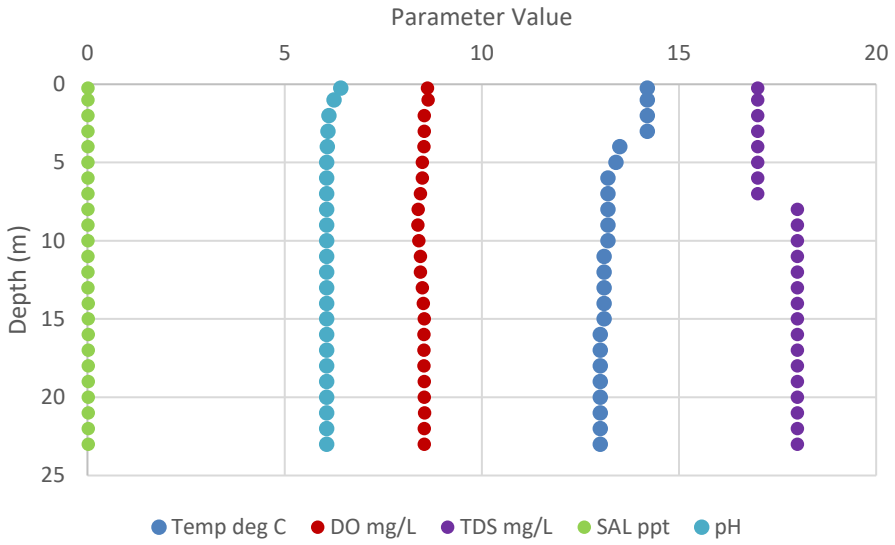

Figure 12. A profile of Minamkeak Lake, conducted on October 10, 2020.

Zooplankton samples were obtained from the same locations as the depth profiles in Minamkeak Lake once per month in 2020. While this analysis was solely to identify specimens and not quantitative, visual inspection of each sample revealed similar densities to those taken from Milipsigate Lake in 2018. Species identified in the Minamkeak Lake samples included *Daphnia catawba*, *Daphnia parvula*, and *Daphnia ambigua*, as well as other arthropods including *Holopedium gibberum, Diaphanosoma birgei, Epischura lacustris, Epischura nordenskiøldi, Diaphanosoma brachyurum, Limnocalanus macrurus, Eurytemora affinis, Chaoborus punctipennis,* and *Leptodora kindtii.* The similar zooplankton density in Minamkeak Lake could be attributed to the absence of gaspereau as these fish are planktivores and can alter zooplankton communities in lakes (Mills et al. 1995).

3.5. Lake Surveys to Assess Candidate Atlantic Whitefish Translocation Sites

Two lakes, Lonesome and Dauphinees Mill, were assessed according to DFO protocol. No invasive fishes were found in either lake by angling. See Figures 13 and 14 for profiles of each lake. Water samples were provided to DFO for nutrient and metals analysis. Zooplankton samples were similarly provided to DFO for identification. This data will be assessed and compared between lakes by DFO-Science once lake surveys have been completed on all candidate lakes.

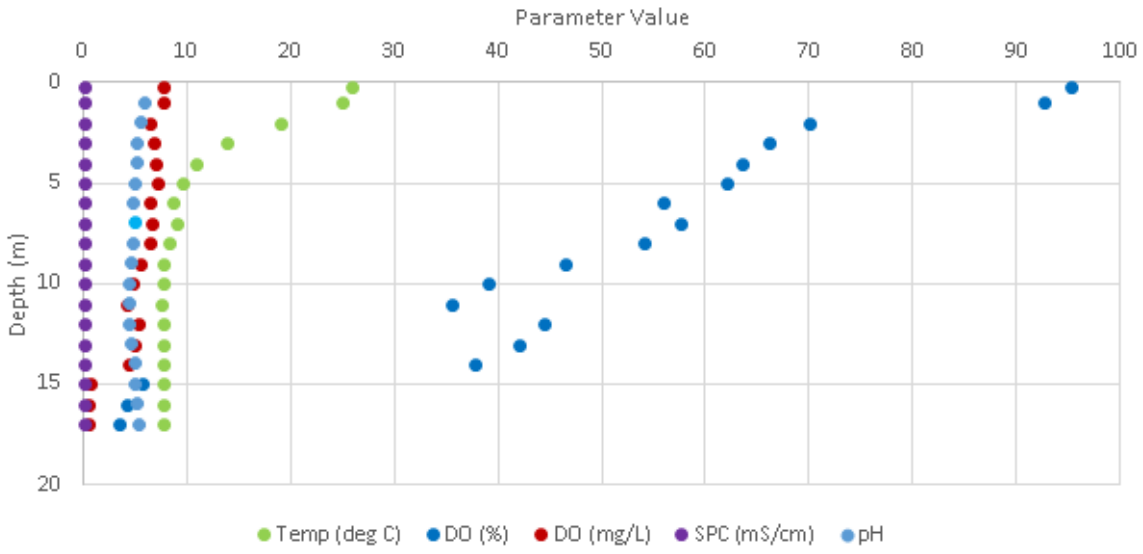

Figure 13. A profile of Lonesome Lake in the LaHave River watershed, conducted on August 13, 2020.

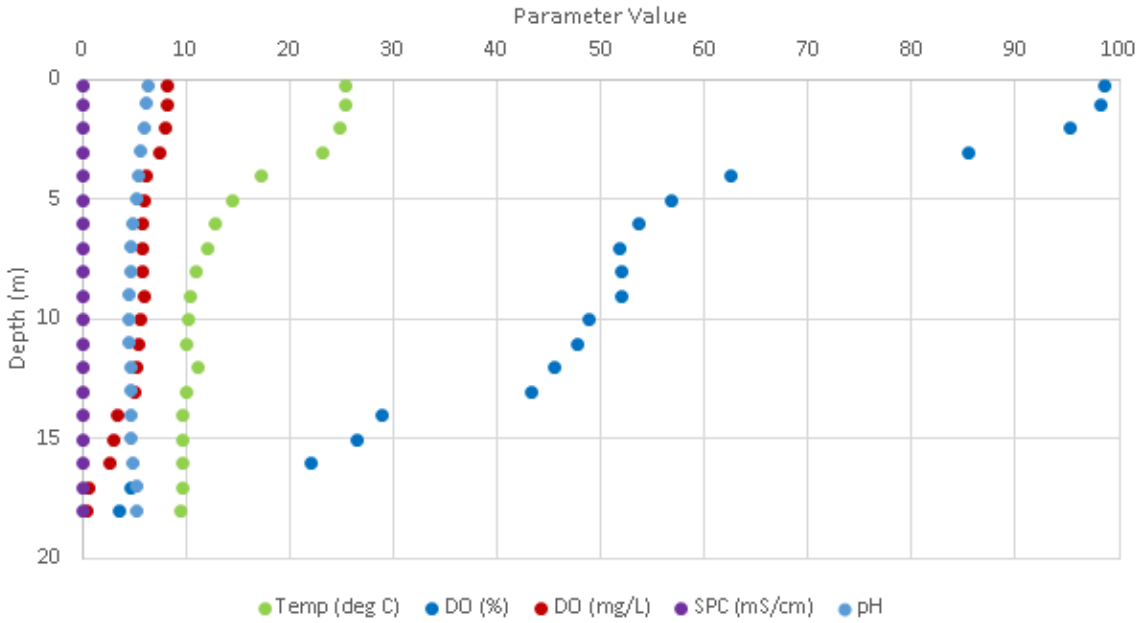

Figure 14. A profile of Dauphinees Mill Lake in the Hubbards River, Chester, conducted on August 14, 2020.

3.6. Fall Monitoring of RST-CA at Milipsigate Dam

American eels were the most frequent fish species captured during the fall monitoring of the rotary screw trap installed at Milipsigate Dam. One male chain pickerel measuring 27 cm (total length) was captured and sampled during this monitoring period (Figure 15). No Atlantic whitefish were observed during the fall monitoring of the trap.

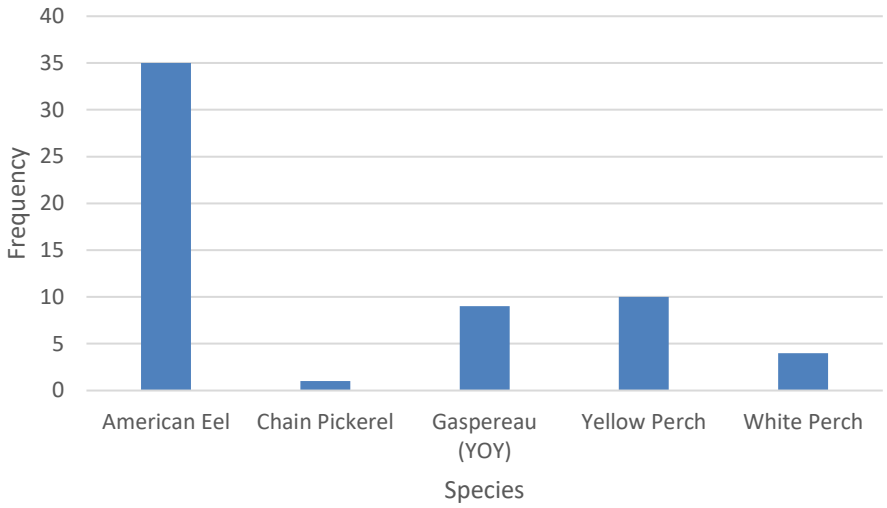

Figure 15. Species captured and frequency of capture during the fall monitoring of the rotary screw trap installed at Milipsigate Dam.

4. Outreach, Education, and Media Coverage

An important component of the AWRP is to provide the local community and beyond with information about the plight of the Atlantic whitefish and ongoing recovery efforts.

Throughout the year, Coastal Action presented to local community groups within Lunenburg County and Shelburne County, and outreach materials were available at Coastal Action events. Social media was used to highlight AWRP fieldwork throughout the field season. Online material was used more frequently than in-person outreach due to COVID-19 restrictions.

The AWRP was highlighted at the following events:

- Atlantic Whitefish Symposium (winter of 2021)
- Community guided walks in Lunenburg and Shelburne Counties (delivered through local municipalities)
- Canadian Conference for Freshwater Fisheries Research

Social Media Posts

Coastal Action posted 14 AWRP-related social media posts on Instagram, Facebook, and Twitter during the 2020-21 project year. These posts showcased photos from the field and were designed to engage Coastal Action's followers with updates about project activities. These posts reach Coastal Action's 9143 combined followers from Instagram, Facebook, and Twitter social media platforms and had a total of 947 interactions.

Media Coverage in 2020

Paul Withers of CBC wrote an article on the sighting of adult Atlantic whitefish in Minamkeak Lake on September 12, 2020 (Withers 2020).

5. Conclusions and Recommendations

The activities described in this report serve to contribute to the ongoing process to recover the endangered Atlantic whitefish, by complementing work done by Fisheries and Oceans Canada. The goals outlined in Section 1.2 of this report were met and these activities will continue into the next year of the project.

Recommendations for 2021

1. Continue to monitor the upstream migration of gaspereau in the spring.
2. Continue with control methods targeting invasive species.
3. Expand to include eDNA sampling throughout the Petite Rivière system to locate unknown populations of Atlantic whitefish.
4. Continue with lake survey work to determine suitable areas for Atlantic whitefish range expansion opportunities.
5. Continue outreach and education activities at local schools and community events.

6. Acknowledgments

Coastal Action would like to extend our gratitude and appreciation to those who contributed to the successful completion of the 2020 field season. The following groups and individuals played a critical role in supporting the Atlantic Whitefish Recovery Project (AWRP):

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- Bridgewater Public Service Commission staff: Nick Denaro and Audrey Buchanan.
- Dalhousie University staff: Paul Bentzen and John Batt.
- CBC staff: Paul Withers.
- The many volunteers, students, and community members who helped with field activities.

7. References

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Withers, P. (2020) 'Fluke' sighting of endangered Atlantic whitefish brings hope for survival. Canadian Broadcasting Corporation *Nova Scotia.* https://www.cbc.ca/news/about-cbc-news-1.1294364