2019-20 Review of Fisheries Activities for the Atlantic Whitefish Recovery Project

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Executive Summary

This report details activities performed by Coastal Action for the 2019-2020 Atlantic Whitefish Recovery Project field season, the 2nd year of a three-year project designed to contribute to and complement Fisheries and Oceans Canada activities to recover the endangered Atlantic Whitefish (*Coregonus huntsmani*). These activities were funded by the Habitat Stewardship Fund 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 East River (Chester) and Gold River watersheds. Activities included the monitoring of upstream gaspereau (*Alosa pseudoharengus)* migration into Hebb Lake, smallmouth bass (*Esox niger*) nesting survey and nest destruction, bathymetry mapping on Hebb Lake, zooplankton hauls and depth profiling on Hebb 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 (*Coregonus huntsmani*) 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 "Endangered" and as such, recovery actions are required. These activities in the Petite Rivière watershed are a continuation of the 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 Fisheries and Oceans Canada that included the collection of juvenile Atlantic whitefish in the spring from the wild for rearing and husbandry, removal of invasive smallmouth bass (*Micropterus dolomieu)* and chain pickerel (*Esox niger)* through angling and boat electrofishing, as well as the monitoring of the Hebb Dam Fish Passage Facility in October through 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.

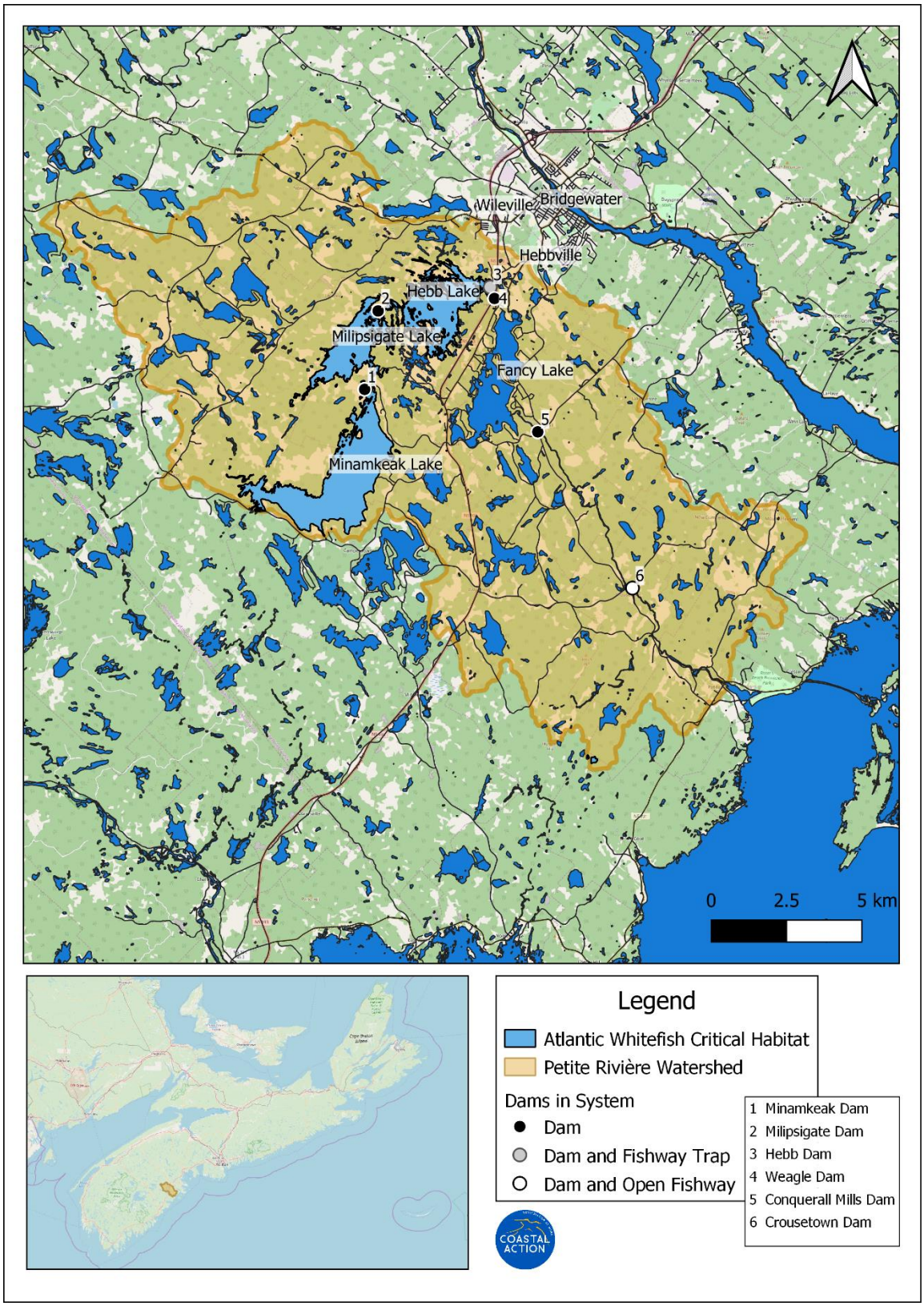

Figure 1. Map of the Petite Rivière watershed showing the three lakes (Minamkeak, Milipsigate, and Hebb) which contain the existing wild Atlantic whitefish population, as well as the dams and fishways present in the system.

1.2. Project Objectives

Coastal Action's Atlantic Whitefish Recovery Project (AWRP) had several goals and objectives for the 2019 field season. These goals and objectives are 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 aims to give 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 field work activities and results from Atlantic Whitefish Recovery Project work in 2019, conducted between April 23, 2019 and December 13, 2019, mainly 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 Henry Lake on the Gold River, and Officers Camp and Timber Lakes on the East River, Chester.

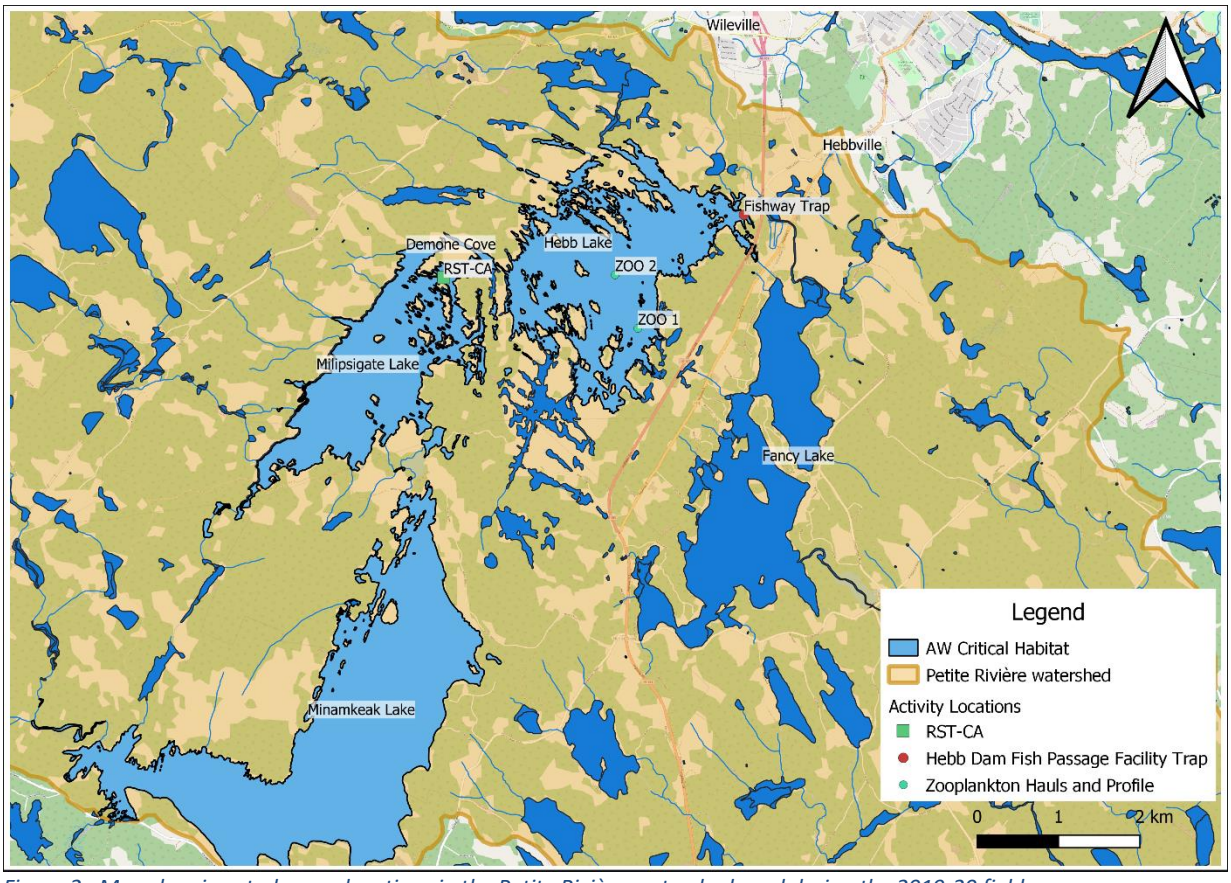

Figure 2. Map showing study area locations in the Petite Rivière watershed used during the 2019-20 field season.

2. Methods

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

The Hebb Lake Dam Fish Passage Facility (Figure 2) was opened by Coastal Action staff on April 27, 2019 and was operated until June 28, 2019, to allow for the upstream migration of gaspereau (*Alosa pseudoharengus*). 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. In the springtime, the trap was monitored daily until June 14, 2019, and, henceforth, closed on Fridays and reopened Monday as follows: closed: June 15-16; reopened June 17 and checked daily: until June 21; closed: June 22-23; reopened June 24 and checked daily until June 28, 2019 upon which date the fishway was closed until the fall monitoring season.

Each day, a Coastal Action staff member 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 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 (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 (*Alosa pseudoharengus*), brook trout (*Salvelinus fontinalis*), and American eel (*Anguilla rostrata*). Smallmouth bass (*Micropterus dolomieu*) and chain pickerel (*Esox niger*) were sacrificed for the biological study. Sea lamprey (*Petromyzon marinus*) were released downstream of Hebb Dam as the monitoring plan 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 and then allowed to pass upstream. In addition, the relative Hebb Lake water level was recorded (inches) daily using a gauge attached to the fishway (Figure 3); along with water temperature which was measured (°C) using a digital thermometer.

2.2. Smallmouth Bass NestSurvey

Building on work completed in summer 2018 that evaluated smallmouth bass nests in Demone Cove in Milipsigate Lake, in 2019, staff returned to the same study area (Figure 2) to determine if nest destruction and removal of male smallmouth bass nest guards in 2018 decreased the number of nests created this year. Bass nest surveys began on June 19, 2019, once 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 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 was 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 four times over June and July 2019.

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.

2.3. Bathymetry Survey on Hebb Lake

On July 11, 2019, Coastal Action staff began to map the bathymetry of Hebb Lake. Using a Humminbird 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 18 visits to the lake and completed it on August 23, 2019.

2.4. Zooplankton Hauls and Depth Profiling

Vertical zooplankton hauls and a depth profile were taken throughout the month of August on August 1, August 8, and August 20, 2019 at ZOO 1, the 13 m deep-water station of Hebb Lake (Figure 2). Firstly, a Secchi disk reading was taken followed by a profile using a ProDSS Digital Professional Series YSI sonde (model # 18A104818). Lastly, a vertical zooplankton haul was done using a modified CABIN kick net (mesh size 355 µm). The ZOO 2 location (Figure 2) was used for a single additional zooplankton haul.

The YSI probe 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) to the bottom at 1 m intervals.

The zooplankton hauls were done 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 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. Henry Lake in the Gold River watershed was surveyed on August 28, 2019, Timber Lake, in the East River, Chester watershed, was surveyed on September 5, 2019 and Officers Camp Lake, also in the East River, Chester watershed was surveyed on Sept 25, 2019. DFO's preliminary criteria for selection involved 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 aluminium fishing vessel with 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 measurement was also taken.

Chlorophyll-a was measured using a FluoroSense handheld Fluorometer (Turner Designs P/N 2860-000-C). The Fluorometer was calibrated using Turner Design's rhodamine calibration solution prior to use in the field. The tip of the Fluorometer was placed just under the surface of the water and the resultant reading was recorded. Next, to collect water samples to be tested for nutrients and metals at the surface and 1-meter above 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. Using the messenger, the Van Dorn was closed and then pulled out of the water. The water sample was poured into the relevant bottles and labelled with the date, site, 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 at Milipsigate Outlet (Figure 2) was deployed for the fall monitoring session on October 21, 2019 and was checked daily until December 13, 2019. 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.

3. Results and Discussion

3.1. Spring Monitoring at Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility monitoring trap was fishing from April 27, 2019 to June 28, 2019 and was monitored for captured fish daily. A total of 6,472 fish were intercepted, comprising five different species. 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. Of the five species captured in 2019, gaspereau, white sucker, and brook trout were transferred to the upper section of the fishway to continue into Hebb Lake. No chain pickerel were captured, and all captured smallmouth bass 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 analysed using a software program to determine the effectiveness of using this camera. The software DFO has access to would 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 2013-2019.

Species	2013	2014	2015	2016	2017	2018	2019
American Eel	3	1	1	2	4	3	0
Brook Trout	1	10	2	2	1	1	1
Chain Pickerel	0	1	0	1	4	4	0
Chub Spp.	5	0	0	0	0	0	0
Gaspereau	2120	2924	4793	2333	11738	20350	6449
Shad	1	0	0	0	0	1	0
Sea Lamprey	1	1	70	11	8	0	6
Smallmouth Bass	18	35	59	43	25	19	10
White Sucker	174	37	61	26	79	39	6
Total	**2323**	**3009**	**4986**	**2418**	**11 859**	**20 417**	**6472**

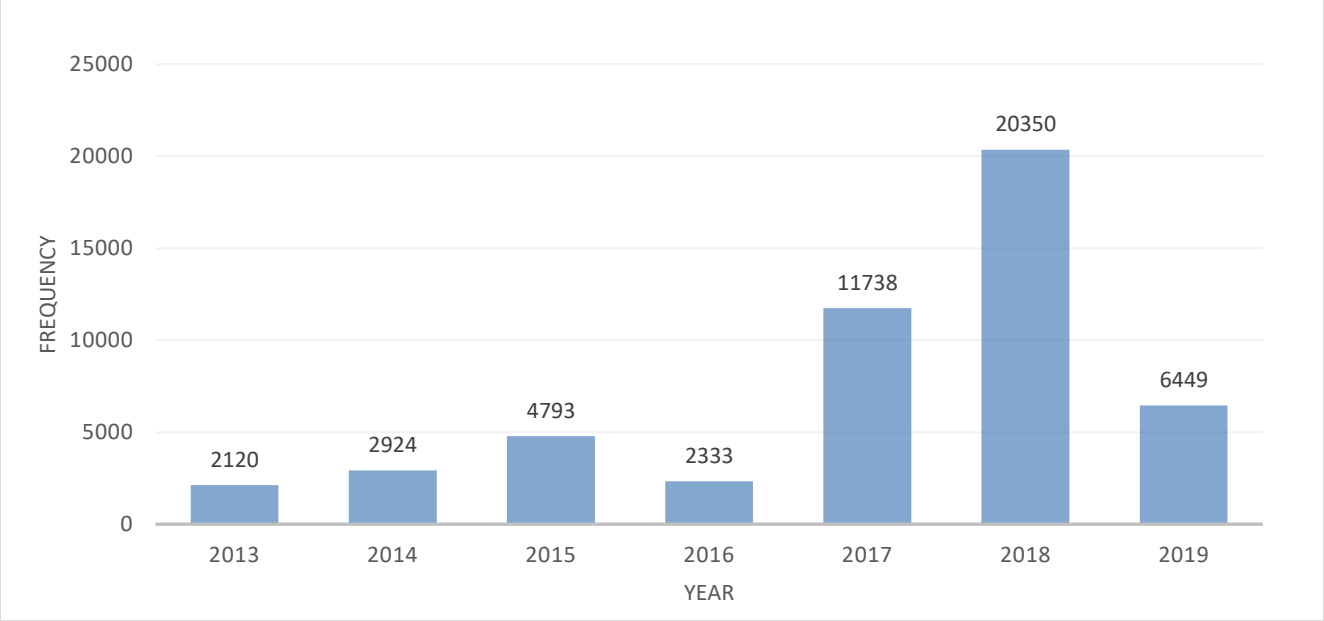

Figure 6. Adult gaspereau captures at Hebb Dam Fish Passage Facility in Spring 2013-2019.

3.2. Smallmouth Bass Nest Survey

Demone Cove was surveyed four times between June 19 and July 5, 2019. During this time, 16 nests were identified. All nests assessed were Class A for the duration of the study period. A total of three nests were found to have a male smallmouth bass nest guard. These fish were removed via angling and the nests were raked. All 16 nests were raked as of July 5, 2019. In 2018, 25 nests were found in Demone Cove between June 4 and June 21, 2019. This is a decrease of nine nests visible in the shallow waters along the shoreline of Demone Cove. Substrate for all nests was found to be pebble and cobble and nests were found at depth of approximately 0.3 to 1.5 m. No nests were found with eggs deposited through the duration of the study.

3.3. Bathymetry Survey on Hebb Lake

100% of Hebb Lake was surveyed using the Humminbird Helix SI 9 unit over 18 visits to the lake in 2019. This data has been provided to DFO to create an updated bathymetric map of Hebb Lake.

3.4. Zooplankton Hauls and Depth Profiling

Profiles taken at the deep-water spot on Hebb Lake using a ProDSS Digital Professional Series YSI sonde were graphed to determine stratification of the lake twice during August 2019. Profiles indicated that conductivity remained stable across each sample date while dissolved oxygen and total dissolved solids were more variable. At the beginning of August, the thermocline was approximately 5 m deep, and by August 20th, had moved to 8 m.

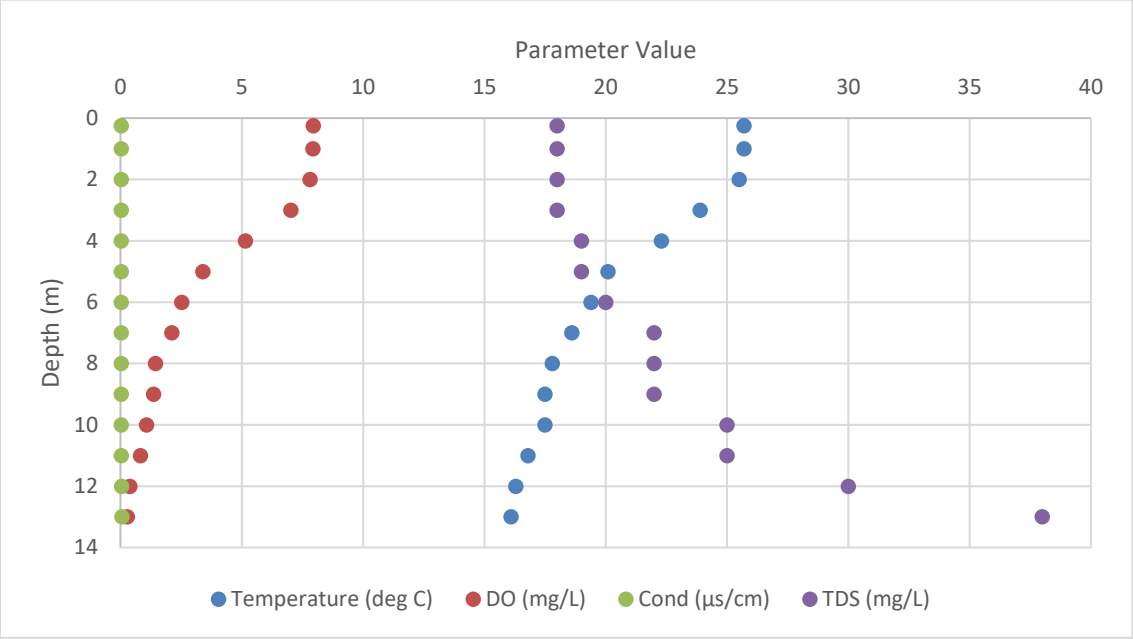

Figure 7. A profile of Hebb Lake conducted on August 1, 2019.

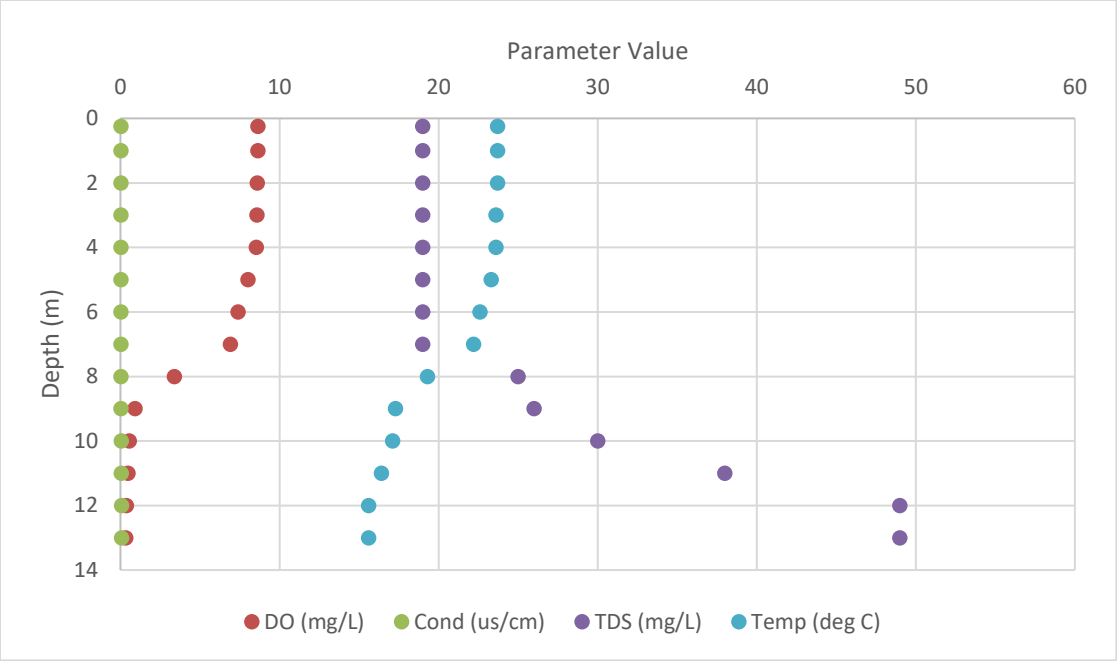

Figure 8. A profile of Hebb Lake conducted on August 20, 2019.

Zooplankton samples were obtained from two deep-water locations in Hebb Lake in August 2019. While this analysis was solely to identify specimens and not quantitative, visual inspection of each sample revealed extremely low density of zooplankton as compared to the previous year's samples taken in Milipsigate Lake with the same net. Species identified in the Hebb Lake samples included *Daphnia catawba*, and *Daphnia ambigua*, as well as other arthropods *Hydracarina*, and *Mochlonyx* spp. The lower zooplankton density in Hebb Lake, as compared to Milipsigate Lake is possibly attributed to the large population of gaspereau present in Hebb Lake. Gaspereau are planktivores and can alter zooplankton communities in lakes (Mills *et al.*, 1995).

3.5. Lake Surveys to Assess Candidate Atlantic whitefish Translocation Sites

Three lakes were assessed according to DFO protocol. Henry Lake, Timber Lake, and Officers Camp Lake were surveyed. No invasive fishes were found in any of the lakes by angling. See Figures 9, 10, and 11 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 on all candidate lakes have been completed.

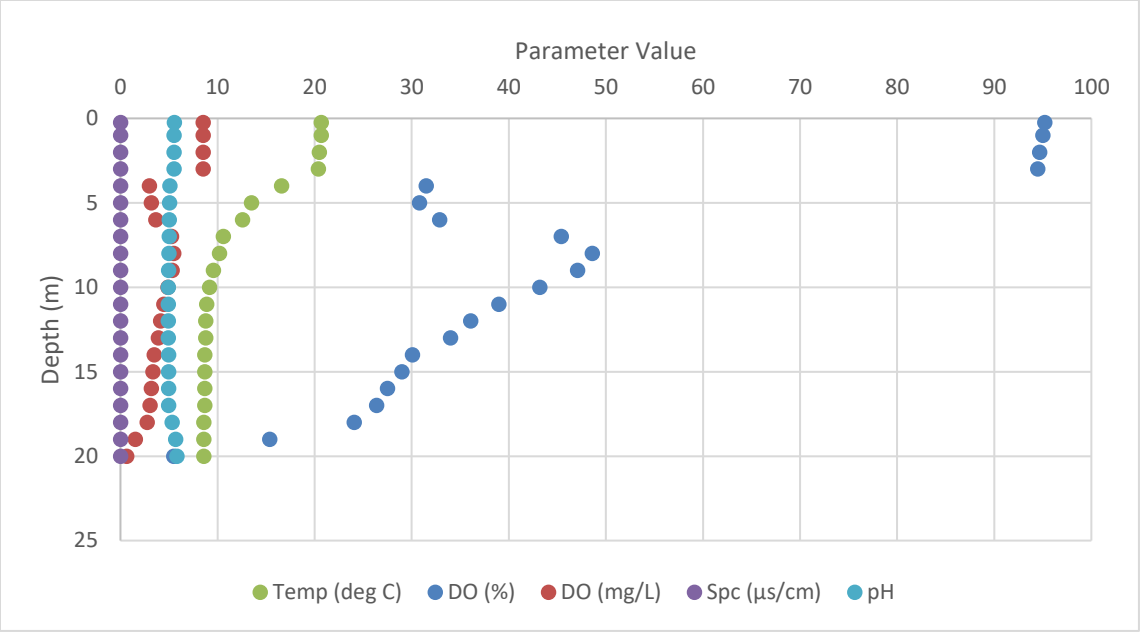

Figure 9. A profile of Henry Lake in the Gold River watershed conducted August 28, 2019.

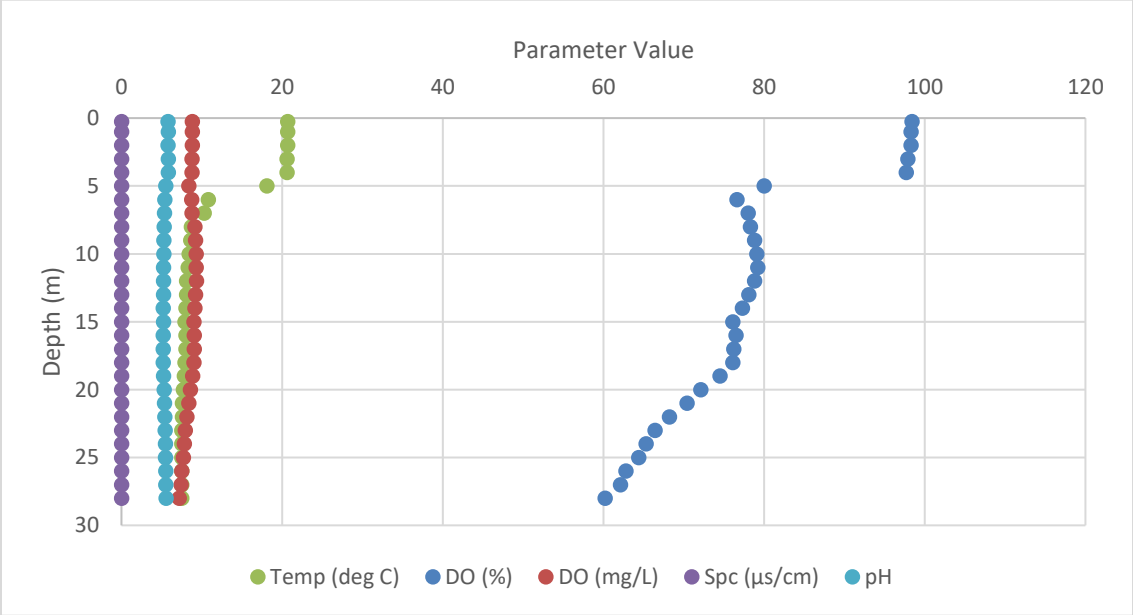

Figure 10. A profile of Timber Lake in the East River, Chester watershed conducted September 5, 2019.

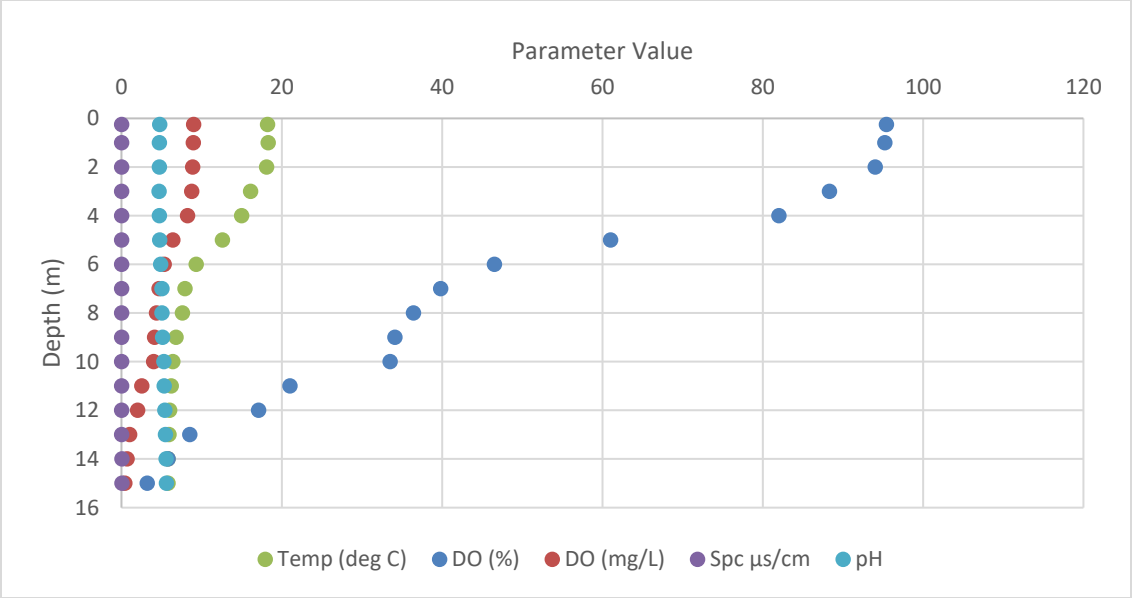

Figure 11. A profile of Officers Camp Lake in the East River, Chester watershed conducted September 25, 2019.

3.6. Fall Monitoring of RST-CA at Milipsigate Dam

The RST-CA was redeployed in the fall on October 21, 2019 and was monitored daily until December 13, 2019. One chain pickerel was captured during this time and retained for stomach content analysis. No adult Atlantic whitefish were captured in the trap.

Table 3. Fish species captured in the RST-CA at Milipsigate Dam between October 21 and December 13, 2019.

Species	Frequency
American Eel	28
Brown Bullhead	1
Gaspereau (yoy)	1125
Chain Pickerel	1
Yellow Perch	1

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.

During the year, Coastal Action presented to local community groups as well as various schools within Lunenburg County, and outreach materials were available at Coastal Action events throughout the year. Social media was also used to highlight Atlantic Whitefish Recovery Project field work through the field season.

- Fish Friends presentations at several South Shore Regional School Board schools
- Michelin Safety Fair – Bridgewater, Nova Scotia

- Privateer Days – Liverpool, Nova Scotia
- World Oceans Day – Lunenburg, Nova Scotia
- Morton Centre Open House – Lunenburg, Nova Scotia
- 25th Annual Children's Fun Fair – Bridgewater, Nova Scotia
- Take Your Kid to Work Day – Bluenose Academy Grade 9 student through Coastal Action's Youth Leaders
- NS Species at Risk Recovery Action Forum

Social Media Posts

Coastal Action posted 15 Atlantic Whitefish Recovery Project related social media posts on Instagram, Facebook, and Twitter during the 2019-20 project year. These posts showcased photos from the field and were designed to engage Coastal Action's followers with updates about project activities. These reach Coastal Action's 3850 combined followers from Instagram, Facebook and Twitter social media platforms.

Media Coverage in 2019

Paul Withers of CBC visited our field sites on May 16, 2019 to interview Coastal Action staff about larval Atlantic whitefish collections, as well as film a segment to be shown on local 6 PM news. Paul Bentzen (Dalhousie University) also attended this site visit and was interviewed regarding Dalhousie's initiative to house the previous year's wild captured cohort and accept spring 2019's incoming juvenile Atlantic whitefish. An article was published on the CBC website on May 23, 2019: https://bit.ly/3dww5KQ.

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 2020

1. Continue to monitor the upstream migration of gaspereau in the spring.
2. Continue with control methods targeting invasive species.
3. Expand bathymetry work into Fancy Lake.
4. Continue with lake survey work to determine suitable areas for Atlantic whitefish range expansion opportunities.
5. Continue the outreach and educational activities at local schools and community events.

6. Acknowledgements

Coastal Action would like to extend its gratitude and appreciation to those who contributed to the successful completion of the 2019 field season. The following groups and individuals played a critical role in supporting the Atlantic Whitefish Recovery Project (AWRP):

- Coastal Action field crew: Andrew Breen, Melissa Risto, Shawn Feener, Emma Kinley, Philip

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- Coastal Action staff: Taylor Creaser, Simon Inness, Molly LeBlanc, Sarah Macleod, Jennifer McKinnon, and Bailey Silver.
- Fisheries and Oceans Canada staff: Jeremy Broome, Greg Stevens, Donald Humphrey, Jennifer MacDonald, and Kimberly Robichaud-LeBlanc.
- Bridgewater Public Service Commission staff: Nick Denaro and Audrey Buchanan.
- Dalhousie University staff: Paul Bentzen and John Batt.
- CBC staff: Paul Withers and camera crew.
- Bluenose Academy: Kajtek Jaskowiak.
- Many various volunteers, students, and community members that helped with field activities.

7. References

Mills, E.L., Adams, C., O'Gorman, R., Owens, R.W., and Roseman, E.F. (1995). *Planktivory by alewife (Alosa pseudoharengus) and rainbow smelt (Osmerus mordax) on microcrustacean zooplankton and dreissenid (Bivalvia: Dreissenidae) veligers in southern Lake Ontario.* Canadian Journal of Fisheries and Aquatic Sciences. Vol 52(5). Pages: 925-935.