

Report on the Progress of Recovery Strategy Implementation for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada for the Period 2012 to 2017

Atlantic Whitefish



2022

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« Rapport sur les progrès de la mise en œuvre du programme de rétablissement du corégone de l'Atlantique (*Coregonus huntsmani*) au Canada pour la période 2012 à 2017 »

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Preface

The federal, provincial, and territorial government signatories under the [Accord for the Protection of Species at Risk \(1996\)](#) agreed to establish complementary legislation and programs that provide for the protection of species at risk throughout Canada. Under section 46 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the competent ministers are responsible for reporting on the implementation of the recovery strategy for a species at risk, and on the progress towards meeting its objectives within five years of the date when the final recovery strategy was placed on the [Species at Risk Public Registry](#) and in every subsequent five-year period, until its objectives have been achieved or the species' recovery is no longer feasible.

Reporting on the progress of recovery strategy implementation requires reporting on the collective efforts of the competent minister(s), provincial and territorial governments and all other parties involved in conducting activities that contribute to the species' recovery. Recovery strategies identify broad strategies and approaches that will provide the best chance of recovering species at risk. Some of the identified strategies and approaches are sequential to the progress or completion of others and not all may be undertaken or show significant progress during the timeframe of a report on the progress of recovery strategy implementation (progress report).

The Minister of Fisheries and Oceans is the competent minister under SARA for the Atlantic Whitefish and Fisheries and Oceans Canada (DFO) Maritimes Region has prepared this progress report.

As stated in the preamble to SARA, success in the recovery of species at risk depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in the recovery strategy and will not be achieved by DFO or any other jurisdiction alone. The cost of conserving species at risk is shared amongst different constituencies. All Canadians are invited to join in supporting and implementing the recovery strategy for the Atlantic Whitefish for the benefit of the species and Canadian society as a whole.

Acknowledgments

This progress report was prepared by Fisheries and Oceans Canada (DFO), Maritimes Region. To the extent possible, this progress report has also been prepared with inputs from the many partners in the recovery of Atlantic Whitefish, including the multi-interest membership of the Atlantic Whitefish Conservation and Recovery Team (appendix A). DFO would also like to express its appreciation to all individuals and organizations that have made valuable contributions to the recovery of the Atlantic Whitefish.

Executive summary

The Atlantic Whitefish (*Coregonus huntsmani*) was listed as endangered under the federal *Species at Risk Act* (SARA) in 2003. The “Recovery Strategy for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada” was published on the Species at Risk (SAR) Public Registry in 2007. The “Report on the Progress of Recovery Strategy Implementation for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada for the Period 2007 to 2012” was published on the SAR Public Registry in 2016. The recovery strategy was subsequently amended to incorporate new information and changed conditions, and re-published on the SAR Public Registry in 2018. Accordingly, all references to the recovery strategy (unless otherwise specified) are to the amended 2018 version of the recovery strategy. The activities undertaken and progress towards implementing the original recovery strategy can be found in the first [5-year progress report](#) which covered the period from February 2007 to February 2012. This second progress report highlights activities undertaken and progress towards implementing the amended recovery strategy covering the period of 2012 to 2017.

The main past and present threats to Atlantic Whitefish include: hydroelectric dams and water supply impoundments, acidification of freshwater habitat, poor land use practices (for example, agriculture, residential development, and forestry), unregulated historical fishing activities, and interactions with non-native (invasive) predatory fish species.

The overall recovery goal for Atlantic Whitefish is “to achieve stability in the current population of Atlantic Whitefish in Nova Scotia, reestablishment of the anadromous form, and expansion beyond its current range”. The recovery strategy identifies four broad strategies for recovery:

Broad strategy 1: conserve, protect and manage the species and its habitat

Broad strategy 2: increase the number and range of viable populations

Broad strategy 3: address knowledge gaps relating to the species and its habitat

Broad strategy 4: increase public involvement in, and acceptance of, measures required for the species’ survival and recovery

The population and distribution objectives for the Atlantic Whitefish are:

Population objective: a minimum population size of greater than 1,275 mature individuals in the Petite Rivière

Distribution objective: establishing self-sustaining anadromous populations in several watersheds in the Nova Scotia Southern Uplands eco-region, including the Petite Rivière

This report outlines activities undertaken between February 2012 and February 2017 in support of the overall recovery goal and the population and distribution objectives for the Atlantic Whitefish. During this period, progress has been made in: developing an Atlantic Whitefish action plan, identifying and understanding Atlantic Whitefish critical habitat, improving fish passage on the Petite Rivière, understanding the threat posed by invasive fish species to Atlantic Whitefish survival and the effectiveness of various mitigation measures for addressing this threat, understanding opportunities and challenges associated with re-establishing anadromy on the Petite Rivière and range expansion, and raising public awareness about the Atlantic Whitefish.

Although some progress toward recovery of the Atlantic Whitefish was made during the reporting period, the arrival of Chain Pickerel (*Esox niger*) in the Petite Rivière lakes in 2013

represented a setback in achieving the overall recovery goal and population and distribution objectives. Smallmouth Bass (*Micropterus dolomieu*) and Chain Pickerel in the Petite Rivière lakes represent a serious threat to the survival of the Atlantic Whitefish. No mature Atlantic Whitefish were captured in the Petite Rivière during this reporting period in gear set to monitor the status of the population. As a result, it was not possible to estimate abundance or population trends. However, several observations of both adult-sized and young-of-the-year Atlantic Whitefish captured in or swimming around other sampling gear confirmed that mature Atlantic Whitefish continued to persist in the Petite Rivière lakes.

Anadromy has not been established in the Petite Rivière or elsewhere in the Southern Uplands eco-region of Nova Scotia, nor has a self-sustaining population of Atlantic Whitefish been established beyond the Petite Rivière. It does not appear, from monitoring results, that captive-raised Atlantic Whitefish released into Anderson Lake in Dartmouth, NS, from 2005 to 2012 were able to successfully produce progeny and establish a population. The Atlantic Whitefish captive breeding program carried out at the Mersey Biodiversity Facility in Milton, NS concluded in 2012. The expanding range of invasive fish species in watersheds throughout the Southern Uplands eco-region and beyond, and the absence of a viable range expansion mechanism at present, represent important challenges in achieving the population and distribution objectives for the Atlantic Whitefish.

Fisheries and Oceans Canada, its partners, and the Atlantic Whitefish Conservation and Recovery Team remain committed to the protection and recovery of Atlantic Whitefish and will continue to collaborate on implementing the recovery strategy and action plan. Important next steps include continued monitoring of Atlantic Whitefish status, securing legal protection of critical habitat^a, mitigating the threat of invasive fish species, and identifying strategies for range expansion and the re-establishment of anadromy.

Measures for mitigating current threats to the species, particularly invasive fish species, and expanding the range of the Atlantic Whitefish may need to be implemented in a timely manner to achieve the population and distribution objectives for this species and for its recovery to remain feasible.

^a A critical habitat order made pursuant to subsections 58(4) and 58(5) of SARA was completed outside the reporting period in September 2018. The critical habitat order invokes the subsection. 58(1) prohibition against the destruction of the identified critical habitat.

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1. Introduction

In 2007, the “Recovery Strategy for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada” (DFO 2007) was published as final on the Species at Risk (SAR) Public Registry (henceforth called the original recovery strategy). The “Report on the Progress of recovery strategy implementation for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada for the period 2007-2012” (DFO 2016) documented progress toward recovery implementation for the Atlantic Whitefish. In 2018, the recovery strategy was amended and re-published to the SAR Public Registry (DFO 2018a; henceforth called the recovery strategy or the amended recovery strategy).

This progress report outlines the progress made towards meeting the objectives outlined in the recovery strategy for the Atlantic Whitefish from February 2012 to February 2017 and is the second progress report since the publication of the [original recovery strategy](#) in 2007. This document is part of a series of documents that are linked and that should be taken into consideration together; including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) Status Report ([COSEWIC 2010](#)), the Science Advisory Report from the species’ Recovery Potential Assessment ([DFO 2009](#)), the recovery strategy ([DFO 2018a](#)), the action plan ([DFO 2018b](#)), and the first 5-year progress report ([DFO 2016](#)).

Section 2 of this progress report summarizes information on the threats to the Atlantic Whitefish, population and distribution objectives for achieving its recovery, approaches to meeting these objectives, and performance indicators to measure the progress of recovery. For more details, readers should refer back to the recovery strategy. Section 3 reports on the specific activities undertaken in support of the recovery strategy and achieving the population and distribution objectives. This includes a continuation of activities described in the first 5-year progress report as well as new activities undertaken between February 2012 and February 2017. Section 4 summarizes the progress toward achieving the objectives.

2. Background

2.1 COSEWIC assessment summary

Date of assessment: November 2010

Common name: Atlantic Whitefish

Scientific name: *Coregonus huntsmani*

COSEWIC status: Endangered

Reason for designation: This species, a unique Canadian endemic present in only a single location, is restricted to three interconnected lakes in Nova Scotia. Its viability is threatened by illegal introduction of exotic fishes.

Canadian occurrence: Nova Scotia

COSEWIC status history: Designated endangered in April 1984. Status re-examined and confirmed in November 2000 and November 2010.

The listing of the Atlantic Whitefish under SARA in 2003, which led to the development and publication of the original recovery strategy for Atlantic Whitefish in 2007 (DFO 2007), was based on the information provided in the COSEWIC Status Report from 2000 (COSEWIC 2000). In 2010, COSEWIC re-examined and confirmed the status of the Atlantic Whitefish as endangered (COSEWIC 2010). This status information has also been included in section 1.1 of the recovery strategy.

2.2 Threats

This section summarizes the information found in the recovery strategy (DFO 2018a) on threats to survival and recovery of the Atlantic Whitefish and threats to its critical habitat.

2.2.1 Threats to the Atlantic Whitefish

Current threats

- Barriers to fish passage resulting from the construction of hydroelectric dams and water supply impoundments
- Interactions with non-native fish species in the Petite Rivière watershed, particularly Smallmouth Bass (*Micropterus dolomieu*) and Chain Pickerel (*Esox niger*)
- Land-based activities causing siltation, eutrophication, substrate alteration, or acidification

Other threats of lower potential concern

- Sources of direct mortality (for example, bycatch in recreational angling and other fisheries, entrainment of fish into water intakes, removals or mortality from sampling for scientific or recovery purposes)

- Fluctuations in lake levels from municipal water drawdown or irrigation
- Acidification of freshwater habitat from acid rain or acid run-off

2.2.2 Threats to critical habitat

Critical habitat for the Atlantic Whitefish has been identified, to the extent possible, in section 8 of the recovery strategy. Table 1 provides examples of activities that are likely to result in destruction to critical habitat (that is, threats to critical habitat). The list of activities provided in this table is neither exhaustive nor exclusive, and their inclusion has been guided by the relevant threats to habitat described in the recovery strategy. For more details on the activities likely to result in the destruction of critical habitat, consult the recovery strategy.

Table 1. Threats to critical habitat of the Atlantic Whitefish, adapted from the recovery strategy (DFO 2018a).

Threat category	Activities	Effect-pathway
Threats to habitat	Infilling and dredging	Loss or change of established lake bottom and water column
Threats to water quantity	Significant manipulation of water levels outside standard operations	Decrease in water levels resulting in exposure of previously submerged areas, risk of exposure of eggs, reduced flows, altered thermal refugial habitat
Threats to water quality	Persistent and excessive releases of deleterious substances from land-based activities (for example, road construction, quarry excavation or mining)	Degradation of water quality

2.3 Recovery

This section summarizes the information, found in the recovery strategy, on the population and distribution objectives that are necessary for the recovery of the Atlantic Whitefish and on performance indicators that provide a way to define and measure progress toward achieving these objectives.

2.3.1 Population and distribution objectives and broad strategies for recovery

The overall goal of the recovery strategy is to:

“Achieve stability in the current population of Atlantic Whitefish in Nova Scotia, reestablishment of the anadromous form, and expansion beyond its current range.”

This recovery goal will be achieved by addressing the following interim population and distribution objectives identified in section 2.3 of the recovery strategy:

Population objective: a minimum population size of greater than 1,275 mature individuals in the Petite Rivière

Distribution objective: establishing self-sustaining anadromous populations in several watersheds in the Nova Scotia Southern Uplands eco-region, including the Petite Rivière

Section 2.4 of the recovery strategy describes four broad strategies for recovery that are intended to create and maintain the necessary conditions for achieving the population and distribution objectives:

Broad strategy 1: conserve, protect and manage the species and its habitat

Broad strategy 2: increase the number and range of viable populations

Broad strategy 3: address knowledge gaps related to the species and its habitat

Broad strategy 4: increase public involvement in, and acceptance of, measures required for the species survival and recovery

2.3.2 Performance indicators

Section 2.6 of the recovery strategy includes 12 performance measures to define and measure progress toward achieving the population and distribution objectives for the Atlantic Whitefish over the reporting period. Table 2 lists each of the performance measures according to the applicable broad strategy for recovery.

Table 2. Broad strategies for recovery and corresponding performance indicators for the Atlantic Whitefish, found in the recovery strategy.

Broad strategy for recovery	Performance indicator(s)
1. Conserve, protect and manage the species and its habitat	1. Critical habitat has been identified and protected 2. Research activities outlined in the schedule of studies have been completed 3. Abundance of the existing wild population in the Petite Rivière lakes has been estimated and meets target (>1,275 mature adults) 4. The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière 5. Human activities permitted by this recovery strategy continue to not jeopardize the survival or recovery of the Atlantic Whitefish 6. An action plan has been completed and is posted in the Species at Risk Public Registry
2. Increase the number and range of viable populations	7. Anadromy has been established on the Petite Rivière. 8. A self-sustaining population has been established in another freshwater waterbody (for example, Anderson Lake) 9. Anadromy has been established in a second watershed in Nova Scotia's Southern Uplands eco-region 10. The feasibility of repatriating an anadromous run to the Tusket River has been evaluated, and repatriation pursued if appropriate
3. Address knowledge gaps relating to the species and its habitat	11. Progress has been made towards filling other knowledge gaps identified in this recovery strategy
4. Increase public involvement in, and acceptance of, measures	12. An adaptive communication plan has been developed, engaged stewards are active, and public awareness and

Broad strategy for recovery	Performance indicator(s)
required for the species survival and recovery	acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions

3. Progress towards recovery

As described in section 2.3.1 above, the recovery strategy for the Atlantic Whitefish divides the recovery effort into four broad strategies. Progress in carrying out these broad strategies is reported in section 3.1 of this progress report. Section 3.2 reports on the status of implementation of the critical habitat schedule of studies outlined in the recovery strategy. Section 3.3 assessed progress against the performance indicators and other commitments (for example, action plan and critical habitat order) identified in the recovery strategy and information obtained through implementing the recovery strategy.

3.1 Activities supporting recovery

Tables 3 to 5 provide information on the implementation of activities undertaken during the five-year reporting period from February 2012 to February 2017 to address the broad strategies and approaches identified in the recovery strategy.

Table 3. Research and monitoring recovery activities for Atlantic Whitefish during the February 2012 to February 2017 period.

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
1	Ph.D. Thesis on addressing conservation priorities for the Atlantic Whitefish	A Dalhousie University PhD thesis examining conservation and recovery priorities for data poor species, focusing on the Atlantic Whitefish as a case study, was completed in 2012. The thesis examined Atlantic Whitefish genetic diversity, effective population size, and evolutionary status; its response to perceived environmental threats; and, options for translocation and repatriation of Atlantic Whitefish considering habitat suitability. This information will inform ongoing conservation and recovery planning for the Atlantic Whitefish. References: Cook (2012)	3 - Address knowledge gaps relating to the species and its habitat	11 - Progress has been made towards filling other knowledge gaps identified in this recovery strategy	Dalhousie University, Fisheries and Oceans Canada (DFO)
2	Publication of criteria to discriminate between Atlantic Whitefish larvae and other species	Criteria to discriminate larval and juvenile Atlantic Whitefish from two similar species, Lake Whitefish (<i>C. clupeaformis</i>) and Cisco (<i>C. artedii</i>), were developed and published. References: Hasselman and Bradford (2012)	3 - Address knowledge gaps relating to the species and its habitat	11 - Progress has been made towards filling other knowledge gaps identified in this recovery strategy	DFO
3	Publication of comparative tracking study of hatchery-reared and wild Atlantic Whitefish	Results of a 2006 comparative hydroacoustic tracking study examining the survival, depth preferences and movements of hatchery-reared and wild Atlantic Whitefish was published in 2013. Reference: Cook et al. (2013)	3 - Address knowledge gaps relating to the species and its habitat	11 - Progress has been made towards filling other knowledge gaps identified in this recovery strategy	Dalhousie University, DFO
4	Research on advanced-aged Atlantic Whitefish	Eleven second and third generation captive-bred Atlantic Whitefish (five females and six males) housed at the Bedford Institute of Oceanography were transferred to Dalhousie University Faculty of Agriculture, Aquaculture Centre (Dal-AC) in	3 - Address knowledge gaps relating to	11 - Progress has been made towards filling other	Dal-AC

^b Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically.

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<p>Truro in December 2013. These fish were the offspring of wild Atlantic Whitefish spawned at the Mersey Biodiversity Facility (MBF) about ten years prior. The purpose of this project was to: 1) develop technical expertise in the successful transport of Atlantic Whitefish; 2) assess the potential for adult Atlantic Whitefish of an advanced age to mature and spawn; and 3) assess the suitability of untreated local groundwater sources at the facility for housing and rearing Atlantic Whitefish.</p> <p>Results:</p> <ul style="list-style-type: none"> • Fish were successfully transported to the Dal-AC • Efforts to induce spawning by manipulating temperature were unsuccessful, due to eggs being overripe • Fish were found to be in better condition when reared in seawater or brackish water, rather than freshwater • Fish were active and feeding at temperatures of 10°C • Most of the fish (8 of 11) were successfully reared until fall 2014 and the last remaining fish (four males) were found to be sexually mature on December 9, 2014 <p>Reference: Manríquez-Hernández and Duston (2015)</p>	the species and its habitat	knowledge gaps identified in this recovery strategy	
5	Report on the stocking of Atlantic Whitefish in Anderson Lake	<p>A report describing the Atlantic Whitefish stocking and monitoring activities undertaken by DFO in Anderson Lake between 2005 and 2012 was developed.</p> <p>Results:</p> <ul style="list-style-type: none"> • Results of Anderson Lake 2012 monitoring activities are reported in Recovery Activity (RA) #17. • November 2012 releases of captive-raised Atlantic Whitefish are reported in RA #7. <p>References: Bradford et al. (2015)</p>	2 - Increase the number and range of viable populations	8 - A self-sustaining population has been established in another freshwater waterbody (for example, Anderson Lake)	DFO
6	Atlantic Whitefish Culture Handbook	<p>The Atlantic Whitefish Culture Handbook, published in 2016, documents and describes the methods used to culture Atlantic Whitefish at the former MBF between 2000 and 2012, and</p>	2 - Increase the number and range of	11 - Progress has been made towards filling other	DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<p>identifies knowledge gaps and future research opportunities related to the culture of Atlantic Whitefish.</p> <p>References: Whitelaw et al. (2016)</p>	<p>viable populations 3 - Address knowledge gaps relating to the species and its habitat</p>	<p>knowledge gaps identified in this recovery strategy</p>	
7	<p>Release of remaining captive-raised Atlantic Whitefish into Anderson Lake</p>	<p>Releases of captive-bred Atlantic Whitefish into Anderson Lake prior to February 2012 are described in the first 5-year progress report (DFO 2016) and the project is detailed in the recovery strategy (DFO 2018a; see RA #20). During this reporting period, all remaining captive-bred Atlantic Whitefish (80 fish ages 5+ and 6+ years) from the MBF were released into Anderson Lake on November 5, 2012 following the facility's closure. The fish were marked for future identification.</p> <p>Monitoring activities conducted in Anderson Lake following the release are described in RA #17 and reports about the stocking and monitoring of Atlantic Whitefish in Anderson Lake are described in RA #5.</p> <p>References: Bradford et al. (2015)</p>	<p>2 - Increase the number and range of viable populations</p>	<p>8 - A self-sustaining population has been established in another freshwater waterbody (for example, Anderson Lake)</p>	<p>DFO</p>
8	<p>Smallmouth Bass Nest Surveys</p>	<p>Annual Smallmouth Bass nest surveys, ongoing since 2007, continued to provide information about Smallmouth Bass habitat use in the Petite Rivière lakes during this reporting period. Additional nest surveys were included in areas of Minamkeak, Milipsigate, and Hebb lakes in 2012 and in areas of Milipsigate and Hebb lakes in 2013. Locations (coordinates) and physical habitat characteristics were recorded at nest sites.</p> <p>Results:</p> <ul style="list-style-type: none"> In the three Petite Rivière lakes, 235 nests were found in 2012 and 53 nests were found in 2013 (Note: survey effort was greater in 2012) 	<p>1 - Conserve, protect and manage the species and its habitat</p>	<p>4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their</p>	<p>BCAF, Nova Scotia Department of Fisheries and Aquaculture (NSDFA)</p>

Report on the Progress of Recovery Strategy Implementation for Atlantic Whitefish (2012 to 2017)

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<ul style="list-style-type: none"> Nests were observed in water depths of 0.5 m to 1.0 m at distances of approximately 2.5 m to 9.0 m from shore, and were typically constructed of cobble substrate and positioned adjacent to a large boulder The nest surveys showed that Smallmouth Bass are reproducing in all three Petite Rivière lakes <p>References: Bluenose Coastal Action Foundation (BCAF^c) (2012, 2013)</p>		abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière	
9	Assessment of Chain Pickerel distribution in the Petite Rivière watershed	<p>Following the first confirmation of the presence of Chain Pickerel in the upper Petite Rivière watershed on May 17, 2013, BCAF and DFO collaborated in conducting initial surveys to determine the extent of their distribution within the Petite Rivière lakes. Sampling methods included angling, fyke nets, eel and minnow pots, and electrofishing. In September 2015, backpack electrofishing was also conducted at select locations to further evaluate the distribution of Chain Pickerel.</p> <p>Results:</p> <ul style="list-style-type: none"> In the first year of surveying (May to October 2013), a total of 28 Chain Pickerel of multiple age classes and measuring from approximately 15 cm to 45 cm fork length (FL) were found in Hebb and Milipsigate lakes as well as other smaller lakes (Garber and Little lakes) that are connected to these larger lakes by streams During the September 2015 backpack electrofishing surveys, no Chain Pickerel were captured at sampling sites on the western shore of Hebb Lake or the northern shore of Minamkeak Lake Four Chain Pickerel ranging in size from 9 cm to 32 cm FL were captured in Wildcat Brook, a tributary to Hebb Lake, during the September 2015 survey <p>References: BCAF (2013, 2015)</p>	1 - Conserve, protect and manage the species and its habitat	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière	BCAF, DFO

^c Bluenose Coastal Action Foundation are currently known as Coastal Action

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
10	Assessment of the effectiveness of invasive fish species control using an electrofishing boat	<p>In July 2013, exploratory sampling of Milipsigate and Minamkeak lakes using an electrofishing boat was conducted to assess its effectiveness in removing invasive fish species (Chain Pickerel and Smallmouth Bass) from the Petite Rivière lakes. DFO and NSDFA subsequently signed a Memorandum of Understanding for a three-year project from 2014 to 2016 to use boat electrofishing to:</p> <ul style="list-style-type: none"> • evaluate the potential to reduce the abundance of invasive fish species in areas of the lake previously known to be frequented by Atlantic Whitefish • capture and remove Chain Pickerel and Smallmouth Bass, and assess removal rates • explore the use of boat-electrofishing as a tool to determine population size of invasive species based on depletion estimates • determine the scope for harm to Atlantic Whitefish by evaluating the feasibility of boat-electrofishing to catch this species and the potential for population estimate work (to be carried out annually during the three years of the agreement) <p>Results:</p> <ul style="list-style-type: none"> • During the exploratory sampling in 2013, 32 Chain Pickerel and 170 Smallmouth Bass were removed from Milipsigate Lake. No Chain Pickerel and 118 Smallmouth Bass were removed from Minamkeak Lake. No Atlantic Whitefish were captured in either lake. • During the three-year study (2014 to 2016): <ul style="list-style-type: none"> - it was determined that boat electrofishing is effective in targeting invasive species life stages that are confined to the shore (≤ 2 m depth) and that a multi-pass method is effective in reducing localized populations. - a total of 3,280 Chain Pickerel and 1,767 Smallmouth Bass were removed from Hebb Lake by boat electrofishing - eradication is considered highly unlikely using boat electrofishing, however control of the population may be achieved with ongoing effort 	1 - Conserve, protect and manage the species and its habitat	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière	BCAF, DFO, NSDFA

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<p>In February 2017, DFO and NSDFA signed a second agreement for a three-year invasive fish species control project (2017 to 2019) using the electrofishing boat in the Petite Rivière lakes. The control strategy will be informed by the results of the first three-year research project. Results of the 2017 to 2019 invasive species control project will be summarized in the next five-year progress report.</p> <p>References: Themelis et al. (2014); J. LeBlanc, pers. comm. (2016)</p>			
11	Invasive fish species angling study	<p>Targeted Smallmouth Bass and Chain Pickerel angling surveys were undertaken in the three Petite Rivière lakes during spring and summer 2012 to 2016 to mitigate the impact of invasive fish and to reduce their risk of spread. This technique complements the boat electrofishing described in activity 10 by removing a different size component of the populations. Effort was concentrated in Hebb Lake at the Milipsigate Dam outlet area. All invasive fish were retained and sampled as part of a biological study (see RA #12).</p> <p>Results:</p> <ul style="list-style-type: none"> • Between 2012 and 2016, 2,977 Smallmouth Bass and 308 Chain Pickerel were removed by angling in the three Petite Rivière lakes • No Chain Pickerel were captured in Minamkeak Lake despite substantial angling effort in 2016 • Atlantic Whitefish were not targeted, but two were incidentally captured in Hebb Lake: one (17.7 cm FL) was captured and safely released on August 31, 2012, and one was hooked but not captured in Hebb Lake at the Milipsigate Dam outlet area on April 30, 2014 <p>References: BCAF (2012, 2013, 2014, 2015, 2016); Themelis et al. (2014)</p>	1 - Conserve, protect and manage the species and its habitat	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière	BCAF, DFO
12	Biological study of invasive fish	A biological study of invasive fish species in the Petite Rivière lakes was conducted to better understand the invasive fish	1 - Conserve,	4 - The threat posed by	BCAF

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
	species in the Petite Rivière lakes	<p>populations. Biological parameters of all Smallmouth Bass and Chain Pickerel captured in the Petite Rivière watershed from 2012 to 2016 were documented, including: length, weight, age, sex and stomach contents. The stomach contents of 3,212 Smallmouth Bass were analyzed during the 2012 to 2016 period and the stomach contents of 390 Chain Pickerel were analyzed during the 2013 to 2016 period.</p> <p>Results:</p> <ul style="list-style-type: none"> • Stomach content analyses confirm that invasive fish species are preying upon native fish species • A single Atlantic Whitefish was positively identified in the stomach of a Smallmouth Bass in 2013 • Length data indicate that multiple size classes of Smallmouth Bass are present in all three Petite Rivière lakes and multiple size classes of Chain Pickerel are present in Hebb and Milipsigate lakes • No Chain Pickerel were observed or captured in Minamkeak Lake during this reporting period (see RA #11) <p>References: BCAF (2012, 2013, 2014, 2015, 2016)</p>	protect and manage the species and its habitat	Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière	
13	Assessment of the potential for Chain Pickerel to disperse from Milipsigate Lake into Minamkeak Lake	<p>The potential for Chain Pickerel to move from Milipsigate Lake into Minamkeak Lake via a small brook and shallow lake (Caribou Lake) during high water conditions was assessed. Caribou Lake was investigated on August 22, 2016 by backpack electrofishing and angling, and hydraulic connectivity and flow direction were assessed.</p> <p>Results:</p> <ul style="list-style-type: none"> • No fish were captured or observed in Caribou Lake. • Based on the connectivity and directional flow assessment, the dispersal of Chain Pickerel from Milipsigate Lake to Minamkeak Lake via Caribou Lake is thought to be unlikely because the direction of flow is toward Milipsigate Lake, and because there is significant build-up of debris creating a barrier between the two lakes. 	1 - Conserve, protect and manage the species and its habitat	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of	BCAF, DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<p>References: BCAF (2016)</p>		Atlantic Whitefish in the Petite Rivière	
14	Water quality monitoring within Petite Rivière watershed	<p>BCAF has been monitoring water quality in the Petite Rivière watershed since 2011. During this reporting period, BCAF conducted water quality sampling and monitoring at 18 sites, including four within Atlantic Whitefish critical habitat (Minamkeak Brook, Milipsigate Dam, Hebb Dam, and below Hebb Dam). Monthly temperature, dissolved oxygen, conductivity, total dissolved solids, salinity and pH testing was completed at each site.</p> <p>Results:</p> <ul style="list-style-type: none"> • Water quality is relatively good and has remained largely stable over the monitoring period. • The water quality data was added to an online database maintained by Community-University Research Alliance (CURA) H2O. <p>References: BCAF (2012)</p> <p>Weblinks:</p> <ul style="list-style-type: none"> • Water Quality of Petite Rivière Watershed • CURA H2O 	1 - Conserve, protect and manage the species and its habitat	<p>2 - Research activities outlined in the schedule of studies have been completed</p> <p>11 - Progress has been made towards filling other knowledge gaps identified in this recovery strategy</p>	BCAF
15	Monitoring Atlantic Whitefish population status	<p>Various methods were used to monitor the presence and status of Atlantic Whitefish in the Petite Rivière watershed, including the Petite Rivière lakes during this reporting period:</p> <ul style="list-style-type: none"> • a rotary screw trap (RST) downstream of Hebb Dam in spring 2012 to 2013 • a RST in Hebb Lake (at the base of Milipsigate Dam) in spring and fall 2014 and 2016, and spring 2015 • a trap net in Hebb Lake (at Milipsigate Dam outlet area) in spring 2012 and 2013 • two trap nets in Minamkeak Lake in fall 2013 • two trap nets in Hebb Lake in fall 2016 • a single trap net upstream of Crousetown Dam in fall 2013 	3 - Address knowledge gaps relating to the species and its habitat	3 - Abundance of the existing wild population in the Petite Rivière lakes has been estimated and meets target (>1,275 mature adults)	BCAF, DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<ul style="list-style-type: none"> • a fyke net below Hebb Lake in spring 2013 • three video cameras in Hebb Lake (at Milipsigate dam outlet area) in spring 2015 <p>During all of these monitoring activities, all native fish species were sampled and released, while all Chain Pickerel and Smallmouth Bass were retained for biological studies. These activities were all undertaken as part of BCAF's Atlantic Whitefish Recovery Project.</p> <p>Results:</p> <ul style="list-style-type: none"> • No Atlantic Whitefish were captured or observed in 2012 and 2013 using any of these methods • A school of adult-sized Atlantic Whitefish was observed in Hebb Lake downstream of the RST in 2014 only • Four young-of-the-year Atlantic Whitefish were captured in the RST in Hebb Lake below Milipsigate Dam in spring 2015, and another 53 were captured in the spring of 2016 <p>References: BCAF project reports (2012, 2013, 2014, 2015, 2016)</p>			
16	Monitoring at the Hebb Lake Dam Fish Passage Facility	<p>Upstream fish passage was monitored at the Hebb Lake Dam Fish Passage Facility during spring/summer and fall migration periods from 2012 to 2015 in accordance with the revised Hebb Lake Dam Fish Passage Facility Interim Monitoring Plan (IMP). All native fish were sampled and released, while all Chain Pickerel and Smallmouth Bass captured were removed from the fishway and retained for biological studies.</p> <p>Results:</p> <ul style="list-style-type: none"> • During spring/summer monitoring, a total of 12,736 fish representing eight different species were intercepted, of which Gaspereau (<i>Alosa pseudoharengus</i>) was the most abundant (>90% of total catch) each year • During fall monitoring, a total of 46 fish, representing six different species, were intercepted 	2 - Increase the number and range of viable populations	7 - Anadromy has been established on the Petite Rivière.	BCAF, DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^b
		<ul style="list-style-type: none"> A total of 19 Atlantic Whitefish (only one showing signs of hatchery rearing) were intercepted in the fall of 2012 No fish were intercepted in the fishway in fall 2016 <p>References: BCAF (2012, 2013, 2014, 2015, 2016); Themelis et al. (2014)</p>			
17	Monitoring the status of stocked Atlantic Whitefish in Anderson Lake	<p>Monitoring of captive-bred Atlantic Whitefish releases in Anderson Lake occurred in fall 2012 and 2016 to assess the general status of Atlantic Whitefish and to determine whether spawning had occurred. Monitoring previously occurred annually from 2007 to 2010 and is summarized in DFO 2016 (see RA #20) and detailed in Bradford et al. (2015) (see RA #5).</p> <p>Results:</p> <ul style="list-style-type: none"> Two adult Atlantic Whitefish were captured in 2012, measuring 34 cm and 36 cm FL Neither of the two adult Atlantic Whitefish captured had any observable fin clips or markings indicative of their potential presence since 2006 when the last group of unmarked age 1+ fish were released No Atlantic Whitefish were captured or observed during the 2016 monitoring activities in Anderson Lake <p>References: Broome and Redden (2012); Bradford et al. (2015); DFO unpublished data (for 2016 monitoring)</p>	2 - Increase the number and range of viable populations	8 - A self-sustaining population has been established in another freshwater waterbody (for example, Anderson Lake)	DFO

Table 4. Management and protection recovery activities for Atlantic Whitefish during the February 2012 to February 2017 period.

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
18	Development and publication of 5-year progress report (2007 to	The first 5-year progress report on recovery strategy implementation for the Atlantic Whitefish (February 2007 to	All	All	DFO , Atlantic Whitefish Conservation

^d Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically.

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
	2012) for the Atlantic Whitefish	February 2012) was developed and published to the Species at Risk (SAR) Public Registry in June 2016. References: Fisheries and Oceans Canada (DFO) (2016)			and Recovery Team (AWCRT)
19	Amendment to the recovery strategy for the Atlantic Whitefish	The recovery strategy for the Atlantic Whitefish, first published in 2007, was amended to include new and updated information including population and distribution objectives, critical habitat, revisions to the recovery feasibility determination and additional activities permitted by the recovery strategy. The amended recovery strategy was published as proposed in June 2016, and the final version was published outside this reporting period in 2018. References: DFO (2018a)	All	All	DFO, AWCRT
20	Development and publication of Atlantic Whitefish action plan	The proposed version of the action plan for the Atlantic Whitefish was published to the SAR Public Registry in June 2016. The action plan identifies specific measures or actions to implement the recovery strategy and mitigate threats, and describes 26 recovery measures that will be undertaken by DFO, partners, and/or other jurisdictions or organizations. The final version of the action plan was published outside the reporting period in September, 2018. References: DFO (2018b)	1 - Conserve, protect and manage the species and its habitat	6 - An action plan has been completed and is posted in the Species at Risk Public Registry	DFO, AWCRT
21	Development of critical habitat order	The protection of identified critical habitat is afforded using a critical habitat order made pursuant to subsection 58(4) and subsection 58(5) of <i>Species at Risk Act</i> (SARA). As required, a regulatory package was prepared for approval. With the Order in place, the subsection 58(1) prohibition against the destruction of critical habitat applies to these areas and any future identified critical habitat. The order was completed outside the reporting period in September 2018.	1 - Conserve, protect and manage the species and its habitat	1 - Critical habitat has been identified and protected	DFO
22	SARA permitting	Activities that would otherwise contravene the prohibitions of SARA can be permitted under SARA provided certain conditions are met. Applications for SARA section 73 Permits are reviewed and evaluated by DFO. Within the reporting period, DFO issued 14 SARA section 73 permits for activities	1 - Conserve, protect and manage the species and its habitat	5 - Human activities permitted by this recovery strategy	DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
		<p>affecting Atlantic Whitefish. These activities were determined not to jeopardize the survival or recovery of the species and permit conditions included mitigation measures to ensure minimal impact to the species.</p> <p>Weblinks: SAR Public Registry Permits and Agreements page</p>		continue to not jeopardize the survival or recovery of the Atlantic Whitefish	
23	Administration of federal funding programs for Species at Risk and fish habitat	<p>The federal government administers several competitive funding programs that have supported Atlantic Whitefish stewardship projects including: the Habitat Stewardship Program (HSP), the Aboriginal Fund for Species at Risk (AFSAR) and the former Recreational Fisheries Conservation Partnerships Program (RFCPP).</p> <p>Annual funding from the HSP supported many of BCAF's activities outlined herein over the reporting period. Annual funding from RFCPP supported BCAF's habitat assessment and restoration activities in the Petite Rivière watershed (RA #38).</p> <p>Weblinks:</p> <ul style="list-style-type: none"> • HSP • AFSAR 	4 - Increase public involvement in, and acceptance of, measures required for the species survival and recovery	12 - An adaptive communication plan has been developed, engaged stewards are active, and public awareness and acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions	DFO, Environment and Climate Change Canada (ECCC)
24	Development of the <i>Live Fish Possession Regulations</i> and information sheet	<p>In response to the illegal introduction of invasive fish species in provincial waters, the Government of Nova Scotia developed regulations that prohibit the live possession and transport of certain fish species.</p> <p>The Government of Nova Scotia enacted the Live Fish Possession Regulations pursuant to the <i>Fisheries and Coastal Resources Act</i> in November 2012. Nova Scotia Department of Fisheries and Aquaculture (NSDFA) also posted an information sheet about the Regulations on its website to raise</p>	1 - Conserve, protect and manage the species and its habitat	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management	NSDFA

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
		<p>awareness and increase understanding of the <i>Live Fish Possession Regulations</i>.</p> <p>Weblinks:</p> <ul style="list-style-type: none"> • Nova Scotia Live Fish Possession Regulations • Live Fish Possession Regulations information sheet 		<p>measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière</p>	
25	Compliance monitoring	<p>During this reporting period, DFO Conservation and Protection (C&P) continued Atlantic Whitefish-focused monitoring and surveillance patrols and investigations in the Petite Rivière watershed and at Anderson Lake. Patrols were conducted by foot, all-terrain vehicle (ATV), trail motorcycle, boat, and using technology (for example, trail cameras).</p> <p>Results:</p> <ul style="list-style-type: none"> • Over 1,000 hours were spent conducting regular patrols of the Petite Rivière lakes and investigations directed at the protection of Atlantic Whitefish • There were no violations of persons catching and retaining Atlantic Whitefish but C&P officers issued warnings or proceeded with prosecutions on 13 violations of angling in closed areas in the Petite Rivière watershed or fishing in open areas without a license • No violations were detected during dedicated patrols in Anderson Lake 	1 - Conserve, protect and manage the species and its habitat	5 - Human activities permitted by this recovery strategy continue to not jeopardize the survival or recovery of the Atlantic Whitefish	DFO
26	Revised Hebb Lake Water Management Agreement	<p>In fall 2015, the Hebb Dam Fish Passage Facility (the fishway) was inoperable due to low water levels in Hebb Lake. An agreement was reached between BPSC and DFO to maintain ecological maintenance flows in the Petite Rivière and fish passage through the fishway. These new procedures were implemented in August 2016.</p>	1 - Conserve, protect and manage the species and its habitat	5 - Human activities permitted by this recovery strategy continue to not jeopardize the survival or	Bridgewater Public Service Commission (BPSC), DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
				recovery of the Atlantic Whitefish	
27	Completion and commissioning of the Hebb Dam Fish Passage Facility	<p>The construction of the Hebb Dam fishway was completed in spring 2012, and commissioned in fall 2012. Its construction is described in the first 5-year progress report (DFO 2016).</p> <p>Results:</p> <ul style="list-style-type: none"> Fish passage monitoring activities at the fishway are described in RA #16. 	2 - Increase the number and range of viable populations	7 - Anadromy has been established on the Petite Rivière	BPSC , DFO
28	Revisions to Interim Monitoring Plan (IMP) for the Hebb Dam Fish Passage Facility	<p>An IMP for the Hebb Dam Fish Passage Facility was originally developed in 2011. The IMP identifies: a long term goal of allowing free passage to all wild, native fish species at the facility; ownership and responsibilities related to the facility and achieving the stated goal; and, a multi-phased monitoring approach with goals and protocols. The IMP was revised in May 2013 based on experience and knowledge gained to date, and the ongoing evaluation of potential risks, impacts and interactions associated with the introduction of native and non-native fish species to the Petite Rivière lakes.</p> <p>To inform the revisions to the IMP, Brook Trout (<i>Salvelinus fontinalis</i>) were collected from both above and below Hebb Dam in 2012 and 2013 to evaluate the risk of disease transmission to fish populations in the Petite Rivière lakes from fish migrating upstream. Fish were sampled for bacterial and viral infections according to the <i>Fish Health Protection Regulations</i>. All of the fish tested were determined to be healthy.</p> <p>Results:</p> <ul style="list-style-type: none"> Communicable fish pathogens and diseases were not found in the lake fish populations and were determined unlikely to be introduced by species migrating into the lakes through the fishway. The revised IMP was finalized and implemented for the spring 2013 monitoring season (see RA #16). 	2 - Increase the number and range of viable populations	7- Anadromy has been established on the Petite Rivière	DFO , BPSC, BCAF, Native Council of Nova Scotia, NSDFA, Nova Scotia Power Incorporated (NSPI), (former) South Shore Naturalists Club

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
		<p>References: Robichaud-Leblanc and O’Neil (2013); Themelis et al. (2014)</p>			
29	Review of water withdrawal applications	<p>Under the Nova Scotia <i>Environment Act</i>, a water withdrawal approval is required for certain surface water withdrawal activities. DFO reviews all water withdrawal applications for compliance with the <i>Fisheries Act</i> and <i>Species at Risk Act</i>.</p> <p>Results:</p> <ul style="list-style-type: none"> Through the water withdrawal approval renewal process, fish passage downstream of Hebb Dam on the Petite Rivière was improved in the fall of 2016 at a small dam associated with an agricultural operation. 	<p>1 - Conserve, protect and manage the species and its habitat 2 - Increase the number and range of viable populations</p>	<p>5 - Human activities permitted by this recovery strategy continue to not jeopardize the survival or recovery of the Atlantic Whitefish 7 - Anadromy has been established on the Petite Rivière</p>	DFO, Nova Scotia Environnement (NSE)
30	Removal of rock debris from base of Hebb Dam	<p>Large boulders located at the base of the Hebb Dam sluiceway presented a risk of harm to Atlantic Whitefish and other species migrating downstream on the Petite Rivière. Accordingly, BPSC moved as many of the boulders as possible from the base of the sluiceway in April 2015, thereby reducing the risk of fish mortality during downstream migration.</p>	<p>1 - Conserve, protect and manage the species and its habitat</p>	<p>5 - Human activities permitted by this recovery strategy continue to not jeopardize the survival or recovery of the Atlantic Whitefish</p>	BPSC
31	Bridge pre-construction electrofishing survey below Hebb Dam	<p>A backpack electrofishing survey was conducted on July 12, 2012 below Hebb Dam, in the area between Weagle’s Dam and Fancy Lake in the Petite Rivière watershed, to determine whether Atlantic Whitefish were using the area as habitat prior to the start of road repaving and bridge reconstruction work by Nova Scotia Transportation and Infrastructure Renewal</p>	<p>1 - Conserve, protect and manage the species and its habitat</p>	<p>5 - Human activities permitted by this recovery strategy continue to not jeopardize the survival or</p>	BCAF, NSTIR

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^d
		<p>(NSTIR^e). This activity was undertaken as part of BCAF's Atlantic Whitefish Recovery Project.</p> <p>Results:</p> <ul style="list-style-type: none"> • Fifteen fish from five species were observed during the electrofishing survey. • No Atlantic Whitefish were captured or observed. • The road repaving and bridge construction work was completed in fall 2012. <p>References: BCAF (2012)</p>		recovery of the Atlantic Whitefish	
32	Regulatory review of projects in the Petite Rivière watershed	<p>The DFO Fisheries Protection Program (FPP; referred to as the Habitat Management Program prior to 2013 and as the Fish and Fish Habitat Protection Program since 2018) undertook regulatory reviews of works, undertakings, or activities in the Petite Rivière watershed to ensure compliance with SARA and the <i>Fisheries Act</i>.</p> <p>Results:</p> <ul style="list-style-type: none"> • FPP provided advice to proponents through Letters of Advice to avoid and mitigate impacts on four projects during the reporting period. • No <i>Fisheries Act</i> Authorizations were issued for works in the Petite Rivière or for the destruction of Atlantic Whitefish habitat 	1 - Conserve, protect and manage the species and its habitat	1 - Critical habitat has been identified and protected	DFO

Table 5. Stewardship and outreach recovery activities for Atlantic Whitefish during the February 2012 to February 2017 period.

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^f
33	Atlantic Whitefish Conservation and	Meetings of the AWCRT were ongoing during the reporting period.	4 - Increase public involvement	12 - An adaptive communicatio	Fisheries and Oceans Canada (DFO), AWCRT

^e Nova Scotia Department of Transportation and Infrastructure Renewal is now known as Nova Scotia Department of Transportation and Public Works (NSTPW)

^f Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically.

Report on the Progress of Recovery Strategy Implementation for Atlantic Whitefish (2012 to 2017)

#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^f
	Recovery Team (AWCRT) meetings	<p>Results: Meetings were held in April and October 2012, February and May 2013, May 2014 (conference call), and February 2016. Members of this multi-stakeholder team provided updates on recovery activities and plans related to the Atlantic Whitefish and discussed issues concerning the species survival and recovery.</p> <p>Meeting notes were produced and distributed to recovery team members following each meeting.</p>	in, and acceptance of, measures required for the species survival and recovery	n plan has been developed, engaged stewards are active, and public awareness and acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions	
34	Atlantic Whitefish and invasive fish species information in the Nova Scotia Angler's Handbook	<p>The Nova Scotia Angler's Handbook contains information about fishing regulations and is provided annually to each recreational fishing licence holder. It includes a description of Atlantic Whitefish, the regulations in place to protect it, and contact information to report sightings to DFO. The handbook also includes general information about aquatic invasive species, including Chain Pickerel, and how to help stop their spread.</p> <p>Weblinks:</p> <ul style="list-style-type: none"> • Nova Scotia Sportfishing Laws and Regulations 	1 - Conserve, protect and manage the species and its habitat 4 - Increase public involvement in, and acceptance of, measures required for the species survival and recovery	4 - The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in	DFO, Nova Scotia Department of Fisheries and Aquaculture (NSDFA)

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^f
35	Media features	<p>Several National and Regional media features have showcased Atlantic Whitefish over the last five years, including:</p> <ul style="list-style-type: none"> • Canadian Broadcasting Corporation (CBC) Land and Sea – “Vanishing Whitefish” Episode 13, 2017 Season, February 5, 2017 which highlights Bluenose Coastal Action Foundation’s (BCAF^g) Atlantic Whitefish Recovery Project and DFO’s monitoring efforts, the closure of the Mersey Biodiversity Facility (MBF) and conclusion of the Atlantic Whitefish captive rearing program, and the threat posed by invasive fish species to the survival and recovery of the Atlantic Whitefish • Canadian Television Network (CTV) News – “Concerns over invasive species of fish”, 2017 which focused on the threat invasive fish species pose to the survival and recovery of the Atlantic Whitefish and other species at risk • Articles in CBC News: <ul style="list-style-type: none"> – “Search for endangered Atlantic Whitefish comes up empty in Dartmouth lake”, November 24, 2016, about DFO’s fall 2016 monitoring in Anderson Lake – “Endangered fish in 'dire trouble' without DFO program, scientists say”, June 24, 2016, about the potential contributions of an Atlantic Whitefish captive breeding program to the species’ survival and recovery – “Atlantic Whitefish young discovered in Bridgewater lake system”, May 14, 2016, about the young-of-the-year Atlantic Whitefish captured in the rotary screw trap (RST) in Hebb Lake at the Milipsigate Dam outlet area – “Endangered Atlantic Whitefish faces new threat”, March 25, 2014, about the discovery of Chain Pickerel in the 	4 - Increase public involvement in, and acceptance of, measures required for the species survival and recovery	the Petite Rivière 12 - An adaptive communication plan has been developed, engaged stewards are active, and public awareness and acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions	BCAF, CBC, CTV, DFO, The Chronicle Herald

^g Bluenose Coastal Action Foundation are currently known as Coastal Action

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^f
		<p>Petite Rivière watershed and the threat to Atlantic Whitefish posed by this invasive species</p> <ul style="list-style-type: none"> - “Endangered Atlantic Whitefish could be on the comeback”, October 26, 2012, about the capture of adult Atlantic Whitefish in the Hebb Dam Fish Passage Facility in fall 2012 - “N.S. fishway created to save endangered species”, May 1, 2012, about the construction of the fishway at the Hebb Dam Fish Passage Facility <ul style="list-style-type: none"> • Articles in The Chronicle Herald: <ul style="list-style-type: none"> - “Tracking the rare Atlantic Whitefish”, July 31, 2016, about DFO and BCAF’s Atlantic Whitefish monitoring activities in the Petite Rivière and Anderson Lake 			
36	Atlantic Whitefish outreach and education activities	<p>A variety of outreach and education activities were carried out by DFO and BCAF each year during the reporting period to provide Canadians with information about the status of the Atlantic Whitefish and recovery efforts.</p> <p>BCAF activities:</p> <ul style="list-style-type: none"> • Atlantic Whitefish presentation were provided to several local community groups such as: schools, Girl Guides, Camp Mushamush, and the Fancy Lake Home Owners Association • An Atlantic Whitefish Recovery Project informational display was set up at a number of community events and locations such as provincial parks, youth fishing derbies, farmer’s markets, festivals, boat shows, White Point Beach Resort, Lunenburg tall ships celebrations, the Mahone Bay Regatta and Pirate Festival, the Kejimikujik Mi’kmaw Celebration, and World Oceans Day and World Water Day celebrations • An AWCRT tour of the Hebb Dam Fish Passage Facility was hosted in fall 2012 <p>DFO activities:</p>	4 - Increase public involvement in, and acceptance of, measures required for the species survival and recovery	12 - An adaptive communication plan has been developed, engaged stewards are active, and public awareness and acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions	BCAF, DFO

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants ^f
		<ul style="list-style-type: none"> • The Atlantic Whitefish display at the Bedford Institute of Oceanography in Dartmouth, Nova Scotia (NS) was updated. It provides information about threats and recovery activities • Informational displays about aquatic species at risk, including the Atlantic Whitefish, were set up at a number of public events including Science Odyssey 2016 and the annual Oceans Day event in Halifax, NS • DFO Conservation and Protection (C&P) officers continued to regularly engage with local fishers and the public for the purposes of education and stewardship • Species at risk awareness was raised by C&P officers during ongoing regular patrols and dockside conversations • C&P officers also visited schools to talk about their role in Atlantic Whitefish conservation • Awareness signs about Atlantic Whitefish were created, and posted at Rissers Beach and Anderson Lake <p>References: BCAF (2012, 2013, 2014, 2015, 2016)</p>			
37	Habitat assessment and restoration projects within the Petite Rivière watershed	<p>From 2014 to 2016, several fish habitat assessment and restoration projects were carried out within streams connected to the Petite Rivière lakes, which may provide habitat for Atlantic Whitefish or whose water quality may impact Atlantic Whitefish habitat. These projects included:</p> <ul style="list-style-type: none"> • Wildcat Brook Stream Restoration Project: Historically, Wildcat Brook, a tributary to Hebb Lake, was straightened and widened as part of mining operations. The restoration project aimed to restore the brook to a more natural state by installing digger logs and deflectors. In 2014 and 2015, BCAF assessed the sub-watershed of Wildcat Brook for habitat restoration opportunities and completed in-stream restoration work. A total of eight digger logs and eight deflectors were installed to enhance fish habitat. 	1 - Conserve, protect and manage the species and its habitat	2 - Research activities outlined in the schedule of studies have been completed	BCAF, East Coast Aquatics, Nova Scotia Transportation and Infrastructure Renewal (NSTIR)

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#	Activity	Descriptions and results	Broad strategy	Performance indicator	Participants'
		<ul style="list-style-type: none"> <li data-bbox="562 277 1318 553">• Wildcat Shale Pit Remediation and Wetland Expansion Project: Acidification of freshwater habitat is recognized as a threat to Atlantic Whitefish. This restoration project aimed to reduce the acidic runoff from an abandoned shale pit into the adjacent Wildcat Brook, a tributary of Hebb Lake, and to create a wetland habitat for wildlife. In 2015 and 2016, BCAF and East Coast Aquatics covered 1.10 hectares of the Wildcat shale pit with organic wetland material and seeded and planted it with native wetland plants. <li data-bbox="562 586 1318 797">• Stream assessments: Stream assessments were conducted to search for potential restoration opportunities to improve fish habitat and to document the current health of the Petite Rivière watershed. In 2015, BCAF completed stream assessments of the sub-watersheds of Birch, Wallace, and Fredericks brooks and an assessment of Brown Brook was partially completed. <p data-bbox="562 829 688 854">Weblinks:</p> <ul style="list-style-type: none"> <li data-bbox="562 862 1289 919">• Habitat Restoration in the Petite Rivière Watershed (2014 and 2015 reports) <li data-bbox="562 927 1199 984">• Wildcat Brook Shale Pit Remediation and Wetland Expansion Project 			

3.2 Activities supporting the identification of critical habitat

Table 6 provides information on the implementation of the critical habitat schedule of studies outlined in the recovery strategy. Each study has been assigned one of four statuses:

- 1) completed: the study has been carried out and concluded
- 2) in progress: the study is underway and has not concluded
- 3) not started: the study has been planned but has yet to start
- 4) cancelled: the study will not be started or completed

Table 6. Status and details of the implementation of the schedule of studies outlined in the recovery strategy for the Atlantic Whitefish (DFO 2018a). Linkages to the recovery activities (RA) from tables 3, 4 and 5 are identified. The timeline column refers to the timeline associated with completion of the outlined study as provided in DFO 2018a.

#	Study	Timeline	Status	Descriptions and results	Participants ^h
1	Evaluate the spatial and temporal distribution of Atlantic Whitefish in the Petite Rivière watershed for all life history stages, including the population within the three lakes and the anadromous component (contingent on the provision of fish passage and their usage of such).	2015 to 2020	In progress	<p>Evaluation of the spatial and temporal distribution of Atlantic Whitefish in the Petite Rivière watershed was accomplished by Bluenose Coastal Action Foundation (BCAFⁱ) and Fisheries and Oceans Canada (DFO) during the 2012 to 2017 reporting period through annual monitoring activities (see recovery activity (RA) #15).</p> <p>Results suggest that the spatial distribution of Atlantic Whitefish in the Petite Rivière watershed may be decreasing. During this reporting period, Atlantic Whitefish were not observed in the Hebb Dam fishway after 2012; however, a school of adult-size Atlantic Whitefish were observed swimming around sampling gear in Hebb Lake in 2014. Young-of-the-year Atlantic Whitefish were captured in the rotary screw trap (RST) in the Milipsigate Dam outlet area of Hebb Lake in 2015 and 2016, suggesting that mature Atlantic Whitefish continue to persist in the Petite Rivière Lakes.</p>	BCAF, DFO

^h Lead participant(s) is/are listed on top and in bold; other participants are listed alphabetically.

ⁱ Bluenose Coastal Action Foundation are currently known as Coastal Action

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#	Study	Timeline	Status	Descriptions and results	Participants ^h
2	Complete bathymetric surveys of the three lakes to help better describe the identified critical habitat	2015 to 2020	In progress	Bathymetry surveys of the three Petite Rivière lakes were initiated and ongoing during the previous reporting period. Coarse-grid bathymetric maps were produced for both Hebb and Milipsigate lakes (DFO 2016). During this reporting period these surveys were completed and a coarse-grid map for Minamkeak was also produced. More comprehensive bathymetry surveys are required to provide additional information about the features and attributes of the critical habitat identified for the Atlantic Whitefish, and estimating available Atlantic Whitefish habitat during each season, including determining possible locations of cold-water refugia.	BCAF, Nova Scotia Power Incorporated (NSPI), Nova Scotia Department of Fisheries and Aquaculture (NSDFA)
3	Live trapping and electrofishing surveys of the streams that feed into the lakes to assess population use	2015 to 2018	In progress	<p>Although not all were undertaken with the specific purpose of targeting Atlantic Whitefish, live trapping and electrofishing surveys were conducted in several of the streams that feed into the Petite Rivière lakes:</p> <ul style="list-style-type: none"> backpack electrofishing surveys: between Weagle's Dam and Fancy Lake on July 12, 2012 (see RA #32), in Wildcat Brook to the north of the Petite Rivière lakes on September 23, 2015 (see RA #9), and in the Caribou Lake area south of Minamkeak Lake on August 22, 2016 (see RA #13) a fyke net was deployed at Weagle's Dam outlet of Hebb Lake in spring 2013 (see RA #15) <p>No adult or juvenile Atlantic Whitefish were captured or observed during these surveys.</p> <p>Additional streams to be surveyed include Birch Brook with flows into Milipsigate Lake and the outflow of Frederick Lake (unknown stream name) that flows into Minamkeak Lake.</p>	BCAF
4	Assess use of river, estuary and relevant marine habitat of the existing population in the Petite Rivière once anadromy	2015 to 2020	Not started	Completion of the Hebb Dam Fish Passage Facility in 2012 enabled upstream fish passage for Atlantic Whitefish at Hebb Dam (see RA #27), and annual monitoring of the fishway has been conducted by BCAF	BCAF, DFO

#	Study	Timeline	Status	Descriptions and results	Participants ^h
	is successfully established with the provision of fish passage around Hebb Dam.			in subsequent years (see RA #16). A total of 19 Atlantic Whitefish were observed in the fishway in fall 2012; however, no additional Atlantic Whitefish have been intercepted in the fishway since that time or observed during any monitoring activities below the Hebb Dam (RA #15). No targeted assessments of river, estuarine and marine habitats are planned at this time because there is no indication that anadromy has been re-established on the Petite Rivière despite the provision of fish passage (see Performance indicator #4 in table 5).	

3.3 Summary of progress towards recovery

3.3.1 Status of performance indicators

Table 7 provides a summary of the progress made toward meeting the performance indicators outlined in section 2.3.2 of this progress report. Each indicator has been assigned one of four statuses:

1. not met: the performance indicator has not been met, and little to no progress has been made
2. partially met, underway: the performance indicator has not been met, but there has been moderate to significant progress made
3. met: the performance indicator has been met and no further action is required
4. met, ongoing: the performance indicator has been met, but efforts will continue until such time the population is considered to be recovered (that is, the indicator will be reported against in the next five-year progress report)

Table 7. Progress made toward meeting the performance indicators (PI) outlined in the recovery strategy for the Atlantic Whitefish. Linkages to the recovery activities (RA) from tables 3, 4 and 5 are identified.

#	Performance indicator	Status	Details and next steps/recommendations
1	Critical habitat has been identified and protected.	Partially met, underway	Critical habitat is considered identified when it is published in a final recovery strategy. During this reporting period, critical habitat was identified in the proposed version of the amended recovery strategy (Recovery Activity (RA) #19), but the final version was not published until 2018 (DFO 2018a).

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#	Performance indicator	Status	Details and next steps/recommendations
			Critical habitat protection for the Atlantic Whitefish was accomplished through the making of a <i>Species at Risk Act</i> (SARA) critical habitat order, as required by subsection 58(4) and (5) of SARA, which invoked the subsection 58(1) prohibition against the destruction of the identified critical habitat. The critical habitat order was not in place until September 2018 which was outside this reporting period.
2	Research activities outlined in the schedule of studies have been completed.	Partially met, underway	<p>Three studies identified in the critical habitat schedule of studies are currently in progress and one has not yet started. For more information, see table 4 and RA #9, #12 to 13, #15, #1 to 22, #27, and #31 in table 3.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Continue habitat research activities outlined in the schedule of studies until all studies are completed, with priority aimed at localizing spawning habitat and defining habitat requirements (study #1) • Initiate study #4 upon the successful establishment of anadromy on the Petite Rivière
3	Abundance of the existing wild population in the Petite Rivière lakes has been estimated and meets target (>1,275 mature adults).	Not met	<p>The monitoring activities undertaken during this reporting period did not provide the information needed to estimate population abundance. Despite ongoing monitoring activities, primarily focused on Hebb Lake (for example, Hebb Dam Fish Passage Facility, Milipsigate Dam outlet area - RA #15 and #16), the number of adult-sized Atlantic Whitefish observations declined since the last reporting period.</p> <p>Observations of adult-sized Atlantic Whitefish during this reporting period include those 19 intercepted in the fishway in 2012 (RA #16), two individuals incidentally captured in Hebb Lake during invasive species mitigation work (RA #11), and a school of Atlantic Whitefish near the rotary screw trap (RST) in 2014 (RA #15). Several young-of-the-year Atlantic Whitefish were also captured in the RST in Hebb Lake in 2015 and 2016 (RA #15).</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Continue to monitor for the presence of various life stages of Atlantic Whitefish in the Petite Rivière lakes • Undertake additional monitoring activities in Milipsigate and Minamkeak lakes to confirm the presence of Atlantic Whitefish • Explore other methods and techniques for estimating population abundance (for example, environmental DNA and acoustic surveys) • Continue to mitigate threats and implement recovery measures outlined in the action plan (DFO 2018b) aimed at achieving the population and distribution objectives for Atlantic Whitefish in an effort to stabilize and meet the population abundance target

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#	Performance indicator	Status	Details and next steps/recommendations
4	Anadromy has been established on the Petite Rivière.	Not met	<p>The Hebb Dam Fish Passage Facility became operational in fall 2012 (RA #27) and 19 adult-sized Atlantic Whitefish were observed in the fishway that same fall (RA #16). Despite this initial positive sign, no Atlantic Whitefish have been observed in the fishway since and there is no evidence that anadromy has been established on the Petite Rivière.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Continue monitoring the Hebb Dam fishway each fall for migrating Atlantic Whitefish • Revisit the existing water control plan for Hebb Dam and evaluate the effectiveness of the Hebb Dam fishway to ensure it has the necessary conditions for Atlantic Whitefish passage (such as stream flow and access) • Evaluate potential options for re-establishing anadromy on the Petite Rivière (for example, identifying partnering opportunities and propagation mechanisms) • Implement relevant recovery measures identified in the action plan (that is, recovery measures #4, #12, and #14 to 15 in DFO 2018b), such as improving other impediments to fish passage in the Petite Rivière
5	A self-sustaining population has been established in another freshwater waterbody (for example, Anderson Lake).	Not met	<p>A self-sustaining population of Atlantic Whitefish has not been established in another freshwater waterbody. Results of the Anderson Lake stocking activities are summarized in Bradford et al. (2015); see RA #17. Approximately 12,000 captive-bred Atlantic Whitefish were stocked in Anderson Lake during the years 2005 to 2008, with a final allotment in 2012, but no progeny were observed during monitoring conducted in 2006 to 2010, 2012, and 2016. It appears that F1 Atlantic Whitefish (that is, first generation fish resulting from parents bred in captivity) survived to sexual maturity, but there was no indication of spawning activity, or that progeny resulted from any spawning activity within the lake. The Anderson Lake experience yielded useful insights concerning the spawning potential of F1 Atlantic Whitefish, the potential effects of captive rearing on survivability of F1 released to the wild, stocking strategies, and habitat suitability.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Implement relevant recovery measures outlined in the action plan, including: <ul style="list-style-type: none"> – identify viable mechanisms and partnering arrangements to support range expansion – identify priority locations for Atlantic Whitefish introduction initiatives – develop and implement operational plans for Atlantic Whitefish range expansion activities
6	Anadromy has been established in a second watershed in Nova	Not met	<p>Efforts to establish anadromy in other watersheds in Nova Scotia's Southern Uplands eco-region have not been made. Instead, recovery activities have been focused on supporting survival of the existing population in the Petite Rivière lakes and monitoring in existing locations (RA #8 to 16, #25 to 31).</p>

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#	Performance indicator	Status	Details and next steps/recommendations
	Scotia's Southern Uplands eco-region.		<p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Identify viable mechanisms and partnering arrangements to support range expansion • Identify priority locations for Atlantic Whitefish introduction initiatives • Develop and implement operational plans for Atlantic Whitefish range expansion activities
7	The feasibility of repatriating an anadromous run to the Tusket River has been evaluated, and repatriation pursued if appropriate.	Met, ongoing	<p>The feasibility of repatriation to the Tusket River has been evaluated, but repatriation has not been pursued. A PhD thesis completed in 2012 (RA #1; Cook 2012) included a framework for assessing habitat suitability for Atlantic Whitefish introductions and a preliminary evaluation of the feasibility of repatriating an anadromous run of Atlantic Whitefish to the Tusket River. This evaluation assessed habitat suitability for repatriation and translocation of Atlantic Whitefish to various watersheds in the Southern Uplands eco-region of Nova Scotia using the available information on survival in relation to several environmental conditions. The predicted survival rates of Atlantic Whitefish in the Tusket River through the first year of life were among the lowest for the habitats examined in the study.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Do not pursue repatriation of an anadromous run of Atlantic Whitefish to the Tusket River as a priority at this time • Identify and pursue suitable priority locations for Atlantic Whitefish introduction initiatives within the Southern Uplands eco-region of Nova Scotia
8	The threat posed by Smallmouth Bass and Chain Pickerel is understood, and appropriate mitigation and management measures are in place to control their abundance and ensure the survival of Atlantic Whitefish in the Petite Rivière.	Partially met, underway	<p>DFO, Bluenose Coastal Action Foundation (BCAF^j), and Nova Scotia Department of Fisheries and Aquaculture (NSDFA) carried out studies and monitoring activities to better understand the threat invasive fish species pose to Atlantic Whitefish survival (RA #8 to 13). Studies were undertaken to estimate abundance and distribution of invasive fish species, and to evaluate methods to reduce their abundance including a three year boat-electrofishing study, a directed angling study, and analyses of stomach contents (RA #10 to 12). What should be considered appropriate mitigation and management measures to ensure the survival of Atlantic Whitefish are still, however, unknown.</p> <p>Since the 2013 discovery of Chain Pickerel in the Petite Rivière lakes, monitoring suggests that native fish abundance and diversity in Hebb Lake changed over a relatively short period of time (for example, RA #9). As of February 2017, over 3,200 Smallmouth Bass and nearly 400 Chain Pickerel were removed from the system by boat electrofishing and other control methods (RA #8 to 13). Preliminary results of boat electrofishing and angling surveys indicate that they have the potential to be efficient methods of controlling Smallmouth Bass and Chain Pickerel abundance and production (RA #10 to 11).</p>

^j Bluenose Coastal Action Foundation are currently known as Coastal Action

#	Performance indicator	Status	Details and next steps/recommendations
			<p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Review results of invasive fish surveys to evaluate appropriate next steps and future mitigation options • Evaluate the effectiveness of the mitigation measures used to date (boat electrofishing and angling) as well as additional tools and mechanisms for removing invasive fish (for example, nest destruction, altering boat electrofishing protocols to sample earlier in the year when Smallmouth Bass are spawning) and implement them as needed • Increase the total invasive species mitigation effort applied and expand efforts into all three lakes • Continue invasive species mitigation in the Petite Rivière lakes and undertake an adaptive approach while the most effective approach is evaluated and implemented • Pursue efforts to establish a self-sustaining population of Atlantic Whitefish in a waterbody free of invasive fish species as a priority. This will include securing a viable range expansion mechanism and partnering arrangement to support implementation • Pursue efforts to establish anadromy on the Petite Rivière (see PI #4)
9	Progress has been made towards filling other knowledge gaps identified in the amended recovery strategy.	Met, ongoing	<p>Progress has been made in addressing knowledge gaps of importance to recovery planning and recovery strategy implementation (see tables 3, 4 and 5). Information is now available or forthcoming in the following areas:</p> <ul style="list-style-type: none"> • phylogenetic status and population status of the species (RA #1 and 15) • genetic health of the remaining members of the species (RA #1) • accurate field identification of living specimens using external characteristics (RA #2) • genetic markers to support enforcement efforts and future assessments of species distribution (RA #1) • captive breeding and rearing protocols (RA #6) • feasibility of establishing additional freshwater resident populations using seed stock reared in captivity (RA #5, #7, and #17) • life-history stage specific assessments of susceptibility to acid (rain) toxicity, thermal preferences, and salinity tolerance (RA #1) • trophic position of Atlantic Whitefish residing in lakes • potential threat to survival or recovery resulting from the presence of invasive species (RA #8 to 13) • fish passage requirements around dams (RA #16 and #27 to 29) <p>Next steps/recommendations: Continue to undertake studies to address knowledge gaps identified in the recovery strategy (DFO 2018a).</p>

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#	Performance indicator	Status	Details and next steps/recommendations
			<p>Continue or undertaken action plan (DFO 2018b) recovery measures aimed at addressing knowledge gaps:</p> <ul style="list-style-type: none"> • assess the status of the species in the Petite Rivière lakes • undertake habitat research identified in the schedule of studies • evaluate the applicability of the residence concept under SARA for the Atlantic Whitefish against new national level guidance and criteria • explore mitigation options for addressing invasive fish species in the Petite Rivière lakes
10	<p>An adaptive communication plan has been developed, engaged stewards are active, and public awareness and acceptance of the Atlantic Whitefish has increased and been expanded to new areas selected for introductions.</p>	<p>Partially met, underway</p>	<p>Various organizations such as BCAF, BPSC and NSDFA, and other members of the Atlantic Whitefish Conservation and Recovery Team (AWCRT), have demonstrated their continued commitment and dedication to Atlantic Whitefish public awareness and stewardship efforts (see table 3). Outreach and education activities carried out by DFO and its partners (RA #36), as well as extensive media coverage during the reporting period (RA #35), helped raise public awareness about the status and plight of the Atlantic Whitefish. An adaptive communication plan has not been developed.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Continue existing communication efforts and explore new opportunities to engage stewards and increase public awareness and acceptance of Atlantic Whitefish • Develop and implement an adaptive communication plan as identified in the action plan (DFO 2018b)
11	<p>Human activities permitted by the recovery strategy continue to not jeopardize the survival or recovery of the Atlantic Whitefish.</p>	<p>Met, ongoing</p>	<p>Human activities permitted by the recovery strategy (that is, authorized scientific conservation and recovery activities led by DFO, authorized electrofishing, and authorized fishing activities for other species that result in incidental capture of Atlantic Whitefish) have been managed (for example, by application of the conditions set in the recovery strategy) throughout the reporting period to ensure that they do not jeopardize the survival or recovery of the Atlantic Whitefish.</p> <p>Next steps/recommendations:</p> <ul style="list-style-type: none"> • Continue to manage human activities permitted by the recovery strategy such that they do not jeopardize the survival or recovery of the Atlantic Whitefish
12	<p>An action plan has been completed and is posted in the Species at Risk Public Registry.</p>	<p>Partially met, underway</p>	<p>A proposed action plan for the Atlantic Whitefish was completed and posted to the Species at Risk (SAR) Public Registry in 2016 (RA #20). The final version was published outside this reporting period in 2018 (DFO 2018b). The action plan outlines 26 recovery measures that will be undertaken by DFO, partners, and/or other jurisdictions or organizations to implement the four broad strategies for recovery described in the recovery strategy.</p> <p>Next steps/recommendations:</p>

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#	Performance indicator	Status	Details and next steps/recommendations
			<ul style="list-style-type: none">• Work collaboratively with partners to implement the recovery measures identified in the action plan for the Atlantic Whitefish

3.3.2 Completion of action plan

A draft action plan for the Atlantic Whitefish in Canada was developed during this reporting period and the proposed version was published to the Species at Risk (SAR) Public Registry in June 2016. The final version of the action plan was published outside the reporting period in 2018 (DFO 2018b; RA #20). The action plan is comprehensive in scope and includes all the recovery measures deemed necessary to address threats and fully implement the recovery strategy by addressing all four broad strategies. The action plan seeks to build on previous and ongoing activities that address the recovery objectives.

3.3.3 Critical habitat identification and protection

The original recovery strategy (DFO 2007) was amended to include an identification of critical habitat, to the extent possible. The proposed version of the amended recovery strategy (DFO 2018a) was published to the SAR Public Registry in June 2016. The final amended recovery strategy, with Atlantic Whitefish critical habitat identified in section 2.5, was published on the SAR Public Registry in September 2018 (DFO 2018a) outside the reporting period of this progress report (RA #19).

Under SARA, critical habitat for aquatic species must be legally protected within 180 days after it is identified in a final recovery strategy or action plan published to the SAR Public Registry. Work to establish a SARA subsection 58(4) and (5) critical habitat order was initiated during this reporting period. The critical habitat order was completed and published outside the reporting period in September 2018 (RA #21). The critical habitat order invokes the prohibition in subsection 58(1) against the destruction of the identified critical habitat (table 3.2, RA #22). Additional critical habitat may be identified in the future if efforts to establish anadromy or expand the species' range are successful.

3.3.4 Recovery feasibility

Recovery feasibility was assessed in section 2.1 of the recovery strategy (DFO 2018a). The recovery strategy concluded that recovery of the Atlantic Whitefish is considered to be both biologically and technically feasible; however, the time to recovery will be dependent both upon the current status of the remaining wild population in the Petite Rivière lakes and the timing and extent of human intervention (DFO 2018a). It further states that success in mitigating current threats to the species, particularly invasive fish species, and identifying viable range expansion mechanisms that can be implemented in a timely manner will be essential for achieving the population and distribution objectives for this species.

A review of recovery feasibility may be warranted in the next iteration of the recovery strategy given that the Government of Canada has published a new Policy on Survival and Recovery (Government of Canada 2021), and given the severity of the threat posed by invasive fish species. In the meantime, recovery should continue to be deemed feasible and threat mitigation and recovery efforts should continue.

4. Concluding statement

Tables 3 to 7 summarize the progress made toward implementing the recovery strategy during this five-year reporting period (February 2012 to February 2017). Activities were undertaken in support of the overall recovery goal and the population and distribution objectives. Three of the 12 performance indicators were met, and progress was made toward meeting five other indicators. Little progress was made to address the remaining four indicators which include areas of performance that are fundamental to the survival and recovery of Atlantic Whitefish, such as stabilizing the population in the Petite Rivière lakes, re-establishing anadromy, and range expansion.

Although some progress toward Atlantic Whitefish recovery was made during the reporting period, there were also new and significant challenges. The arrival of Chain Pickerel in the Petite Rivière lakes in 2013 further compounded the threat already presented by Smallmouth Bass. Together, these species present a serious threat to the survival and recovery of Atlantic Whitefish. The continued spread of invasive fish species throughout Nova Scotia further constrains potential Atlantic Whitefish range expansion opportunities. The conclusion of DFO's Atlantic Whitefish captive-rearing program in 2012 also left recovery efforts without a viable range expansion mechanism.

It has not been possible to estimate Atlantic Whitefish abundance using the population monitoring methods employed; therefore, the status of the population in relation to the population objective cannot be reported at this time. During this reporting period, although several adult-sized Atlantic Whitefish were intercepted or observed in the Petite Rivière, these observations were minimal. Whether these limited observations reflect declining abundance or are the result of other factors is unknown. Comparisons of fish sampling studies before and after the establishment of Chain Pickerel in the Petite Rivière lakes suggest that the fish community is already being altered (BCAF 2016). These adult observations, coupled with observations of young-of-the-year Atlantic Whitefish in Hebb Lake at the Milipsigate Dam outlet area in 2015 and 2016, however confirm that mature Atlantic Whitefish continue to persist in the Petite Rivière lakes.

The small group of Atlantic Whitefish observed in the fishway at Hebb Dam Fish Passage Facility in fall 2012 was an encouraging sign that improvements to fish passage could help establish anadromy in the Petite Rivière and that progress was being made toward achieving the distribution objective. Unfortunately, no Atlantic Whitefish have been observed in the fishway since, and anadromy has not been established in the Petite Rivière or elsewhere in the Southern Uplands eco-region. Factors that may have contributed to the lack of Atlantic Whitefish observations at the fishway may include their extremely low production combined with the presence and spread of Chain Pickerel within the Petite Rivière system. A review of the efficacy of the Hebb Dam fishway for Atlantic Whitefish passage and the water management regime may also be warranted. Results of monitoring activities in Anderson Lake suggest that the stocked Atlantic Whitefish did not successfully reproduce within the lake and no individuals have been observed since 2012, meaning that the species' range has not yet been successfully expanded beyond the Petite Rivière. In contrast, the range of invasive fish species continues to expand to waterbodies throughout the Southern Uplands eco-region and beyond. The presence of invasive fish species, and the absence of a viable range expansion mechanism, represent important challenges to achieving the distribution objective for the Atlantic Whitefish going forward.

DFO and its partners remain committed to the protection and recovery of the Atlantic Whitefish and will continue to collaborate on implementing the recovery strategy and action plan. Important next steps include to continue monitoring (using a variety of sampling methods) the status of the Atlantic Whitefish in the Petite Rivière lakes, enforcing and promoting the protection of critical habitat, continuing to mitigate the impact of invasive fish species in the Petite Rivière lakes whilst analyzing results and evaluating future mitigation options, and identifying strategies for range expansion and re-establishing anadromy. DFO will continue to work with partners to explore options and opportunities to implement these measures. For example, since the conclusion of DFO's Atlantic Whitefish captive-rearing program and outside this reporting period, DFO has developed a new partnership with the Dalhousie University Aquatron Laboratory for the holding, raising and breeding of wild-caught Atlantic Whitefish to support potential future research and recovery efforts. Dalhousie University is also working with partner organizations Coastal Action and the Nova Scotia Salmon Association to construct a streamside rearing trailer to use for acclimating and imprinting captive-bred progeny to a potential future home waterbody, whilst DFO and these same partners are surveying Nova Scotia lakes to determine their suitability as Atlantic Whitefish habitat. The future outcomes of these initiatives will be reported on in the next 5-year progress report.

Measures for mitigating current threats to the species, particularly invasive fish species, and for expanding the range of the Atlantic Whitefish need to be implemented in a timely manner to achieve the population and distribution objectives for this species and for its recovery to remain feasible.

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Appendix A: Atlantic Whitefish Conservation and Recovery Team 2017 membership

Organization	Members
Bluenose Coastal Action Foundation	Nodding, Brooke Breen, Andrew Longley, Philip
Bridgewater Public Service Commission	Hiltz, Tim
Fisheries and Oceans Canada (DFO)Science	Showell, Mark
DFO Fisheries Management	Stevens, Greg Whorley, David (Chair)
DFO Species at Risk Management Division	Robichaud-LeBlanc, Kim
DFO Fisheries Protection Program	Delaney, Leanda
DFO Conservation and Protection	Burgess, Roland Wolfe, William
DFO Communications	Hayden, Jazmine
Native Council of Nova Scotia	Stevens, Jeff
Maritime Aboriginal Peoples Council	McNeely, Joshua
Nature Nova Scotia	Comolli, Jill
Nova Scotia Department of Fisheries and Aquaculture	LeBlanc, Jason
Nova Scotia Museum of Natural History	Gilhen, John (co-Chair)
Nova Scotia Power Corporation	Wamsley, Jay
Nova Scotia Transportation and Infrastructure Renewal	Pett, Bob