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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2022/020

Maritimes Region

Proceedings of the Regional Peer Review of the Stocking Strategy for the Establishment of Self-Sustaining Atlantic Whitefish (*Coregonus huntsmani*) Population(s) and Development of a Framework for the Evaluation of Suitable Lake Habitat.

November 1–2, 2017
Dartmouth, Nova Scotia

Chairperson: Lottie Bennett
Editor: Lottie Bennett

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May 2022

Canada

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca

ISSN 1701-1280
ISBN 978-0-660-43191-8 Cat. No. Fs70-4/2022-020E-PDF

Correct citation for this publication:

DFO. 2022. Proceedings of the Reginal Peer Review of the Stocking Strategy for the Establishment of Self-Sustaining Atlantic Whitefish (*Coregonus huntsmani)* Population(s) and Development of a Framework for the Evaluation of Suitable Lake Habitat; November 1–2, 2017. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2022/020.

Aussi disponible en français :

MPO. 2022. Compte rendu de la réunion régionale par les pairs sur l'évaluation de la stratégie d'empoissonnement pour l'établissement d'une ou de plusieurs populations autosuffisantes de corégones de l'Atlantique (Coregonus huntsmani) et création d'un cadre pour l'évaluation d'habitats propices dans des lacs; du 1er au 2 novembre 2017. Secr. can. des avis sci. du MPO. Compte rendu 2022/020.

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SUMMARY

A Regional Science Peer Review meeting was held on November 1–2, 2017, at the Bedford Institute of Oceanography (BIO) in Dartmouth, Nova Scotia, to review stocking strategies that could support the establishment of a self-sustaining Atlantic Whitefish population in a new location and to evaluate a framework for determining suitable habitat for the successful establishment of an Atlantic Whitefish population outside of its current distribution. Participation in this meeting included Fisheries and Oceans Canada (DFO), non-DFO scientists, Aboriginal and Environmental non-government organizations.

The Atlantic Whitefish was listed as Endangered under the *Species at Risk Act* in 2003. The species is restricted to three interconnected lakes in Nova Scotia and its viability is threatened by illegal introduction of aquatic invasive species, in particular Smallmouth Bass and Chain Pickerel. The 2007 Atlantic Whitefish Recovery Strategy and Action Plan, which outline measures to help achieve survival and recovery of the species, identified range expansion as part of the overall recovery goal.

This proceedings document includes a summary of the presentation and is the record of the meeting discussions and conclusions. A Science Advisory Report resulting from this meeting will be published on the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website.

INTRODUCTION

The Atlantic Whitefish (*Coregonus huntsmani*) is an anadromous member of the whitefish family that is restricted to three interconnected landlocked lakes (Minamkeak, Milipsigate, and Hebb lakes) within the Petite Riviére catchment in Lunenburg County. Long-term survival of the Petite Riviére populations is considered to be at risk from numerous factors including the presence of illegally introduced, non-native, piscivorous Smallmouth Bass and Chain Pickerel. Smallmouth Bass were first reported in the Petite Riviére system in 2000 (LeBlanc 2010), and are currently present in all three lakes. The presence of Chain Pickerel in both the Hebb and Milipsigate lakes was confirmed in 2013 (Themelis et al. 2014).

Atlantic Whitefish was assessed as 'Endangered" by the Committee on the Status of Endangered Wildlife in Canada in 1984 and has been listed and protected as endangered on Schedule 1 of the *Species at Risk Act* since 2003. A proposed Action Plan for Atlantic Whitefish was published by DFO in 2016 (amending DFO 2006), outlining measures to help achieve survival and recovery of the species.

The meeting Chairperson, Lottie Bennett, introduced herself, followed by an introduction of meeting participants (Appendix 1). The Chair thanked meeting participants for attending the DFO Regional Peer Review Process. The Chair provided a brief overview of the Canadian Science Advisory Secretariat (CSAS) peer review process and invited participants to review the meeting Terms of Reference (Appendix 2) and Agenda (Appendix 3). This Proceedings report is the record of the discussion of the meeting.

To guide discussions, a technical report and draft CSAS Science Advisory Report had been prepared and distributed to participants prior to the meeting, and is not to be used in any other forum, distributed, or cited. This CSAS Proceedings document constitutes a record of meeting discussions, and any statements within should not be attributed as being consensus-based.

PRESENTATION AND DISCUSSION

STOCKING STRATEGIES FOR THE ESTABLISHMENT OF SELF-SUSTAINING ATLANTIC WHITEFISH POPULATION

Working Paper: Supplementation Options to Aid Recovery of the Endangered Atlantic Whitefish (*Coregonius huntsmani*). Prepared by Rod Bradford.

Science Lead: J. Broome
Rapporteur: L. Bennett

Presentation Summary

The historical distribution, present range, as well as the status of and threats to Atlantic Whitefish within its range were presented. The Petite Rivière Lakes were described as the only remaining source of Atlantic Whitefish to support population survival and recovery activities. Invasive Smallmouth Bass and Chain Pickerel have been illegally introduced into these lakes and pose a significant and emergent threat to the ongoing survival of Atlantic Whitefish, which are considered to be at imminent risk for global extinction.

An overview of catches from monitoring activities was presented. Population abundance of Atlantic Whitefish has never been quantitatively assessed, but is considered to be very low. No adult Atlantic Whitefish have been captured or observed since 2014. Atlantic Whitefish are considered to be below detectable levels in Hebb Lake, following the establishment of both

Chain Pickerel and Smallmouth Bass. Between 2015–2017, limited numbers (n = < 100 total) of larval stage Atlantic Whitefish have been collected using a Rotary Screw Trap positioned below Milipsigate Dam. These captures indicate the continued survival and reproductive success of an unknown adult population in Milipsigate and/or Minamkeak Lakes.

Past experience in husbandry and rearing at the former Mersey Biodiversity Facility, and releases of Atlantic Whitefish were briefly presented. Previous release activities did not result in self-sustaining populations; however, the program was successful in developing expertise and techniques for captive spawning and rearing of Atlantic Whitefish.

Propagation program release targets, which were assumed from successful Coregonid release programs in the United Kingdom (UK), were highlighted. Proposed release targets of 12,500–15,150 larvae per year would require approximately 220–320 mature adults (50:50 sex ratio) exhibiting the traits (i.e., size, fecundity) of the lake-resident donor population or approximately 95–135 mature adults (50:50 sex ratio) using wild-caught fish maintained in a captive environment. A long-term program requiring ongoing commitment would be required to meet the proposed release targets.

Habitat suitability considerations in reference to selecting potential waterbodies for release were presented. Based on the limited knowledge of Atlantic Whitefish in the wild, habitat suitability focused on water quality parameters such as temperature, pH, and salinity, which have been evaluated under laboratory conditions.

Discussion

Introduction and Background

The historical and current distribution of Atlantic Whitefish was discussed. Atlantic Whitefish have been exclusively restricted to the Petite Rivière watershed, within Minamkeak, Milipsigate, and Hebb Lakes, for several decades and are under increasing pressure from illegally introduced invasive species within these lakes. Atlantic Whitefish were suspected to have been historically distributed throughout Nova Scotia's Southern Uplands Eco-Region (DFO 2009). The historical range of Atlantic Whitefish within the Southern Uplands should be defined and added for clarification to the maps within meeting documentation.

Adult Atlantic Whitefish were last observed in 2014 outside a rotary screw trap situated in the outflow channel below the Milipsigate Lake Dam, and from a gill net in the Minamkeak Lake; however, the number of Atlantic Whitefish and their locations within the lakes are currently unknown. It was suggested that sightings of uncaptured fish, separated by life stages, be included in the meeting documentation

To maintain consistent language across species, such as Atlantic Salmon, it was suggested that the term "stocking" be changed to "release" throughout the meeting documentation.

Supplementation Options and Stocking Considerations

Supplementation options and stocking considerations of Atlantic Whitefish were discussed. In 2017, the following three stocking options were presented for consideration to Fisheries and Oceans Canada (DFO): simple translocation, translocation with temporary holding, and establishment of a propagation program at DFO's Coldbrook Biodiversity Facility. Of the three stocking options, translocation with temporary holding was approved by DFO management. The following issues were identified and would need to be resolved for this option to succeed.

- The length of the approval process did not permit translocation to occur in the spring of 2017. The fish health screening, which is required as part of the Introduction and Transfer (I&T) permitting process, takes a minimum of five week to complete.

- The number of Atlantic Whitefish available for translocation makes the success of this option unlikely.
- The length of time required to obtain a sufficient number of larvae is unknown.
- Details of the translocation area were not confirmed.
- The optimal life stage for release was not identified.

Moving forward, additional quarantine facilities other than DFO, such as Dalhousie University, should be considered for inclusion in future I&T permitting. Assuming approval of the I&T permit following the health screening, it was asked whether fish should be moved given their limited numbers, the short amount of time to hold them, and the lack of knowledge regarding their spawning habitat requirement. The risks associated with increased movements of fish should be considered.

A salmonid species (i.e., Brook Trout) is the preferred substitute for Atlantic Whitefish for the fish health screening. However, it was noted that the Fish Health Lab is willing to accept Smallmouth Bass, White Perch, and Brown Bullhead as substitute species should a salmonid species not be readily available. This testing is currently underway, and results of the screening are expected in the near future; however, I&T permits are only valid for six months. The timelines associated with the permit do not enable an early spring research project to proceed, despite the substitution of the species for the health screening, unless arrangements are made to secure an extension in the fall of the previous calendar year.

Propagation, Augmentation and Reintroduction

Definitions of propagation, augmentation and reintroduction were provided to meeting participants. It was recommended that examples and clarity on the limits and scope of each activity should be included in meeting documentation.

Four rationales for supplementation were provided and discussed. The rationales included small global distribution of the species, the presence of two invasive species, the lack of an abundance estimate, and the insufficient number of Atlantic Whitefish to support population survival and recovery objectives. Discussion concerning each rationale is provided below.

Small Global Distribution

The abundance of Atlantic Whitefish has not been quantified. It was asked whether data concerning the percent decline of other species present within the Petite Lakes were available since the introduction of invasive species. The results of sampling completed by Nova Scotia Department of Fisheries and Aquaculture indicate that Catch Per Unit Effort (CPUE) of native species has generally declined in systems where Chain Pickerel were introduced. It was also noted that, in fall of 2016, following a month of fishing effort, only Chain Pickerel were caught in a trap net set in the same location where Atlantic Whitefish and other native species had been captured in 2007. It was recommended that CPUE data collected by the Nova Scotia Department of Fisheries and Aquaculture be included in the meeting documentation.

Presence of Two Invasive Species

Participants noted that ongoing efforts to maintain the Petite Lakes population should be continued and expanded in effort and scope, particularly in the absence of other direct interventions. A previous CSAS meeting, which reviewed Invasive Species Control Strategies, suggested concluded that the current magnitude of invasive species control efforts within the Petite Lakes is too low and that invasive species control within the Lakes would require a multi-strategy approach that would require a long-term commitment of resources. It was recommended that these conclusions be referenced in the meeting documentation. In addition

to removal-based efforts, lowering the water level of the Petite Lakes during the spawning periods of invasive species as well as piscicide application (i.e., Rotenone) were potential techniques suggested by meeting participants to remove Chain Pickerel and Smallmouth Bass from the lakes.

There are currently only two lakes where Atlantic Whitefish complete their lifecycle. It was proposed that predation mortality may be so high that recruitment to the adult population cannot occur.

Lack of an Abundance Estimate

It was suggested that the numbers concerning low abundance should be qualified to indicate that adults and sub-adults are currently below detection levels.

Insufficient Numbers to Support Population Survival and Recovery Objectives

There are currently an insufficient number of Atlantic Whitefish to support survival and recovery of the population. It may be possible to propagate enough fish to support translocation; however, it remains unknown what the impact of any level of removals will be on the wild population. The minimum number of fish needed to establish a viable population will be difficult to determine given the available information. The value presented in the Recovery Potential Assessment was based on an effective population size; however, there was no empirical basis for this value.

Ranking Atlantic Whitefish Supplementation Options

A ranking of release options was presented and discussed. The supplementation option presented in Bradford (2017) builds upon the Decision Support Tool (DST; DFO 2004) and is consistent with the global thinking on translocation. Bradford (2017) gives attributes relative rankings of high, medium and low. It was noted that the attributes were binned in broad and general categories that should be considered when evaluating a waterbody for supplementation activities; however, as knowledge of a waterbody increases or activities shift from maintaining survival to population recovery, the attributes and/or rankings may change. It was suggested that rankings be put in context with the long-term (restoration of anadromy) and short-term goals (to achieve stability in the current population, and establishment of additional self-sustaining populations through range expansion).

In addition to the attributes presented in Bradford (2017), it was suggested that partnering opportunities be considered when deciding on potential translocation sites as the potential impact of this activity can influence public receptiveness.

The definitions of survival and recovery were discussed and it was suggested that the definitions of survival and recovery within meeting documentation should align with the definitions in the Atlantic Whitefish Recovery Strategy. It was noted that maintaining the survival of Atlantic Whitefish within the Petite Lakes alone does achieve established recovery objectives for the population.

Stocking Source Options

Potential source stock of Atlantic Whitefish for supplementation was discussed. There is a natural loss of fish from the downstream dispersal/spillover of larvae over the Milipsigate Lake Dam. There is no upstream passage that allows these fish to return to their lake of origin and the risk of predation is high downstream. These larval stage fish are considered lost from the population. As they are considered “lost”, removal of these spillover larvae is thought to be of lower overall risk to the existing population. Because spawning locations and requirements for Atlantic Whitefish are currently unknown and the population is below detection levels, the use of spillover larvae as a source stock for translocation activities was considered a viable option of

lower overall risk to the existing population; however, it is unknown whether this source would continue to remain available in the long term and it was suggested that contingency strategies to collect other life stages should be considered. Translocation of adults from the current population was not considered a viable option as the number of adults is considered to be very low and the consequence of removing the number of fish required for successful translocation activities from the existing population is unknown.

Understanding the level of genetic risk associated with the removal of adults and lost larvae would be helpful. Given the low population numbers, the level of genetic diversity is low and has declined; additional genetic risks are expected to be minimal. The collection of larvae over multiple years that represent different year classes/cohorts could increase the likelihood of maximizing available genetic diversity.

Effective population size (N_e) estimates are based on the number of fish required to stem decline of genetic diversity. Given the timeframe for which population abundance values have been low, it is likely that deleterious mutations have been deleted from the population. It was suggested that it may be worthwhile to see if there is enough genetic diversity to examine relatedness; however, it may not be possible given the low abundance of Atlantic Whitefish.

Stock Life Stage

While there are advantages and disadvantages to the use of different life stages for stocking; meeting participants agreed that fish should be released at the earliest possible stage, with post-yolk sac larvae being the preferred life stage for release. To further reduce the potential risks of domestication selection, the release of F1 offspring spawned from wild-caught parents should be prioritized over releasing offspring from parents bred and reared in captivity.

Stocking Level and Duration

Conservation release programs of related coregonid species have been successful at establishing self-sustaining populations. Comparable egg (55,00–81,500) and larvae (12,500–15,150) propagation targets for Atlantic Whitefish would require, approximately 220–320 mature adults exhibiting the traits (i.e., size, fecundity) of the lake-resident donor population or approximately 95–135 mature adults using wild-caught fish maintained in a captive environment.

There was a lengthy discussion concerning the need for a propagation program to ensure that sufficient numbers of either freshwater resident or anadromous Atlantic Whitefish are available for release activities. Based on stocking programs of related coregonid species carried out in the UK, it is anticipated that between 95–135 wild sourced adult broodstock maintained in captivity is needed to meet the egg and larvae release targets, assuming 50% egg survival, 80% larval survival, and 90% broodstock survival. It was noted that broodstock would be comprised of Atlantic Whitefish initially sourced from the Petite Lakes as larvae. It is expected that minimally 5–6 years of effort would be required to introduce multiple year classes of the F1 generation in a waterbody, after which several years of monitoring would be required to determine whether a self-sustaining population has been established. It was stressed that this will be a long-term program that requires ongoing commitment and that failure to restore a propagation program is expected to contribute to the expedited extinction of the species. Alternatively, stocking the system with wild origin fish was also suggested as a possibility; however, it is not unreasonable that the supply of lost/spillover juveniles currently found at the outflow of the Milipsigate Lake Dam will no longer be available within the next decade given the decline of the current adult population to levels below detection thresholds.

Performance Indicators

The ultimate goal of the stocking strategy is to have a self-sustaining reproducing population. A population of 1,275 adults, the interim recovery target, is an estimate of the number of adults needed to maintain a long term evolutionary potential in the Petite system. This estimate could be considered low, and higher numbers have been advocated and recommended in recent literature (Frankham 1995, Frankham et al. 2014). The estimate is dependent on the properties of the system, such as predation rate.

Short, medium, and long-term performance indicators should be applied to all segments of the release program (broodstock, egg, wild population) to demonstrate the extent to which program goals are being met. At a minimum, it was suggested that the short-term performance indicators meet the survival targets set by the previous propagation program at the DFO Mersey Biodiversity Facility. Potential short and medium-term performance indicators could be linked to the collection, survival, and maturation of juveniles, egg and larvae survival, and successful spawning while long-term performance indicators could be linked to growth, the presence of a stable age structure, and evidence of spawning.

Ongoing monitoring would be required to determine if the long-term performance indicators are being met. Monitoring goals, the techniques to detect and quantify fish, and collection metrics need to be established. Currently, sampling gear allows for the detection of fish but does not allow for quantitative evaluations. It was suggested that detection of a broadening age structure should be a monitoring priority. Monitoring efforts will need to be put in place to capture all life-stages as a first step for detecting presence and growth, which will enable monitoring of abundance and survival.

Stocking Location and Habitat Suitability

It was asked whether lakes outside of the Southern Uplands Ecoregion could be considered for stocking. According to recovery documents, the Southern Uplands (SU) Ecoregion is suspected to have been the historical range of the Atlantic Whitefish (DFO 2006) and will be the first area of focus; however, lakes located outside of the SU Ecoregion, which contain the necessary physical attributes and lack invasive species, should not be excluded from consideration. It was recommended that additional information concerning the potential use of the SU region for translocation be included within the meeting documentation.

Lakes with little or no development, as well as watersheds that may have a natural barrier, should also be considered. It was also suggested that data on the attributes of different systems, where DFO is conducting work on other species, be considered when identifying potential sites for translocation.

Reduced pH has been linked to decreased survival of all Atlantic Whitefish life stages. It was noted that the pH of the Petite Lakes varies throughout the year but has maintained a mean annual average greater than 5.6. In simulations, anadromous migration has permitted higher survival in the most acidified systems, but data for locations with higher pH values, outside the Southern Uplands watershed, demonstrate high numbers of invasive species. The pH must be considered when selecting potential translocation sites.

There are no historical records on the use of the Tusket system for residency; however, historical records from fishways imply that fish used the lakes above the fishways for reproduction.

At present, it is difficult to assess the relative importance of physical habitat characteristics of the Petite Rivière lakes as Atlantic Whitefish habitat requirements or preferences are not well understood, and the current population numbers are unknown. Lack of knowledge regarding

specific habitat requirements of Atlantic Whitefish introduces significant challenges toward selection of a potential release waterbody for establishment of a self-sustaining population. Generalized habitat considerations have been given relative rankings, and should be adapted as further research is conducted and feedback from real time monitoring is obtained. Not all characteristics are weighted equally with the presence of invasive species and the pH granted a higher weighting. Each characteristic would be evaluated in terms of relative risk and benefits.

The minimum lake size that should be considered for translocation was discussed. Small lakes cannot support as large of a population but may be easier to monitor than larger lakes. Although a self-sustaining population did not become established, work completed on Anderson Lake demonstrated that a lake of approximately 60 hectares in size supported the survival and growth of Atlantic Whitefish over several years. Methods to evaluate habitat suitability have not been fully developed as the habitat requirements by life-history stage are not well understood.

In addition to habitat requirements of lake resident fish, marine habitat requirements remain unknown. Where there is capacity to monitor, it was suggested that the acoustic telemetry predation tags implanted in Atlantic Whitefish which would then be released into the Kejimikujik Seaside could provide important information on marine habitat use.

Between May 2007 and March 2009, 12,025 Age 2+ (or older) Atlantic Whitefish were released below Hebb Dam (Whitelaw et al. 2015). Of the fish released, some were captured in an eel weir. Fish that returned to Hebb Dam had doubled in size the first summer. A group of 19 adult Atlantic Whitefish were captured in 2012 in the newly opened Hebb Dam Fishway Trap. These Atlantic Whitefish may have been survivors of the 2007–2009 hatchery releases, or could be returns of wild Atlantic Whitefish that passed over Hebb Dam.

Biological Considerations

The species composition of a lake must be fully understood before the introduction of Atlantic Whitefish. There is low diversity of native species in Petite Lakes which includes forage species such as Yellow Perch, White Perch, and White Sucker, which are generally indicative of a neutral pH. The risk of negative interaction between Atlantic Whitefish and these species is considered lower as they are natural fauna that have co-existed with Atlantic Whitefish. Given the limitations associated with water quality and the presence of invasive species, a watershed containing Lake Whitefish should not be excluded from consideration; however, its presence should be flagged as a concern. Spawn timing and the spatial overlap of spawning habitat should be compared between Atlantic Whitefish and Lake Whitefish. A lake that supports a diverse species assemblage would be a good option for stocking and there is an increased likelihood that adequate resources would be available to support the population. Food requirements for the pelagic phase of Atlantic Whitefish are similar to Brook Trout and perch. It was suggested that a macrofauna survey of a lake be completed prior to the release of Atlantic Whitefish into a system. Lakes with anadromous species may have higher nutrients due to marine derived nutrients being carried to the system by species such as Alewife.

An important consideration is the potential for introduction of disease from the existing environment. A river/lake should be sampled to ensure it is disease free before introducing Atlantic Whitefish.

The type of bedrock, specifically the alkalinity or buffering capacity, within the lake/watershed is linked to fish diversity. It was recommended that geological bedrock layers be examined and watersheds with monolithic sandstone, bluestone, or meta-greywacke rock could be a useful starting point for investigating potential release locations. It was also recommended to incorporate search effort of watersheds that are not included on the map of secondary watersheds, which was developed through the Nova Scotia Watershed Assessment Program.

It was advised that multiple potential release locations should be selected and that broodstock estimates should be adjusted to reflect the additional sites. The current broodstock estimate incorporates mortality associated with husbandry but only represents an estimate of release numbers required for a single location. Meeting documentation should indicate that production targets and requisite broodstock numbers will increase if releases are to occur in multiple sites. It was suggested that broodstock estimates could be reported as numbers per hectare.

Research Recommendations

Throughout the meeting, suggestions for additional research were noted and are included in the following list. List order is not intended to imply order of priority.

- Commence work to identify spawning locations and habitat requirements of each lifecycle stage for lake-resident Atlantic Whitefish.
- Commence work to identify marine habitat requirement of anadromous Atlantic Whitefish.
- Develop techniques to monitor progress of the propagation program over time.
- Develop sampling methods to detect and quantify population abundance.

DOCUMENTS

A CSAS Research Document will not be produced as a product of this meeting. Rather, a technical report (Bradford 2017) served as the background document for this meeting. A CSAS Science Advisory Report (SAR) will be published. All meeting products will be published on the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat's (CSAS) Website as they become available.

This Proceedings Document constitutes the record of meeting discussions and recommendations.

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APPENDICES

APPENDIX 1: LIST OF MEETING PARTICIPANTS

Name	Affiliation
LeBlanc, Jason	Nova Scotia Dept. Fisheries & Aquaculture
Arany, Jillian	Confederacy of Mainland Mi'kmaq
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Bradford, Rod	DFO Science, Maritimes Region

APPENDIX 2: TERMS OF REFERENCE

Stocking Strategy for the Establishment of Self-Sustaining Atlantic Whitefish Populations of a Framework and Development of a Framework for the Evaluation of Suitable Lake Habitat

Regional Advisory Process – Maritimes Region

November 1–2, 2017
Dartmouth, Nova Scotia

Chairpersons: Lottie Bennett and Lei Harris

TERMS OF REFERENCE

Context

The Atlantic Whitefish (*Coregonus huntsmani*) was listed as Endangered under the *Species at Risk Act* in 2003. The species is currently restricted to three small interconnected lakes in the upper Petite Rivière watershed in southwest Nova Scotia and is currently threatened by invasive predatory fish species (Smallmouth Bass and Chain Pickerel) within this last remaining habitat. Range expansion, the establishment of additional self-sustaining populations outside the currently occupied habitat in the Petite Rivière, is identified as part of the overall recovery goal in the Atlantic Whitefish Recovery Strategy and Action Plan (DFO 2016a, 2016b) and could also prevent extinction.

Undertaking introduction activities in any new habitat will require Science advice on the recommended stocking strategy to guide introduction actions that maximize the likelihood of a self-sustaining Atlantic Whitefish population being successfully established. The provision of this advice may be guided by the Atlantic Whitefish Culture Handbook (Whitelaw et al. 2015), stocking mechanisms of *Coregonid sp*. used elsewhere in support of survival and recovery (e.g., translocation, propagation, genetic, and non-genetic based captive-breeding), as well as the experience gained from the Atlantic Whitefish release experiment in Anderson Lake (Bradford et al. 2015).

Opportunities to expand the range of the species to another system within its historic distribution, as well as partnering opportunities, are being explored. Science advice is required to develop a framework in which potential waterbodies can be evaluated for their suitability for Atlantic Whitefish.

Objectives

The first objective of this meeting is to determine a recommended stocking strategy to guide introduction actions to increase the likelihood that a self-sustaining Atlantic Whitefish population will be successfully established in a new location within the Southern Upland ecoregion of Nova Scotia.

The second objective of this meeting is to evaluate a framework for determining suitable habitat for the successful establishment of an Atlantic Whitefish population outside its current distribution.

Based on what is known about the historical range of Atlantic Whitefish, as well as its habitat requirements and life history characteristics (in both the Petite Rivière lakes and the former anadromous population in the Tusket River system), advice is required to answer the following questions:

Stocking Strategy

1. What stocking strategies could be used to establish a self-sustaining Atlantic Whitefish population into another waterbody?
    a. What are the risks to the existing Atlantic Whitefish population in the Petite Rivière lakes associated with stocking and how can these risks be minimized?
2. What is the recommended stocking strategy (e.g., number of fish, life stage, number of releases, composition, release locations, timeline) to maximize the likelihood of success in establishing a self-sustaining Atlantic Whitefish population in another waterbody?
3. What are the recommended performance indicators and monitoring requirements to evaluate success?

Habitat Suitability Framework

4. What characteristics (e.g., habitat type, water quality, species assemblage) would provide suitable habitat for the successful establishment of a self-sustaining Atlantic Whitefish population? What are the knowledge gaps and how can these uncertainties be addressed?
5. How should the potential ecological risks to a receiving waterbody from the introduction of Atlantic Whitefish be assessed and what measures should be put in place to avoid or minimize risks?

Expected Publications

- Science Advisory Report
- Proceedings

Expected Participation

- Fisheries and Oceans Canada (DFO) Ecosystems and Oceans Science
- DFO Ecosystem Management
- DFO Fisheries Protection Program
- Nova Scotia Department of Fisheries and Aquaculture
- Parks Canada Agency
- Aboriginal communities/organizations
- Non-governmental organizations

References

Bradford, R.G., Themelis, D., LeBlanc, P., Campbell, D.M., O'Neil, S.F., and Whitelaw, J. 2015. Atlantic Whitefish (*Coregonus huntsmani*) Stocking in Anderson Lake, Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 3142: vi + 45 p.

DFO. 2016a. Amended Recovery Strategy for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada [Proposed]. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa. xiii + 60 pp.

DFO. 2016b. Action Plan for the Atlantic Whitefish (*Coregonus huntsmani*) in Canada [Proposed]. *Species at Risk Act* Action Plan Series. Fisheries and Oceans Canada, Ottawa. vii + 39 pp.

Whitelaw, J., Manríquez-Hernández, J., Duston, J., O'Neil, S.F., and Bradford, R.G. 2015. Atlantic Whitefish (*Coregonus huntsmani*) culture handbook. Can. Manuscr. Rep. Fish. Aquat. Sci. 3074: vii + 55 p.

APPENDIX 3: MEETING AGENDA

Stocking Strategy for the Establishment of Self-Sustaining Atlantic Whitefish Populations and Development of a Framework for the Evaluation of Suitable Lake Habitat

Regional Peer Review – Maritimes Region

November 1–2, 2017
Needler Boardroom

Bedford Institute of Oceanography
Dartmouth, Nova Scotia

Chairs: Lottie Bennett and Lei Harris

DRAFT AGENDA

DAY 1 (Wednesday, November 1, 2017)

Time	Topic
09:00– 09:30	Welcome
09:30–10:30	Introduction and Background
10:30–10:45	***Break*** *(Coffee/tea provided)*
10:45–12:00	Review of Supplementation Options and Stocking Considerations
12:00–13:00	***Lunch*** *(Hospitality Not provided – cafeteria is on-site)*
13:00–14:30	Continuation of Stocking Considerations and Habitat Suitability
14:30–14:45	***Break*** *(Hospitality not provided)*
14:45–16:00	Discussion

DAY 2 (Thursday, November 2, 2017)

Time	Topic
09:00–09:15	Recap of Previous Day
09:15–10:30	Review of the Science Advisory Report (SAR)
10:30–10:45	***Break*** *(Coffee/tea provided)*
10:45–12:00	Review of the SAR cont'd
12:00–13:00	***Lunch*** *(Hospitality Not provided – cafeteria is on-site)*
13:00–14:30	Review of SAR cont'd (if necessary)