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Central and Arctic Region

Proceedings of the Regional Peer Review on the Recovery Potential Assessment – Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence population (DU5)

Meeting date: December 10, 2019
Location: Burlington, ON

Chairperson: Lynn Bouvier
Editor: David Andrews

Fisheries and Oceans Canada
Great Lakes Laboratory for Fisheries and Aquatic Sciences
867 Lakeshore Rd.
Burlington ON L7S 1A1 Canada

April 2021

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.

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

A regional science peer-review meeting was held on December 10th, 2019 in Burlington, Ontario. The purpose of the meeting was to assess the recovery potential of Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence population (DU5) to provide advice that may be used for a listing decision under the Species at Risk Act, for the development of a recovery strategy and action plan, and to support decision making with regards to the issuance of permits or agreements. Participants included DFO Science and Species at Risk programs, the United States Geological Survey (USGS), the U.S. Fish and Wildlife Service (FWS), the United States Environmental Protection Agency (EPA), and experts from universities in Canada and the United States.

In November 2016, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence populations (Designatable Unit [DU] 5]) as Threatened. This designation was based on a decline in abundance over the last several decades along with the potential for invasive species and/or native predators to threaten or limit recovery.

This proceedings report summarizes the relevant discussions from the meeting and presents recommended revisions to be made to the associated research document. The Proceedings, Science Advisory Report, and Research Documents resulting from this science advisory meeting are published on the DFO Canadian Science Advisory Secretariat (CSAS) website.

INTRODUCTION

In November 2016, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assessed Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence populations (Designatable Unit [DU] 5) as Threatened. This designation was based on a decline in abundance over the last several decades along with the potential for invasive species and/or native predators to threaten or limit recovery (COSEWIC 2016). The Recovery Potential Assessment (RPA) process has been developed by Fisheries and Oceans Canada (DFO) to provide information and scientific advice needed to fulfill requirements of the federal Species at Risk Act (SARA), including the development of recovery strategies and authorizations to carry out activities that would otherwise violate SARA (DFO 2007). The purpose of the meeting, as described in the Terms of Reference (Appendix 1), was to assess the recovery potential of Pygmy Whitefish (*Prosopium coulterii*; DU5). The RPA is a science-based peer review process based on DFO (2007) and updated guidelines (DFO unpublished) that involve the assessment of 22 recovery potential elements, including biology, abundance, distribution and life history parameters, habitat, threats and limiting factors to survival and recovery, and scenarios for mitigation of threats and alternatives to activities. A peer-review meeting was held on December 10th, 2019 to discuss the Pygmy Whitefish (DU5) RPA. Meeting participants included DFO (Central and Arctic Region), the United States Geological Survey (USGS), the U.S. Fish and Wildlife Service (FWS), the United States Environmental Protection Agency (EPA), and academic experts (Appendix 2). The meeting followed the agenda outlined in Appendix 3.

DETAILED DISCUSSION

The meeting chair provided the participants with an introduction to the RPA process and explained the purpose of the meeting. This included information on where the RPA process fits with respect to the COSEWIC assessment and SARA listing process for Pygmy Whitefish (DU5). This included the intent of the meeting and how the products of the meeting might be used. Terms of Reference were outlined. Three draft research documents entitled “Information in support of a Recovery Potential Assessment of Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence population (DU5)”, “Recovery Potential Modelling of Pygmy Whitefish (*Prosopium coulterii*) in Canada (Great Lakes – Upper St. Lawrence populations)”, and “Lake Superior Pygmy Whitefish (*Prosopium coulterii*) population trends, habitat characteristics, and abundance” had been developed by DFO and provided to participants in advance of the meeting. The draft research documents were the basis for discussion, and participants were encouraged to add to or change the material, as needed, to ensure that the best and most up-to-date information was included.

SPECIES DESCRIPTION

Presenter: Dave Andrews

This presentation included information on the description of Pygmy Whitefish in Lake Superior, including morphological characteristics, coloration, lifespan, growth rates, diet, and distribution. There was much discussion among multiple participants regarding the use of scales vs. otoliths as appropriate ageing structures for Pygmy Whitefish. In the recovery potential modelling document, scales were used to estimate age of maturity of females. Participants agreed that the documents should state the uncertainty with using scales as an ageing structure. One participant asked the group if there is any new fecundity data given the historical data is on the low side. A participant responded that there is not any new data, but that this type of data would be nice to have going forward.

CURRENT STATUS AND POPULATION ASSESSMENT

Presenter: Adam van der Lee

Results from the paper "Lake Superior Pygmy Whitefish (*Prosopium coulterii*) population trends, habitat characteristics, and abundance" were used to address the population status of Pygmy Whitefish in Lake Superior. A participant noted that the heat map of Western Lake Superior is lit up in recent years and wanted to know if catches reflect this. The author stated that this is mostly due to a couple of sites having greater than expected catches over the last few years. The same participant asked if this was a result of sampling site changes in recent years. The author stated that nearshore trawls have been fairly consistent in that area, however, another attendee noted that some sites were dropped.

A discussion soon followed involving multiple participants about estimates of density. A participant stated that hydroacoustics are not used to estimate density or biomass of Pygmy Whitefish as the fish live too close to the bottom, and therefore, are not picked up by the sonar. Another participant asked for clarification of the trawl survey by USGS with respect to depth contours. A participant stated that the depth sampled is consistent between years, however, Canadian sites are generally in deeper water than American sites. Despite this, the participant suggested that depth should not be driving population decline unless fish have changed their depth distribution which would not be expected.

A participant asked if Lake Trout (*Salvelinus namaycush*) population recovery throughout the lake was occurring and if that was thought to influence Pygmy Whitefish population dynamics. The response from the group was that Lake Trout populations have generally rebounded but that this varied spatially. Lake Trout in Michigan and Wisconsin waters have rebounded but this has not been observed on the eastern Canadian side of the lake. This respondent stated that this could be the reason why lots of Pygmy Whitefish are found in this region.

Results of the population modelling led one participant to state that the trend in biomass declines of Pygmy Whitefish has occurred over one generation and this differs from the interpretation of population trajectory that was published by COSEWIC in 2016. The participant then went on to state that this will be an important point that DFO will use to make any future listing decisions under the SARA. Another contributor agreed that declines have been observed over the last several years but wondered if this would be in the realm of typical population cycling. Participants generally agreed but one reviewer stated that the model is still at the lowest population level since 1989. The author stated that they are definitely at a low point, the significance of which will be revealed over the next few years of trawl data collection. This led to one participant to ask if COSEWIC would need to see 10 more years of decline to conclude that there is cause for concern. A participant then responded that declines over three generations are just one criteria for which COSEWIC considers a status of "threatened" or "endangered" but that there are other criteria as well.

Discussions on populations status led the group to discuss recruitment for Pygmy Whitefish in the lake. One person suggested that there has not been any great recruitment event in recent years, which is concerning given the recent population decline. Another attendee asked what whitefish species in the lake has the most similar life history characteristics to Pygmy Whitefish and what does recruitment look like for that species. A participant responded that Lake Whitefish is most similar and their recruitment is also down. This led to one participant to ask if there are any current working theories on why whitefish recruitment is down in Lake Superior and if this could this be related to predation by invasive species, storm events, or combinations thereof. The response from attendees was that there are no working theories given that there are not any invasive species that occupy that depth that were not there 20 years ago. This respondent went on to state that very little is known about larval habitat use and whether larvae are benthic or pelagic. These questions have not been answered and could provide context with respect to declines in this species. In response to participants being concerned with the biomass of the latest year being at the lowest point of the time series, the author stated that there is an edge effect as a result of the gamma distribution. This means that the edge of the plot declines further than what might be real. This would be rectified by having 2019 data.

The presenter proceeded to explain the covariate model which solicited a question from one participant regarding the use of data. This participant asked if the covariate data was limited to 2013 onwards. The presenter acknowledged that this was true since the collection of most water profile data began in 2013. The question was then raised if differences between the generalized linear model and the Integrated Nested Laplace Approximation (INLA) model could be explained by spatial autocorrelation. The presenter agreed with this interpretation.

The presentation of maps showing density of Pygmy Whitefish in grid cells throughout the lake spurred a discussion on how this map was displayed. One participant thought that cells with a zero density should be white to highlight that they are different from neighbouring cells that are coloured. The author explained that there is not much difference between 0 and 0.005 density, therefore this is not important. On the contrary, the participant pointed out that zero vs. non-zero density values are important as they will factor into decisions that programs make. The presenter then stated that areas that have low density, based on neighbouring trawls, may not have Pygmy Whitefish in reality as this is a model prediction. The group discussed the potential for fish to be found in transit in some of these low density areas. The consensus was that this is possible but there is not enough information on dispersal capability of this species, especially with respect to larvae.

Estimated biomass of Pygmy Whitefish was published in 2012 according to one participant. This estimate used a dataset from the early 2000s and biomass was found to be 10 times higher than what is estimated here but still within the range of error in van der Lee and Koops (2020). The author noted that the biomass estimate in this study is conservative because of the small extent of the spatial field used in the INLA model. Also, another participant noted that the estimate published in 2012 was based on the early 2000s when Pygmy Whitefish biomass was much higher than present day.

Depth as a predictor of occurrence led to discussion among group participants. One attendee asked if Pygmy Whitefish are always present when bottom trawls occur at 90 m. A participant stated that this is typically true, but in some cases they are not. Instances of absence at 90 m depth have occurred west of the Apostle Islands. The participant noted that this area, interestingly, is flat and contains sand and mud substrates. The participant suggested that it could be that rocky, steeper habitats are more preferred than flat areas containing sand and mud.

Group discussion then turned to recruitment of Pygmy Whitefish. A participant suggested that you could take 90–100 mm fish that are vulnerable to bottom trawls and back calculate two years to recruitment class. This may be the best way to get at recruitment since Pygmy Whitefish individuals less than 70 mm are not vulnerable to bottom trawls. This prompted one person to ask if other small fishes are similarly less vulnerable to this gear type. A participant responded that sculpin between 40 mm and 100 mm in total length are captured but these fish are much more abundant than Pygmy Whitefish. Another participant stated that there is evidence that small Pygmy Whitefish individuals use shallower waters than adults. This prompted another participant to note that young of the year were caught in waters less than 15 m deep near the Apostle Islands in 2008 using similar gear.

Model parameters were discussed by the group with a participant asking how maturity based on otoliths would impact age at maturity estimates. A participant noted that 100% maturity at age four may not be perfectly accurate. Age at maturity may be slightly higher but this probably has little influence on the model. Another parameter discussed was the distance correlation value in the INLA model. The author stated that this value is not known and that he tried to choose a biologically appropriate value. The group discussed how individuals in the lake may disperse and whether or not populations are connected throughout the lake or if the lake consists of only one population. Participants agreed that if multiple populations are isolated in the lake, then this decreases the probability of extinction. Although genetics or quasi-extinction thresholds were not investigated in this study, we know that increasing the quasi-extinction model rapidly ramps up minimum viable population size to keep extinction risk low. Participants pointed out that population structure was not identified in this study but that this would be impacted by how larvae disperse. If larvae are benthic then the probability of dispersal is much lower. A participant suggested that it is unrealistic to expect that individuals across the lake belong to one population, but rather there are likely many populations. This led one participant to question an extinction threshold at the lake level. They asked what would cause a 50% decline in the population across the entire lake. Participants postulated on what may be contributing to declines in Lake Superior, with Lake Trout predation or recruitment failure due to environmental variables as possible hypotheses. The INLA model, according to one participant, shows a periodic fluctuation in biomass which suggests that climate or food web impacts could be the cause. However, this remains unknown.

The group discussed elasticities in the model and mortality by life stage. A participant asked why the juvenile life stage is the most sensitive to harm with respect to population size. The coauthor stated that this was due to the length of the juvenile stage as well as a short adult life stage. Typically, the juvenile stage is the most important unless the fish is long-lived. The model uses an estimated catastrophe rate to estimate MVP, and some participants questioned how relevant this is to Pygmy Whitefish in Lake Superior. A coauthor responded that a disease outbreak could cause mass mortality, which is an example of a rare catastrophic decline.

A participant suggested to look at density by size classes to see how recruitment has changed over time. A coauthor stated that this would not be possible since there is not enough data to make statistical inferences on size classes. The data already have broad confidence intervals and for that reason the authors are reluctant to break it down further.

HABITAT REQUIREMENTS; FUNCTIONS, FEATURES, AND ATTRIBUTES TABLE

Presenter: Dave Andrews

The presentation included a description of Pygmy Whitefish habitat requirements for three life stages: spawn to hatch, young of the year and juvenile, and adult. Key habitat variables and their functions for each stage were listed. This included the importance of deepwater nearshore habitat.

The group discussed juvenile vs. adult habitat in Lake Superior. There are some that believe Pygmy Whitefish individuals are at shallower depths than adults. One participant asked if comparisons could be made with Round Whitefish (*Prosopium cylindraceum*), another member of the genus *Prosopium* that can be found in Lake Superior. Another participant stated that there are similarities in life history between the two species, but Pygmy Whitefish are found at deeper depths.

Temperature range for Pygmy Whitefish was thought to be narrow by one participant. Another attendee stated that there is not much variation in temperature range at the discussed depths in Lake Superior. This does not mean that temperature does not matter, but over the range given, it does not appear to be important. For this reason, participants suggested that temperature and similarly, dissolved oxygen, be removed from the description for critical habitat.

The discussion of habitat use by life stage led one participant to ask if it makes sense to lump young of the year and juveniles together into one category. Given that it is not known how spawning sites differ from hatching sites or where young of the year are found, a coauthor stated that it is appropriate to lump these together with habitat stated as unknown.

THREAT STATUS AND ASSESSMENT

Presenter: Dave Andrews

The presentation on threat status overviewed the likelihood and impact of threats, as well as the causal certainty associated with the threat impact. It was established that threat likelihood of occurrence (LO) would be categorized as “known” (K), “likely” (L), “unlikely” (UL), “remote” (R) or “unknown” (U); and threat impact level (LI) would be categorized as “extreme” (E), “high” (H), “medium” (M), “low” (L), or “unknown” (U). The causal certainty (CC) associated with threat level of impact would be categorized as “very high” (1), “high” (2), “medium” (3), “low” (4), or “very low” (5). The threat status was presented for the entire DU.

During the discussion of pollution, one participant stated that dioxins can also get absorbed through the skin, and therefore fishes can get exposed to these chemicals outside of direct consumption. This should be noted in the research document. Another participant asked if there are any sampling sites near Thunder Bay where pollution could be an issue. A participant responded that there are three sites but they were not sure if the water was deep enough to expect to catch Pygmy Whitefish at these locations.

The discussion of invasive species as a threat to Pygmy Whitefish led to a discussion on how threats in general may be contributing to Pygmy Whitefish biomass decline. A coauthor noted that they struggled with the threat section as evidence linking threats to population decline is weak or nonexistent. Alternatively, the authors tried to present potential ways in which these threats could be linked to population decline, while noting the lack of evidence. This led to the group discussing possible ways in which invasive species may be impacting Pygmy Whitefish. Rainbow Smelt (*Osmerus mordax*) could be impacting Pygmy Whitefish through food web effects such as competition or predation but participants noted that the overlap between these two species with respect to habitat use is not very strong. Another participant noted that if Rainbow Smelt were increasing and Pygmy Whitefish were decreasing this might be a concern but this trend has not been observed. Others discussed which species may use similar habitats to Pygmy Whitefish including Threespine Stickleback (*Gasterosteus aculeatus*) and Round Goby (*Neogobius melanostomus*).

Pygmy Whitefish, and prey fish in general, have declined in abundance throughout Lake Superior. Some people suggest that top-down pressure from recovering Lake Trout populations could be to blame. A participant stated that with declines in prey fish, one might expect zooplankton prey to increase but that the opposite has happened. Declines in biomass at multiple trophic levels are not consistent with the top-down hypothesis and one might wonder if bottom-up processes are important in Lake Superior. One participant noted that the algal fauna has been shifting in Lake Superior with smaller diatoms dominating, leading to shifts in the food web. A participant asked if Pygmy Whitefish are ever found in the stomachs of Lake Trout. In response, an attendee said that only a handful of Pygmy Whitefish have been found in Lake Trout stomach samples, with many stomachs sampled very year. However, encounter rate between an individual Lake Trout and Pygmy Whitefish is likely to be low given the low density of this prey fish.

Climate change and its potential impacts on Pygmy Whitefish was discussed amongst participants. Lack of ice cover and its potential impacts on reproduction were discussed with one participant noting that this hypothesis has not been tested. However, according to their knowledge, high recruitment is not always observed in years with good ice coverage. Others noted that changes in the food web in Lake Superior such as the reduction in size spectra of algal communities and its potential impacts on prey fish is a hypothesis that is worth testing.

The causal certainty of the threats impacting Pygmy Whitefish should be lowered to a '5', according to one participant. Another attendee noted that potential of pollution to harm fish in Lake Superior seems like a tenuous connection. Limiting factors such as predation or prey availability may contribute to declines in Pygmy Whitefish but participants felt that this could not be concluded at this time.

SOURCES OF UNCERTAINTY

Presenter: Dave Andrews

The presentation addressed sources of uncertainty related to Pygmy Whitefish life history, habitat needs, and population abundance. This included gaps in knowledge of spawning habitat, habitat requirements for each life stage, and potential impacts of threats or limiting factors such as predation and prey availability. One participant suggested that the authors work with limnologists to better understand how changes in Lake Superior over the last few decades can be related to Pygmy Whitefish populations.

CONCLUDING REMARKS AND NEXT STEPS

The Chair thanked all participants for all of their comments on the three research documents, and next steps were discussed. Participants stated that they wanted to review the Science Advisory Report once a draft was completed and then the meeting was adjourned.

REFERENCES CITED

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2016. COSEWIC assessment and status report on the Pygmy Whitefish *Prosopium coulterii*, Southwestern Yukon Beringian populations, Yukon River populations, Pacific populations, Western Arctic populations, Great Lakes – Upper St. Lawrence populations, Waterton Lake populations and Saskatchewan - Nelson Rivers populations in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, ON. iv + 69 p.

DFO. 2007. Revised Protocol for Conducting Recovery Potential Assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/039.

van der Lee, A.S., and Koops, M.A. 2020. Lake Superior Pygmy Whitefish (*Prosopium coulterii*) population trends, habitat characteristics, and abundance. DFO Can. Sci. Advis. Sec. Res. Doc. 2020/074. iv + 18 p.

APPENDIX 1. TERMS OF REFERENCE

Recovery Potential Assessment – Pygmy Whitefish (Prosopium coulterii), Great Lakes – Upper St. Lawrence population (DU5)

Regional Peer Review Meeting – Central and Arctic Region

December 10, 2019
Burlington, ON

Chairperson: Lynn Bouvier

Context

After the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses an aquatic species as Threatened, Endangered or Extirpated, Fisheries and Oceans Canada (DFO) undertakes a number of actions required to support implementation of the Species at Risk Act (SARA). Many of these actions require scientific information on the current status of the wildlife species, threats to its survival and recovery, and the feasibility of recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment. This timing allows for consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

In support of listing recommendations for Pygmy Whitefish by the Minister, DFO Science has been asked to undertake an RPA, based on the national RPA Guidance. The advice in the RPA may be used to inform both scientific and socio-economic aspects of the listing decision, development of a recovery strategy and action plan, and to support decision making with regards to the issuance of permits or agreements, and the formulation of exemptions and related conditions, as per sections 73, 74, 75, 77, 78 and 83(4) of SARA. The advice in the RPA may also be used to prepare for the reporting requirements of SARA s.55. The advice generated via this process will update and/or consolidate any existing advice regarding the Pygmy Whitefish.

Objective

To provide up-to-date information, and associated uncertainties, to address the following elements:

Biology, Abundance, Distribution and Life History Parameters

Element 1: Summarize the biology of Pygmy Whitefish.

Element 2: Evaluate the recent species trajectory for abundance, distribution and number of populations.

Element 3: Estimate the current or recent life-history parameters for Pygmy Whitefish.

Habitat and Residence Requirements

Element 4: Describe the habitat properties that Pygmy Whitefish needs for successful completion of all life-history stages. Describe the function(s), feature(s), and attribute(s) of the habitat, and quantify by how much the biological function(s) that specific habitat feature(s) provides varies with the state or amount of habitat, including carrying capacity limits, if any.

Element 5: Provide information on the spatial extent of the areas in Pygmy Whitefish's distribution that are likely to have these habitat properties.

Element 6: Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.

Element 7: Evaluate to what extent the concept of residence applies to the species, and if so, describe the species' residence.

Threats and Limiting Factors to the Survival and Recovery of Pygmy Whitefish

Element 8: Assess and prioritize the threats to the survival and recovery of the Pygmy Whitefish.

Element 9: Identify the activities most likely to threaten (i.e., damage or destroy) the habitat properties identified in elements 4-5 and provide information on the extent and consequences of these activities.

Element 10: Assess any natural factors that will limit the survival and recovery of the Pygmy Whitefish.

Element 11: Discuss the potential ecological impacts of the threats identified in element 8 to the target species and other co-occurring species. List the possible benefits and disadvantages to the target species and other co-occurring species that may occur if the threats are abated. Identify existing monitoring efforts for the target species and other co-occurring species associated with each of the threats, and identify any knowledge gaps.

Recovery Targets

Element 12: Propose candidate abundance and distribution target(s) for recovery.

Element 13: Project expected population trajectories over a scientifically reasonable time frame (minimum of 10 years), and trajectories over time to the potential recovery target(s), given current Pygmy Whitefish population dynamics parameters.

Element 14: Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present and when the species reaches the potential recovery target(s) identified in element 12.

Element 15: Assess the probability that the potential recovery target(s) can be achieved under current rates of population dynamics parameters, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.

Scenarios for Mitigation of Threats and Alternatives to Activities

Element 16: Develop an inventory of feasible mitigation measures and reasonable alternatives to the activities that are threats to the species and its habitat (as identified in elements 8 and 10).

Element 17: Develop an inventory of activities that could increase the productivity or survivorship parameters (as identified in elements 3 and 15).

Element 18: If current habitat supply may be insufficient to achieve recovery targets (see element 14), provide advice on the feasibility of restoring the habitat to higher values. Advice must be provided in the context of all available options for achieving abundance and distribution targets.

Element 19: Estimate the reduction in mortality rate expected by each of the mitigation measures or alternatives in element 16 and the increase in productivity or survivorship associated with each measure in element 17.

Element 20: Project expected population trajectory (and uncertainties) over a scientifically reasonable time frame and to the time of reaching recovery targets, given mortality rates and productivities associated with the specific measures identified for exploration in element 19. Include those that provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.

Element 21: Recommend parameter values for population productivity and starting mortality rates and, where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts in support of the listing process.

Allowable Harm Assessment

Element 22: Evaluate maximum human-induced mortality and habitat destruction that the species can sustain without jeopardizing its survival or recovery.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participants

- Fisheries and Oceans Canada (Science Sector, Species at Risk Program, and Fisheries Protection Program)
- Ontario Ministry of Natural Resources and Forestry
- Academics
- Other invited experts

APPENDIX 2. LIST OF PARTICIPANTS

Name	Organization/Affiliation
Dave Andrews	DFO - Science
Jason Barnucz	DFO - Science
Lynn Bouvier (Chair)	DFO - Science
Tessa Brinklow (Rapporteur)	DFO - Science
Andrew Drake	DFO - Science
Marten Koops	DFO - Science
Tom Pratt	DFO - Science
Adam van der Lee	DFO - Science
Doug Watkinson	DFO - Science
Joshua Stacey	DFO - Species at Risk Management
Owen Gorman	U.S. Geological Survey
Mark Vinson	U.S. Geological Survey
Joel Hoffman	U.S. Environmental Protection Agency
Jared Myers	U.S. Fish and Wildlife Service
Mike Rennie	Lakehead University
Taylor Stewart	University of Vermont

APPENDIX 3. AGENDA

Recovery Potential Assessment of Pygmy Whitefish (*Prosopium coulterii*), Great Lakes – Upper St. Lawrence population (DU5) Regional Peer Review Meeting

Central and Arctic Region

Canada Centre for Inland Waters, 867 Lakeshore Rd., Burlington, ON

Date: 10th December 2019
Chairperson: Lynn Bouvier

South Seminar Room (L225S)		Presenter
9:00	Welcome and Introductions	L. Bouvier
9:15	Purpose of Meeting	L. Bouvier
9:30	Species Description, Life History, and Distribution	D. Andrews
9:45	Population Assessment: INLA Spatial Model and Recovery Potential Modelling	A. van der Lee
10:45	Break	-
11:00	Population Assessment: INLA Spatial Model and Recovery Potential Modelling continued	A. van der Lee
12:00	Lunch	-
13:00	Habitat Requirements; Functions, Features and Attributes Table	D. Andrews
13:30	Threat Status	D. Andrews
15:00	Break	-
15:15	Threat Mitigation and Uncertainties	D. Andrews
15:30	Review of Terms of Reference	L. Bouvier
16:00	End of Meeting	-