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Proceedings of the Regional Peer Review of the Recovery Potential Assessment – River Darter, *Percina shumardi*, Great Lakes-Upper St. Lawrence Populations (Designatable Unit 3)

Meeting date: January 31, 2019

Location: Burlington, ON

Chairperson: David Andrews

Editor: Jofina Victor

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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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SUMMARY

A regional science peer-review meeting was held on January 31, 2019 in Burlington, Ontario. The purpose of the meeting was to assess the recovery potential of the Great Lakes-Upper St. Lawrence populations (Designatable Unit [DU] 3) of River Darter (*Percina shumardi*), to provide advice that may be used for the listing decision, development of a recovery strategy and action plan, and to support decision making with regards to the issuance of permits and agreements. Participants included DFO Science, Species and Risk, Policy, and Fisheries Protection programs, Ontario Ministry of Natural Resources and Forestry (OMNRF), and regional Conservation Authorities.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated River Darter in DU 3 as Endangered in 2016. This species has a very restricted distribution, occurs at few locations, and is exposed to a number of threats including shoreline hardening, exotic species, dredging, and nutrients and effluents from urban waste, spills, and agriculture.

This proceedings report summarizes the relevant discussions from the meeting and presents recommended revisions to be made to the associated research documents. 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

Fisheries and Oceans Canada (DFO) Science has been asked to assess the recovery potential of River Darter (Great Lakes-Upper St. Lawrence populations; Designatable Unit [DU] 3). As a result, a peer review meeting was held on January 31, 2019 in Burlington, ON. Participants included DFO Science, Species at Risk, Policy, and Fisheries Protection programs, and regional Conservation Authorities (Appendix 1).

The intent of this meeting, as described in the Terms of Reference (Appendix 2), was to provide up to date information and associated uncertainties to address the following elements of River Darter:

- biology, abundance, distribution, and life history parameters;
- habitat and residence requirements;
- threats and limiting factors to the survival and recovery of this species;
- recovery targets;
- scenarios for mitigation of threats and alternatives to activities; and,
- allowable harm assessment.

A research document on River Darter mitochondrial DNA haplotype diversity (Reid et al. 2020) was also presented.

The meeting generally followed the agenda (Appendix 3). The rapporteur for this meeting was Jofina Victor. The meeting Chair provided a brief overview of DFO's Canadian Science Advisory Secretariat's (CSAS) Science Advisory Process and the guiding principles for the meeting.

The Proceedings summarizes the relevant meeting discussions and presents the key conclusions reached during the meeting. The advice from the meeting will be summarized in a Science Advisory Report. The Research Documents (van der Lee and Koops 2020; Sawatzky 2020) that include the technical details supporting the advice will be revised based on the information from this meeting. All reports will be published on the CSAS website.

INFORMATION IN SUPPORT OF A RECOVERY POTENTIAL ASSESSMENT OF RIVER DARTER (DU 3)

BIOLOGY, ABUNDANCE, DISTRIBUTION AND HABITAT REQUIREMENTS

Presenter: David Andrews

Abstract

In May 2016, a meeting of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that River Darter, *Percina shumardi* (Great Lakes-Upper St. Lawrence populations, designatable unit [DU] 3) be designated as Endangered. The reason given for this designation is: "This is a small-bodied species that inhabits medium to large rivers and shorelines of larger lakes. It has a very restricted distribution, occurs at few locations, and is exposed to high risk threats from shoreline hardening, exotic species such as Round Goby, dams and water management, dredging, nutrients and effluents from urban waste, spills, and agriculture" (COSEWIC 2016, p. iii). The species was previously assessed as a single unit in April 1989 and was designated as Not at Risk (Dalton 1989).

The Recovery Potential Assessment (RPA) provides information and scientific advice needed to fulfill various requirements of the *Species at Risk Act* (SARA), including informing both scientific and socioeconomic elements of the listing decision and permitting activities that would otherwise violate SARA prohibitions, and the development of recovery strategies. This Research Document describes the current state of knowledge of the biology, ecology, distribution, population trends, habitat requirements and threats to River Darter (Great Lakes-Upper St. Lawrence populations). Mitigation measures and alternative activities related to identified threats, which can be used to protect the species, are also presented. The information contained in the RPA and this document may be used to inform the development of recovery documents and for assessing permits, agreements and related conditions, as per sections 73, 74, 75, 77, 78 and 83(4) of the SARA. It may also be used to prepare for the reporting requirements of SARA s.55. The scientific information also serves as advice to the Minister of Fisheries and Oceans Canada regarding the listing of the species under the SARA and is used when analyzing the socio-economic impacts of adding the species to the list as well as during subsequent consultations, where applicable. This assessment considers the available scientific data pertaining to the recovery of River Darter (Great Lakes-Upper St. Lawrence populations) in Ontario. The advice generated via this process will update and/or consolidate any existing advice regarding River Darter (Great Lakes-Upper St. Lawrence populations).

Discussion

Species Description

Participants did not recommend any changes to this section of the research document.

Biology, Abundance, and Distribution

Participants did not recommend any changes to this section of the research document.

Habitat Requirements and Features, Functions and Attributes Table

A participant noted that habitat information specific to DU 3 was missing from the report and offered to provide this information from the limited number of collection records in the Thames and Sydenham rivers. A participant commented that most of these captures occurred over large substrates (small boulder, cobble, and gravel with snaggy substrate) and that River Darter seem to have an affinity for these substrate types because they are not typically found over soft substrates.

A participant asked why the spatial extent of suitable habitat was inferred to be declining. This would not be possible to determine due to the low number of previous collection records. We should be careful about applying COSEWIC criteria to spatial extent of suitable habitat. Spatial extent was inferred to be declining in the COSEWIC report based on the declining distribution; however, suitable habitat may not actually be declining. It was agreed that this statement would be removed from the research document.

A participant commented on the statement that River Darter occur only in three systems in the Lake St. Clair watershed – Lake St. Clair and the East Sydenham and Thames rivers. The participant noted that River Darter were last collected in the North Sydenham River in early 2000 and that sampling has not occurred there since then so they may still be present in that system. It was agreed that 'East Sydenham' would be revised to 'Sydenham'.

RECOVERY POTENTIAL MODELLING

Presenter: Adam van der Lee

Abstract

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has assessed the River Darter (*Percina shumardi*) as Endangered within the Great Lakes – Upper St. Lawrence Biogeographic Zone (DU 3) in Canada. Here we present population modelling to assess the impacts of harm, determine population-based recovery targets, and conduct long-term projections of population recovery in support of a recovery potential assessment (RPA). Limited species-specific data were available for Canadian populations of River Darter and there was much uncertainty in life-history characteristics and vital rate values. Our analysis demonstrated that River Darter population growth was most sensitive to perturbations to young-of-the-year (YOY) survival rate and fertility. Harm to these aspects of River Darter life-history should be avoided. The risks associated with different levels of stage-specific anthropogenic harm were investigated. Population viability analysis was used to identify potential recovery targets. Demographic sustainability, (i.e., a self-sustaining population over the long term) can be achieved with population sizes of 27,000 to 31,000 adults based on conservative simulation criteria. A population of this size required between 10.6 and 12.1 ha of suitable habitat (assuming densities of 0.25 fish/m²). Population projections predicted that recovery could occur in 33–35 years with an initial density of 10% of the abundance targets.

Discussion

A participant noted that for spawning River Darter sampled in the Trent River in 2001, the sex ratio at two sites was slightly male-biased and in 2002–2003 it was slightly female-biased. The presenter explained that the sex ratio used in the model is based on eggs and the model does not have differential survival for different sexes. More information can be incorporated into the model only if the mechanism underlying the different sex ratio is known. We do not have differential growth curves and survival for River Darter so it would be prudent to leave the sex ratio at 50% in the model but add comments concerning this issue to the text of the research document.

A participant asked if the density estimates account for aggregations during the spawning periods. The presenter responded that abundance estimates are just population size and fecundity is the total across all seasons. Targeted sampling was not done in spawning areas.

A participant commented that the life history data used in this model (and for other RPA models) borrows from areas that are, from productivity and growing season standpoints, very different from the region we are concerned with. Work needs to be done on life history variation across the range. The presenter noted that there is not a lot of variation in the modelling between locations (model was run for three locations).

A participant asked if the presenter came across any reference estimates on catchability. The presenter searched but could not find any. Based on what we know of the habitat they have been found in, low catchability is supported.

A participant commented on the frequency of catastrophic events. They noted that spills do happen in DU 3 and that these are often catastrophic. The Ministry of Environment and Climate Change has a database of these from which it may be possible to calculate frequency. The presenter agreed to have a look at this. The presenter noted that a catastrophe is anything that could cause population decline and that in the model it is based on Reed et al. (2003) which did not include many fish species. Some catastrophes are just random stochasticity. The model looks at the worst case scenario by treating the catastrophe as if it impacts the entire population at once.

The presenter, discussing the Minimum Area for Population Viability, explained that of the 109 ha of habitat available in the Thames River, 12% needs to be suitable habitat for River Darter. This was not calculated for Lake St. Clair or the Sydenham River. The habitat patchiness in Lake St. Clair was discussed. Participants agreed that habitat mapping followed by more sampling is needed for these areas.

RIVER DARTER MITOCHONDRIAL DNA HAPLOTYPE DIVERSITY

Abstract

River Darter (*Percina shumardi*) is a small, benthic fish that is a member of the perch family (Percidae). In Canada, the species has a continuous distribution through most of Manitoba into northwestern Ontario in the Saskatchewan-Nelson drainage as well as the Hudson Bay drainage west of James Bay. River Darter is also found in Lake St. Clair and its tributaries in southwestern Ontario. Based on evidence of discreteness and evolutionary significance, groups of populations can be assessed by COSEWIC as separate Designatable Units (DUs). For freshwater fishes, the delineation of DUs has been informed using COSEWIC National Freshwater Biogeographic Zones (NFBZ) and population genetic structure. Based on a three DU structure, COSEWIC assessed the status of the River Darter as *Not at Risk* in the Saskatchewan–Nelson River (DU 1) and Southern Hudson Bay–James Bay (DU 2) zones and *Endangered* in the Great Lakes–Upper St. Lawrence (DU 3) zone. In this study, haplotype data from two mitochondrial DNA genes (cytochrome-b (cyt-b) and cytochrome oxidase subunit 1 (CO1)) were used to assess whether River Darter population genetic structure corresponds with the three NFBZ. The assessment was based on: (i) the distribution of private and shared haplotypes; (ii) phylogenetic relationships among haplotypes; and, (iii) distance- and ordination-based tests of haplotype structure. One hundred-forty-nine sequences from both mitochondrial DNA genes were used in the analysis, representing River Darter from 14 waterbodies. Overall, 29 cyt-b haplotypes and eleven CO1 haplotypes were identified. Based on private haplotypes, the cyt-b minimum spanning network, and Principal Coordinate Analysis (PCoA) of cyt-b and CO1 haplotype data, differentiation among River Darter populations was greatest between DU 3 and the two western DUs. Private haplotype data and PCoA (cyt-b only) provide some evidence of differentiation between DU 1 and DU 2. These interpretations are largely influenced by samples from two waterbodies: Lake Batsydawa (DU 2) and the Thames River (DU 3). Samples from additional populations within DU 2 are required for more robust support of the existing DU structure.

Discussion

A participant commented that they thought there was still a fair amount of support differentiating DU 1 and DU 2. The presenter agreed, but noted that the evidence is strongest for DU 3. The DU structure decision is based on multiple lines of evidence – the more evidence, the stronger the support. There is still support for differentiating DU 1 and 2 but it is less strong than that for DU 3.

A participant noted spelling errors in lake names. The presenter indicated that these will be corrected in the final document.

REVIEW OF THREATS

Presenter: David Andrews

Discussion

Naturally Occurring Limiting Factors

A participant suggested changing the research document statement ‘...abundance has never been high’ to ‘only a small number of individuals have been collected’ because we do not know enough to say that abundance has never been high. It was agreed that this statement would be changed.

Anthropogenic Threats

A participant noted an interactive effect between Zebra Mussel and Round Goby. Zebra Mussels are a preferred food source of Round Goby and as such may facilitate Round Goby invasion. It was agreed that a comment to this effect would be added to the research document.

There was discussion about the statement in the research document that the increased water transparency as a result of Zebra Mussels may negatively impact River Darter. A participant noted that there is no link between River Darter and increased water transparency. High water quality is a good thing for darter populations. Another participant noted that the fact that River Darter can tolerate turbid water may give them an advantage over other species that cannot. If water transparency increases, other species may be able to live in River Darter habitat. If there is a strong linkage between increased water transparency due to Zebra Mussels and River Darter, the effects will be different across the range of DU 3 (e.g., Zebra Mussel would not do well in the Thames River due to flows, but do very well in the Sydenham River). It was agreed that this line in the research document would be removed due to lack of evidence.

Participants expressed concern about the dredging section of the research document. A participant noted that the negative impacts found in Freedman (2010) should not be discounted based on Barnucz et al. (2015). A lack of significant results in Barnucz et al. (2015) does not indicate lack of negative effects (i.e., dredging may not have impacted fish species at risk at the locations sampled, but if it were to occur in River Darter habitat there could be negative impacts to the species). Additional information should be added from the Barnucz et al. (2015) report concerning the low abundance of species of risk, the lack of a detection analysis, and the fact that sites were not visited immediately after dredging occurred. It was also agreed that dredgeate disposal sites should be mentioned.

Participants did not recommend any changes to the shoreline hardening section of the research document.

A participant noted that there was a lot of information in the research document on the Sydenham River in the nutrients and contaminants and toxic substances sections but not much information on the Thames River. It was agreed that information should be added for the Thames River (e.g., data from Provincial Water Quality Monitoring Network, consultant reports that would be sent to report author). Another participant noted that a lot of the sources are dated (going back to 2003). It was agreed that an effort would be made to include recent sources if available.

A participant disagreed with the statement in the sediment loading section of the document that most sediments are being inputted through tile drainage – overland flow is a larger contributor. It was agreed that this statement would be revised in the document. A participant commented that this section could be improved. Information on acute exposure and chronic events should be added. Increased sediment loading due to anthropogenic activities is not good for darters. A participant noted that high turbidity is too vague. As turbidity goes from low to high, the effect on fish will go from behavioural to physiological and then mortality. Tolerance to high turbidity

makes it seem as if it is okay to dump fine sediments on these cobble-gravel substrates. It was agreed that this section would be revised.

Threat Assessment

A participant commented that it should be explained in the research document how the threat assessment rankings were reached. The presenter noted that this is captured in the Proceedings document.

The level of impact, causal certainty, likelihood of occurrence, threat frequency, threat occurrence, and threat extent for Round Goby were discussed. A participant noted that the impacts of Round Goby on other species is high (e.g., Round Goby is one of the causes for the decline of Channel Darter). The flows in the Thames River will likely keep some of the Round Goby in check but they are not going to go away (Round Goby were first captured in the Thames River in 2015). There are patches of Round Goby in the Thames River, while there is a continuous wave of them in the Sydenham River likely because of the slightly lower flows. A participant noted that there is a growing body of work showing that Round Goby is impacting the benthic fish community although there is no direct data pertaining to River Darter. It was agreed that the level of impact would be changed from unknown to medium, and the causal certainty from unknown to low. The likelihood of occurrence, threat occurrence, threat frequency, and threat extent should remain unchanged.

Participants did not recommend any changes to the level of impact, causal certainty, likelihood of occurrence, threat frequency, threat occurrence, or threat extent for Zebra Mussel.

Concerning dredging, a participant noted that the likelihood of dredging occurring in some of the locations known to be occupied by River Darter is low. The larger risk is dredgeate disposal. Another participant noted that we do know that dredging is occurring in Lake St. Clair. It was agreed to change the level of impact from high to medium, the likelihood of occurrence from known to likely, and the threat extent from narrow to broad. The causal certainty, threat occurrence, and threat frequency should remain unchanged.

A participant suggested that the causal certainty for shoreline hardening should be changed from unknown to low because the research document discusses how this threat can impact River Darter. It was agreed that this would be revised. Participants also agreed that the threat extent should be changed from extensive to narrow–broad. Changes were not recommended for the level of impact, likelihood of occurrence, threat occurrence, or threat frequency for shoreline hardening.

Concerning nutrient loading, a participant noted that impacts are related to exposure duration and concentration and wondered what the levels mentioned in the document mean in terms of risk. There may be a positive impact of nutrient loading with respect to increased benthic invertebrates. Participants agreed that this threat is likely low impact at current levels, but the impact would be likely to increase with increasing nutrient loading. It was agreed that the level of impact would be changed from medium to low. The likelihood of occurrence, causal certainty, threat occurrence, threat frequency, and threat extent should remain the same.

Concerning contaminants and toxic substances, a participant noted that there is not a lot of direct evidence that River Darter are being impacted. Participants agreed that the level of impact should be changed from medium to low. The likelihood of occurrence, causal certainty, threat occurrence, threat frequency, and threat extent should remain unchanged.

For sediment loading, a participant commented that we know it is bad for the type of habitat that River Darter have been found in and that darters could be vulnerable to sedimentation considering the habitat they occupy. We know sediment loading is bad but we don't know if it is

contributing to the decline of River Darter. A participant noted that there are two kinds of sedimentation – sediment in the water column which impacts behaviour, and deposited sediment which impacts habitat. The report author suggested dividing this threat into two categories, namely sedimentation and siltation. This was not discussed further. A participant commented that less sedimentation and siltation occur when sediment enters high energy rivers, such as the Thames River, due to the regular flushing out of materials in interstitial spaces. Future research should investigate whether River Darter occur in areas with good flushing. It was agreed that the level of impact would be changed from unknown to medium. The likelihood of occurrence, causal certainty, threat occurrence, threat frequency, and threat extent should remain unchanged.

Dams were discussed. A participant noted that there are dams in the Thames and Sydenham watersheds, but none in habitat known to be occupied by River Darter. A participant asked whether there were any plans for future dams. There are no known dams being considered. There is a temporary dam on the north branch of the Sydenham River, but it is only put in place for a short period during spring flooding. The economic incentive for new dams no longer exists. If a new dam were to be developed, it would likely be a threat to River Darter. It was agreed that a paragraph would be added to the document stating that while dams were not assessed as a threat because none exist in known River Darter habitat, future dams would pose a threat to this species.

PROJECTS AND ACTIVITIES IN RIVER DARTER HABITAT

Presenter: David Balint

The presenter noted that the search of DFO's Program Activity Tracking for Habitat (PATH) system was limited to projects that occurred near River Darter occurrence records (within 1 km). The presenter also highlighted an issue within PATH. Some projects identified as being within Lake St. Clair are actually in a tributary. The location of a bridge project that was in Lake St. Clair according to PATH has been double-checked and will be moved to the Thames River column of the table.

Discussion

A participant commented that they were surprised at the low number of shoreline stabilization projects on Lake St. Clair and asked if it was possible that people do this without permission. The presenter replied that yes, this is always a possibility and the search was limited to within 1 km of River Darter occurrence records.

MITIGATION OF THREATS AND ALTERNATIVES TO ACTIVITIES

Discussion

The report author questioned whether harvest mortality should be removed from the Additional Mitigation and Alternative Measures section. Participants agreed that this should be removed because it is not an identified threat to River Darter. This line will also be removed from the works, projects and activities table.

SOURCES OF UNCERTAINTY

Presenter: David Andrews

Discussion

A participant commented that the COSEWIC report mentions that there are a number of places where River Darter are no longer found. There are historical records but no current records largely due to the fact that sampling of these areas has not occurred since then. The current distribution of River Darter should be added as an uncertainty. It was also agreed to add catchability and life history parameters which are extrapolated from other populations as uncertainties.

REVIEW TERMS OF REFERENCE

Presenter: David Andrews

The Chair reviewed the elements listed in the Terms of Reference. All elements with the exception of 17 and 19 were covered during the meeting. Further research is needed in order for these elements to be addressed.

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APPENDIX 1. TERMS OF REFERENCE

Recovery Potential Assessment – River Darter, *Percina shumardi*, Great Lakes-Upper St. Lawrence Populations (Designatable Unit 3)

Regional Peer Review Meeting – Central and Arctic Region

January 31, 2019
Burlington, ON

Chairperson: Dave Andrews

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.

COSEWIC met in May 2016 and recommended that River Darter Great Lakes-Upper St. Lawrence populations (designatable unit [DU] 3) be designated Endangered (COSEWIC 2016). The species was previously considered a single unit and designated Not at Risk in April 1989 (Dalton 1989).

In support of listing recommendations for River Darter 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 River Darter.

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 River Darter.

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 River Darter.

Habitat and Residence Requirements

Element 4: Describe the habitat properties that River Darter 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 River Darter'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 River Darter

Element 8: Assess and prioritize the threats to the survival and recovery of the River Darter.

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 River Darter.

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 River Darter 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(s)

Participants

- Fisheries and Oceans Canada (DFO) (Science sector, Species at Risk Program and Fisheries Protection Program)
- Ontario Ministry of Natural Resources and Forestry
- Academia
- Conservation Authorities
- Other invited experts

References

- COSEWIC. 2016. [COSEWIC assessment and status report on the River Darter *Percina shumardi* Saskatchewan – Nelson River populations, Southern Hudson Bay – James Bay populations and Great Lakes-Upper St. Lawrence populations, in Canada](#). Committee on the Status of Endangered Wildlife in Canada. Ottawa. xix + 53 pp.
- Dalton, K.W. 1989. COSEWIC status report on the River Darter *Percina shumardi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 12 p.

APPENDIX 2. LIST OF MEETING PARTICIPANTS

| Name | Organization/Affiliation |
|----------------------------|--|
| David Andrews (Chair) | DFO, Science |
| Jofina Victor (Rapporteur) | DFO, Science |
| Adam van der Lee | DFO, Science |
| Marten Koops | DFO, Science |
| Jason Barnucz | DFO, Science |
| Chantelle Sawatzky | DFO, Science |
| Doug Watkinson | DFO, Science |
| Tom Pratt | DFO, Science |
| Sara Eddy | DFO, Fisheries Protection Program |
| Josh Stacey | DFO, Species at Risk Program |
| Dave Balint | DFO, Species at Risk Program |
| Jessica Epp-Martindale | DFO, Species at Risk Program |
| Scott Reid | Ontario Ministry of Natural Resources and Forestry |
| Vicki McKay | Lower Thames Valley Conservation Authority |

APPENDIX 3. MEETING AGENDA

Recovery Potential Assessment – River Darter (DU 3)
Regional Peer Review Meeting – Central and Arctic Region
Canada Centre for Inland Waters
867 Lakeshore Road, Burlington, ON and WebEx
Date: January 31, 2019
Chairperson: D. Andrews

| | | |
|-------|---|----------------|
| 9:00 | Welcome and Introductions | D. Andrews |
| 9:15 | Purpose of Meeting | D. Andrews |
| 9:30 | Biology, Abundance and Distribution | D. Andrews |
| 9:50 | Habitat Requirements; Functions, Features, and Attributes | D. Andrews |
| 10:20 | BREAK | |
| 10:30 | Recovery Potential Modelling | A. van der Lee |
| 11:30 | River Darter Microchondrial DNA Haplotype Diversity | S. Reid |
| 12:00 | LUNCH | |
| 13:00 | Threat Status | D. Andrews |
| 14:15 | Review of Projects and Activities in River Darter Habitat | D. Balint |
| 14:30 | Mitigation of Threats and Alternatives to Activities | D. Andrews |
| 15:00 | BREAK | |
| 15:15 | Sources of Uncertainty | D. Andrews |
| 15:45 | Review Terms of Reference | D. Andrews |
| 16:15 | END | |