Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2016/014

Central and Arctic Region

Proceedings of the regional peer review on the effects of water flow management regimes in the Trent River on Channel Darter (*Percina copelandi*) spawning activities

January 15, 2016
Burlington, Ontario

Chairperson: Kathleen Martin
Editor: Kathleen Martin

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

June 2016

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

Correct citation for this publication:

DFO. 2016. Proceedings of the regional peer review on the effects of water flow management regimes in the Trent River on Channel Darter (*Percina copelandi*) spawning activities; January 15, 2016. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2016/014.

TABLE OF CONTENTS

SUMMARY

A regional science peer-review meeting was held on 15 January 2016 in Burlington, Ontario. The purpose of the meeting was to provide advice on the effects of water flow management regimes on Channel Darter spawning activities in the Trent River (Trent-Severn Waterway), Ontario.

The Channel Darter (*Percina copelandi*) is a small benthic fish, listed as Threatened on Schedule 1 of the *Species at Risk Act* (SARA) and under the Ontario *Endangered Species Act* (ESA). Many of the Canadian rivers that support Channel Darter populations are affected by dams, and the species is considered sensitive to altered flow regimes, particularly during spawning. In the Recovery Strategy for Channel Darter, Critical Habitat has been delineated in the Trent River from Glen Ross to Trenton, Ontario. A habitat modelling study was undertaken to inform setting of minimum flow level or regime recommendations for the Trent River during the spawning period of the Channel Darter and is the basis for this peer review.

Participants included DFO Science and Species at Risk programs, Parks Canada Agency, Ontario Ministry of Natural Resources and Forestry, University of Toronto, University of Guelph and Ontario Power Generation Inc.

This proceedings report summarizes the relevant discussions from the meeting and presents recommended revisions to be made to the associated research document. The working papers presented at the workshop will be published as Canadian Science Advisory Secretariat Research Document. The advice from the meeting will be published as a CSAS Science Advisory Report.

Compte rendu de l'examen régional par des pairs sur les effets des régimes de gestion des débits d'eau dans la rivière Trent sur les activités de frai du fouille-roche gris (*Percina copelandi*)

SOMMAIRE

Une réunion régionale d'examen scientifique par les pairs s'est tenue le 15 janvier 2016 à Burlington, en Ontario. Le but de la réunion était de fournir des conseils sur les effets des régimes de gestion des débits d'eau sur les activités de frai du fouille-roche gris dans la rivière Trent (voie navigable de Trent-Severn), en Ontario.

Le fouille-roche gris (*Percina copelandi*) est un petit poisson benthique inscrit comme espèce menacée à l'annexe 1 de la *Loi sur les espèces en péril* et protégé en vertu de la *Loi sur les espèces en voie de disparition* de l'Ontario. Bon nombre des rivières canadiennes qui abritent les populations de fouille-roche gris comportent des barrages, et l'espèce est considérée comme vulnérable aux modifications des régimes d'écoulement, particulièrement en période de frai. Dans le plan de rétablissement du fouille-roche gris, l'habitat essentiel a été désigné dans la rivière Trent, de Glen Ross à Trenton, en Ontario. Une étude de modélisation de l'habitat a été entreprise pour guider l'établissement d'un débit minimal ou les recommandations en matière de régime d'écoulement pour la rivière Trent pendant la période de frai du fouille-roche gris. Cette étude constitue la base de cet examen par les pairs.

Parmi les participants, on comptait le programme scientifique et le Programme des espèces en péril du MPO, Agence Parcs Canada, le ministère des Richesses naturelles et des Forêts de l'Ontario, l'Université de Toronto, l'Université de Guelph et Ontario Power Generation Inc.

Le présent compte rendu résume les discussions pertinentes tenues lors de la réunion et présente les modifications suggérées à apporter au document de recherche connexe. Les documents de travail présentés lors de l'atelier seront publiés en tant que documents de recherche du Secrétariat canadien de consultation scientifique. L'avis découlant de la réunion sera publié en tant qu'avis scientifique du SCCS.

INTRODUCTION

Fisheries and Oceans Canada (DFO) Science has been asked for advice on the effects of water flow management regimes in the Trent River on Channel Darter spawning activities. As a result, a peer review meeting was held on January 15, 2016 in Burlington. Participants included DFO Science and Species at Risk programs, Parks Canada Agency, Ontario Ministry of Natural Resources and Forestry, University of Toronto, University of Guelph, and Ontario Power Generation Inc. (Appendix 1).

The intent of this meeting, as described in the Terms of Reference (Appendix 2), was to provide advice on water flows in the Trent River system to ensure that they are sufficient to support Channel Darter spawning activities.

Specifically, science advice was required to:

1. Determine the minimum flow required to ensure that Channel Darter successfully spawn in the Trent River.
2. Provide alternatives to the current flow management regime that would minimize the impacts to Channel Darter in the Trent River.
3. Provide additional mitigation measures that could be implemented to minimize the effects of the current flow management regimes in areas known to be occupied by Channel Darter.

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

This Proceedings summarizes the relevant meeting discussions and presents the key conclusions reached during the meeting. The advice from the meeting is summarized in the Science Advisory Report (DFO 2016) and the Research Document includes the technical details supporting the advice (Reid et al. 2016). All reports will be published on the Canadian Science Advisory Secretariat (CSAS) website.

ASSESSMENT

CHANNEL DARTER FLOW MANAGEMENT REGIMES – BACKGROUND

Presenter: Amy Boyko

Summary

The Channel Darter is very sensitive to changes in flow, particularly during its spawning and egg incubation period (May to mid-July). Rapid, repeated, and prolonged changes in water flow can have a negative impact on the species' habitat. Flow alterations in the Trent River had been identified in the recovery strategy as a potential threat to the Channel Darter and its critical habitat.

Parks Canada Agency (PCA) is responsible for flow management in the Trent Severn Waterway where a 22 km section has been identified as critical habitat for the Channel Darter. Prior to signing off on the proposed recovery strategy in 2013, PCA wanted to ensure that dam operations in the Trent River are in compliance with the *Species at Risk Act* (SARA).

PCA requested the insertion of a Section 83(4) exemption into the proposed recovery strategy for dam activities. Section 83(4) of SARA allows for activities to be exempted in a recovery strategy if there is:

1. An explanation as to why the activity has been determined to be eligible for an exemption as per s.83(4);
2. A summary of the results of the scientific evaluation that determined that the preconditions of s. 73(3) and 83(4) have been met (i.e., all reasonable alternatives have been considered; all feasible measures will be taken to minimize impacts; and the survival and recovery of the species will not be jeopardized).

However, there was no scientific information on the impacts of dam activities on the Channel Darter. Therfore, a determination whether current flow management activities in the Trent River have the potential to jeopardize survival and recovery of Channel Darter was needed.

Since 2012, several meetings have been held to discuss an instream flow needs study, a monitoring program, and whether there is a link between dam activities and the destruction of critical habitat. An action item from 2012 was to conduct an instream flow needs study to better understand the impacts of flow alterations on the Channel Darter in the Trent River. The study would also provide recommendations for alternative mitigation measures or alternatives to current flow regimes, to minimize impacts to Channel Darter in the Trent River. The results of the study would be used to identify minimum flows and mitigation measures to ensure Channel Darter is protected especially during its spawning period. Based on this information, agencies can then decide whether a s.83(4) exemption is appropriate in the recovery strategy.

Discussion

A participant indicated that it was not known whether minimum flows were needed. Therefore, identification of minimum flows was not a foregone conclusion and the research would determine whether they were needed. Another participant agreed although there was an expectation that an instream flow needs study might identify a minimum flow requirement at certain sites for spawning to occur. Participant agreed that it is a tool but may not be the only tool available, which was why identification of alternatives and mitigations were included in the objectives.

HABITAT MODELLING IN SUPPORT OF THE RECOVERY OF CHANNEL DARTER (*Percina copelandi*) POPULATIONS ALONG THE TRENT RIVER, ONTARIO

Authors: Scott M. Reid, Stan Brown, Tim Haxton, James Luce, and Bob Metcalfe

Presenter: S. Reid

Abstract

A habitat-modelling study was undertaken to inform the setting of minimum flow levels for the Trent River (Trent-Severn Waterway, Ontario) during the spawning period of the Threatened Channel Darter. Flow recommendations are required for all populations along the Trent River and for tailwater habitat below the Lock 5 dam.

The study included the following components:

(i) habitat suitability curves developed for water depth and water velocity;

(ii) regression relationships between river discharge and water depth and water velocity developed for three Channel Darter populations (Glen Ross, Lock 5 dam, Sonoco);

(iii) a two-dimensional hydrodynamic model (River2D) calibrated to predict local water depths and velocities downstream of the Lock 5 dam; and,

(iv) habitat suitability curves coupled with the River2D model's hydrodynamic predictions to provide site-specific guidance for releasing flow through dam control gates at Lock 5.

Channel Darter were generally associated with shallow water depths (0.1 - 0.4 m), water velocities greater than 0.2 m/s, and coarse river bed material (gravel, cobble, boulder). River discharge and habitat suitability relationships differed among the three Channel Darter populations. Water depth and velocity were significantly and positively correlated to discharge only at Glen Ross. Predicted improvements to habitat suitability at Sonoco occur at discharges twice as high (> 80 m^3/s) as that expected to be optimal at Glen Ross (30 to 50 m^3/s). Water depth, water velocity, and habitat suitability downstream of the Lock 5 dam were predicted to be strongly influenced by river discharge, the amount of water released through the eastern-most gate (spill discharge) and downstream water elevation. River2D model output predicted that most improvements in habitat suitability would occur with spill discharges between 5 and 7.5 m^3/s.

Discussion

A participant asked what the flows were during the validation of the 2D River model. The presenter indicated that the river discharge during the September period was 22 m^3/s, representative of lower flow conditions at that site.

A participant asked whether extreme flood events are being monitored and if there is a threshold after which the model will no longer work. The authors indicated discharge is monitored upstream and it can be reconstructed at the site. They also indicated that extreme events do happen. Theoretically, you would be able to predict the flows that would move the bed material around. During validation of the model, five water level sensors were deployed attached to cinder blocks. After a fall flooding event, only two were recovered, which shows how dynamic this system is. You can tell what size of materials a certain level of discharge will move, but it is hard to pinpoint the threshold when the river would change so much that the model would no longer be valid. There is morphological shifting but a substantial scour chute would be needed to change the results substantially; most would be within the error bounds of the model.

A participant noted that he understood HSI models are generally good within 2–2.5 times the measured flow. The model was validated at 87 m^3/s so, by that rule, it would be good to about 200 m^3/s.

A participant asked what kind of bed material was at the site. The author indicated it was generally a cobble to boulder veneer overlaying bedrock. The authors used optical data to estimate grain sizes. However, they used survey information to look at standard deviation around a small area to calculate an index of the bed roughness. The size of grains was not the best indicator of how much energy was consumed by the roughness. It was how much grains protrude above the bed into the flow. Authors felt this was best captured by the standard deviation with the measured data. We feel that this was accurate in the research document.

A participant asked for further clarification on the bed material inputs to the models. Authors used aerial imagery to extract the depth of water. Once they extracted the effect of diminishing light with depth, they used it to classify the bed, indicative of the type of bed material. That matched reasonably well with field measured grain size. In deeper flows, the relationship started to break down. They noted a strong correspondence between their observations of grain size roughness and the standard deviation used in the survey. They felt that using the topographic data, which corresponded with both the observations in the field and extracted observations from the optical data, provided a better spatial representation of the grain size roughness and they used this in development of the bed roughness grid for the model.

A participant asked what method was used to capture bed irregularities and elevations in the model. Authors indicated that topographic survey points (~1,000) were taken for all areas that were above the water surface elevation down to about 0.5 ft depth. In addition, an M9 (SonTek River Surveyor) was towed to provide depths and positions (~31,000) throughout the upper survey area, which was included in development of the mesh. There were still some gaps that were filled in with aerial imagery to extract a bathymetric map at 30 cm pixel resolution, giving a dense grid of points.

A participant asked if the topographic survey was tied to the datum elevation. The authors addressed this by tying to the benchmarks and using datum in ArcGIS.

A participant asked the presenter if he had an idea of the nature of the relationship between population size and habitat suitability indices for Channel Darter. The presenter has not done work relating habitat suitability and population characteristics. In 2002-2003, he tried to do mark-recapture studies at two sites in the Trent River but was unsuccessful. He has not undertaken further projects to estimate population size and relative densities and relate these to habitat availability. A participant identified that the river discharge estimates were back-calculations from energy production rather than being measured directly and felt this was not adequately captured in the report. The presenter indicated that this was stated in the research document with the notation that the accuracy of the estimates was unknown and maybe poor given the age of the facility. The participant was asked for suggested wording that better reflects their understanding of the information so that it can be incorporated in the research document. The authors pointed out that the model calibration was based on measured flows using an M9. The uncertainty the participant was noting would relate to the width of the error bars or the slope of the relationship. The Chair noted that the uncertainty in the river discharge estimates would also be captured within the Sources of Uncertainty section of the Science Advisory Report.

Another participant asked if there would be periods of time where there was not enough water flowing through the Trent River system to provide suitable flows for Channel Darter. Would there be enough water in the system to maintain the necessary flow in drought events? The presenter indicated that there would be low spring flows that will not provide enough flow for Channel Darter habitats but that is beyond human control, it would happen in a natural system as well. Water depths and velocities could be too low for spawning to be initiated or to be successful. Naturally high flows could also delay or prevent spawning of Channel Darter.

A participant noted that the research document makes recommendations to ensure spawning of Channel Darter is protected. For example, it recommends that Lock 5 should release spill discharge between 5-7.5 m^3/s. How does this relate to what is currently happening and whether these recommendations are a change in flow management? The presenter considered these as guides to select daily river discharges in the Trent River system or specifically at Lock 5 for how much should be released from the eastern dam gate. Suitable depth and water velocity ranges are characterized for Channel Darter and these have been linked to river discharge. The research document illustrates how the relationships change as discharge changes and where you get the maximum level of improvement. They do not give the range of discharges to ensure spawning but describe how suitability changes as discharge changes.

The Chair reiterated that we are discussing the science at this meeting. It is laying the foundation for making management decisions based on the best evidence. The advice will be captured in the Science Advisory Report. A participant noted that this needs to be written in a way that can be interpreted, so it needs to be clear in what is being recommended.

MINIMUM FLOW REQUIREMENTS FOR CHANNEL DARTER SPAWNING

The presenter identified that there are two components to the discussion of minimum flow requirements:

1) What might be done to bound targets for flow going throughout the Trent River system?
2) What might be done on a site specific scale?

Looking at the river as a whole, the report concludes that the flow requirements differ between the three sites.

A participant asked if there were flow issues at Sonoco and Glen Ross sites on the Trent River in addition to the Lock 5 site. The presenter noted that the flow issue at Glen Ross was that a large dewatering event was observed there. Best management practices were identified (e.g., how quickly flows can be dropped) and lock staff at the site were educated to prevent this from happening again.

A participant asked whether minimal flow requirements need to be set at all three sites or is it sufficient to set flows for Lock 5. The presenter suggested target flows can be set but, depending on which site decisions are based, one site will benefit more than the other. For example, 30-50 m^3/s to maximize habitat suitability at Glen Ross will only begin to provide benefit at the Sonoco site. Conversely, if you were maximizing suitability at the Sonoco site, the suitability at the Glen Ross site would result in poor habitat conditions.

A participant felt it would help to set targets for Glen Ross so that, in the event that maintenance happens at the site, there would be minimal flow levels that have to be followed to prevent another dewatering event. The presenter agreed. He indicated that the information may be useful as a guide, for example, if Trent-Severn waterway is managing flows coming into May and June on a lower than normal flow year, this provides information on where flows should be directed if the objective is to maintain the suitability of Channel Darter habitat.

A participant asked if there were flows coming from another source at Sonoco to explain the difference at that site. The presenter indicated that there are no large watersheds inputting new water between Glen Ross and Sonoco. However, the configuration of habitat and how flow is concentrated is very different between the two sites. At Sonoco, flow is concentrated along one bank in contrast to Lock 5 where the flow is concentrated over the Channel Darter shoal. Glen Ross is a higher gradient reach than Sonoco, so any increase in river discharge would have a larger impact on water velocities at Sonoco.

A participant asked how boat lockage affects minimal flows and how it was taken into account. The authors did not take it into account. It did not occur while they were doing their field surveys and it is not clear what the frequency would be.

A participant asked if weighted usable area was considered or was something analogous used. The presenter noted that weighted usable area is output from the River2D model. It is often done in concert with selectivity for bed material and reflects how field measurements are done. When representations of habitat quality are not of equal area, weighted usable area corrects for this by using an average at different points where suitability is calculated. It was not applicable in this area because of the way predicted water depths and velocities were translated to suitability at Lock 5. Instead, they used the percentage of habitat falling within the bounds of suitable habitat. They also looked at how average conditions changed with discharge across the river at each site.

The participant pointed out that one could look at the difference in suitability settings and include how much habitat is available under different discharges, then look at how discharge affects the suitability, not just whether the habitat is suitable or not. This would provide a gradient of suitability. Another participant indicated that to do this in River2D, you would have to include substrate. Although the presenter agreed that this would provide output using language that is consistent with some expectations, it may not be any more informative.

The participant noted that in the figures with availability of suitable habitat, there is one line representing suitable water depth, which suggests suitability is all-or-none rather than there being a gradation of suitability. It might be more informative to have different lines representing differences in habitat suitability to illustrate how they change. This does not change the outcome of anything as percent of habitat is included, but is another way of showing the data. The presenter suggested one could represent the response of percent habitat based on a range of suitable habitat values and also present that relationship for the most suitable depth category. The figure with availability of suitable water depths at varying flow was informed by the figure with estimated Channel Darter habitat suitability for water velocity and water depth.

A participant noted the importance of elevation in the availability of suitable water depths at Lock 5 at differing discharges. The presenter confirmed that elevation was measured at Lock 4, several kilometres downstream. The participant indicated that there is change of less than 1 m elevation downstream and yet that drives the change in percent of habitat. Flow through the spillway does change this, but elevation is the key driver. The presenter agreed that this is correct for water depth. That is where the most profound influence of the downstream boundary conditions exist in terms of water depth, but elevation has an impact on water velocities although to a lesser extent.

Another participant pointed out that the figure with the surface plot of spatial pattern of capture probability and bed material, illustrates how the patches of quality change as a function of discharge. The presenter indicated that one could develop similar figures that could illustrate where within the monitoring station there are the greatest amounts of improvement. Similarly, one could recast the other figures spatially and over a range of spill discharges. A participant thought producing spatial patterns of capture probability for different flows would be informative. River2D with bed material suitability indices set to 1 could be used to produce various maps under different flows and one could then plot levels of suitability and how their areas change as a function of discharge. The authors had developed the plots for different flows but did not include all of them in the research document. It is possible to develop representative figures however the author felt this information would be redundant as the relevant information was already captured in the plots of average conditions and how they changed with river discharge. The authors can translate their outputs into something analogous to weighted usable area but this is essentially the composite habitat suitability index.

Participants discussed including figures that reflected the quality of the habitat. The habitat suitability index would vary so there would be different polygons with different values which could be summed and then plotted as lines in separate bins of suitability as a function of discharge. A participant asked how these figures would help us to make a decision. Although they may provide a visual representation, the link between habitat suitability and population-level effects, which is currently missing, is more important for decision making.

A participant noted that they would expect the Science Advisory Report to include a range in discharges that should be maintained to protect Channel Darter spawning, at the three sites. The presenter indicated that they could use the figures to set discharge ranges at Glen Ross and Lock 5. Sonoco does not have an asymptote to the relationship between the Composite Suitability Index (CSI) and river discharge making it difficult to provide target advice. The participant felt that it would be important to include information on risks associated with setting flows within the range to better inform management decisions. The presenter indicated that the limits to where the relationships apply could be identified.

A participant asked if there was research that could be done to inform the relationship between habitat suitability and population-level effects. The presenter indicated the following two approaches could be taken:

1) Do more research to build flow habitat models that are linked to demographic responses. The research would either develop the relationships or inform existing demographic models.
2) Take an adaptive management approach. Using the best available information, set flow recommendations and then monitor. One of the first steps would be to verify that predicted flow changes at different spill discharges are realized. Population-level monitoring would also be needed to detect demographic changes that might be linked to spawning and recruitment success.

Channel Darter has a short generation time, age at reproduction is two years, so any demographic response (e.g., recruitment failure) would be realized quickly compared to longer-lived species.

A participant agreed with the approaches and suggested that the population modelling from the recovery potential assessment for Channel Darter (DFO 2010, Venturelli et al. 2010) could provide guidance. In general, the minimum adult population size, based on a 0.05 probability of catastrophe per generation, should be 6,800 adults requiring at least 27.5 ha (lakes) or 0.9 ha (rivers)[1] of suitable adult habitat (i.e., not spawning habitat). Using the allowable harm analysis, there can be 10–15% of allowable harm on first- and second-time spawners. The modelling also indicates if survival can be increased by 10%, recovery would be attained. So, major improvement in population size could be realized through increasing survival by as little as 10%. Unfortunately, the population size of Channel Darter in the Trent River is unknown and the relationship between population size and habitat suitability is also unknown. If the relationship is linear, then 10% change could be sufficient but we do not know if this is the case.

Participants discussed whether more information is needed before proceeding or whether the state of knowledge is sufficient to identify targets that managers could implement now and then follow the adaptive management approach. This should be included under future steps in the science advisory report.

A participant asked for more information on the spatial pattern of capture probability figures. At higher flows, the pattern may change so extrapolations may not be valid. The presenter indicated capture probability figures are based on empirical data, not modelled data. The figures are a representation of where the fish were caught relative to the habitat and flow. It was not meant to show differences in flow. There are areas where the probability of catching Channel Darter is greater. There are catch data at other flows that could be plotted.

The presenter noted the river discharge at the time of suitability modeling was not captured in the research document but should be included. The upper discharges during the spawning

[1] In the Channel Darter recovery potential assessment (DFO 2010, Venturelli et al. 2010), the the minimum adult population size was evaluated for varying probabilities of catastrophe per generation. If the probability of catastrophe was 0.10 then the minimum adult population size would be 31,000 which requires at least 125.2 ha (lakes) or 4.1 ha (rivers) of suitable adult habitat.

period were around 50-60 m^3/s, which is slightly less than what was used for the Lock 5 simulations. The Glen Ross suitability curves would be based on a range of discharges up to what was used at Lock 5. High velocities would affect capture success and, therefore, affect suitability. However, at Glen Ross, conditions were never such that electrofishing was not effective. Most of the scenarios of concern here are low flow scenarios.

A participant asked if the capture probability data combined multiple years at multiple flows. The authors would need to confirm, but they thought the data were grouped together from the fish caught in June.

A participant asked about the conditions (river flow and dam flow) at the time data were collected for the graphs illustrating the relationship between discharge and Channel Darter CSI. As there is no generating station at Glen Ross, river flow and dam flow are essentially the same thing but this is not the case for Lock 5 and Sonoco where the river flow can be moved between the generating station and the dam. The generating station at Lock 5 passes a maximum of 80 m^3/s. At Sonoco, the discharge capacity through the generating station is about 130 m^3/s. Is the CSI based on river discharge with the entire dam closed and all water going through the generating station? The presenter indicated that at Lock 5 and Sonoco, most flow was going through the generating stations and only leakage was coming through the dams. There is leakage through the dam that prevents all of the water from going to the generating station. For the composite suitability index ratings, both dams were completely closed, but there was still leakage.

A participant noted that usually the dams are not opened unless the generating stations are maxed out or there is maintenance being undertaken.

The presenter clarified that river discharge are the daily discharge data that the Trent-Severn Waterway provided. It was not measured discharge at the sites. If there is a range of flows that the Trent-Severn Waterway is trying to maintain, to provide suitable Channel Darter habitat, the curves are a way of relating measured discharges in the river system at a point in time with where you want to go in the future. Clarification should be added to the figure captions.

A participant asked if leakage was measured. The author indicated that it was measured across the spill side and across the whole river channel when flows were at 22 m^3/s.

A participant made note that, as part of the adaptive management approach, ground-truthing was identified to verify that predicted flow changes at different spill discharges are realized. The model would be ground-truthed using controlled releases and would address the concerns with the back calculated flows provided by Ontario Power Generation Inc.

Participants agreed that the figures (CSI versus river discharge and availability of suitable water depths) could be used to make guidance recommendations. They also agreed that a single recommendation for the entire stretch of river would not work equally well for the three areas so recommendations may be site specific.

SCIENCE ADVICE REPORT

The Chair identified that figures would be added to the research document (and Science Advisory Report) showing the configuration at each of the three sites including where spawning habitat was located. Participants agreed with this. Both flow and path of the flow need to be considered when evaluating benefits for Channel Darter spawning. It is relevant to understand where the spawning habitat is located at each of the sites. Setting a target for flow has to consider where the spawning is occurring. Flow at the appropriate target level that is not directed in the appropriate place would not be effective. Flow regulation on the river is relatively course and should be considered in the advice.

A draft SAR was developed pulling relevant information directly from the research document. Participants reviewed the report identifying appropriate inputs.

A brief summary of Channel Darter collection information from Glen Ross and Lock 5 were included in the Science Advisory Report. The presenter indicated that there was no electrofishing to develop habitat suitability models done at Sonoco. Sampling there was just to inform discharge habitat modelling, consequently, the summary information on numbers of fish and where they were collected are not available for Sonoco. These sections do not need the full detail from the research document, just a general description of habitat characteristics in addition to the timing of when spawning-ready individuals were captured as this indicates the time period of when the spawning regulation is necessary. Habitat suitability summary text should be included.

The request for advice was to provide river discharges for managers to use to make decisions. Participants agreed to include the figure illustrating the relationships between Trent River discharges and Channel Darter habitat suitability.

A participant asked which site has the best Channel Darter population. The presenter indicated that Glen Ross and Sonoco are doing the best of the three. You are more likely to encounter Channel Darter there. Lock 5 has an intermediate number. It is difficult to rate the sites as it is based on the number of Channel Darter captured. The annual monitoring data along the Trent River is highly sensitive to the flow conditions. Most sampling is done in late summer when flow is generally low. Some years when there was low flow, very few fish were caught.

The presenter clarified that the sites studied as part of the research program were chosen for several reasons. The Glen Ross study site was chosen based on the dewatering event. The other two sites (Sonoco and Lock 5) were selected based on knowledge of where Channel Darter were found and knowing they respond differently to flow changes. There is also a healthy population of Channel Darter at Frankford (Sills Island Dam) and a population below the Lock 1 Dam. The configuration of the river at those sites is also different than any of the other sites. When comparing which population is better than the other, we have to remember that there are more populations than just the three at Glen Ross, Sonoco, and Lock 5. All of these locations are within the area of critical habitat for Channel Darter delineated in the Recovery Strategy from Glen Ross to Trenton, Ontario. Advice related to the three locations may impact other locations with Channel Darter.

The most upstream population, Glen Ross, has the numbers indicating that relatively low flows are sufficient. We may not be able to get by with as low a flow at the other sites downstream. The discussions bolster support for an adaptive management approach. Such an approach should include monitoring other populations and monitoring abundance, and habitat characteristics at the other sites (e.g., water depth, water velocity and flow).

A participant asked at which site there is the most concern for low flow that could cause disruption in spawning. Glen Ross was identified as a concern because of the dewatering event that resulted during maintenance activities. The presenter indicated that the concern around Glen Ross is how responsive it is to changes in discharge. As discharge is low, the water depth and velocities become low. There is a concern with Lock 5 that once you get below a certain overall river discharge (at a much higher level than we are discussing at Glen Ross), water starts being diverted away from Channel Darter habitat (except for leakage from dam and backed up water). The least vulnerable of the populations is Sonoco. Whatever water is in the system goes through the generating station and stays in the Channel Darter critical habitat.

GLEN ROSS

The presenter indicated that there were two options for setting targets at the Lock 5 site:

1) Develop a model and apply.
2) Complete experiments and release water at practical discharge increments and measure the response of water depths and water velocities.

The research document should give the range and provide the figure to describe the improvements to habitat suitability over the range of river discharges at Glen Ross. A participant described this figure as a description of the micro-habitat perspective. The range in velocity and water depth provides the macro- or meso-habitat perspective. It must include something about the range of habitat suitability relevant to the areas that are important for Channel Darter spawning.

There are also operational considerations that need to be included. If all flow is constrained to the side of the river opposite to where Channel Darter is found, this guidance would not mitigate impacts. So text must be included about where spawning occurs as this is relevant to guidance on discharge, as is timing of the spawning period. So advice should include the range of flows that has to be maintained in the particular area of the river during a specified time.

From the graph, the greatest impact on habitat suitability comes at 50 m^3/s. Above that level of discharge, habitat suitability decreases. From the context of maintaining minimal flows, the interpretation is that you would not want to see flows go below 30 m^3/s at Glen Ross. Participants agreed with the minimum value and that an upper level would not be identified. Typical conditions are generally above the optimal. It is more about building up from low flows rather than decreasing high flows.

A participant asked about caveats for drought conditions. The presenter suggested that if constrained by lower flows, you would try to redirect flows to the western bank where Channel Darter habitat is located. The best way to mitigate extreme drought events is to funnel what water that is left to the area of concern (i.e., the west bank at Glen Ross).

A participant asked whether, as part of the adaptive management approach, flow meters could be put in at the locations to know if levels dropped below the recommended 30 m^3/s. Would this be a monitoring recommendation? The Chair pointed out that this would be a consideration once management decisions were made. How one monitors the flow and maintains the recommended minimum flow is beyond the scope of this meeting.

A participant noted that 30 m^3/s at Glen Ross represents optimal flow (30-50 m^3/s) that allows for spawning, not minimum flow. The goal is to ensure successful spawning, not optimize it. The presenter asked, if not the optimum what you would use? What flow would you choose between 0-30 m^3/s and what would you use to make the decision? Nobody had other suggestions for setting a target. As we do not have sufficient information to make a different decision, the recommendation is to use 30 m^3/s. We do not know the relationship between population size and habitat suitability. The first objective for the meeting is not that they successfully spawn but that there is not a negative effect of greater than 10% on the population, which is the allowable harm estimate (DFO 2010, Venturelli et al. 2010). The adaptive management approach and collecting additional data as part of that give us a better understanding of the relationship between population size and suitability. It will also help to determine if 30 m^3/s is appropriate or whether we can go below that to maintain spawning.

It might also be helpful to look at the range of historical flows. Historical flows were examined and 30 m^3/s seemed to be the around the median for the low flow period.

A participant cautioned that for some dams the bathymetry below the dam has to be considered when directing flow. For example if there is a plunge pool immediately downstream of a dam, diverting out of one gate or another will fill the pool and ultimately spread the water out as a result of the bathymetry. It may move water to a certain area, regardless of which gate was opened so we should not be too prescriptive with the advice. Lock 5 has a scour hole that acts in this way. The presenter noted that the text should be worded carefully so that is seen as advice, not direction. It may make no sense to try to funnel water to a certain location if the river topography right below the dam negates the benefits of doing so.

A participant noted that there are two ways to maintain elevation downstream, with flow or elevating the tailwater. If there are dewatered areas during low flow, could you use another dam farther downstream to create backwater? The presenter noted that the next dam is 7-8 km downstream which is a long distance over which to create backwater. This is also a high gradient reach, so the elevation gain relative to other spots is quite high, which makes backwatering difficult. A participant clarified that in the case of the Dam 5 at Lock 5, there is backwater effect from Dam 4 that does impact to the toe of Dam 5. However, that is not the case as it pertains to the backwater effect from Dam 6 up to the toe of Dam 7. That is partly why the dewatering event occurred; the entire site went completely dry because the backwater effect of Dam 6 did not reach the toe of Dam 7.

The Chair asked how many dams are on this waterway. A participant indicated that there are 104 dams on the Trent-Severn Waterway. There are six dams in the section of river we are discussing between Glen Ross and Sonoco, including both these dams. There are eight dams along the Trent River that affect Channel Darter populations from Dam 1 at Trenton to Glen Ross. Parks Canada Agency operates seven of the dams but not the dam at Sonoco. Glen Ross is Dam 7 on the Trent Severn Waterway, they are numbered down to Dam 1 at Trenton. Sonoco is not part of the Trent Severn Waterway so it is not part of this numbering convention, it is between Dam 2 and Dam 3.

SONOCO

The text describing the habitat conditions at Sonoco would follow the template discussed for Glen Ross.

The CSI-river discharge relationship for the Sonoco site would be included. However, the relationship at Sonoco differs from Glen Ross. At 50 m^3/s habitat suitability at Sonoco increases while at Glen Ross it declines. It is hard to apply a range to Sonoco because there is no asymptote to the graph. The presenter clarified that the CSI is generally a product of the suitability scores associated with water depth, water velocity and substrate.

Participants discussed why there was not a consistent relationship between the CSI curves for Glen Ross and Sonoco. At Glen Ross, as you get deeper water and as flows increase habitat becomes less suitable, which lowers the CSI. At Sonoco, depth is not as responsive to increases in flow as it is at Glen Ross which may explains why the velocity would increase and suitability would rise with velocity but the depth wouldn’t increase as much. The channel at Glen Ross is wider than at Sonoco, the gradient is different and there is a dam a short distance downstream at Sonoco. The morphology of the two sites is quite different.

The Chair asked if the minimum flow at Sonoco should also always be above 30 m^3/s. A participant noted that, if the same logic was used for Sonoco as was used for Glen Ross, the minimal flow should be 80 m^3/s at Sonoco based on using the CSI of about 0.25 which resulted in the 30 m^3/s minimum flow. A participant asked how you would manage a river with 80 m^3/s at the downstream end and 30 m^3/s at the upstream end of a 22 km stretch. The presenter did not know how you can manage the two sites at the same time with the same goal. Considering the responsiveness of the sites, Glen Ross is a more vulnerable to low flow conditions or drops in flow than the Sonoco site. If one was to prioritize between those two sites, Glen Ross is the more sensitive site. So, if you applied the CSI target of 0.25 to Sonoco that would reduce the suitability at Glen Ross.

The presenter suggested that taking the adaptive management approach would provide the opportunity to evaluate the choices made. If we go with the low flow recommendation for Glen Ross and then we go out during a low flow year and everything else is dewatered, then we would know it was not a satisfactory recommendation. We are forced to make conflicting decisions, so adaptive management monitoring would be very important to evaluate the consequences of the management decisions.

A participant noted that there is Channel Darter Critical Habitat at all three sites. Since we do not know what the impact of maintaining the 30 m^3/s at Glen Ross will be on the other sites, this would need to be tested. If 30 m^3/s is too low and what we see at Sonoco is total dewatering, then we would have to think about raising the minimum amount at Glen Ross.

A participant noted that the system is flat, not like a typical reservoir where water can be stored and flows can be maintained by drawing down the reservoir. If the system doesn't have the water in it to support the flow the minimum won't be maintained. Participants noted that the flows we are talking about are for managed flows. For example, not dropping the flow below 30 m^3/s to do maintenance.

A participant asked where historically there were management problems with the greatest drawdown impacts. The presenter indicated there were two scenarios. Glen Ross was the site of a large dewatering event that precipitated this research program. It is through this program that the situation at Lock 5 came to light.

A participant asked if there was any capacity in the system to store water for a low flow year. A participant noted that Parks Canada would be very hard pressed to maintain flow under drought conditions. It is not possible to maintain 30 m^3/s in drought conditions. A participant suggested that we should not get caught up on drought years because those are beyond our control, those are stochastic events. In a drought year, you may not have the capacity to maintain 30 m^3/s. However, you could direct what water you did have to the critical spawning area.

Text will be included in the Science Advisory Report to recognize that there may not be the capacity in the system to support 30 m^3/s, under certain circumstances (i.e., low-flow year). A participant pointed out that the greatest impact from a drought would come in the fall, not in the spring when Channel Darter are spawning. However, another participant noted that low flow would occur after spring freshet in June on the Trent River.

The presenter reiterated that it is important in this report to strike balance between what the science evidence is recommending for flows and where that meets the challenge in operationalizing that advice. We should have operational considerations for extremes (low flow) (e.g., directing flow). In the context of the system, in the Trent River, the recommendations may not be operational in years when water levels are very low. It should be clearly articulated in the Science Advisory Report that we know it may not always be possible to maintain the recommended minimal flow level, but if it is possible then it should be maintained.

A participant noted that there is a Generating Station at Sonoco so that flow should go through the Generating Station rather that the spillway as there is more habitat there. The presenter indicated that by including the figure for the site, it will identify where the habitat is in the river so as to ensure that whatever flow is coming out of the generating station is flowing over Channel Darter habitat. Participants agreed that one of the recommendations would be that during low flow years, flow should be directed over the Channel Darter spawning habitat during the spawning period.

Although the CSI curve indicates that you can improve suitability as you increase discharge, it is the least vulnerable of the populations because whatever water is going through the system goes through the Generating Station and stays along the bank where the Channel Darter shoal is located.

LOCK 5

Output from River2D over the range of simulation conditions shows that most of the improvements in habitat suitability are gained between releasing 5 and 7.5 m^3/s of water.

A participant suggested that water elevation is key and this should be maintained. The presenter indicated that point is correct and that the guidance should include the following two points:

1) What amounts can be released along the eastern bank?
2) To what degree can you mitigate low flow conditions by also maintaining downstream water elevations as well?

The presenter noted that spillage can be manipulated at the Lock 5 site by removing stoplogs. Is it operationally possible for the Trent Severn Waterway to control downstream water elevations?

Dam 5 is a completely mechanized structure and has a vertical lift gate so that is how upstream water levels are managed. On the downstream side, towards Dam 4, there is a hydroelectric facility that is not owned by Ontario Power Generation Inc., but is owned and operated by Energex. Dam 4 is a stoplog dam so it has the 12” stoplogs throughout the dam. The generating station at Dam 4 runs about 120 m^3/s at full capacity. When river flows are below 120 m^3/s the stoplog dam is completely closed off and all water is diverted through the generating station, similar to Dam 5. So when the dam is closed the generating station is responsible for maintaining water levels. They normally maintain the full head levels to optimize generation at that facility. As far as raising water levels at Dam 4 to generate more backwater, that is not an option. Elevating water levels above the full supply level of the reach would start to spill water over the stoplogs across the entire dam. This could impact the lock infrastructure and could cause shoreline erosion. At Dam 4 they try not to exceed the operating limit of 99.99 m.

A participant asked if the shoal could be lowered through bed modification explaining that the bed could be modified to ensure it stays wet under certain conditions, or additional habitat could be created elsewhere. The author indicated that the amount of power on the bed of the river is substantial. The alluvial cover is on top of bedrock. It would not be a prime candidate for long-term success of instream measures based on the literature. It might be possible but it would have to be constantly maintained, resupplying bed material where and when it was needed. The design life could be very short. You can calculate the watts/m^2 of power on the bed, which is the ability of the river to do work. Results of other studies show that with the stream power exerted below this dam you would expect that any material added would be modified within a short period of time. The bed below Lock 5 is very mobile. It would not be a onetime solution but you would have to continuously apply material to that shoal.

Participants expressed some concern with that approach from a *Species at Risk Act* perspective. This is critical habitat and modifications to it may impact the population. Another participant noted that you would essentially have to be taking another adaptive approach with augmenting or creating habitat that, according to physics, is not a very plausible approach to begin with.

A participant pointed out that this system is not a natural system. The river is highly modified. Natural habitat forming processes that used to support Channel Darter habitat have been interrupted. In other systems, for other species, spawning channels have been constructed where you can control the flow and substrate within the channel.

The Chair pointed out that the meeting must focus on the terms of reference and the questions being asked which is looking at how flows impact Channel Darter.

The presenter proposed a recommendation of 5-7.5 m^3/s to start, especially if an adaptive management approach is taken especially if there will be follow-up monitoring. It is possible to argue for higher amounts because there is continual improvement but 5-7.5 m^3/s is where the models predict the greatest amount of gain, the rest is incremental. This is not evident in the first CSI graph (with the three sites separated) which illustrates large-scale relationships between daily river discharge and habitat suitability. On that graph, the horizontal line for Lock 5 indicates that once you get below a certain level of discharge the habitat suitability is relatively low and constant which is the rationale for adding extra water along the eastern bank. The comment about most of the gains coming from 5-7.5 m^3/s is illustrated in the three figures that follow for Lock 5 from the River2D modelling. Some of those reviewing the research document commented that this range may be overly conservative and you could continue to see some incremental improvements as you to release more water.

The two figures with percent habitat versus spill discharge (with water velocities and water depths) at Lock 5 should be included in the Science Advisory Report to support the Lock 5 recommendation. The text from the abstract with the recommendation and information about adaptive management should be added to this section of the report.

While the model identified the sensitivity of this site to downstream water elevations and suitability of habitat, in terms of operationalizing any recommendations, there is not a lot that the Trent-Severn Waterway can do to build up downstream elevation. Despite there being a potential positive impact of having a high water elevation it may not be operational and should be articulated in the Science Advisory Report.

A participant asked about how much leakage occurs at the dam and how it might contribute to the flows. They asked to better understand whether the flow recommendation was in addition to the amount of leakage or whether it included the leakage. Authors measured 2 m^3/s of leakage and used this to validate the model. Flow funnels through some scour shoots formed in the bar that crossed the full width of the river below the dam. Based on River2D modelling, where the leakage came from (i.e., which gates) didn't have much impact. However, leakage is difficult to measure. Ultimately we will come up with the recommended flow but how it is delivered will be discussed by manager.

A participant noted that leakage varies depending on several things including how rotten the logs are, so it is not a constant flow. Mechanized dams have significantly less leakage than stoplog dams.

A participant asked if the minimum flow at Glen Ross is 30 m^3/s, does that mean there should be that same minimum flow at each of the downstream sites, or are there obstructions along the way that would prevent this. A participant indicated that this was generally true. The locks don't use much water. The only locations that would not get that water is where there is a hydro facility or where the dam is completely closed off. So leakage would not necessarily be a problem given these minimum flows although management may have to direct the flow appropriately during the spawning season.

ALTERNATIVES

Participants discussed the difference between an alternative and mitigation. A participant noted that for Fisheries Protection Program reviews, using the example of a bridge construction, the alternatives are constructing a bridge with piers or a clear span bridge. They are different design alternatives and could include moving or redesigning the bridge. In that case, the clear span bridge is the best alternative to minimize impacts to the aquatic ecosystem. In the Recovery Potential Assessment process to address Species at Risk questions, we would be considering an alternative to the activity which could be an alternative to operating a facility or dam or possibly the alternative to how it is operated. Another participant suggested that for the Trent Severn Waterway, the alternative would be to manage the waterway for Channel Darter rather than for power and boating.

Definitions should be added to the sections of the report dealing with alternatives and mitigation.

A participant asked whether the changes to flow management that were implemented at Glen Ross in the event of maintenance activities to ensure a dewatering event does not happen again, would be considered an alternative. However a participant suggested that this is mitigation and the alternative would be not doing the maintenance.

Alternatives are generally considered when there is a new project or when undertaking maintenance. Creating alternatives for the operation of existing facilities does not really work so mitigations generally would apply.

A participant suggested there would not be any real alternatives because the river cannot stop being managed for power.

MITIGATION AND OFFSETTING OPTIONS

Mitigation lessens the impact of an activity. Participants generally agreed and it was suggested that mitigation may be combined with offsetting options.

A participant asked whether offsetting would be considered a type of mitigation. Mitigation would be maintaining certain flows to maintain spawning, while offsetting would be creating new habitat because you are destroying habitat elsewhere. The new habitat would be an offset for the destruction of previously established habitat.

Population augmenting should be included in the offsetting section of the Science Advisory Report. This would be a feasible direction to explore although it is not a recommended way to offset impacts. All potential offsets would need to be explored further to see if they will make a difference.

In relation to current flow management, significant draw-down events are replaced by slow lowering of water levels following best-practice guidelines. This should be included. Coker and Portt (2011, 2012) have developed best management practice guides that are relevant.

Minimum flow is the first mitigation measure. We discussed keeping a minimum flow when possible at Glen Ross and having an adaptive management approach to see what that minimum flow does in the other locations and possibly adjusting strategies in the future.

The presenter suggested habitat augmentation or creation but the challenges with these, as alternatives to flow management, are the design and the project life. Would it have the same habitat function as the natural (current) habitat already in the system? You can augment an area but you cannot guarantee that it will have the same function as the previously existing habitat.

Bed lowering was briefly discussed but may not be viable from an engineering standpoint. This should be included in the Science Advisory Report. A participant asked for more information on where habitat augmentation is possible and would be beneficial in the system. The presenter indicated that when we discuss habitat augmentation or creation there are constraints and risks that need to be detailed. In terms of locations, if something could be designed and that was the only option, there would have to be fieldwork done to inform the decision on the placement of the created habitat. Based on current knowledge, locations cannot be included in the Science Advisory Report.

A participant asked whether another mitigation measure would be water level maintenance or water elevation. The Chair asked how water level would be augmented without adjusting flow as earlier discussions indicated that there is no capacity in the system to hold back water. A participant thought that you can back the water up a little, for a day or so, which may be enough. You could hold the elevations a little higher than normal and then as flow drops, you would hold those elevations. It may be possible on some of the flat reaches, but probably not at Glen Ross. The participant indicated that we do not have storage capacity in the system. However, he also indicated that raising 10 cm in a 4 km stretch could maintain the 30 m^3/s for half a day.

A participant then asked whether 30 m^3/s needs to be maintained continuously for six weeks. Is there a potential temporal mitigation so that water could be stored and released intermittently? Would Channel Darter turn on spawning at the appropriate flow? The presenter indicated that there is a risk to increasing variability in water depth and water velocity. Winn (1953) found that Channel Darter stop spawning when there were changes in water depth and velocity. Intentionally adding variability in water depth and velocity should be avoided.

A participant asked if there are any temperature triggers that could be used to identify the spawning period. The presenter could provide the range in temperatures where they found the spawning-ready individuals, which could be a guide. However, for riverine fishes it seems to be an interaction between water temperature and flow volume that stimulates spawning, it is not just one or the other. There can be good water temperature but really high or low flow levels you don’t see the initiation of spawning or it is delayed. Water temperature could be used as a guide though.

As discussed earlier, the Science Advisory Report has to identify the spawning period over which the minimum flows should be maintained. The presenter suggested that dates and water temperature should be used to identify the spawning period and this information, including both the observed range in when spawning-ready fish were collected (Trent River and Salmon River) but also the likely number of days for eggs to successfully develop for hatching.

A participant asked for more details on the adaptive management approach. What actions would be taken? For example, what type of monitoring should take place to make future decisions? In the mitigation section, should there be details on monitoring and contingency plans if flows go below the thresholds? If fish are stranded should there be mitigation measures identified to save the stranded fish? The presenter noted that adaptive management is a process and there are decisions needed about the process. The process has to include implementation of a recommendation, monitoring, action and then revision of the recommendation. There has to be a decision about what, when and where sampling is needed as part of the monitoring. Once this is decided, an experimental monitoring design is needed. How much of this goes into the Science Advisory Report, or is it separate advice? It seems to be appropriate to recommend the adaptive management approach now but not specify the details of the process. Participants agreed but felt it would help to include some text about the purpose along with the recommendation for adaptive management.

A participant pointed out that we can make a recommendation for Glen Ross but we cannot make a recommendation for Sonoco, as we do not know how this site will be impacted by the flows set for Glen Ross. We need to indicate that an adaptive management plan should be developed and that it needs to consider what is happening downstream of Glen Ross and what things should be changing in the future. Other sites would require further evaluation. Flows are being suggested at Glen Ross and Lock 5 but there are also other locks that have not been studied. We need to look at is the relationship between Channel Darter, flow (m^3/s) and locks.

A participant noted that the report should indicate that the recommendations do not apply to any other river systems that have Channel Darter.

A participant asked if the thresholds are not met, would that not require offsetting, rather than mitigation. Offsetting is required if there is a negative impact on the population or habitat.

The research document currently lists some recommendations for additional work. The presenter noted that there is some work that can be done at Lock 5 that would confirm recommended flow releases result in the required water depths and velocities. There is also some uncertainty around whether the habitat suitability curves at Glen Ross can be transferred between different populations and habitats that could be evaluated.

Another participant suggested another level of uncertainty is that we made an assumption that as long as we have flow that allows Channel Darter to spawn, we have addressed all the other life history stages. Could there be impacts on the young of the year from changes in flow that are not addressed by the flow regime recommendations?

The presenter noted that this is a highly modified system. The characteristic flow regime in late May and June is between the spring freshet and the summer low flow conditions. The low flow conditions are relatively stable and predictable although the absolute river discharge may change. We do not have evidence that habitat is limiting for the other life stages but we do have information that shows that how flow is managed is negatively impacting spawning. The other life stages are not as vulnerable to flow management practices on the Trent River. A participant noted that the recovery potential assessment population modelling (DFO 2010, Venturelli et al. 2010) identified the most sensitive life stage as years 1-3, with first and second time spawners being the most sensitive. The current exercise related to spawning habitat would address this sensitivity. This should be added to the research document.

One of the limitations of the habitat suitability index are things other than habitat that influence the population. A participant asked about the impacts of Round Goby on Channel Darter. Although they do occur in the same area, a link would need to be established between Round Goby and problems for Channel Darter before suggesting that removal of Round Goby would be a mitigation recommendation. George Coker (Cam Portt and Associates) continued the sampling until 2009 that was implemented by the presenter in 2002-2003. The presenter now monitors 14 sites in the spring and fall throughout the Trent River to evaluate the effect of Round Goby on the fish community. The impact of Round Goby on Channel Darter varies from year to year as do the population levels of both species. Long term monitoring of this relationship is on-going.

A participant asked whether this long term monitoring gives any indication about whether habitat creation would work. In the original design after the new generating station was put in at Sonoco, they put in a large amount of material to create appropriate habitat for Channel Darter. Within two years, a large flow event pushed that material downstream so the original shoal that was at Sonoco is now being augmented by what is being pushed downstream. The river decided where the material should go.

Ontario Power Generation also added some material to create habitat for Walleye at the Frankford Generating Station. The water in that area comes up to 1 m so it may not be suitable for Channel Darter but it may be worth checking to see if it is used by Channel Darter.

A participant asked if we have identified a bare minimum flow required to sustain the population. The 30 m^3/s is optimal flow but not a minimum requirement. The presenter indicated that we cannot provide a recommendation on the absolute minimum flow needed. We can only provide flows that will provide more suitable habitat conditions during a sensitive time period. We do not have a link between habitat suitability and demographic response of Channel Darter.

Based on the study of habitat suitability at Glen Ross linked to daily river discharge, the point at which suitability is maximized is in the range of 30-50 m^3/s. So the minimum target for providing suitable habitat for Channel Darter is at the point where suitability is maximized.

A participant noted that the document should have background on the current flow management in the system. The report currently indicates minor to complete dewatering occurred but doesn't describe the event that instigated the study nor does it indicate that there are steps in place to ensure that it does not happen again. The dewatering event that occurred is not common practice. There is currently no water management plan for the Trent-Severn Waterway although Parks Canada Agency has documentation describing the water management regime as a whole that is available. The Trent River is very complex. All of the dams work together as a system and the lower portion of the river is a product of those operations. The lack of capacity to store water should be included with the background information.

One of the authors pointed out that in Europe, a favorable solution was to use waste water (i.e., water that has already gone through the dam) to increase flow. We could look at the possibility of taking water from the tail race and elevating it to the pool. It is coming out with a lot of momentum with not a large difference in head. The water would be pumped under its own force. This should be included as a mitigation option.

NEXT STEPS

The Research Document will be revised according to today's discussion and submitted to CSAS for online publication. The Science Advisory Report and Proceedings will be drafted and sent to participants for their review before they are approved and submitted to CSAS for posting on the website. Once all documents are published online the Chair will provide participants a link to the online documents

The Chair thanked meeting participants and adjourned the meeting.

REFERENCES CITED

Coker, G. and Portt, C. 2011. Operational considerations for the protection of fish and mussel species at risk, Trent-Severn Waterway. Unpubl. rep. prep. for Trent-Severn Waterways, Parks Canada. (Available upon request from Parks Canada Agency)

Coker, G. and Portt, C. 2012. Compilation of existing information and identification of data needs to assess the potential impacts of water control operations to aquatic species-at-risk. Unpubl. rep. prep. for Trent-Severn Waterways, Parks Canada. (Available upon request from Parks Canada Agency)

DFO. 2010. Recovery Potential Assessment of Channel Darter (*Percina copelandi*) in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/058.

DFO. 2016. Effects of water flow management regimes in the Trent River on Channel Darter, *Percina copelandi,* spawning activities. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2016/019.

Reid, S.M., Brown, S., Haxton, T., Luce, J., and Metcalfe, B. 2016. Habitat modelling in support of the recovery of Channel Darter (*Percina copelandi*) populations along the Trent River, Ontario. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/043. v + 28 p.

Venturelli, P.A., Vélez-Espino, L.A., and Koops, M.A. 2010. Recovery Potential Modelling of Channel Darter (*Percina copelandi*) in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2010/096. v + 34 p.

Winn, H.E. 1953. Breeding habits of the Percid fish *Hadropterus copelandi* in Michigan. Copeia 1953: 26-30.

APPENDIX 1. PARTICIPANTS

Tracy Allison	Parks Canada Agency
Dave Balint	DFO, Species at Risk
Amy Boyko	DFO, Species at Risk
Eva Enders	DFO, Science
Haitham Ghamry	DFO, Science
Tim Haxton	Ontario Ministry of Natural Resources and Forestry
Nick Jones	Ontario Ministry of Natural Resources and Forestry
James Luce	Ontario Ministry of Natural Resources and Forestry
Nick Mandrak	University of Toronto
Kathleen Martin (Chair)	DFO, Science
Kelly McNichols-O'Rourke	DFO, Science
Debbie Ming	DFO, Species at Risk
Dave Ness	Parks Canada Agency
Scott Reid	Ontario Ministry of Natural Resources and Forestry
Meg Sheldon (Rapporteur)	University of Guelph
Dave Stanley	Ontario Power Generation Inc.

APPENDIX 2: TERMS OF REFERENCE

Effects of water flow management regimes in the Trent River on Channel Darter spawning activities

Regional Science Peer Review – Central and Arctic Region

January 15, 2016
Burlington, Ontario

Chairperson: Kathleen Martin

Context

Water levels in the Trent River, Ontario are managed by the staff of the Trent-Severn Waterway (Parks Canada Agency). There have been observations of dewatering events in areas within the Trent River resulting from current water management practices. Channel Darter, *Percina copelandi*, is known to inhabit the Trent River and is currently listed as Threatened under Schedule 1 of the *Species at Risk Act*. A recovery strategy for Channel Darter has been published and critical habitat has been delineated from Glen Ross to Trenton, Ontario. Areas delineated as Channel Darter critical habitat have been observed to undergo minor to complete dewatering. There is concern that water flows in this system are not sufficient to support Channel Darter spawning activities.

The information will be used to inform Parks Canada Agency staff, who manage water flow in the Trent-Severn Waterway, of alternative water flow management regimes that will minimize the impacts on the Channel Darter population in the Trent River.

Objectives

The objectives of the meeting are to:

1. Determine the minimum flow required to ensure that Channel Darter successfully spawn in the Trent River.
2. Provide alternatives to the current flow management regime that would minimize the impacts to Channel Darter in the Trent River.
3. Provide alternative mitigation measures that could be implemented to minimize the effects of the current flow management regimes in areas known to be occupied by Channel Darter.

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Participation

- Fisheries and Oceans Canada (DFO) (Ecosystems and Oceans Science)
- Ontario Ministry of Natural Resources
- Parks Canada Agency
- Academia (University of Toronto)
- Other invited experts

APPENDIX 3: AGENDA

Effects of water flow management regimes in the Trent River on Channel Darter spawning activities

Room L205, Canada Centre for Inland Waters, Burlington, ON.
WebEx and teleconference

Room L205

Chairperson: Kathleen Martin

Friday, 15 January 2016

9:00 - 9:15	Welcome and Introductions - Kelly McNichols-O'Rourke (DFO)
9:15-9:30	Purpose of Meeting and Terms of Reference – Kelly McNichols-O'Rourke and Kathleen Martin (DFO)
9:30 - 9:45	Background information – Debbie Ming or Amy Boyko (DFO)
9:45 – 10:30	Presentation on Channel Darter Habitat Modelling – Scott Reid (OMNRF)
10:30-10:45	Break
10:45 - 12:00	Minimum flow requirements for Channel Darter discussion
12:00 - 1:00	Lunch (not provided)
1:00 - 2:15	Discussion of alternatives to the current flow management regime and alternative mitigation measures that would minimize the impacts to Channel Darter
2:15-2:30	Break
2:30 - 4:00	Draft of SAR summary bullets and conclusion of meeting – Kelly McNichols-O'Rourke (DFO)