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Proceedings of the Central and Arctic Regional Science Advisory Process on the Recovery Potential Assessment of Black Redhorse

Compte rendu du processus régional de consultation scientifique du Centre et de l'Arctique sur l'évaluation du potentiel de rétablissement du chevalier noir

7 December 2007
Canada Centre for Inland Waters
Burlington, ON

le 7 décembre 2007
Centre canadien des eaux intérieures
Burlington (Ont.)

M. A. Koops
Meeting Chairperson

K. A. Martin
Editor

M. A. Koops
Président de réunion

K. A. Martin
Réviseurs scientifiques

Fisheries and Oceans Canada/Pêches et Océans Canada
Great Lakes Laboratory for Fisheries and Aquatic Sciences/
Laboratoire des Grands Lacs pour les Pêches et les Sciences Aquatiques
867 Lakeshore Rd./ 867, Chemin Lakeshore
Burlington ON L7R 4A6 Canada

May 2009 / **Mai 2009**

Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings 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.

Avant-propos

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d’analyses ou d’interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d’indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l’information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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200, rue Kent Street
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http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

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SUMMARY

A regional science peer review meeting was held on 7 December 2007 in Burlington, Ontario. The purpose of the review was to provide science advice on the recovery potential of Black Redhorse (*Moxostoma duquesnei*), following the 17-step process outlined in the Fisheries and Ocean Canada (DFO) Recovery Potential Assessment (RPA) framework. In May 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designated the Black Redhorse as Threatened. The Minister of Fisheries and Oceans Canada (DFO) recommended not listing the Black Redhorse under the *Species at Risk Act* (SARA).[1] The RPA meeting was held to complete advice on the recovery potential of Black Redhorse to support the recovery process in the event the listing decision is re-evaluated. The advice will be provided to the DFO Minister for his consideration and for any socio-economic analyses, consultations and recovery planning related to this species. Meeting participants included DFO representatives from the Science, Fish Habitat Management and Policy sectors of the Central and Arctic Region and specialists from the University of Waterloo, Trent University, and Biotactic. This proceedings report summarizes the relevant discussions and presents the key conclusions reached at the peer review meeting.

This report will be published in the Canadian Science Advisory Secretariat (CSAS) Proceedings Series. A CSAS Research Document was produced from the working papers presented at the workshop. The advice from the meeting will be published as a Science Advisory Report.

[1] On 26 December 2007, Governor in Council decided not to add Black Redhorse to Schedule 1 of SARA as the RPA and subsequent socio-economic analysis had not yet been completed.

SOMMAIRE

Une réunion régionale d'examen scientifique par des pairs a eu lieu le 7 décembre 2007 à Burlington, en Ontario. Le but de cet examen était de formuler un avis scientifique sur le potentiel de rétablissement du chevalier noir (*Moxostoma duquesnei*), selon les 17 étapes du cadre d'évaluation du potentiel de rétablissement (EPR) de Pêches et Océans Canada. En mai 2006, le Comité sur la situation des espèces en péril au Canada (COSEPAC) a désigné le chevalier noir en tant qu'espèce menacée. Le ministre des Pêches et des Océans du Canada (MPO) n'a pas recommandé l'inscription du chevalier noir à la liste de la *Loi sur les espèces en péril* (LEP)[2]. La réunion concernant l'EPR a été tenue pour que l'on puisse terminer l'avis sur le potentiel de rétablissement du chevalier noir afin de soutenir le processus de rétablissement au cas où la décision concernant l'inscription de l'espèce serait réévaluée. L'avis sera fourni au ministre des Pêches et des Océans et servira à orienter la tenue d'analyses socio-économiques et de consultations ainsi que la planification du rétablissement pour cette espèce. Parmi les participants, mentionnons les secteurs des Sciences, de la Gestion de l'habitat du poisson et des Politiques de la Région du Centre et de l'Arctique du MPO ainsi que des spécialistes de l'Université de Waterloo, de l'Université Trent et de Biotactic. Le présent compte rendu résume les discussions pertinentes tenues au cours de cette réunion d'examen par des pairs et présente les principales conclusions formulées.

Le présent compte rendu sera publié dans la série des comptes rendus du Secrétariat canadien de consultation scientifique (SCCS). Un document de recherche du SCCS sera aussi produit en lien avec les documents de travail présentés à l'atelier. L'avis découlant de la réunion sera publié en tant qu'avis scientifique.

[2] Le 26 décembre 2007, le gouverneur en conseil a décidé de ne pas inscrire le chevalier noir à l'annexe 1 de la LEP étant donné que l'EPR et l'analyse socio-économique subséquente n'étaient pas encore complétées.

INTRODUCTION

In May 2006, the Committee on the Status of Wildlife in Canada (COSEWIC) designated the Black Redhorse as Threatened. The Minister of Fisheries and Oceans Canada recommended not listing the Black Redhorse under the *Species at Risk Act* (SARA). Although a Recovery Potential Assessment (RPA) was initiated for this species in 2005, it was never completed pending further guidance from DFO National Headquarters on the Recovery Potential Assessment process. This guidance was provided during a workshop held in August 2007. The RPA is now being completed in the event that the listing decision is re-evaluated and to provide the basis for other SARA-related functions such as socio-economic analyses, consultations, recovery planning, Allowable Harm permitting and use by Habitat Management.

The purpose of the meeting, as described in the Terms of Reference (Appendix 1) made available prior to the meeting, was to assess and provide advice on the recovery potential of Black Redhorse. The RPA is a science-based peer review and includes assessing the current status of the population, what is known about its habitat, the scope for human-induced mortality and scenarios for mitigation and alternatives to activities that negatively impact the population and its habitat. The RPA framework developed by DFO includes 17 questions (Appendix 2).

Meeting participants (Appendix 3) included DFO representatives from the Science, Fish Habitat Management and Policy sectors of the Central and Arctic Region, and specialists from Biotactic, University of Waterloo and Trent University. The meeting generally followed the agenda as outlined in Appendix 4.

This proceedings report summarizes the relevant discussions and presents the key conclusions reached at the peer review meeting. A CSAS Research Document was produced from the working papers presented at the workshop (Vélez-Espino and Koops 2008), which provided the basis for the discussions. The Science Advisory Report is the synopsis of the advice from the meeting.

DETAILED DISCUSSION

The RPA for Black Redhorse was initiated in 2005. Experts were invited to participate in several meetings and provide input into the recovery potential assessment of Black Redhorse along with several other species of freshwater fishes and mussels. The draft RPA document was updated and this became the working paper reviewed at the current meeting. Participants were invited to the meeting because of their knowledge of the species and associated ecosystems, and included researchers working on Black Redhorse to ensure the most recent information on the species could be considered, discussed and reviewed.

RPAs are intended to include the best available information including personal observations provided by species experts during the meeting. The participants discussed and decided that if unpublished data or information came available after the meeting and was to be added to the report, it would be sent to the participants for their review. A teleconference call would be arranged if warranted. A review would not be necessary if the new unpublished data or information supported the currently-available literature. Participants were asked to provide text as well as references for information to be added to the document.

There was discussion about how the advice would be used and whether it could be used for purposes other than for what it was originally intended. Decisions are being made now without the advice contained in an RPA. The RPA process will be transparent and the material made available to managers but the onus is on them to use it appropriately. There will be some checks and balances, through SARA permitting, for example, but the information will be available and may be used for other purposes such as inclusion in watershed management plans. It is very important that the process is transparent, follows the precautionary approach and limitations of the data are clearly explained and included in the Sources of Uncertainty section. The accompanying Research Document also includes uncertainties and contains information on the cover page that describes how it fits in the advisory process.

All tables referred to in this document were in the initial draft RPA discussed at the meeting and will be included in the final RPA Science Advisory Report.

Species Status and Habitat Requirements

Presenter: N. Mandrak

Species Status

The first section in the draft recovery potential working paper provides the background information on the species and is taken from the COSEWIC status report (COSEWIC 2005). Participants were asked for comments and suggestions to improve the material. Editorial comments could be given to the Chair at the end of the meeting but those comments requiring discussion should be brought forward.

As Spencer Creek was introduced and contains one record, should it be included in the population table? Although it was only one record, there were several specimens. In the species status, it only indicates occurrence and in the population table it indicates that it was introduced.

Habitat Requirements

It was suggested that information on diet should be included under this section to put the habitat information in context since both diet and habitat are closely linked. If no diet information is available, that should be noted. There may be diet summarized in the COSEWIC report that could be added.

Participants asked if uncertainty about the descriptions of habitat use should be identified. The current descriptions seem very authoritative but the reality is far from it. There is an uncertainty section in the report which is quite general but would be the best place to capture more specific information about uncertainty and knowledge gaps.

<u>Spawn to Hatch</u>

There is information available for the Grand River that includes spawning times, temperatures, locations and habitat, etc. that can be added. (S. Reid to provide the reference.)

Unpublished data that can be added regarding larval habitat utilization and habitat shift, etc. in the Grand River from swim-up until November. (C. Bunt to provide information).

Young-of-the-Year

The information on Swamp Loosestrife (*Decodon verticullatus*) did not come from the COSEWIC report but was added from Bowman.

This section can be updated with new information from the Grand River, especially with respect to vegetation association. (C. Bunt to provide information.)

Juvenile (age 1 until sexual maturity)

This section can be updated with some limited potential over-wintering habitat information. (C. Bunt to provide information).

Adult

Participants asked for clarification on the statement about not undergoing long distance migrations as it is too qualitative. Is there some quantification that can be added as there seems to be a disconnect between this statement and the Threats sections where habitat fragmentation and dams are the main concerns. If they don't migrate, why are barriers a threat? They definitely migrate several kilometres in the spring and they seem to be motivated to move upstream. They also use fishways at the Manheim weir on the Grand River. There are published descriptions of them being migratory. The term "long distance" is subjective. Data can be added from J. Clark, S. Reid and C. Bunt's data to provide known migration estimates about fish movement in the Grand River.

S. Reid has information from his research that would help flesh out the habitat quality related descriptions.

Black Redhorse are identified as a "cool" water species in the description yet they occur in large numbers in the Grand, Thames and Ausable rivers that are better described as warm water systems. It would be more appropriate to include a range of temperatures that they are known to tolerate, based on the systems where they are found. They may be considered eurythermal (i.e., distributed across a wide range of temperatures).

Is it accurate to say that this species does not tolerate high levels of siltation and turbidity as it is found in turbid systems? This is the *de facto* threat for species at risk in the Great Lakes basin. It is based on observations that have not been tested. It is not clear if the statement refers to chronic or episodic siltation. The relationship between occurrence of Black Redhorse and turbidity is unknown, however, it might be possible to come up with a range of turbidities for the systems where they are found.

Siltation and turbidity are a context-dependant habitat alteration. At one end of the spectrum, situations can range from chronic loading, long-term large-scale habitat changes to riffles and pools, and overall water clarity and productivity. At the other end of the spectrum are individual events that result in pulses of high amounts of suspended sediments, which have physiological impacts and also result in the localized deposition of large amounts of sediment on specific habitat. This context is not recognized in the statement but there are consequences for mitigation. S. Reid has distribution modelling results for redhorse from the western Lake Erie drainages that identify the association between occurrence and habitat conditions such as course and fine substrates.

Should the effects of siltation or turbidity be included under the other life-stages? Would there be greater impacts at particular times of the year? Could the sentence be re-phrased to make the linkage between the impacts that high sediment load would have on components of redhorse habitat? Siltation may be a stressor that does not necessarily cause mortality (C. Bunt), so doesn't directly impact the fish, but negatively impacts the habitat of adult Black Redhorse (S. Reid). It was agreed the sentence would be rephrased to make it less definitive and more explanatory. Uncertainty in the tolerances should be included in the Sources of Uncertainty section.

Residence

There was discussion about whether depressions in riffles made during spawning could be considered residences. They probably result from the act of spawning and are not specifically constructed. The most recent guidance from DFO Headquarters is that in order for something to qualify as a residence, it must be constructed by the organism. Since we don't know of instances of Black Redhorse constructing habitat, the residence concept probably does not apply to this species. The DFO policy on this is currently under review.

Population Status

Presenter: N. Mandrak

The information in the working document is a summary taken directly from the COSEWIC report and is a general overview. The number of populations used in the COSEWIC report was based on the assumption that dams could be used to separate populations in watersheds. This logic is questionable given the population genetic information for the Grand River and the permeability of the Springbank Dam to upstream and downstream movement during much of the year on the Thames River (Reid and Mandrak 2006). This point should be included in this section because it deviates from the COSEWIC report and is important to understanding the status of the species. The populations in Table 1 are identified on a watershed level. The basis for this approach is the limited structure found in the Grand River associated with the fragments that had been identified as populations in the COSEWIC report. In addition, dams are not necessarily barriers to gene flow. It was not possible to resolve the gene flow question as there were high levels of genetic diversity and low levels of population differentiation in the samples. Since the watershed approach is used here and differs from the information presented in the COSEWIC assessment report it is important to clarify what a population is in this document.

Use of the word "destroyed" to describe the Catfish Creek habitat seems a little strong. One of objectives in the Essex-Erie Recovery Strategy was to try to restore that habitat. It sounds like it is beyond recovery when described that way. "Degraded" may be a better descriptor.

Update the last sentence in the Population Status section to include demographic information and population genetic information for the Grand River. There should be one or two sentences added based on S. Reid's research.

Table 1 contains detailed summary information about status, trajectory and importance on a population-by-population basis. One of the regional modifications to the RPA process is to consider status on a population-by-population basis rather than on a species basis especially since many of the species are listed based on declining numbers of populations. The method for assessing populations (DFO 2006) considers three components and their associated uncertainties. Status is a qualitative evaluation of whether a population is in a healthy, cautious, or critical state. Population trajectory was described as stable, declining, increasing or unknown (not enough data points or observations), which is also required in the COSEWIC technical summary. Standardized sampling over time would be needed to provide information on the trajectory. Importance of the population refers to the weighting of the importance to the overall recovery of the species. Certainty of the information was assessed as either expert opinion, based on quantitative criteria (e.g., CPUE, age frequency) or based on rigorous quantitative analysis (detailed published study supporting the assessment). Participants divided the species into populations and then assessed the status, trajectory and importance of each population. The results can be used by managers to make different decisions for different populations.

Participants discussed the relative importance of populations and how meaningful it is that there are so few populations of Black Redhorse. All populations would be considered of high importance to the recovery of the species, with the possible exception of an extirpated population, when the number is below the COSEWIC threshold of 10 populations. If there were many populations, it might be important to consider this criterion so that decisions could be made about where emphasis should be placed for recovery.

Prior to development of the modelling by Vélez-Espino and Koops (2007), the population status table was meant to be used to come up with recommendations for Allowable Harm. The Allowable Harm Assessment (AHA) column was added to capture this information. Based on the status and trajectory of the population, harm may or may not be allowed. For example, harm may not be allowed for a population with critical status but may be for populations with a cautious or healthy status. The information can be put into a risk management framework matrix with colours representing the risk of jeopardizing population survival or recovery (e.g., red=high, yellow=medium, green=low). The advice is that for high-risk populations no harm would be allowed and that any activity causing harm to the species may jeopardize its survival and recovery. For medium-risk populations, Allowable Harm may be permitted under certain circumstances with further information to consult the DFO document on mitigations to habitat threats. For low risk populations, Allowable Harm may be permitted under certain circumstances and the populations would be treated like any others under the provisions of the *Fisheries Act*. Whoever was making a decision would have the information in the table and would have to consider the risk in their decision making. This approach can be used if there are no data but since we have the modelling is the AHA column needed?

The original table was populated based on one individual's experience. The information was provided to the participants so that additional information could be included, discussed and a consensus decision made as to the final contents of each cell.

Participants felt it would be helpful if there was some information about the population size for each river even if it was only the size of the population relative to each other. There was discussion about whether to rank them. The Grand River, for example, might be the highest rank as it is the largest and healthiest population. All other populations could be ranked relative to this so the Ausable River population would be much lower. Quantitative ranking suggests a linear relationship when in realty it could represent an exponential increase in change in status of the population and the basis for the ranking would generally be a best guess. Documenting why a population was given a particular status would be more informative.

The terminology used for the status was taken from the precautionary approach framework, and there was lengthy discussion about what each term meant for the Black Redhorse. When would the population status be considered critical? This would be used when there are very low numbers of individuals and when it is not known if the population will persist. A critical status would be based on area of occupancy, how widely they are distributed in the watershed, number of recapture locations, as well as population size inferred from the number of individuals that have been caught in that area. There may also be some sense of the population trajectory, and whether it may be in decline. There may be some situations where there are no time series data for the trajectory, but there may be other information about limited recruitment, or truncated age distribution that would provide evidence for a trajectory. The difference between critical and cautious implies that there is some imminent need for protection for the critical population or it will be lost (i.e., the population is at more risk of decline), whereas cautious means that the population needs to be protected but it is not in imminent danger of disappearing. Small populations in small areas may be at more risk of decline than populations in larger areas or with more individuals. The Ausable population was used as an example. After three years of sampling, there have been very few individuals caught suggesting that the population size is low and it has only been sampled from a few sites suggesting it has a limited distribution within the watershed. Does this take this population to critical status?

Should status of the population take into account evidence of reproduction as well as area of occupancy and number of animals? Evidence for reproduction may only be the number of ages or sizes present in the samples and this may not be available if the sampling only targets adults. The size- and age-structure information may inform the trajectory and the population status. It was suggested documenting this information separately would be useful. As a result of the discussions, a table was created that included Area of Occurrence (limited or wide) and Abundance (i.e., population size) (low, medium or high) and Trajectory (i.e., reproductive output or recruitment) (declining, stable, increasing or unknown) with a certainty rank for each to be used to determine the overall Status of the population (Critical, Cautious, Healthy, Extirpated or Introduced). The trajectory information relates to recent population trends using the COSEWIC criteria of three generations or the last ten years in the case of Black Redhorse. When trajectory is unknown would it equate to “declining” using the precautionary approach? Is the status of the Ausable River population critical given its limited distribution, small population size and unknown trajectory? There was agreement that if the status was unknown, it would be treated as the worst-case scenario. The resulting table was considered more explicit and participants agreed with using this format.

There has been directed sampling in all of the waterbodies. In the Ausable, there has been sampling over three years and directed sampling in 2007 that yielded few samples from three sites. The original sampling from the COSEWIC assessment was based on one site. There is no trajectory information. For the Bayfield and Maitland, there was limited area of occurrence with few individuals but the trajectory was considered stable based on recent information in the COSEWIC assessment report. The original sampling from the Bayfield used in the COSEWIC assessment was based on one site. There has been a lot of research and sampling carried out on the Grand River. Black Redhorse have a wide distribution and are found in large numbers there, particularly in the central parts of the watershed. Sampling has occurred in both spring and fall resulting in the capture of juveniles and multiple age classes which indicate ongoing recruitment. They have the greatest longevity in the Grand. Sampling in the Thames River indicates this species is widely distributed and in relatively high numbers there as well, whereas in Catfish Creek, they are considered extirpated.

Participants agreed with the summary of information presented in Table 1 that is similar to the information presented in the COSEWIC report. It does not include threats but it was agreed that this should be kept separate in the RPA.

Recovery Targets

Authors A. Vélez-Espino and M. Koops

Presenter M. Koops

Two types of Recovery Targets are needed: an abundance Recovery Target (i.e., how many Black Redhorse are needed to consider a population to be recovered) and a distribution Recovery Target (i.e., how many populations do we need to consider the species to be recovered). Both are quantitative targets but other population attributes (e.g., growth rate or level of recruitment) may also be considered as requirements for recovery. There are no specifications on how to set the targets as long as the approach taken is scientifically defensible.

There are several Recovery Strategies that include Black Redhorse. They contain qualitative recovery goals that refer to healthy populations and communities, and the maintenance of ecosystem components and the interactions between them.

There are several approaches to setting Recovery Targets:

- Status quo (i.e., current population size). This is not usually considered acceptable unless there is evidence the population is healthy.

- Maximum numbers (i.e., as many individuals as possible or carrying capacity which can be based on the historic baseline, i.e., as many as there were in the past). This target aims for abundant, not just healthy, populations in excess of what is needed to consider a population recovered.

- Social dynamics, in order to maintain social behaviours. This requires long-term demographic and behavioural information which, in many cases is not available.

- Ecological function, which requires community and ecosystem-based research with which to maintain interactions between ecosystem components. This type of Recovery Target is often included to describe reasons to recover a population. Usually there is not enough information available to set Recovery Targets based on these criteria.

- Evolutionary potential, that aims to maintain genetic diversity. The idea of an effective population size would influence this, but there is often not enough information to use it.

- Demographic sustainability, which is quantitative and is the most tractable approach available to us now, fitting well into our current modelling. It uses Population Viability Analysis (PVA). The abundance target is set to give a reasonable probability of maintaining the target over the long term.

Abundance Target [3]

Demographic sustainability was used to set abundance targets. The long-term demographic sustainability used was the 99% probability of persistence over 40 generations. This is a fairly conservative target based on Reed *et al.* (2003), a meta-analysis developed for all vertebrates. They found a relationship between minimum viable population (MVP) size (Y-axis) and maximum population growth rate (X-axis). The faster a population can grow, the lower the MVP size. Assumptions of this analysis are that there is no habitat loss and these are discrete and isolated populations (no immigration). The limitation with this analysis is

[3] The values for Recovery Targets and MAPV reported here are the values presented at the workshop. These values were revised following the workshop based on comments from workshop participants. The final values are reported in Vélez-Espino and Koops (2008) and in footnotes 2-5.

that while the meta-analysis is based on vertebrates, it is heavily biased towards mammals and birds and very limited for fishes. The range in population growth rates used in this analysis was compared to those observed at low abundances and found to be consistent with what would be expected for fishes. This relationship is used to generate MVP sizes.

For the Reed regression, is the R_0 population or species specific? The R_0 predicts the MVP size for each population.

The model generates the maximum population growth rate which then gives the MVP size ranging from 338 adults to 1229 adults[4] depending on the age at maturity. The minimum area for population viability (MAPV), which is the amount of adult habitat needed to sustain the MVP, is also determined. Two estimates have been made, one if the population is based on young adults and the second if it is based on old adults. Given the uncertainty with the age of maturity and the influence that the age of maturity has on the MVP size, the most precautionary target was chosen. The precautionary Recovery Target is 1229 adult Black Redhorse in 94867 m^2 of habitat[5]. The intent here is not say that anything above 95000 m^2 of habitat is surplus. This is the minimum area that is needed for the population when it reaches the Recovery Target. The estimate of river kilometers would suggest that habitat limitations are not likely to force the reconsideration of the Recovery Target.

For age at maturity, the Missouri information should be disregarded since much of it is based on aging scales that underestimate actual age. Since there could be a latitudinal gradient in vital rates and Canadian data are available, they should be used. The Grand River work suggests that the earliest age at maturity is either 5 or 6 years old, not 2 to 4 years. The mean age of maturity of spawners (not the whole population) is closer to 8 or 9 years so the minimum age used for modelling should be 5 years. The most influential factor in MAPV is the age of maturity; if the age of maturity is increased, MAPV will increase.

If the minimum area estimate for population viability is divided by 50 m, which is about the width of Canadian rivers, it would be amount to 800-2000 m of river[6]. Participants thought this underestimates the amount of habitat needed. The MAPV is only adult habitat and stretches of river might have patches of adult habitat. There was discussion about adult Redhorse habitat which includes riffles, pools and runs but, it seems, not backwaters. The MAPV is the minimum area for population viability for Black Redhorse, not the recommended area. Participants felt it would be helpful if the MAPV was translated into river kilometres.

How do we address the fact that other redhorse species also occupy this habitat? Black Redhorse may represent 10-30% of the redhorse in the river and they compete for the same habitat. There should be a correction factor to account for this. Depth stratification is not being considered, and there may be fine-scale habitat separation between the species. The area per individual (API) calculation is based on data collected in the field, some of which would include competing species thereby integrating this component into the model. Assuming all redhorse species use the same habitat, then the minimum area would have to be increased to account for this.

For comparison, there are habitat fragments in the Trent River separated by dams. In areas where four species of redhorse occur, the minimum area needed to have sustainable

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[4] The revised values are 7,671 to 8,049.
[5] The revised values are 8,049 adults in 621,544 m^2 of habitat.
[6] The revised values would be 12,000 to 13,000 m of river

populations is 260000 m^2, more than twice the minimum habitat required for Black Redhorse. Habitat fragments smaller than these do not have sustaining populations. The area estimate for this analysis is for adults only, whereas, in the Trent River example the area estimate includes all life stages for the four species.

Research to try to validate the API models should be encouraged since it influences the model. If this modelling approach is going to be applied to all our different species then we need to do some research to validate the model.

What implications does the MVP Recovery Target have for the population status table? Those populations that are considered healthy probably have numbers in excess of this Recovery Target.

Would any population less than 1000 in size be considered critical or cautious? Possibly, although a population that has 1229 or more adults (i.e., the Recovery Target) might still be considered cautious if it occupied a small area. Small populations will always be more sensitive to perturbations or stochastic variation, so their existence is always going to be more tentative, since there is a higher probability of some event happening that will negatively impact them than if they were larger or occupied a larger area. If the population contained at least 1229 adults, however, the risk of that happening is probably low.

How good is the fecundity data from Canadian populations and how sensitive is the model to fecundity levels? Fecundity is used to estimate population growth rate. If the life cycle is very sensitive to fecundity in adults, influencing population growth rates, then that will strongly influence the calculation of MVP. The results indicate the model is not very sensitive to fecundity and more sensitive to age at maturity and young adult survival.

How is population growth rate calculated for redhorse? It is based on the life history data and the estimates from the population matrices.

Are redhorse annual spawners and, if not, what does it mean to the model? If they don't spawn annually, then this will influence the MVP. If they spawn every two years then the maximum growth rate per generation is lower and the MVP will be higher. If spawning habitat is limited, there might be a benefit to not spawning every year. If the whole adult population spawns every year and spawning habitat was limited, then there would be density-dependant effects impacting survival of eggs. The population growth rate might be higher with spawning every year as a result. However, for a population at low abundance, it is much less likely that spawning habitat would be driving the density-dependant effects. Most of the modelling uses the API approach and very rarely is spawning habitat limiting.

Can the uncertainty about whether or not Black Redhorse spawn every year be captured in the model? It is possible to explore various spawning periods (i.e., every two years, every three years, etc.)

If the sex ratio is assumed to be 1:1 and the actual spawning sex ratio is different, will this affect the model? This would have more impact on the fecundity estimates than spawning periodicity. A male-biased sex ratio on the spawning ground is fairly typical.

Black Redhorse are sensitive to habitat limitations in the Young-of-the-Year (YOY) stage.

How do you gauge whether you think the output number is right? We rely on the precautionary approach so that if there is a range of values to choose from, the most conservative value is chosen.

In general, there was agreement with the approach taken to estimate the MPV and MAPV. They will be recalculated to reflect the new information and meeting discussions. Additional calculations will be made to explore the influence of older ages of maturity (i.e., 5-8 years) on the Recovery Target. In addition, the sensitivity of the Recovery Target to spawning periodicity will be explored. This will be included in the revised RPA document.

Distribution Target

The number of populations over the geographic range would be the distribution target. COSEWIC used the number of populations for assessment criteria: less than or equal to 5 populations for Endangered (EN) and less than or equal to 10 populations for Threatened (TH). Although there is no set number of populations at which a species is considered healthy, based on the COSEWIC criteria there would have to be in excess of 10 populations of Black Redhorse for this species to be considered not at risk. COSEWIC also looks at the trend or the rate of change in the number of populations and a secondary consideration is rescue effect.

The COSEWIC report indicates there are 15 extant populations and one extirpated population. This number of extant populations is based on each river supporting a distinct population separated by barriers (dams). This basis for population separation has been reconsidered since the report was written because it doesn't always hold. In keeping with the recovery strategy goal, participants proposed that all current extant (native) Canadian populations, in the five watersheds, should be identified for recovery to, or above, the abundance target. All populations are needed for recovery of the species.

Spencer Creek was not included in the distributional target since the species was introduced to this location and is not a native population. Whether the Spencer Creek population should be enhanced could be considered as an option if it is needed for recovery of the species.

There was discussion about what would be considered recovery. Although the logical measure of recovery is reversing the COSEWIC listing criteria, this may not be the same as what DFO considers recovery and COSEWIC does not have specific criteria for a "recovered" designation. Participants indicated that it also doesn't seem reasonable to have to extend the range of a species beyond its historic range for it to be deemed recovered.

If a species is considered at risk yet there are healthy populations with good abundance (i.e., in excess of the Recovery Target), the recovery strategies should focus on recovering those populations that are below the Recovery Target and maintaining the healthy ones. There was some concern that the Recovery Target might be used as a destruction target. Would the Grand River population, which is probably quite large, still be considered recovered if it was reduced from its current healthy level to the Recovery Target? The Recovery Target will be larger than what was presented at the meeting once it has been revised using the new age-at-maturity information. The Target is something to aim for when population size is lower than the Target and provides useful information to develop scope for Allowable Harm when the population is higher than the Target. The recovery team may use the science advice provided and decide that, for healthy populations, the Recovery Target is to maintain the current population abundance and, for the other populations, the Target is the value based on the modelling.

Threats
Presenter: N. Mandrak

The written section is a summary from the COSEWIC report. Table 2 was developed at one of the previous RPA meetings where participants reviewed the contents to see if the rankings were appropriate using the threats identified in the COSEWIC assessment. It includes threats ranked for magnitude and probability taken from the literature across the entire range of the species. The magnitude of each threat was ranked as low (sometimes a threat), medium (often a threat), or high (always a threat). Table 3 ranks the magnitude of the threats for each Canadian population. The magnitude in Table 2 comes from the literature and is informed by Table 3. There is concern about the lack of standardization of the term “threat” used in COSEWIC reports, how it is used, and what it means. To overcome this, the threats are linked to Habitat Management’s Pathways of Effects model in Table 4, which provides specifics about what the potential impact might be and how it can be prevented. Table 5 identifies threats for closely related species that were not identified for Black Redhorse.

Participants reviewed and discussed the magnitude identified for each of the threats in Tables 2 and 3. Literature Cited numbers in Table 2 were not correct and needed to be updated.

The magnitude and probability for siltation/turbidity in Table 2 is listed as high but participants were not sure that it should be. Although it is always highlighted, there is no direct evidence that it has a deleterious effect on Black Redhorse populations at the level of siltation seen. Perhaps the level of siltation and turbidity should be considered. Whether it is chronic or episodic, siltation/turbidity may impact whether it would be a threat to Black Redhorse but this may not be distinguishable in the literature. Participants discussed siltation/turbidity and agreed they should be assessed separately, and that chronic and acute situations should be identified for each. Siltation is fine sediment over substrate while turbidity is suspended sediment. If conditions were very turbid all of the time, the threat level might be ranked as high, whereas if conditions were moderately turbid, the threat level might be medium. The threshold was unknown.

Table 3 represents a subset of the range of Black Redhorse, therefore the ranking of threats for individual populations in Table 3 may be different from Table 2. Participants decided it made more sense to review Table 3 first. Participants pointed out inconsistencies between earlier discussions and what was presented in Table 3, particularly for the Ausable and Grand rivers. For the Ausable River, which has been identified as critical, most of the threats listed have a low magnitude; whereas, for the large population in the Grand River, most of the threats are ranked as medium. The magnitude and distribution of threats were reported without considering the status of the population. The Table also lists current threats rather than the historic threats, which may have resulted in the current status of the population.

“Current” should be added to the Table 3 caption. The Table 2 caption should indicate that the ranked threats for Black Redhorse as a species come from the literature.

The only threats that have been validated are the impacts of dams and impoundments; the other threats are just long-term observations of ichthyologists or general habitat degradations without the research done to validate them. The really large hydroelectric storage reservoirs, with fluctuating flows downstream and hypolimnetic reaches with low oxygenated cold water, are the only dams and impoundments that are threats to redhorse. The report recognizes that dams and impoundments cause flow regime changes as well as present a physical barrier that fragments the habitat. The size and operation strategies of the dams have a strong influence on whether a threat is realized by Black Redhorse populations. Some dams improve water quality for redhorse downstream by reducing turbidity and siltation. More insight into the impact of dams needs to be added to the report.

There was also discussion of other threats to this species and whether they should be added to the report. Exotics may compete with redhorse for food (e.g., Round Goby), prey on them (e.g., Brown Trout) or affect their habitat (e.g., Common Carp increasing turbidity). Exotic pathogens, such as Viral Hemorrhagic Septicemia (VHS), may impact Black Redhorse. Drought or draw-downs (water-taking) currently impact Black Redhorse more than other species because they spawn in shallow riffles, which are the first areas to be affected. Water removals are currently occurring in some locations. The opposite situation also occurs at the Springbank Dam, which is open in the spring allowing redhorse to move upstream to spawn. At the beginning of June, the gates are closed and the water level in the areas with eggs goes from three feet deep to 18 feet deep. Instream flow is, therefore, a current threat. Climate change may be a threat in the future, although it is unknown if it will have a uniform effect on all populations or whether there will be variations across the basins. It was agreed that only current threats would be included in the tables. It was also agreed that Spencer creek should be removed from the tables.

It was decided that instream flow would not be specifically added to Table 3 since it is part of urban and agricultural development. However, the water extraction pathway (#12) should be added to the urban development threat under Table 4. It was noted that some of the threats, such as urbanization, are very broad. Urbanization is ranked as low because Black Redhorse seem to be found within urban areas even in fairly poor water quality conditions. There may be a link between nutrient loading and invertebrate production downstream of urban areas that may be why there are redhorse associated with these areas. There are some practices, such as use of salt in urban areas, for which there is no specific information. It was also pointed out these are current threats and may change with future development.

Angling is included as it occurs in all of the rivers so there is chance that a Black Redhorse will be caught although they are likely only taken as bycatch.

Allowable Harm and Time to Reach Recovery
Authors A. Vélez-Espino and M. Koops
Presenter A. Vélez-Espino

The discussion of Allowable Harm is one of the most important parts of the meeting. Allowable harm is related to the provision in SARA where, under certain circumstances, the Minister can allow harm if it doesn't jeopardize the survival or recovery of the species. A quantitative approach to determine Allowable Harm was needed for species where time-series data are not usually available and where there is no information on levels of exploitation. A model to provide guidance for data-poor species and follows the precautionary approach was developed by Vélez-Espino and Koops (2007). The model looks at harm not only as a function of mortality but also through changes to somatic growth rate or fecundity rates. The matrix population model portrays the dynamics of the species or population with demographic transition linkages (probability of moving from one life-stage to the next). Life history data compiled from the relevant literature were used to determine the growth patterns and values of age-specific vital rates, annual survival and fertility to populate the model. Depending on the type of data available, a deterministic or stochastic approach can be used. Some habitat information (quality or quantity) can be used, as it was for Black Redhorse, to see if the population is sensitive to habitat loss.

The basis for the modelling is perturbation analysis, which indicates (1) how much each of the population metrics that represent vital rates (e.g., fecundity, survival, and somatic growth) will be perturbed whether from harm or recovery efforts and (2) how population growth rate changes. There are several types of outputs, and the precautionary approach was used to determine the maximum Allowable Harm and the minimum time to recovery. The modelling was not based on a specific population but used the best information available from the different populations of Black Redhorse. A stochastic approach to the computation of elasticities was used to incorporate the variation in vital rates and its effect on population responses to demographic perturbations. For this approach, Monte Carlo simulation analysis was used. The model was populated with as much data as available even in the absence of time-series. If time-series data for different demographic parameters are available they can be included in the modelling, which will improve the validity of the values. A stochastic matrix perturbation analysis was conducted to determine Allowable Harm following a precautionary approach. In determining Allowable Harm, consideration was given to a designation of population growth rate.

The analyses demonstrated that Black Redhorse population dynamics are particularly sensitive to perturbations on Young-of-the-Year (YOY) survival. Juvenile habitat was found to be the most limiting. Allowable Harm for YOY, juveniles and young adults should be less than 19, 14 and 13% respectively. Reduction of fertility rates in young adults should be less than 17%. Reductions in habitat areas used by YOY, age one and older (except spawning habitat) and spawners should be less than 12, 37 and 13%, respectively.

The results allow determination of allowable fishing mortality for minimum size limits. For example, if the catchable size of Black Redhorse were over 250mm, based on this analysis would be possible to remove 30% of fish over 250mm without jeopardizing the survival or recovery of the species if this fishing mortality were the only source of harm incurred by the population.

As habitat loss can reduce the rate of population growth, habitat information should be considered when determining the maximum capacity of a population or species to increase. Habitat loss has the highest impact on Black Redhorse population growth rate for YOY and spawners. Sensitivity to habitat loss assumes no other harm is occurring. For example, if one is willing to sacrifice 13% of the spawning habitat (as harm to the population), then there is no scope for harm from other sources (e.g. from recreational fishing). Although scope for harm is presented as a set percentage per annum, this does not mean that 13% of the spawning habitat can be lost annually. Although habitat loss is often permanent, it can refer to a temporary loss such as the temporary loss of spawning habitat that results from reduced seasonal flow. Once the habitat is regained, then there would once again be scope for harm. This illustrates the importance of using the population approach. In a healthy population, there may be less concern with coming close to the 13% level of harm than in a critical population where population growth is needed to reach the Recovery Target. It is also important to understand that in the model there is no distinction between quality and quantity of habitat. Decline in habitat quality is the same as if it was an actual physical loss of habitat.

For populations where habitat constraints indicate that the MAPV in terms of old adults is not available, but the MAPV in terms of young adults is available, then a Recovery Target of

1229 young adults might be considered. If there are no habitat constraints and current population size is far below the Recovery Target, then 1229 adult fish, regardless of their age, would constitute an appropriate Recovery Target. If the adult population size is estimated to be close or above the Recovery Target, then choosing 1229 old adults as a Recovery Target would constitute an appropriate Recovery Target and counterbalance the perception that fishing mortality in this stage can be absolute without causing important reductions to population fitness.

Projections were generated using a logistic model which incorporated the lower and upper bounds of population responses to recovery for individual vital rates. This analytical approach can be used to incorporate the influence of environmental stochasticity on recovery timeframes. To implement this approach pragmatically, the population size, particularly of adults, the amount of habitat available and habitat suitability information is needed. Given the data limitations, long-term projections correspond to hypothetical scenarios. Stochastic projections of recovery timeframes were not possible. However, the use of lower and upper bounds of population responses to recovery served as a means to incorporate the influence of environmental stochasticity on recovery timeframes.

Long-term projections of population size (old adults) were generated using five hypothetical management strategies that covered a range of increasing recovery effort, each of which targeted different vital rates. The management strategies were cumulative beginning with (1) habitat rehabilitation, (2) stocking, (3) fishing regulations for young adults, (4) rehabilitation and enhancement of spawning habitat and (5) closing fisheries for old adults. Deterministic modelling was used since the paucity of data did not allow a stochastic approach. In the modelling, the first four management strategies combined resulted in an increase in all life-stages. Recovery time frames would be shorter when more than one management scenario is followed. It was also suggested that rehabilitating spawning habitat would not just benefit spawners because the areas were also used by other life stages. Based on the projections, any reduction in fishing mortality of old adults, including complete closure of the fishery, produced a meagre demographic benefit and a poor contribution to the protection or recovery of the population.

Based on the information presented on minimum viable population size and how much area is needed to maintain a population, habitat supply should not be a problem. However most of the threats identified are habitat-related threats. This suggests that the problem with Black Redhorse is habitat quality as opposed to habitat quantity. All the material presented, including the results of the modelling, is consistent with this interpretation.

The main reason why this species is considered at risk is its limited distribution in Canada. There is also evidence of decline and identified threats that led COSEWIC to consider Black Redhorse as at risk. There may not be a lot of suitable habitat for the species, either historically or currently, therefore the recovery goals are to maintain stable populations, not to expand the distribution of the species throughout Southern Ontario.

Participants agreed there is scope for Allowable Harm for Black Redhorse as described in the draft RPA document. This indicates that there is potential for minimal levels of human-induced harm in all life stages without jeopardizing the survival or recovery of the Black Redhorse. The juvenile and young adult stages are most sensitive to increased mortality, and the YOY stage is most sensitive to habitat loss. Black Redhorse populations are predicted to be very resilient to harm applied to the old adult stage. Decreases in survival for all other life stages, of up to 10% in any one stage, are not expected to jeopardize the population.

The time frames for these mortality rates should be articulated in the document. They are annual mortality rates. The 10% scope for harm is for any one life stage. However, if the human-induced harm affects more than one life stage, the scope for harm is reduced since the harm to the population would be increased. For example, with the allowable fishing mortality based on size limits, when you have a large size limit, you are effectively removing one life stage from the population (older adults). As the size limit decreases, more and more life stages are affected, resulting in an exponential decline in Allowable Harm.

Next Steps

The documents resulting from the meeting will be revised based on these discussions. The results of the modelling by Vélez-Espino and Koops will be updated to include new information provided by participants. Updated MVP and MAPV estimates will be added to the revised Science Advisory Report along with the updated Recovery Target.

Some participants will be asked to review the threats and their rankings to see if they should be updated based on the modelling and Allowable Harm discussions. The baitfish harvesting threat, for example, should be considered in light of the sensitivity of the YOY life stage. There may be some information from the baitfish survey results that will provide information on level of harm to Black Redhorse. Although it may not change the ranking, it is worth reviewing.

The revised report will be distributed for comment. If further discussion is warranted, a teleconference call may be arranged.

SOURCES OF UNCERTAINTY

More information is required regarding population sizes particularly for adults, population trends, amount of habitat available and habitat suitability information, within the various Canadian watersheds. Difficulties in identifying Black Redhorse may lead to inaccurate estimates of the number of individuals present. Further research into the life history of the species is required.

YOY diet, habitat use and ecology are uncertain. This information would have implications for the population modelling.

There was further discussion about threats and whether more detail is needed. Some broad threats, such as urbanization and agricultural development, include various types of habitat alterations (e.g. instream flow, water quality).

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APPENDIX 1: Terms of Reference

Recovery Potential Assessment of Black Redhorse

Regional Peer Review Meeting – Central and Arctic Region

Canada Centre for Inland Waters
Burlington, ON
Black Redhorse - December 7th, 2007

A. Background

In May 2006, the Committee on the Status of Wildlife in Canada (COSEWIC) designated the Black Redhorse as Threatened. The Minister of Fisheries and Oceans Canada has recommended not listing the Black Redhorse under the *Species at Risk Act* (SARA). Although a Recovery Potential Assessment (RPA) was initiated for this species in 2005, it was never completed pending further guidance from DFO National Headquarters. This guidance was provided during a workshop held in August 2007. The RPA should now be completed in the event that the listing decision be re-evaluated.

The purposes of SARA are to protect wild species at risk and their habitats in Canada, and to promote their recovery. The Act stipulates that it is forbidden to kill individuals of a species listed under the Act as threatened, endangered or extirpated or to harm, harass, capture or take them. The SARA also prohibits damaging or destroying their residence or any part of their critical habitat. Furthermore, the SARA provides for the preparation of a recovery strategy for species listed as threatened, endangered or extirpated. The provisions of these recovery strategies must ensure that any possible threat to a given species and its habitat does not jeopardize its survival and recovery.

Section 73 (2) of the SARA provides the competent ministers with the authority to permit normally prohibited activities affecting a listed species, its critical habitat, or its residence, even though they are not part of a previously approved recovery plan. Such activities can only be approved if: 1) they are scientific research relating to the conservation of the species and conducted by qualified persons; 2) they will benefit the species and are required to enhance its chance of survival in the wild; or, 3) affecting the species is incidental to the carrying out of these activities.

The decision to permit allowable harm and the development of a recovery strategy must take into consideration the species' current situation and its recovery potential, the impacts of human activities on the species and on its ability to recover, as well as the alternatives and measures to reduce these impacts to a level which will not jeopardize the survival and recovery of the species.

Therefore, a species RPA process was developed by DFO Science to provide the information and scientific advice required to meet the various requirements of the SARA, such as the authorization to carry out activities that would otherwise violate the SARA as well as the development of recovery strategies. In the case of a species that has not yet been added to Appendix 1 of the SARA, the scientific information also serves as advice to the DFO Minister regarding the listing of the species under SARA. Consequently, the information is used when analyzing the socio-economic impacts of adding the species to the list as well as during subsequent consultations, where applicable.

B. Objectives

The intent of this meeting is to assess the recovery potential of the Black Redhorse. It is a science-based peer review of the designatable unit assigned by COSEWIC and the 17 steps in the RPA framework outlined in the Appendix. The advice will be provided to the DFO Minister for his consideration in any listing decision under SARA for these species.

C. Products

The meeting will generate a proceedings report summarizing the deliberations of the participants. This will be published in the CSAS Proceedings Series. There may be CSAS Research Document(s) produced in relation to the working paper(s) presented at the workshop. The advice from the meeting will be published in the form of a Science Advisory Report.

D. Participants

Participants will include experts from DFO Science and Policy sectors, Royal Ontario Museum and Ontario Ministry of Natural Resources. Participants will not exceed a maximum of 20 people.

E. Timetable for FY 2007/08

The draft Science Advisory Report will be circulated to participants for comments in December 2007 and the final version will be submitted to the Canadian Science Advisory Secretariat (CSAS) for publication in early 2008.

APPENDIX 2: Topics that should usually be covered in a recovery potential assessment.

The topics (from the national framework) for which an assessment should be done for any species/designatable unit is as follows:

Phase I: Assess Current Species Status

1. Evaluate **present species status** for each population
2. Evaluate **recent species trajectory** for each population
3. Estimate, to the extent that information allows, the current or recent **life history parameters** for the species (total mortality [Z], natural mortality[m], fecundity, maturity, recruitment, etc) or reasonable surrogates; and associated uncertainties for all parameters.
4. Address the **habitat requirements and habitat use patterns** of the species using the separate Terms of Reference for describing and quantifying habitat outlined below (to the extent possible)
5. Estimate expected **population and distribution targets** for recovery.
6. Project **expected population trajectories** over three generations (or other biologically reasonable time), and trajectories over **time to the recovery target** (if possible to achieve), given current population dynamics parameters and associated uncertainties (step 3) using DFO guidelines on long-term projections.
7. Evaluate **residence requirements** for the species, if any.

Phase II: Scope For Management to Facilitate Recovery, Taking Account of Associated Uncertainties.

8. Assess the **probability that the recovery targets 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**
9. Quantify to the extent possible the **magnitude of each major potential source of mortality** identified in the pre-COSEWIC RAP, and considering information in COSEWIC Status Report, from DFO sectors, and other sources.
10. Quantify to the extent possible the **likelihood that the current quantity and quality of habitat is sufficient** to allow population increase, and would be sufficient to support a population that as reached its recovery targets
11. Assess to the extent possible the magnitude by which current **threats to habitats have reduced habitat quantity and quality.**

Phase III: Scenarios for Mitigation and alternative to activities

To the extent possible with the information available:

12. Using input from all DFO sectors and other sources as appropriate, develop an **inventory of all feasible measures to minimize/mitigate** the impacts of activities in Steps 9 and 11.
13. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all reasonable **alternatives to the activities** in tasks 9 and 11, but with potential for less impact. (e.g. changing gear in fisheries causing bycatch mortality, relocation of activities harming critical habitat)

14. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all **reasonable and feasible activities that could increase the productivity or survivorship parameters** in steps 3 and 8.
15. Estimate, to the extent possible, the **reduction in mortality rate expected** by each of the mitigation measures in 12 or alternatives in 13. and **the increase in productivity or survivorship** associated with each measure in 14
16. Project **expected population trajectory** (and uncertainties) over three generations (or other biologically reasonable time), and to the time of reaching recovery targets when recovery is feasible; given mortality rates and productivities from 15 that are **associated with specific scenarios** identified for exploration. Include scenarios which provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.
17. 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 of listing the species.

APPENDIX 3: List of Participants

Name	Affiliation	e-mail
C. Bunt	Biotactic	cbunt@biotactic.com
A. Doherty	DFO Fish Habitat Management	andrea.doherty@dfo-mpo.gc.ca
A. Edwards, (Rapporteur)	DFO Science	amy.edwards@dfo-mpo.gc.ca
M. Finch	University of Waterloo, DFO Habitat	mary.finch@dfo-mpo.gc.ca
K. Hurst	DFO Policy	karen.hurst@dfo-mpo.gc.ca
M. Koops (Chair)	DFO Science	marten.koops@dfo-mpo.gc.ca
N. Mandrak	DFO Science	nicholas.mandrak@dfo-mpo.gc.ca
R. Randall	DFO Science	robert.randall@dfo-mpo.gc.ca
S. Reid	DFO Science Visiting Fellow, Trent University[1]	
S. Staton	DFO Science	shawn.staton@dfo-mpo.gc.ca
A. Vélez-Espino	DFO Science	luis.antonio.velez-espino@dfo-mpo.gc.ca

[1]formerly with Trent University, now with Ontario Ministry of Natural Resources (reid.scott@ontario.ca)

Proceedings prepared by K. Martin, CSA-C&A, kathleen.martin@dfo-mpo.gc.ca

APPENDIX 4: Meeting Agenda

Recovery Potential Assessment of Black Redhorse

Regional Peer Review Meeting – Central and Arctic Region

South Seminar Room
Canada Centre for Inland Waters
Burlington, ON

December 7th, 2007
9:00-5:00

Chair: Marten Koops

9:00	Welcome and Introductions (Koops)
9:15	Purpose of Meeting (Mandrak)
9:30	Species Status and Habitat Requirements (Mandrak)
9:45	Population Status (Mandrak)
10:30	Break
10:45	Recovery Targets (Vélez-Espino/Koops)
12:00	Lunch (provided)
1:00	Threats (Mandrak)
2:00	Allowable Harm (Vélez-Espino/Koops)
3:00	Break
3:15	Alternatives to Activities/Feasible Mitigation Methods
4:15	Wrap-up