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Proceedings of the National Advisory Meeting on Conservation translocations of SARA-listed freshwater fishes and mussels

October 19–22, 2021
Virtual Meeting

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Foreword

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

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SUMMARY

These Proceedings summarize the relevant discussions and key conclusions that resulted from the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS) National Advisory Meeting to provide science advice on conservation translocations of freshwater fishes and mussels listed under the *Species at Risk Act* (SARA).

This meeting was held virtually October 19–22, 2021.

The objective of this meeting was to provide science advice about the potential benefits and risks of conservation translocations. The advice will support the survival, recovery, or management of SARA-listed freshwater fishes and mussels, which will ensure consistency in their application.

The conclusions and advice resulting from this meeting are provided in the form of a Science Advisory Report which is available on the CSAS website. The supporting Research Document reviewed and discussed at the meeting will also be made available on the CSAS website.

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS) National Advisory Meeting was held virtually October 19–22, 2021 to provide science advice on conservation translocations of freshwater fishes and mussels listed under the *Species at Risk Act* (SARA).

The Chair opened the meeting and participants introduced themselves. The Chair provided an overview of the CSAS policies, reviewed the Terms of Reference (Appendix 1) that served as the foundation for this CSAS process, and reviewed the Agenda (Appendix 2). The list of participants is provided in Appendix 3.

Participants were free to speak in either English or French. LMB Systems Inc. provided simultaneous translation throughout the meeting.

BACKGROUND AND CONTEXT FOR SCIENCE ADVICE

Approximately one-third of SARA-listed freshwater fishes and mussels have a form of conservation translocation identified in species management or recovery documents. However, only about a third of those have had translocation interventions performed on wild populations.

The four types of conservation translocation are supplementation, reintroduction, mitigation translocation, and assisted colonization. Currently, translocation is underutilized across the suite of freshwater SARA-listed species for which it has been identified in recovery documents. This is likely because of a lack of general scientific guidance about how it can benefit species recovery, as well as any related risks. Nonetheless, there are some strong examples of reintroduction programs in Canada.

The goal of this National Advisory Meeting was to establish a high level, flexible, ecologically sound framework for determining under which circumstances conservation translocations would benefit SARA listed species and identifying the potential risks to the species and broader ecosystem components. This framework was designed to work with the data poor SARA listed species as this is a common attribute of these populations. Because this was not a species-specific exercise, the decision support framework can also be useful for data rich species.

Additional science advice may be needed on how to design, implement, and monitor conservation translocations when they are deemed to benefit the species. The most important focus of the current process was on “under what circumstances” should translocation be initiated. Additional questions include “where”, “what time of year”, “how many”, and “how frequently”.

Below is a summary of additional discussion points:

- The Working Paper will clarify if it is acceptable to translocate within one Designatable Unit (DU) to save another DU.
- The framework could be used to evaluate the suitability of reintroduction as the result of an offset.
- The Working Paper is not focused on the development of quantitative methods but may use quantitative methods as part of the assessment.

OVERVIEW OF THE FIVE STEP DECISION SUPPORT FRAMEWORK

STEP 1: IDENTIFY OBJECTIVES FOR CONSERVATION TRANSLOCATIONS

The presentation described the primary reasons to initiate conservation translocations:

- Improve population recruitment.
- Establish a population.
- Rescue individuals of populations at immediate risk of extirpation.

Below is a summary of the discussion points:

- The risk of impact on the source population should be examined first but recognize that supplementation can pose substantial risk on the existing population.
- The definition for “immediate” is a relatively short timeframe. For example, not addressing a problem right away means there is “immediate” danger.
- The COSEWIC (Committee on the Status of Endangered Wildlife in Canada) use of generation time should be used to inform the definition of “immediate” as it relates to the wildlife species under consideration.
- The capacity of species, the lifespan of species, and their capacity for immigration should be considered, which can differ between mussels and fishes.
- It is important to consider the extant genetic diversity of the source, where they exist, and recipient populations.
- The complex life cycle of freshwater mussels makes reintroduction challenging. The well-being of host species must be considered when doing translocation. It should be clarified when an immediate risk to a species may be justified.
- Propagules are needed from a DU to accomplish the desired objectives, which is a restrictive scenario. A DU that occupies a single lake means the available translocation options are very limited.

Below is a summary of the proposed revisions to the Working Paper:

- Figure 1 illustrated that reintroduction is riskier than supplementation. In reintroduction, the threat mechanisms are often unknown for species at risk, and reintroduction results in more failure than supplementation. “Risk” should be clearly defined as the risk of failure to achieve the fundamental means and fundamental objectives.
- Step 1’s definitions of “risk” and “immediate” should consider the causes of decline prior to translocation, which will help determine how to assess the translocation. The risk section of the Working Paper would benefit from emphasizing the appropriateness of introducing a species if the species is extirpated from the wild.
- The DU concept should clarify that the intent is for the Working Paper to be used at the level of Wildlife Species, as defined by COSEWIC and under the *Species at Risk Act*.
- The Working Paper should clarify “the sufficient number of” populations or subpopulations needed to do translocations.
- There are issues around DU designation. The Working Paper should clarify that this peer review is focused on SARA species, which are defined “on the basis” of COSEWIC’s DU decisions.

STEP 2: ASSESS THE PROBABILITY OF ACHIEVING THE FUNDAMENTAL AND MEANS OBJECTIVES

The presentation covered the following points:

- Estimate the probability that achieving the means objective improves survival or recovery of the species.
- Identify factors that may influence the ability to achieve the means objective.
    - Population considerations, habitat, community considerations, threats.
- Estimate the ability to achieve the means objective.

Below is a summary of the discussion points:

- Table 2 is useful to work through the decision support framework process, while the Working Paper describes the context and information for developing Table 2.
- The way captive breeding or captive rearing is done will influence its success.
- The audience needs working knowledge and a proposed “how” to conduct the translocation before working through Table 2 to get the factors that affect the means objective. Multiple approaches could be evaluated if there are multiple ways to do translocation. Table 2 (and later, Table 3) are used to compile scientific evidence to inform success and risks, but do not directly make the decision itself on their own (that is, they require interpretation).
- A low likelihood in Table 2 may mean that more directed research is needed.
- The risks of doing nothing must be weighed against performing the translocation.
- Table 2 identifies community considerations but will clarify that it doesn’t differentiate between positive and negative species dependencies.

Participants were invited to share their experiences using Table 2:

- Some categories are more important than others, depending on how much value the user places on them. This is likely an exercise at whatever scale of translocation conservation being evaluated.
- One table should be completed for each population under consideration for translocation.
- The Table allows a wide range of users to investigate knowledge gaps around translocations. For implementation, the Table guides users through various questions that should be considered. The text on habitat preferences is very important but may be difficult at times when assessing the habitat quality because it is hard to see what is required for species and whether the essential feature is present in the target habitat. Sometimes, the questions may not be enough to provide a comprehensive picture. The example of the water quality question is noted as difficult because twelve sampling points over a year is not sufficient to conclude that the water quality is high. Even if the environment is not identical to historic conditions, an ancestral approach may be used. If the environment is not reflecting the ancestral approach, then perhaps the Table is not as useful in this application.
- Table 2 will provide an important scientific record to justify to the public why translocation decisions were made.
- The Table does not identify specific human threats, such as bycatch, sport fishing, or other human disturbances. While not applicable for all species, those threats still exist.

Below is a summary of the proposed revisions to the Working Paper:

- The Working Paper should include an expanded explanation of the intended use of Table 2; that is, who should use it. There are several uses of this Table within the SARA science and management process, including:
    - Recovery biologists may use it to determine the suitability of translocation for inclusion within Recovery Documents.
    - Science may use it as a planning and evaluation tool.
- Table 2 should include the COSEWIC threat categories.

STEP 3: ASSESS THE ECOLOGICAL RISKS OF PERFORMING CONSERVATION TRANSLOCATIONS

The presentation emphasized the suite of ecological risks that can occur due to translocation, which encompass listed species and broader ecosystem components. The presentation covered the following points:

- Identify risks of performing conservation translocations.
    - Reduction in source and recipient population persistence and genetic variation.
    - Change in community and ecosystem dynamics in source and recipient ecosystems.
    - Transfer of disease to recipient populations and ecosystems.
- Estimate the risk of performing conservation translocations.

Below is a summary of the discussion points:

- The literature on the risk of translocation is heavily based on Pacific Salmon, where important considerations are mate choice and selectivity for domestication or captivity. Leaving out mate choice, matters greatly to these species, and it is not outbreeding itself.
- If everything was done from the ecological and biological side, economic and social aspects would never be discussed. The emphasis should be on ecological issues to help inform decision-making, whether or not management accepts the information.

Below is a summary of the proposed revisions to the Working Paper:

- A decrease in population abundance should be noted, and Section 3.1.3 in the Working Paper should note reductions in founder effects.
- In Table 3, the biggest obstacle was the risks to other ecosystem components. Table 3 would be improved by including the broader ecosystem responses, and how to capture non-focal, non-target species.
- Another option, “unknown”, was suggested for inclusion in the risk table, and the references column can be amended to identify what the unknowns are. This would provide an important scientific record of information quality and gaps, which could be used to identify critical information needs prior to reassessment and implementation.
- Table 3 will include the risks that will be identified. Additionally, feasibility of performing the translocation was not included to ensure the Table was focused on science. Feasibility would be considered in a future advisory process.

STEP 4: COMPILE AND WEIGH SCIENTIFIC EVIDENCE TO INFORM THE CONSERVATION TRANSLOCATION DECISION

The presentation covered the following points:

- Expected improvements in survival or recovery.
- Risk versus benefits for focal species.
- Benefits for focal species against risks to broader ecosystem.
- Other fishery or ecosystem management objectives.

Below is a summary of the discussion points:

- The Tables are designed to be flexible and prompt users to ask how to estimate population sizes of species under consideration. When populating the Tables, users will realize what information is lacking, forcing an assessment of whether or how a decision can be made.
- Including more detail in the initial translocation plan results in more specificity when using Table 2 and Table 3, which will help users in Step 4.

Below is a summary of a proposed revision to the Working Paper:

- Fisheries Management objectives should be renamed more broadly as “other management objectives”.

STEP 5: IMPLEMENT AND MONITOR THE EFFECTS OF CONSERVATION TRANSLOCATIONS

The presentation covered the following points:

- Monitoring requires a much longer timeframe than the conservation translocation action.
- Monitoring should allow conclusions of success or failure but need to identify monitoring endpoints and objectives.
- Many monitoring designs are suitable, such as BACI (before-after-control-impact) design.

Below is a summary of the discussion points:

- Determining when to stop the translocation activity is very important consideration. Developing “stopping rules” in advance can help with this decision.
- Often, more fish are produced (e.g., during captive breeding) than should be released. There should be a plan for excess progeny because euthanizing extra fish is not ideal. It would be valuable to create a table on these and related considerations around fish production.
- There will be a need for long term funding for translocation initiatives and experiments. The monitoring component may exceed the costs of stocking. Monitoring is done for some but not all translocations. Monitoring efforts can shift due to feedback from the community.
- The cost of fish production (if pursuing captive breeding) must be considered independently from the cost of monitoring. Monitoring can encompass a range of costs. For mussels, production and cultivation are expensive, while subsequent monitoring is inexpensive.
- Monitoring can mean different things depending on the species and objectives. Monitoring should be included in the working plan and adapted to the species with the ability to stop when desired. Monitoring should also include evaluation of the risk of species not recovering.
- Frequency of monitoring can be a human impact and have an impact on the community.

- Care must be taken regarding the messages being broadcast. It has been observed that there are experiments with unauthorized translocation of local species, and that observers in provinces speak authoritatively in spreading information that may not be accurate.

Below is a summary of a proposed revision to the Working Paper:

- Management often plans for the short term. The lack of immediate positive results may make management reluctant to continue translocation efforts. Section 5 should be reinforced with the emphasis that translocation restoration is a long-term experiment in ecosystem restoration and requires long term follow-up. Recruitment metrics are needed to determine when to stop, including whether the result is a success or a failure.

EXAMPLES OF APPLYING THE FIVE STEP DECISION FRAMEWORK

FISH EXAMPLE: EASTERN SAND DARTER

The presentation provided an example of how the five-step conservation translocation decision support framework can be implemented for Eastern Sand Darter. The example stops at Step 4 as the Research Document was not intended to provide a decision on whether to implement reintroduction.

- Step 1: Identify objectives
- Step 2: Assess the probability of achieving the fundamental and means objectives
- Step 3: Identify and assess the likelihood and magnitude of unintended consequences

Below is a summary of the discussion points:

- The quadrants in the figure are asymmetric because each quadrant is weighted and plugged into quantitative modeling. The result is nine quadrats.
- There is uncertainty regarding why Eastern Sand Darter was extirpated in the first place, if these factors have changed over time, understanding how the ecosystem has changed, how current the data will be for evaluating decisions, and if the available empirical data influences the model.
- Eastern Sand Darter is a good species because it is relatively data rich, with field data used where possible. Even though the best available information was used, in some cases the data used for model parameterization was more than a decade old.
- The Science Advisory Report's Summary Bullets will emphasize that there is much uncertainty throughout the application of the decision support tool, and for translocations in general. A key question for Eastern Sand Darter is whether the source population can withstand a local decrease owing to different removal levels.

MUSSEL EXAMPLE: SNUFFBOX

The presentation provided an example of how the five-step conservation translocation decision support framework can be implemented for Snuffbox, a species with less data than Eastern Sand Darter. The example stops at Step 4 as the Research Document was not intended to provide a decision on whether to implement reintroduction. Steps 1, 2, and 3 were summarized for the species.

Below is a summary of the discussion points:

- This example is a good test of Figure 4. There are no large host populations to consider. There is one poor population and one fair. In this case, captive rearing would work without harming the source population.
- If these populations were reduced to two individuals, they would be considered extinct in Canada. A future debate might be whether to consider nearby American populations to help raise the numbers due to the shared ancestry.

RECAP OF DAY 1 AND ADDITIONAL DISCUSSION

The second day of the Meeting began with a recap of the first day and an invitation to raise new discussion points or revisit previous ones:

- In the decision-tree seen in Figure 4, the first “yes/no” path, where the population is at immediate risk of extirpation, arrives directly at a solution of assisted colonization. More feasible solutions would be captive rearing and captive breeding, where individuals under threat are removed from their environment and placed in a captive environment to create an “ark population”, also known as a population under human care.
- Dichotomous “yes/no” choices in the decision-tree may be ineffective and some of the steps could benefit from including multiple choices. In defense of the decision-tree, it is to be used as a guide and a risk step, it is not meant to be prescriptive. The information in the documents should be considered in a fuller context. Each path through the decision-tree requires extensive consideration of ecological benefits and risks based on the elements identified in Figure 3. The science advice needs to ensure that the context is solid.
- The risks and genotypes of original stocks, particularly of anadromous fish, salmonids, and trout, should be considered.
- For a population in a single watershed with no change in distribution or abundance, translocation might not be relevant until a catastrophic event occurs. Therefore, it may be worthwhile to have a translocation assessment conducted in advance using the proposed decision-support framework, which could foster rapid action in the case of a catastrophe.
- In most cases, it will be rare to have high certainty and low risk of achieving the objectives. The cost-benefit evaluation will not always produce a clear winner, yet there is the need to be very transparent about scientific criteria used to inform a translocation decision. Like any recovery action with good intentions, there is the potential for an unexpected ecosystem result.

Below is a summary of a proposed revision to the Working Paper:

- Working through Tables 2 and 3 should provide information on the potential benefits and risks of the conservation translocation; in some circumstances, this information may be used to pursue other conservation measures that are not related to translocation. The Science Advisory Report and Working Paper will expand upon this idea.

RECAP OF DAY 2 AND ADDITIONAL DISCUSSION

The third day of the Meeting began with a recap of the second day and an invitation to raise new discussion points or revisit previous ones:

- A revised version of Figure 4 was presented.

- An ark population was defined as retaining individuals in captivity to save them, and then reintroducing them to the wild. They also could represent novel wild populations under threat which are moved away to another habitat that is similar but with a reduced threat probability, similar to translocation or assisted colonization.
- Traditionally, ark populations were used to denote populations under human care, different from wild populations. It is considered if the habitat needs to be fixed and can be fixed in the wild before a species can be reintroduced to it. It may be considered necessary to intervene and establish ark populations when wild populations are so small that one catastrophic event could eliminate the species and when the loss of a species is imminent. They are also useful for genetic diversity.
- The flowchart (Figure 4) should be kept simple, and more detail about habitat restoration can be included in the text. Arks have no finite timeline but are a last resort until there is a safe place to put the animals.
- The endpoint for an ark population could be:
    - To return it to a habitat when the habitat is restored.
    - To return it to the wild where it had not occurred.
    - To retain it long-term in a research facility, aquarium, or zoo.
- Removing one aspect of the figure will have an impact on the use of the figure where a user will arrive at a dead end and decide to let a species die because there is no suitable option to save it. This is not an option to compensate for human development.
- COSEWIC guidelines imply that when a source population is chosen, it must be from within that DU. However, COSEWIC implicitly recognizes outside populations. For example, if a DU goes extinct, it is exempt from SARA. SARA is written for species – defined by whatever level of assessment COSEWIC chooses. DUs can be very rigid, with important implication for translocations (e.g., Striped Bass).
- The level at which population is interpreted becomes very important. Even within a DU, there are distinct populations. It should be made clear that the most local population should be chosen. For example, the choices ranked should be from the same river, then the same DU, then another DU.
- This tool is designed to be used with Wildlife Species, which can vary from whole species to smaller conservation units (DUs). In some cases, DU structure will have strong implications for the feasible options of conducting conservation translocations. COSEWIC has guidelines on manipulated wild populations, with references to populations within a DU and outside of a DU. They do not count hatchery fish within a DU.

Below is a summary of the proposed revisions to the Working Paper:

- Arks allow captive breeding, rearing to be initiated, especially for species that have very little habitat and are threatened with extinction. Figure 4 should capture these ideas and it should also be reinforced in the Working Paper.
- The concept of animals brought to a previous or new habitat seems to already be covered by supplementation, reintroduction, or assisted colonization. If so, it should be included in the Working Paper text and not the figure.
- The Working Paper text could elaborate on the ark population terminology to include the different ways that species can be under laboratory or human care, maybe with a temporal

aspect. However, it would be preferable to avoid prescribing assisted colonization because the process might end there.

- The Working Paper will emphasize that ark populations are an option of last resort, not an endpoint, and because some species are in captivity to have artificial reproduction. Translocation in suitable habitats still needs to be considered because the goal is to allow the species the chance to live in the wild, not to permanently keep animals in captivity.
- A simplified Figure 10 flowchart was presented from the Working Paper and received positive feedback from participants. If a habitat is not available for a species, then source population selection might be irrelevant. At this point, habitat restoration becomes important. Secondly, there is hierarchical decision-making for making a match, then environmental match can be considered. The most complex aspect is the adaptive potential to provide the greatest genetic diversity in hopes that the population will flourish. The figure's emphasis on habitat protection and restoration will be added to the text of the Working Paper.
- The recommendation to stick with the term Wildlife Species will be included in the Summary Bullets of the Science Advisory Report and in the Working Paper.

EXTERNAL REVIEWER COMMENTS AND PRESENTATIONS

REVIEWER 1

The legislation at federal and provincial levels in Canada tries to stop species decline but is unable to actually facilitate species recovery. The Working Paper fills a critical gap in species recovery efforts and is the first possibility to take active measures for recovery by providing a framework for decisions and actions. The Working Paper addresses the themes of the International Union for Conservation of Nature (IUCN) reintroduction team and provided the context for application in Canada.

The Working Paper could benefit from additional emphasis that the Framework is not a rigid set of prescriptive rules, but intended to be flexible, adapted to different species, and focused on translocation.

The Working Paper should mention that there will likely be a future need for a separate document on ark populations, captive breeding, and captive rearing.

Table 2 should reinforce genetic considerations and consider the life stages that will do the least damage to populations. Non-random selection of source populations may do damage. For the recipient population, founder effects should be minimized. It is better to do several smaller introductions than one big one. Outbreeding depression and founder effects should be treated separately.

The main message of Section 5 is to emphasize to stakeholders that any restoration effort is a long-term effort in ecology and is not a quick fix. There will always be some risk in outcome or investment.

The Framework is a decision support framework to help inform a decision-making process, not a decision framework for making actual decisions. Discussions will need to occur at all levels.

REVIEWER 2

This experiment is recognized as difficult because there are no controls. There is also not much literature on reintroduction biology. The Working Paper will help increase knowledge in this topic and should be used by practitioners.

The audience and the intention should be identified. The advice is for DFO management and practitioners, but also may be read by others who are interested in species at risk, including biologists, consultants, and non-governmental organizations.

As a practitioner, it is hard to stop at initiation. It would be beneficial to include a follow-up that explores the extra issues and a table that is consistent across conservation programs. Those data are lost when reintroducing animals.

It would be helpful for future practitioners to complete Tables 2 and 3 for a fish and a mussel species for those who want to adopt it.

As more introduction programs are initiated, there should be a focus on recordkeeping and documenting.

The Working Paper was focused on the single species level because of SARA. As habitats are recovered, multiple species are considered because a single species never goes through the Framework alone.

Practitioners need to consider how to handle excess progeny in captive situations. Excesses are difficult to euthanize because the genetic diversity isn't right or because of disease concerns.

Translocation has a strong social science component because translocation is seen as hands on conservation. If a second document is developed, it would be useful to include a human dimensions component to raise support for conservation. Conversely but equally importantly, the human factor can also be detrimental to populations.

Augmentation and supplementation programs such as assisted colonization are risky. The risk to receiving populations is so high that the genetic diversity can be hurt instead of broadened. These programs would benefit from additional approvals and firm genetic advice at all stages.

REVIEWER 3

The Working Paper provides the Framework for the decision-making process while integrating a scientific base. It brings transparency while fostering consensus. Restoration actions are very important measures and are a last resort to be used when species are at risk.

The Working Paper can be improved by defining the threshold and identifying how decisions are made and at what level. The reason it is used could be covered by other documents. The introduction should recognize that the group in the southern United States that resembles extinct Canadian species and targeted for translocation to Canada was genetically distinct.

Categories for grouping include those that have a long life or small size that don't move much but quickly reach sexual maturity, and others that reach sexual maturity later but move much more.

The result of actions and decisions must be considered, particularly regarding reproduction and breeding under captive conditions, where genitors are kept for a long time. Males have their capability to reproduce naturally during the same season, then are released, then the focus shifted to females. This is not a typical situation but it does happen.

It is important to create a library of information, especially documenting both positive and negative results. Captive breeding must be limited over time, so it must be clear how long it will take. Species at risk is a field that must change radically.

Diversification might be important. To improve survival, threatened fish must be conserved as soon as possible to stop the domestication effect. When work began on cryopreservation at birth, a surrogate species was used, a recommended practice to minimize risk. This involved

being on the ground earlier to pick up some fish sooner, which helped detection of some individuals that had a relatively constant migration path. Some individuals came faster, some later, and others had no particular characteristics.

Size has an effect, and human activity has an impact. An attempt will be made to determine if it appears in the genetic profile.

There should be a risk-benefit approach. A yearly review will allow adjusting the process. Costs and benefits need to be assessed. Monitoring must be adjusted to the objectives while minimizing the risks to reconstitute the population. To know if recruitment is increasing, it must be monitored. This can always be done later, but not required.

Establishing the population means the population must be able to perpetuate. It is not easy to determine a period and a threshold. Patience must be exercised. The source population and the newly established one must be monitored regularly to determine positive and harmful effects to provide benchmarks to indicate when to stop or reduce their frequency.

The impact on other species at risk and the community should be considered.

Logistics should be considered. These include all steps, catching manipulation of genitors, captive breeding, and captive rearing.

There should be protocols with surrogate species.

In summary, emphasis should be placed on documentation, being prescriptive to the reader, and including more genetics.

AUTHORS' RESPONSE

More information will be provided on how there will be differences in decision-making across different groups, such as:

- Between long-lived and short-lived species.
- High versus low fecundity.
- Movement patterns.

Monitoring is important to make decisions to help with transparency of the process and to learn from the actions taken.

More information will be provided about the "how", the logistics, and the questions to be answered to actually implementing the conservation translocation.

A table or description can be included in the Working Paper to answer who, what, when, where, why, and how. The "how" might be more suitable for a future document.

SCIENCE ADVISORY REPORT AND RESEARCH DOCUMENT

Participants believed the Working Paper was well developed and trusted the authors to incorporate all discussed changes. External reviewers will review to ensure revisions have been made. The Working Paper is considered upgraded to a Research Document.

Participants received a draft of the Summary Bullets and provided live feedback during the meeting to arrive at consensus. These Bullets are the basis for the Science Advisory Report, which participants will be provided for review.

NEXT STEPS AND RESEARCH RECOMMENDATIONS

Transport related stress and mortality:

- Eastern sand darter had 70% mortality of translocated individuals.
- Sources of stress include capture, transport, and release.

There is a big difference between translocation of wild individuals versus the holding or translocation of captive/human-held populations. More information needs to be known about breeding requirements to minimize genetic harm and risks by mimicking natural mating behaviour. The fitness of captive fish can be improved by:

- Trying to closely match captive conditions to natural conditions.
- Researching the hatchery side's natural food production and emulating the natural diet.
- Increasing fitness post-release, especially regarding exposure to predators.

For releasing small numbers of individuals into a habitat where there are small numbers or none at all, ground truthing species should be done using monitoring methods or assessment tools for detecting species at low abundance. That includes being able to investigate population trends, which may be difficult. Important questions are:

- Is the extant population growing or declining?
- Are multiple supplementation or introduction events needed when the first few are unsuccessful?

The need for recordkeeping remains important.

There is the need to determine defensible reference points for the population when doing modeling and simulations in data-poor environments on the stock assessment side.

Considerations for pre-emptive evaluation of source stocks for populations:

- Timing of collections, transport, and release.
- Release methods:
    - Soft releases. Species are in an enclosure and given time to acclimate to a new environment.
    - Hard releases. Straightforward release into a new environment.
- Additional biogeographic analysis to understand the source population.
- Abundance estimates. Coarse tools are needed to understand whether populations are above a critical threshold and if they can be harvested without jeopardizing their survival or recovery.
- Reducing gaps in all other SARA science research areas such as population attributes, habitat associations, and availability and threats.
- Research community responses, other ecosystem components, how they can change, and how to frame those ecological outcomes and potential trade-offs.
- Host fishes. For example, critical abundance needed to support translocated mussels.
- How to rear animals in captivity before releasing.

For freshwater mussels, there is a lack of basic knowledge of life cycle, mean period, and temperature. Important temperature questions are:

- What is the best thermal timing? At the beginning? What season?
- What is known about the thermal preferences of young mussels for the purposes of releasing them after being reared in captivity?

There is a thermal aspect and acclimation for soft releases of invertebrates. This can be applied to juvenile stages of mussels. Knowing the following would be a way of reducing expenditures when raising large numbers of animals:

- What is the age at which to release mussels? Is it months or years?
- Is it better to release them when they are small, or larger when they have filtration capacity?

There is the need to understand and consider:

- The composition of the existing community, such as the species present and their location.
- Water chemistry, quality, and temperature to have a better idea of habitat matching.
- Measures of relative fitness between the wild population and stocked individuals, because reproduction can affect fitness.
- Diet, maternal effects, epigenetics, and carry over effects.
- Preserving genetic diversity.
- Investigating germplasm, cryopreservation, and transplantation. There are studies that have used transplantation of a gene into the gametes of another to increase the rate of reproduction. This applies to both fish and mussels.

Work should begin on:

- The naturalization of the environment where fish are reared in the facility and the effect of their adaptation. This area would benefit from more knowledge.
- Surrogate species to develop expertise on certain groups that may be susceptible under activities like artificial breeding.
- Protocols for cryopreservation and fecundation. The method for maintaining a bank of cryopreserved semen must be considered.

The impact of climate change versus the rearing of individuals is a two step process. The environment where animals were first removed might or might not look the same as when returning the individuals to the same environment.

Disease transfer is a large uncertainty and recognized as a potential ecological risk. Even reared individuals have very short lists of tested pathogens. The species considered are data-poor and little is known about the diseases that impact these species, which would affect the rehabilitation efforts and is a significant challenge. Parasites include water mites, nematodes, and zebra mussels.

CLOSING REMARKS

All participants provided feedback on this CSAS process, the documents, and the simultaneous translation.

Participants will review the Science Advisory Report and the Proceedings.

The small panel of external reviewers will review the Research Document.

These three documents will eventually be approved and posted on the CSAS website.

APPENDIX 1: TERMS OF REFERENCE

Conservation translocations of SARA-listed freshwater fishes and mussels

National Peer Review – National Capital Region

October 19-22, 2021
Virtual Meeting

Chairperson: Keith Clarke

Context

For freshwater fishes and mussels listed under the *Species at Risk Act* (SARA), a federal recovery strategy or management plan is required that identifies recovery targets and the related recovery measures for best achieving population and distribution objectives. Conservation translocations[1] are commonly identified as potential measures to improve the survival or recovery of Endangered, Threatened and Extirpated species, or the management of Special Concern species.

Approximately one-third of the federal recovery strategies or management plans for SARA-listed freshwater fish and mussel species have identified conservation translocation, specifically supplementation[2] or reintroduction[3], as a potential approach for improving survival and/or recovery; however, it has occurred infrequently (Lamothe and Drake 2019). Limited progress in undertaking conservation translocations has been the result of basic information gaps (e.g., on species distribution, abundance, habitat associations), as well as uncertainty about how to assess the potential ecological benefits and risks to freshwater species and ecosystems from proposed conservation translocations.

Although conservation translocations have been identified as recovery or management measures for many SARA-listed freshwater fish and mussel species, the scientific rationale for proposing these actions for some species and not others remains unclear. Science advice is therefore needed about the potential benefits and risks of conservation translocations to support the survival, recovery or management of SARA-listed freshwater fishes and mussels, which will ensure consistency in their application.

Objectives

- To identify and evaluate the potential benefits and risks of conservation translocation as a tool for improving the survival, recovery or management of SARA-listed freshwater fish and mussel species;
- To identify science-based considerations and methods for determining when conservation translocation could improve the survival, recovery or management of SARA-listed freshwater fishes and mussels.

[1] Conservation translocation is a broad term that encompasses the intentional movement of animals with the principal aim of meeting conservation objectives, and includes both supplementation and reintroduction.

[2] Supplementation is defined here as “the intentional release of individuals of a focal species to an area presently occupied by conspecifics” (Seddon et al. 2012).

[3] Reintroduction is defined here as “the intentional movement and release of an organism inside its indigenous range from which it has disappeared” (IUCN/SSC 2013).

Expected Publications

- Science Advisory Report
- Proceedings
- Research Document

Expected Participation

- Fisheries and Oceans Canada (DFO)
- Ontario Ministry of Natural Resources and Forestry (OMNRF)
- Ministère des Forêts, de la Faune et des Parcs du Québec (MFFP)
- Academia

References

IUCN/SSC. 2013. Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp.

Lamothe, K.A., and Drake, D.A.R. 2019. Moving repatriation efforts forward for imperilled Canadian freshwater fishes. Canadian Journal of Fisheries and Aquatic Sciences 76(10): 1914-1921.

Seddon, P.J., Strauss, W.M., and Innes, J. 2012. Animal translocations: what are they and why do we do them? In: Reintroduction Biology: Integrating Sciences and Management. First edition. J.G. Ewen, D.P. Armstrong, K.A. Parker, and P.J. Seddon (eds). Blackwell Publishing Ltd. pg. 1-32.

APPENDIX 2: AGENDA

National Science Advice on Conservation Translocations of SARA-listed Freshwater Fishes and Mussels

Fisheries and Oceans Canada, Canadian Science Advisory Secretariat (CSAS)
National Science Advisory Process – National Capital Region

Virtual National CSAS Meeting
October 19 - 22, 2021

Chair: Keith Clarke

Note: All times tentative and subject to change depending on progress of discussions

	Day 1: Tuesday, October 19	
Time	**Topic**	**Presenter**
8:00 PDT 11:00 EDT 12:00 ADT **60 min**	• Welcome and context • Introduction of participants/roundtable • Overview of CSAS policies • Review Terms of Reference • Meeting process / agenda	Keith Clarke
60 min	• Terminology for describing conservation translocations • Background on conservation translocation use in Canada • *Questions and Discussion*	Karl Lamothe
30 min	**Break**	
120 min	• Overview of 5-step decision framework for using conservation translocations to improve the survival or recovery of SARA-listed freshwater fish and mussel species • **Step 1: Identify objectives for conservation translocations** - Improve population recruitment - Establish a population - Rescue individuals or populations at immediate risk of extirpation • *Questions and Discussion*	Karl Lamothe
12:30 PDT 15:30 EDT 16:30 ADT	**Adjourn (Day 1)**	

	Day 2: Wednesday, October 20	
Time	**Topic**	**Presenter**
8:00 PDT 11:00 EDT 12:00 ADT **120 min**	• Recap of Day 1 • **Step 2: Assess the probability of achieving the fundamental and means objectives** - Estimate the probability that achieving the means objective improves survival or recovery of the species - Identify factors that may influence the ability to achieve the means objective ▪ Population considerations, habitat, community considerations, threats - Estimate the ability to achieve the means objectives • *Questions and Discussion*	Karl Lamothe
30 min	**Break**	
120 min	• **Step 3: Assess the ecological risks of performing conservation translocations** - Identify risks of performing conservation translocations ▪ Reduction in source and recipient population persistence and genetic variation ▪ Change in community and ecosystem dynamics in source and recipient ecosystems ▪ Transfer of disease to recipient populations and ecosystems - Estimate the risk of performing conservation translocations • *Questions and Discussion*	Karl Lamothe
12:30 PDT 15:30 EDT 16:30 ADT	**Adjourn (Day 2)**	

	Day 3: Thursday, October 21	
Time	**Topic**	**Presenter**
8:00 PDT 11:00 EDT 12:00 ADT **120 min**	• Recap of Day 2 • **Step 4: Compile and weigh scientific evidence to information the conservation translocation decision** • **Step 5: Implement and monitor the effects of conservation translocations** • *Questions and Discussion*	Karl Lamothe
30 min	**Break**	
120 min	• External reviewer comments/presentations • Drafting of Summary Bullets	Karl Lamothe, External Reviewers, and other Participants
12:30 PDT 15:30 EDT 16:30 ADT	**Adjourn (Day 3)**	

	Day 4: Friday, October 22	
Time	**Topic**	**Presenter**
8:00 PDT 11:00 EDT 12:00 ADT **120 min**	• Recap of Day 3 • Final review of Summary Bullets • Science Advisory Report (SAR) development	All
30 min	**Break**	
120 min	• Science Advisory Report (SAR) development (continued) • Final review of Research Recommendations • Upgrading of Working Paper and Next Steps • Closing remarks	All
12:30 PDT 15:30 EDT 16:30 ADT	**Adjourn (Day 4)**	

APPENDIX 3: LIST OF PARTICIPANTS

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