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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2022/044

National Capital Region

Proceedings of the National Advisory Meeting to Provide Science advice to the Fish and Fish Habitat Protection Program on estimating impacts and offsets for death of fish

Meeting dates: April 12–16, 2021
Location: Virtual Meeting

Chairperson: Keith Clarke
Editors: Cody Dey and Alex Tuen

Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON K1A 0E6

December 2022

Canada

Foreword

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

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SUMMARY

A National Advisory Meeting was held to peer review the science advice on estimating impacts and offsets for death of fish. This meeting provided science advice on potential consequences and how to quantify impacts from works, undertakings, or activities (WUAs), other than fishing, that cause the death of fish, and ways that death of fish can be offset. The goals include being able to:

- Conduct reviews of WUAs.
- Develop regulatory tools to avoid, mitigate, and offset the death of fish.
- Provide guidance on the requirements for assessing impacts and offsets for death of fish.

Impacts and offsets were quantified with nine equivalency metrics, with “total biomass lost” suggested as the most appropriate for the client’s goals of protecting standing stock biomass and future productive capacity of fish stocks.

Qualitative Network Models were used to examine community responses from WUA impacts. The models could be useful in many situations. The results can estimate how the whole community will adjust to positive and negative perturbations. The results suggest the outcomes of mortality events are unlikely to simply be the sum of species responses considered in isolation.

Factors were presented that might influence decisions about a death of fish authorization. Discussion included what might influence the responses for fish populations and/or fish communities to fish mortality events, and how such factors may be considered in risk-based decision-making. The top three consequences and considerations were determined to be magnitude of mortality, population size, and population trajectory. It is ideal to have a fully quantitative precautionary approach framework.

Results were presented from a systematic review and meta-analysis assessing different offsetting practices commonly used for aquatic ecosystems and their potential application for offsetting fish mortality. The overall goal is to re-evaluate common offsetting practices and their effectiveness as well as the consideration of less commonly utilized methods and how their usage could be applied to mortality scenarios. The necessary assessment and monitoring requirements were discussed.

INTRODUCTION

From April 12 to April 16, 2021, a virtual National Advisory Meeting was held to peer review the science advice on estimating impacts and offsets for death of fish. This meeting provided science advice on potential consequences and how to quantify impacts from works, undertakings, or activities (WUAs), other than fishing, that cause the death of fish, and ways that death of fish can be offset (see Terms of Reference in Appendix 1 for details).

The Chair provided an overview of the Canadian Science Advisory Secretariat (CSAS) peer review process and the Objectives found in the Terms of Reference (Appendix 1), which this meeting seeks to address.

The Science Advisory Report and supporting Research Document will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

CONTEXT OF THE SCIENCE ADVICE REQUEST

WUAs that result in the death of fish or prohibited effects to aquatic species at risk are in contravention of the *Fisheries Act* and the *Species at Risk Act*, unless otherwise excepted (i.e.: authorized), under subsection 34.4(2) of the Fisheries Act and under section 73 or section 74 of the *Species at Risk Act*. Fisheries and Oceans Canada's (DFO) Fish and Fish Habitat Protection Program (FFHPP) is seeking science advice on potential consequences and how to quantify impacts from these WUAs that cause the death of fish and the ways that death of fish associated with these WUAs can be offset. The primary end users of this advice will be FFHPP staff responsible for conducting reviews of WUAs and developing regulatory tools to avoid, mitigate, and offset the death of fish, as well as proponents of these WUAs who are seeking guidance on the requirements for assessing impacts and offsets for death of fish.

QUANTIFYING IMPACTS AND OFFSETS

PRESENTATION

The equivalency metrics were summarized for fish mortality quantification, with an example calculation for each. These metrics included:

- Count;
- Biomass;
- Equivalent age;
- Reproductive potential;
- Production forgone;
- Habitat suitability index;
- Forgone fisheries yield;
- Total biomass lost; and,
- Population modeling.

Accounting for time-lags and uncertainty was discussed with example calculations based on simulated data.

"Total biomass lost" was suggested as the most appropriate metric given for FFHPP's goals of protecting standing stock biomass and future productive capacity of fish stocks. The expected publications from this meeting willl provide a range of methods that can be more broadly applied, and will list the advantages and limitations of each method.

FORMAL REVIEW

Nine categories of methods (metrics) were demonstrated to estimate the impacts and offsets of death of fish. The choice of methods is consistent with the scientific literature and is a good summary of the main methods available to, and used by, proponents. However, more detail needs to be provided in the text to guide the reader through the equations, as well as more detail on describing the implications of choosing one metric over another. The risks and uncertainty section does not include a discussion on how to estimate and incorporate the error surrounding vital-rates, which are a key component of most of these methods.

DISCUSSION

None of the metrics predict the probability of death after an event has occurred. Instead, they quantify the impacts based on known amounts of mortality.

Quantifying impact is a challenging step. When there is a spill or fish kill, it is often difficult to evaluate the number of fish and the size of fish impacted. This information needs to be captured.

The level of risk is a policy discussion rather than science, but perhaps still worth having science disclose any risk statements for the benefit of managers and decision-makers who may not realize they are doing risk analyses.

The metrics in this section are accounting metrics. The objective is to consider the most appropriate metric given the offset and impact. If a WUA causes mortality, the offset to address that mortality should ideally be comparable.

When calculating equivalency metrics, the impacts to the population are not considered. All that is considered is an accounting of the fish that have been killed.This section, "Quantifying impacts and offsets", could be renamed, "Quantifying losses and gains". Discussions on equivalency are about accounting.

The methodology was satisfactory from a freshwater and marine perspective. Many lessons from the freshwater perspective, including some population modeling techniques and aspects, could be addressed further and applied to marine systems. Additional freshwater and marine perspective discussions included:

- Many marine situations are different than freshwater because of the different number of species present.
- In marine, predation effects are somewhere between five to ten times greater than freshwater.
- Freshwater data availability is generally low compared to marine.
- Mitigation options are different in freshwater and marine systems.
- A marine example was not originally included in the Working Paper because of the differences in values used in calculations. However, the calculations and methodologies would be performed the same as freshwater. In the expected publications, the authors could include marine calculations and clearly identify any differences.

- In marine dredging, mortality magnitude is increased, since many benthic species get dredged. This has implications under the *Fisheries Act* since some (but not all) benthic organisms are considered “fish” under its definition.

The expected publications will clearly define “fish” and ensure that shellfish, freshwater mussels, fish, and all other relevant species are included.

In many instances, density dependent compensation is important for ongoing mortality, and should be included in the expected publications when discussing the approach being used to calculate losses.

The Shiny applications under development will be useful for proponents to perform calculations, and should be mentioned in the expected publications.

If climate change is considered an important factor, attention should be paid to non-stationarity and productivity.

The expected publications would benefit from including sensitivity tests that incorporate changing parameters affecting biomass estimates. There is the need to explore uncertainty.

ASSESSING COMMUNITY IMPACTS

PRESENTATION

Qualitative Network Models (QNM) are a simple method for examining community responses from WUA impacts. This modelling approach was applied to a number of simple community networks and the results suggest the outcomes of mortality events are unlikely to simply be the sum of species responses considered in isolation.

FORMAL REVIEW

QNM is a useful, highly specific, and detailed method to explore network impacts in low data situations, and other methods are not mentioned. While the CSAS review is not meant to be exhaustive or complete, the expected publications would benefit from remaining general and include a brief description of other methods that might be applied in other situations.

This is a specific example of using QNM to assess community impacts on fish death through press perturbation experiments in QNM. The work should be published as a separate standalone paper.

DISCUSSION

The Working Paper sought to determine whether the simple models could generate any general rules or guidance that could help address community impacts. In freshwater, there will be many cases where data is limited.

Besides QNM, other methods include Mizer and Ecopath with Ecosim (EwE).

- The biggest difference is in the amount of data that different approaches need.
- QNM requires only limited data, including the species present and the connections between them, to arrive at simple conclusions of whether a positive or negative change is expected. Losses are characterized by identifying pressures from perturbation and where the pressures are being applied. For example, negative pressure was applied to specific nodes to represent killing fish, and the model indicates if a positive or negative change is expected.

- In QNM, different mortality sources do not need to be considered together. Nodes can be added for additional mortality sources, or for factors that would have positive impacts on different species. Negative perturbation pressures can be applied to some nodes while positive perturbation pressures can be applied to other nodes.
- EwE includes parameterization in its model, such as diet and biomass ratios for the species, or definable trophic groups. Once parameters are established, the software indicates how much the biomass will change as a result of perturbation. As a result, it has much higher data requirements

The results from community models can estimate how the community as a whole will adjust to positive and negative perturbations.

Community impacts were presented in a simple, straightforward manner. Because of their simplicity, these models could be useful in many situations. These community approach models are an approach to evaluating death of fish events where multiple species are affected. There could be other ways of using these models as well.

CONSEQUENCES AND CONSIDERATIONS

PRESENTATION

Factors were presented that might influence decisions about a death of fish authorization, and included a discussion of:

- What might influence the responses for fish populations and/or fish communities to fish mortality events; and,
- How such factors may be considered in a risk-based management decision context.

The presentation included a precautionary approach framework based off the ICES precautionary approach framework for fisheries decision making. One option is to use models and tools in a quantitative approach. If there are not sufficient data to allow a quantitative application, the framework could be applied in a more qualitative approach.

FORMAL REVIEW

The main suggestions for improvement in the expected publications included:

- Requiring more guidance on determining what a “local” population is;
- Adding more detail to the introduction to support (or provide rationale for) the “considerations” on the legislative elements (s34 (1)) and the factors that allow an authorization;
- Clarifying any ambiguity around the terms used to described mortality; and,
- Addressing the overlap within and among sections of the Working Paper.

DISCUSSION

The authors of the Working Paper agreed that the eight consequences and considerations are not equally important. Thought should be given to which of these considerations are most important for FFHPP’s authorization decisions.

The topic of local population versus population as a whole was explored, as the population’s sensitivity will depend on the scale at which the population is defined.

- The definition of local population should be established, especially from a management perspective.
- One challenge is looking at the fish population as a whole, then determining the portion of the population which is susceptible to mortality.
- The Working Paper was written with whole population in mind, not local population. This discussion can re-evaluate how to frame the consideration of local habitat use. This would be a concern for larger systems where there are “zones” in the spatial structure, where a mortality event might only impact a portion of the population and leave other “zones” alone. The expected publications could include this.
- One participant warned that because of the dilution of effects and residual effects, there is the possibility for a proponent to defend even a large impact as having negligible impact in the grand scheme of an entire system.

The participants discussed the minimum data required to apply the precautionary approach framework.

The participants determined that the top three consequences and considerations are magnitude of mortality, population size, and population trajectory. Of the three, population size most often lacks information. The duration of the mortality event and the timing of the mortality event both help to feed into magnitude of mortality.

Other consequences and considerations, such as life history and life stage, fall into a second tier which still have scientific relevance, while the remainder in the third tier relate to management.

It is important to know the relationship between stock status and reproduction to set the reference limits in the precautionary framework.

Knowing the spatial scale (ie: local, regional, or national) is required to estimate stock status (ie: healthy, cautious, or critical) to be able support a risk evaluation of a residual death of fish from a WUA.

In the absence of data, the framework becomes a subjective communication tool, and its intent as such should be communicated.

There is the need to determine what the minimum data requirements mean in a qualitative context.

When discussing mortality versus mortality rate, the latter will be complicated if it is not well defined.

A thorough summary for vital rate statistics would be nice to have. These are easily referenced and used for populating a model in the absence of data.

Stocks can be classified according to data availability. For example, ICES has six stock categories (see page 7), and various methods are applied depending on the available data.

The ideal precautionary approach framework is quantitative but not always possible due to a lack of data. Given the available data, a qualitative or partial quantitative approach may be the best option to provide management with a concept of mortality, though it will lack precision. The long term goal is to obtain a fully quantitative framework.

In mortality events, biomass can be left in the system which contributes to energy dynamics because nutrients are cycled in the food web, while other events result in removing biomass and nutrients from the system.

Mortality events have varying degrees of social acceptability. Less socially acceptable methods might mean more scrutiny and more onus to offset.

Counts of the number of fish deaths may be underestimated, depending on the method by which fish are killed.

It is better to acknowledge mortality during authorization than for the proponent to report on emergencies. DFO should be prepared for low probability, high impact events.

Figure 4.2 from the Working Paper was discussed.

- A 1:1 offset was used to demonstrate hypothetical continuous mortality.
- Higher ratios would help pull *C* (the population after the offset) below the level of *B* (the population after the mortality event) and to the right. However, restoring *A*-type levels is a challenge, requiring very high ratios (sometimes 200:1) which translates into restocking with unrealistically immense numbers of fish.
- The space between *A* and *C* contributes to cumulative effects.
- There is also sometimes the option to apply the offset first (before *A*), then allow the mortality event to happen.
- Other considerations are the timing of the offset, the harm, and how the amount of time spent at *B* before *C* relates to the overall risk to the population.

OFFSETTING MORTALITY

PRESENTATION

Results were presented from a systematic review and meta-analysis assessing different offsetting practices commonly used for aquatic ecosystems and their potential application for offsetting fish mortality.

Method effectiveness is based on before-and-after results as well as reference systems. The presentation covered additional factors for consideration, including monitoring timeframes, offset size, offset ratio, costs, and target species.

The overall goal is to re-evaluate common offsetting practices and their effectiveness as well as the consideration of less commonly utilized methods and how their usage could be applied to mortality scenarios. In addition, the presentation included discussion of what assessment and monitoring requirements are necessary.

Habitat creation has been mainly used for mortality related to a habitat aspect and is rarely used to compensate for fish kill events.

Ongoing monitoring is important to inform decision-making and authorizations.

Stocking is a complex issue with no simple answer.

Transient dynamics are important to consider.

One participant asked about the mechanism driving increased success when pre-impact monitoring occurs. Cases with pre-impact monitoring take into consideration any potential impacts and offsets of death of fish prior to the project. Projects that did not conduct pre-impact monitoring are in reactionary mode when responding to unforeseen death of fish.

One participant asked if there were there cases where an equivalency metric was done both ways, such as habitat units converted to fish losses, and vice versa.

If stocking ends up being a recommended offset, stocked fish sometimes have relatively lower fitness, but it depends on the species and system. Higher ratios may compensate for lower fitness.

The expected publications will include that stocking an offsetting option considered by science, but not one that science typically recommends to management. It can be used in certain situations, and is most appropriate when there are not significant impacts to habitat in the focal area.

FORMAL REVIEW

The main suggestions for improvement in the expected publications included:

- Considering and incorporating guidance from previous CSAS processes related to spawning habitat creation, functional monitoring, and regional productivity benchmarks.
- Referencing the impacts of bias in the systematic review process, and the overall small evidence base.
- Considering the risks of project failure and/or unexpected adverse effects.
- Considering creating a decision-tree related to selecting the most appropriate offset type.

The points raised on systematic review will be revised accordingly.

DISCUSSION

There are challenges for stocking related to larger mortality events and continuous mortality events. Stocking may be more useful for one-off, discrete, and smaller events if a proponent wishes to offset.

The challenge on converting death of fish metrics into offset metrics was addressed in the discussion on quantifying impacts and offsets. The metrics were evaluated to give common currency to estimate losses from death of fish and gains from offsetting. The proponent needs to select an appropriate metric to monitor the offset and consider what data needs to be generated to choose the appropriate offset metric that works for both sides of equation.

In some cases, there may be a need to create overall productivity estimates for the whole system.

Long term effectiveness of habitat based offsets was discussed. Created habitat along floodplains may need periodic reconnecting. A participant wondered if these maintenance plans are part of offsetting plans.

Creating artificial reefs may help offset losses since they serve as new breeding habitats. There is abundant information available especially as it applies to artificial reefs in marine environments.

Replacing like-for-like is an admirable goal but not always achievable. Sometimes, there is a bias against less desirable species in favour of more desirable species.

How offsetting should differ for one-time death of fish events versus ongoing mortality was discussed.

- One-time events are common for mining projects where whole lakes or portions of water bodies need to be dewatered for a period of time, such as with hydroelectric construction and in maintenance. Both habitat and fish are impacted.

- Maintenance shutdowns of hydroelectric facilities should be considered as an ongoing or regular (e.g. biannual) event.
- One-time events may be authorized, depending on the project, the time of year, and the impact on the environment.
- Death of fish is typically not assessed for one-time events.

The connectivity and adverse effects topics in the Working Paper were discussed.

- Improving connectivity could be a cheap offset in many cases, but also need to consider the negative effects on increasing connectivity. There is the potential for adverse effects such as allowing access for invasive species, letting them in where they weren't permitted before. They may trade off against the benefits.
- The removal of low head and defunct dams may see an increase in anadromous populations.
- Removal of barriers can result in the destruction of habitat and the killing of fish.
- Connectivity is context dependent.

DRAFTING THE SCIENCE ADVISORY REPORT

During the virtual meeting, the screen sharing feature in Microsoft Teams was used to present the draft Summary Bullets that form the basis of the Science Advisory Report. The Chair led the discussion and revision of the Bullets based on real-time participant feedback. Participant consensus was obtained on each Bullet before moving on to the next.

There was extended discussion related to the relationship between success and longer monitoring programs. Participants wanted to emphasize that performing longer monitoring programs was no guarantee of success, but that it can contribute indirectly to success by allowing better assessment of the effectiveness of the offset. This distinction was captured in the appropriate Summary Bullet.

SOURCES OF UNCERTAINTY AND OTHER CONSIDERATIONS

The following additions were suggested:

- Community impacts of mortality on one or multiple species. Modeling results are complicated especially with mortality on multiple species.
- Non-linear threshold effects and their association with cumulative effects.
- Sublethal impacts.
- Delayed mortality or indirect mortality.
- Fisheries management activities.
- Knowledge of other management activities in the system.

NEXT STEPS AND RESEARCH NEEDS

The development of Shiny apps and other tools for quantifying losses and gains from death of fish and offsets would be greatly appreciated inside and outside DFO. In addition, tools related to risk assessment would be useful. Where possible, existing tools should be leveraged to develop current and future tools.

More work needs to be done to understand how to apply the precautionary approach framework in a qualitative or semi-quantitative sense. DFO needs to determine what information is required from proponents so that FFHPP can use the framework under real life conditions.

Consideration should be given regarding lifetime type estimates for loss when mortality and offset are iterative over a long period of time, including an entire lifetime of production foregone. The same calculation can be applied to mortality and offset.

FFHPP could benefit from more knowledge on the impacts of sublethal effects.

More information is needed to determine which tool, process, or technique is best suited for offsetting species at risk. Some may be better than others.

More research on community models and methods of assessing impacts to communities would be useful.

Analysis of some of ongoing offsetting from monitoring data should be made available to determine effectiveness of approaches.

More research needs to be done to understand how an ecosystem approach can be applied for death of fish, especially because many WUA result in both death of fish and habitat impacts

Overall, more work on the application of death of fish accounting and decision-making tools in the marine environment will benefit from further research. The coastal zone makes the most sense to address next, as information lacking in this area is long overdue.

APPENDIX 1: TERMS OF REFERENCE

Science advice to the Fish and Fish Habitat Protection Program on estimating impacts and offsets for death of fish

National Advisory Meeting – National Capital Region

April 12-16, 2021, 11-3:30pm (EST)
Virtual meeting

Chairperson: Keith Clarke

Background Context

The Fish and Fish Habitat Protection Program (FFHPP) has requested science advice on: 1) potential consequences and how to quantify impacts from works, undertakings or activities (WUAs), other than fishing, that cause the death of fish; and 2) ways that death of fish can be offset.

Legislative Context

Works, undertakings or activities that are likely to cause the death of fish, including impacts to aquatic species at risk, would contravene the *Fisheries Act* and/or the *Species at Risk Act* unless otherwise authorized. Before considering whether to issue an authorization under the *Fisheries Act*, the Minister must consider several factors, such as:

- Factor 34.1(1)(a) – the relative contribution of the affected fish and their habitat to the productivity of the relevant fisheries;
- Factor 34.1(1)(b) – relevant fisheries management objectives;
- Factor 34.1(1)(c) – whether there are measures and standards to avoid, mitigate or offset the death of fish;

- Factor 34.1(1)(d)– the cumulative effects of the WUA in combination with other WUAs that have been or are being carried on; and
- Factor 34.1(1)(e) – any fish habitat banks that may be affected.

If aquatic species at risk are also affected by a WUA[1], the *Species at Risk Act* also establishes that the WUA must not jeopardize the survival or recovery of the species.

Death of Fish

The Department applies a risk-based approach to determine the likelihood and severity of potential impacts to fish and fish habitat that could result from the carrying on of a WUA. In doing so, the Department is guided by various principles, such as the precautionary approach and the ecosystem approach, and considers a number of criteria, including species likely to be affected, and the frequency, duration, magnitude, and extent of a WUA that can lead to the death of fish.

FFHPP authorizes many activities that can lead directly or indirectly to the death of fish. The magnitude of residual mortality (i.e. the death of fish that cannot be avoided and/or mitigated) from these events and ongoing operations can vary greatly, from a few fish of a single species, to a large multi-species mortality event.

FFHPP is seeking advice on potential consequences and how to quantify impacts from WUAs, other than fishing, that cause the death of fish and ways that death of fish associated with these WUAs can be offset. For offsetting, this includes advice on how to offset for WUAs that could result in the death of fish, information on this type of offsetting in domestic and international jurisdictions, and a summary of mechanisms and effectiveness of these practices should the information be available.

Objectives

Participants will review Working Paper(s) and other information to address the following questions:

1. What approaches can be used to quantify the impacts of WUA-related residual mortality, and associated offsetting requirements?
    a. What are the advantages and limitations of the different approaches?
2. What determines local fish population or community responses to WUA-related residual mortality?
    a. Does the effect on local fish populations or communities change with respect to when and how frequently fish are killed?
    b. What criteria should be considered when quantifying or describing impacts from WUA-related residual mortality?
3. What are the current domestic and international practices for offsetting the effects of WUA-related residual mortality?
    a. What are the options for offsetting WUA-related residual mortality?
    b. What is the effectiveness of the available offsetting options?

[1] The exception in the form of an authorization under subsection 34.4(2) and subsection 35(2) of the *Fisheries Act* will also act as a *Species at Risk Act* permit.

c. What are the rationales for selecting certain offsetting options?

It is expected that this process will also have synergy with other current CSAS processes focused on freshwater habitat science advice, namely revisiting Pathways of Effects and understanding cumulative effects across freshwater landscapes.

Expected Publications

- Science Advisory Report
- Research Document(s)
- Proceedings

Expected Participation

- Fisheries and Oceans Canada (Ecosystems and Oceans Science, Fish and Fish Habitat Protection Program, Fisheries Management, Species At Risk Program)
- Academia
- Other invited experts

APPENDIX 2: AGENDA

Fisheries and Oceans Canada

Canadian Science Advisory Secretariat (CSAS)
National Science Advisory Workshop

AGENDA

Science advice to the Fish and Fish Habitat Protection Program on estimating the impacts and offsets for death of fish

MS Teams: April 12-16, 11am-330 pm EDT daily.

DAY 1		
Time	**Monday, April 12th, 2021**	**Lead**
11:00-12:00	Welcome	Chair
	Housekeeping notes	Facilitators
	Participant introductions	Chair and all
	Introduction to CSAS advisory process	Chair
	FFHPP context of the science advice request	Youser Al-Ali
	Review Terms of Reference including the overview of goals and objectives of meeting	Chair

DAY 1		
Time	**Monday, April 12th, 2021**	**Lead**
12:00-12:45	Break	
12:45-1:00	**Presentation:** *Quantifying impacts and offsets*	Adam van der Lee
1:00-1:15	**Presentation:** Formal review of *Quantifying impacts and offsets*	Dak de Kerckhove
1:15-2:00	*Quantifying impacts and offsets* – Objective 1 Discussion	All
2:00-2:10	Health Break	
2:10-3:15	*Quantifying impacts and offsets* – Objective 1 Discussion continued	All
3:15-3:30	Draft initial SAR points related to Objective 1	All

DAY 2		
Time	**Tuesday, April 13th, 2021**	**Lead**
11:00-12:30	Recap of Day 1	Chair
	Review of SAR bullets captured from Day 1	All
	Quantifying impacts and offsets – Objective 1 Discussion continued	All
	Draft further SAR points related to Objective 1	All
12:30-1:30	Break	
1:30-1:45	**Presentation:** *Assessing community impacts*	Simon Fung
1:45-2:00	**Presentation:** Formal review of *Assessing community impacts*	Daniel Duplisea
2:00-2:45	*Assessing community impacts* – Objective 2 Discussion	All
2:45-2:55	Health break	

DAY 2		
Time	**Tuesday, April 13th, 2021**	**Lead**
2:55-3:30	*Assessing community impacts* – Objective 2 Discussion	All

DAY 3		
Time	**Wednesday, April 14th, 2021**	**Lead**
11:00-11:30	Recap of Day 2 Review of discussion from Day 2	Chair All
11:30-11:45	**Presentation:** *Consequences and considerations*	Marten Koops
11:45-11:55	Health break	
11:55-12:10	**Presentation:** Formal review of *Consequences and considerations*	Mike Bradford
12:10-1:00	*Consequences and considerations* – Objective 2 Discussion	All
1:00-2:00	Break	
2:00-2:45	*Consequences and considerations* and *Assessing community Impacts* – Objective 2 Discussion	All
2:45-3:30	Draft SAR points related to Objective 2	All

DAY 4		
Time	**Thursday, April 15th, 2021**	**Lead**
11:00-11:30	Recap of Day 3 Review of SAR bullets captured from Day 3	Chair All
11:30-11:45	**Presentation:** *Offsetting mortality*	Sebastien Theis
11:45-11:55	Health break	

DAY 4		
Time	**Thursday, April 15th, 2021**	**Lead**
11:55-12:10	**Presentation:** Formal review of *Offsetting mortality*	Eva Enders
12:10-1:00	*Offsetting mortality* – Objective 3 Discussion continued	All
1:00-2:00	Break	All
2:00-3:00	*Offsetting mortality* – Objective 3 Discussion continued	All
3:00-3:30	Draft SAR points related to Objective 3	All

DAY 5		
Time	**Friday, March 12th, 2021**	**Lead**
11:00-11:45	Recap of Day 4 Review of SAR bullets captured from Days 1-4	Chair All
11:45-11:55	Health break	
11:55-1:00	Continue drafting Science Advisory Report Overflow/continued Discussion	All
1:00-2:00	Break	
2:00-3:30	Complete drafting Science Advisory Report Wrap up/Next Steps Meeting ends	All

APPENDIX 3: LIST OF PARTICIPANTS

Name	**Affiliation**
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MacLean, Barb	Turtle Island Staffing (facilitator)
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Rotinsky, Brenda	DFO Aquatic Ecosystems
de Paiva, Alex	DFO Aquatic Ecosystems
Patterson, David	DFO Science
Poesch, Mark	University of Alberta
Stevens, Cameron	Golder Associates Ltd.
Theis, Sebastian	University of Alberta
Thomas, Jennifer	DFO Aquatic Ecosystems
Tuen, Alex	DFO Science
Tunney, Tyler	DFO Science
van der Lee, Adam	DFO Science