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Proceedings of the National Peer Review for Science advice on operational guidance on functional monitoring: Surrogate metrics of fish productivity to assess the effectiveness of mitigation and offsetting measures

Meeting dates: February 26-28, 2018

Location: Ottawa, Ontario

Chairs: Bronwyn Keatley and Karen Smokorowski

Editors: Amanda Winegardner and Luc Glover

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Foreword

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

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SUMMARY

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS) National peer review process was held February 26 – 28, 2018 at the Alt Hotel, Ottawa, Ontario. The Fisheries Protection Program (FPP) had requested advice on the utility and development of functional monitoring approaches for use in the assessment of management (mitigation, offsetting, restoration) measures applied to fish habitat. FPP is interested in how monitoring techniques relying on surrogate information for fisheries productivity can be used to collect data on projects that may not require detailed effectiveness monitoring.

The meeting included discussion around the differences between compliance, effectiveness, and functional monitoring. It was agreed that functional monitoring can be used under certain situations for both project-specific monitoring as well as program-level analysis of aquatic habitat management measures related to mitigation, offsetting, and restoration.

Participants in this meeting included DFO staff from various sectors as well as external experts. A Science Advisory Report was prepared following the meeting.

INTRODUCTION

A previous science advisory process provided science advice to the Fisheries Protection Program (FPP) on monitoring the effectiveness of aquatic management measures (mitigation, offsetting and restoration) (DFO 2012). While effectiveness monitoring is required for many *Fisheries Act* authorizations, this is not likely the case for all or for projects that may receive Letters of Advice or be subject to routine measures and/or guidance but still warrant some level of monitoring.

The purpose of this National peer review meeting was to discuss the scope and development of functional monitoring programs as they apply to the assessment of aquatic management measures. More details can be found in Appendix I (Meeting Agenda) and Appendix III (Terms of Reference).

PRESENTATIONS AND DISCUSSION

OVERVIEW OF THE FISHERIES PROTECTION PROGRAM AND THE NEED FOR FUNCTIONAL MONITORING (M. NARDINI)

FPP gave some introductory context on FPP's interest in functional monitoring and the need for science advice on this topic. FPP indicated that, largely due to capacity, the majority of monitoring activities are for compliance monitoring of *Fisheries Act* authorizations. Compliance monitoring is conducted by FPP primarily via desktop review of materials submitted by proponents, followed by site visits to verify information. Projects covered by Letters of Advice are mostly monitored via site visits. For projects where standard measures can be used to avoid harming fish and fish habitat, proponents generally self-assess and do not submit any information to DFO. However, if these projects are known to FPP, the program can monitor these projects to determine if the standard measures are effective in safeguarding fisheries productivity.

It was stressed that monitoring is an ongoing challenge for FPP, especially with resource-intensive effectiveness monitoring. The use of functional monitoring may facilitate more rapid assessment, as well as provide for more clear requests for information from proponents.

It was discussed that functional monitoring may be used in the future by FPP to assess projects under Letters of Advice or routine projects covered under standard measures, but that there may also be a role for proponents for functional monitoring, in that it may allow for FPP to be more prescriptive about what information it requires from proponents.

The point was raised that functional monitoring might be useful in the context of projects that are found on a 'designated projects' list (related to impact assessment and potential changes to the *Canadian Environmental Assessment Act*).

There was discussion around the difference between compliance monitoring and functional monitoring. It was discussed that compliance monitoring is about verifying that a proponent has done what they were directed to do by DFO in an authorization or Letter of Advice. Functional monitoring is a science-based activity focused on providing information on whether a management measure has functioned the way it was supposed to, to apply adaptive management and to make decisions about future *Fisheries Act* authorizations and Letters of Advice, using data from projects where effectiveness monitoring was/is not required.

It was brought forward that functional monitoring may have a different level of certainty associated with it than compliance monitoring because compliance monitoring results must hold

up in a court of law, whereas functional and effectiveness monitoring are both about learning from past practice to make better management decisions.

The point was raised that FPP would like to use functional monitoring to improve and standardize information required of proponents and would eventually use consistently collected functional monitoring data to conduct meta-analyses of management measures across different project types.

PRESENTATION OF THE WORKING PAPER: A REVIEW OF FUNCTIONAL MONITORING ASSESSMENT METHODS AND INDICATORS OF FISH PRODUCTIVITY FOR ASSESSING, MITIGATION, RESTORATION, AND OFFSETTING ACTIVITIES IN CANADA (D. BRAUN, CO-AUTHORS: K. SMOKOROWSKI, M. BRADFORD, L. GLOVER)

D. Braun presented the working paper (Braun et al. 2018), which was a literature review to gather information about how and where functional monitoring is conducted and its key components. Important considerations for designing a functional monitoring program were identified and discussed in the following sections: 1) Monitoring Designs, 2) Rapid Assessments, 3) Metrics to Measure Function, and 4) Standardized Monitoring. Each section described the benefits and challenges of common approaches and methods as well as considerations relevant to implementation.

Discussion

There was some discomfort with defining functional monitoring as being only for ‘low-impact’ or ‘low-risk’ projects. There was discussion as to what was meant as ‘low-impact’ and whether a better descriptor is the degree of certainty of the impacts from a particular management measure.

It was agreed that if a management measure had high certainty associated with the subsequent effects, it would be a candidate for functional monitoring, regardless of project risk. In contrast, if there was uncertainty or low certainty regarding the effects of a management measure, this should be a candidate for effectiveness monitoring, regardless of risk associated with the actual project.

There was discussion regarding the value of information achieved with functional versus effectiveness monitoring and the related figures in the working paper. This discussion was deferred to the next day.

There was a question about how many marine studies were included in the review of functional monitoring methods. In total, 77 studies were included in the review; approximately 10 of those were marine studies.

Presentation of external review 1

The reviewer emphasized the high quality of the working paper.

The main points brought forward in this review of the working paper were:

- The need for biological indicators, especially fish.
- Recommendations regarding time windows for monitoring.
- Recommendations regarding control sites.
- Sample size not addressed in review, nor discrete versus continuous sampling.

-
- Need for baseline data in situations where habitat enhancement occurs as an offset, but recognizes that baseline data not available when terrestrial environment converted to aquatic habitat.
 - Importance and value of imperfect information.

Presentation of internal review

The reviewer emphasized the high quality of the working paper.

The review stimulated discussion on whether there is a clear difference between effectiveness and functional monitoring. From a scientific perspective, the group agreed that functional monitoring should be science-based, not just monitoring that involves rapid assessment.

There was a discussion of where compliance monitoring fits into the bigger picture of effectiveness and functional monitoring, as compliance monitoring is not science-based.

There was discussion of Figure 1 in the working paper, particularly about whether the lines associated with functional and effectiveness monitoring shared a common origin.

The point was brought forward that biota, especially fish, make poor indicators and are prone to measurement error. Additionally, the presence of fish alone does not mean that a habitat is functioning optimally for fish.

There was a brief discussion on the use of derived indices in monitoring versus multivariate statistics; the discussion touched on concerns around information loss when using derived indices (for example a diversity or evenness metric), when multivariate statistics such as ordination can be used to find relationships between many variables and a response.

There was a discussion around the information presented in the working paper in that only 13% of the studies reviewed in the paper used a Before-After Control-Impact (BACI) design. Meeting participants emphasized that because there are few true BACI design studies in the monitoring literature, that there is still a lack of information between the management measure impacts and effects on fish of many types of projects. Because it had already been established earlier in the meeting that functional monitoring should be used in the context where there is certainty around the link between impact and effects, the lack of clear evidence establishing linkages in the current literature may be a barrier to the use of functional monitoring for many project types.

Presentation of external review 2

The external review was presented by a co-chair on behalf of the external reviewer.

The main points from this review of the working paper were:

- No discussion of when monitoring would begin after management measure applied.
- Environmental Effects Monitoring (EEM; Metal Mining Effluent Regulations) was not discussed in the working paper despite being around for more than 20 years.
- Some confusion around the Reference Condition Approach versus normal range approaches.
- Discussion of the weight of evidence approach versus tiered approaches.
- Discussion of critical effect sizes as another option for design.

There was discussion of whether there could be additional learning from the EEM program. EEM was explained as a tool to evaluate end of pipe regulations in order to determine whether

regulations were protective of the environment. There was confirmation that the factors considered in the development of EEM had been successfully captured in the working paper.

The point was raised that EEM is a diagnostic tool and is not in place as a way to study ecosystem trends. In general, monitoring through FPP is also meant as a diagnostic tool.

There was discussion of what aspects of programs different types of monitoring inform. Compliance monitoring was mentioned as informing proponent behaviour but not providing information for learning about ecosystems.

The point was raised that there is a desire to be more transparent in how FPP does monitoring.

Additional introductory discussion

There was considerable discussion around the definition of functional monitoring before a definition was agreed upon for the Science Advisory Report (SAR). The discussion included reviewing the definition included in the working paper as well as the definition given in the earlier SAR on effectiveness monitoring.

There was considerable discussion around Figure 1 of the working paper and how best to quantify and visualize the costs and trade-offs of obtaining information from effectiveness and functional monitoring.

There was discussion of under what circumstances functional monitoring would be used.

OBJECTIVE 1: RECOMMENDED MONITORING DESIGNS AND METHODS

There was some introductory discussion of the different monitoring designs that had been presented in the working paper and brought forward from the internal and external reviews. There was general consensus that various designs could be appropriate for functional monitoring but that there is likely the expectation from the operational perspective that collection of data and analyses for functional monitoring will be both straight forward and quicker than for effectiveness monitoring.

There was discussion of the Reference Condition Approach (RCA) in the sense that it generally refers to macroinvertebrate sampling with a large number of established reference sites. The Canadian Aquatic Biomonitoring Network (CABIN) was mentioned as a key example. The point was raised that there is an upcoming review of a project that used the RCA/CABIN approach with macroinvertebrates as a proxy for fish habitat. There were concerns around prescribing the RCA method in terms of advice for functional monitoring, but also acknowledgement that it may be appropriate in some situations.

The point was raised that the RCA described in the working paper was more of a normal range approach, and that care was needed with a normal range approach to prevent shifting baselines.

It was agreed that the group would split up the monitoring designs outlined in Table 4 (Monitoring designs commonly used in the assessments of habitat alteration (e.g., impacts, habitat mitigation, restoration and offsetting.)) of the working paper and provide short reports to the rest of the group on Day 3. These reports would outline: if any considerations were absent from the table, whether the method would be appropriate for site/project-specific monitoring or program-level assessment (e.g. are the measures prescribed for a specific project type adequate) along with a case study if appropriate.

On Day 3, the group discussed the reports given on the following designs: Before-After Control-Impact (BACI), Before-After (BA), Control-Impact (CI), RCA (primarily using

macroinvertebrates), Normal Range Approaches (use of benchmarks), and Trend by Time and Level by Time designs. The group agreed upon additions to Table 4 of the working paper based on these reports.

OBJECTIVE 2: INFORMATION AND ANALYSES NEEDED TO SUPPORT SCIENCE-BASED FUNCTIONAL ASSESSMENT OF MITIGATION, OFFSETTING, AND RESTORATION MEASURES

There was an understanding by the group that the information and analyses needed for functional monitoring will depend on the monitoring design chosen and that some monitoring designs include analyses specific to the design.

There was extensive discussion about whether there would be a recommendation for or against the use of biotic measures (primarily fish) in functional monitoring. Various points of discussion were brought forward with regard to the use of fish in functional monitoring programs.

Participants concerned about the inclusion of fish presence as a metric for functional monitoring pointed out that this would most likely involve a simple presence/absence observation, without any indication of variability. Additionally, fish might be present in an area not considered optimal fish habitat, for reasons not easily delineated. However, some participants were concerned about not explicitly recommending the use of fish presence/absence as a metric for functional monitoring because whether fish are using an area is the ultimate measure of whether or not an area functions as fish habitat. A lack of fish use may be due to exogenous factors such as connectivity or fish population size, but that demonstrates that the construction of the habitat was inappropriate in the first place (at best, non-beneficial). However, it was acknowledged that the presence of fish alone may be insufficient for demonstrating functionality, for example if fish use was transient or the habitat was acting as a productivity sink, thus both biotic and abiotic indicators are likely needed. It was decided that the group would not provide a specific recommendation regarding the use of biotic measures in functional monitoring, but rather that the advice would emphasize that choices of measures should be clearly linked to monitoring objectives.

There was discussion of Appendix D (examples of indicators that could be used in functional monitoring) from the working paper and that the majority of the indicators were also reviewed during the peer review meeting on effectiveness monitoring. The point was made that many of the indicators in Appendix D can be measured in both quantitative and qualitative ways.

The point was raised that there could be value in recommending that an analysis be completed that would construct a matrix with project activity, management measure and ecosystem impacts as dimensions in order to better provide advice on information and analyses for functional assessment of mitigation, offsetting and restoration measures, but that this would represent a considerable amount of effort.

The group agreed not to provide specific advice on how to sample various metrics as there is already an abundance of this type of information available, rather the group could point to some useful resources.

OBJECTIVE 3: GATHERING FUNCTIONAL MONITORING DATA USING A CHECKLIST STYLE APPROACH

After discussion on gathering functional monitoring data using a checklist style approach, it was decided that the group considers this approach to be feasible but that a single checklist for use across all project types/management measures would not be possible.

The group discussed two pre-existing checklists that were brought forward as examples of compliance monitoring checklists for culverts. One example was provided by FPP staff in the Maritimes region and another was a published checklist by the Government of British Columbia. The group viewed these checklists as good starting points for functional monitoring programs as some of the information collected via these checklists extends past compliance monitoring and is functional monitoring in nature.

The group discussed the utility of such checklists to ensure that data were collected appropriately in site/project-specific situations but also to ensure consistency in data collected for larger, program-level analyses (e.g., meta-analyses).

OBJECTIVE 4: RECOMMENDED FIELDS FOR CHECKLIST STYLE APPROACH

The group continued to discuss the example checklists that had been provided on compliance monitoring for culverts. There was agreement that examples like these could be built on for functional monitoring.

The point was raised that it would be important to avoid giving advice that was just a long list of potential metrics as this information already exists.

The group agreed that Table E1 (Checklist of standardized indicators for in-water activities and Pathway of Effects) in Appendix E of the working paper was a good reference for checklist fields. There was agreement that Table E1 should be modified slightly in the working paper to improve clarity and should also be included in the SAR.

There was discussion that in terms of Objective 4, this peer review meeting has not produced a useable tool for FPP, even though the SAR will provide some general advice on the use of checklists. There was further discussion that checklists for specific projects could potentially be developed in the future, and would be best done in partnership between FPP and Science. It was also discussed that the development of such checklists should be designed so that the data gathered in this approach is useful to program-level analyses.

CONCLUSIONS

All four objectives from the Terms of Reference were discussed in plenary. The participants together agreed on summary bullets for the SAR, based on key pieces of advice related to each of the objectives.

REFERENCES CITED

- Braun, D.C., Smokorowski, K.W., Bradford, M.J., and Glover, L. 2018. A Review of Functional Monitoring Methods to Assess Mitigation, Restoration and Offsetting Activities in Canada. DFO Can. Sci. Advis. Sec. Res. Doc. 2019/057. In press
- DFO. 2012. Assessing the Effectiveness of Fish Habitat Compensation Activities in Canada: Monitoring Design and Metrics. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/060.

APPENDICES

APPENDIX I: MEETING AGENDA

February 26-28, 2018

Alt Hotel, Ottawa, ON

DAY 1

Time	Monday, February 26, 2018	
9:00 AM	<ul style="list-style-type: none"> ○ Introduction to CSAS advisory process ○ Introduction of participants ○ Review Terms of Reference ○ Overview of goals and objectives of meeting ○ Overview of the FPP program and need for Functional Monitoring 	Chairs/FPP
10:30 AM	Break	
10:45 AM	<ul style="list-style-type: none"> ○ Presentation of the Working Paper and Discussion 	D. Braun
12:00 PM	Lunch	
1:00 PM	<ul style="list-style-type: none"> ○ Presentation of Internal Review and Discussion ○ Presentation of External Review and Discussion 	Chairs/Reviewers
2:30 PM	Break	
2:45 PM	<ul style="list-style-type: none"> ○ Objective 1: Recommended monitoring designs and methods for FM. Discussion and draft SAR points. 	All
4:30 PM	Meeting closing (Day 1)	Chairs

DAY 2

Time	Tuesday, February 27, 2018	
9:00 AM	<ul style="list-style-type: none"> ○ Re-cap of day 1 (progress). ○ Objective 2: Information and analyses needed to support FM. Discussion and draft SAR points. 	Chairs/All
10:30 AM	Break	
10:45 AM	<ul style="list-style-type: none"> ○ Objective 3: Feasibility of checklist style approach. Discussion and draft SAR points. 	All
12:00 PM	Lunch	
1:00 PM	<ul style="list-style-type: none"> ○ Continued discussion of Objectives 1-3 as needed. Draft SAR points. 	All
2:30 PM	Break	
2:45 PM	<ul style="list-style-type: none"> ○ Objective 4: Recommended fields for checklist style approach (if considered feasible). Discussion and draft SAR points. 	All

Time	Tuesday, February 27, 2018	
4:30 PM	Meeting closing (Day 2)	Chairs

DAY 3

Time	Wednesday, February 28, 2018	
9:00 AM	<ul style="list-style-type: none"> ○ Re-cap of day 2 ○ Presentation of homework from Day 2 ○ Review and edit SAR points from Days 1 and 2. 	Chairs
10:30 AM	Break	
10:45 AM	<ul style="list-style-type: none"> ○ Continue drafting Science Advisory Report 	Chairs
12:00 PM	Lunch	
1:00 PM	<ul style="list-style-type: none"> ○ Complete drafting Science Advisory Report ○ Wrap Up / Next Steps 	All
3:30 PM	Meeting ends	All

APPENDIX II: MEETING PARTICIPANTS

Name	Affiliation
Smokorowski, Karen (Co-chair)	DFO Science, Central & Arctic (C&A)
Keatley, Bronwyn (Co-chair)	DFO Science, National Capital Region (NCR)
Berryman, Court	DFO FPP, C&A
Bradford, Mike	DFO Science, Pacific (PAC)
Braun, Doug	DFO Science, PAC
Breau, Cindy	DFO Science, Gulf
Clarke, Keith	DFO Science, Newfoundland (NL)
Cooper, Jennie	DFO FPP, C&A
Cormier, Roland	DFO Science, Gulf
Delaney, Leanda	DFO FPP, Maritimes (MAR)
Doka, Sue	DFO Science, C&A
Enders, Eva	DFO Science, C&A
Glover, Luc (rapporteur)	DFO Science, C&A
Gregory, Bob	DFO Science, NL
Harwood, Andrew	Ecofish Research
Hussey, Darryl	DFO FPP, PAC
Koops, Marten	DFO Science, C&A
Lapointe, Nicolas	Canadian Wildlife Federation
Lemieux, Jeffrey	DFO Science, PAC
Loughlin, Kristen	DFO Science, NL
MacDonald, Steve	DFO Science, PAC
McMaster, Mark	Environment and Climate Change Canada
Midwood, Jon	DFO Science, C&A
Mochnacz, Neil	DFO Science, C&A
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Rose, Al	DFO FPP, NCR
Winegardner, Amanda (rapporteur)	DFO Science, NCR
Ziai, Chad	DFO FPP, NCR

APPENDIX III: TERMS OF REFERENCE

Science advice on operational guidance on functional monitoring: Surrogate metrics of fish productivity to assess the effectiveness of mitigation and offsetting measures.

National Peer Review - National Capital Region

Date: February 26-28, 2018.

Location: Ottawa, Ontario.

Chairpersons: Karen Smokorowski and Bronwyn Keatley.

Context

In December 2011 DFO held a science advisory process to examine the feasibility of designing a standardized monitoring approach to determine the effectiveness of habitat compensation (or offsetting) activities in achieving 'No Net Loss of the productive capacity of fish habitat' as was the policy at that time. The Science Advisory Report (SAR) produced from this workshop is [available online](#) (henceforth referred to as the 2012 SAR). The 2012 amendments to the *Fisheries Act* required the focus of monitoring programs for offsetting activities be adjusted according to the new Fisheries Protection Provisions. Three hierarchical levels of monitoring were briefly described (compliance, functional, and effectiveness monitoring) but the focus of the 2012 CSAS process was on *effectiveness* monitoring, applicable to projects with offsetting measures that warrant detailed monitoring. The technical report (Smokorowski et al. 2015) produced following the 2012 SAR focused on developing the design and metrics for comprehensive effectiveness monitoring.

In contrast, proponents of some projects that may require a *Fisheries Act* authorization, or proponents that receive a letter for project-specific advice may not be required to undertake long term, detailed effectiveness monitoring. DFO's Fisheries Protection Program (FPP), however remains interested in understanding the outcomes of a subset of these projects. In the 2012 SAR, *functional* monitoring was briefly described as a scaled-down assessment of habitat offsetting effectiveness, using quantitative techniques but relying on surrogate information to assess changes in fisheries productivity (e.g., change in macrophyte density or amount of a substrate type) but further science guidance is needed on its application. The objective of this science advisory process is to provide FPP staff with advice on standardized monitoring design and metrics appropriate for undertaking scaled-down monitoring which could utilize surrogate(s) of fisheries productivity in marine and freshwater environments, and for analyzing data to assess the effectiveness of mitigation, offsetting and restoration measures.

Standardized functional monitoring techniques could have several potential uses:

- FPP may use the information to undertake functional monitoring.
- By proponents that do not require large-scale monitoring programs.
- By FPP to improve future advice and/or requirements related to mitigation and offsetting measures.
- If consistent monitoring programs/approaches for particular projects (e.g. stream diversions, bridge and culvert installations, dredging, offset habitat construction, etc.) can be planned and implemented (and tracked) in a regionally and nationally consistent approach, analyses of results of functional monitoring may be possible and could in turn improve future project assessments.

Objectives

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

- i) What are the recommended monitoring designs and methods (e.g., rapid assessment techniques/use of surrogates or indicators) to assess mitigation, offsetting and restoration measures that are designed to reduce impacts to fish and fish habitat using functional monitoring approaches (i.e., without a comprehensive effectiveness monitoring program)?
- ii) What information and analyses are needed to support a science-based functional assessment of mitigation, offsetting and restoration measures?
- iii) Is it feasible to gather functional monitoring data using a checklist style approach that can be applied consistently among project types and stages of construction (i.e., for each project type, a checklist of specific information to collect with proponent led monitoring, site visit during construction monitoring, and post construction monitoring that can be applied in a consistent manner by FPP biologists)?
- iv) If a checklist style approach is considered feasible for various project types and stages of construction, what are the recommended fields?

Cited reference:

Smokorowski, K.E., Bradford, M.J., Clarke, K.D., Clément, M., Gregory, R.S., Randall, R.G. 2015. Assessing the effectiveness of habitat offset activities in Canada: Monitoring design and metrics. Can. Tech. Rep. Fish. Aquat. Sci. 3132: vi + 48 p.

Expected Publications

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

Participation

- Fisheries and Oceans Canada (Ecosystems and Oceans Science, Fisheries Protection Program)
- Academia
- Other invited experts