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Proceedings of the National peer review of Science Guidance for Fisheries Protection Policy: Advice on Equivalent Adult Calculation

June 9-10, 2014
Burlington, Ontario

Chairperson: Jake Rice
Editor: Jim Kristmanson

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

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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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MPO. 2017. Compte rendu de l'examen national par les pairs sur les orientations scientifiques relatives à la politique sur la protection des pêches : avis sur le calcul des équivalents adultes; du 9 au 10 juin 2014. Secr. can. de consult. sci. du MPO, Compte rendu 2017/028.

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SUMMARY

A national science advisory process was held June 9-10, 2014 at the Canadian Centre for Inland Waters in Burlington, Ontario. The purpose of the meeting was to examine the support and utility of options for a common metric for discussing impacts to habitat quantity and/or quality on freshwater Canadian fish (Equivalent Adult and Production Foregone) as a means of informing the Fisheries Protection Program decision-making framework.

The advisory process was conducted around a working paper and 3 presentations by DFO researchers who have been participating in a core group developing science advice to inform implementation of the Fisheries Protection Program. A total of 13 DFO participants from 5 Regions participated in this advisory process. These Proceedings summarise the discussions held at the meeting. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SOMMAIRE

Une consultation scientifique nationale s'est déroulée les 9 et 10 juin 2014 au Centre canadien des eaux intérieures de Burlington, en Ontario. L'objectif de cette consultation était d'examiner le soutien et l'utilité des options pour une mesure commune permettant de traiter les impacts sur la quantité ou la qualité de l'habitat des poissons d'eau douce du Canada (équivalents adultes et perte de production) comme moyen d'étayer le cadre décisionnel du Programme de protection des pêches.

La consultation s'est appuyée sur un document de travail et trois présentations données par des chercheurs du MPO qui ont participé aux travaux d'un groupe central qui élabore des avis scientifiques pour étayer la mise en œuvre du Programme de protection des pêches. Un nombre total de 13 employés du MPO émanant des cinq régions ont participé à cette consultation. Le présent compte rendu résume les discussions qui ont eu lieu pendant la consultation. D'autres publications concernant cet événement seront affichées sur le calendrier des avis scientifiques de Pêches et Océans Canada lorsqu'ils seront disponibles.

INTRODUCTION

Recent changes to the *Fisheries Act* (2012) will change the way the Department assesses and manages impacts on aquatic ecosystems. The amended Act focuses on the sustainability and ongoing productivity of Commercial, Recreational or Aboriginal (CRA) fisheries.

Fisheries and Oceans Canada (DFO) Ecosystems and Fisheries Management Sector requested scientific guidance related to the implementation of these amendments to the *Fisheries Act*. DFO Science has undertaken a series of meetings in which participants reviewed scientific information related to fisheries productivity losses due to human development, and provided operational guidance to the Fisheries Protection Program (FPP). This meeting looked specifically at the concept of using "Equivalent Adult" and Production Foregone as means of providing information to the Fisheries Protection Program's decision-making framework.

Participants were welcomed to the meeting (Annex I) and invited to comment on the Terms of Reference (Annex II). The Chair presented an overview of the goals and objectives of the meeting and participants were tasked with addressing the following questions:

1. Is it feasible to use an Equivalent Adult approach as a common metric for discussing impacts to habitat quantity and/or quality on freshwater Canadian fish?
2. Is it feasible to use fish production (or Production Forgone) as a common metric for discussing impacts to habitat quantity and/or quality?
3. What are the appropriate groupings of data (e.g., body size, ecosystem type)?
4. What are the preliminary estimates of the amounts of habitat (e.g. orders of magnitude) required to produce one equivalent adult in the appropriate groupings identified in #3?
5. If both approaches are feasible, are there circumstances where one may be more appropriate than the other?

PRESENTATIONS

Context

Presentation – Bronwyn Keatley, and Anne Phelps

An overview of Fisheries Protection Program was presented and changes to *Fisheries Act* were highlighted. The need for science advice on how to implement the new Fisheries Protection Policy was emphasized. The advice will be used by the Program to develop consistency in the decision making process and facilitate communications between staff and proponents. The authors stated that there is a need for a common currency (EA, PF) on which to base decisions to manage risk and the certainty of outcomes.

Equivalent Adults Approach

Presentation – Mike Bradford

The ecological and energetic basis for patterns of abundance based on trophic level or fish size classes was discussed. Some background information to the EA approach was provided using entrainment data of juvenile fish from a Great Lakes power plant. An EA approach was used to calculate compensation currency based on the loss of juveniles.

How to convert this model to a habitat loss model was discussed. The density of juvenile fish was presented through a set of area per recruit curves for different species of fish. The author explained that the variation between the curves probably represented differences between southern (productive) data and northern (less productive) Canadian ecosystems. Recruits were

defined by size at first appearance in a fishery or size at maturity, depending on data available. Area per recruit was noted to vary depending on size and relative rarity of the species in the community. The conclusion was that, though uncertain, a unit of habitat can be used to assess the annual production of adult fish. Factors causing variability included: condition of habitat, species, species assemblages and particular habitat uses.

It was noted that there was an abundance of brook trout data that could be used to characterise long-term survival patterns between age-classes and could be linked to habitat productive potential.

Participants discussed how inherent differences in fisheries productivity need to be characterised through percentiles or some other measure. This discussion revolved around how to reduce uncertainty when using the EA model, based on data availability and how to use EA as a screening tool. Participants also discussed how much information is needed to usefully characterise uncertainty and communicate this uncertainty in estimates of productivity.

It was agreed that the EA model was a reasonable approach but needs to take into account regional variation in determinants of productivity such as water temperature and chemistry.

There was a discussion on providing advice on productivity thresholds for model effectiveness. Risk management was also discussed.

It was noted that there seems to be a 4-5 fold range in species density in similar habitats and it was questioned if this is acceptable for national or regional purposes. The need for stratification of the data and how much to stratify (for example: lakes vs rivers, and regional stratification) was discussed. The benefits of using an indicator species, with large amounts of data available was discussed as a way forward. The current decision framework will have to use available data for now and can be fine-tuned in the future as more experience accumulates.

The application of the EA concept was discussed, in terms of whether it would be applied generically, or as an activity-specific approach. How to deal with multiple age-classes in the habitat, and how to consider spawning habitat was also discussed. It was noted that specialised habitat (i.e. spawning) is considered elsewhere and the present focus is on rearing/ nursery habitat.

Simulation Analysis

Presentation – Marten Koops

Modelling of body-size based life history parameters (i.e. longevity, age at maturity, growth rate, mortality) were presented for four length categories to generate estimates of area per recruit. This follows from the observation that key parameters of fish ecology are size structured, both for individual species as well as communities.

There was a lengthy discussion on the effects of total ecosystem biomass, niche sizes, maximum habitat biomass or density and trophic structure. Gear sampling bias was also discussed and whether there was a lower limit of sampling ability. Participants agreed that there was no solution inherent in the data to address these issues but one could assume that the community was not sampled below a certain cutoff.

Both body size and trophic level were used in the model under the assumption that an individual changes trophic levels as it matures. It was pointed out that there was a lot of variability in the trophic level/body size relationship and only one of these elements should be focused on for the model at a time.

There was also discussion on which end of the productivity spectrum to protect. There is a bias to protect lower productive species rather than average productivity. However, using a large area to protect one large adult would have the effect of protecting a large number of small bodied fish as well. It was noted that a smaller area threshold may equate to more protection as more projects would be subject to review. Which approach to use will have to be resolved: either a community/small fish approach or a large bodied/valued species approach.

Production Foregone (PF)

Presentation – Bob Randall

Both biomass and production are embedded in the EA concept, however the change in annual biomass is an underestimate because it does not account for the loss in biomass as a result of mortality over the year. Production can be presented in the spatial context of the area needed to produce an adult fish.

In discussion, it was noted that PF is a valid approach but appeared to have a high degree of variability. It was suggested that utilizing the PF model in combination with the EA and stratification may work to inform offsetting. It was further noted that precision may not be a consideration given that the tool will be used for decision making but that primary productivity would be difficult to communicate compared to fish productivity even without considering precision issues.

There was discussion on the pros and cons of using a species approach such as a valued or CRA species to estimate production. There were concerns that this approach would represent an underestimate of production and could undervalue habitat with regard to other species.

There was also discussion on the time frame for calculating production and implications for when there is a time lag between impact and offsetting actions.

Habitat quality and quantity and the idea that production varied as a function of habitat quality were discussed. There was debate on whether a larger quantity of low quality habitat was adequate compensation for loss of high quality habitat and vice-versa. It was agreed that the assumption for the decision rule was that all habitat was of high quality with further stratification of habitat possible at subsequent steps in the process.

Special or limiting habitats were considered, and whether they should be treated differently. Which approach to take was also considered, whether to use a generic life history or a species-specific approach and what proportion of other species would be protected by these approaches.

DISCUSSION ON QUESTIONS IN TERMS OF REFERENCE

It was agreed that it was feasible to use either or both of these metrics (EA, PF) and that they both represented a biologically sound, defensible approach to use in a framework for decision making. It was also felt that the EA approach was appropriate as a first level decision tool while PF approach was more of an assessment tool for a specific project review because of the data requirements. The EA and PF approaches are not mutually exclusive and can be used in conjunction to assess projects from the different perspectives of numbers of fish and biomass.

There was a request for definitions of the terms in the Science Advisory Report including definitions for; EA, Area Per Recruit (APR), and PF. EA was defined as the number of juveniles that would produce an adult or recruit, APR was defined as the area of nursery habitat occupied by the juveniles which converts the EA to an area metric and PF is a measure of biomass that would have been produced by a habitat lost to development.

The definition of recruit was also discussed, given that recruit has a technical meaning in other contexts. Adult has been defined as mature females in some areas. In the analysis to date presented in the working papers, both have been used; age at maturity and age of recruitment. It was agreed that there was more data available on age-at-maturity than for age at recruitment to a fishery. It was also noted that the difference between the age-at-maturity and age at recruitment to a fishery was no more than a year or two. Age at maturity was supported as a benchmark and may be more conservative in many cases.

There was much discussion on time frames and how to define permanent vs temporary impacts. There was previous work that related impacts to generation time and that three generations was an acceptable metric for longevity of impact based on this precedents.

Habitat quality, quantity and stratification was discussed as well as biases in the data arising from the type of habitat typically studied (wadeable rivers and shallow littoral zone of lakes). For current needs, this level of stratification is not necessary, though ecoregional stratification is appropriate. Further stratification would be necessary for specific projects and will be addressed in upcoming work.

The Chair presented a range of choices possible for the basis of the advice: indicator species approach, modal/risk adverse community trait, and an arbitrary but informed threshold. The participants indicated a moderate preference for a generic approach that focused on an indicator CRA species. After more discussion, the cumulative risk curves presented in the first EA presentation were seen as a way forward. This approach needs to be populated with typical Canadian species productivity and data is available to do this. The curve would be presented as a risk curve that managers can use to choose a preferred tolerance level. The very steep ascending limb of the curve implies that a certain areal value would be appropriate for a large number and range of species.

CONCLUDING REMARKS

Questions and corresponding answers from the Terms of Reference:

- Is it feasible to use an equivalent adult approach as a common metric for discussing impacts to habitat quantity and/or quality on freshwater Canadian fish?
- Is it feasible to use fish production (or production forgone) as a common metric for discussing impacts to habitat quantity and/or quality?

Both approaches are feasible with EA addressing habitat quantity and to a lesser extent quality, while PF addresses both quantity and quality.

- What are the appropriate groupings of data (e.g., body size, ecosystem type)?

The need for this was addressed and awaits further analysis which is forthcoming in the near future.

- What are the preliminary estimates of the amounts of habitat (e.g. orders of magnitude) required to produce one equivalent adult in the appropriate groupings identified in #3?

This can be identified with caveats to an order of magnitude, to be refined with more analysis.

- If both approaches are feasible, are there circumstances where one may be more appropriate than the other?

EA is the first choice with Production Foregone brought in to complement EA or when it represents value added and the data is available.

The data illustrates the viability of the concept. There are known data issues however the computations are sound and when applied to Canadian data may resolve the existence and extent of regional differences that may need to be taken into account.

SOURCES OF INFORMATION

DFO. 2015. Science Guidance for Fisheries Protection Policy: Advice on Equivalent Adult Calculation. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2015/011.

ANNEX I: MEETING PARTICIPANTS

Louise de Mestral Bezanson – DFO Maritimes / FPP
Mike Bradford – DFO Pacific / Science
Gerald Chaput – DFO Gulf / Science
Keith Clarke – DFO Newfoundland and Labrador / Science
Jason Hwang – DFO Pacific / FPP
Bronwyn Keatley – DFO National Capital Region / FPP
Marten Koops – DFO Central and Arctic / Science
Jim Kristmanson (Rapporteur) – DFO National Capital Region / Science
Anne Phelps – DFO National Capital Region / FPP
Bob Randall – DFO Central and Arctic / Science
Jake Rice (Chair) – DFO National Capital Region / Science
Adam Van Der Lee – DFO Central and Arctic / Science
Doug Watkinson – DFO Central and Arctic / Science

ANNEX II: TERMS OF REFERENCE

Science Advice on Equivalent Adult Calculation

National Peer Review - National Capital Region

June 9-10, 2014
Burlington, ON

Chairperson: Jake Rice

Context

Recent changes to the *Fisheries Act* (2012) will change the way Department assesses and manages impacts on aquatic ecosystems. The amended Act focuses on the sustainability and ongoing productivity of commercial, recreational or Aboriginal fisheries.

DFO Program Policy Sector has requested scientific guidance towards the implementation of these amendments to the *Fisheries Act*. DFO Science has undertaken a series of meetings in which participants review scientific information related to fisheries productivity losses due to human development, and provide operational guidance to the Fisheries Protection Program. This meeting will look specifically at the concept of using "Equivalent Adult" and production foregone as means of providing information to the Fisheries Protection Program's decision-making framework.

Objectives

Participants will review research documents to address the following questions:

- Is it feasible to use an equivalent adult approach as a common metric for discussing impacts to habitat quantity and/or quality on freshwater Canadian fish?
- Is it feasible to use fish production (or production forgone) as a common metric for discussing impacts to habitat quantity and/or quality?
- What are the appropriate groupings of data (e.g., body size, ecosystem type)?
- What are the preliminary estimates of the amounts of habitat (e.g. orders of magnitude) required to produce one equivalent adult in the appropriate groupings identified in #3?
- If both approaches are feasible, are there circumstances where one may be more appropriate than the other?

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