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Proceedings of the Pacific regional peer review on the Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas in British Columbia

**December 12-14, 2018 and May 2-3, 2019
Nanaimo, British Columbia**

**Chairperson: Lisa Setterington
Editors: Elise Keppel, Lily Burke, and Lisa Christensen**

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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 Fisheries and Oceans Canada (DFO), Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR) meetings on December 12-14, 2018 and on May 2- 3, 2019 at the Pacific Biological Station in Nanaimo, British Columbia (BC). A working paper (WP) focusing on a Pacific Region risk assessment of permitted human activities in Rockfish Conservation Areas (RCA) in BC was presented for peer review.

The December 2018 meeting reviewed the approaches used in the WP to assess RCAs against current DFO guidance criteria that identifies area-based management measures as other effective area-based conservation measures (OEABCM), examined data sources used in the assessment, and evaluated conclusions generated from the assessment. Suggested revisions from the first RPR were incorporated into the WP and were subject to a second peer review in May 2019.

In-person and web-based participation included representatives from DFO Science, Ecosystems Management, and Fisheries and Aquaculture Management branches. External participation included representatives from Environment and Climate Change Canada, Parks Canada, BC Provincial Ministry of Forests, Lands, Natural Resource Operations and Rural Development, First Nations organizations, commercial and recreational fisheries, and environmental non-governmental organizations.

Conclusions and advice incorporated from both meetings are provided in the form of a Science Advisory Report (SAR) providing advice to DFO Fisheries Management branch on if RCAs meet OEABCM criteria 1 through 5, to assist in identifying the permitted activities with the highest relative risk, and to highlight data-deficient activities and areas needing further research.

This Proceedings document is the record of discussions from both RPR meetings. A SAR and a supporting Research Document will be made publicly available on the CSAS website.

INTRODUCTION

A Fisheries and Oceans (DFO) Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR) meeting was held on December 12-14, 2018 and on May 2-3, 2019 at the Pacific Biological Station in Nanaimo, British Columbia (BC) to review a Pacific Region risk assessment of permitted human activities in Rockfish Conservation Areas (RCA) in BC.

Rockfish Conservation Areas are area-based management measures that were established as a spatial management tool to protect a portion of the Inshore Rockfish population from fishing activity to provide a buffer against scientific uncertainty and to promote the rebuilding of stocks. There are 164 RCAs along the BC coast that were put in place between 2003 and 2007. As a result of RCA implementation, fishing activities causing high Inshore Rockfish mortality were prohibited within RCAs. However, a number of commercial and recreational fisheries along with First Nations' rights to fish for food, social, and ceremonial (FSC) purposes that were considered low risk of causing rockfish mortality were permitted.

DFO conducted an internal evaluation of RCAs in 2016 to assess RCAs against the five OEABCM criteria. As a result of this evaluation, the Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a request for advice from DFO Fisheries Management branch. The focus of the working paper (WP) was to evaluate RCAs against current DFO operational guidance used to identify area-based management measures as other effective area-based conservation measures (OEABCM) (DFO 2016a, 2016b). OEABCMs are one of the five areas of action that support the Government of Canada's commitment to conserving at least 10 percent of Canada's coastal and marine areas through protected areas and OEABCMs by 2020 (United Nations Convention on Biological Diversity Aichi Target 11).

The following WP was prepared and made available to meeting participants prior to the meeting (WP abstract provided in Appendix E):

Risk assessment of permitted human activities in Rockfish Conservation Areas in British Columbia by K. Thornborough, D. Lancaster, J.S. Dunham, F. Yu, N. Ladell, N. Deleys, L. Yamanaka. CSAS Working Paper 2017SFF02b

The Chair, Lisa Setterington, welcomed participants, reviewed the role of CSAS in the provision of peer-reviewed advice, and gave a general overview of the CSAS process. The Chair discussed the role of participants, the purpose of the various RPR publications (Science Advisory Report (SAR), Proceedings and Research Document), and the definition and process around achieving consensus decisions and advice. Everyone was invited to participate fully in the discussion and to contribute knowledge to the process, with the goal of delivering scientifically defensible conclusions and advice. It was confirmed with participants that all had received copies of the TOR and the WP.

The Chair reviewed the Agenda (Appendix C) and the TOR, highlighting the objectives and identifying the Rapporteurs. The Chair then reviewed the ground rules and process for exchange, reminding participants that the meeting was a science review and not a consultation. The room was equipped with microphones to allow remote participation by web-based attendees, and in-person attendees were reminded to use the microphones when addressing comments and questions so they could be heard by those online.

Members were reminded that everyone at the meeting had equal standing as participants and that they were expected to contribute to the review process if they had information or questions relevant to the paper being discussed. In total, 48 people participated in the RPR for the December 12-14, 2018 meeting and 29 people participated in the May 2-3, 2019 meeting

(Appendix D). Elise Keppel and Lily Burke were identified as the Rapporteurs for the December 2018 meeting and Lily Burke was the Rapporteur for the May 2019 meeting.

Participants were informed that Dana Haggarty (Inshore Rockfish and Lingcod Program Head, DFO), Rebecca Martone (Marine Biologist, Ministry of Forests, Lands, and Natural Resource Operations and Rural Development), and Sarah Dudas (Aquatic Science Biologist III, DFO) with Sharon Jeffery (Aquatic Science Biologist II, DFO) had been asked before the meeting to provide detailed written reviews of the WP to assist everyone attending the peer-review meeting. Participants were provided with copies of the three written reviews (Appendix B).

The conclusions and advice resulting from this review will be provided in the form of Science Advisory Report (SAR) to DFO Fisheries Management to identify if and how RCAs meet OEABCM criteria 1 through 5 and to identify knowledge and data gaps, and uncertainties in the methods. The SAR and supporting Research Documents will be made publicly available on the [Canadian Science Advisory Secretariat](#) (CSAS) website.

REVIEW

Working Paper: Risk assessment of permitted human activities in Rockfish Conservation Areas in British Columbia.” by Thornborough, K., Lancaster, D., Dunham, J.S., Yu, F., Ladell, N., Deleys, N. and Yamanaka, L.

Rapporteurs: Elise Keppel and Lily Burke

Presenter(s): Amy Mar, Kate Thornborough, Darienne Lancaster, Jason Dunham

PRESENTATIONS OF THE WORKING PAPER

PRESENTATIONS FROM DECEMBER 2018 REGIONAL PEER REVIEW MEETING

Presentation: Risk assessment of permitted human activities in Rockfish Conservation Areas in British Columbia

Presenter(s): Jason Dunham and Kate Thornborough (presented on ERAF), Darienne Lancaster (presented overview of data used in scoping phase of ERAF).

An introduction to the ecological risk assessment framework (ERAF) was presented and included a description of the methodology and risk assessment phases. The ERAF was developed by DFO Pacific Region (O et al. 2015) to evaluate and prioritize the single and cumulative threats from multiple anthropogenic activities and their associated stressors on significant ecosystem components (SECs) and to identify knowledge gaps. It is a peer-reviewed tool that has been applied in a number of marine planning processes (e.g. Pacific North Coast Integrated Management Area (PNCIMA; Murray et al. 2016), SGaan Kinghlas-Bowie Seamount Marine Protected Area (SK-B MPA; Rubidge et al. 2018), Endeavour Hydrothermal Vents MPA (EHV MPA; Thornborough et al. 2018), and Hecate Strait and Queen Charlotte Sound Marine Protected Area (HS/QCS MPA; DFO 2018).

To conduct a risk assessment of human activities permitted within RCAs, a Level 1 ERAF was conducted to provide a comprehensive, but largely qualitative analysis of risk. The level 1 ERAF is a rapid assessment framework and was appropriate to employ for the amount of data available. For this assessment, the Level 1 ERAF methods from O et al. (2015) were used with modifications recommended in the PNCIMA application (Murray et al. 2016).

The scoping phase of the assessment identified the key features or properties of the system (i.e. significant ecosystem components (SECs)) and the activities and associated stressors that have the potential to affect these SECs. SECs identified were: inshore rockfish, rockfish prey species, and rockfish habitat (rocky reefs, glass sponge reefs, eelgrass beds and kelp forests). The risk assessment of rockfish habitat focused on rocky reefs and glass sponge reefs.

Detailed conversations with over 40 experts, a literature review of primary and secondary publications (DFO archives and Pacific Region risk assessments), and examination of fishery catch data identified permitted human activities within RCAs with the potential to harm inshore rockfish, rockfish habitats and rockfish prey species (identified SECs). The conclusions generated from these sources were reviewed by relevant experts and expert opinions were incorporated into the final risk assessment document.

In the risk assessment phase, a SEC-Stressor matrix was used to identify potential negative interactions between SECs and stressors. The risk assessment phase only examined negative and direct effects. Risk is a product of the SECs exposure to a stressor and the consequence of that exposure to the SEC. The number of stressors drives the risk score. As part of the risk calculation, uncertainty is incorporated into the final risk score. Both the relative risk, specific to SEC-stressor interaction, and the cumulative (additive) risk, sum of all risks impacting a SEC, sum of all risks produced by a stressor, sum of all risks produced by an activity, were calculated.

Of the possible 376 interactions, 231 were identified as having a potential negative direct interaction (and moved onto scoring phase) and a total of 898 risk variables were scored and justified. For relative risk by SEC-stressor, the highest risk associated with the highest uncertainties and the lowest risk associated with the lowest uncertainties. In most cases, uncertainty associated with Exposure was higher than uncertainty associated with Consequence. Consequence scored as negligible (score=1) for 86 (43%) interactions.

The relative Risk results were similar for rockfish and rockfish prey species but prey species had a relatively higher cumulative risk score. This difference in scoring is related to several factors, including but not limited to, rockfish prey species are often the direct target of fisheries, and some invertebrates show higher sensitivity than rockfish to disturbances such as oil and contaminants. Scoring is based on the most sensitive species within the rockfish prey SEC for each stressor and, as a result, relative Consequence is scored higher more consistently than if a single prey species had been assessed. This method of scoring resulted in higher uncertainty scores for rockfish prey than for rockfish. The amount of information available for the rockfish SEC, both for terms of relative Exposure and Consequence, far outweighed the information available for other RCA SECs. This helped to reduce uncertainty when scoring relative Consequence for some activities.

For the cumulative risk by SEC, 60 stressors impact rockfish prey, 59 stressors impact rockfish, 39 stressors impact both reef habitats. For the cumulative risk by stressor, removal of biological material (prawn and shrimp by trap) and contaminants (outfalls) had the highest Potency scores, oil (oil spill) and substrate disturbance (sediment resuspension) (crab by trap) had the 3rd and 4th highest Potency scores. The number of SECs contributing to the risk score does not correlate with the highest Potency score (50% of the top 10 stressors had 2 SECs, 50% had 4 SECs). For the cumulative risk by activity, prawn and shrimp by trap had the highest Potency. The second highest was crab by trap and the third, outfalls. Scores driven by the number of SEC-stressor combinations. E.g. crab and prawn created 14 interactions, outfalls created 8 interactions. Discharge = highest number of interactions (23) and is ranked as the 10th highest activity. Oil spill (a notable outlier) ranked 8th highest with only 4 interactions.

In summary, the highest risks to rockfish include removal of biological material (rockfish, prey species) from the two trap fisheries, prawn and shrimp by trap and crab by trap. Risk for

prawn/shrimp is around 3x higher than that for crab. Risk for prawn/shrimp is driven by moderate/high scoring of both Consequence and Exposure (moderate uncertainty). Crab is scored with low Consequence and high Exposure (fishery open year-round in some areas). Rockfish bycatch from prawn/shrimp is higher risk due to their ability to capture juvenile rockfish, while crab are generally more destructive to benthic communities because of the size and weight of traps.

Both reef habitats (rocky and sponge) have similar risk scores. Most at risk from contaminants and the establishment of AIS. Contaminants risk driven by high Exposure scores (year-round in or near 29 RCAs), but Consequence is scored as low/moderate with high uncertainty. AIS: Consequence of establishment is high, but incidents are rare.

Nine outliers identified as having more than two times the average risk score across all activities. This list of nine outliers aligns with the activities with the highest cumulative risk scores: prawn and shrimp by trap, crab by trap, outfalls, shellfish aquaculture, finfish aquaculture, Euphausiid (krill) by mid-water trawl, and oil spill.

- Removal of biological material [prawn and shrimp by trap]
- Contaminants [outfalls]
- Oil [oil spill]
- Substrate disturbance (sediment resuspension) [crab by trap]
- Introductions (aquatic invasive species) [finfish aquaculture]
- Introductions (aquatic invasive species) [shellfish aquaculture]
- Removal of biological material [smelt by gillnet]
- Removal of biological material [Euphausiid (krill) mid-water trawl]
- Contaminants [movement and storage of logs]

Discussion

There was discussion around the length of the commercial prawn season recorded (70 days). The actual season is usually less than the time length found in Appendix B of the WP and that it is unusual for a commercial prawn season to be longer than 30 to 40 days. Concern was expressed that the risk would be higher for the commercial prawn trap fishery if the 70 day long season was used in the analyses and in the risk assessment.

During the development of Appendix B, the length of the prawn season was noted as being up to 60 or 70 days long. Information on the length of the fishing activities that are permitted within RCAs was provided by DFO employees (including managers for the fisheries) and experts. For the analyses and in the risk assessment, commercial prawn log book data were used to better reflect the actual commercial prawn trapping season length and the Appendix B recorded season length was not used for analyses or in the risk assessment.

Further clarification was requested on how the fishery information in Appendix B was reviewed along with information on the experts involved in putting together the fishery information. Additionally, there were questions on if the iREC data were calibrated and used in the analyses and risk assessment. Details on the data used for the analyses and risk assessment will be discussed later in the meeting when the individual permitted activities are reviewed by the group.

Participants noted there is little discussion in the paper of FSC fishing within RCAs and dual fishing and requested additional discussion later on in the meeting on these topics. It was

pointed out that longline fishing (often the gear used for FSC fishing) as well as anchoring within RCAs would lead to bottom impacts (e.g. substrate disturbances) to the risk assessment SECs and that these are not discussed in paper. More information will be provided on FSC data deficiencies later in the meeting.

A participant provided additional information on FSC fishing and dual fishing – that these fishing activities are subject to the same monitoring requirements as commercial fisheries. As well, some of the First Nations that provide dual fishing licenses to commercial vessels do not allow fishing within RCAs. Concern was expressed that because the paper included little information on FSC fishing it implied that the First Nations are not monitoring FSC fishing or providing FSC fishing information to DFO. FSC fishing information is provided to AFS managers, but at times the data is not entered into an available database and is not accessible, but there are data. Additionally, some First Nations do not harvest groundfish and therefore have no FSC fishing data to share.

There was a discussion on why eelgrass and kelp habitats were not included in the risk assessment as these habitats are important for inshore rockfish and are found within RCAs. SeaSketch has data on eelgrass and kelp that could be used for the assessment. Not including these habitats in the risk assessment would limit the scope of the assessment and this would need to be clearly explained in the paper. Clarification was requested on the amount of eelgrass and kelp habitat identified in rockfish habitats in BC – approximately 26% of these habitats are found within RCAs according to updated habitat models.

The risk assessment relied on a literature review and previous risk assessment on PNCIMA that had been completed without the inclusion of eelgrass and kelp habitat information. To meet the deadline for this paper, there was not enough time to capture additional data (i.e. data from a literature review and spatial data) on these habitats. If an activity is included in the risk assessment with high uncertainty it will skew the assessment results and come out as being important when perhaps it should not be. These habitat types were left out of the assessment at this time because of the data limitations.

See Appendix F for a list of revisions to the WP from the December 2018 meeting.

Presentation: A regional assessment of ecological attributes in Rockfish Conservation Areas in British Columbia

Presenter: Jason Dunham

The purpose of this assessment (herein referred to as the location review) was to evaluate how effective RCAs are at achieving their conservation objective, which is to protect portions of inshore rockfish populations and their habitat. Analyses were conducted using spatial data and updated habitat models. The amount of rockfish habitat within RCAs was calculated from spatial data layers created using a combination of rocky reef (using substrate (20 m x 20 m resolution) and multi-beam (5 m x 5 m resolution) habitat models), kelp canopy, eelgrass bed, and sponge reef layers.

The research and writing of this assessment took pace from December 2017 to May 2018, and the CSAS Science Response process occurred in July 2018. As this process was related, and the completion of the documents delayed, the authors presented a summary of their findings (the Science Response is now posted, DFO Can. Sci. Advis. Sec. Sci. Resp. 2019/022).

PRESENTATIONS FROM MAY 2019 REGIONAL PEER REVIEW MEETING

Presentation: Changes to the working paper from the December 2018 RPR meeting

Presenters: Neil Ladell and Kate Thornborough

An overview of the major revisions made to the WP was presented. Nine outliers were identified as having more than two times the average risk score across all activities. This list of nine outliers aligns with the eight activities with the highest cumulative risk scores: outfalls, Crab by trap, coastal infrastructure, oil spill, Prawn and Shrimp by trap, dual-FSC groundfish (hook and line), movement and storage of logs, and finfish aquaculture.

- Outfalls [contaminants]
- Oil spill [oil]
- Coastal infrastructure [AIS]
- Dual-FSC groundfish (hook and line) [removal of biological material]
- Prawn and Shrimp by Trap [removal of biological material]
- Movement and storage of logs [contaminants]
- Crab by Trap [removal of biological material]
- Finfish aquaculture [contaminants]
- Crab by Trap [entrapment/entanglement]

At the end of the first meeting (December 2018), a table of recommended revisions to the WP was reviewed and agreed upon by meeting participants and the Authors. There was a discussion amongst the group today on if the Authors addressed all of the revisions noted in the table. Revisions to the WP were made in response to the list of recommended revisions. Some of the revisions were identified as being at the Authors' discretion and therefore, may not have taken place. Participants accepted the revisions, and additional revisions were discussed.

See Appendix F for a list of revisions to the WP from the May 2019 meeting.

GENERAL DISCUSSION

TERMS OF REFERENCE (TOR)

Discussion of TOR 1a

Some participants felt the TOR objectives were not clearly laid out in the paper. This made it challenging to understand the scope of the paper and how some sections fit in with the TOR objectives. Rather than look to change the TOR, it was suggested to add detailed information around criteria 1-4 in the WP, and to remove the conclusion that RCAs do meet these criteria.

Participants agreed that the changes and additions to the WP that described how RCAs meet OEABCM criteria 1-4 (TOR objective 1a) were satisfactory. There were general discussions under each of the OEABCM criterion sections with suggested revisions for each section, as noted below.

Criterion 1: clearly defined geographic location

The regional assessment of ecological attributes in RCAs (Location Review) recommends reviewing RCAs to potentially change the boundaries, but currently no boundaries have been

changed. Since this WP evaluates RCAs in their current state there was general consensus to not include information on the potential boundary changes to RCAs under Criterion 1 as a result of the regional assessment of ecological attributes in RCAs in BC.

Criterion 2: conservation or stock management objectives

This section includes information on RCA Goals and Objectives that was based on a literature review of documents on the RCA development and implementation processes. These documents were validated with Lynne Yamanaka (DFO), who was a significant part of RCA development and implementation.

Participants expressed concern that the objectives described in this section are the Authors' interpretation of the RCA objectives. However, these objectives have not been defined in the RCA development or implementation literature. How the information was presented in this section implied that RCAs meet OEABCM criterion 2. If no conservation or stock management objectives were defined for RCAs then this needs to be explicit in the text when describing if RCAs meet OEABCM criterion 2.

It was noted that management objectives need not come from a science paper nor were developing objectives a purpose of this WP. Literature cited in this section could be used in the future to inform development of RCAs objectives as this section provides an excellent overview of the historical context of RCA development and implementation.

An author noted that there was a rockfish conservation strategy consultation plan (2002) that was publicly circulated until at least 2005. This document listed general management objectives for then proposed Rockfish Protection Areas (RPAs), which later became RCAs. However, it was noted that the RPA objectives outlined in this document were not specific or measurable, nor did they capture later developments to RCAs that occurred during their implementation. Participants agreed that this section could state the objectives noted in this 2002 publication but to also acknowledge that these objectives need improvement.

Criterion 3 - presence of ecological components of interest

A Regional Assessment of Ecological Attributes in Rockfish Conservation Areas in British Columbia by DFO 2019 (i.e. location review) was circulated to participants weeks prior to the May 2019 meeting (originally scheduled for completion Fall 2018). This WP did not include results from the regional assessment of RCA ecological attributes to describe how RCAs meet OEABCM criterion 3.

Criterion 4: long-term duration of implementation

In the operational guidance used to assess if a conservation area meets OEABCM criterion 4, long-term is defined as a minimum of 25 years.

There was a question on if the implementation date of a conservation area is the start date of the long-term duration (e.g. 25 years). The duration of a conservation area is calculated by the year when the area was implemented. The long-term duration identified as 25 years in the operational guidelines is the minimum duration but the duration could be longer.

RCAs are assessed as an aggregate and not on an individual RCA by RCA level. Conclusions generated from the WP are limited because they are at the scale of all RCAs. These limitations should be explicitly described in the WP, along with noting that in order to determine whether RCAs meet OEABCM criteria, an assessment at the individual RCA level would be required.

Discussion of TOR 1b

There was a discussion on the applicability of evaluating RCAs relative to meeting OEABCM criterion 5 given the spatial scale that was used in the risk assessment. Information on how permitted activities impact a specific RCA is not evaluated. The risk assessment can identify, out of all of the activities considered, which ones have the highest relative potential impact. This risk assessment methodology can be used as a prioritization tool for assessing permitted activities across all RCAs. The spatial scale used was insufficient to assess on an individual RCA level.

Suggestion to include plots of exposure against consequence with error bars as these plots would visualize that the activities assessed are not actually the highest stressors in comparison to activities that are already prohibited.

The first version of the WP included scatter plots of exposure and consequence but participants identified in the December 2018 RPR that the figures were difficult to understand. The Authors ran a couple of scenarios to try and identify visually how to show the riskiness of activities but were unable to clearly demonstrate this in an informative way and so the figures were not included in the revised WP.

Discussion on changes to OEABCM criteria

There are discussions taking place to update DFO guidance on OEABCM criteria to align with updates to international OEABCM voluntary guidance. Since the WP assesses RCAs based on current DFO OEABCM guidance criteria, RCAs may need to be reassessed as OEABCMs at a later date under the updated guidance criteria.

There was a request from participants for information on the specific differences between current DFO OEABCM guidance and the updated international OEABCM criteria. Fisheries Management will circulate new international OEABCM guidelines.

RISK ASSESSMENT

Discussion on the ERAF methodology

There was a discussion on how activities identified as having the highest risk from the risk assessment are actually low risk activities to Inshore Rockfish. Since the ERAF assesses the “relative risk” of permitted activities, the assessment results place higher emphasis on the risk of these low risk activities on a relative scale. How the communication of assessment results and the identification of the “highest risk activities” occurs in the WP may misplace concern – that is, highlighting low risk activities as needing management changes when change may not be required. Since no actual thresholds are used it can make the top activities identified as having the highest risk less meaningful because their risk rating is relative. Examples mentioned are contaminants and sedimentation.

The impact of the contaminants stressor on the risk assessment SECs is mostly unknown due to data limitations but it is likely not a huge issue and is still identified as one of the highest stressors relative to those included in the assessment. Sedimentation is identified as a high stressor but this result was thought to be overemphasized because Inshore Rockfish (another SEC) are observed over sediment covered rocky reef habitat (one of the SECs, e.g. Fraser River).

Information was provided that assessment of the sedimentation stressor also looks at the community that utilizes the rocky reef habitat such as algae and sponges, which may be smothered by sediment. The activities and potential stressors are assessed for the rocky reef

SEC – looking at it as a separate component, not quantifying the impact of degraded habitat on Inshore Rockfish. However, if rocky reef habitat is a primary habitat for Inshore Rockfish and this habitat is degraded we would assume it would impact Inshore Rockfish communities.

Thresholds are not available for activities assessed in this WP. The ERAF process used for the risk assessment is qualitative and therefore, does not identify thresholds. Conclusions from this risk assessment are not supposed to suggest prevention of the highest relative risk activities from occurring within RCAs, but to flag stressors that come out as high from all the activities assessed (e.g. > 6.9 times the average across all of the activities assessed). The results from the risk assessment can be used for 1) monitoring and 2) management – providing information on the best science advice on a relative scale.

There are assumptions associated with the scores given to each of the permitted activities and for some of the permitted activities – participants felt the scores/loads given to the activities did not have enough justification. The WP needs to be clear in how the results of the ERAF are interpreted and how the results will be used. For example, the focus is on the three SECs – what is the impact of sedimentation on smothering rocky reef? If the habitat assessed is less affected by sedimentation we can assume Inshore Rockfish will also be less affected. There is a lot of scientific uncertainty due to data/knowledge limitations.

Data limitations

Concern was expressed that there are insufficient data and/or information to support input parameters used in the risk assessment. The Authors agreed with participants that if there are available data and/or information that are currently not used in the risk assessment, then these sources should be included. If the data are not used in the risk assessment, there was a suggestion to add commentary on reasons why these data were not included.

Expert consultation

More information was requested on the experts that were interviewed and how information was collected. In some cases expert opinion was used in place of quantitative data. Consequently, data were thought to be missing and a broader pool of experts should have been consulted.

Suggestion was made to cite expert opinion information as *personal communication* within the paper, and report experts who provided information or reviewed sections with details in acknowledgements.

Uniformity of stressors

Reviewers suggested providing a summary of the uniformity of stressors in different RCAs (or between North and South RCAs, or by bioregion). However, was outside the scope of work.

It was suggested to further emphasize that the spatial scale used in the risk assessment was done across all RCA's and include why it was done this way, and that future work needs to be done at the individual RCA spatial scale (to gain a better understanding of the stressors and associated risk in each RCA).

Potential vs real risk

Participants requested clarity around where risk is potential compared to assessed real risk from permitted activities (referred to as 'potential' and 'current snapshot' in the WP). Authors to clarify throughout paper where risk is potential compared with actual risk.

Spatial scale

This assessment is understood to be considering risk from permitted activities in the RCA network rather than assessing individual RCAs for the level of risk in each.

There were several requests to capture in the WP that this paper does not assess risk at the level of individual RCAs.

Concern was raised over activities being scored overly precautionary when occurring at a small spatial scale rather than throughout the entire space of an RCA (may cause over or under inflation of a high risk activity). Future work to include assessments at the individual RCA level.

Temporal scale

Request from authors for participants to provide feedback on scoring bins. It was challenging to score for fisheries for which there was limited information. Gear types were rolled up. Not a lot of information was available on FSC fishing, so focused on gear type (this is mostly applicable to commercial fishery).

Methods used were adapted from the PNCIMA ERAF application. Once scored, most things fell into two bins (relatively often or frequent) which was not useful to differentiate the activities. With so many activities that occurred in only a few RCAs, authors felt that some activities were falling into a bin that was higher than it should be. Authors to clearly state changes made from the published ERAF, and why they were made.

Request from participants for authors to use real data for temporal scale rather than potential (e.g. for the prawn trap fishery, use trap data instead of 2.5-6 month range).

Inclusion of other activities

There was some discussion around activities not related to fisheries. Anchoring was not added as a stressor on rockfish habitat.

Compliance

Concern was expressed that recreational fishers are unfairly targeted. The data used in these papers may be assuming that every vessel observed fishing within an RCA is a recreational vessel while some of the vessels could actually be an FSC fishing vessel. Preference was noted to label non-compliance fishers as “poachers” instead of “recreational” fishers.

The authors noted non-compliance is beyond the scope of the paper.

Sponge reefs

It was questioned why sponge reef habitat was included in the risk assessment but not eelgrass or kelp beds given sponge reefs make up such a small proportion of RCAs.

There is minimal spatial overlap between eelgrass, kelp forest, and sponge reef habitats. However, sponge reefs were relatively easy to include in the risk assessment because a previous risk assessment was already completed for this habitat type. Although all four habitat types (rocky reef, sponge reef, eelgrass and kelp beds) are important, the objective of the paper was to assess rocky reef habitat as it is the predominant habitat in RCAs.

It was suggested to combine prey species, rocky reef and rockfish SECs in the cumulative risk assessment but not sponge reefs. By including sponge reefs, importance of sponge reefs is emphasized when they're not necessarily in the RCAs.

Authors agreed to group together only the rockfish, prey species and rocky reef SECs in the risk assessment and report sponge reef habitat assessment separately. It was noted that it is

important to include content on all 4 habitats to ensure future assessment of these habitats was highlighted.

Eelgrass Beds and Kelp Forests

Participants expressed concern about kelp and eelgrass rockfish habitat not being included in the risk assessment. The concern was that the paper and risk assessment were missing important components if these two rockfish habitats were omitted and asked if the absence of these habitats would hamper the ability of the paper to evaluate OEABCM criteria 3 and 5.

Some participants felt that the cumulative risk scores were inaccurate and not reflective of all rockfish habitats without including eelgrass and kelp habitat types.

The authors agree that these are important habitat. However, it was not possible to add up the information to the scale of what is available for the other habitats, particularly because of the low spatial overlap of these habitats within RCAs. This would create much higher uncertainty and inflated risk scores. When the RCAs were selected, they were based on rocky reef habitat and not selected on kelp/eelgrass. There is much more rocky reef habitat than kelp or eelgrass habitat in RCAs.

The risk assessment also relied on the literature review that had already been completed and did not include kelp and eelgrass. Therefore, information was not available for these habitats and the consequences of stressors on these habitats when the risk assessment was being conducted.

If data are not available to conduct a risk assessment on kelp and eelgrass it was suggested that information be included in the paper on what data were lacking and why and the consequences of leaving these two habitats out – caveats included on the limited scope of the ERAF conducted.

There was a suggestion to use results from the PNCIMA risk assessment – perhaps there would be information from the PNCIMA assessment that could be used to incorporate kelp and eelgrass into this assessment. The Authors looked at stressors between the work done for PNCIMA and this assessment and PNCIMA looked at consequence scores for 20-24 stressors out of 94 that this paper looked at.

If RCAs will be assessed individually in the future, it is important to include a risk assessment on eelgrass and kelp habitats at that point to capture effects of stressors for these habitat types and because these habitats are important for rockfish.

The authors referred back to the OEABCM guidelines, in order to assess criterion 5, only one habitat needs to be assessed. RCAs were established based on rocky reefs on purpose. Information was additionally provided in the WP on eelgrass and kelp, and the previously-assessed sponge reefs, but these are in addition to what is required.

There was support for leaving kelp and eelgrass habitats out, with clarity in the WP that if this document will be used for selection of which RCAs are going to be assessed individually, it needs to include these other habitats at that stage. However, the authors agreed to provide eelgrass and kelp habitat maps.

May 2019 peer review meeting – Discussion on Scoring

Prey were included as a SEC to provide information and guidance about the potential impact to prey from activities permitted within RCAs. The risk score for prey is inflated because it is scored based on the most sensitive species. Having Inshore Rockfish prey species as a SEC helps identify what we should look at and if there are potential impacts for prey species “as a whole”. The risk assessment does not look at the proportion of prey species that Inshore

Rockfish eat but if Inshore Rockfish prey species are impacted by activities permitted within RCAs. This highlights potential secondary impacts on Inshore Rockfish.

There were questions on the commercial crab by trap and commercial prawn fishing consequence scores. In the risk assessment, the scoring of crab by trap bycatch was higher than the prawn by trap bycatch, but this is not what the data show (in Appendix B in WP). A review of the scoring for these two fisheries was requested as there was concern that the risk assessment results are inconsistent with the actual reality of the fisheries bycatch data.

Both commercial crab by trap and commercial prawn fishing remove rockfish as bycatch. The data show the prawn fishery has higher rockfish bycatch than crab by trap bycatch, but the prawn bycatch consists mostly of juvenile rockfish. The impact of removing juvenile rockfish, when taking natural mortality into account, is less significant than the removal of adult rockfish, decreasing the prawn score. Crab by trap rockfish bycatch consists of adult rockfish (i.e. greater impact to the Inshore Rockfish SEC than juvenile rockfish) in addition crab bycatch data is limited and both the greater impact of adult rockfish bycatch and this uncertainty leads to an increase in the crab impact score. For these reasons, commercial crab by trap and commercial prawn fishing have the same consequence scores.

It was demonstrated using the available data in Appendix B that rockfish bycatch in the crab by trap and prawn by trap are orders of magnitude different with the prawn by trap fishery catching many more rockfish than the crab by trap fishery. Taking this information into account, there was a suggestion to decrease the consequence score for crab by trap – removal of biological material or increase the consequence score for prawn by trap – removal of biological material.

Crab by trap bycatch monitoring is conducted by the service provider which is usually a contract biologist. To sample the crab traps for bycatch, the contract biologist will request five traps and look at what is in the traps. There are many data gaps on crab by trap bycatch that are not yet understood. Agreement that there is uncertainty in how much Inshore Rockfish is removed as bycatch in the crab by trap fishery especially considering how biased the bycatch monitoring is.

Discussion that expertise on rockfish biology can be used to justify a lower or higher consequence score but the context of the scoring should not be considered in comparison to other fisheries.

The consequence score for crab by trap – removal of biological material could be lowered but the uncertainty score should then increase, which leads to the same final score. The scores should reflect what is appropriate for both consequence and uncertainty and not just the final score. Currently there is no rockfish bycatch monitoring program for the crab by trap fishery. If the uncertainty and lack of data are highlighted for this fishery for the removal of biological material, it could be the impetus needed to start a crab by trap bycatch monitoring program.

There was a discussion on how *Load* is scored for the exposure of a SEC to a stressor. *Load* was scored separately for each SEC and therefore needed to be standardized to activity and stressor. This allowed for consistency across activities, but caused for the *Load* score to be at a relative scale. Scoring of *Load* did not provide absolute values on if a stressor is more dense or persistent.

Discussed revisions

Authors will look into crab by trap, and prawn by trap scoring. Participants suggested to describe how the ERAF risk assessment methodology was changed for this risk assessment and to provide information on the limitations of the risk assessment (e.g. useful tool for relative comparison among stressors but is unable to compare absolute values). This again highlights

the WP needs to be explicit in the information on what the scores do and do not provide in regards to conservation measures.

Authors will have to look into relative differences and consequences. For example, crab by trap has lower scores and this is because the mesh size of crab traps is larger so smaller Inshore Rockfish prey are less impacted. Participants brought up that mesh size also influences the fish bycatch caught in traps – fish caught in crab traps are smaller and more likely to be juveniles and are the fishes eaten by Inshore Rockfish. Prawn traps with smaller mesh size would catch smaller shrimps, which are Inshore Rockfish prey.

Herring are a significant prey of Inshore Rockfish but the herring fishery by gillnet does not have a high consequence score. Provide more context in justification on the herring fishery – the fishery focuses on adult herring but adult herring are not eaten as much by rockfish (prey more on juveniles). The consequence score is specific to the SEC so you have to consider prey size eaten by rockfish.

Participant noted that the Inshore Rockfish species have very different diets, e.g. pelagic rockfish versus benthic rockfish. Additionally, Inshore Rockfish experience barotrauma differently so much of the diet information we have is species specific.

The uncertainty score for prawn and shrimp trapping at a minimum was a 2. This score had less to do with information on the prey leaving the traps but was because of the unpredictability in trap loss. Little information is available on the number of traps lost or on the density of traps in a particular area and the score given highlights this uncertainty.

The Authors looked into the removal of biological material scoring for prawn, crab and herring fisheries and it came down to the size of the target being removed by the specific fishery – whether it was rockfish prey or not. The herring caught are generally too large, same for crab and some rockfish species eat prawn so that is why there is a moderate effort of removal of biological materials for prawn and shrimp by trap.

Authors to provide a link to the R code which is published on an accessible open government site and to separate out scoring for recreational, commercial sectors and FSC.

Further information was provided on the two types of data collected for vessels that run under a dual fishing license (groundfish hook and line, and FSC). For commercial fishing, there are spatial data available on vessel track lines (even if these data are not usually provided to DFO), identifying where every set occurs and the log books provide information on what was caught during each set. There are monitoring data also provided through the dock side monitoring program, but these monitoring data do not always provide specific information on where the fish were caught.

All available fish monitoring data from vessels that run under the dual fishing license (groundfish hook and line, and FSC) were used in the paper. The start and end positions and log book data for these were included in this paper, but the track line data held by Archipelago Marine Research were not available to DFO.

Provide clarity on no matter the spatial scale of the stressor, if it occurs in RCAs as a whole, it is considered as having an effect in this assessment. Also, provide clarity around the potential of over-inflating or under-inflating risk due to uncertainties/limitations of the data.

CONCLUSIONS

ACCEPTANCE OF WORKING PAPER

At the December 2018 meeting, there was support among participants for accepting the paper with major revisions, and holding a second meeting after the agreed-upon revisions to the paper have been made. The meeting Chair stated that the paper is provisionally accepted with major revisions. Authors will revise and a meeting will be scheduled when the revised WP is ready for circulation. Participants will be given as much advance notice as possible (4 weeks). The Location Review documents will be circulated at the same time. Development of the SAR is deferred until the second meeting.

At the May 2019 meeting, the WP was accepted with minor revisions. However, before the meeting concluded, participants requested the table of revisions (Appendix F) be updated and circulated to record the changes. Consensus was reached that the participants did not need to review the WP again.

DISCUSSION ON SAR

Participants noted it is important for the Recommendations to be explicit if and how RCAs meet OEABCM criterion 1 – 4 (relating back to the TOR objective of “if and how”). If unable to assess that RCAs meet the OEABCM criteria then include in the document that the assessment was unable to meet the TOR objectives and that further work is needed.

Criterion 1

Criterion is met.

Criterion 2

The OEABCM guidance document does not provide details of what is required for objectives in order to meet OEABCM criterion 2.

RCAs meet criterion 2 because of the objectives noted in the 2002 paper but include language around work needed to update RCA objectives based upon changes in RCA development since the 2002 paper.

Criterion 3

Criterion is met.

Criterion 4

Currently, there is no legislation, policy or documentation that indicates RCAs meet OEABCM criterion 4 (long-term duration of implementation). Long-term intent of protection needs to take into consideration the biological characteristics of species the area is to protect. However, in the OEABCM guidance the biological consideration is not explicit.

General consensus of the group determined RCAs do not meet criterion 4. Suggestion to include language used in OEABCM guidance document in summary point (e.g. minimum of 25 years, entrenched in legislation or regulation).

Criterion 5

Include information on how assessment provides information on cumulative risk across all RCAs and does not provide risk on the individual RCAs. The WP currently identifies that further research is needed across all RCAs and at the individual RCA level.

Authors said that they could include more specific language regarding the results such as these eight activities had more than 2 times the average risk score. Authors felt it was important to capture that the risk assessment examined relative risk collectively across all RCAs as that was the spatial scale and objective of the risk assessment. Results from this risk assessment do not mean that there are individual RCAs that may be at greater or less risk due to certain activities taking place within the individual RCAs.

Participant noted that the risk assessment examined *legal* activities so it is important to note this as it does not address *illegal* activities, even though they are a concern.

The WP suggests that we need additional research and/or management actions on the eight activities to look into realized risk but activities would not necessarily be prohibited.

ACKNOWLEDGEMENTS

We appreciate the time contributed to the RPR process by all participants. In particular, we thank the reviewers, Rebecca Martone, Dana Haggarty, Sarah Dudas, and Sharon Jeffrey for time and expertise. We would also like to thank the Chair, Lisa Settington, and the Rapporteurs, Elise Keppel and Lily Burke for their thorough note-taking.

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APPENDIX A. TERMS OF REFERENCE

Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas in British Columbia

Regional Peer Review Process – Pacific Region

December 12-14, 2018 and May 2-3, 2019
Nanaimo, British Columbia

Chairperson: Lisa Setterington

Context

In 2010, the Government of Canada agreed to conserve at least 10 percent of Canada's coastal and marine areas through protected areas and other effective area-based conservation measures by 2020 (United Nations Convention on Biological Diversity Aichi Target 11). Since then, Canada has reaffirmed this international commitment for Canada. In 2016, the Minister of Fisheries and Oceans Canada announced a plan to reach our domestic marine conservation targets (MCTs) of protecting five percent of Canada's marine and coastal areas by 2017 and ten percent by 2020. As of December 2017, Canada exceeded the interim target set for 2017, bringing the total ocean territory under protection to 7.75 percent. Five areas of action that will support reaching Canada's marine conservation targets have been laid out, one of which is the advancement of "other effective area based conservation measures" (OEABCM) by identifying existing OEABCMs and by establishing new ones".

Operational Guidance for Identifying 'Other Effective Area-Based Conservation Measures' in Canada's Marine Environment (DFO 2016a) has been developed to ensure that a "consistent and science-based approach to identifying and reporting on marine OEABCMs that contribute to Canada's international and domestic marine conservation targets" is used. The guidance has been informed by international direction (International Union for Conservation of Nature and Convention on Biological Diversity) and domestic discussions and DFO science advice (Canadian Council of Ecological Areas; DFO 2016b), and identifies five criteria that area-based management measures must meet in order to be considered as OEABCMs:

1. Clearly defined geographic location
2. Presence of ecological components of interest
3. Conservation or stock management objectives
4. Long-term duration of implementation
5. The ecological components of interest (the important habitat and species identified earlier) are effectively conserved

In the Pacific Region, 164 Rockfish Conservation Areas (RCAs), totaling approximately 4,800 km², were established between 2003 and 2007 to protect inshore rockfish populations from fishing activity (achieve near zero fishing mortality in these areas) to ensure stocks have the opportunity to rebuild. In addition, RCAs are intended to protect rockfish habitat from impacts of fishing activities. In 2016, a preliminary review of RCAs was conducted to evaluate RCAs against OEABCM criteria; however, limited time and data were available and a formal risk assessment was not completed. Consequently, RCAs were initially screened out of the OEABCM process and therefore did not contribute to the 2017 MCTs of five percent protection. Nevertheless, RCAs have the potential to contribute to the 2020 MCTs of ten percent protection if they can meet all OEABCM criteria.

DFO's Resource Management (Sustainable Fisheries Framework unit), in collaboration with Science Branch, is conducting a risk assessment to identify any permitted human activities that do not allow RCAs to meet all OEABCM criteria and achieve their conservation objectives. The assessment and advice arising from this Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR) process will be used to help guide fisheries managers in determining whether further management measures in RCAs should be considered to allow RCAs to achieve their conservation objectives and contribute to the 2020 MCTs.

This RPR will be informed by advice from a recent CSAS Science Response process (DFO 2018) which evaluated select ecological attributes in RCAs to help determine RCAs' conservation value to rockfish and their habitats. RCAs were identified that could be high priority for inclusion in MCTs or might benefit from further review of their configurations or locations to improve their conservation value to rockfish.

Objective

The following working paper will be reviewed and provide the basis for discussion and advice on the specific objectives outlined below:

Lancaster D, Thornborough K, Dunham JS, Yu F, Deleys N, Ladell N, Yamanaka L. 2018. *Risk assessment of permitted human activities in Rockfish Conservation Areas in British Columbia*. CSAP Working Paper 2017SFF02b.

The specific objectives of this review are to:

1. Identify current RCA management measures (i.e., permitted human activities) that may inhibit RCAs from fulfilling their conservation objectives by not meeting particular OEABCM criteria:
 - a. Identify if and how RCAs meet OEABCM criteria #1 through 4
 - b. Conduct a risk assessment of activities in relation to OEABCM criteria #5.
2. Identify knowledge and data gaps, and uncertainties in the method that may contribute to inconclusive results.

Expected Publications

- Research Document
- Science Advisory Report
- Proceedings

Expected Participation

- Fisheries and Oceans Canada (Science, Resource Management)
- Province of BC
- Non-Government Organizations
- First Nations
- Fishing sectors (Commercial, Recreational)

References

- DFO. 2018. A regional assessment of ecological attributes in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Sci. Rep. In prep.
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- Dunham JS, Yu F, Haggarty D, Deleys N, Yamanaka L. 2018. A regional assessment of ecological attributes in Rockfish Conservation Areas in British Columbia. DFO Can. Sci. Advis. Sec. Res. Doc. In prep.

APPENDIX B. WORKING PAPER REVIEWS

REVIEWERS: SARAH DUDAS (AQUATIC SCIENCE BIOLOGIST III, DFO), SHARON JEFFERY (AQUATIC BIOLOGIST II, DFO)

We will begin this review by congratulating the authors on presenting a clear, concise and well written paper that was a pleasure to read. We also want to acknowledge the amount of work that has gone into the preparation of this risk assessment- pulling together enough information to score so many variables and assess uncertainty is not an easy task.

We have each provided more specific comments documented as tracked changes in two separate copies of the RCA risk assessment, along with comments on the scoring justification table. A lot of our comments are suggestions to improve the readability of the paper for those without a background in risk assessments (particularly the ERAF process), and to reduce the reliance on the Murray et al. 2016 paper that is cited as a reference document. Below we have summarized our general comments related to the Res Doc objectives.

General comments

1. Objectives from the TOR were not explicitly stated in the document. We think that they should be explicitly laid out in a numbered list, and that the structure of the document should be laid out to address them. This is not currently the case. The objectives stated in the abstract should be consistent with those stated in the TOR and the introduction. Additionally, the organization of the document is a little confusing, where the risk assessment figures first, complete with a discussion and conclusions, followed by 2 other main document headings. It seems odd to have a conclusion and summary in the middle of a document and we feel like section 5 and 6 should have preceded them. We would recommend presenting conclusions and a summary for the entire paper, after all of the material has been presented. This would provide a more logical flow for the information and wouldn't leave the reader feeling like the document should be coming to an end at section 4.5, when in reality there is still half the document left. Further Appendix B represents the bulk of the data analysis and should be included within the body of the document rather than as an appendix.
2. Kelp and eelgrass habitats are highly important habitats for rockfishes, and their exclusion from this analysis was not sufficiently justified, in our opinion. Given that there were only 6 SECs identified initially, omitting 2 from the analysis is significant and a justification for that should have figured more prominently in the methods. Additionally, it should have figured more prominently in the discussion since some activities/stressors that might be impacting eelgrass and kelp will not be highlighted now. It is not completely clear to us why they could not be included, however. This might warrant a discussion at the CSAS meeting. Given that the activity/stressor interaction matrix is scored based on a literature review, there should have been sufficient information about the effects of each stressor on eelgrass and kelp in the literature (both habitats were scored in Murray et al. 2016 for PNCIMA); when scoring stressors for exposure, the SECs were rolled up and not scored individually, so it would seem possible to have included eelgrass and kelp at that step. Perhaps a more thorough explanation of the problem with an example would be worthwhile to help justify for the reader why these important habitats were not included. If they are not included in the paper, their omission and the consequences should definitely be discussed more thoroughly in the discussion section
3. It is important to know what the justifications for the exposure scores are in order to understand the ERAF, so we were happy to receive Appendix D as an addendum and think that it should be included in the paper. We also think that the methods need to be more

detailed to make them more understandable to the average reader- see details within the Word document- especially to do with the incorporation of uncertainty into the risk score, which we found very difficult to comprehend (even after referencing Murray et al. 2016).

4. It is not clear if the scores have been made assuming ALL RCAs are exposed to all SECS and stressors or if they represent an average or 'representative' RCA (and if so, how the 'representative' conditions were determined). Appendix D provided some insight, but the paper would benefit from a clear description of the assumptions made prior to conducting the scoring.
5. The TOR objective of identifying uncertainties, knowledge and data gaps seems to be well integrated throughout the document, but it would be more informative to see the major gaps summarized at the end of the document since this was a major objective for the paper. Further, these will be very useful for directing future research efforts and to identify the limitations to interpreting and applying the results.
6. Several of the scores for the reef habitats in the activity/stressor-SEC interaction matrix are scored as zero when it seems that they should be scored as one. These are highlighted as comments in the review by SJ and were all for the substrate disturbance stressors (e.g. rocky reefs- Movement and storage of logs/ Substrate disturbance (sediment resuspension)). Our worry with these zeros is that it will reduce the cumulative risk scores for these SECs because they will have less associated stressors totaled into their cumulative scores.
7. Introductions (aquatic invasive species) were identified as an important stressor, however this term is not defined until Appendix D. It appears the reference to introductions is only to those that are unintentional but this is not stated. After reviewing Appendix D it appears that only invasive (i.e. species that demonstrate ecological harm) are being considered but it is unclear how a species 'invasiveness' is assessed or if all non-indigenous species are assumed to be 'invasive'. This definition is important as it will influence how species are scored and what species may be considered, particularly given the results from this risk assessment, which highlight aquaculture as being a high risk activity because of their association with AIS. Further, sea lice are considered AIS because they fit the given definition but it is unclear if other native 'invasive' species were considered (including other parasites and pathogens).
8. One addition to this paper that would be informative to management (and for the development of monitoring plans) is a summary of the uniformity of stressors in different RCAs. All of this information is contained in Appendix B, categorized by human activity, but it would be useful to group it and summarize it by RCA. Doing so would show which RCAs have the most human activity in them and how this varies geographically. In the recommendations, the authors suggest different approaches depending on whether the goal is for a particular RCA to meet OEABCM criteria or for all of them to meet the criteria. Understanding (and being able to easily see) how different stressors affect particular RCAs would provide useful information for assessing which approach is more feasible.
9. Overall there needs to be a clear statement of the limitations of the data and where the assessment of risk may be compromised by the lack of knowledge (e.g. such as the assessment of outfalls). It is unclear what level of uncertainty is high enough to prohibit the assessment of risk in a meaningful way. This is important not only for knowing the limits of what can be said but also for identifying data gaps and directing future research efforts.

REVIEWER: REBECCA MARTONE (MARINE BIOLOGIST, MINISTRY OF FORESTS, LANDS, NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT)

Thank you for the opportunity to review this paper. The authors have presented a comprehensive risk assessment of permitted activities in RCAs to determine whether the permitted activities may limit the ability of the RCAs to meet their conservation objectives. This is a comprehensive analysis, the paper is well written and the authors have done a good job tracking and explaining their assumptions, decisions and analysis. However, I have some suggestions to improve clarity on the scope of the paper and the key objective(s), as well as some questions and suggestions about the methods and results and interpretation of the outcomes. I have organized my review around a set of key issues outlined below:

- Clarity of the objectives and scope of the document
- Methods
 - Spatial scale of the assessment
 - SECs – lack of key habitats
 - Risk from restricted activities
 - Precautionary scoring and Uncertainty
- Results
 - Figures
 - Appendix B
 - Justifications and scoring in the table
 - Median risk
 - Sedimentation stressors
- Discussion
- Section 5
- Section 6
- Section 7

Clarity of objectives and scope of the assessment

The introduction of the paper suggests that the assessment will determine whether the RCAs meet all OEABCM criteria. The primary objectives of this paper listed in the TOR are to (1) identify current RCA management measures (i.e. permitted human activities) that may inhibit RCAs from fulfilling their conservation objectives by not meeting particular OEABCM criteria. While the TOR goes on to say that the objective will be to identify if and how RCAs meet OEABCM criteria 1 through 4, the risk assessment and assessment of compliance with existing management measures are the primary focus of the paper. I suggest that this be better described in the Introduction, with a particular emphasis on why risk assessment is a tool selected to determine if OEABCM criterion 5 is met. In addition, acknowledgement of the second objective listed in the TOR (2. Identify knowledge and data gaps, and uncertainties in the method that may contribute to inconclusive results) also is warranted. I suggest the authors reduce the scope of this document, and focus on the OEABCM Criterion 5, in particular because the other criteria are out of scope, either because they are being addressed elsewhere (DFO 2019) or because the criterion is not sufficiently addressed by this analysis (e.g., Criterion 4) – (see my notes in the discussion section on this). I suggest that either the authors remove the sections on the other criteria, the information be more clearly presented as background to this

document, or the information be better linked to the objectives to the paper. Recommendations on whether the RCAs are meeting the other criteria are not appropriately scoped here.

Furthermore, the way the document is currently structured, Section 2.3 seems out of place and not relevant. Either the authors should remove it from the paper, or make it clearer how it ties into the objectives of the paper. With regards to this, because the assessment is selects other habitats and features as SECs to evaluate the OEABCM criterion, perhaps this information can be moved into the methods section or as an appendix. Importantly, the other features should be mentioned and mapped where possible. Alternatively, this information could be removed.

Methods

Using the Level 1 risk assessment is reasonable for assessing whether the RCAs are meeting their intended conservation objectives, but as I mentioned before, the use of it for the intended purpose should be better described and justified. In particular, there are very little data from the RCAs (which would be one way to assess whether they are meeting their objectives) and they haven't been in place long in relation to the life history of the species they are trying to conserve. Thus, the risk assessment approach is one way to determine which key activities may limit the RCAs meeting their objectives.

The authors applied this method at the spatial scale of all 164 RCAs together. While this may be reasonable, the authors need to justify why this is reasonable, and better describe their assumptions and limitations. In particular, not all RCAs may have all of the human activities that are being assessed nor encompass all SECs within their boundaries. Thus, some RCAs may be "doing better" than others at meeting Criterion 5. If the purpose is to assess all RCAs together due to management constraints, that should be more clearly described. Despite this, I think the approach is described well and the authors clearly document their scoring methodology.

Another key challenge with the methods is that the assessment is only done for some of the SECs (forage species, rocky reef habitats, and glass sponge reefs). Given that kelp and eelgrass are key habitats for rockfish, this is a major limitation of interpreting the results of the assessment. The authors say that the reason they do not assess eelgrass and kelp is that there was not enough data to support an analysis of the overlap of eelgrass and kelp in the RCAs. However, this analysis was done for the location review (DFO 2019) and as such, could be used in this assessment. Furthermore, the assessment of forage species and rockfish species was done without spatial overlap data. Finally, other datasets, such as the sponge reef data, are very limited and thus highly uncertain. The assessment says that only 0.16% of the rockfish conservation areas contain sponge reef habitat type. Thus, I think the authors must do the assessment for kelp and eelgrass.

Furthermore, although he authors say that the Exposure scoring was assisted by an analysis of the habitat types found in RCAs and the proportion of RCAs containing each habitat type, it is not clear how this was done. If only 0.16% of the RCA areas cover sponge reef, then I would expect that the sedimentation stressors scores would be much lower. Related to this, Table 6 has some surprising outcomes – is it correct to interpret that 74% of the area within RCAs contain soft sediment/cobble/gravel habitats (obviously with some uncertainty)? This seems very surprising and in itself suggests that the RCAs are not likely to meet their conservation objectives, regardless of what human activities occur within their boundaries. More discussion of this is warranted.

The human activities and associated stressors section is well described and I think relatively comprehensive. However, there are a few activities that could be assessed in addition to these activities including (a) kelp harvest (if you include kelp as an activity); and (b) illegal fishing activities. The authors do try to assess illegal fishing in section 6, which is ok but they should

describe better why these activities were not chosen to be included in the risk assessment portion of the document. In addition, the authors chose to ignore the potential impacts of activities from outside of the RCAs applied with a buffer (e.g., sedimentation can occur from outside of the RCA boundaries; land-based nutrient inputs). I think a better justification is warranted.

The assessment of gear type using a single fishery, even when multiple fisheries are used (page 18) is ok but again the potential outcome on the results should be better addressed in the discussion.

The authors use a precautionary approach to scoring, where the higher the uncertainty, the higher the score. This is likely inflating risk scores. For example, if existing infrastructure is considered to have a minor consequence on rocky reef ecosystems but the scoring is precautionary and then uncertainty is moderate-high, this will mean that the standard deviation from which the score is selected will include very high scores, when the precautionary measure is already in place. Alternatively, the authors could select the score that is suggested by the literature (i.e. rocky reef organisms will be impacted but not likely in a large area so the consequence might be negligible but the uncertainty would be high). Regardless, the authors assumptions should be better justified and explained in the methods and the potential outcomes on the results and interpretation of the results should be more clearly discussed.

Results

Appendix B is well written and I like that the authors clearly lay out what information they have. However, it isn't clear how the types of information are used for scoring. It might be helpful to have an introductory portion of the Appendix or somewhere in the document that lays out how scoring was generally done for different types of activities. For example, was the effort data used to inform Load of biomass removal stressors? What about log book data on gear loss? Clarity would be very helpful, otherwise the reader is forced to guess, even when looking at the tables.

The results section is well organized and presented although I have a few suggestions for improvements, particularly with regards to the figures. Specifically, in Figures 3 and 5 while the authors have separated out the activities using the dotted lines, it is still hard to link the different stressors to the different activities to the different risk scores. I made a few suggestions in the document including bolding the name of the activities in the legend; using colours to highlight the same stressor type within different activities OR different activities within the same stressor type, depending on how the figures are organized. Figures 4 and 6 would then follow to use the same colour scheme (or shapes as an option). I like the reporting of cumulative risk by SEC, by stressor (Potency) and by activity. However, I don't think the 10/90% quantiles for cumulative risk by activity was clearly described. The approach should be the same as for potency (individual scores from the n=100 runs is summed across all SEC-stressor interactions for that activity).

The Table with the final scores of exposure and consequence and their justification is well organized. It would be good to include how and where uncertainty is addressed in some introductory material up front. The authors need to check that the scores in the justification section match the scores in the table. I found several discrepancies, particularly in the uncertainty scoring. Also, was the N+1 scoring used for uncertainty if there was both lack of information and lack of scientific consensus? It was described in the document but not clear if it was used anywhere in the scoring.

The authors appropriately report median risk scores for overall Risk, as well as the individual Exposure and Consequence scores, and report the 10/90% quantiles throughout the results

section. However, the median risk scores are often falling outside the 10/90% quantiles of the assessment. This suggests that something may be wrong with the code. Median risk is by definition supposed to be the 50% quantile. The authors need to check that their results are right, particularly, for the rocky reef and glass sponge reef scoring. Furthermore, the median risk scores for Rockfish prey species seem to be somewhat inflated. For example, if you multiply the median scores for exposure and consequence together for Prawn and shrimp trapping_Entrapment/entanglement, the score would be 55.97. Why is the median risk score coming out as 132.67? Could this be due to a coding error or is it driven by high uncertainty? Check the median scores for Table 11 as well.

Sedimentation stressors seem to be very high compared to other stressors, especially given that rockfish tend to prefer rocky reef habitats. This is likely due to (a) the RCAs not being placed in rocky reef habitat, and (b) higher uncertainty and thus precautionary scoring. The authors need to clearly explain in the results and discussion how uncertainty may emphasize some stressors over others, particularly if the assessment will help prioritize which activities and stressors will need to be addressed to improve management of RCAs.

It is interesting that the highest cumulative risk from a given activity across SECs and stressors is not always the activity with the highest number of SEC-stressor interactions.

Discussion

This section could be better organized.

The authors need to be more explicit in the discussion on how uncertainty and precautionary scoring may inflate risk scores for some stressors and that this influences the results and the interpretation of the results. In addition, the issue that much of the habitat within the RCAs is not rocky reef habitat or glass sponges (or kelp/eelgrass) and how this may interact with some of the scoring (e.g. sedimentation stressors).

The section on selection of SECs needs to be more fulsome and describe the major limitation of kelp/eelgrass not being in the assessment. Better yet, the assessment should include kelp and eelgrass.

The discussion section needs to include more about how the spatial scale of the assessment influences the interpretation of the risk assessment results. If all RCAs were assessed separately, there might be different outcomes for each.

The final bullet in the conclusions section could be brought up into a final paragraph in the discussion section.

Section 5

I think it would be better to have Section 5 integrated into the Discussion section. It seems like this is the key objective of the paper and this section is basically repeating the results/discussion. In fact, the final paragraph in this section is really the crux of the whole thing.

Section 6

How is this information being used towards the objective of the paper? Is this information going to inform whether Criterion 5 is being met? It should. Where analysis has been done, it seems like where RCAs have had low compliance they should not be considered as meeting OEABCM criterion 5.

Section 7

This section is key and should be used to help inform the introduction of the paper.

First, I would remove the recommendation regarding OEABCM criterion 4 from the assessment. Either the authors need to have a more robust and clearer description of how they assessed long-term duration or drop it from the assessment. I recommend dropping it since this is a policy issue and not a scientific one, unless the authors include science-based specific recommendations around the length of time the RCAs would need to be closed to be considered long-term duration in relation to rockfish biology/life history and our understanding of the effectiveness of spatial closures on rockfish from other areas.

Point 2-8 are the crux of this paper. They explain what needs to be done with the information that is presented here. Because of the way this is organized, I suggest that Section 5 be integrated into the discussion section of Section 4 and Section 6 be better introduced up front and how the approaches used will help inform the objectives of the paper alongside the risk assessment.

REVIEWER: DANA HAGGARTY (INSHORE ROCKFISH AND LINGCOD PROGRAM HEAD, DFO)

A large amount of material is covered in this work. However, I found that it was very disjointed and difficult to follow and that it would benefit from a good re-organization. At the moment, it reads like three separate topics that are not even united by an overall discussion.

Understanding and evaluating the appropriateness of the risk assessment scoring is contingent on carefully reading the information in Appendix B. I think that much of Appendix B should be presented in the body of the paper before the risk assessment in order to give context to the risk assessment. I see great value in the presentation of the rockfish bycatch rates as well as the impacts on rockfish prey but in order to understand the relative importance of the various stressors, one needs to read the appendices. Once these data are presented and understood, the next logical step would be to evaluate their relative importance to the effectiveness of the RCAs.

I often struggle with the ERAF framework as I find it to be overly complicated. I also think that too many stressors, and subcomponents of stressors are scoped into them. For instance, we have no information about the effects of hypothetical species introductions from various fishing gear on rockfish. There are no documented cases and no examples of this having occurred (that are presented). Furthermore, it's an assumption that these would be negative and not positive effects on rockfish (despite the fact that they are generalist predators who might choose to eat a hypothetical introduced species). Instead of acknowledging that we don't know anything about this, they are included in numerous parts of the risk assessment. Doing so complicates the whole analysis and makes it difficult to communicate and evaluate. For instance, I found that Figures 3-6 are not useful because the authors try to present too much information in them. If these figures were limited to a reasonable set of stressors, they would be much more meaningful. I recommend not providing information (or perhaps moving this information into an appendix) on these much less certain, hypothetical risks.

The overall objective of the risk assessment, according to the TOR is to: "Conduct a risk assessment of activities in relation to OEABCM criteria 5". Criteria number 5 is: "The ecological components of interest (the important habitat and species identified earlier) are effectively conserved."

Nowhere in criteria 5 does it specify that the effectiveness needs to be related to activities that are permitted or not permitted. Therefore, I fail to understand how the risk assessment about the

effectiveness of the RCAs became limited to the inclusion of “permitted” activities. Although the question of recreational non-compliance that I and colleagues have studied and published on (Lancaster et al. 2015, Frid et al. 2016, Haggarty et al. 2016, Lancaster et al. 2017) are acknowledged in section 6, not including it in the risk assessment itself diminishes the threats that this activity poses to the effectiveness of the RCAs.

In my 2016 analysis of recreational compliance in RCAs in BC’s South Coast we estimated that up to 10% of the recreational fishing effort in a PFMA may be taken out of RCAs (See Figure 3 in the Supplement of Haggarty et al 2016 and reproduced below.) This relates to between 0 and 700 fish (in 2011) from RCAs by PFMA, with a total estimate of 1646 fish that were directly removed from the RCAs in 2011. This is also, likely an underestimate given that RCAs likely contain rockfish habitat so the chance of catching a rockfish in an RCA should be higher than it is just by proportion to anywhere else in the PFMA (i.e. I did not correct this estimate for habitat). By comparison, if we were to compare this to the estimate of rockfish that may have been caught as bycatch in the prawn fishery in 2011, 5,442 (I calculated this estimate using the coastal bycatch estimate (Table 19) divided by the % strings fished in RCAs in Table 18). Although this number is higher than the estimate of fish caught recreationally in RCAs, it is for the whole coast, rather than just the S. Coast, and also represents juvenile fish, rather than adults and sub-adults that are prone to hook and line gear. Given the uneven natural mortality rates of juvenile to adult rockfishes, removing adult fish from the population is often more important than removing juvenile fish.

I do not point this out to minimize the threats to rockfish and their prey from prawn fishing that are communicated in this report, but instead, I compare recreational non-compliance to it to show how much of an oversight this is. I recommend that recreational non-compliance should be included in the risk assessment, rather than including it in a separate, disjointed section. Similarly, FSC fishing should also be included in the risk assessment. A more specific comment about the risk assessment is confusion that is introduced by the terminology “removal of biological material” with respect to the bycatch of rockfish because the catch of rockfish prey that is also scored is also the “removal of biological material.” Can this be cleared up by using “bycatch?”

The material presented in the addendum tables that I just received helps immensely to clarify the justifications used in the scoring. Although I only had time to do a cursory review, I think this information should be included in the paper, perhaps in a condensed form as per my comment above. The justifications for the scores do, however, I think need to be revised in some cases. For instance, the exposure scoring shown in Appendix D lists the load score for bycatch in the prawn/shrimp fishery equal to that in the crab fishery as well as handpicking of invertebrates (I’ve never heard of a fish being hand-picked and spear fishing is prohibited) etc.

I also think that threat of re-suspension of sediments from crab trapping on rocky reefs, must be revisited because it doesn’t make any logical sense to me. If the trapping is on rocks, it could cause crushing (a separate stressor) but not sedimentation. If trapping is on sediment, it’s not on a rocky reef. Is a dispersal field assumed? Is this necessarily a negative impact on a rocky reef? This report also needs to acknowledge that Dungeness Crabs and rockfish do not occupy the same habitat. Therefore, I think that threats to rockfish habitat from the crab fishery are overstated. The bycatch score, given the data presented, should also be revisited, granted a large uncertainty is reasonable.

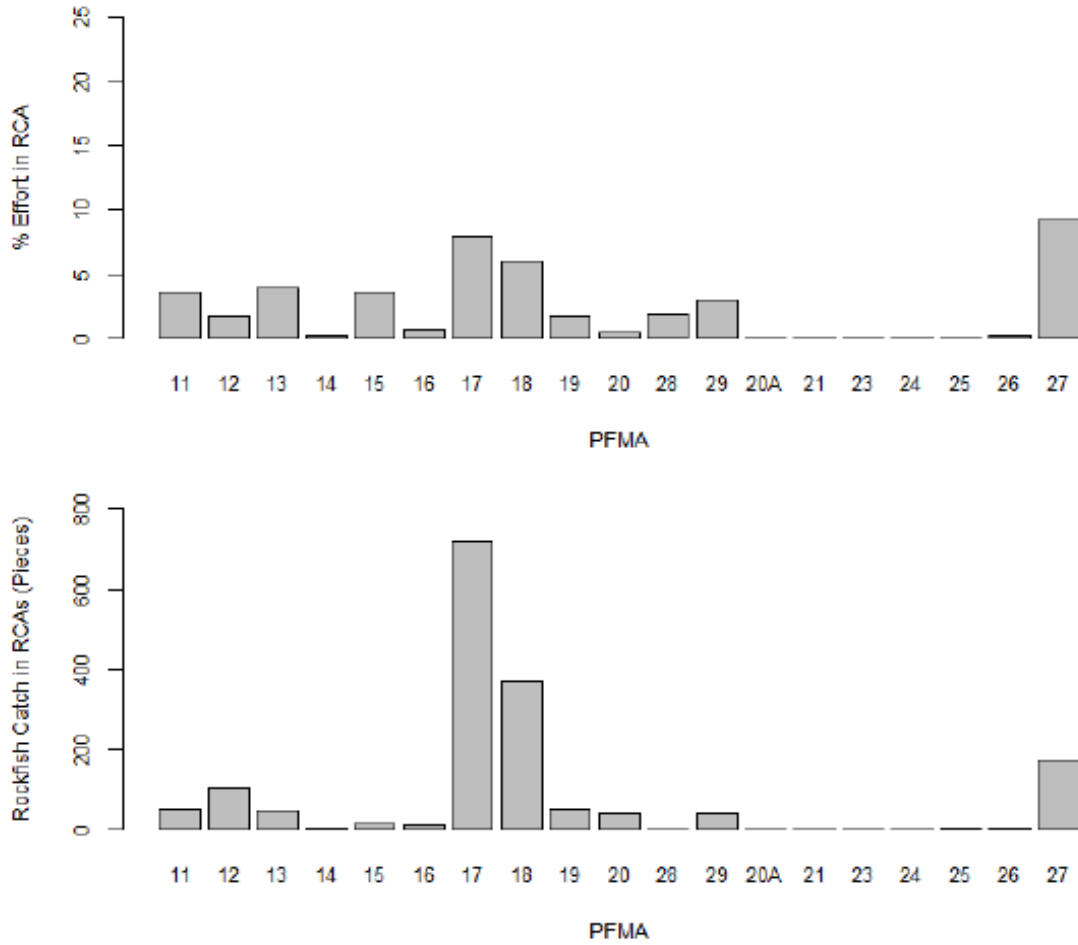


Figure 3 of Supplement in Haggarty et al. (2016). Relative fishing effort (%) in RCAs by Pacific Fishery Management Areas (PFMA). This proportion was applied to the estimated rockfish catch by PFMA in 2011 to estimate the number of rockfish that could have been taken in the recreational fishery in RCAs in each PFMA. Areas 17 and 18 (near Nanaimo and the Gulf Islands), has the highest estimated rockfish catch, followed by area 27, NW Vancouver Island. Note this analysis is limited to the S. Coast.

I hope that you have productive meetings at the RPR process. I look forward to seeing to positive results that will bolster the effectiveness and our understanding of the RCAs. I'll look forward to reading the proceedings when I return.

APPENDIX C. REGIONAL PEER REVIEW AGENDAS

Regional Peer Review Meeting (RPR)

Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas in British Columbia

December 12-14, 2018

Pacific Biological Station, Nanaimo, British Columbia

Chair: Lisa Setterington

DAY 1 – Wednesday, December 12, 2018

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping CSAS Overview and Procedures	Chair
0915	Review Terms of Reference	Chair
0930	Presentation of Context: Other Effective Area-Based Conservation Measures and Rockfish Conservation Areas	Resource Manager: Amy Mar
1015	Break	
1030	Presentation of Working Paper <ul style="list-style-type: none">• Questions of clarification	Authors
12:00	Lunch Break	
1300	Overview Written Reviews	Chair + Reviewers & Authors
1430	Break	
1445	Identification of Key Issues for Group Discussion <ul style="list-style-type: none">• Scoring of activities<ul style="list-style-type: none">○ Activities other than fishing	RPR Participants
1600	Check in on progress and confirmation of topics for discussion Day 2	Chair
1630	Adjourn for the Day	

DAY 2 – Thursday, December 13, 2018

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping Review Status of Day 1 (<i>As Necessary</i>)	Chair
0915	Carry forward outstanding issues from Day 1 <ul style="list-style-type: none">• Scoring of activities<ul style="list-style-type: none">○ Aquaculture○ Fishing activities<ul style="list-style-type: none">▪ Handpicking of invertebrates▪ Recreational	RPR Participants
1030	Break	
1045	Carry forward outstanding issues from Day 1 cont'd... <ul style="list-style-type: none">• Scoring of activities<ul style="list-style-type: none">○ Fishing activities cont'd....<ul style="list-style-type: none">▪ Pelagic▪ FSC	RPR Participants
1200	Lunch Break	
1300	Carry forward outstanding issues from Day 1 cont'd.... <ul style="list-style-type: none">• Scoring of activities<ul style="list-style-type: none">○ Fishing activities cont'd.....<ul style="list-style-type: none">▪ Bottom contact	RPR Participants
1445	Break	
1500	Discussion and Resolution of Results and Conclusions	RPR Participants
1600	Develop Consensus on Paper Acceptability and Agreed upon Revisions (ToR Objectives)	RPR Participants
1630	Adjourn meeting	

DAY 3 (revised) – Friday, December 14, 2018

Time	Subject	Presenter
0900	Introductions Review Status of Day 2	Chair
0915	<i>Scoring of activities</i> <ul style="list-style-type: none">• Fishing activities<ul style="list-style-type: none">○ Recreational○ FSC dual fishing	RPR Participants
1030	Break	
1045	<i>Scoring of activities</i> <ul style="list-style-type: none">• Fishing activities cont'd....<ul style="list-style-type: none">○ Pelagic○ Bottom contact• Non-fishery activities	RPR Participants
1200	Lunch Break	
1300	<i>Recommendations and Conclusions</i> <i>Agreed Upon Revisions to Working Paper and Paper Acceptability</i>	RPR Participants
1445	Break	
1500	Next Steps	Chair
1600	Adjourn meeting	

Regional Peer Review Meeting (RPR)
Risk Assessment of Permitted Human Activities in Rockfish Conservation Areas
in British Columbia

May 2 to 3, 2019

Pacific Biological Station, Nanaimo, British Columbia

Chair: Lisa Settingington

DAY 1 – 2 May, 2019

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping CSAS Overview and Procedures	Chair
0915	Review Terms of Reference and Objectives for Meeting	Chair
0930	Presentation of Changes to Working Paper	Authors
1030	Break	
	Discussion on Major Changes to Working Paper	
1045	<ul style="list-style-type: none"> • Ecological Risk Assessment Framework (ERAF) • Kelp/eelgrass SEC • Data limitations and uncertainty • Risk scoring <ul style="list-style-type: none"> ○ Precautionary approach scoring ○ Application of exposure ○ Application of consequence 	RPR Participants
12:00	Lunch Break	
	Discussion on Major Changes to Working Paper	
1300	<ul style="list-style-type: none"> • Risk scoring cont'd.... <ul style="list-style-type: none"> ○ Precautionary approach scoring ○ Application of exposure ○ Application of consequence 	RPR Participants
1445	Break	
	Discussion on Major Changes to Working Paper	
1500	<ul style="list-style-type: none"> • Risk scoring cont'd.... <ul style="list-style-type: none"> ○ Precautionary approach scoring ○ Application of exposure ○ Application of consequence • Other changes as required 	RPR Participants

Time	Subject	Presenter
1630	Adjourn for the Day	

DAY 2 – 3 May, 2019

Time	Subject	Presenter
0830	<p><i>Science Advisory Report (SAR) cont'd...</i> Develop consensus on the following for inclusion:</p> <ul style="list-style-type: none"> • Summary bullets • Sources of Uncertainty • Results & Conclusions 	RPR Participants
1030	Break	
1045	<p><i>Science Advisory Report (SAR) cont'd...</i> Develop consensus on the following for inclusion:</p> <ul style="list-style-type: none"> • Figures/Tables • Additional advice to Management (as warranted) 	RPR Participants
1130	<p>Next Steps – Chair to review</p> <ul style="list-style-type: none"> • SAR review/approval process and timelines • Research Document & Proceedings timelines • Other follow-up or commitments (<i>as necessary</i>) 	Chair
1145	Other Business arising from the review	Chair & Participants
1200	Adjourn meeting	

APPENDIX D. REGIONAL PEER REVIEW PARTICIPANTS

DECEMBER 2018 REGIONAL PEER REVIEW PARTICIPANTS

Last Name	First Name	Affiliation
Ahern	Pat	Sport Fishing Advisory Board (SFAB)
Ashcroft	Chuck	Sport Fishing Advisory Board (SFAB)
Buitendyk	Willem	Crab Fishery, Pacific Coast Fishery Service
Burke	Lily	DFO Science
Candy	John	DFO Science, Centre for Science Advice
Christensen	Lisa	DFO Science, Centre for Science Advice
Convey	Laurie	DFO Fisheries Management
Dudas	Sarah	DFO Science
Dunham	Jason	DFO Fisheries Management
Edwards	Brent	Nanoose / Snaw-naw-as, Fisheries Manager
Falk	Jenna	Galiano Conservancy Association
Fredrickson	Nicole	IMAWG, Marine Biologist
Frid	Alejandro	Central Coast Indigenous Resource Alliance
Gale	Katie	DFO Science
Iacarella	Josephine	DFO Science
Jeffery	Sharon	DFO Science
Johansson	Todd	DFO Fisheries Management
Johnson	Guy	Prawn Industry Caucus
Kelly	Mike	Sport Fishing Advisory Board (SFAB)
Keppel	Elise	DFO Science
Kristianson	Gerry	Sport Fishing Advisory Board (SFAB)
Ladell	Neil	DFO Fisheries Management
Lancaster	Darienne	DFO Science
Lane	Jim	Nuu-chah-nulth Tribal Council
Lee	Lynn	Parks Canada
Mar	Amy	DFO Fisheries Management
Martone	Rebecca	Province of BC
McIsaac	Jim	BC Commercial Fishing Caucus
McNaughton	Andrew	Nanoose / Snaw-naw-as, Contract Biologist
Ormond	Chad	Q'ul-Ihanumutsun Aquatic Resources Society
Orr	Emily	Prawn Industry Caucus
Picco	Candace	T'aaq-wiihak, Biologist
Rubidge	Emily	DFO Science
Rusel	Christa	Atlegay Fisheries Society, Biologist
Rutherford	Dennis	Pacific Prawn Fishermen's Association
Settington	Lisa	DFO Science
Shaikh	Sharlene	DFO, Species at Risk
Shaw	Kerra	DFO Fisheries Management

Last Name	First Name	Affiliation
Spence	Brenda	FM, Resource Manager
Sporer	Chris	Pacific Halibut Management Association
Tadey	Robert	DFO Fisheries Management
Thornborough	Kate	Contractor
Turris	Bruce	BC Groundfish Conservation Society
Wallace	Scott	David Suzuki Foundation
Wareham	Bill	David Suzuki Foundation
Yakgujanaas	Jaasaljuus	Haida Nation Biologist
Yamanaka	Lynne	DFO Science
Yu	Faith	DFO Fisheries Management

MAY 2019 REGIONAL PEER REVIEW PARTICIPANTS

Last Name	First Name	Affiliation
Ahern	Pat	Sport Fishing Advisory Board (SFAB)
Burke	Lily	DFO Science
Candy	John	DFO Science, Centre for Science Advice
Christensen	Lisa	DFO Science, Centre for Science Advice
Convey	Laurie	DFO Fisheries Management
Dudas	Sarah	DFO Science
Dunham	Jason	DFO Fisheries Management
Fredrickson	Nicole	IMAWG, Marine Biologist
Frid	Alejandro	Central Coast Indigenous Resource Alliance
Gale	Katie	DFO Science
Iacarella	Josephine	DFO Science
Kelly	Mike	Sport Fishing Advisory Board (SFAB)
Ladell	Neil	DFO Fisheries Management
Lane	Jim	Nuu-chah-nulth Tribal Council
Lee	Lynn	Parks Canada
Mar	Amy	DFO Fisheries Management
Martone	Rebecca	Province of BC
Orr	Emily	Prawn Industry Caucus
Picco	Candace	T'aaq-wiihak, Biologist
Rusel	Christa	Atlegay Fisheries Society, Biologist
Rutherford	Dennis	Pacific Prawn Fishermen's Association
Settington	Lisa	DFO Science
Shaw	Kerra	DFO Fisheries Management
Tadey	Robert	DFO Fisheries Management
Thornborough	Kate	Contractor
Turris	Bruce	BC Groundfish Conservation Society
Wallace	Scott	David Suzuki Foundation
Yakujanaas	Jaasaljuus	Haida Nation Biologist
Yu	Faith	DFO Fisheries Management

APPENDIX E. ABSTRACT: RISK ASSESSMENT OF PERMITTED HUMAN ACTIVITIES IN ROCKFISH CONSERVATION AREAS IN BRITISH COLUMBIA

The Government of Canada has committed to reaching domestic marine conservation targets (MCTs) of protecting 10% of Canada's marine and coastal areas by 2020. One area of action that supports reaching Canada's MCTs is the identification and advancement of "other effective area based conservation measures" (OEABCM). To determine whether Rockfish Conservation Areas (RCAs) in Canada's Pacific marine waters contribute to the MCTs as OEABCMs, RCAs were evaluated against the five criteria for inclusion as OEABCMs. In 2016, an internal evaluation of RCAs by DFO determined that a more fulsome review was required, including a risk assessment to assess whether permitted human activities inhibit RCAs from meeting criterion 5. To this end, a literature review of RCA documents provides evidence that RCAs align with OEABCM criteria 1 through 3, while greater clarity that RCAs will be in place for a long-term duration is required to meet criterion 4. A Level 1 qualitative risk assessment was conducted to assess RCAs against OEABCM criterion 5. The assessment was conducted on three significant ecosystem components: Inshore Rockfish, their Prey and Rocky Reef habitat, and the impact of twenty-one currently permitted activities. Eight activities were identified as having the potential to prevent RCAs from fulfilling the OEABCM criteria: outfalls, Crab by Trap, coastal infrastructure, oil spill, Prawn and Shrimp by Trap, FSC dual fishing groundfish hook and line, movement and storage of logs, and finfish aquaculture. Future assessments at the scale of individual RCAs will provide clarity regarding the impacts of stressors in each RCA. Recommendations include: developing clear long-term conservation and/or stock management objectives; collecting empirical observations of habitat in RCAs; improving research and monitoring efforts to reduce uncertainties about activities with highest relative risks; and improving fishery monitoring and catch reporting of sectors fishing inside RCAs.

APPENDIX F. REVISIONS TO WORKING PAPER

MAY 2019 REGIONAL PEER REVIEW REVISIONS

Subject	Follow-Up	Author Response
Terms of Reference		
Strong framing of objectives and moving sections around (last three sections in particular) - how information linked to objectives (as per written reviews)	<i>Authors will address</i>	The introduction and framing of the paper has increased focus on the ToR and clarifies the primary objective of the work and what question it is answering.
List Terms of Reference objectives in Introduction	<i>Authors will address</i>	ToR included in the intro.
Address Terms of Reference Objective 1a more explicitly (criteria 1-4) i.e. add lat/longs; include more references and data to support; cite (or include) RCA Location Review data or findings; remove conclusions ("The RCAs meet this criteria...."; define long-term in criteria 4 - geographic location tied to RCA Location Review and needs to be reflected	<i>Authors will address</i>	These points have been addressed. NL can provide more detail if required.
Specific Additions/Clarifications to Paper		
Define 'removal of biological material'	<i>Addition of table in Appendix that defines stressors including removal of biological material</i>	A table of stressor definitions was added to the paper (Table 10).

Subject	Follow-Up	Author Response
Figures 3-6 with all stressors - authors to redo figures for visual clarity, label with stressor names instead of numbers	<i>Authors will review and determine best way to show figures</i>	Figures completely redone.
Group uniformity of stressors/activities by RCA/bioregion - helpful for managers	<i>Authors will review - possibly dependent on other revisions</i>	Considered a level of detail beyond the scope of this work.
Clarify activities that were considered out of scope (based on guidelines for meeting criterion 5) but may have an impact (inside or outside RCA)	<i>Authors to review and determine if inclusion is warranted</i>	Clarified scope of work and why activities were included. Also discussed long-range stressors or those activities that occur outside the boundaries of RCAs but stressors may impact inside of boundaries. Clarified in the discussion.
Appendix B: High level description/more information in main body of how Appendix B was used in scoring and a few examples (summary of Appendix B)	<i>Authors will address</i>	Efforts were made to show that the information in appendix B was used in the scoring both in the methods/main document, as well as in appendix b. An example of how this information was not considered to add value, as the level of information in appendix B varies for each activity, and the scoring justifications in appendix d include summaries of relevant info from appendix b.
Appendix B: Include justification tables in body of document	<i>Authors will address</i>	The document has undergone a restructure, but after discussions with authors this level of detail was deemed too great for the main body of the document (and distracted from results discussion). This aligns with the format for all other ERAF applications and standard risk assessment framework format.
Appendix B: Include experts who provided input for specific information and reviewed	<i>Authors to determine if this should go into Acknowledgements</i>	Added a detailed description of methods for how information was gathered for Appendix B from databases, literature, and experts. (pg. 29).

Subject	Follow-Up	Author Response
<p>Appendix B; including how/when they were approached (questions asked, etc)</p>	<p><i>section, Pers. Comms., references for expert opinion</i></p> <p><i>Further discussions with scientists, fisheries managers, external experts, data experts (Archipelago; Maria Surrey) needed</i></p>	<p>Information on how expert guidance was used is included and all experts who provided specific information are cited as <i>pers. comm.</i> Throughout the document.</p> <p>“Internal DFO experts (e.g. Fishery Managers, Scientists, Database Managers) were contacted to explain details of how specific fisheries operate (e.g. gear type, deployment style, fishing season, monitoring protocols, etc.), or to help locate and gather existing data from numerous databases (e.g. Groundfish Fisheries Fishery Observation System (GFFOS), Prawntrap_Bio, etc.). Some external experts also provided their data or guidance on where to locate data on various fisheries and stressor impacts. Experts were selected through snowball sampling.”</p> <p>It is important to note that experts were not giving their opinion but instead providing clarification on how/when/where the fishery operates or providing existing data/literature.</p> <p>Additionally, we found this process of communicating with experts and reviewing scores extremely productive. This is reflected in the revised scoring.</p>
<p>Appendix B: include footnote of when extracted data from databases</p>	<p><i>Authors will address</i></p>	<p>Footnotes have been added to each fisheries table in appendix B to include date of when data was extracted and from which logbook.</p>

Subject	Follow-Up	Author Response
Does focussing on one habitat (i.e. rocky reefs) hamper ability to evaluate criterion 5 at broad scale of RCA network, but need to consider other habitats if moving forward with individual RCA by RCA assessment - addressing rocky reef, prey and rockfish and other habitats (eelgrass, kelp, sponge reefs) not included in risk score	<i>Authors will review and determine</i>	A risk assessment can be run on as few or as many SECS as you like – it just depends on the objectives and how the results are interpreted. The OEBCM criterion requirement was for an ecological component of interest as well as habitat supporting that component. Rocky reef was selected as it has the highest spatial overlap with RCAs but has also been identified in the literature as the primary habitat of Inshore Rockfish. This is discussed in more detail in the paper, as well as the possibility of including more SECS in more detailed future reviews, etc.
Address section 2.3 sponge overlapping RCAs paragraph - either remove or tie-in better to objectives	<i>Authors will address</i>	Removed from paper.
Make Figure 2 clear with respect to RCA overlap	<i>Authors will address with possible inclusion of maps to show eelgrass and kelp canopy habitats and show sponge reefs that are outside closures</i>	Additional tables and figures to highlight the spatial overlap with RCAs.
Add table with percent habitat types per RCA (or reference Location Review paper is data has been published)	<i>Authors will address</i>	Included.
Address compliance as a separate issue (i.e. being considered to meet criterion 5 but not part of risk assessment and not a stressor)	<i>Authors will address</i>	Further clarified the scope of the risk assessment and why non-compliant RCA activities are not included in formal RA. (pg. 30).

Subject	Follow-Up	Author Response
		<p>“This Level 1 risk assessment does not consider the potential impact of non-permitted RCA activities such as illegal fishing, non-compliance, or other illegal activities. The goal of this paper is to assess the potential negative impact from the permitted human activities within RCAs on Inshore Rockfish, and their habitat and; therefore, assessing non-compliant RCA activities is beyond the scope of this paper. However, enforcement and monitoring of illegal activities is an important part of designing effective marine reserves and is discussed in more detail in Section 4.”</p>
<p>Risk assessment addresses 'permitted activities'; include recreational fishery non-compliance literature</p>	<p><i>Authors will address</i></p>	<p>Expanded information on recreational fishery compliance. Added more information from research by Haggarty et al. Clarified wording to emphasize the localized nature of the study by Lancaster et al. (pg. 23-24).</p>
<p>Include other activities regarding non-compliance that should be included</p>	<p><i>Authors will address</i></p>	<p>Added a detailed section on compliance in the Aquaculture section with extensive details provided by Kerra Shaw. (pg. 25-26).</p>
<p>Expand compliance section to include aquaculture activities</p>	<p><i>Authors will address</i></p>	<p>Added a detailed section on compliance in the Aquaculture section with extensive details provided by Kerra Shaw. (pg. 25-26).</p>
<p>Kelp/Eelgrass SEC</p>		
<p>Include now or include that this needs to be considered in any future RCA by RCA assessment and if not included need to be explicit why and identify that may lead to false positives</p>	<p><i>Authors will address and determine whether should be considered</i></p>	<p>As above. This is noted in the paper.</p>

Subject	Follow-Up	Author Response
Data Limitations and Uncertainty		
Add new section in main body of document related to uncertainty	<i>Authors will address</i>	Made more explicit in the paper and the implications.
Include language on limitations of study (i.e. not addressing all habitat types, spatial scale, etc)	<i>Authors will address</i>	Included
Include some uncertainty about other non-compliance issues than fishing activities and need for more science/monitoring	<i>Authors will address</i>	Included
Clearly state how precautionary scoring may cause inflation of scoring and how will influence results	<i>Authors will address</i>	Included
Spatial and temporal scale is confounded by the approach to 'average-out' the risk assessment. Be explicit on limitations of interpretation of data.	<i>Authors will address</i>	Have tried to be more explicit around the methods and implications.
Include additional data provided by others to rescore and reduce uncertainty around other activities	<i>Authors will address</i>	See above comments. The authors spoke with a number of experts around the scoring, many of whom provided additional data.
Clarify why included sponge reefs in assessment and not others (i.e. kelp and eelgrass)	<i>Authors will address</i>	Clarified and removed from assessment at this stage.
Stressors (General)		
Separate out recreational fisheries	<i>Authors will address</i>	Yes. Separated from scoring.

Subject	Follow-Up	Author Response
Separate out FSC fisheries	<i>Authors will address</i>	Yes. Separated.
Add more language to define different risk activities	<i>Authors will address</i>	Better definitions are included.
Temporal scale needs to be dependent on effort not on range of time or days (mostly issues with prawn data)	<i>Authors will address and revisit commercial data and perhaps separating commercial fisheries from recreational fisheries will clear this up</i>	Agreed. This has been fixed where appropriate.
Risk Assessment/ERAF Methodology		
Provide information on why ERAF is the right tool to assess RCAs against OEABCM criteria; include other assumptions and how that affects result interpretation	<i>Authors will address</i>	Added to the paper in the scoping/intro, the methods, and the discussion
Provide clarity on scope and scale of this risk analysis - n not by individual RCA but overall RCAs (include scientific recommendations that if making decisions about individual RCAs meeting criterion 5 then additional work needs to be done)	<i>Authors will address</i>	Clarified scope (as collective RCAs) to align with criterion 5.
Specify explicitly any changes made to application of ERA framework in present assessment and why - including that it is not a 'specific RCA assessment'	<i>Authors will address</i>	ERAF modifications are clear in paper. Have clarified that we're examining collective RCAs, not individual RCAs.
Missing references to other ERAF applications (PNCIMA; Murray et al)	<i>Authors will address</i>	Have added in a few more places.

Subject	Follow-Up	Author Response
Regarding non-permitted activities, not required for risk assessment but should be included in assessment of criterion 5 on individual RCA scale	<i>Authors will address</i>	Discussed assessment at individual RCA scale in discussion.
Be explicit where existing data used to inform risk assessment came from (data versus expert opinion) (e.g. prawn data from IFMP)	<i>Authors will address</i>	This has been made clearer in the document now, particularly with how explicit appendix b is.
Be more explicit about the purpose of the risk assessment (will help inform uncertainty/limitation section)	<i>Authors will address</i>	Clarified in the scope and again in the discussion.
Risk Assessment Scoring		
All scores to be checked between body and appendices, and check correlation with input file	<i>Authors will address</i>	Checked.
Revisit precautionary approach scoring issues - inflation of scores	<i>Authors will address</i>	Fixed this for consistency.
Check r-code calculating quantiles and error bars	<i>Authors will address</i>	Not a problem with the R code. Recalculated this and it fixed it.
Explain quantiles for cumulative risk better in document	<i>Authors will address</i>	Clarified that I used for the code for these quantiles
Remove recreational fisheries from score (all) and be explicit where data does or does not exist	<i>Authors will address</i>	Rec removed and clarified uncertainty in text.

Subject	Follow-Up	Author Response
Revisit consistent application of exposure: may need to rescore with separation of FSC and separation of recreational fisheries	<i>Authors will address</i>	Fixed this.
Revisit consistent application of consequence	<i>Authors will address</i>	Revisited for consistency and discussed/reviewed with experts
AIS		
Add definition of AIS in introduction	<i>Authors will address</i>	The issue of AIS has been addressed in the paper, including a revised definition to not include sea lice.
Sea lice to be removed from AIS scoring	<i>Authors will address</i>	Fixed
Include wording around how species are classified as AIS	<i>Authors will address</i>	Clarified
More justification around scoring of AIS by gear type and address consistency amongst different scoring by activity/gear type (can cite the ERAFs that used to inform here)	<i>Authors will address</i>	Clarified how AIS is scored and that this aligns with other ERAF applications
Aquaculture		
Include text in document around contaminants being considered	<i>Authors to send specific contaminants to Kerra (e.g. SLICE, hydrogen peroxide)</i> <i>Kerra to provide additional information to authors on contaminants</i>	Experts were very helpful providing reference material for this.

Subject	Follow-Up	Author Response
Include more background information on overlap of farms and RCAs - table with info on bottom type and temporal scale of open/active farms	<i>Kerra to send list of AIS species considered in aquaculture section</i>	Only active farms included.
Handpicking of Invertebrates		
Revisit scoring for handpicking of invertebrates particularly related to invertebrates being considered as rockfish prey and resuspension of sediment related to geoduck harvest (reefs occur adjacent and surrounded by sandy habitat)	<i>Authors will address</i>	Fixed this scoring
Recreational Fisheries		
Angling data overstated - crab and prawn trap	<i>Authors will address</i>	Included percentage (19.5%) of recreational effort directed at invertebrate trapping from iREC data (pg. 124).
Smelt by gillnet - not occurring or likely to occur and received reasonably high score	<i>Authors will address</i>	Scoring has been revised to reflect this
Recreational effort inside versus outside RCAs - clarification needed on page 41	<i>Authors will address</i>	Expanded information on recreational fishery compliance. Added more information from research by Haggarty et al. Clarified wording to emphasize the localized nature of the study by Lancaster et al. (pg. 23-24)
Refer back to original RCA process related to activities not permitted	<i>Authors will address</i>	Restricted activities included on p. 8 but as discussed in previous meeting there was no former process used in the original RCA process. Various fisheries were categorized into low, medium, high

Subject	Follow-Up	Author Response
		categories but there were no final version of list available to the authors.
FSC Dual Fisheries		
Define dual FSC - needs to capture longline fishing	<i>Authors will address</i>	Added definition earlier in the document and explained in more detail in appendix b
Not need to focus on offload - electronic monitoring provides track lines of fishery	<i>Authors will look into track line information and how to obtain for possible inclusion</i>	Unable to get EM trackline data for this analysis.
Rankings of habitat impact - no reference to what used for longline gear	<i>Authors will provide clarification on how got to conclusion</i> <i>Candace has information to provide</i>	Changed scoring and added detail
Include history of Fishing allowed in RCAs and history of dual fishing	<i>Authors will address</i>	See previous comment about original RCA process. Legal history of dual fishing is outside scope of paper.
Consequence scoring - how determined in FSC dual fishing?	<i>Authors will address</i>	Clarified in doc
Pelagic Fisheries		
Was not discussed at the meeting	-	Revised to be consistent with changes made to scoring method

Subject	Follow-Up	Author Response
Bottom Contact Fisheries		
Expert opinions on prawn as rockfish prey - include references; need clarification what is considered 'major' source of diet	<i>Authors will address</i>	Section has been added about prey and implications of this type of scoring on the results
Crab: Targeting of red rock crab - needs clarification as do not target red rock crab	<i>Authors will address</i>	Clarified
Crab: Dungeness crab habitat does not overlap with rockfish habitat	<i>Authors will address</i>	Clarified that Dungeness crab habitat rarely overlaps with rocky reef habitat in discussion. (pg. 80)
Crab: location data from logbook data and not precise; have electronic monitoring data	<i>Authors: future work if complete RCA by RCA assessment</i>	Crab EM data were evaluated in RCAs which is already included in appendix B; added language in appendix B that overlaying EM data with rockfish habitat model would be future work and habitat model was provided to Willem Buitendyk at the beginning of April to run analysis at the RCA level.
Crab: check scoring	<i>Authors to include more info related to what would need for managers to use</i>	Scoring revised carefully
Crab: Comparison of lobster traps and crab traps	<i>Authors: area for future research</i> <i>Laurie has a reference to provide authors</i>	Differences highlighted in doc in terms of size and what is retained, etc.
Crab: Dragging effects	<i>Authors: area for future research</i>	Revised scoring

Subject	Follow-Up	Author Response
Crab: check consequence scoring	<i>Authors will check scoring</i>	Revised scoring
Prawn: Separate out recreational and commercial fisheries	<i>Authors will address</i>	Yes
Prawn: Consider separating out shrimp and prawn fisheries	<i>Authors to consider depending on author consideration related to coonstripe shrimp as prey</i>	Clarified that directed fisheries do not overlap with RCAs and focused on prawn and presented info on incidental catch of shrimp fisheries.
Prawn: Update Table 16 to include 2017 data	<i>Authors will address</i>	Yes
Prawn: Update Table 18 to include number of days RCAs fished	<i>Authors will address</i>	Included column for soak time (the time during which the fishing gear is actively in the water) to report number of days RCAs were fished; added 2015-2017 years
Prawn: Update Table 18 to add column on total commercial coonstripe catch in RCAs	<i>Authors will address</i>	Column for total coastwide catch of coonstripe and total coastwide catch in RCAs.
Prawn: how prey and bycatch are incorporated and input into risk assessment - does this inflate scoring?	<i>Authors will consider</i>	Discussed in the discussion under prey groupings
Prawn: Consider using temporal data that already exists	<i>Authors will consider incorporation of additional data</i>	See table 16a; reported fishing effort in RCAs using soak time (number of days fishing gear is actively in the water)

Subject	Follow-Up	Author Response
Prawn: Consideration of prawn as prey for rockfish	<i>Authors will clarify prawn and shrimp prey issue</i> <i>Alejandro has some references he could provide</i>	Addressed in the paper. Added a comprehensive section on inshore rockfish diet and added section on how this is scored.
Prawn: Consider incidental coonstripe and humpback shrimp data that is available	<i>Authors will try and get DFO data that is available</i>	Added 2 tables (tables 18b and 18c) for coonstripe and humpback incidental data and included soak time (number of days fished) for years 2007-2017
Prawn: Consider wording related to ghostfishing	<i>Authors will review and clarify language</i>	Clarified
Prawn: consider wording related to prawn fishery closures and sponges	<i>Authors will review and clarify language</i>	Section on sponges and scoring on sponges were removed.
Prawn: consider consequence scoring particularly high scores related to juveniles	<i>Authors will review scoring</i> <i>Could look at RPA Assessment for Rockfish</i> <i>Guy to provide Walters reference to authors</i>	Scores revisited
Prawn: Review references and how characterized in paper	<i>Authors will address</i>	Reviewed in paper and appropriate adjustments made
Prawn: Consider wording and conclusions related to striking stressor	<i>Authors will review and clarify language</i>	Striking stressor removed from assessment

Subject	Follow-Up	Author Response
Groundfish mid-water trawl: Data exists in GFFOS by start and end points therefore could use electronic monitoring track lines	<i>Authors will look into track line information and how to obtain for possible inclusion</i>	Was advised that trackline EM data is not available for this analysis. Mentioned in appendix B of paper.
Groundfish mid-water trawl: Revisit wording that data shows no inshore rockfish captured	<i>Authors will review and clarify language</i>	Added clarification to Mid-water trawl section that it's unlikely fishery observers are misidentifying inshore rockfish due to extensive training. (pg. 84). Clarified wording concerns pg 85.
Groundfish mid-water trawl: Page 59 wording re trawls should be revisited	<i>Authors will review and clarify language</i>	Added clarification to Mid-water trawl section that it's unlikely fishery observers are misidentifying inshore rockfish due to extensive training. (pg. 84). Clarified wording concerns pg 85.
Groundfish mid-water trawl: Page 60 wording in paragraph above Table 17 should be revisited	<i>Authors will review and clarify language</i>	Added clarification to Mid-water trawl section that it's unlikely fishery observers are misidentifying inshore rockfish due to extensive training. (pg. 84). Clarified wording concerns pg 85.
Groundfish mid-water trawl: Page 61 re discussion of rockfish species removal by mid-water trawl should be revisited	<i>Authors will review and clarify language</i>	Added clarification to Mid-water trawl section that it's unlikely fishery observers are misidentifying inshore rockfish due to extensive training. (pg. 84). Clarified wording concerns pg 85.
Groundfish mid-water trawl: Review references for characterization of conclusions (bottom trawl versus mid-water trawl)	<i>Authors will review and clarify</i>	Removed reference to mid-water trawl studies from outside Canada

Subject	Follow-Up	Author Response
Groundfish mid-water trawl: Page 61 - ERAF from Hecate and QCS mid-water trawl could contact bottom - should review wording	<i>Authors will review and clarify</i> <i>Authors will provide Rogers paper</i>	Removed reference to mid-water trawl studies from outside Canada
Scallop trawl and Euphausiid by Mid-Water Trawl: Clarification of what in IFMP regarding uncertainty should be revisited	<i>Authors will review</i> <i>Laurie can provide reference and expert opinion</i>	Uncertainty scores were addressed.
Scallop trawl and Euphausiid by Mid-Water Trawl: Consequence scoring related to prey impact in scallop trawl should be revisited	<i>Authors will review</i> <i>Laurie can provide reference</i>	Addressed
Scallop trawl and Euphausiid by Mid-Water Trawl: Consequence scoring for both fisheries should be revisited	<i>Authors will review scores</i>	Addressed
Scallop trawl and Euphausiid by Mid-Water Trawl: Issue related to spatial wording of both fisheries	<i>Authors will review and clarify language</i>	Addressed
Non-Fishery Activities: was boat anchoring considered (or should be considered) as a stressor?	<i>Authors will review and clarify</i>	No – multiple reasons.
Non-Fishery Activities: revisit coastal infrastructure scores based on Josie	<i>Authors will review and clarify</i>	Revised scores. This bumped up the risk associated with this activity

Subject	Follow-Up	Author Response
Recommendations/Conclusions/Future Work: Recommendations in WP to be revisited pending revisions to paper	<i>Authors will review</i>	Discussion and recommendations both revised extensively based on feedback from first meeting.

DECEMBER 2018 REGIONAL PEER REVIEW REVISIONS

Subject	Follow-Up
General	
Regarding updated OEABCM international guidelines - reword scope of paper - clarify purpose of paper is to address criterion 1-5 and include date and OEABCM guidelines used for assessment. If an assessment takes place under the updated OEABCM international guidelines, the results from this working paper can feed into this new assessment.	-
Potential error in paper - two sections seem to talk about the same thing, on pages 95 and 213 - the entrapment text. The text may not have been updated in these sections to reflect working paper changes.	<i>Authors to review</i>
ERAF	
Paper needs to be clear about what ERAF does and what it doesn't do as a Level 1 qualitative risk assessment - e.g. the ERAF process used here is a prioritization tool that identifies the relative risk of permitted activities that occur across all RCAs but it is limited in that results from the ERAF are unable to address if and how RCAs meet OEABCM criterion 5 (and why ERAF is unable to address this) and does not provide information on the individual RCAs.	<i>Authors to review paper to make more explicit what ERAF does and doesn't do</i>
Provide context - information is not currently available that allows us to evaluate if/how RCAs meet criterion 5 but results from ERAF can identify higher relative risk permitted activities that may prevent RCAs from meeting criterion 5 and/or their conservation measures and these activities identified need future investigation.	<i>Authors to review and provide wording</i>
Provide language in paper on activities that are identified as having a higher relative risk may not require management changes.	<i>Authors to review and provide wording</i>

Subject	Follow-Up
Exposure and Consequence Scoring	
Rockfish prey scoring - consequence for crab by trap, prawn and shrimp by trap, and herring.	<i>Authors to review to determine if consequence scoring for three activities are appropriate</i>
Crab by trap - uncertainty related to removal of biological material	<i>Authors to review to determine if uncertainty scoring is appropriate</i>
Prawn by trap - uncertainty related to removal of biological material	<i>Authors to review to determine if uncertainty scoring is appropriate</i>
Criteria 1 to 4	
Explicitly state whether each criteria is met or not	<i>Authors to do</i>
Criterion 2 - Section 3.2.2 include first two sentences of paragraph under title then remove rest of information and put into appendix while changing "objectives" to "intent" of RCAs	<i>Authors to do</i>
Recommendations	
Do not specify "how" in the recommendations	<i>Authors to review recommendations and remove "how" from recommendations</i>
#1 - Reword to remove the how	<i>Authors to do</i>
#2 - remove "ground-truthing" and replace with "collection of empirical observations"	<i>Authors to do</i>

Subject	Follow-Up
#4 - Needs to be reworked based on what ERAF can do and can't do; remove "high risk permitted activities" and replace with different wording; remove second and fourth sub-bullet and sub-bullet #3 - simplify language e.g. "Focus research and monitoring effort to reduce uncertainties to the activities listed here (in bullet 3) and to effects on Inshore Rockfish, rockfish prey, rocky reef habitat."	<i>Authors to do</i>
#5 - to be revisited	-
#6 - remove	<i>Authors to do</i>
#7 and #8 - reword and combine - update wording to reflect language in OEABCM criteria guidelines.	<i>Authors to reword and combine two recommendations</i>
# 9 and #10 - could combine recommendations or not, up to authors	<i>Authors to review</i>
#11 - research on non-compliance	-
Table 12	
Titles of columns to be re-worded to make clear that the first five columns are "in RCAs" whereas final column is both inside and outside	<i>Authors to do</i>
Table 16	
Add columns for incidental catch of humpback and coonstripe shrimp (i.e. 7th column in table are the coastwide total trap days (inside and outside) not the trap days inside and outside of RCAs while columns 2-6 are numbers inside and outside of RCAs)	<i>Authors to do</i>
Tables 18b and 18c	
Remove tables	<i>Authors to do</i>

Subject	Follow-Up
Table 30	
Change events to sets	<i>Authors to do</i>
Data limitations and uncertainty:	
iRec data - clarify in paper if presenting calibrated or un-calibrated iRec data and what the potential impacts of using un-calibrated iRec data could be (e.g. reliability of iRec data/biases).	-
Include figures that show consequence and exposure - Rebecca and Dana have some good ideas on how this could take place - gets at relative risk between activities and highlights low relative risk in grand scheme of things. Note from yesterday and in notes from previous meeting.	<i>Authors to do on discretion</i>
Exposure by consequence figure - no activities got a 4-6 consequence - provides important understanding of this.	-
Could be useful to highlight that none of the activities made 4-6 consequence scores - include in working paper.	-
Helpful to have good understanding of relative risk - provides context	-
Plot results from Table 11!!!	-