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Proceedings of the Pacific regional peer review of the Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Offshore Pacific Bioregion

February 11-12, 2015
Nanaimo, BC

Chairperson: Karen Hunter
Editor: Karen Hunter

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Canada

Foreword

These Proceedings 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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TABLE OF CONTENTS

SUMMARY

These Proceedings summarize the relevant discussions and key conclusions that resulted from the Fisheries and Oceans Canada (DFO), Canadian Science Advisory Secretariat (CSAS) Regional Peer Review meeting of February 11-12, 2015, at the Pacific Biological Station in Nanaimo, B.C. One working paper was presented for peer review on identifying Ecologically and Biologically Significant Areas (EBSAs) in the Offshore Pacific Bioregion.

In-person and web-based participation included Fisheries and Oceans Canada staff from the Science Sector and Oceans Management plus external participants from First Nations, academia, Environment Canada, consultants, and non-governmental organizations.

As part of Canada's commitment to identifying and protecting Ecologically and Biologically Significant Areas (EBSAs) within its territorial waters, an assessment of habitat features in the Offshore Pacific Bioregion was completed and reviewed. Six areas or features (hydrothermal vents, seamounts, the continental slope, abyssal/bathypelagic waters, and two pelagic/surface features) were assessed against eight EBSA criteria established by Fisheries and Oceans Canada and the Convention on Biological Diversity. Five EBSAs were identified by consensus based on the review of the working paper and associated EBSA criteria scores.

The conclusions and advice resulting from this review will be provided in the form of a Science Advisory Report.

The Science Advisory Report and supporting Research Document will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

Compte rendu de l'examen par les pairs régional du Pacifique sur la Désignation de zones d'importance écologique et biologique (ZIEB) dans la biorégion du Pacifique située en mer

SOMMAIRE

Le présent compte rendu résume les discussions et les principales conclusions de la réunion régionale d'examen par des pairs de Pêches et Océans Canada (MPO) et du Secrétariat canadien de consultation scientifique (SCCS) qui a eu lieu les 11 et 12 février 2015 à la Station biologique du Pacifique de Nanaimo, en Colombie-Britannique. Un document de travail a été présenté aux fins d'examen par les pairs afin de désigner les zones d'importance écologique et biologique (ZIEB) dans la biorégion du Pacifique située en mer.

Au nombre des participants qui ont assisté à la réunion en personne ou par conférence Web, on comptait des employés des secteurs des Sciences et de la Gestion des pêches, ainsi que des représentants externes des Premières Nations, des universités, d'Environnement Canada et des organisations non gouvernementales.

Dans le cadre de l'engagement du Canada à désigner et à protéger les zones d'importance écologique et biologique (ZIEB) dans ses eaux territoriales, une évaluation des caractéristiques de l'habitat de la biorégion du Pacifique située en mer a été réalisée et examinée. Six zones ou caractéristiques (cheminées hydrothermales, monts sous-marins, pente continentale, eaux abyssales/bathypélagiques et deux surfaces superficielles/pélagiques) ont été évaluées par rapport à huit critères des ZIEB établis par Pêches et Océans Canada et la Convention sur la diversité biologique. Cinq ZIEB ont été désignées par consensus en fonction de l'examen du document de travail et des cotes des critères des ZIEB.

Les conclusions et avis découlant de cet examen seront présentés sous la forme d'un avis scientifique.

L'avis scientifique et le document de recherche à l'appui seront rendus publics sur le site Web du calendrier des avis scientifiques du Secrétariat canadien de consultation scientifique.

INTRODUCTION

A Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS), Regional Peer Review meeting was held on February 11-12, 2015, at the Pacific Biological Station in Nanaimo, BC, to review the Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Offshore Pacific Bioregion.

The Terms of Reference (TOR) for the science review (Appendix A) were developed in response to a Request for Science Advice (RSIA_PAC_OCN05_2014-15): Identification of offshore Ecologically and Biologically Significant Areas (EBSAs) in Pacific Region. Notifications of the science review and conditions for participation were sent to external representatives with relevant expertise from First Nations, academia, Environment Canada and non-governmental organizations.

The following working paper (WP) was prepared and made available to meeting participants prior to the meeting (Abstract provided in Appendix B): Identification of Ecologically and Biologically Significant Areas (EBSAs) in Canada's Offshore Pacific Bioregion by Stephen Ban, Janelle M. R. Curtis, Candice St. Germain, Ian Perry, and Thomas Therriault (CSAP 2013OCN05).

The meeting Chair, Karen Hunter, welcomed participants and invited them to each introduce themselves. In total, 28 people participated (Appendix D). She reviewed the role of CSAS in the provision of peer-reviewed advice, and gave a general overview of the CSAS process. She discussed the role of participants, the purpose of the various resulting meeting publications (Science Advisory Report, Proceedings and Research Document), and the definition and process around achieving consensus decisions and advice. Vanessa Hodes was identified as the Rapporteur. 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 Terms of Reference, Agenda (Appendix E) and the working paper.

The Chair reviewed the meeting's Agenda (Appendix C) and Terms of Reference (Appendix D). She 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 address 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.

The terms of reference for this process outlined two main objectives:

1. Provide evidence and justification indicating which areas or features in the Offshore Pacific Bioregion from the shelf break to Canada's EEZ, including the seafloor and water column, meet EBSA criteria, using the best available information and the criteria defined by DFO (DFO, 2004) and the CBD [Convention on Biological Diversity].
2. For the Offshore Pacific Bioregion areas or features identified in Objective 1: propose EBSA boundaries (including maps), and indicate the level of confidence associated with the delineation of identified EBSAs, including sources of uncertainty.

Participants were informed that Karin Bodtker (Living Oceans Society) and Michelle Greenlaw (DFO Science, Maritimes Region) had been asked before the meeting to provide a detailed written review of the working paper to assist everyone attending. Additional topic experts were

invited to review individual chapters of the working paper. Verena Tunnicliffe (University of Victoria) reviewed Chapter 2: Hydrothermal Vents, and Emily Rubidge (DFO Science, Pacific Region) reviewed Chapter 3: Seamounts. Participants were provided with copies of the written reviews prior to the meeting.

Each Chapter focused on an evaluated area or feature. For each chapter, reviews were presented on the background literature review prepared by the authors. Authors responded to reviewer comments, and then participants commented on contents of the chapter and reviewed criteria scores and EBSA boundaries. The group reached final criteria scores by consensus.

The conclusions and advice resulting from this review will be provided in the form of a Science Advisory Report, which together with the resulting Research Document (the revised Working Paper) will be made publicly available on the Canadian Science Advisory Secretariat (CSAS) website.

REVIEW

Working Paper: Identification of Ecologically and Biologically Significant Areas (EBSAs) in Canada's Offshore Pacific Bioregion by Stephen Ban, Janelle M. R. Curtis, Candice St. Germain, Ian Perry, Thomas Therriault (CSAP 2013OCN05).

Presenters: Stephen Ban and Janelle Curtis

PRESENTATION OF WORKING PAPER

Signatory countries to the Convention on Biological Diversity (CBD), including Canada, have committed to identifying ecologically and biologically significant areas (EBSAs) and establishing marine protected areas (MPAs) within their waters. An EBSA is an area deemed to be ecologically or biologically "significant" because of either its structural properties and/or the function that it serves in an ecosystem (DFO 2004, 2011). Identification of EBSAs is one way for countries to prioritize areas for potential protection with MPAs, a key principle of the Canada-British Columbia Marine Protected Area Network Strategy.

Identification of an area or feature as an EBSA does not confer or imply any degree of specific protection; rather, it is a means of recognizing an area with special features where threats and risks should be more carefully scrutinized when undertaking management of activities in that area. To this end, identification of an area as an EBSA is the first of three steps. The second step is to consider societal values and potential threats in setting management objectives; the third step is for managers and regulators to devise and implement a management plan for each area (DFO 2004). Conversely, an area need not be identified as an EBSA in order to be designated as a Marine Protected Area or to be protected under the National Marine Conservation Areas Act (DFO 2004, 2011).

EBSA criteria were developed by Fisheries and Oceans Canada (DFO) in response to the passing of Canada's Oceans Act in 1996 as a way to operationalize and standardize the process of identification of areas deemed "significant" and to support an ecosystem-based approach towards integrated management (DFO 2004, 2011). This guidance stated that an area was an EBSA if it either scored high on at least one of three primary criteria (uniqueness, aggregation, or fitness consequences for species or life history stages), or if it scored above average (medium or high) across a range of criteria (i.e., cumulative importance). In addition, resilience and naturalness were also deemed important attributes of EBSAs but insufficient on their own to designate an area as an EBSA. DFO guidance (2004, 2011) recommended that data analyses or expert-driven processes be used to evaluate areas.

In addition to DFO's (2004) EBSA criteria, Canada endorsed the seven EBSA criteria developed by the Convention on Biological Diversity (CBD) in Annex 1 of Decision IX/20 of COPIX. These CBD criteria are internationally accepted for identifying EBSAs: uniqueness/rarity, importance for species' life history stages, importance for threatened or endangered species, potential for recovery from disturbance, productivity, diversity, and naturalness (CBD 2008). While there is considerable overlap in the DFO and CBD criteria (Table 1), the CBD criteria include three additional criteria. In this assessment, authors assumed a correspondence between DFO's criterion of fitness consequences and CBD's criterion of special importance for life history stages or species, and DFO's criterion of resilience and CBD's criterion of Vulnerability, fragility, sensitivity, or slow recovery.

Table 1. Correspondence between DFO (2004) and CBD (2008) EBSA criteria.

DFO (ESR2004/006)	**CBD (Annex 1 of Decision IX/20 of COPIX)**
Uniqueness	Uniqueness or rarity
Aggregation	
Fitness consequences	Special importance for life history stages or species
Resilience	Vulnerability, fragility, sensitivity, or slow recovery
Naturalness	Naturalness
	Importance for threatened, endangered or declining species and/or habitats
	Biological productivity
	Biological diversity

Features within the Offshore Pacific Bioregion were evaluated against 8 criteria using a CBD template modified by the authors (Table 2). The EBSA evaluation included a literature review, relevant data analyses, and an assessment table used to assess areas against each of the CBD criteria. A template developed by the CBD Secretariat and applied in an earlier workshop (CBD 2014) was modified and used to structure the literature review and any data analyses in this assessment. Each EBSA template was reviewed and revised as needed by workshop participants. Consensus was then achieved on the relative rankings of each criterion and the overall merits of the feature as an EBSA. A feature was deemed ecologically or biologically significant if it scored high on any of the three core DFO criteria, or if the area/feature scored medium or high on the majority of criteria as recommended in DFO (2004). Boundaries of identified features or areas were discussed and altered where necessary. Insufficient time and information meant that not all areas within the Offshore Pacific Bioregion were evaluated against the CBD/DFO criteria. Participants identified several priorities for further evaluation which are noted in the review of each Chapter below.

Table 2. The CBD evaluation template, modified to include DFO criteria.

CBD EBSA Criteria (Annex I to decision IX/20)	**Description (Annex I to decision IX/20)**	**Ranking of criterion relevance (please mark one column with an X)**			
		No information	**Low**	**Medium**	**High**
Uniqueness or rarity	Area contains either (i) unique ("the only one of its kind"), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.				
Rationale:					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive. Areas that have important fitness consequences.				
Rationale:					
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.				
Rationale:					
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.				
Rationale:					
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.				
Rationale:					
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats,				

CBD EBSA Criteria (Annex I to decision IX/20)	Description (Annex I to decision IX/20)	Ranking of criterion relevance (please mark one column with an X)			
		No information	Low	Medium	High
	communities, or species, or has higher genetic diversity.				
Rationale:					
Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.				
Rationale:					
Importance for species aggregation (DFO criterion)	Area where species aggregation for important life cycle functions (breeding/spawning, rearing, feeding, migrating, etc).				
Rationale:					

The purpose of this review was to assess features and areas in Canada's Offshore Pacific Bioregion using criteria established by the CBD and DFO. Five types of features in the Offshore Pacific Bioregion were evaluated, including the seafloor and water column, against the seven CBD and five DFO EBSA criteria. Specifically, this included hydrothermal vents, seamounts, the continental slope, abyssal/bathypelagic waters, and pelagic/surface waters. Known marine features and their associated fauna were defined, and the processes that create or maintain these features if known were described. Authors evaluated the features with respect to each of the EBSA criteria, giving each criterion a score in terms of importance (high, medium, low, or no information), and proposed the boundaries of features or areas that meet EBSA criteria. In the case of the continental slope, although portions of this area were evaluated by Clarke and Jamieson (2006b) and Jamieson and Levesque (2014), authors re-evaluated the slope in terms of its benthic attributes because previous analyses had focused predominantly on oceanographic (pelagic) features.

WRITTEN REVIEWS

A summary of the major issues identified in the meeting by the reviewers is included below, and full reviews appear in Appendix E.

REVIEW OF ENTIRE WORKING PAPER

Reviewer: Karin Bodtker

The reviewer congratulated the authors on pulling together a large amount of information for the purposes of this review.

- Working paper needs a Methods section. The presentation given this morning helped to clarify what was done to arrive at a criteria score.
- How were proposed EBSA boundaries rationalized?
- The reviewer suggested that the paper should document uncertainties by assigning a confidence rating to each ranking score based on the amount of information currently available.
- New geospatial materials were suggested for consideration.
- Reviewer called for the confusion on the names of regions and boundaries within DFO and CSAS to be rectified.

Reviewer: Michelle Greenlaw

The reviewer stated that in general, the purpose of the papers was clear and the authors conveyed caveats and uncertainties. However several additional points requiring attention or clarification were raised:

- No discussion on how authors came to choose the areas in the assessment. Were any left out, and if yes, why?
- Need more definitions of the offshore region, and the proportion of these areas that have been surveyed and where.
- Discussion/explanation needed to describe how proposed EBSA were scored against the EBSA criteria and what guidance was used. On a finer level, what are the definitions of low, medium and high? How are they different?
- Clarification on the author's interpretations of CBD criteria and the DFO criteria would be helpful. More discussion why the authors use both the DFO and CBD criteria.
- How will the process be modified with the addition of future data or conflicting or corroborating data in the future?
- Need more discussion and summary in the document to aid the reader to understand the results of the assessment.

Author response

Authors provided some clarification on ranking and evaluating a criterion. To date, there is no specific guidance on how to make decision on which rank applies. The authors applied the following logic:

- Low: the area or feature was relatively unimportant for a given criterion
- Med: the area or feature was moderately important for a given criterion
- High: the area or feature was highly important for a given criterion

From the 2004 DFO guidance paper, an area meets the EBSA if it is scored high on uniqueness aggregation or fitness consequences. An EBSA can be designated if there are a number of criteria that score a combination of medium or high.

DFO guidance suggests scoring criteria by comparing information relative to the region under assessment and that you can extrapolate from one area to another when data are limited.

Authors defined feature or area boundaries based on evidence in the literature. Applying a bathymetric assessment was not undertaken due to low resolution in the data.

REVIEWS OF INDIVIDUAL CHAPTERS

Hydrothermal vents

Reviewer: Verena Tunnicliffe

The reviewer suggested highlighting and clarifying the fundamental geological differences in vent environments to accurately reflect status of vent features including a complete map showing confirmed, inferred, and inactive sites. She discussed the importance of the variability of biological diversity among vent sites. For example, Middle valley is globally unique, whereas smaller vent sites have a subset of the diversity found at larger sites. The Canadian vent system is a good site globally as it demonstrates how diversity builds up across the system over time. The Baby Bare vent/seamount and its relationship with Grizzly Bare was discussed as an important and unique feature that requires special acknowledgement.

The reviewer requested justification of the 40km boundary either side of the ridge and considered the scoring of criteria appropriate. She suggested acknowledging growing interest in seafloor massive sulphur deposits for exploitation at hydrothermal vents.

Author response:

Inactive sulphides have unique communities but they are not well described. Information is lacking to score vents independently. Inactive sites will be included in the boundary based on existing communities.

Hydrothermal Vent Criteria Review

Table 4. Hydrothermal Vent Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	High	Good evidence for sites that have been studied. Vents are unique or unusual geomorphological features, and unique worldwide. Some sites are venting, others not. Some well-studied, some not.
Special importance for life history stages of species	High	Consensus
Importance for threatened endangered or declining species and/or habitats	No information	Consensus
Vulnerability, fragility sensitivity or slow recovery	High	Consensus
Biological productivity	High	Consensus
Biological diversity	High	Vent systems are distinct compared to everything in the area. They are not necessarily more diverse than other systems.
Naturalness	High	Consensus
Importance for species aggregation	High	Consensus

Hydrothermal Vent Boundary Review

Participants agreed that the Grizzly Bare/Baby Bare feature meet criteria as seamounts and hydrothermal vents and were described as a special ‘complex’.

Experts discussed that once you get away from the vent sites, the community dynamic and structure change completely. Vent-associated animals do not survive away from the sites. Many species inhabit the plume and are not necessarily associated with the vent itself.

Author response

The ridge was included in the boundary because vents can emerge from the ridge. This boundary was selected because the system is dynamic and the frequency with which EBSAs are reviewed is relatively long. Criteria were evaluated for vent sites only.

Vents in American waters were included for illustrative purposes to show a contiguous system.

Seamounts

Reviewer: Emily Rubidge

There seemed to be lot of maps and tables in the paper. It was difficult to know how they contributed to the assessment of EBSA criteria.

Better justification for 20km boundary required.

Did you use any other criteria other than the seamounts being named?

Be clear that this assessment is an extrapolation to many seamounts from a few, and that knowledge is limited to ‘shallow’ seamounts. The chapter relies on information from Cobb seamount. Authors could incorporate any available information from Bowie seamount.

Reviewers: Karin Bodtker and Michelle Greenlaw

Manson 2009 created a spatial inventory of large undersea structures for this coast. Authors should consider including this work.

Why only named seamounts? Why a 20m buffer?

Author response

See Boundary discussion

Seamounts Criteria Review

Table 5. Seamounts Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	High	Consensus
Special importance for life history stages of species	Medium	Consensus
Importance for threatened endangered or declining species and/or habitats	No information changed to Medium	With the exception of Bowie Seamount, most of the other seamounts, particularly deep seamounts, are data poor. Medium for shallow seamount and low for deep? Precautionary approach accepted: medium for feature as a whole. Bowie Seamount has known occurrences of endangered and threatened seabirds. Without the seamounts, their migration or feeding routes would be changed. Deeper seamounts provide habitat for SARA listed fish (i.e. Thornyheads).
Vulnerability, fragility sensitivity or slow recovery	High	Consensus
Biological productivity	Medium changed to High	Decision is driven by shallow seamounts where there is more information. Agreed that group would score this as a high based on precautionary principle.
Biological diversity	High	Consensus
Naturalness	Medium	Consensus
Importance for species aggregation	Medium	Consensus

Seamounts Boundary Discussion

The 20km boundary around named seamounts was chosen because of insufficient data regarding the footprint around individual seamounts, and it corresponds to the approximate diameter of circles surrounding Bowie, Hodgkins and Peirce Seamounts within the SGaan Kinglas Bowie Seamount Marine Protected Area.

Participants discussed the justification for a larger boundary (currents, productivity influence) and agreed that a 30km buffer better reflects the influence of seamounts on associated species communities and habitats.

Author response

Authors did not use bathymetric analysis to determine boundary. Datasets used by Manson (2009) were not available to authors until shortly before the meeting. Use of bathymetry data to

identify seamounts would require a separate analysis. Unnamed seamounts were not proposed because existence is unconfirmed. Most named seamounts are very close to seamounts identified by Manson 2009.

Baby Bare and Grizzly Bare Complex

Participants agreed to a 30km boundary around Baby Bare and Grizzly Bare features, calling it the Baby Bare - Grizzly Bare complex.

Continental Slope

Reviewers: Karin Bodtker and Michelle Greenlaw

The description of how proposed EBSAs were bounded is inconsistent and absent in the case of the slope and the pelagic EBSAs. Does the information from Manson change your opinion?

Author response

Authors wanted to repeat the Manson analysis to provide more information but did not receive data in time for the meeting. The Manson work helped to identify southern canyons and northern valleys but there are many features that span the entire slope area. Its value was acknowledged but the analysis did not change any proposed boundary or feature evaluation. Settling on the entire unit was to ensure the features we know about and potential features were captured. Given the results from Manson (2009), they suggested discussing other features within the slope that might be designated (i.e. canyons).

Criteria ranks were based on the entire area. Authors compared the slope to the abyssal plain and the shelf above the slope.

General discussion

Participants discussed whether the slope region was too large to consider as one EBSA and whether there were features within the suggested boundary that could be identified as separate EBSAs. The conclusion was that there was not sufficient information presented in the working paper to evaluate additional features. Further research was suggested to evaluate additional features within the slope region for future review. Participants raised the alternate solution discussed in DFO (2011) where it was recommended to develop heat maps to determine the importance of large features and processes within an EBSA boundary.

The proposed EBSA remained as one unit with additional slope features described:

- Canyons
- Valleys
- Methane hydrates (risk of extraction)
- Plumes
- Oxygen minimum zone
- Ridges
- Areas of high bathymetric relief off the west coast of Haida Gwaii
- The Hog Back off Haida Gwaii
- Scott islands

Continental Slope Criteria Review

Table 6. Continental Slope Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	Medium	Consensus
Special importance for life history stages of species	Medium changed to High	The upper slope is one of the most data rich areas. Evidence from groundfish surveys – important breeding and spawning area. Suggestion that this area is used by sperm whales for breeding. Evidence from multiple different taxa at various food web levels.
Importance for threatened endangered or declining species and/or habitats	Medium changed to High	Changed to high based on importance for air breathing animals.
Vulnerability, fragility sensitivity or slow recovery	Medium changed to High	Low oxygen zone, slow recovery, potential impacts from climate change, in some parts, for some species. Large portionhighly susceptible to human degradation If we were to consider climate change anoxia and acidification would change it to high.
Biological productivity	Medium	Productivity considered high relative to the adjacent abyssal waters and low(er) relative to the adjacent shelf break waters. The comparison between this area and the abyssal plain and the shelf break led the group to agree on a medium ranking. The lack of information on the abyssal plane decreased the level of confidence in this ranking.
Biological diversity	Medium changed to High	There is higher diversity than the abyssal plain and the shelf due to the depth range of the slope.
Naturalness	Low changed to Medium	There is evidence supporting a low ranking at shallow depths. There is also evidence supporting a medium ranking of naturalness for deeper depths. Applied precautionary principle.
Importance for species aggregation	High	There is strong evidence for air breathing organisms and groundfish.

Continental Slope Boundary Review

Earlier EBSA processes that included the continental slope evaluated the area from the shelf break in towards the coast (Clarke and Jamieson 2006a,b; Jamieson and Levesque 2014). The boundary is described as the area between the shelf break out to the base of the slope. Participants agreed the 200m isobath was an appropriate definition for the shelf break.

Bathypelagic and Abyssal Plain

Reviewers: Karin Bodtker and Michelle Greenlaw

Manson (2009) offered additional features to add to the discussion.

Vulnerability and biological diversity rankings warrant further discussion.

Abyssal plain contains several basins with potential for oil and gas exploration and development.

Bathypelagic and Abyssal Plain Criteria Review

Table 7. Bathypelagic and Abyssal Plain Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	Low	The abyssal plain is poorly sampled. The low amount of data that is available seems to indicate that the ranking should be low, but this may change as more data become available.
Special importance for life history stages of species	No information	Consensus
Importance for threatened endangered or declining species and/or habitats	No information	Information is only available for species we measure. Based on the species we measure, we don't expect this area to be used by them, but there is no information to confirm this. There is no information to know if species are declining.
Vulnerability, fragility sensitivity or slow recovery	Low changed to No information	There is low confidence regarding the amount of data available to determine the relative proportion of sensitive habitat. If compared with other adjacent environments (e.g. slope), would this area recover more slowly? Deep water / abyssal black corals are not very abundant, but are very fragile, and slow to recover There is little data to determine whether they are a large component of the environment, or if they are very sparse. The precautionary approach suggests no information.
Biological productivity	Low	Confident that there is no chemosynthesis and low primary productivity relative to adjacent areas.
Biological diversity	Low	Most evidence supports the ranking of a low biological diversity. Participants indicated mixed level of confidence in the evidence; there is some evidence that local diversity of some species (zooplankton, ctenophores) can be high.
Naturalness	High	There was general confidence with the high ranking, with some discussion regarding ocean dumping sites.
Importance for species aggregation	No information	Consensus

Bathypelagic and Abyssal Plain Boundary Review

There is no EBSA recommended for this area.

PELAGIC WATERS

Table 8. Haida Eddy Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	Medium changed to High	Compared with local, regional and global – there may be others: in the North Pacific there are the Haida eddies and Sitka eddies. Based on the information we have there is some uncertainty regarding how unique they are globally. There was confidence that it is unique from a Pacific region perspective. The Haida eddy carries larvae to shelf - source sink relationship. Other eddies are not carrying organisms from one place to and other, increases unique character.
Special importance for life history stages of species	High changed to Medium	Unsure there is evidence that this is a source-sink relationship that is required for a population to survive. The inputs are likely helpful to some populations, may potentially be harmful to other populations…but it is not certain that it is the only source or the only method of transport. Lower confidence: sources of information are not specifically about the Haida eddies but about pelagic in general; and there is little evidence the source-sink relationship for larval/species distribution is required for a population to survive.
Importance for threatened endangered or declining species and/or habitats	No information	Consensus
Vulnerability, fragility sensitivity or slow recovery	Low	Little or no information available; higher uncertainty regarding the level of vulnerability. The eddy is seasonally ephemeral. Source of uncertainty is the difference between the eddy and pelagic system as a whole.
Biological productivity	Medium	Precautionary approach and known trophic connections justifies a ranking of medium.
Biological diversity	Medium	Consensus Marine mammal information is specific to the eddy; in spite of pelagic area being lower biological diversity than coastal and benthic.
Naturalness	Medium	Eddy would potentially concentrate pollutants/microplastics. Speculative consideration, based on plankton concentration. Ephemeral structure – also may increase its ‘naturalness’ though.
Importance for species aggregation	Medium	There is no question that the margins of the eddies result in species aggregation. Seabirds found in pelagic waters may be transiting to higher productivity areas. Lower trophic levels may be aggregated (e.g. zooplankton, squid) in the eddy at the margins.

Haida Eddy Boundary Review

The Haida Eddy is large, and its annual movement is not predictable. It was agreed that the boundaries should reflect the variability in location and trajectory of the Haida Eddy.

Participants discussed including multiple EBSA boundaries with lower probabilities of the eddy's path extending from the origin on the map.

Table 9. North Pacific Transition Zone Criteria Review

Criteria	Score	Discussion on Scoring
Uniqueness or rarity	Low changed to Medium	Large feature occupying a portion of the Pacific region seasonally. Only two places where it intersects with the continental shelf. On a local and regional scale it is unique; on a global scale not unique.
Special importance for life history stages of species	High	A large number of species migrate from the subtropical frontal zone or from subarctic domain and spend their critical life stages in the NPTZ.
Importance for threatened endangered or declining species and/or habitats	High	Participants noted that we don't know all of the species that use the area and/or if they are declining. There is a lot of tracking of seabirds and megafauna data driven by turtles and whales.
Vulnerability, fragility sensitivity or slow recovery	Low	Higher trophic level species may use this area and they are slower to recover (whales). Climate change may affect both the physical properties and biological properties. Unclear whether these changes would be specific to this feature and there is a lack of evidence to link this to a vulnerability of the transition zone.
Biological productivity	High	Consensus. Higher confidence regarding the evidence associated with the productivity in the NPTZ
Biological diversity	Medium changed to High	Lower confidence in the evidence/specifics indicated by the authors. Northern and southern species converge in the zone suggesting an area of high diversity…but there is minimal evidence specific to this area.
Naturalness	Medium	Transport vector for Aquatic Invasive Species, debris, radiation … uncertain. Are there issues around non-indigenous species? Ballast, pollution?
Importance for species aggregation	High	Available evidence isn't specific to the Pacific region portion of the NPTZ. Important feeding area and migration pathway in Pacific region.

North Pacific Transition Zone Boundary Review

This feature is seasonal in Canadian Pacific waters. The chlorophyll front is a feature within the EBSA. The boundaries are set to capture the front moving north to south.

CONCLUSIONS

Participants accepted the working paper with suggested changes.

Participants agreed that all hydrothermal vents (active, inactive), all known seamounts, the continental slope, Haida Eddy and NPTZ all meet criteria as EBSAs.

The Bathypelagic and Abyssal Plains area did not comprise one or more EBSAs in part because there was not enough information.

The maps of the EBSAs are key outputs of the meeting.

Lessons learned: Discuss approach, successes and challenges of combining the CBD and DFO criteria, explain how scoring was completed, clarify CBD criteria descriptions, and assess confidence of rankings systematically in future.

Future improvements could include:

- Evaluation of features associated with the continental slope
- Improved explanation of the classes of seamounts and hydrothermal vents
- Clear description of low, medium, high ranks
- "No information" needs to be accompanied by a warning or an explanation.

SOURCES OF UNCERTAINTY

Data richness varied among features that were assessed and influenced the consistency in criteria assessment.

Improved bathymetric resolution may influence the evaluation of several EBSAs identified here. For example; information on unnamed seamounts is limited to their locations, and features that have an estimated height of 1000m or more.

Comprehensive and high resolution bathymetry data would help to clarify the EBSA boundaries and possibly reveal new features.

DFO suggests reviewing the offshore EBSAs every 5 years. Participants anticipated more data from slope and seamounts would become available in the near future.

REFERENCES

CBD. 2014. Report of the North Pacific Regional Workshop to facilitate the description of ecologically or biologically significant areas. UNEP/CBD/RW/EBSA/NP/1/4. 187p. (Accessed 13 April 2016)

Clarke, C. and Jamieson, G. 2006a. Identification of ecologically and biologically significant areas in the Pacific North Coast Integrated Management Area: Phase I–Identification of important areas. Can. Tech. Rep. Fish. Aquat. Sci. 2678.

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DFO 2012. Evaluation of proposed ecologically and biologically significant areas in marine waters of British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/075

Jamieson, G. and Levesque, C. 2014. Identification of Ecologically and Biologically Significant Areas on the West Coast of Vancouver Island and the Strait of Georgia, and in some nearshore areas on the North Coast: Phase II – Designation of EBSAs. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/101. vii + 36p.

UNEP/CBD. 2008. Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting IX/20. Marine and coastal biodiversity COP/DEC/IX/20. 12p. (Accessed 27 May 2016)

APPENDIX A. TERMS OF REFERENCE

IDENTIFICATION OF ECOLOGICALLY AND BIOLOGICALLY SIGNIFICANT AREAS (EBSAS) IN THE PACIFIC OFFSHORE BIOREGION

Pacific Regional Science Advisory Process

February 11-12, 2015
Nanaimo, British Columbia

Chairperson: Karen Hunter

Context

Under Canada's Oceans Act (1997), "conservation, based on an ecosystem approach, is of fundamental importance to maintaining biological diversity and productivity in the marine environment". The Act provides the legislative framework for an integrated ecosystem approach to management in Canada's oceans, particularly in areas considered ecologically or biologically significant. DFO has developed guidance for the identification of ecologically or biologically significant areas (EBSA) (DFO 2004), and has endorsed the scientific criteria used by the Convention on Biological Diversity (CBD) for identifying ecologically or biologically significant marine areas as defined in Annex I of Decision IX/20 of its 9th Conference of Parties (UNEP/CBD, 2008).

Identification of EBSAs in the Canadian Pacific Offshore Bioregion could inform a broad range of management and policy issues related to marine use in the Pacific Region. Specifically, EBSAs identified in the Pacific Offshore Bioregion's waters will serve as a key component of the knowledge base for: i) development activities and marine use planning; ii) the development of Canada's network of Marine Protected Areas (MPA) under the Oceans Act; and, iii) facilitating the implementation of DFO's Sustainable Fisheries Framework under the Fisheries Act. In addition, this information will be valuable to other federal Departments and the Province of British Columbia, who are responsible for the management of marine activities in this region (e.g., resource extraction, marine shipping, ocean dumping, spill response, cable laying, land use planning, etc.).

EBSAs were recently identified in three marine Pacific Bioregions: Northern Shelf, Southern Shelf, and Strait of Georgia (DFO 2012), and reviewed in a Canadian Science Advisory Secretariat (CSAS) regional peer review held in February 2012. However, potential Pacific Offshore Bioregion EBSAs from the shelf break to the Exclusive Economic Zone (EEZ) boundary were not addressed in the earlier CSAS process. A number of productive and ecologically unique features within this Pacific Offshore Bioregion may meet EBSA criteria defined by DFO, and are contiguous with high seas EBSAs proposed at a Convention on Biological Diversity workshop held in Moscow in March 2013. The Canadian portion of these EBSAs includes seamounts, hydrothermal vents and other oceanographic features that have not yet been evaluated against EBSA criteria.

DFO Oceans Program has requested that Science Branch provide an evaluation of the areas from the shelf break to the boundary of Canada's EEZ, including the seafloor and water column, against EBSA criteria used by DFO and the CBD, to provide advice regarding the identification of ecologically and biologically significant areas (EBSAs) in the Pacific Offshore Bioregion. It is not the objective of this advisory process to review the specific methods for identifying ecologically and biological significant areas; these have been reviewed as part of national DFO advisory processes (DFO, 2004; 2011).

This assessment, and advice arising from this Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR), will be used to inform a broad range of management and policy issues related to marine spatial planning in Pacific Region, including the development of MPA networks.

Objectives

The objective of this CSAS Regional Peer Review is to provide advice respecting the identification of ecologically and biologically significant areas (EBSAs) in the Pacific Offshore Bioregion.

The following working paper will be reviewed and provide the basis for discussion and advice for two objectives:

Ban, S., Curtis, J.M.R., St. Germain, C., Therriault, T. Perry, R.I. Identification of ecologically and biologically significant areas in the Pacific Offshore Bioregion. CSAP Working Paper 2013/OCN05.

1. Provide evidence and justification indicating which areas or features in the Pacific Offshore Bioregion from the shelf break to Canada's EEZ, including the seafloor and water column, meet EBSA criteria, using the best available information and the criteria defined by DFO (DFO, 2004) and the CBD.
2. For the Pacific Offshore Bioregion areas or features identified in Objective 1: propose EBSA boundaries (including maps), and indicate the level of confidence associated with the delineation of identified EBSAs, including sources of uncertainty.

Expected publications

- CSAS Science Advisory Report (1)
- CSAS Research Documents (1)
- CSAS Proceedings (1)

Participation

- DFO Science Branch
- DFO Fisheries Management Branch
- DFO Ecosystem Management Branch
- Province of BC
- Commercial and recreational fishing interests
- First Nations
- Non-government organizations
- Academia

References Cited

DFO 2013. Evaluation of proposed ecologically and biologically significant areas in marine waters of British Columbia. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2012/075.

DFO. 2011. Ecologically and Biologically Significant Areas – Lessons Learned. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2011/049.

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UNEP/CBD. 2014. Report of the North Pacific Regional Workshop to facilitate the description of ecologically or biologically significant areas. UNEP/CBD/RW/EBSA/NP/1/4. 187p. (Accessed 27 May 2016)

UNEP/CBD. 2008. Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting IX/20. Marine and coastal biodiversity COP/DEC/IX/20. 12p. (Accessed 27 May 2016)

APPENDIX B. WORKING PAPER ABSTRACT

Canada has committed to identifying and protecting Ecologically and Biologically Significant Areas (EBSAs) within its territorial waters. Five habitat types (hydrothermal vents, seamounts, the continental slope, abyssal/bathypelagic waters, and pelagic/surface waters) in Canada's Offshore Pacific Bioregion were assessed against eight EBSA criteria established by Fisheries and Oceans Canada and the Convention on Biological Diversity. All known or inferred active and inactive hydrothermal vent fields and their associated structures, vent fluids, gases, and biological communities ranked as highly unique, vulnerable, productive, diverse, natural, and important for life history stages, species and species aggregation. All named seamounts, including the seafloor, substrata, and associated water column, were identified as EBSAs, as well as the Baby Bare – Grizzly Bare complex. Seamounts ranked highly as unique, vulnerable, diverse, natural, and important for species aggregation. The continental slope was assessed as a whole and ranked highly as vulnerable, diverse, and important for life history stages/species, threatened, endangered or declining species or habitats, and for species aggregation. Two EBSAs in the pelagic/surface waters were identified: the Haida Eddy and the North Pacific Transition Zone (NPTZ). The Haida Eddy was ranked as high for uniqueness and medium in terms of productivity, diversity, naturalness, and importance for life history stage or species, and species aggregation. The NPTZ ranked highly as productive, diverse, and important for life history stages or species, threatened, endangered or declining species or habitats, and for species aggregation. The abyssal/bathypelagic habitats did not meet EBSA criteria. The hydrothermal vents and NPTZ EBSAs in Canada's Offshore Pacific Bioregion are contiguous with corresponding EBSAs identified in international waters of the North Pacific Ocean, and seamount EBSAs in Canada are consistent with eight EBSAs identified in the northeast Pacific Ocean.

APPENDIX C. ATTENDEES

Last Name	First Name	Affiliation
Alidina	Hussein	World Wildlife Federation
Ban	Stephen	University of Victoria
Barron	Alexandra	CPAWS
Bodtker	Karin	Living Oceans Society
Boldt	Jennifer	DFO Science
Boutillier	Jim	DFO Scientist Emeritus
Coopper	Tola	DFO Fisheries Protection Program
Curtis	Janelle	DFO Science
Davies	Sarah	DFO Science
Evanson	Melissa	DFO Fisheries Management
Gauthier	Maeva	University of Victoria
Greenlaw	Michelle	DFO Science, St. Andrews
Hargreaves	Marilyn	DFO Science, Centre for Science Advice Pacific
Hillier	Joy	DFO Oceans, Habitat and Enhancement
Holmes	John	DFO Science
Hunter	Karen	DFO Science
Ibey	Hilary	DFO Oceans, Habitat and Enhancement
Jones	Greg	Environment Canada
MacDougall	Lesley	DFO Science, Centre for Science Advice Pacific
Morgan	Ken	Environment Canada
Perry	Ian	DFO Science
Pinnell	Nadine	DFO Science
Rubidge	Emily	University of Victoria
St. Germain	Candace	Ocean Blue Consulting
Therriault	Tom	DFO Science
Thompson	Jason	Haida Oceans Technical Team
Tunnicliffe	Verena	University of Victoria
Workman	Greg	DFO Science

APPENDIX D. MEETING AGENDA

Canadian Science Advisory Secretariat
Centre for Science Advice Pacific
Regional Peer Review Meeting (RPR)

Identification of Ecologically and Biologically Significant Areas (EBSAs) in the Pacific Offshore Ecoregion

February 11-12, 2015
Pacific Biological Station

Chair: Karen Hunter

DAY 1 – Wednesday, February 11th, 2015

Time	Subject	Presenter
0900	Introductions Review Agenda & Housekeeping CSAS Overview and Procedures	Hunter
0915	Review Terms of Reference and Process for This Review	Hunter
0930	Presentation of Working Paper	Ban, Curtis et al.
1030	***Break***	
1045	CHAPTER 2: Hydrothermal Vents Overview of Written Reviews	Tunnicliffe, Bodtker, Greenlaw
1100	Criteria assessment/proposed EBSA boundary discussion	RPR Participants
1200	***Lunch Break***	
1300	CHAPTER 3: Seamounts Overview of Written Reviews	Rubidge, Bodtker, Greenlaw
1315	Criteria assessment/proposed EBSA boundary discussion	RPR Participants
1430	***Break***	
1445	CHAPTER 4: CONTINENTAL SLOPE Overview of Written Reviews	Greenlaw Bodtker
1500	Criteria assessment/proposed EBSA boundary discussion	RPR Participants
1615	Recap of Day 1 and Review of Agenda Day 2	Hunter
1630	***Adjourn for the day – Thank you for your participation***	

DAY 2 – Thursday, February 12th, 2015

Time	Subject	Presenter
0830	Introductions Review Agenda & Housekeeping Review Status of Day 1/Development of SAR	Hunter
900	CHAPTER 5: BATHYPELAGIC AND ABYSSAL ZONE Overview of Written Reviews	Greenlaw, Bodtker
915	Criteria assessment (no proposed EBSA)	RPR Participants
1000	***Break***	
1015	CHAPTER 6: PELAGIC AND SURFACE WATERS Overview of Written Reviews	Greenlaw, Bodtker
1030	Criteria assessment/proposed EBSA boundary discussion	RPR Participants
1100	• Review of Any Remaining Issues and Results APPLICABLE TO ENTIRE WORKING PAPER • Develop Consensus on Paper Acceptability & Agreed-upon Revisions	RPR Participants
1200	***Lunch Break***	
1300	*Science Advisory Report (SAR)* Develop consensus on the following for inclusion: • Sources of Uncertainty • Results & Conclusions • Additional advice to Management (as warranted)	RPR Participants
1430	***Break***	
1450	*Science Advisory Report (SAR)* • Continued	RPR Participants
1545	Next Steps • SAR review/approval process and timelines • Research Document & Proceedings timelines • Other follow-up or commitments (*as necessary)*	Chair
1615	Other Business arising from the review	Chair & RPR Participants
1630	***Adjourn meeting – Thank you for your participation***	

APPENDIX E. WRITTEN REVIEWS

KARIN BODTKER, LIVING OCEANS SOCIETY

General Comments (Entire Paper Reviewed)

The authors have collated and presented an immense amount of information and data relevant to the physical, biological and ecological characteristics of the Pacific Offshore region of Canada's marine environment to inform the identification of EBSAs. This is a considerable achievement for an area that is arguably less well-studied than most other types of habitat on our planet. Numerous maps and tables help to present a diverse collection of data. I do not profess to be an expert in the data available on species communities or distributions in the study area. Therefore, my comments are mostly concerned with the presentation and analysis of material such that methods are rationalised, conclusions are supported, and uncertainties are recorded.

Having said that, I was able to identify two sources of information that I felt were missed or overlooked in this work. The additional information that I submit to the authors for their consideration includes the following:

1. Manson, M.M. 2009. Small scale delineation of northeast Pacific Ocean undersea features using benthic position index. Can. Manuscr. Rep. Fish. Aquat. Sci. 2864: iv + 16 p.

This work created a spatial inventory of large undersea features in the northeast Pacific Ocean, including features relevant to the slope and abyssal zones (i.e., canyon and valley features along the entire slope, hills, knolls, ridges, seamounts, troughs, basins, valleys and abyssal plains).

2. From Jamieson, G.S. and Levesque, C. 2014. Identification of Ecologically and Biologically Significant Areas on the West Coast of Vancouver Island and the Strait of Georgia, and in some nearshore areas on the North Coast: Phase II – Designation of EBSAs. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/101. vii + 36 p.

   One EBSAs identified along the continental slope in this previous EBSA process was omitted in the working paper under review (i.e., page 30, Brooks Peninsula Jets is missing from Figure 4.2, Table 4.3 and from the discussions).

Overall, the material presented in the working paper can be used to meet the two objectives from the Terms of Reference, with a major exception. Indications of the level of confidence associated with delineation of proposed EBSAs are not provided, neither are sources of uncertainty. Objectives are:

1. Provide evidence and justification indicating which areas or features in the Pacific Offshore Ecoregion from the shelf break to Canada's EEZ, including the seafloor and water column, meet EBSA criteria, using the best available information and the criteria defined by DFO (DFO, 2004) and the CBD.
2. For the Pacific Offshore Ecoregion areas or features identified in Objective 1: propose EBSA boundaries (including maps), and indicate the level of confidence associated with the delineation of identified EBSAs, including sources of uncertainty.

In order to address the lack of information about confidence levels, the authors may want to consider adding a confidence rating to each ranking score, which would be based on the amount of information currently available to make the assessment. Currently, there is no way to distinguish between a rank based on abundant data and one based on very few data. The inherent level of uncertainty is not transparent and needs to be presented somehow.

In addition there are two areas where the conclusions/recommendations about specific EBSAs are unclear. The extent of a proposed EBSA for the continental slope zone is unclear because the abstract and the summary (p. 112) differ in their statements (i.e., is it the whole slope or the canyons?). It is also not clear if and why unnamed seamounts are not proposed as EBSAs in addition to the named seamounts. The feature description refers to all seamounts meeting the criteria, but the maps illustrate only named seamounts with buffers as proposed EBSAs.

Comments on presentation and analysis of material

1. The purpose is not clearly stated in the abstract, or in the introduction. In the abstract it says the region is assessed against EBSA criteria for five habitat types and the introduction says the "report evaluates five habitat types in the ...region against the CBD and DFO EBSA criteria." The stated purpose seems to be the assessment, rather than the conclusion one might draw from that, or the identification of EBSAs. Further, the abstract never spells out what areas or features are proposed or identified as EBSAs and why, but it does detail the results of assessments against criteria.

   It is still somewhat unclear to me after re-reading the Terms of Reference (ToR) and the working paper introduction and abstract several times, whether the working paper was meant to identify and delineate EBSAs (as suggested at the very end of the introduction, p 1-2), or whether the working paper was intended to provide a basis for discussion and advice (e.g., ToR pg 2) and the decision on EBSA recommendation would take place at the Review Meeting. I will proceed with this review assuming the former, as that is my experience with other CSAP working papers.

2. There are significant gaps in the methods description and I recommend adding a methods section to clarify and answer questions such as these:

   a. How was the list of ecosystems/habitat types derived?

   b. What criteria were used to identify the "important" marine features within each ecosystem?

   c. How was the ranking for each feature/area against each criterion done? As a team of authors? Subjective assessment by area experts? Using some criteria provided in the form by the CBD?

   d. How were boundaries for each proposed or identified EBSA chosen?

I acknowledge that currently the methods are summarised at the end of the introduction section: "For each of these ecosystems/habitat types, we define the important marine features and their associated fauna, review the processes that create or maintain these features, evaluate these features with respect to each of the EBSA criteria, giving each criterion a rank of relevance (high, medium, low, or no information) to the overall designation, and define the boundaries of features or areas that meet EBSA criteria." I am suggesting that this be filled out with more detail and put in a separate methods section so that readers can quickly locate that content.

3. I found some inconsistencies among the chapters assessing different zones/areas, especially in terms of the content of a few of the subsections. Improvements here would increase the readers' access to certain types of information and the overall readability.

   a. For example, in each chapter the sub-section where EBSAs are proposed and described varies.

      i. A hydrothermal vent EBSA is proposed in the 'location' section (2.2).

ii. EBSAs related to seamounts and the pelagic zone are proposed in the 'feature description' section (3.3 and 6.3). This section is also used to state that no EBSAs are proposed in the bathypelagic/abyssal zone (5.3).

iii. The Slope chapter never mentions any proposed EBSA, while in the abstract it says "submarine canyons are identified as EBSAs," and in the summary (p 112) it says the entire continental slope is an EBSA, but no mapped region corresponding to the entire slope or the canyons of the slope is illustrated in Figure 7.1, the boundaries of all EBSAs identified.

b. The description of how proposed EBSAs were bounded is also inconsistent and absent in the case of the slope and the pelagic EBSAs. When delineations/boundaries where proposed, the rationale for the method was sometimes lacking (i.e., Why buffer seamounts by 20 km?).

c. Following the description and assessment of proposed EBSAs within each chapter, a statement of conclusion that describes whether each proposed EBSA met sufficient criteria to pass the test would clarify the analysis process.

4. Figure 1.1 should clearly illustrate the study area, the Offshore Pacific Ecoregion/Bioregion. (See my comment about region names and boundaries.)

5. As there is no indication of how the ranking against EBSA criteria was done, I recommend confirming these rankings at the Review meeting.

   In general, I found that the criteria that were comparative (e.g., biological productivity, biological diversity, and naturalness) sometimes used the surrounding area to compare to, sometimes used some other habitat, and sometimes it was not clear. In other words there was no standard baseline or consistent method.

   In addition, I have specific comments or questions about these ranks in particular:

   a. Seamounts, uniqueness: "by definition distinct habitats and unusual features", however page 13 says there are 30,000 seamounts in the Pacific Ocean.

   b. Seamounts, importance for threatened species: "No information", but we know threatened and endangered rockfish are found in the vicinity of seamounts and "there is limited recruitment between seamounts", so I would rank this as med, but with limited information.

   c. Seamounts, naturalness: assessed as medium, compared to inshore and coastal areas... why? Why not compared to the surrounding abyssal plain?

   d. Slope, vulnerability: with rationale listed, why is rank not high?

   e. Abyssal plain, vulnerability: I would argue the slow recovery warrants at least a med rank.

   f. Abyssal plain, biological diversity and productivity: these low ranks in particular need to acknowledge limited data.

   g. Haida eddies, special importance for life-history: The high rank seems speculative, perhaps based on little knowledge specific to the Haida eddies. If the Haida eddies no longer formed, would a population of some species suffer?

   h. North Pacific Transition Zone, special importance for life-history: What is the confidence in this high ranking? Is there a reference for the information that says a large number of species spend their critical life stages in the NPTZ?

i. NPTZ, Importance for threatened species: Again the rationale is lacking a reference; how certain are we of this rank?

Comments on uncertainty and gaps in knowledge

Although there are several places throughout the paper that acknowledge lack of information on zones and particular features or aspects of habitats, I recommend adding a general statement about our state of knowledge of the areas being assessed to the abstract and the introduction. Is limited knowledge the reason that previously used methods to identify EBSAs in the Canadian Pacific were abandoned in favour of the approach used here with templates developed by the CBD Secretariat? If so, acknowledging that would be informative.

The summary section identifying the proposed EBSAs could also use a general statement acknowledging that the work is based on limited understanding. For example, no EBSAs identified in the bathypelagic abyssal zone could be the result of our limited exploration and understanding of this zone.

Comments on outstanding confusion about region names and boundaries

12 Biogeographical units were delineated in 2009 at a national CSAS process (DFO 2009). The figure in that report calls them “ecoregions” and the document refers to them as biogeographical units. The report also identifies 29 Parks Canada “ecoregions”, 17 previously identified marine “ecoregions” (DFO), and 9 “ecoregions” identified by Canadian Council of Resource Ministers (CCRM).

Since 2009, processes to identify EBSAs have referred to the biogeographical units as ecoregions, while somewhere along the way the planning region that coincides spatially with PNCIMA was named the Northern Shelf Bioregion, and MPA network planning is being undertaken by “bioregion.” The 12 bioregions match the 12 biogeographical units spatially. The spatial dataset provided by DFO, national office, calls the delineation bioregions.

- I recommend that this working paper and/or the associated Science Advice Report (SAR) clarify the preferred terminology for the future.

Further, the boundaries in the spatial data for the Northern Shelf and Southern Shelf regions extend to the foot of the continental slope and the Offshore Pacific region extends seaward from there. Essentially this means that the continental slope, as defined in Chapter 4 of this working paper, is contained in regions that were previously assessed for EBSAs and it is not clear why the slope is assessed again as part of this Offshore Pacific region. On the other hand, I acknowledge that verbal instructions/zone descriptions differ from the spatial data file. For example, the ToR for this work says that the Offshore Pacific runs “from the shelf break to the Exclusive Economic Zone (EEZ)” and CSAS (2009) defines a “large Offshore Pacific Zone extending outward from the shelf break which includes the Alaska Gyre, the California Gyre, and a transition zone.”

- I recommend that the authors clarify why their assessment includes the continental slope region, as it is not immediately obvious looking at the lack of overlap with the spatial data for the Offshore Pacific zone.

Detailed comments and suggestions made in the working paper

I provided a series of suggestions and comments in the working paper and made that available to the authors. These comments focused on clarifying language that I found vague or unclear and identifying errors in figure captions and legends.

References:

DFO (2009). Development of a framework and principles for the biogeographic classification of Canadian marine areas, DFO Canadian Science Advisory Secretariat Science Advisory Report 2009/056.

MICHELLE GREENLAW, DFO SCIENCE, MARITIMES REGION

(Full paper reviewed)

The purpose of the meeting is clearly stated in the TOR and in the paper

Where available, the data and methods are adequate to support the conclusions, although I expect there will be some debate at the meeting about how the EBSAs actually score against the EBSA criteria. I found the slope and pelagic sections were the weakest. They had the least amount of supporting information in regards to how the proposed areas met the EBSAs criteria, and how they were delineated. The slope EBSA seemed large, and to possibly have many smaller EBSAs within it. The pelagic EBSAs seem too transitory to designate as EBSAs.

At times I found there was too much supporting information, or supporting information that didn't aid the assessment against the EBSA criteria (particularly in the form of tables and figures). I feel that many of these tables should be removed and the relevant information should be summarized in the text.

The document does little to describe uncertainty and gaps in the assessment, or data available. How will the process be modified with the addition of future data, or conflicting/corroborating data in the future?

The abstract should be limited to essentials of new knowledge, the abstract is longer than the introduction, and contains much of the information that should be in the introduction.

There is possibly too much global background hydrothermal vents.

I found the figures to be too zoomed out, such that I could not read the legends and get a good idea of the distribution of EBSAs in relation to other factors. Maybe include underlay bathymetry on the maps so we can understand where they are. There is no figure for the bioregions, such that I really could not understand where they were. The previously identified EBSAs and MPAs were too hard to see on the map.

There is little discussion/summary in the document that would aid the readers on the results of the assessment, although this may be covered in the SAR.

VERENA TUNNICLIFFE, UNIVERSITY OF VICTORIA

(Hydrothermal Vent Section only)

My comments here are constructed in consideration of what I believe to be the potential use of the document. The extent to which any rewriting takes place would depend on the next steps. I will note up front that there are three large major vent sites in Canadian waters that likely form the biodiversity hotspots for vent organisms. All sites are not created equal. Thus, I emphasize below that this distinction should be made.

Hydrothermal vent habitat is linked so intimately with the geological setting that it is important to highlight the linkages – especially when the next stage of the EBSA process ("The second step is to consider societal values and potential threats in setting management objectives ") should include the mineral interests in the polymetallic sulphide deposits. Some of the world's largest are in Canadian jurisdiction (Hannington 2011; Jamieson 2014). To this end, I suggest that

Table 2.1 include deposit estimates where available. Vent sulphide mining is now upon us. This EBSA will need to keep this issue clearly in focus.

This review should be sure to distinguish active vents from those long dead and therefore unlikely to have EBSA interest.

It should also note that the Baby Bare venting is a very different system with a fauna distinct from the ridgecrest vents (has a non-magmatically driven circulation).

Canadian Juan de Fuca vents were first visited in 1984; many of the 1980s references have been superseded by later studies (e.g. Speer and Rona 1989, Tunnicliffe 1988, CASM 1985 "Chase").

Specific Comments:

1. "The vents in Canadian waters range in depth from 300 m (Dellwood Seamount) to 3200 m (Explorer Deep) (Beaulieu 2010)" These two end members are not vents; they are hydrothermal deposits and the geological setting makes it very unlikely they will reactivate. I suggest the text focus on known active sites.
2. "The ridge valleys host current dynamics that are distinct from those on surrounding abyssal plains" being what? A relatively important point for connectivity – suggest referencing Thomson work.
3. Gorda Ridge: Actually, the Blanco Transform is pretty effective as a dispersal barrier for some species so there is greater isolation of JdF/Explorer (e.g. Johnson 2006)
4. "Vent fields" vs "vent sites" vs "vents". Be consistent (in some paper, I did define them…). A vent field has one main feeder while a site is a group of fields that tend to be affected by the same geological processes. Middle Valley is a site with three fields.
5. "With the exception of Baby Bare Seamount, all known hydrothermal vent fields in the northeast Pacific Ocean occur within 33 km of the main ridge and fault axes (Lavelle, Baker et al. 2003, Beaulieu 2010). The proposed EBSA boundaries (Figure 2.3) include all areas within 40 km of the main ridge" I am not sure I understand whether these numbers are useful; can you confirm their origin? (The Lavelle paper is about currents on Axial – surely not vent distribution). There may be implications in the size of the resultant EBSA …
6. "Venting temperatures up to 375 °C are reported from black smoker chimneys in a vent field in Endeavour…" See Butterfield 1994 paper: >400°C.
7. Table 2.1 is created from Beaulieu's database. I suggest the authors re-organize it to present:
   i. the major axis vent sites along with deposit information; group the ventfields for each site together (e.g. which fields are in the Endeavour MPA site?)
   ii. the small (some only know from dropcams and could be long gone) sites
   iii. the inactive sites
   iv. the offaxis sites
8. I won't really comment on the "Feature Description" section; it builds well to the most important point: the biogeographic uniqueness of the region (actually, the key paper here was Tunnicliffe & Fowler. 1996. You can drop the Tunnicliffe 1997, Jamstec which no one can find anyway). But please note that most of the biological description comes from Endeavour, Axial and Cleft with some more on Explorer. So for the Canadian zone, just the two sites. Thus, it is important to highlight a very different system: Middle Valley. Active

ridge sedimented systems are rare in the world and this one has a huge PMS deposit. There is not a lot on the site but it starts with Juniper 1992 through Black 1997, Grehan & Juniper 1996 to Levin 2009.

9. "Currently there are several mining companies investigating the possibilities of mining seafloor massive sulphides (Scott 2001), but so far none have made this a profitable endeavour." Not so. That is an old reference. Mining is a huge endeavour now with the deep-sea research biology community watching closely. The ISA has now granted prospecting licences in several international areas and there are leases granted for exploration in numerous countries. Actual exploitation agreements exist with Nautilus Minerals in PNG – they will start mining vents next year. This issue is a very big one. To revise this paragraph, start with Boschen 2013. There are meetings worldwide to address approaches to deep-sea mining with PMS deposits leading the concerns. I have particular interest because I believe the Explorer-Juan de Fuca sites are extremely valuable as models for the deposits of interest. Teck Cominco toyed with Middle Valley as a target but the metals market is not there for this grade of deposit.

Section 2.5 the Assessment

Uniqueness: We now know nearly all the vent species at JdF/Expl are unique. The CoML and IFREMER databases document this. Delete "Hydrothermal vents on the East Pacific Rise show similar community succession processes (Shank, Fornari et al. 1998), but the species involved are different as vents of the northeast Pacific Ocean host an endemic assemblage of vent fauna (Tunnicliffe 1988)." and just reference Marcus et al 2009; it covers a large number of the JdF species.

"Area containing habitat for the survival and recovery of endangered, threatened, …" I would note that both Middle Valley and the Endeavour MPA contain species recorded nowhere else in the world.

Black, M.B., Halanych, K.M., Maas, P.A.Y., Hoeh, W.R., Hashimoto, J., Desbruyères, D., Lutz, R.A. & Vrijenhoek, R.C. (1997) Molecular systematics of vestimentiferan tubeworms from hydrothermal vents and cold-water seeps. *Marine Biology (Berlin)*, **130**, 141.

Boschen, R.E., Rowden, A.A., Clark, M.R. & Gardner, J.P.A. (2013) Mining of deep-sea seafloor massive sulfides: A review of the deposits, their benthic communities, impacts from mining, regulatory frameworks and management strategies. *Ocean & Coastal Management*, **84**, 54-67.

Grehan & Juniper, 1996. Clam distribution and subsurface hydrothermal processes at Chowder Hill (Middle Valley), Juan de Fuca Ridge. MEPS 13-105.

Hannington, M., Jamieson, J., Monecke, T., Petersen, S. & Beaulieu, S. (2011) The abundance of seafloor massive sulfide deposits. *Geology*, **39**, 1155-1158.

Jamieson, J.W., Clague, D.A. & Hannington, M.D. (2014) Hydrothermal sulfide accumulation along the Endeavour Segment, Juan de Fuca Ridge. *Earth and Planetary Science Letters*, **395**, 136-148.

Johnson, S.B., Young,C.R., Jones,W.J., Ware´ n, A., Vrijenhoek, R.C. 2006. Migration, isolation, and speciation of hydrothermal vent limpets (*Gastropoda; Lepetodrilidae*) across the Blanco Transform Fault. Biological Bulletin 210, 140–157.

Juniper, S.K., Tunnicliffe, V. & Southward, E.C. (1992) Hydrothermal vents in turbidite sediments on a Northeast Pacific spreading centre: organisms and substratum at an ocean drilling site. *Canadian Journal of Zoology*, **70**, 1792-1809.

Levin, L.A., Mendoza, G.F., Konotchick, T. & Lee, R. (2009) Macrobenthos community structure and trophic relationships within active and inactive Pacific hydrothermal sediments. *Deep Sea Research Part II: Topical Studies in Oceanography*, **56**, 1632-1648.

Marcus, J., Tunnicliffe, V. & Butterfield, D.A. (2009) Post-eruption succession of macrofaunal communities at diffuse flow hydrothermal vents on Axial Volcano, Juan de Fuca Ridge, Northeast Pacific. *Deep-Sea Research Part II Topical Studies in Oceanography*, **56**, 1586-1598.

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Note that all of my comments are restricted to the seamounts chapter only.

Is the purpose of the working paper clearly stated?

Yes, the authors do a good job providing context for the research paper. The figures are clear, and in general the paper is well-presented. Given the amount of work in the time provided, I think the authors have done a solid job.

Are the data and methods adequate to support the conclusions?

Compiling all information available to assess the ecological and biological importance of an area is not an easy task, particularly when there is little data available and/or the data have not yet been published or in some cases, analysed. I think the authors presented a good literature review on the state of our knowledge on offshore seamounts and only have a few comments about sources and additions that I have highlighted in the document.

With respect to the “methods being adequate to support the conclusions” I have a few comments.

- Is there an explicit definition to each of the relative rankings that guided those decisions for each criteria? For example, number of supporting publications, scientific consensus, or some other decision making process?
- The criteria are comparative so I think it would be helpful to be explicit about what you are comparing it to. For example the biological productivity criterion is “area containing species, populations or communities with comparatively higher natural biological productivity” I am not sure if there are guidelines about this but what are you comparing it to? I think it is okay to compare the seamounts natural productivity with the natural productivity of the surrounding areas/adjacent areas but I think it would be helpful if this was clearly explained.
- The seamount chapter draws a lot on work done on Cobb which is understandable given the paucity of information on seamounts within Canadian waters, but although I think Cobb can be used as an example of how seamounts in general fit the ebsa criteria, but where possible use Canadian examples (e.g. there is a species list for SKB that could be used for reference rather than just species encountered in the trap fishery).

Are the data and methods explained in sufficient detail to properly evaluate the conclusions?

Yes, although noticed that some seamounts were selected as ebsas and some were not, only the named ones are highlighted in Figure 3.5 but in the text they state that all semaounts in Canada’s Pacific waters meet the criteria for EBSAs.

If the document presents advice to decision-makers, are the recommendations provided in a useable form, and does the advice reflect the uncertainty in the data, analysis or process?

Yes, I think so. It is clear that the authors are providing the relative rankings based on the available science, but also that there is still a lot to be learned about seamount communities. Based on the data they provided, I agree with their recommendation of the proposed seamount EBSAs.