



Fisheries and Oceans Canada / Pêches et Océans Canada

Science

Sciences

## **C S A S**

**Canadian Science Advisory Secretariat**

**Proceedings Series 2011/069**

**Pacific Region**

**Proceedings of the Centre for Science Advice, Pacific Region Review of A framework for an ecosystem-based approach to managing the Strait of Georgia, British Columbia**

**February 16-17, 2011  
Nanaimo Conference Centre,  
Nanaimo, British Columbia**

**Marilyn Joyce and Jim Boutillier,  
Chairpersons**

**Marilyn Joyce  
Editor**

## **S C C S**

**Secrétariat canadien de consultation scientifique**

**Compte rendu 2011/069**

**Région du Pacifique**

**Compte rendu du Centre des avis scientifique de la région du Pacifique sur l'Examen du cadre d'une approche écosystémique dans la gestion du détroit de Georgia, en Colombie-Britannique**

**Les 16 et 17 février 2011  
Vancouver Island Conference Centre,  
Nanaimo (Colombie-Britannique)**

**Marilyn Joyce et Jim Boutillier,  
coprésidents**

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**April 2012**

**Avril 2012**

## **Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings 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.

## **Avant-propos**

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenues dans le présent rapport puissent être inexactes ou propres à induire en erreur, elles sont quand même reproduites aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considérée en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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## TABLE OF CONTENTS

SUMMARY .....	V
SOMMAIRE .....	V
INTRODUCTION .....	1
DISCUSSION.....	2
WRITTEN REVIEWS.....	2
GENERAL DISCUSSION .....	5
Is this framework intended to contribute to Ecosystem-based Management (EBM) or an Ecosystem approach to Management (EAM)? .....	5
Indicators and Monitoring .....	6
Reference levels (baselines) .....	6
Spatial Management.....	7
Stressors (Pressure Indicators) .....	7
Thresholds.....	7
Modelling .....	7
Knowledge Gaps .....	8
Current state of the Strait of Georgia and Current understanding of how the Strait functions .....	8
CONCLUSIONS.....	9
RECOMMENDATIONS.....	10
APPENDIX 1: AGENDA.....	11
APPENDIX 2: LIST OF PARTICIPANTS .....	13
APPENDIX 3: TERMS OF REFERENCE .....	15
APPENDIX 4: WORKING PAPER SUMMARY.....	17

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## SUMMARY

A Canadian Science Advisory Secretariat (CSAS), Regional Advisory Process (RAP) was held to review a framework for developing an ecosystem-based approach to managing human interactions with the Strait of Georgia marine ecosystem that builds upon the preliminary findings of the DFO Strait of Georgia Ecosystem Research Initiative. Participation in this meeting included Fisheries and Oceans Canada (DFO) Science, Habitat Management and Aquatic Management Sectors and external participants from Environment Canada, non-governmental organizations and academia.

The results of this meeting are to be used to provide advice to management regarding a way forward for the development of an ecosystem-approach to management of the Strait of Georgia.

This Proceedings report summarizes the relevant discussions and presents the key conclusions reached at the meeting. A Science Advisory Report and supporting Research Document, resulting from this advisory meeting, are published on the DFO Canadian Science Advisory Secretariat Website at <http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm>

## SOMMAIRE

Un processus de consultation scientifique régional du Secrétariat canadien de consultation scientifique (SCCS) visant à examiner un cadre concernant l'adoption d'une approche écosystémique de gestion des interactions entre les humains et l'écosystème marin du détroit de Georgia a été lancé. L'approche se fonde sur les résultats préliminaires obtenus dans le cadre du Projet de recherche sur l'écosystème du détroit de Georgia de Pêches et Océans Canada. Au nombre des participants à la réunion, il y avait notamment des représentants des secteurs de la gestion des sciences, de l'habitat et des pêches et des océans du Ministère, ainsi que des personnes provenant d'Environnement Canada, d'organisations non gouvernementales et du milieu universitaire.

Les résultats de cette réunion serviront à formuler des conseils à la direction dans le cadre du processus visant l'adoption d'une approche écosystémique dans la gestion du détroit de Georgia.

Le présent compte rendu résume les discussions pertinentes et présente les conclusions importantes tirées de la réunion. Un avis scientifique et des documents de recherche à l'appui découlant de cette réunion de consultation sont publiés sur le site Web du SCCS à l'adresse suivante : <http://www.dfo-mpo.gc.ca/csas-sccs/index-fra.htm>

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## INTRODUCTION

The history of managing human interactions with marine systems has focused on single issues, for example single fish stocks, or single habitat alterations. Increasingly, however, this approach is being seen as insufficient for the stresses and complexities of the demands placed on marine systems today, and a modern approach is now favoured that should take account of the interactions among stressors and among components of marine ecosystems. The term “ecosystem-based management” has come to embody a more holistic and integrative approach to regulating human interactions with marine systems.

There is interest now in developing such an approach to manage human interactions in the Strait of Georgia. This would include establishment of design properties for such an approach, identification and monitoring of indicators of ecosystem state and consideration for some of the implementation issues that will arise from such an endeavor.

A Canadian Science Advisory Secretariat (CSAS) Regional Advisory Process (RAP) was held February 16<sup>th</sup> and 17<sup>th</sup>, 2011, at the Nanaimo Conference Centre, Nanaimo, British Columbia, to review one working paper (*A framework for an ecosystem-based approach to managing the Strait of Georgia, British Columbia*)

The Chairs, Marilyn Joyce and Jim Boutillier, welcomed participants and reviewed the role of CSAS in the provision of peer reviewed advice and gave a general overview of the CSAS process. The Chairs discussed the role of participants, and the expected RAP document outputs (Science Advisory Report, Proceedings and Research Document) and their general purposes, as defined by CSAS. Everyone was invited to participate fully in the discussion and 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 RAP Terms of Reference (Appendix 3) and the working paper.

The Chairs reviewed the Agenda and the Terms of Reference (TOR) for the meeting (Appendix 3) and highlighted the objectives of this meeting which were to review a framework for developing an ecosystem-based approach to managing human interactions with the Strait of Georgia marine ecosystem. This broad objective had been broken into four components (see TOR). The Chairs indicated that the specific objectives would be used to develop advice pursuant to this review. In total, 45 people participated in the RAP (Appendix 2).

Participants were informed that Dr. Jake Rice, Fisheries and Oceans Canada, Ottawa and Dr. Phil Levin, US National Oceanographic and Atmospheric Administration, were asked to provide detailed written reviews of the working paper for the meeting. Participants were provided copies of the written reviews in advance of the meeting.

Ian Perry and Diane Masson presented an overview of their working paper, *A Framework for an ecosystem-based approach to managing the Strait of Georgia. CSAP Working Paper 2010*. Perry, R.I., Masson, D. for meeting participants. A summary of the working paper can be found in Appendix 4.

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## DISCUSSION

### WRITTEN REVIEWS

As Drs. Rice and Levin were unable to attend in person, Co-chair Jim Boutillier agreed to provide a summary of the comments. Following each of the main reviewers comments are the responses by the authors.

Dr. Jake Rice felt that the report should present, by way of review, more of the work already existing internationally and also nationally to develop similar frameworks. He felt this would strengthen the paper and place the existing effort in context. He felt it would be important to show how this work fits into advice that is being provided both internationally and from Canada's commitments to biodiversity as well as the existing Canadian framework for establishment of ecosystem-based management. Regarding the reports he felt should be included; he particularly noted the very well developed and regionally implemented framework in Australia and felt this in particular should be included.

The authors noted that they were selective in their review and had not intended this to be an exhaustive review. They agree the Australian and a few others suggested by the reviewer should be included and will make revisions accordingly. They note that they did include reference to DFO policies such as those under SFF, but they will add paragraph and text to broaden this further, with guidance from this review meeting.

Dr. Jake Rice noted that in Section 2 the vast majority of the DFO Ecosystem Research Initiative (ERI) projects focus on only one of the four pillars of an Ecosystem Approach to Management (EAM). That is they take natural forcing into account. While this pillar is important he noted that it is equally important to take into account the full footprint of human activities in the sea, and ensure coherence and integration of management decision-making across the range of human activities that impact marine ecosystems. He was also concerned that a framework built on one aspect of EAM and based on a suite of ERI studies may not be able to adapt when other aspects of EAM are considered seriously. He also had concern that the suite of ERI studies may not have been appropriately balanced for management issues. He implies that there should be a mechanism to look at what support science might provide (or need) to address all the issues if all aspects of an ecosystem approach were taken into account and to set priorities to identify the most crucial information gaps for all these pillars.

The authors acknowledged that the broad issue is that the framework as presented is a bit too narrow, focussing on only some environmental aspects and leaving out the human aspect. They acknowledge that the broader human aspects are important and suggest that this should be something the group needs to discuss as this will also tie in with what is the focus of this paper. They also note that this was done consciously because it reflected the extent of the expertise of the DFO Ecosystem Research Initiative (ERI) participants. They noted that expertise in measuring human impacts was in most cases not present among the ERI participants. The authors suggested revising the title of the paper to reflect the narrower scope of the framework than is portrayed by the present title.

Dr. Rice commented on the important distinction between EAM and Ecosystem-based Management (EBM). He pointed out that an ecosystem *approach* (EA) means that one starts from the assumption that sectoral management will continue to dominate in the (near) future, as it has in the past. That means fisheries will be managed by fisheries managers in DFO, marine transportation will be managed by Transport Canada, offshore gas and oil by federal and

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provincial agencies, etc. Governance aspects of the EA mean that there will be improved communication mechanisms and settings to promote cross-sector coherence, but those mechanisms will rarely, if ever, be able to place binding constraints on the options available to the sectors. On the other hand, in an ecosystem *based* management scenario, it is the ecosystem, not the existing sectoral management structure that is the organizing principle. In an ecosystem based management scenario, based on scientific assessments of what is needed for healthy ecosystem functioning, governance mechanisms decide how (and how much) human uses can be accommodated given the ecosystem needs, and then what regulatory mechanisms best deliver the mix of human uses that can be accommodated given the ecosystem needs. Under this approach, sectoral management as we know it may or may not continue, depending on what best serves the ecosystem.

The authors agreed this distinction needs to be discussed in the meeting and addressed in the paper.

Dr. Rice noted that each of the proposed indicators in the list at the bottom of page 20 links to the various DFO Ecosystem Research Initiative (ERI) projects summarized in section 2. However he felt that such linkages were insufficient to propose a series of indicators for EAM. He felt there should be a process to document either if *all* the ERI projects found outcomes that were important to policy and management, or that if in combination, the ERI projects covered *all* the structural ecosystem components that vary and whose variation can directly affect the outcomes of policy and management. He noted the importance of indicators is not just that they demonstrate patterns of variation in certain ecosystem properties, but that the variation reflects processes that are important in guiding management and policy decision-making when these are taken into account.

The authors responded by pointing out that this framework document is only one of many outcomes of the ERI, so that it is misleading to think that the only outcome was to identify indicators that could be used by management. The ERI had other initial objectives too. The Chair followed up by commenting that it would be useful to talk also about all the objectives of the ERI.

With regard to section 3.3 Pressures on the Strait of Georgia, Dr. Rice noted that the treatment of this topic in this working paper is in strong contrast to that experienced elsewhere. Pressures are treated in a single paragraph, which descriptively summarizes the pressures that exist but does not lay out how the pressure part of the EA framework will be developed further. He noted the imbalance between the fairly long list of proposed state indicators of ecosystem properties and the single paragraph which is a quick pass over the entire pressure issue. He felt this topic needed much greater priority in the paper.

The authors acknowledged Dr. Rice's comments and noted that the Chair had listed Pressures (Stressors) as a topic for further discussion during the meeting. The Chair commented that the discussion would be around how the pressures were chosen and whether the meeting participants agree. It would also likely focus some discussion on the initial objectives of the Strait of Georgia Ecosystem Initiative.

Dr. Rice commented on spatial management. He noted that spatial management has expanded greatly in the past decade. Spatial management has moved beyond inventories of areas receiving some sort of protection. He noted that it is now important to get not only the spatial distribution of protected areas right, but also the spatial distribution of industry sector footprints and that this is at least as important as taking account of environmental forcings.

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The authors acknowledged that they did not include a detailed analysis of the footprint of human impacts in the paper, because to do so would have been beyond the science expertise of the Strait of Georgia Ecosystem Initiative contributors. They did note however that some of this type of spatial mapping has been done for the Pacific North Coast Integrated Marine Area (PNCIMA). The authors concluded that space is a different topic from the other stressors, particularly in terms of thresholds. They proposed to move the Spatial Management section to stand on its own outside of the Pressures (Stressors) section.

Dr. Rice had a series of other comments. These were, that emotive words like “damage” should be replaced with words such as “impacts” because not all human activities cause damage if there is good management. He felt that in section 2 there should be an introduction with each project summary as to why the project was selected for the Strait of Georgia Ecosystem Initiative.

Dr. Rice commented on the Governance section. He did not feel it appropriate for a science document to have such a section. The section should be renamed Implementation Issues and that it should include more elements from the DFO Sustainable Fisheries Framework (SFF). By rewording it as Implementation Issues it would be clearer and would avoid the impression that Science and Oceans is straying into policy.

The authors agreed the title should be Implementation Issues. The section was going to include a recommendation that DFO decide if it really wants to adopt an ecosystem approach, then commitments to such a process would be needed. However authors chose to leave this comment out of the draft.

The second reviewer Dr. Phil Levin acknowledged the accomplishments of the paper and thanked the Chair for the opportunity to review the document. His first comment was that the paper uses the standard definition of an ecosystem that “includes humans” as a stressor or a threat, and not a part of the ecosystem. He noted that including humans as a dimension of the ecosystem would be more inline with EBM but that to do so would be a major undertaking. As an alternative he suggested that the authors include caveats to indicate that this document focuses on the non-human components of the ecosystem.

The authors noted that this is similar to a comment from the first reviewer which relates to the scope or context for this paper, i.e., is the scope an ecosystem view and approach or is it ecosystem based management. Where this paper fits into the spectrum from fisheries to people will need to be a discussion during the meeting.

Dr. Levin commented that the indicator list seemed sensible and felt that it should be clearer how and why these were chosen. Also with regard to indicators, the reviewer was concerned about the baseline selection proposed for the status indicators because baselines that intentionally shift ( e.g. running average) he felt were unwise. He had particular concern for indicators that are affected by decades of human activities. He cited the case of Canary rockfish in Puget Sound. The species population plummeted in the 1990s and has not recovered, but by using a moving baseline they will appear to be doing better relative to that baseline ,even if the population does not recover.

The authors felt a discussion by the group about how to select baselines would be warranted. The authors had felt in writing the document that if, for example, temperature was measured today what would it mean in the context of the longer time series of temperature? They felt

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some average would be needed against which to compare to give it meaning. The chair agreed to bring this issue forward for general discussion.

Dr Levin commented that the paper should have a more direct explanation of tradeoffs and he noted this in several places in the draft.

The authors agreed but wondered how to talk about tradeoffs without clear objectives.

Dr Levin commented that he found section 2 to be a bit long. He thought that a short overview of all activities would suffice and then the reader could go to the appendices. He also points out that each section should probably explain why it was chosen for inclusion and that this would help understand the objectives for the ERI.

The authors agreed that they could reduce section 2 in some way.

The Chair also noted that to conform to the terms of this science peer review the project descriptions in section 2 may need to give more of an overview rather than the specific findings, conclusions and recommendations that are presently included. The reason is that this science peer review is not tasked with reviewing the science of these projects, but rather the framework. Therefore, it is important that there is not a misleading implication that these projects were reviewed.

The authors noted that there needs to be further discussion and agreement about what should go into the final appendices because many of the projects are soon to be completed primary publications. Therefore, it may not be appropriate to include them here before they appear in the primary literature.

Dr Levin's final comment was that the paper would be strengthened by a timeline that lays out what could be accomplished and when. Upon reading the recommendations he was struck by the size of the implied undertaking and felt that it would be helpful to have sense of what managers and fellow researchers thought could be accomplished in say 4 + years.

The Chair noted this was an important point and tied in with the Implementation Issues section of the working paper that needs further discussion.

## **GENERAL DISCUSSION**

The Chair opened the floor for comments and discussion by all RAP participants. The following represents the nature of the discussion organized by topic.

### **Is this framework intended to contribute to Ecosystem-based Management (EBM) or an Ecosystem approach to Management (EAM)?**

Ecosystem management is a misnomer as it was pointed out that we do not manage the ecosystem, we manage people. It was generally agreed that this paper was more on the side of an ecosystem approach to management and that some text should be added to the paper to clarify this. However, it is still important to clarify the distinction between EBM and EAM in the paper and it was suggested that a table might be developed that would list what goes into EBM and then identifies which of these are covered in this paper by this framework. Concern was expressed that the human dimension had not been included in the framework and that a reference to the Wild Salmon Policy (WSP) should be included as an example of inclusion of the human dimension in a process from this Region. It was noted that the WSP has benchmarks and distinguishes between science and social components of decision making. The WSP is a

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good example of an ecosystem approach to management, rather than just a fisheries approach to management. The conclusion was that the title should be changed to something like “Science in support of an Ecosystem Approach”.

### **Indicators and Monitoring**

There was a general discussion about the status indicators as presented in the paper. Concerns were raised that it was not clear how they had been selected. It was clarified that indicators were generally chosen based on their fit into a network using a Driver-Pressure-State-Response (DPSR) framework. In this regard, indicators were selected because they could be connected to other indicators, at least to some extent. It was noted that the Bayesian Belief Network approach had been useful in identifying relevance through correlations. There was speculation that the choice of indicators may have been driven by what was available in terms of historical data, and/or what ERI projects had to offer.

Two recent systematic processes for the selection of indicators were mentioned by meeting attendees: one was used to select indicators for the west coast of Vancouver Island by the West Coast Vancouver Island Aquatic Management Board and the other to select indicators for Puget Sound by the Puget Sound Partnership. There was also concern as to whether the indicators identified were appropriate for the Strait of Georgia, or might some of them represent a larger area, which brought up the question of boundaries for monitoring the effects. Concern was expressed that the process as presented might exclude options to add new indicators going forward.

There was also concern that the indicators were focused on quantity and not quality. For example, numbers of harbour seals is a quantity indicator, but trends in blubber thickness, weight or weight at weaning, or zooplankton lipid content might be quality indicators that might reflect on the health of the ecosystem. There was also the question of monitoring these indicators. Opportunities to collaborate with other agencies, departments and researchers were acknowledged as important to maximize monitoring and collection of data for indicators. It was also pointed out that this will require consideration for data archiving and for data sharing.

It was generally agreed that since the indicator list was incomplete and the objectives not clarified, it was difficult to talk about frequency or scale of monitoring.

The general conclusion of the discussion was that this was an incomplete list of status indicators and that a process for their selection is needed that will also include an explanation of the relevance of these indicators. Similarly, a process to determine the scale and frequency of monitoring is required.

### **Reference levels (baselines)**

There was a discussion about baselines and reference points against which to compare variation in indicator measures. The authors explained that their suggestion about using an oceanographic standard (average over a time period e.g. 30 years) was so that it would be possible to track the variation in an indicator against this average or baseline. Phil Levin and others expressed concerns about having a moving baseline. It was suggested that this approach may be suitable for physical properties but may not be suitable for biological processes for which there is often not an average condition. Other concerns were that by comparing to an average one may lose sight of the short term variability which may be important. There was also concern about data quality, e.g., typically over long periods data tend and techniques tend to improve. Presumably, this might be lost by averaging. An example was improvements in zooplankton taxonomy in recent years. Overall, it was felt that different types of

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baselines may be needed for different indicators rather than just the one suggested in the paper. The authors acknowledged that it may not be possible to have one type of baseline. The attendees were prepared to accept a rewrite of this section to broaden it to allow for investigation of suitable baselines for indicators.

### **Spatial Management**

In discussion, it was pointed out that spatial management is an approach rather than a stressor. Spatial management as an approach should be placed in its own section in the paper and it should be advanced as an analytical tool with examples. There was also discussion about how one might spatially link indicators in the marine environment to terrestrial stressors that are influencing them

### **Stressors (Pressure Indicators)**

Selection of stressors was based on the DPSIR framework, which was the basis of one of the ERI projects (led by I. Perry). That there was good agreement between this resulting list of stressors and those identified in the Puget Sound Indicator process was viewed as some validation of the stressors identified. There are two kinds of stressors, those that are anthropogenic and those that are natural. In discussion, it was observed that vessel traffic as a stressor had not been included. There was some opinion that it should have been because of impacts related to bilge pumping, ship noise and ship strikes. Additional stressor indicators suggested were trends in *E. coli* at beaches and shellfish closures. Opinions were expressed that the stressors as listed are lumped categories and that perhaps they should be split. The IUCN framework for identifying stressors was suggested as a model to look at for splitting and organizing hierarchically. There was general consensus that the stressor list was not complete. Therefore it was recommended that the list go forward for quantification, but that allowance is made for the addition of new stressor indicators. An opinion was expressed that there should be a consistent process for identifying and grouping stressors into a hierarchy.

### **Thresholds**

Thresholds can be viewed as levels that should not be crossed (either above or below). There are also thresholds reflecting desired outcomes (targets). This latter type is not discussed in this paper. It was noted that an Ecosystem based framework should have both types of thresholds, but that the framework in this paper only has the biological and physical, but not social, values. Identifying a threshold corresponding to a healthy zone must include socio-economic considerations. There was discussion as to how to identify thresholds of biologically or physical properties. It was suggested that one could use data to back cast and look for historic tipping points. Whatever threshold is selected, however it was also opined that buffer zones should be applied around a threshold level. It was noted that hind casting to look at historic tipping points may provide insight but that applying these into the future may be more difficult. It was recommended that various models should be used to identify and assess uncertainties around thresholds; work which is yet to be completed.

### **Modelling**

There was discussion about the modelling with respect to the framework and identifying thresholds. It was noted that the framework heavily recommends modelling to identify thresholds, without equal emphasis on the need for data to be collected to go into the models to produce useful results. It was felt there needs to be an equal emphasis in the paper on the need for data collection, monitoring and analysis. It was also noted that the framework relies on models but does not specifically recommend any particular models.

It was noted that the paper does not explain how the models work but recommends use of models. The Chair clarified that the meeting participants were not in a position to review or

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evaluate the models, based on the Terms of Reference for the meeting and review. It was acknowledged that models developed through the ERI initiative will need to be presented for review to CSAS in a separate process.

It was felt that it was important to identify the data that models are reliant on and to state the uncertainties in these measurements. It was discussed whether a list of the existing models that arose from the ERI projects might be presented, but not specifically recommended. There was general consensus that this would be useful and agreement that it would not be appropriate to recommend any of them before they have been evaluated.

It was noted it would be good to clarify that there were modelling projects done under the ERI that were new but these models have not yet been evaluated. Also that one of the outcomes of the ERI was tools and approaches to model the Strait of Georgia.

It was suggested that it would be useful to include in the paper examples of new information gained as a result of modelling in the ERI projects. Examples given were: The Bayesian Belief Network that allowed estimation of the probability of Coho survival based on plankton bloom timing. The Regional Ocean Modeling System (ROMS) confirmed what had been suspected about certain oceanographic processes and finally modelling demonstrated differences in productivity between the northern and the southern Strait of Georgia. It was also noted that models serve to highlight knowledge gaps, for example reference was made to an Ecopath salmon model that relies on key assumptions about plankton. A final summary point was that good models require good data and that both the need for models and good data should be emphasized in the paper.

### **Knowledge Gaps**

Discussion began on the list of knowledge gaps presented in the paper and whether it was a sufficient or complete list. There was a comment that incomplete nearshore habitat classification was a missing knowledge gap. Gaps regarding species such as sand lance and gaps regarding trophic level linkages and changes over time were missing. There was a suggestion that the gaps identified among the ERI projects in section 2 should link with the knowledge gaps section but that as it stands they do not.

There was further concern raised regarding a lack of assimilation between section 2 project descriptions and the rest of the document. Overall it was concluded that the paper should go forward with recognition that this is an incomplete list of knowledge gaps. There should be a discussion of how knowledge gaps should be identified, by what process.

### **Current state of the Strait of Georgia and Current understanding of how the Strait functions**

There was discussion as to whether these topics, which were two of the objectives listed in the terms of reference for the paper and meeting, were addressed in the paper. The question was if the group concluded no, that these objectives were not addressed, then should there be any changes made to the appendices? There was some thought that the appendices regarding the ERI projects should be removed altogether, so that the paper was more focussed on the framework aspect. The projects should and would need to be summarized in an alternative document. Additionally, it was noted that the work in the appendices will be published elsewhere as primary papers. If the appendices stay in it was suggested that they should have a common style. Regarding section 2, which is a summary of some of the projects, it was determined that this should be revised to tie more closely with section 3 and further that only the material of the projects that informed the Framework would stay. Another suggestion was a flow chart explaining how the ERI projects fit into the paper. As for the current state and current



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understanding of the Strait it was noted that these would be addressed more appropriately in primary publications. It was generally agreed that section 2 should be revised to integrate the outcomes of the individual projects and explain how it supports the framework. It was also agreed that the appendices should be removed or reduced to abstracts.

## CONCLUSIONS

The working paper was accepted with revisions as summarized below. A small editorial working group was struck to assist the authors in making the revisions. The editorial working group members are: Jim Irvine, John Holmes, Peter Olesiuk, Chris Neville and Cecelia Wong.

- There needs to be explicit and clear linkages made to international frameworks and guidelines. It should be noted that SFF policies and guidelines for example regarding forage fish, benthic habitat and the Wild Salmon Policy have been built from international commitments and guidelines.
- Section 2 of the report and the appendices need to be tied more clearly to the framework components of the paper. This should be the guiding determinant of what aspects of the ERI projects should stay in and what information can be left out of the paper.
- The focus of the paper should be narrowed to make it clear that this is science in support of an ecosystem approach to management and stressing that this paper deals only with science aspects not social or economic.
- The title should be modified accordingly to *Science in support of a framework for an ecosystem approach to aquatic management*, or something similar.
- It was concluded that DFO is firmly in the sphere of an ecosystem approach to management and not ecosystem-based management. This needs to be clarified in the paper.
- The Governance Issues section should be retitled Implementation Issues.
- The Australian approach and the Great Barrier Reef example of ecosystem-based management should be included. Both of these examples should go into the Implementation Issues section.
- The term “hotspot” in the paper should be replaced with Ecological and Biological Significant Areas (EBSA) or Vulnerable Marine Ecosystems (VME)
- It was concluded that the paper presents an incomplete list of status indicators and that a process for their selection is needed that will also include an explanation of the relevance of each indicators. The question of monitoring frequency and scale of these indicators was determined to fall under the same process as indicator selection.
- There should be a distinction between quantity and quality state indicators which relates to ecosystem health.
- More emphasis is needed in the document on evaluating current monitoring efforts as to whether they are adequate or not for some measures and why or why not.
- The paper should acknowledge that various reference or baselines may be needed depending on the indicator and these would need to be investigated.
- It should be clarified in the paper that the knowledge gaps list is incomplete. The paper should include text regarding how knowledge gaps should be identified, by what process. Further, more text is needed to explain the rationale for the importance of the knowledge gaps presented in the paper.

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- It should be emphasized in the paper that good models and good data are needed and this means a commitment to monitoring, supporting appropriate data collection.
  - The paper needs to emphasize the need for a commitment to monitoring and reporting on indicators.
  - Spatial management needs to be in its own section and it should be advanced as an analytical tool with examples in future reviews.
  - The paper should note that modelling will be a major part of developing the framework particularly for assessing uncertainties around thresholds.

## **RECOMMENDATIONS**

In support of continuing to advance Ecosystem Based Approaches to Management for the Strait of Georgia and are based on the results of the Ecosystem Research Initiative completed to date, the following recommendations were agreed to by RAP participants and are to be included in the Science Advisory Report:

- Develop a collaborative process for the selection/evaluation of indicators and the monitoring programs needed to collect associated data. Support existing monitoring programs likely to be critical for maintaining time series should continue;
- Operationalise the collection of data and reporting on indicators and their implications as a significant and important activity of an ecosystem approach to management;
- Evaluate the anthropogenic stressors identified above for the Strait of Georgia and consider if any important stressors are missing;
- Continue to develop and evaluate the models developed under the Strait of Georgia Ecosystem Research Initiative, and consider and evaluate additional models for specific tasks/issues, for example to identify critical thresholds;
- Recognise that spatial management and spatial analyses are important components of an ecosystem approach to management, incorporate research on ecologically and biologically sensitive areas and vulnerable marine ecosystems within the Strait of Georgia;
- Ensure the archiving and accessibility of data and metadata for the Strait of Georgia, including sharing of data within and outside of DFO (where legal issues permit) and collaboration with non-DFO data collection programs. Resources for this activity are currently inadequate;
- Move from narrow topic-specific research programs to integrated planning and programming;
- Expand discussions on an ecosystem approach for the Strait of Georgia to include DFO Fisheries Management, Oceans, Habitat, and other Sectors;
- Collaborate with the process being developed in the PNCIMA region to identify ecosystem-level objectives for managing marine systems in Pacific Region. This would benefit both initiatives.

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## APPENDIX 1: AGENDA

### The Strait Of Georgia Ecosystem Research Initiative: Developing An Ecosystem-Based Approach For The Strait of Georgia

A two-day Canadian Science Advisory Secretariat (CSAS) peer review of a draft working paper developed in response to a request for science advice from SARA managers

hosted by  
The Centre for Science Advice Pacific (formerly PSARC)

16-17 February 2011  
Vancouver Island Conference Centre  
101 Gordon Street  
Nanaimo, BC

**Chairpersons:** Marilyn Joyce & Jim Boutillier

#### **Day 1 - Wednesday, 16 February**

*Working Paper to be reviewed:*

Perry, R.I., Masson, D., et al. A framework for an ecosystem-based approach to managing the Strait of Georgia. CSAP Working Paper 2010/P57.

9:00	Introductions	Marilyn Joyce
9:10	Review Agenda & Housekeeping	Marilyn Joyce
9:20	CSAS Overview & Meeting Procedures	Marilyn Joyce
9:30	Review of Terms of Reference	Jim Boutillier
9: 45	Presentation Part I: Background & Overview of the Ecosystem Research Initiative	Diane Masson
<b>10:45</b>	<b><i>Break</i></b>	
11:00	Presentation Part II: Framework for Ecosystem-based Management	Ian Perry
<b>12:15</b>	<b><i>Lunch Break</i></b>	
1:30	Reviewers Comments & Author's Response	Reviewers
2:30	Discussion	RAP Participants
<b>4:30</b>	<b><i>Adjournment</i></b>	

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## **Day 2 - Thursday, 17 February**

9:00 Introductions & Housekeeping Marilyn Joyce

9:10 Review Day One Progress & Confirm Agenda for the day Jim Boutillier

9:30 Discussion and resolution on key points from Day One RAP Participants

**10:45 Break**

11:00 Acceptability of the working paper and confirmation of required edits for publication (Alignment with Terms of Reference Objectives) RAP Participants

11:30 Review expected publications from CSAS process and additional publications resulting from the Ecosystem Research Initiative Ian Perry & Diane Masson

**12:00 Lunch Break**

1:15 Science Advisory Report: Develop Consensus on: RAP Participants

- Key findings & conclusions
- Uncertainties
- Advice for Management / application of framework
- Recommendations for future work

**4:30 Adjournment**

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## APPENDIX 2: LIST OF PARTICIPANTS

Last Name	First Name	Affiliation	Feb-16	Feb-17
<b>DFO PARTICIPATION</b>				
Araujo	Andres	Science	√	√
Beamish	Dick	Science	√	√
Boldt	Jennifer	Science	√	
Boutillier	Jim	Science	√	√
Brown	Robin	Science	√	√
Cummins	Patrick	Science	√	√
Curtis	Janelle	Science	√	
Davies	Sarah	Science	√	√
Davis	Neil	OHEB Oceans	√	
de Lange Boom	Bodo	Science	√	√
Ford	John	Science	√	
Freeland	Howard	Science	√	
Fu	Caihong	Science		√
Gillespie	Graham	Science	√	
Gower	Jim	Science	√	√
Holmes	John	Science	√	√
Holt	Carrie	Science	√	√
Irvine	Jim	Science	√	√
Joyce	Marilyn	Science	√	√
Kronlund	Rob	Science		√
Lake	Diane	Communications	√	
Lessard	Joanne	Science	√	√
Ludke	Wilf	South Coast Science SA	√	√
Mackas	Dave	Science	√	√
Magnusson	Gisele	Policy	√	√
Masson	Diane	Science	√	√
Neville	Chrys	Science	√	√

<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>	<b>Feb-16</b>	<b>Feb-17</b>
Nichol	Linda	Science	√	√
Nishimura	Derek	OHEB Habitat	√	√
Olesiuk	Peter	Science	√	√
Pena	Angelica	Science	√	
Perry	Ian	Science	√	√
Rasmussen	Glen	OHEB Oceans	√	
Richards	Laura	Science	√	√
Rogers	Juanita	South Coast RM Invertebrates		√
Ross	Peter	Science	√	√
Schweigert	Jake	Science	√	
Sheng	Mel		√	√
Workman	Greg	Science	√	
<b>EXTERNAL PARTICIPATION</b>				
El-Sabaawi	Rana	University of Victoria	√	√
Okey	Tom	West Coast Aquatic	√	√
Pearsall	Isobel	Pacific Salmon Foundation	√	√
Tunncliffe	Verena	University of Victoria	√	√
Wilhelmson	Christanne	Georgia Strait Alliance	√	√
Wong	Cecelia	Environment Canada, Vancouver	√	√

The reviewers for the Centre for Science Advice Pacific (CSAP) working paper presented at this meeting are listed below. Their assistance is invaluable in making the CSAP process work.

<b>Last Name</b>	<b>First Name</b>	<b>Affiliation</b>
Rice	Jake	Fisheries and Oceans Canada
Levin	Phil	U.S. National Oceanographic and Atmospheric Administration

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## APPENDIX 3: TERMS OF REFERENCE

### The Strait of Georgia Ecosystem Research Initiative:

Developing an ecosystem-based approach for the Strait of Georgia

### Pacific Regional Science Advisory Process

February 16-17, 2011  
Nanaimo, B.C.

**Chairpersons:** Marilyn Joyce, James Boutillier

#### Context

DFO is committed to develop ecosystem-based approaches to managing human interactions with marine systems. This commitment is a result of Canada's Oceans Act and recommendations from international bodies such as the Food and Agriculture Organization of the United Nations. To develop such approaches, Ecosystem Research Initiatives (ERIs) were established by DFO Science in each Region as pilot projects to enhance the capacity to provide scientific advice in support of ecosystem-based management.

In Pacific Region, the Strait of Georgia was selected as the pilot study ecosystem. The Strait of Georgia Ecosystem Research Initiative began in January 2008, and the Initiative will conclude its directly-funded phase on 31 March 2011. The project has involved approximately 30 individual projects each year. The findings of each of these projects have been presented at annual ERI workshops; their annual reports plus additional information on the objectives and themes of the Initiative are available on the [Strait of Georgia Ecosystem Research Initiative Website](#).

#### Objective

The objective of this Regional Advisory Process (RAP) is to review a framework for developing an ecosystem-based approach to managing human interactions with the Strait of Georgia marine ecosystem. The following working paper will provide the basis for discussion and advice.

Perry, R.I., Masson, D., et al. A framework for an ecosystem-based approach to managing the Strait of Georgia. CSAP Working Paper 2010/P57.

Specifically, this RAP is intended to:

1. Provide a brief overview of the current state of the Strait of Georgia;
2. Describe the current understanding of how the Strait of Georgia functions;
3. Identify the current critical gaps in knowledge regarding the Strait of Georgia marine ecosystem;
4. Propose a framework for providing advice for an ecosystem-based approach to managing human interactions with the Strait of Georgia marine ecosystem, including:
  - a. Ecosystem indicators
  - b. Ecosystem reference levels
  - c. Direction for an integrated DFO science program needed to achieve ecosystem-based management of the Strait of Georgia
  - d. Recommendations for next steps.

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## **Expected publications**

CSAS Science Advisory Report (1)  
CSAS Research Document (1)  
CSAS Proceedings

## **Participation**

DFO Science Branch  
DFO Fisheries and Aquaculture Management Branch  
DFO Oceans, Habitat and Enhancement Branch  
Parks Canada  
Academia  
Non-Government Organizations  
First Nations Organizations  
Commercial and Recreational Fishing Interests

For further information on participation in the peer review process:

[http://www.dfo-mpo.gc.ca/csas/csas/Process-Processus/ExtPart-PartExt/Ext-Part-RAP\\_e.htm](http://www.dfo-mpo.gc.ca/csas/csas/Process-Processus/ExtPart-PartExt/Ext-Part-RAP_e.htm)

## **References cited**

Research objectives, plans, and annual reports from the Strait of Georgia Ecosystem Research Initiative projects are available from the project's website at:

<http://www.pac.dfo-mpo.gc.ca/science/oceans/detroit-georgia-strait/index-eng.htm>



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## APPENDIX 4: WORKING PAPER SUMMARY

This framework provides strategic direction on an ecosystem-based approach to managing human interactions with the Strait of Georgia marine system. It adopts an ecosystem-based management rather than a narrower ecosystem-based fisheries management approach, although the latter is better developed internationally and so has an important influence on this paper. The framework proposes the overarching goal of ecosystem-based management in the Strait of Georgia as “to protect ecosystems and their components from serious or irreversible harm, but also to allow the use of these ecosystems and components as long as the social-ecological Strait of Georgia system is sustainable”. The framework identifies the essential components of an ecosystem-based approach for the Strait of Georgia as 1) continuing management practices to ensure conservation of individual stocks; 2) preventing by-catch of non-target species; 3) avoiding habitat disruptions; 4) developing a more integrated approach to spatial management; and 5) considering the impacts of anthropogenic stressors to trophic interactions and ecosystem function. These build on existing DFO policies relating to the sustainable fisheries framework, fisheries on forage species, and benthic habitat disruptions, but also represent new directions (e.g. on trophic interactions).

The preliminary findings of the DFO Strait of Georgia Ecosystem Research Initiative are summarised, including contributions to understand the structure and function of the Strait of Georgia ecosystem (identification of important locations for biological activities and important trophic linkages), to develop predictive models to synthesise this understanding and to provide ecosystem-based management tools, and to forecast the future of the Strait of Georgia with climate change and other stressors. These findings are used to identify a set of environmental indicators of the ‘state’ of the ecosystem, including sea surface temperature, near surface stratification, deep-basin dissolved oxygen concentrations, Fraser River flow, spring phytoplankton bloom timing, spring copepod biomass, abundance of juvenile salmon, abundance of herring, abundance of Harbour seals, and wind speed. It is proposed that these be monitored and reported regularly by the Canadian Science Advice Pacific’s Fisheries and Oceanography Working Group, including analyses of the potential impacts of the values of these indicators to the Strait of Georgia ecosystem. These findings are also used to identify the dominant anthropogenic stresses on the Strait of Georgia marine ecosystem, including fishing, introductions of non-native species, fish culture activities, contaminants, and development and land use changes. For each of these stressors it is recommended to follow the DFO precautionary approach to identify critical thresholds beyond which the Strait of Georgia ecosystem would be substantially altered in some way. These thresholds would form the basis for management of these stressors within an ecosystem context.

Significant knowledge gaps remain, for example the diets of pinnipeds in the Strait, the abundance and ecological roles of Pacific hake, and the abundance, interactions, and use of particular locations within the Strait by juvenile salmon. Critical next steps include continued development of integrated ecosystem models, design and implementation of a targeted ecosystem monitoring program in the Strait of Georgia, reduction of scientific uncertainties concerning these significant knowledge gaps, and a scenario-building activity that would look forward to the potential ecosystem impacts and management issues relating to the expected significant changes due to climate and increasing anthropogenic stresses.

This paper also identifies some governance issues that have been encountered elsewhere in moving towards ecosystem-based management of marine systems, including clarification of the objectives, bridging science and policy, changing public perceptions to consider the Strait as a connected system, and to facilitate community participation.