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Proceedings of the Pacific Region Science Advisory Process for Outside Stocks of Lingcod (*Ophiodon elongatus*) and the Inside Population of Yelloweye Rockfish (*Sebastes ruberrimus*) in British Columbia, Canada

Compte rendu du processus d'avis scientifique régional pour les stocks des eaux extérieures de morue-lingue (*Ophiodon elongatus*) et la population de sébastes aux yeux jaunes des eaux intérieures (*Sebastes ruberrimus*) en Colombie-Britannique au Canada

April 7-8, 2011
Nanaimo, British Columbia

Les 7 et 8 avril 2011
Nanaimo (Colombie-Britannique)

A.R. Kronlund
Chair

A.R. Kronlund
Président

Fisheries and Oceans Canada / Pêches et Océans Canada
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April 2012 / **Avril 2012**

Canada

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 contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré 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.

Proceedings Series 2011/070

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SUMMARY

A regional advisory process meeting was held April 7-8, 2011 in Nanaimo, British Columbia (BC) to conduct science peer reviews of the status of four outside lingcod (*Ophiodon elongatus*) stocks and the inside population of yelloweye rockfish (*Sebastes ruberrimus*). The science review was conducted in response to requests from DFO Fisheries and Aquaculture Management (FAM) for advice regarding the current stock status and appropriate fishery reference points for the stocks. In addition, an evaluation of the impacts of varying harvest levels on future population trends was requested.

Lingcod in British Columbia are assessed and managed as five separate units based on DFO Statistical Areas; one inside stock in the Strait of Georgia and four outside stocks. The four outside stocks include southwest Vancouver Island (Area 3C), northwest Vancouver Island (Area 3D), Queen Charlotte Sound (Areas 5A and 5B), and Hecate Strait and the west coast of Haida Gwaii (Areas 5C, 5D, and 5E). Data inputs included annual catch from all commercial sectors and recreational fisheries beginning in 1927. At least three abundance indices were available for each area, drawn from commercial trawl fishery catch per unit effort (CPUE), the U.S. National Marine Fisheries Service (NMFS) triennial trawl survey, shrimp trawl surveys, the Hecate Strait multi-species assemblage survey and the multi-species synoptic trawl surveys.

A Bayesian surplus production (BSP) model was applied to assess lingcod stock status within each of the four stock areas. As a result of contradictory trends between fishery-dependent and survey indices, a technological efficiency parameter was introduced to adjust commercial trawl catch rates for time-dependent changes in efficiency. Stock-specific parameter estimates for the intrinsic rate of increase, r, and carrying capacity, K, were used to calculate management parameters such as maximum sustainable yield (MSY), the optimum fishing mortality rate at MSY (F_{MSY}), and the optimal stock size at MSY (B_{MSY}). Stock-specific prior probability distributions were supplied for estimated parameters. Limit and upper stock reference points were set at $0.4B_{MSY}$ and $0.8B_{MSY}$, respectively, with a candidate target reference point of B_{MSY}. Even with informative priors, the stock assessment and projection results was imprecise. However, under the reference case model configuration, it appeared to be unlikely that the exploitable biomass in 2009 for any of the stocks was depleted below the limit reference point of $0.4B_{MSY}$. Application of a variety of harvest policy options spanning the current range of catches all resulted in higher than a 50% probability of maintaining stocks at or above B_{MSY} up to 20 years into the future. Stock status and projection results were relatively insensitive to alternative priors for r. However, stock status and projection results for Areas 3C, 5AB, and 5CDE were sensitive to the choice of alternative Bayesian priors for the “tech” parameter that determined time-varying adjustment to catchability.

Yelloweye rockfish in British Columbia are assessed and managed as separate “inside” and “outside” units. This review considered an assessment of the inside population of yelloweye rockfish, which is primarily located in protected waters to the east of Vancouver Island in Area 4B. Both inside and outside populations of yelloweye rockfish have been designated as *Species of Special Concern* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Population dynamics were modeled using a Bayesian surplus production model. The model was fitted to (*i*) reconstructions of historical catches, (*ii*) four standardized commercial catch per unit effort (CPUE) series that covered four different periods in the history of the fishery; and (*iii*) eight fishery independent longline survey indices that varied in spatial coverage within the assessment area. A suite of sensitivity tests was conducted to evaluate the

effects of uncertainty in key model parameters, the magnitude of the commercial catch and the influence of different indices.

Advice to fishery managers was based on the BSP model reconstructions of stock status in 2009 and associated projections of the stock trajectory under a range of constant annual harvest policies calculated at intervals over an 80-year time horizon. The 2009 exploitable stock biomass of the inside population of yelloweye rockfish was estimated using the reference case model to be 780 t (with standard deviation, SD=390 t), or 12% of the initial biomass in 1918. The probability of the exploitable biomass exceeding the limit reference point was estimated to be $P(B_{2009} > 0.4B_{\mathrm{MSY}}) = 0.05$. All sensitivity test results were similar and indicated a high probability that the exploitable biomass of yelloweye rockfish was less than the limit reference point of $0.4B_{\mathrm{MSY}}$ in 2009. For the fixed annual catch levels considered in the projections, the probability of stock recovery to levels above the limit reference point ranged from 0.12 to 0.14 over a 5-year time horizon and increased to about 0.4 to 0.7 over a 40-year time horizon.

In order to allow investigations into non-fishery factors that may affect stock status, the BSP model was extended to incorporate changes in the level of predation of yelloweye rockfish by pinnipeds. The predation form of the model (PBSP) included mortality due to harbour seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), and California sea lions (*Zalophus californianus*) implemented using a Type I functional response relationship where the amount consumed per predator increases linearly with rockfish density up to a maximum. This model extension represents the first application of predator-prey interactions involving marine mammals to yelloweye rockfish assessment. Future development of this model depends on obtaining improved estimates of the proportion of yelloweye rockfish in pinniped diets and the consideration of alternative forms of the predator-prey functional response. Evaluation of future stock status depends as well on the development of plausible scenarios for the abundances of the predator species. The identification of B_{MSY}-based fishery reference points for the PBSP model remains problematic because multiple equlibria conditions exist that depend on the magnitude of pinniped predation.

SOMMAIRE

Une réunion du processus de consultation régionale a été tenue les 7 et 8 avril 2011 à Nanaimo en Colombie-Britannique (C.-B.), pour entreprendre un examen scientifique par les pairs de l'état des quatre stocks de morue-lingue des eaux extérieures (*Ophiodon elongatus*) et de la population de sébastes aux yeux jaunes des eaux intérieures (*Sebastes ruberrimus*). L'examen scientifique a été effectué en réponse aux demandes de consultation formulées par Gestion des pêches et de l'aquaculture du MPO concernant l'état du stock actuel et les points de référence qu'il convient d'établir pour les pêches. En outre, on a demandé une évaluation des répercussions des divers niveaux de capture sur les futures tendances démographiques pour ces espèces.

La morue-lingue en Colombie-Britannique est évaluée et gérée en fonction de cinq unités distinctes fondées sur des zones statistiques du MPO; un stock en eaux intérieures dans le détroit de Géorgie et quatre stocks en eaux extérieures. Les quatre stocks en eaux extérieures se répartissent comme suit : le sud-ouest de l'île de Vancouver (zone 3C), le nord-ouest de l'île de Vancouver (zone 3D), détroit de la Reine-Charlotte (zones 5A et 5B), le détroit d'Hecate et la partie ouest de l'archipel Haida Gwaii (zones 5C, 5D et 5E). Les données visées comprenaient les prises annuelles de tous les secteurs commerciaux et de toutes les pêches récréatives à compter de 1927. Au moins trois indices d'abondance étaient disponibles pour chaque zone. Ces indices ont été tirés des données déterminant les captures par unité d'effort (CPUE) issues de la pêche commerciale au chalut, du relevé au chalut triennal du National Marine Fisheries Service (NMFS) des États-Unis, des relevés au chalut des stocks de crevettes, du relevé des assemblages de multiples espèces de poissons dans le détroit d'Hecate et des relevés synoptiques au chalut de multiples espèces.

Un modèle bayésien de production excédentaire (modèle BPE) a été utilisé pour évaluer l'état du stock de morue-lingue dans chacune des quatre zones où l'on trouve ces stocks. En raison de tendances contradictoires entre les indices fondés sur les pêches et ceux fondés sur les relevés, un paramètre visant à favoriser l'efficacité technologique a été appliqué pour ajuster les taux de capture au chalut commercial en fonction des fluctuations associées au temps de l'année du point de vue de l'efficacité. Des estimations de paramètre propres à un stock particulier liées au taux d'augmentation intrinsèque, r, et à la capacité de charge, K, ont été utilisés pour calculer des paramètres de gestion comme le rendement maximal soutenable (RMS), le taux de mortalité optimal dû à la pêche selon le RMS(B_{RMS}), et la taille optimale de chaque stock selon le RMS (B_{RMS}). Les répartitions de probabilité relatives à un stock en particulier ont été fournies en fonction des paramètres estimés. Le point de référence limite et le point de référence supérieur du stock ont été fixés respectivement à $0,4B_{RMS}$ et à $0,8B_{RMS}$, avec un point de référence cible de B_{RMS}. Même avec l'utilisation de valeurs a priori, l'évaluation du stock et le résultat des projections étaient imprécis. Cependant, en vertu de la configuration du modèle de référence, il semble peu probable que la biomasse exploitable en 2009 pour les stocks à l'étude était sérieusement diminuée sous le point de référence limite de $0,4B_{RMS}$. L'application de diverses options stratégiques de prélèvement visant l'éventail actuel de prises a résulté en une probabilité supérieure à 50 % de maintien des stocks selon un taux égal ou supérieur à B_{RMS} pendant une période pouvant s'étendre sur les 20 prochaines années. L'état des stocks et les résultats des projections semblaient peu influencés par les valeurs à priori pour le taux d'augmentation r. Cependant, l'état des stocks et les résultats des projections pour les zones 3C, 5AB et 5CDE étaient influencés par le choix de valeurs bayésiennes à priori pour le paramètre « technique » déterminant l'ajustement pour les fluctuations en fonction du temps de l'année par rapport au taux de prélèvement.

Le stock de sébastes aux yeux jaunes en Colombie-Britannique est évalué et géré selon des unités distinctes «eaux intérieures » et « eaux extérieures. » Le présent examen représentait une évaluation de la population en eaux intérieures de sébastes aux yeux jaunes, qui est surtout localisée dans les eaux protégées à l'est de l'île de Vancouver dans la zone 4B. Le Comité sur la situation des espèces en péril au Canada (COSEPAC) a désigné comme une « espèce préoccupante » les populations de sébastes aux yeux jaunes et ce tant pour les stocks en eaux intérieures que pour ceux en eaux extérieures. Les modèles de dynamique de population ont été établis au moyen d'un modèle bayésien de production excédentaire. Le modèle a été adapté à une (*i*) reconstitution des prélèvements historiques, (*ii*) quatre séries uniformisées de captures commerciales par unité d'effort (CPUE) visant quatre périodes différentes dans l'histoire de cette pêche; et (*iii*) huit indices indépendants de relevés à la palangre d'étendues diverses dans la zone d'évaluation. Une série d'essais de sensitivité ont été menés afin d'évaluer les effets du facteur d'incertitude sur certains paramètres clés du modèle, l'ampleur du prélèvement commercial et l'influence de divers indices.

L'avis aux gestionnaires des pêches était fondé sur les reconstitutions modélisées BPE de l'état des stocks en 2009 et sur les projections connexes de la trajectoire des stocks selon un éventail de politiques de prélèvements annuels constants calculés à diverses intervalles sur un horizon de 80 ans. En 2009, la biomasse exploitable du stock de la population en eaux intérieure des sébastes aux yeux jaunes a été estimée au moyen du modèle de référence à 780 t (en tenant compte d'un écart-type, = 390 t), soit 12 % de la biomasse initiale en 1918. On a estimé que la probabilité que la biomasse exploitable dépasse le point de référence limite se situait à $P(B_{2009} > 0{,}4B_{\mathrm{RMS}}) = 0{,}05$. Tous les résultats aux essais de sensitivité étaient similaires et indiquaient une forte probabilité que la biomasse exploitable de sébastes aux yeux jaunes soit inférieure au point de référence limite de $0{,}4B_{\mathrm{RMS}}$ en 2009. En ce qui concerne les niveaux de prélèvements annuels fixés qui ont été utilisés pour les projections, la probabilité de redressement des stocks au-dessus du point de référence limite se situait dans une fourchette allant de 0,12 à 0,14 sur un horizon de 5 ans et la probabilité augmentait pour se situer dans une fourchette allant de 0,4 à 0,7 sur un horizon de 40 ans.

Afin de permettre des analyses de facteurs non liés aux pêches pouvant affecter l'état des stocks, le modèle BPE a été élargi de manière à intégrer des changements au niveau de prédation des sébastes aux yeux jaunes par les pinnipèdes. Le volet prédation du modèle (PBSP) comprenait la mortalité due aux phoques communs (*Phoca vitulina*), aux otaries de Steller (*Eumetopias jubatus*) et aux otaries de Californie (*Zalophus californianus*), et mettait en oeuvre l'interaction selon un rapport de réponse fonctionnelle de type I où le volume total de poissons consommés par les prédateurs augmente de façon linéaire en fonction de la densité de sébastes jusqu'à un point maximum. Ce modèle élargi représente la première application des interactions prédateur-proie visant des mammifères marins pour l'évaluation des populations de sébastes aux yeux jaunes. Le peaufinement de ce modèle dépend de l'obtention de meilleures estimations du pourcentage que représente les sébastes aux yeux jaunes dans la diète des pinnipèdes et de l'examen d'autres formes de réponse fonctionnelle prédateur-proie. L'évaluation de l'état futur des stocks dépend également de l'élaboration de scénarios plausibles quant à l'abondance des espèces prédatrices. La détermination des points de référence sur les pêches fondés sur une valeur B_{RMS}pour le modèle PBSP demeure problématique étant donné que de nombreuses conditions d'équilibre dépendent de l'ampleur de la prédation par les pinnipèdes.

INTRODUCTION

A Pacific Region science advisory process peer review of stock assessments for outside stocks of lingcod (*Ophiodon elongatus*) and the inside population of yelloweye rockfish (*Sebastes ruberrimus*) in British Columbia was conducted in Nanaimo (BC) on April 7-8, 2011. The Terms of Reference for the science review (Appendix 1) were developed by the CSAP office, Pacific Region for both lingcod and yelloweye rockfish in response to a request for advice from Fisheries Management (FAM). Notifications of the science review and conditions for participation were sent to identified industry associations, recreational fishing sector representatives, non-governmental organizations, and First Nations organizations with an interest in both the outside stocks of lingcod and the inside population of yelloweye rockfish in British Columbia on March 15, 2011 (Appendix 2).

Two working papers were prepared and made available for review by meeting participants on March 16, 2011 (lingcod) and March 30, 2011 (yelloweye rockfish):

Lingcod (*Ophiodon elongatus*) stock assessment and yield advice for outside stocks in British Columbia. J.R. King, M.K. McAllister, K.R. Holt, and P.J.Starr.

Stock assessment for the inside population of yelloweye rockfish (*Sebastes ruberrimus*) in British Columbia, Canada for 2010. K.L. Yamanaka, M.K. McAllister, M.-P. Etienne, S. Obradovich, and R. Haigh.

The meeting began at 9:00 AM, Thursday, April 7, 2011. Acting Committee Chair A.R. Kronlund welcomed participants and explained room arrangements. Meeting participants were asked to introduce themselves; two reviewers and one author participated via 'webinar' (Appendix 3). The Chair invited M. Joyce to review the CSAP process and rules of exchange for the meeting. The Chair reviewed the agenda (Appendix 4) for the meeting and noted that rapporteur duties were assigned to L. Lacko (Science, Pacific Region) for the review of lingcod and to R. McPhie (Science, Pacific Region) for the review of yelloweye rockfish. The Terms of Reference for the lingcod working paper were reviewed followed by presentation and discussion of the working paper. Consideration of the lingcod working paper was closed at 3:00PM.

The meeting re-convened at 9:00AM, Friday, April 8, 2011 with a review of the CSAP process and the Terms of Reference for the yelloweye rockfish working paper. The Chair explained that the working paper was originally tabled at a CSAP advisory process held September 22, 2010 (DFO 2011) and the role of the Committee was to evaluate major revisions undertaken as a result of the original review. Presentation and discussion of the yelloweye rockfish working paper followed the introductory remarks by the Chair. The proposed agenda was completed and the meeting was closed at 3:00PM. Expected outcomes as a result of this science review process include this Proceedings document, two Science Advisory Reports, and two Research Documents.

The proceedings presented in this series focus on the main points discussed in the presentations and deliberations stemming from the activities of the science advisory regional Committee. The regional review is a process opened to all participants who are able to provide a critical outlook on the status of the assessed resources. In this regard, participants from outside the DFO are invited to take part in the Committee's activities. Proceedings also focus on recommendations made by the meeting participants.

LINGCOD

CONTEXT FOR LINGCOD

Lingcod (*Ophiodon elongatus*) are distributed in nearshore waters from California to Alaska, with the centre of abundance off the coast of British Columbia. Lingcod in British Columbia are assessed and managed as five separate units based on DFO Statistical Areas, with one inside stock in the Strait of Georgia (Area 4B) and four outside stocks: southwest Vancouver Island (Area 3C), northwest Vancouver Island (Area 3D), Queen Charlotte Sound (Areas 5A and 5B), and Hecate Strait and the west coast of Haida Gwaii (Areas 5C, 5D, and 5E). An important component of the groundfish fisheries in British Columbia, they are caught primarily by trawl gear but are also taken by handline, longline, and troll gears. The total lingcod commercial catch for the outside management areas in 2009 was 2,014 t. The total lingcod recreational catch in 2009 was estimated as 44 t based on 27,275 pieces caught.

The last stock assessment for lingcod in outside waters was completed in 2000 when stocks were considered to be at a moderate level of abundance (King and Surry 2000). The purpose of this assessment is to provide updated science advice for outside lingcod stocks in British Columbia that is compliant with both the "*DFO Sustainable Fisheries Framework*" (SFF) policy and "*A fishery decision-making framework incorporating the Precautionary Approach*" (PA) policy (DFO 2009). The request for advice from FAM included the requirement to recommend a limit reference point (LRP), upper stock reference point (USR), target reference point (TRP) and removal reference for outside lingcod stocks. Assessment of the status of outside lingcod stocks relative to the recommended reference points was requested, as well as an evaluation of the consequences of varying harvest levels on future population trends.

STOCK ASSESSMENT FOR THE OUTSIDE STOCKS OF LINGCOD (*OPHIODON ELONGATUS*) IN BRITISH COLUMBIA, CANADA FOR 2011

The working paper was presented in person by authors J. King, M. McAllister, and K. Holt, with P. Starr participating via 'webinar'. The presentation was organized into eight sections:

- General biology, stock structure and fishery history;
- Assessment and management history;
- Review of input data;
- Stock assessment methodology;
- Model parameters and sensitivity runs;
- Bayesian analysis of model outcomes;
- Reference points, projections and decision tables; and
- Conclusions and recommendations.

The authors reviewed general and unique aspects of lingcod life history (e.g., nest-guarding by males, seasonal sex-segregation with nest guarding adult males distributed at shallower depths than adult females during winter). Although tagging studies suggest that adult lingcod are not highly migratory, stock-structure is not well-known so that stocks were defined based on four large regional management units, i.e., areas 3D, 3C, 5AB and 5CDE. Management measures have relied primarily on annual quotas for the commercial fishing sectors and on daily catch limits for the recreational fisheries. Current management of commercial fisheries depends primarily on an Individual Vessel Quota (IVQ) system. Additional management measures include a minimum size limit and seasonal winter closures to protect nest guarding males; the implementation of these measures has varied over management areas and fishing years. For the 2009-2010 fishing year a 65 cm fork length minimum size limit was in place for lingcod retained in commercial fisheries and for recreational fisheries in Areas 3C, 3D and 5A only. A coast wide winter closure (November 16 to March 31) to protect nest-guarding male lingcod was in effect for the hook and line commercial fishery, and for recreational fisheries conducted in 3C, 3D and 5A.

A Bayesian surplus production (BSP) model was applied to assess lingcod stock status within each of the four stock areas. Data inputs included annual catch from all commercial sectors (e.g., trawl, longline hook, longline trap) and recreational fisheries beginning in 1927. At least three abundance indices were available for each area, drawn from commercial trawl fishery catch per unit effort (CPUE), the U.S. National Marine Fisheries Service (NMFS) triennial trawl survey, shrimp trawl surveys, the Hecate Strait multi-species assemblage survey and multi-species synoptic trawl surveys. Commercial trawl stock indices were developed via General Linear Model (GLM) standardization methods that incorporated year, locality, depth, vessel, latitude, and month as explanatory factors. Prior probability distributions were supplied for estimated parameters. Stock-specific parameter estimates for the intrinsic rate of increase, r, and carrying capacity, K, were used to calculate management parameters such as maximum sustainable yield (MSY), the optimum fishing mortality rate at MSY (F_{MSY}), and the optimal stock size at MSY (B_{MSY}).

Three of four commercial CPUE stock indices showed net increases up to 1990 and steeper increases than the coinciding survey indices in most instances. For specific time segments, survey indices sometimes show negative trends in contrast to positive trends for commercial CPUE indices. These differences suggested the possibility that the assumption of proportionality between the abundance indices derived from commercial catch rates and the stock biomass may not be met due to long term changes in fishing efficiency. Therefore, a technological efficiency ("tech") parameter was applied to the structural equation for the commercial CPUE index. A simple exponential function was used to provide an approximation to time-dependent changes in vessel and gear efficiency, improved electronics, fishing master experience, and management-induced changes to fishing behavioural (e.g., collaboration among fishing masters).

The limit and upper stock reference points were set at $0.4B_{MSY}$ and $0.8B_{MSY}$, respectively, with a candidate target reference point of B_{MSY}. Stock status in 2010 was characterized as follows based on the reference case model for each area:

Stock	**B_{2010}/B_{MSY}** *Current biomass relative to biomass at MSY*	**P($B_{2010}>0.4B_{MSY}$)** *Probability current biomass in Cautious or Healthy Zones*	**P($B_{2010}>0.8B_{MSY}$)** *Probability current biomass in Healthy Zone*	**F_{2010}/F_{MSY}** *Current fishing mortality relative to fishing mortality at MSY with 95% confidence bounds*
3C	1.11	0.90	0.67	0.39 (0.06, 2.2)
3D	1.56	<0.99	0.95	0.11 (0.03, 0.85)
5AB	1.13	0.95	0.67	0.51 (0.08, 2.18)
5CDE	1.46	<0.99	0.88	0.31 (0.08, 1.42)

The posterior probability distributions for management quantities of interest were relatively broad for this assessment, i.e., there was high uncertainty in model outputs primarily due to lack of contrast in long-term stock indices.

A suite of sensitivity tests was conducted to evaluate the effects of uncertainty in key model parameters relative to the reference case identified for each stock area. Sensitivity tests were divided into six categories that included specific hypotheses based on alternative choices of parameter values:

a) Value assumed for the prior mean of the intrinsic rate of population growth, *r* (two alternatives to reference case value);
b) Comparison of technological efficiency parameter fixed at 0 or estimated;
c) Range of alternative fixed values for technological efficiency (five alternatives);
d) Range of alternative prior mean values for technological efficiency (three alternatives);
e) Comparison of all areas treated as four separate stocks or a single outside stock; and,
f) All areas treated as a single outside stock with a range of alternative prior mean values for technological efficiency (four alternatives).

The trajectory of each of the four stocks was projected five years into the future for a range of alternative constant annual catch levels. Decision tables were constructed that showed the probability of the exploitable biomass in 2016, B_{2016}, exceeding three MSY-based reference points ($0.4B_{MSY}$, $0.8B_{MSY}$, B_{MSY}). Additional performance statistics included the probability of current exploitable biomass exceeding B_{2016}, $P(B_{2016}>B_{2010})$, and the ratio of B_{2016}/B_{MSY} based on the median of the posterior distribution.

DISCUSSION OF LINGCOD REVIEWS

The Committee considered reviews by O. Hamel (NOAA Northwest Fisheries Science Center, Seattle, Washington, USA) and T. Branch (School of Aquatic and Fishery Sciences, University of Washington), respectively. A summary of the major issues identified by each reviewer is included below.

Summary of Review 1

Reviewer 1 judged the assessment to be thorough, concluded the analyses explore a wide range of possible states of nature, and considered the assessments adequate for making management decisions. He questioned the decision to model British Columbia lingcod as four outside stocks based on the belief that adult lingcod are not highly migratory. He suggested that because of dispersion of the larval stage, the notion of a simple stock-recruitment relationship for each area, or even a separate production parameter like *r*, might be invalid.

The reviewer questioned why the process error appears to be zero in the years 2003, 2006-2008 (e.g., Figure G-3 of the working paper) and suggested that the problems in interpreting the wide posteriors could be assisted by finer division of the quantiles of posteriors for management quantities.

He commented on the exclusion of observations with zero catch from the CPUE indices and acknowledged that the technological efficiency parameter might absorb hyper-stability effects. However, he expressed concern that stock recovery might be under-estimated when the technological efficiency parameter assumes values that are too high.

Reviewer 1 commented extensively on the decision to calculate the posteriors for growth and maturity separately for each area. He argued that there are no intrinsic reasons these parameters should be different, other than those attributable to differences in the time of sampling among areas and differences in the availability and amount of data among years. He concluded that there is little need for different priors on *r* in the absence of a strong hypothesis, such as a gradient in temperature or productivity, which could affect growth and maturity.

The reviewer noted that a single prior mean for natural mortality (M=0.193) was adopted in this assessment. This assumption contrasts with the approach used for the west coast U.S. lingcod assessment where very different values of M for males (0.32) and females (0.18) are applied.

Reviewer 1 provided extensive comments on the technological efficiency parameter. He focused on the idea that "tech" parameters should be at least similar among areas but suggested there was a weaker argument that technological efficiency changes should be the same across time periods. His view was similar to that of Reviewer 2, who suggested that efficiency changes should occur in temporal stanzas. Reviewer 1 concluded that the data support a prior mean for the tech parameter of 0.01 rather than the value of 0.02 used in the reference case. Most importantly, he noted that the tech prior $N(0.02, 0.005^2)$ is quite precise and effectively determines the depletion level for each stock. He argued that the effect of the tech parameter could create a mismatch between catch and the observed change in the population, and thus masking the underlying population dynamics. Consequently he suggested that model sensitivity tests that exclude the commercial CPUE index should be conducted to evaluate the magnitude of commercial CPUE influence on results. This view was also expressed by Reviewer 2.

Summary of Review 2

Reviewer 2 noted the comprehensive nature of the assessments and concluded there were no substantial problems with the assessment of each stock. He described two major points: (*i*) the effort expended fully developing the surplus production model analysis might have been better employed developing an age- and sex-structured model given the clearly different impacts of the fishery on males and females, and (*ii*) the lack of explicit measurable objectives made the application of the results problematic given the very broad posterior distributions.

In particular the reviewer questioned the decision to combine the sexes given the probable sex-ratio bias in commercial catches, e.g., 75% or more female lingcod are observed in winter trawl fishing, with no trawl winter closure since 1996. He noted that the B_{MSY} estimate relative to unfished biomass, B_0, was a consequence of the structural assumptions in the assessment model. For example, the Schaefer form of the surplus production model implies B_{MSY}=0.5B_0 and B_{MSY} is approximately 0.35B_0 for most age-structured models. The point is that structural assumptions determine the estimates of reference points, and hence management decisions, to at least as large a degree as parameter or data sensitivities within a specific model.

Reviewer 2 expressed concern that the introduction of a uniform on log-K prior distribution could be providing information in the stock assessment and suggested that the model be run without data to produce post-model and pre-data distributions to assess this possibility. He noted, for example, that the posterior for K differs little between uniform K and log-K, but the log-K prior is very informative.

He commented further on the lack of smoothness in the plots of the posterior distributions that may suggest lack of convergence of the Sampling Importance Resampling (SIR) algorithm. Two solutions were offered: (*i*) run the model for a much longer period in an attempt to resolve any lack of convergence of the SIR algorithm, and (*ii*) use the faster MCMC algorithm although the potential shortfalls of this approach were acknowledged by the reviewer.

Reviewer 2 suggested that a useful sensitivity case would be one where commercial CPUE was excluded from the analysis to skirt problems with implementation of the tech parameter and to remove the strong influence of the commercial CPUE series. This test would also help to evaluate whether increases in CPUE were due to increases in abundance, perhaps attributable to decadal-scale climate changes. The reviewer commented that the tech parameter would tend to down-weight increases in CPUE and emphasize decreases.

The reviewer thought the small (<5%) difference between initial exploitable biomass, B_{1927}, and K was peculiar given the data provide no indication of the relation between B_{1927} and K. He suggested that the SIR algorithm used to generate the Bayesian posterior distribution might not be successfully exploring the joint sample space of these parameters.

Reviewer 2 noted that the catches are consistently less than the total allowable catch (TAC) in most areas and years. He recommended that some explanation be provided in the working paper. For example, the working paper could include a description of the constraints imposed by the multi-species nature of the fishery combined with the IVQ management system to counter conclusions that the quotas could not be achieved for biological reasons.

Both reviewers recommended that figures of the model biomass trajectories relative to the stock indices (Figures 3-6 of the working paper) be separated into multiple panels to allow easier assessment of the fit to each individual time series.

Response by Authors

The authors provided clarification that a prior process error of 0 was applied to every year but that only for years after 2000 are the priors updated. Figure G-3 is the posterior mode, but for some years after 2000 the model predictions did not differ markedly from the prior distributions so there is no update in those years.

The authors responded to reviewer criticism of the decision to apply area-dependent growth and maturity parameters in spite of the paucity of information on stock structure. Although they acknowledged the potential for movement among areas during the prolonged larval stage of lingcod, they suggested that the prevailing oceanographic currents did not support expectations of a single stock based on larval mixing. The authors commented on the difficulties of conducting larval studies in response to a reviewer's suggestion to conduct larval work to help resolve stock structure.

The authors responded to reviewer comments on whether the implementation of the technological parameter was realistic, given the potential for periodic advancements in efficiency. They stated that changes due to vessel size and gear, or improvements in navigation and sounding, could have been introduced in a step-wise fashion. However, the tech parameterization applied to the lingcod assessment is intended as a simple approximation to adjust commercial trawl catch rates for time-dependent changes in efficiency. They noted the parameterization can also accommodate non-technological changes such as those introduced by cooperation among fishing masters to achieve avoidance of a quota-restricted species. A reviewer re-iterated his concern that the long commercial CPUE time series dominates the analysis and should be viewed with skepticism given the general problems associated with the assumption of proportionality between commercial CPUE and stock abundance.

In response to the reviewer's suggestion that the analysis be replicated without commercial CPUE data the authors responded that there are insufficient time-series data to conduct a credible stock assessment without commercial CPUE for two reasons. First, the more recent survey indices do not inform the model regarding unfished conditions. Furthermore, large outliers in the long-term shrimp survey index cause poor model performance.

The authors agreed and recommended that future assessment work should consider age-structured analyses in areas 3C and 5AB, including a sex-segregated model to allow evaluation of the efficacy of winter closures to protect nest-guarding males and the rationale for sex-dependent natural mortality. In response to a reviewer's concerns about skewed sex ratios, the authors commented that if there are trends in the percentage of female mortality during the winter period then mitigating management measures may be required. A reviewer suggested that a table be included in the working paper to summarize the sex-ratio by stock area over time.

In response to the reviewer's concerns about the shape of the posterior distributions, the authors responded that the multiple modes are real and the lack of smoothness was likely a function of the choice of bin size used for the plotting rather than an indication that the SIR algorithm had not converged.

The authors agreed with a reviewer's suggestion that quotas were not fully subscribed in some areas due to the constraints imposed by a multi-species fishery coupled with IVQ management, and the more recent influence of the Integrated Groundfish management program. They agreed to add more explanation of this rationale when completing revisions to the working paper. A Science participant pointed out that there are large penalties associated with exceeding quotas, so that many quotas within the groundfish fishery are often not fully utilized.

GENERAL DISCUSSION FOR LINGCOD

The Chair reviewed the requirements of the working paper identified in the Terms of Reference (Appendix 1), asked that discussion be framed around the questions raised by the reviews, and opened general discussion to the Committee. Committee discussion was focused on (*i*) data sources, (*ii*) effects of the technological efficiency parameter for commercial CPUE indices, (*iii*) the importance of the Bayesian priors in determining model outcomes, (*iv*) the choice of the Bayesian surplus production model, and (*v*) fishery reference points.

Data Sources

A Science participant asked whether International Pacific Halibut Commission (IPHC) survey data had been considered for inclusion in the assessment. The authors responded that their previous experience with calculating a lingcod index from the IPHC survey data had shown large uncertainty (i.e., large coefficients of variation) and therefore they elected to exclude the survey from the current analysis. The authors noted they had included a recommendation in the working paper that the IPHC survey data be re-examined for the next assessment.

A Science participant pointed out that (*i*) commercial longline hook CPUE data are available, and (*ii*) various other survey sources exist such as the collaborative survey conducted with the Pacific Halibut Management Association (PHMA) where lingcod represent about 4 percent of the catch. In addition, the sex ratio may be less biased for these surveys in comparison to that observed in samples obtained during winter commercial fishing. With reference to the IPHC survey data it was suggested that lingcod comprise about 1% of the catch in that survey. The authors responded that when the commercial hook and line logbooks were reviewed recently for work on spiny dogfish (*Squalus acanthius*), they found a high occurrence of trips that lacked reliable fishing effort data. They authors judged the pre-2006 data unusable for lingcod given the poor quality of effort data (e.g., it was not always clear whether the hook count was recorded by set or by skate when the skate count was missing). With respect to the PHMA survey, the authors agreed it would be useful to consider these data for future assessments but noted there were only two years of survey data available when the current analysis was commissioned. An industry participant expressed the view that the directed hook and line lingcod fishery catch and effort could be selected from logbook data and used, and also suggested it may be possible to derive a ratio estimate of mean fish weight from logbook data to approximate the size frequency of the catch. A Science participant was in agreement with re-assessment of the commercial hook and line logbook data for usability before the next assessment of outside lingcod stocks.

As a result of the discussion around stock indices, the Committee recommended that future groundfish stock assessments be required to include a list of abundance index sources and the rationale for their exclusion/inclusion from the analysis.

A reviewer asked for clarification on whether standard errors from abundance indices were included directly in the production model, or whether the variances were inflated. The authors responded that the total error for the indices was comprised of the variances returned from the General Linear Model analysis and variances from process error in the abundance indices.

Fisheries management participants asked for clarification of two points: (*i*) whether Food, Social, and Ceremonial (FSC) catches are included both in the analysis and catch levels listed in the decision tables; and (*ii*) whether sub-legal fish are included in the catch data. The authors stated that catch had been included by fishery code for the period covered by the Fisheries Operations System (FOS) database so that FSC catch may not be included from this source. The release mortality rates contained in the Integrated Fisheries Management Plan (DFO 2010) were used to estimate the release mortality for catches reported as released legal and sub-legal. Release mortality rates used for the calculations were 4% for jig and longline, 2% for troll, 4% for trap, and for legal-size lingcod released by trawl 10% for the first hour towed and an additional 10% for each hour thereafter.

Technological Efficiency Parameter

A Science participant questioned whether the assessment should include the commercial CPUE indices, suggesting that the effect of the technological efficiency parameter may drive the assessment outcomes. The authors stated their view that the influence of the technological efficiency parameter only becomes significant when values of 3-4% are applied and the reference case uses a value of 2%. The Science participant also noted the findings of Carruthers et al. (2010) who demonstrated that GLM standardization of commercial CPUE series can lead to bias when aggregating data over large areas due to un-modeled interactions with the year effect, the selection of overly complex models in part due to the non-independence of records, and the requirement for data imputation when data of a particular time and area are missing.

It was pointed out by a Science participant that attempts to adjust commercial CPUE due to changes in fishing efficiency had been referred to as “compounding fishing power” in past Groundfish assessments and added that their use had been rejected. Some Science and industry participants expressed the view that increases in fishing power were more likely to have occurred via a step-wise manner due to the introduction of technological innovation (e.g., color plotters). However, others noted that multiple factors were sometimes introduced in an overlapping manner, rather than as a sequential series of discrete events. The authors acknowledged that technological efficiency parameter did not distinguish among changes in efficiency due to any particular innovation. The authors re-iterated that the introduction of the parameter was intended as an approximation to probable increases in fishing efficiency over time that improved model fit. They noted that parameter values of 0%, 1% and 2% result in similar outcomes. The effect of the technological efficiency parameter did not become substantial until a prior mean of 3% or higher was applied; a prior mean of 2% was chosen for the reference case, in part based on commonly used values found in the primary literature. The authors acknowledged a reviewer's comment that increased commercial CPUE could also be the effect of increased recruitment for some periods during the fishery history, particularly in the early 1980s following the large 1977 year class. Similarly, the authors suggested that synchronized fishery-dependent responses in CPUE among areas could plausibly be attributed to climate-induced change. The Committee suggested that text be added to the working paper that describes these plausible alternatives for increases in commercial CPUE that were not evaluated in the current assessment.

A Science participant noted that model outcomes were most sensitive to the technological efficiency parameter and asked the authors how this sensitivity affects the interpretation of the decision tables based on the reference case models. The authors responded that advice reported in Appendix Tables G-15, G-17, and G-19 of the working paper demonstrated the impacts of this sensitivity for consideration by decision-makers.

The Committee accepted the inclusion of the technological efficiency parameter in the assessment, noting that (*i*) the approach acknowledged that fishing efficiency was not constant over the assessment period, and (*ii*) results obtained for the reference case value of 2% were similar to outcomes for 0% and 1%. However, the Committee recommended that the general issue of compounding fishing efficiency for groundfish assessments be the specific focus of a working paper so that a common approach could be identified and recommendations developed to guide the future use of structural assumptions related to changes in fishing efficiency.

Bayesian Priors

A Science participant questioned whether the prior distribution for log-*K* added information into the model, noting that across the results for the four stocks there seemed to be little updating of the prior distribution based on inspection of the posterior distributions for *K*. The authors responded that the prior did not reduce the uncertainty of the posterior distribution although it did slightly alter the shape of the posterior distribution compared to when a non-log prior was used. They referred to Figure G-1 for Area 3C in particular and noted similar results in Figures G-2 through G-8 in the working paper as evidence for their statement. The Science participant agreed that there was a minor difference in the posterior distribution that resulted from the two priors.

Bayesian Surplus Production Model

A Science participant echoed the suggestion raised by a reviewer that an age-structured model should be considered, since age data exist. The authors stated that age-structured assessments could be applied to areas 3C and 5AB only and noted the recommendation in the working paper to evaluate the potential for an age-structured assessment for these areas. A Science participant commented that the introduction of age-structure will add structural uncertainty to the problem but would allow consideration of plausible selectivity and separate-sex parameterization options that are not accommodated by the BSP model.

Reference Points and Harvest Advice

A FAM participant asked whether there had been consideration of reference points in addition to the proposed LRP ($0.4B_{MSY}$) and USR ($0.8B_{MSY}$). The authors confirmed that no alternatives had been considered to demarcate the Critical, Cautious and Healthy zones but noted that performance statistics provided in decision tables include P(B_{2016}>B_{MSY}), P(B_{2016}>B_{2010}) and the median posterior estimate of the ratio B_{2016}/B_{MSY}. FAM participants commented on how stakeholder consultations were improved by figures that summarize the posterior distribution of current stock biomass relative to reference points. The Chair noted that detailed stock status summaries had been provided for each stock area, specifically referring to Tables 2-5 of the working paper and the authors agreed to provide graphical summarizes of these results.

A FAM participant asked if annual results over the five-year projection period could be provided in decision tables. The authors expressed their view that the listing of annual results over the projection period would not provide much additional information as it was relatively straight forward to interpolate trends between the 5-, 10-, and 20-year time periods provided. The Chair suggested that the determination of projection time horizons for evaluating future stock status and the interval for reporting results within the time horizon needs to be more broadly addressed for groundfish assessments with consideration to national policy and the requirements of decision-makers, and was beyond the scope of this review.

REVIEW OF TERMS OF REFERENCE FOR LINGCOD

The Chair opened discussion on whether the working paper had met the requirements of the Terms of Reference (Appendix 1). Each requirement was reviewed and any associated Committee discussion is provided below.

1. Recommend a Limit Referent Point, an Upper Stock Reference, Target Referent Point, and Removal Reference for the outside stocks of lingcod.

The Committee agreed that the limit reference point at $0.4B_{MSY}$, upper stock reference point at $0.8B_{MSY}$, and candidate target reference point at B_{MSY} is consistent with the Precautionary Approach harvest strategy policy (DFO 2009). A removal reference rate was not explicitly recommended although current stock status and future stock performance are characterized relative to F_{MSY}.

2. Assess the status of outside stocks of lingcod in British Columbia relative to the recommended reference points.

The Committee agreed that the working paper provides an acceptable characterization of stock status and reflects uncertainty within the surplus production model formulation by adopting a fully Bayesian approach that includes a suite of sensitivity tests. The reference case for each stock area and associated sensitivity test results were accepted as the basis for advice to managers.

The posterior probability distributions for management quantities of interest are relatively broad for this assessment, i.e., there is high uncertainty in model outputs primarily due to lack of contrast in long-term stock indices. The Committee requested that the authors provide a graphical representation of this uncertainty for consideration by fishery managers by showing the posterior distribution of current exploitable stock biomass relative to management reference points (e.g., LRP, USR, candidate TRP). The Committee recommended that the Science Advisory Report include this figure.

3. Provide rationale for the recommended candidate reference points if they differ from the Precautionary Approach reference points.

The analysis adopted B_{MSY}-based reference points consistent with the PA harvest strategy (DFO 2009).

4. Evaluate the consequences of varying harvest levels on future population trends.

The Committee recommended that the decision table provided for the reference case model (Table 6 of the working paper) could be considered as advice to managers for harvest decisions and should be included in the Science Advisory Report. The decision table lists the probability of the exploitable biomass exceeding the limit, upper stock reference and target reference points after a five-year projection to 2016, i.e., $P(B_{2016}>0.4B_{MSY})$, $P(B_{2016}>0.8B_{MSY})$, and $P(B_{2016}>B_{MSY})$, at fixed annual catch levels. The table also provides the median posterior estimate of the ratio B_{2016}/B_{MSY}.

The harvest policy applied to develop the decision tables is a fixed annual catch policy. If the policy is applied, the removal rate is not reduced during the 5-year projection period if stock status declines below the upper stock reference point. Consequently, the Committee suggested that the high uncertainty of the assessments and the five year projection period should be considered when prioritizing requests for future lingcod assessments against requests for advice on other groundfish stocks.

The Committee identified recommendations pertaining to the development of future groundfish stock assessments that are re-iterated here:

5. Future groundfish stock assessments should be required to include a list of abundance index sources and the rationale for their exclusion/inclusion from stock assessment analyses.

6. The general issue of compounding fishing efficiency for groundfish assessments should be the specific focus of a CSAP working paper so that a common approach can be identified and recommendations developed to guide the application of structural assumptions related to changes in fishing efficiency.

It was recommended that the working paper be revised and published as a research document. Consideration of the lingcod stock assessment working paper was closed by the Chair at 3:00PM on April 7, 2011.

YELLOWEYE ROCKFISH

CONTEXT FOR YELLOWEYE ROCKFISH

In 2006 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) requested and received from DFO a report summarizing the biology, life history, catch history and trends in yelloweye rockfish (*Sebastes ruberrimus*) abundance (Yamanaka et al. 2006). In November 2008, COSEWIC reviewed this report and designated both the inside and outside populations of yelloweye rockfish as *Species of Special Concern* (http://www.cosewsic.gc.ca/). Yelloweye rockfish were last assessed by DFO Science in 2001.

Fisheries and Aquaculture Management (FAM) requested an assessment of the status of yelloweye rockfish in support of continued implementation of the Rockfish Conservation Strategy and to address the *Special Concern* designation. The request for advice included the requirement to recommend a limit reference point (LRP), an upper stock reference (USR) point, target reference point (TRP) and removal reference rate for the inside population of yelloweye rockfish. Characterization of the status of the population relative to the proposed reference points was requested. The FAM request also included the requirement to evaluate the consequences of alternative removal levels for both targeted and non-targeted fisheries.

The assessment considered in this meeting was originally tabled at a CSAP advisory process held September 22, 2010 (DFO 2011). The working paper was titled:

Stock assessment for the inside population of yelloweye rockfish (*Sebastes ruberrimus*) in British Columbia, Canada for 2010. K.L. Yamanaka, M.K. McAllister, M.-P. Etienne, S. Obradovich, and R. Haigh.

The original assessment used two forms of a Bayesian surplus production model, one of which included the first application of a pinniped predation component to the inside yelloweye rockfish population assessment. This hypothesis introduced useful discussion of the complexities of ecosystem considerations and was motivated by observations of pinniped consumption of rockfish and increases in the populations of pinnipeds over the last 40 years within the assessment area. However, reviews of the working paper tabled in September 2010 raised concerns about structural assumptions and data uncertainties in the analyses. First, reviews of the document highlighted difficulties in the definition and application of MSY-based reference points in the presence of pinniped predation. Second, uncertainty about the selection of pinniped diet parameters input to the model and problems with the selection of data for pinniped population abundances were identified during Committee review. Finally, plausible factors other than pinniped predation that could influence the stock trajectory of yelloweye rockfish were not evaluated e.g., below average recruitment during the 1990s, or a population response following stock depletion that is consistent with the somatic growth and expected productivity of yelloweye rockfish.

As a result of these considerations, the Committee suggested that management advice be based on the reference case Bayesian surplus production (BSP) model contained in the assessment (DFO 2011). A more complete set of sensitivity tests for the BSP model was advocated by the Committee since the original BSP analyses included limited sensitivity tests. It was also suggested that the form of the BSP model that included pinniped predation (PBSP) model be presented as an alternative model to illustrate fishery-independent factors that could influence future outcomes for this population. Committee recommendations on the applicability of management advice arising from the September 2010 working paper were therefore deferred pending revisions to the working paper and would be considered at a subsequent meeting. This Proceedings document is a record of the CSAP advisory process activities and key discussion points related to the revised working paper.

STOCK ASSESSMENT FOR THE INSIDE POPULATION OF YELLOWEYE ROCKFISH (*SEBASTES RUBERRIMUS*) IN BRITISH COLUMBIA, CANADA FOR 2010

The working paper was presented by L. Yamanaka and M. McAllister, with emphasis on revisions completed as a result of the September 2010 review (DFO 2011). The working paper described a stock assessment of yelloweye rockfish for inside waters in British Columbia that include Queen Charlotte Strait, Johnstone Strait and the Strait of Georgia. Population dynamics were modeled using a Bayesian surplus production model (BSP). The model was fitted to (*i*) four standardized commercial catch per unit effort (CPUE) series that covered four different periods in the history of the fishery; and (*ii*) eight fishery independent longline survey indices that varied in spatial coverage within the assessment area. All survey indices were derived from longline surveys of rockfishes with the exception of a directed spiny dogfish (*Squalus acanthias*) survey that intercepts yelloweye rockfish. A suite of sensitivity tests was conducted to evaluate the effects of uncertainty in key model parameters. Sensitivity tests were divided into four categories that included specific hypotheses based on alternative choices of parameter values:

a) Value assumed for the prior mean of the intrinsic rate of population growth, r (two alternatives to reference case value);

b) Value assumed for B_{1918}/K_0, where B_{1918} is the exploitable biomass in 1918 and K_0 represents the unfished, non-predated population size (two alternatives to reference case value);

c) Uncertainty in catch estimates (two alternatives to reference case value); and,

d) Influence of stock trend data (three alternatives to reference case value).

Exploitable stock biomass of the inside population of yelloweye rockfish was estimated using the reference case of the BSP model to be 780 t (with standard deviation, SD=390 t) in 2009, or 12% (SD=6%) of the initial biomass in 1918. The probability of the exploitable biomass exceeding the limit reference point was estimated to be $P(B_{2009} > 0.4B_{MSY}) = 0.05$. All sensitivity test results were similar and indicated a high probability that the exploitable biomass of yelloweye rockfish was less than the limit reference point of $0.4B_{MSY}$ in 2009, where B_{MSY} was estimated by the model. Stock projections were evaluated for fixed annual catch and fixed annual harvest rate policies over 5, 20, 40, and 80-year time horizons. For the fixed annual catch levels applied in the projections, the probability of stock recovery to levels above the limit reference point ranged from 0.12 to 0.14 over a 5-year time horizon and increased to about 0.4 to 0.7 over a 40-year time horizon. The authors recommended that management advice be based on results obtained from the BSP model.

The BSP model was extended to incorporate changes in the level of predation of yelloweye rockfish by pinnipeds. The predation model (PBSP) included mortality due to harbour seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), and California sea lions (*Zalophus californianus*) using a Type I functional response relationship. In addition to sensitivities (a-c) above, evaluation of the PBSP model included the following sensitivity tests:

e) Consumption rate of predators (six alternatives to reference case value); and,

f) Uncertainty in maximum fraction of rockfish in diet (two alternatives to reference case value).

Sensitivities to stock trend data inputs were not conducted for the PBSP model. The authors presented the PBSP form of the model to illustrate the potential role of non-fishery factors in the determination of yelloweye rockfish stock status, in this case the influence of inter-annual variation in pinniped predation. However, at this point, no management advice is provided from the PBSP model for reasons described below. Projections from the PBSP model were conducted for a range of fixed annual catch and fishing mortality levels under the assumption that pinniped abundance remains at the 2009 level over 5, 20, 40, and 80-year projection horizons. All projection results indicated continued decline of the yelloweye rockfish population from 2009 levels unless pinniped predation decreases. However, B_{MSY}-based reference points cannot be used without the selection of a specific time-dependant level of pinniped predation and are not comparable to those used for the BSP model.

The authors implemented the following revisions to the working paper in response to the initial review process (DFO 2011):

(a) Uncertainty in commercial catch inputs. DFO (2011) identified possible double counting of pre-1951 Dominion of Canada Bureau of Statistics catch data for the assessment area and industry concerns about unreliable fishery logbook data during the 1986 to 2005 period. No adjustment was made to the pre-1951 data, however, the 1986 to 2005 catch data were assumed to be twice the reported values to accommodate concerns about unreported logbook data. The sensitivity of the model outputs to the magnitude of catch was tested by fitting the model with the entire 1918 to 2009 catch series multiplied by 0.5 and 1.5, respectively. The authors suggested that this test was adequate for evaluating model sensitivity to the possible duplication of pre-1951 data.

(b) Pinniped data inputs. Abundance indices for pinnipeds were adjusted to conform more closely to the assessment area. For example, review of the 2009 data resulted in changes for harbour seals from 54,000 to 59,000 animals, Steller sea lions from 4,178 to 1,074 animals, and California sea lions from 1,200 to 1,943 animals.

The Steller sea lion consumption rate of rockfish was parameterized using values obtained from a 2005 diet study that was conducted at Denman Island within the assessment area. Re-evaluation of the proportion of rockfish in seal diets resulted in increases relative to the original version of the working paper from 1.2% to 1.3% for harbour seals, 3.49% to 5.64% for Steller sea lions, and 1.69 to 5.64% for California sea lions.

(c) Form of the predator-prey functional response. No evaluation of alternative Type II or Type III functional response forms was attempted for this analysis. The authors noted that the Type II response had been considered for Atlantic grey seal (*Halichoerus grypus*) predation on cod (*Gadus morhua*), while the Type III response may be plausible for yelloweye rockfish due to spatial heterogeneity in predation. This selection of the predator-prey functional response remains an important area of investigation for future development of PBSP model, however the Type I functional response was retained for this analysis.

(d) MSY-based reference points in the presence of pinniped predation. The authors added text to the working paper that described the derivation of MSY for a given value of the pinniped predation rate in year *y*. The expected carrying capacity of the population consequently becomes dependant on the assumed predation rate. However with inter-annual variation in predation rates, the MSY-based reference points will be time-varying and depend on a function that represents the overall effect of the combined annual abundances of predators. The expression of time-invariant reference points, as applied to the BSP model without predation, requires that a fixed level of pinniped predation is assumed. The choice of the level of pinniped predation is not currently identified on the basis of ecosystem considerations. The authors explained that for the purposes of illustrating the PBSP model they adopted the exploitable biomass in 1918, B_{1918}, as the base for reference points. The authors commented that this choice is arbitrary, and results in $0.5B_{1918}$ as the candidate target reference point and $r_0/2$ as a time-invariant mortality reference point.

GENERAL DISCUSSION FOR YELLOWEYE ROCKFISH

The Committee had considered reviews by I. Stewart (NOAA Fisheries), N. Taylor, and R. Forrest for the original review of the working paper in September 2010 (DFO 2011). No additional reviews were solicited for consideration of the revised working paper discussed here. The Chair reviewed the requirements of the working paper identified in the Terms of Reference (Appendix 1), asked that discussion be framed around the revisions conducted by the authors and opened general discussion to the Committee.

General discussion was primarily focused on the themes of (*i*) reliability of the catch reconstruction, (*ii*) reliability of the estimates of yelloweye rockfish consumption rates by pinnipeds, and (*iii*) reference points for the PBSP model.

Catch Reconstruction

An industry participant questioned whether uncertainty in the catch history had been adequately acknowledged. The authors responded that the reported catch from the 1986-2005 logbook records had been doubled in direct response to industry concerns about under-reporting of catch during this period and that decreasing the entire catch series by 50% or increasing it by 150% were intended to test the sensitivity of model outcomes to uncertainty in the entire catch series as reported in Table 13 of the working paper. Estimates of exploitable biomass were found to be moderately sensitive to the catch assumptions; however reference point estimates were relatively insensitive to the level of catch supplied to the model.

Pinniped Consumption and Abundance Estimates

Committee discussion of the pinniped data from the first review of the working paper (DFO 2011) related to the appropriateness of the Steller sea lion abundance estimates and the credibility of pinniped consumption estimates. The authors described revisions to selection of the data for development of the pinniped abundance indices. The revised abundance time series were deemed appropriate by the principal pinniped biologist who provided these data and participated in the discussion.

However, the pinniped biologist expressed concerns about estimates of the proportions of yelloweye rockfish in pinniped diets that were applied in the updated analyses. Pinnipeds feed primarily on forage fish, such as herring and sardines, encountered in the water column rather than diving to the bottom. He explained that for harbour seals there are no data on the species composition of rockfishes found in scat samples, that harbour seals appear to avoid spiny prey, and that the rockfishes consumed by harbour seals appeared to be mostly juveniles based on the size of recovered hard parts. Furthermore, for Steller sea lions, rockfishes were found in samples obtained from only one location indicating the possibility that rockfish predation is spatially aggregated within the distribution of the sea lions. The pinniped biologist did not agree that longline hook survey data species composition could be used as a surrogate for species composition in pinniped diets and advocated that rigorous diet studies be conducted. He noted that DNA analysis could be applied to identify rockfish species using archived samples of bones from scats. The participant commented that the Steller and California sea lion mix in the assessment area and scats could not be not be identified to the source species. For sea lion scat samples analyzed to date, rockfishes occurred in about 0.6% of the approximately 1000 samples, a value significantly lower than the 5.6% assumed for the PBSP model. He therefore concluded that the consumption rate is over-estimated in the model by a factor of 10. As a result of the discussion, the authors agreed the reference case estimate of the yelloweye rockfish consumption rate for the PBSP model was too high. Finally, the importance of demonstrating the sensitivity of model outcomes to diet assumptions was stated; this sensitivity test was not included in the suite of tests reported in the working paper.

The Committee recommended that that the PBSP model analysis be revised as suggested by the authors and a Science participant to use a mean consumption rate more consistent with available data from the inside area. In addition, the PBSP model reference case should be tested with lower and upper bounds set at the extremes of the observed rockfish consumption data to evaluate model sensitivity over the entire range of inputs. The authors suggested that the results of this test would be equivalent to sensitivity test values already performed for consumption rate values set at 1%, 10%, and 25% of the reference case value.

The consensus of the Committee was that the PBSP model formulation provided a useful introduction to the issue of marine mammal interactions with rockfish stocks, but required additional development work beyond the proposed revisions. The Committee therefore agreed with the author's recommendation that the model should not be used for management advice at this preliminary stage of development. The Committee recommended that future development of the PBSP model requires specific focus and review by subject matter experts on (*i*) the functional form of the predator-prey relationship, (*ii*) pinniped diet analyses, and (*iii)* plausible scenarios for future abundance trends and diet preferences among the predator species. In addition, the Committee identified a need for a broader science process to consider the issue of predator-prey relationships in groundfish stock assessments in anticipation of the development of ecosystem-based management approaches.

Reference Points for the PBSP Model

Several Science participants commented on the difficulty of interpreting B_{MSY}-based reference points for the PBSP model. It was suggested references points of 0.4 and 0.8 of B_{MSY} be removed from decision tables corresponding to the PBSP model (e.g., Table 20) and that differences between B_{MSY} for the BSP and PBSP models receive additional explanation in the text. The Committee agreed that reference points for the PBSP model should be limited to those that express status relative to initial biomass, B_{init} , which is invariant to the definition of MSY.

Other Discussion Points

The authors described their attempt to use Bayes factors to determine if different configurations of the model could be rejected as being inconsistent with the data. For example, when pinniped predation was set to zero, none of the Bayes factors suggest rejecting the BSP model over the PBSP model that included pinniped predation.

A Science participant noted that projections using the PBSP model had been conducted under the assumption that pinniped abundance remains at 2009 levels over the projection period. This assumption was questioned given the recently increasing trajectory of Steller sea lion abundance and the unknown likelihood of harbour seals maintaining their future abundance near historic highs. No population dynamics modelling of pinnipeds for the Strait of Georgia was available to assist the development of plausible population projections for pinnipeds for this assessment. The authors pointed out that they had also suggested a scenario where pinniped abundance declines to about 1/6 of the current level by 2020 and is maintained at that level for the balance of the projection period. The Committee suggested that the rationale for this scenario be provided in the revised text following completion of revised PBSP model results.

A Science participant asked for clarification of the relative magnitude of natural mortality, M, to fishing and pinniped mortality for the PBSP model. The participant suggested that Figure 24 of the working paper be changed to a multi-panel plot showing total F and pinniped natural mortality over time with levels of predation magnitude at 1%, 5% and 25% of the reference case (i.e., graphical representation of the predation magnitude sensitivity case (e)).

A Science participant asked the authors whether concerns raised over broader priors for initial depletion, B_{init}/K, had been addressed. Reviewers had suggested that this prior distribution was too precise and was providing too much information to the model. The authors responded that their choice of prior variance was more liberal than commonly applied in similar assessments, and that sensitivity tests had been conducted with prior means at 0.7 and 1.2 times B_{init}/K when common practice is to set $B_{init}=K$. They pointed out that estimates of exploitable biomass were sensitive to the assumption about initial population size, but not the stock status estimates as indicated in Table 13 of the working paper.

The authors provided clarification on the constant F policy levels reported in decision tables, commenting that the fishing mortality at each of 5, 10, and 15 t in 2009 was calculated and the corresponding value applied as a fixed F policy over each year of the projection period. Various Science and FAM participants noted that the constant F policy suggests effort control which is difficult to achieve for the mixture of commercial and recreational fisheries that intercept yelloweye rockfish in the assessment area.

REVIEW OF TERMS OF REFERENCE FOR YELLOWEYE ROCKFISH

The Chair introduced discussion on whether the working paper had met the requirements of the Terms of Reference. The Committee accepted the reference case Bayesian surplus production model and the expanded suite of sensitivity tests provided in the revised working paper as the basis for advice to managers for the inside population of yelloweye rockfish. Committee discussion of specific Terms of Reference points is summarized below.

1. Recommend a Limit Reference Point, an Upper Stock Reference, Target Reference Point and Removal Reference for the inside population of yelloweye rockfish.

The Committee accepted the use of limit and upper stock reference points of 0.4 and $0.8B_{MSY}$, respectively, and a candidate target reference point of B_{MSY} as estimated by the BSP. A removal reference rate was not explicitly recommended although current stock status and future stock performance is characterized relative to the fishing mortality at F_{MSY}.

2. Assess the status of the inside stock of yelloweye rockfish relative to the recommended reference points.

Based on the BSP reference case, the point estimate of exploitable biomass of the inside population of yelloweye rockfish is 780 t (with standard deviation, SD=390 t) in 2009, or 12% (SD=6%) of the initial exploitable biomass in 1918. For the reference case BSP model, the probability of the exploitable biomass exceeding the limit reference point using the reference case was estimated to be $P(B_{2009} > 0.4B_{MSY}) = 0.05$. All sensitivity test results were similar and indicated a high probability that the exploitable biomass of yelloweye rockfish was less than the limit reference point of $0.4B_{MSY}$ in 2009, i.e., in the Critical Zone. The Committee requested that the authors revise the characterization of stock status in the working paper to include a statement of the median B_{2009}/B_{MSY} and the probabilities of B_{2009} exceeding the LRP and USR, respectively.

3. Provide rationale for the recommended candidate reference points if they differ from the Precautionary Approach default reference points.

Candidate reference points were consistent with guidance provided by the Precautionary Approach harvest strategy policy (DFO 2009).

4. Evaluate the consequences of varying harvest levels on future population trends.

The Committee accepted projections based on the reference case of the BSP model as adequate to portray the consequences of varying levels of constant annual catch. Stock performance relative to fishery reference points is contained in decision tables that summarize projected stock status under a range of fixed catch and fishing mortality levels for 5, 20, 40, and 80-year time horizons (Table 16 of the working paper). Expected stock performance corresponding to sensitivity tests is summarized by two alternatives each for the prior value of the intrinsic rate of growth (Table 17), initial stock size (Table 18), and the magnitude of historical catch (Table 19).

The Committee recommended that that the analysis of the PBSP model be revised to use a lower estimate of yelloweye rockfish consumption rate that is more consistent with all available data. In addition, the PBSP model reference case should be tested with lower and upper bounds set at the observed proportions of rockfish in the diet to evaluate model sensitivity to these inputs. Performance statistics summarizing projection results should be limited to those that report stock depletion relative to B_{init} due to difficulties in selecting and interpreting time-varying MSY-based reference points with multiple equilibria.

5. The Committee identified the need for a science review process that specifically considers the issue of predator-prey relationships in groundfish stock assessments involving marine mammals, in keeping with the development of ecosystem-based management approaches. This process requires participation and review by subject matter experts on topics such as the estimation of marine mammal population size and distribution, marine mammal diet components, and the implementation of predator-prey response models. Expertise on the identification and selection of groundfish management targets in the presence of predator effects would also be required to participate in the review.

It was recommended that the working paper be revised and published as a research document. The Chair closed the meeting at 3:00PM, April 8, 2011.

LITERATURE CITED

Carruthers, T.R., McAllister, M.K., and Ahrens, N.M. 2010. Simulating spatial dynamics to evaluate methods of deriving abundance indices for tropical tunas. Can. J. Fish. Aquat. Sci. **67**: 1409-1427.

DFO. 2009 A fishery decision-making framework incorporating the Precautionary Approach. http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/precaution-eng.htm

DFO. 2010. Integrated fisheries management plan: Groundfish, February 21, 2010 to February 20, 2011. Version 1.3. Fisheries and Oceans Canada. 184 p.

DFO. 2011. Regional Science Advisory Process on the Pacific Review of Yelloweye Rockfish (*Sebastes ruberrimus*), September 22, 2010. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/011.iv + 16p.

King, J.R., and Surry, A.M. 2000. Lingcod stock assessment and recommended yield options for 2001. CSAS Res. Doc. 2000/164. 50p.

Yamanaka, K.L., L.C. Lacko, R. Withler, C. Grandin, J.K. Lochead, J.C. Martin, N. Olsen and S.S. Wallace. 2006. A review of yelloweye rockfish *Sebastes ruberrimus* along the Pacific coast of Canada: biology, distribution and abundance trends. DFO Can. Sci. Adv. Sec. Res. Doc. 2006/076 54 p.

APPENDIX 1: TERMS OF REFERENCE FOR THE MEETING.

Terms of Reference
Reviews of stock assessments for outside stocks of lingcod and inside stocks of yelloweye rockfish in British Columbia
Pacific Regional Science Advisory Process

7th and 8th April, 2011
Nanaimo, British Columbia

Chairperson: Andrew Edwards

Lingcod (7th April)

Context

There are currently commercial and recreational fisheries for lingcod in outside waters along the coast of British Columbia. The last assessment for lingcod in outside waters was completed in 2000. The purpose of the assessment is to provide updated science advice for outside lingcod stocks in British Columbia. These outside lingcod stocks are assessed and managed as four separate areas based on Fisheries and Oceans Canada (DFO) Statistical Areas: 3C, 3D, 5AB and 5CDE. Outside stocks were last assessed at being at a moderate level of abundance, and currently support commercial fisheries using trawl and longline gear, as well as recreational fisheries.

The Fisheries and Aquaculture Management Branch of Fisheries and Oceans Canada has requested updated advice on the status of the lingcod stock in outside waters. Advice will be given in the context of DFO's new *Fishery Decision-making Framework Incorporating the Precautionary Approach* (DFO 2009).

Objectives

Guided by the DFO Sustainable Fisheries Framework, particularly the *Fishery Decision-making Framework Incorporating the Precautionary Approach* (DFO 2009), meeting participants will review this working paper:

Lingcod (Ophiodon elongatus) stock assessment and yield advice for outside stocks in British Columbia. J.R. King, M. McAllister, K.R. Holt and P.J. Starr. CSAP Working Paper 2010/P03.

to meet the following objectives:

- Recommend a Limit Reference Point, an Upper Stock Reference, Target Reference Point and Removal Reference for the outside population of lingcod;
- Assess the status of the outside stock of lingcod relative to the recommended reference points;
- Provide rationale for the recommended candidate reference points if they differ from the Precautionary Approach default reference points;
- Evaluate the consequences of varying harvest levels on future population trends.

Yelloweye Rockfish (8th April)

Context

Declines of inshore rockfish catch indices, particularly within the Strait of Georgia, were first reported early in the commercial fishery. Inshore rockfish assessments throughout the 1990s identified numerous symptoms of stock decline, yet data sources were insufficient to set sustainable total allowable catches. Recommendations to manage rockfish across all fishery sectors and institute spatial management measures to protect a portion of the inshore rockfish population led to the development and implementation of the Rockfish Conservation Strategy (RCS) in 1999.

Fisheries and Oceans Canada initiated action on the RCS in consultation with industry, First Nations, and the general public. The RCS articulated four key objectives: account for all inshore rockfish catch; decrease fishing mortality; establish rockfish protection areas; and improve stock monitoring and assessment.

In 2006 the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) requested and received from DFO a report summarizing the biology, life history, catch history and trends in yelloweye rockfish abundance. In November 2008, COSEWIC reviewed this report and designated the species (both the inside and the outside populations) as Species of Special Concern. Yelloweye rockfish were last assessed by DFO Science in 2001.

In support of continued implementation of the RCS and management of those fisheries where targeted and non-targeted catch of yelloweye rockfish occurs, Fisheries and Aquaculture Management Branch has requested an assessment of resource status.

A previous version of the working paper was reviewed at the Pacific Regional Advisory Process meeting in September 2010. Major revisions were requested. The main outcome of that review is that the model that includes pinniped predation will not be used to formulate advice.

Objectives

Meeting participants will review the following working paper:

Stock Assessment for the inside population of yelloweye rockfish (Sebastes ruberrimus) in British Columbia, Canada for 2010. K.L. Yamanaka, M.K. McAllister, M.-P. Etienne, S. Obradovich and R. Haigh. CSAP Working Paper 2010/P06.

Participants will determine whether the revisions to the original version are acceptable. They will also determine whether the revised version meets the following original objectives:

Guided by the DFO Sustainable Fisheries Framework, particularly the *Fishery Decision-making Framework Incorporating the Precautionary Approach* (DFO 2009), the following objectives for the assessment have been established:

- Recommend a Limit Reference Point, an Upper Stock Reference, Target Reference Point and Removal Reference for the inside population of yelloweye rockfish;
- Assess the status of the inside stock of yelloweye rockfish relative to the recommended reference points;
- Provide rationale for the recommended candidate reference points if they differ from the Precautionary Approach default reference points;
- Evaluate the consequences of varying harvest levels on future population trends.

Expected Publications

CSAS Science Advisory Report (2)
CSAS Research Document (2)
CSAS Proceedings (1)

Participation

DFO Science, Oceans, Habitat and Species at Risk, Aboriginal Communities, Province of BC, External Reviewers, Industry, Non-governmental organizations and Other Stakeholders will be invited to participate in this meeting.

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

References Cited

DFO. 2009. A fishery decision-making framework incorporating the Precautionary Approach. http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/fish-ren-peche/sff-cpd/precaution-eng.htm

APPENDIX 2: EXAMPLE LETTER OF NOTIFICATION

Example letter of notification (to external participants) regarding the CSAP Science Advisory Process review of the outside stocks of lingcod (Ophiodon elongatus) and inside population of yelloweye rockfish (Sebastes ruberriumus) in British Columbia, Canada, April 7-8, 2011.

Invitation to External Participants

The Department of Fisheries and Ocean's **Centre for Science Advice Pacific** (CSAP, previously known as **PSARC**) routinely conducts Regional Advisory Processes, or RAPs. During RAPs, Pacific scientific assessments on issues of importance to fisheries, habitat, ecosystem, Species at Risk and integrated oceans management are reviewed, and science advice is developed for decision makers.

Please accept this invitation to attend a RAP meeting to provide scientific advice following review of the following working papers:

1. Lingcod (Ophiodon elongatus) stock assessment and yield advice for outside stocks in British Columbia. J.R. King, M. McAllister, K.R. Holt and P.J. Starr. CSAP Working Paper 2010/P03.

2. Stock Assessment for the inside population of yelloweye rockfish (Sebastes ruberrimus) in British Columbia, Canada for 2010. K.L. Yamanaka, M.K. McAllister, M.-P. Etienne, S. Obradovich and R. Haigh. CSAP Working Paper 2010/P06.

For further information about this RAP, see the attached Terms of Reference,

Meeting Details:

Date:	Thursday, April 7 and Friday, April 8, 2011
Time:	9:00 – 4:30
Location:	Pacific Biological Station Seminar Room" (2nd floor) 3190 Hammond Bay Rd., Nanaimo, BC.

Please RSVP by **Wednesday, March 23, 2011** indicating whether or not you will participate by responding to this invitation at CSAP@dfo-mpo.gc.ca or phoning 250-756-7208.

While an option to attend via Webinar will be available, your participation in person is preferred. Please specify how you plan to attend so instructions can be provided before the meeting.

The document(s) to be reviewed and the results of the meeting are preliminary until release of the official advice, usually a few weeks after the meeting. Participants are therefore asked not to distribute these preliminary documents or to discuss the results of the meeting until the final publications appear on the national Canadian Science Advisory Secretariat website http://www.dfo-mpo.gc.ca/csas-sccs/index-eng.htm.

We provide photocopies of document reviews at the meeting, but only a very limited number of the documents themselves. If you are unable to bring your own copy of the working paper (electronic or paper), please contact the CSAP office.

The Center for Science Advice Pacific is guided by the policies and procedures established by DFO's Canadian Science Advisory Secretariat (CSAS). For further information on participation in the peer review process by those external to DFO, see the following internet site: http://www.dfo-mpo.gc.ca/csas/csas/Process-Processus/ExtPart-PartExt/Ext-Part-RAP_e.htm.

If you have questions about this review process or the CSAS process in general, please contact the Head of the Centre for Science Advice Pacific, Marilyn.Joyce@dfo-mpo.gc.ca, 250.756-7088.

APPENDIX 3: LIST OF PARTICIPANTS

List of invited and attending participants at the April 7-8, 2011 CSAP Science Advisory Process review of outside stocks of lingcode and the inside population of yelloweye rockfish in British Columbia, Canada. Symbols indicate the invitee attended (√) or participated by Webinar (W).

Last Name	First Name	Affiliation	E-mail Address	Apr 7	Apr 8
Acheson	Schon	Science, Groundfish Section	Schon.Acheson@dfo-mpo.gc.ca		
Ackerman	Barry	FAM, Groundfish Management	Barry.Ackerman@dfo-mpo.gc.ca	√	√
Anderson	Kris	Science, Groundfish Section	Kristina.Anderson@dfo-mpo.gc.ca		
Brown	Laura	MEAD	Laura.L.Brown@dfo-mpo.gc.ca		
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Haigh	Rowan	Science, Groundfish Section	Rowan.Haigh@dfo-mpo.gc.ca	√	√
Holt	Kendra	Science, Groundfish Section	Kendra.Holt@dfo-mpo.gc.ca	√	√
Joyce	Marilyn	Science, CSAP	Marilyn.Joyce@dfo-mpo.gc.ca	√	
Keizer	Adam	FAM, Groundfish Management	Adam.Keizer@dfo-mpo.gc.ca	√	
King	Jackie	Science, Groundfish Section	Jackie.King@dfo-mpo.gc.ca	√	
Krishka	Brian	Science, Groundfish Section	Brian.Krishka@dfo-mpo.gc.ca		
Kronlund	Allen	Science, Groundfish Section	Allen.Kronlund@dfo-mpo.gc.ca	√	√
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Mawani	Tamee	FAM, Groundfish Management	Tameezan.Mawani@dfo-mpo.gc.ca	√	
McPhie	Romney	Science, Groundfish Section	Romney.McPhie@dfo-mpo.gc.ca	√	√
Olesiuk	Peter	Science, Conservation Biology			√
Olsen	Norm	Science, Groundfish Section	Norm.Olsen@dfo-mpo.gc.ca		
Ou	Wan Li	FAM, Groundfish Management	wan-li.ou@dfo-mpo.gc.ca	√	
Rutherford	Kate	Science, Groundfish Section	Kate.Rutherford@dfo-mpo.gc.ca	√	√
Stanley	Rick	Science, Groundfish Section	Rick.Stanley@dfo-mpo.gc.ca	√	√
Tadey	Rob	FAM, Groundfish Management	Robert.Tadey@dfo-mpo.gc.ca	√	√
Taylor	Nathan	Science, Groundfish Section	Nathan.Taylor@dfo-mpo.gc.ca	√	√
Workman	Greg	Science, Groundfish Section	Greg.Workman@dfo-mpo.gc.ca	√	√
Wyeth	Malcolm	Science, Groundfish Section	Malcolm.Wyeth@dfo-mpo.gc.ca	√	√
Yamanaka	Lynne	Science, Groundfish Section	Lynne.Yamanaka@dfo-mpo.gc.ca	√	√
External					
Argue	Sandy	Province of British Columbia	sandy.argue@argusbioresources.ca		
Ashcroft	Chuck	Sport Fish Advisory Board	chuckashcroft@telus.net	√	
Branch	Trevor	University of Washington	tbranch@uw.edu	W	
Carlson	Eric	CIC, Zn Hook and Line Inside	sunridge@connect.ab.ca		√
Chalmers	Dennis	Province of British Columbia	Dennis.Chalmers@gov.bc.ca	√	√
Edwards	Dan	United Fishers & Allied Workers	danedwards@telus.net	√	
Hamel	Owen	NOAA	Owen.Hamel@noaa.gov	W	

Last Name	First Name	Affiliation	E-mail Address	Apr 7	Apr 8
Harling	Wayne	Sport Fish Advisory Board	harling@island.net		√
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Koolman	John	Commercial Industry Caucus, Rockfish Outside	koolmanent@shaw.ca		
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Mose	Brian	Commercial Industry Caucus, Trawl	bmose@nanaimo.ark.com		
Obradovich	Shannon	UBC Fisheries Centre	s.obradovich@fisheries.ubc.ca		√
Renwick	Mike	BC Dogfish Hook & Line Industry Association	mrenwick@telus.net		
Sporer	Chris	Pacific Halibut Management	phma@telus.net		
Starr	Paul	Canadian Groundfish Research and Conservation Society	paul@starrfish.net	W	
Turris	Bruce	Canadian Groundfish Research and Conservation Society	bruce_turris@telus.net		
Wallace	Scott	David Suzuki Foundation	swallace@davidsuzuki.org		

APPENDIX 4. DRAFT AGENDA FOR THE MEETING.

Agenda

Reviews of stock assessments for outside stocks of lingcod and inside stocks of yelloweye rockfish in British Columbia
Pacific Regional Science Advisory Process

7th and 8th April, 2011
Nanaimo, B.C.

Chairperson: Andrew Edwards

Day 1. Review of:

Lingcod (Ophiodon elongatus) stock assessment and yield advice for outside stocks in British Columbia. J.R. King, M. McAllister, K.R. Holt and P.J. Starr. CSAP Working Paper 2010/P03.

Rapporteur: L, Lacko

9:00	Introductions	Chair
	Review agenda & housekeeping	Chair
	CSAS overview & procedures	Marilyn Joyce
	Review Terms of Reference	Chair & participants
9:30	Presentation of working paper	Authors
10:30	***Break***	
10:45	Reviews & authors' responses	Owen Hamel (via Webinar) Trevor Branch (to be read by Rowan Haigh)
12:00	***Lunch Break***	
12:45	Confirmation of key issues for discussion	Chair
1:00	Discussion of working paper. Are the data and methods adequate to support the conclusions? Does the advice reflect the uncertainty in the data, analysis or process? Does the paper meet the objectives in the Terms of Reference?	Participants
2:30	***Break***	
2:45	Decision on acceptability of working paper. Summary of conclusions and advice for Science Advisory Report.	Participants
4:30	***Adjourn***	

Day 2. Review of:

Stock Assessment for the inside population of yelloweye rockfish (Sebastes ruberrimus) in British Columbia, Canada for 2010. K.L. Yamanaka, M.K. McAllister, M.-P. Etienne, S. Obradovich and R. Haigh. CSAP Working Paper 2010/P06.

Rapporteur: R. McPhie

9:00	Introductions	Chair
	Review agenda & housekeeping	Chair
	CSAS overview & procedures	Chair
	Review Terms of Reference	Chair & participants
9:30	Presentation of working paper	Authors
10:30	***Break***	
10:45	Are the revisions to the original version (presented in September 2010) acceptable?	Participants
12:00	***Lunch Break***	
12:45	Confirmation of key issues for discussion	Chair
1:00	Discussion of working paper. Are the data and methods adequate to support the conclusions? Does the advice reflect the uncertainty in the data, analysis or process? Does the paper meet the objectives in the Terms of Reference?	Participants
2:30	***Break***	
2:45	Decision on acceptability of working paper. Summary of conclusions and advice for Science Advisory Report.	Participants
4:30	***Adjourn***	