Fisheries and Oceans Canada | Pêches et Océans Canada
Science | Sciences

C S A S | ***S C C S***

Canadian Science Advisory Secretariat | **Secrétariat canadien de consultation scientifique**

Proceedings Series 2006/027 | **Série des comptes rendus 2006/027**

Proceedings of the PSARC Salmon Subcommittee Meeting

Compte rendu de la réunion du sous-comité du CEESP sur le saumon

October 18, 2006
Pacific Biological Station
Nanaimo, BC

18 octobre 2006
Station biologique du pacifique
Nanaimo, C.-B,

K. Hyatt

K. Hyatt

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

January 2007

Janvier 2007

Proceedings of the PSARC Salmon Subcommittee Meeting

October 18, 2006
Pacific Biological Station
Nanaimo, BC

K. Hyatt

Compte rendu de la réunion du sous-comité du CEESP sur le saumon

18 octobre 2006
Station biologique du pacifique
Nanaimo, C.-B,

K. Hyatt

Fisheries and Oceans Canada
Pacific Biological Station
3190 Hammond Bay Road
Nanaimo, BC V9T 6N7

January 2007

Janvier 2007

ISSN 1701-1272 (Printed / Imprimé)

Published and available free from:
Une publication gratuite de :

Fisheries and Oceans Canada / Pêches et Océans Canada
Canadian Science Advisory Secretariat / Secrétariat canadien de consultation scientifique
200, rue Kent Street
Ottawa, Ontario
K1A 0E6

http://www.dfo-mpo.gc.ca/csas/

CSAS@DFO-MPO.GC.CA

Printed on recycled paper.
Imprimé sur papier recyclé.

Correct citation for this publication:
On doit citer cette publication comme suit :

DFO, 2006. Proceedings of the PSARC Salmon Subcommittee Meeting, October 18, 2006. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2006/027.

PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)
SALMON SUBCOMMITTEE MEETING

SUMMARY

The Pacific Scientific Advice Review Committee (PSARC) Salmon Subcommittee met October 18, 2006 at the Pacific Biological Station in Nanaimo, B.C. The Subcommittee reviewed a working paper on Steelhead and a Science Advisory Report on the Fraser River sockeye forecast for 2007

S2006-04: A simulation model used to investigate the impacts of marine and fresh water fisheries on the Thompson River steelhead trout population *(Oncorhynchus mykiss*)

R. Bison and M. Labelle

Summer run steelhead trout (*O. mykiss*) returning through the Fraser River to the Thompson River and its tributaries support a major freshwater sport fishery. In recent years, conservation concerns over the state of summer run steelhead returning to the Fraser River led the British Columbia Ministry of Environment (MoE)[1] and the Canadian Department of Fisheries and Oceans (DFO) to develop and implement fishery management plans to reduce steelhead by-catch through time, area and gear restrictions on commercial fisheries targeting other salmon species. Subsequent regulations, initiated in 2002, stipulate that all steelhead caught in commercial fisheries must be released. The necessity for strict, fisheries-conservation regulations is commonly assessed within the context of information on the productive capacity of the stocks of concern, current estimates of natural mortality rates, exploitation levels, escapements, and habitat conditions. Although useful information on escapement trends and habitat conditions are available for Thompson steelhead, defensible data on historic exploitation and fishery-dependent, mortality patterns are scarce and incomplete due to the absence of well designed sampling programs focused on steelhead. Consequently, there are no scientifically defensible estimates in most interception fisheries of catches for use in conventional stock-assessment procedures to determine exploitation rates on steelhead. The authors of this paper employed a novel approach involving further development and use of a simulation model within a highly data limited context to generate estimates of the potential range of incidental losses experienced by steelhead intercepted by commercial net fisheries during the 2004 and 2005 fishing seasons. Two external reviewers and the Subcommittee commended the authors on their efforts to identify and account for the multitude of factors influencing catches of Thompson River steelhead. However, the paucity of reliable empirical data and the use of many subjectively determined “observations” preclude validation of the majority of parameter estimates and calculations used in the model. Consequently, specific exploitation and management conclusions offered in this paper for Thompson River steelhead, although plausible, are highly uncertain and certainly inadequate as a basis for any new advice regarding changes to management of the fishery to protect steelhead at this time. Moreover, the

[1] During 1996-2005, management of provincial fisheries was conducted by staff of the BC Ministry of Air, Water and Land Protection (WALP)

Subcommittee concluded that, unless rectified, current empirical data deficiencies for steelhead will frustrate any future analysis as a basis for meaningful advice.

Science Advisory Report: Pre-season run size forecasts for Fraser River sockeye and pink salmon in 2007
S. Grant and A. Cass

The forecast methodology used to forecast Fraser River sockeye were intensively reviewed and approved by PSARC in October 2005. Given that the methods were reviewed last year, a Science Advisory Report (SAR) was tabled. The intent was to update the data inputs and provide forecasts for 2007. The Subcommittee accepted the working paper subject to revisions. Revisions need to include a summary of recent forecast errors by timing group. Forecasts should be revised where appropriate based on the PSARC review and in particular where models with similar performance measures result in large differences in the 2007 forecasts. The Subcommittee agreed that pre-season abundance forecasts for Fraser sockeye and pinks are highly uncertain. For some sockeye timing groups, the forecasts have been positively biased in recent years of poor productivity. Forecasters should continue to strive to improve forecast accuracy. The Subcommittee however recognizes that a recent independent evaluation of forecasting models by researchers at SFU concluded that significant improvements in forecast methods are unlikely given uncertainty about survival conditions.

SOMMAIRE

Le sous-comité du saumon du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) s'est réuni le 18 octobre 2006 à la Station biologique du Pacifique, à Nanaimo (Colombie-Britannique). Le sous-comité a passé en revue un document de travail sur la truite arc-en-ciel anadrome et un avis scientifique sur les prévisions du saumon rouge du Fraser pour 2007.

Document S2006-04 : Modèle de simulation utilisé pour examiner les répercussions des pêches en mer et en eau douce sur la population de truite arc-en-ciel anadrome *(Oncorhynchus mykiss*) de la rivière Thompson

R. Bison and M. Labelle

La truite arc-en-ciel (*O. mykiss*) de remonte d'été qui retourne dans la rivière Thompson et ses tributaires en passant par le Fraser soutient une importante pêche sportive en eau douce. Ces dernières années, la conservation de la truite arc-en-ciel de remonte d'été revenant dans le Fraser a suscité des préoccupations qui ont amené le ministère de l'Environnement (MdE)[2] de la Colombie-Britannique et Pêches

[2] De 1996 à 2005, la gestion des pêches provincials a été assurée par le personnel du ministère de la Protection de l'atmosphère, de l'eau et des terres de la C.-B.

et Océans Canada (MPO) à élaborer et à mettre en œuvre des plans de gestion de la pêche visant à réduire les prises accidentelles de truites arc-en-ciel en imposant des restrictions touchant les engins, les zones de pêche et la durée des pêches commerciales ciblant d'autres espèces de saumon. Des règlements subséquents, adoptés en 2002, prévoyaient que toutes les truites arc-en-ciel capturées dans le cadre des pêches commerciales devaient être remises à l'eau. La nécessité de prendre des règlements de pêche sévèrement axés sur la conservation est évaluée en commun dans le contexte de l'information disponible sur la capacité de production des stocks préoccupants, les estimations courantes des taux de mortalité naturelle, les niveaux d'exploitation, les échappées et les conditions de l'habitat. Bien qu'on dispose d'information utile sur les tendances de l'échappée et les conditions de l'habitat pour la truite arc-en-ciel de la Thompson, les données défendables sur les antécédents d'exploitation et les tendances de mortalité due à la pêche sont rares et incomplètes à cause de l'absence de programmes d'échantillonnage bien conçus, axés sur la truite arc-en-ciel anadrome. Par conséquent, il n'existe pas, dans la plupart des pêches d'interception, d'estimations scientifiques défendables des prises pouvant être utilisées avec les méthodes conventionnelles d'évaluation des stocks afin de déterminer le taux d'exploitation de la truite arc-en-ciel. Les auteurs de ce document ont emprunté une nouvelle démarche qui a consisté à développer davantage un modèle de simulation dans le contexte de données très limitées afin de produire une estimation de l'échelle possible de pertes accidentelles de truites arc-en-ciel interceptées dans le cadre des pêches aux filets pendant les saisons de pêche de 2004 et 2005. Deux examinateurs de l'extérieur et le sous-comité ont félicité les auteurs pour les efforts déployés en vue de déterminer et d'expliquer la multitude de facteurs pouvant influer sur les prises de truites arc-en-ciel de la Thompson. Toutefois, la rareté des données empiriques fiables et l'utilisation de nombreuses « observations » déterminées de façon subjectives font obstacle à la validation de la plupart des estimations de paramètres et des calculs utilisés dans le modèle. Par conséquent, les conclusions particulières sur l'exploitation et la gestion présentées dans ce document concernant la truite arc-en-ciel de la rivière Thompson, quoique plausibles, sont hautement incertaines et certainement inappropriées comme base de tout nouvel avis concernant les changements à apporter à la gestion de la pêche pour protéger la truite arc-en-ciel en ce moment. De plus, le sous-comité est venu à la conclusion que, à moins de rectifications, les lacunes actuelles des données empiriques relatives à la truite arc-en-ciel anadrome vont contrecarrer toute analyse future pouvant servir de base à l'élaboration d'avis valables.

Avis scientifique : Prévisions avant la saison de l'ampleur de la remonte de saumon rouge et de saumon rose dans le fleuve Fraser en 2007
S. Grant and A. Cass

La méthode de prévisions utilisée pour le saumon rouge du Fraser a fait l'objet d'un examen poussé avant d'être approuvée par le CEESP en octobre 2005. Étant donné que les méthodes ont été examinées l'année dernière, un avis scientifique est présenté dans le but de mettre à jour les données et de fournir des prévisions pour 2007. Le sous-comité a accepté le document de travail, sous réserve de certaines

révisions. Celles-ci doivent notamment comprendre un résumé des récentes erreurs de prévisions par groupe d'étude du moment de remonte. Les prévisions devraient être revues, s'il y a lieu, en fonction de l'examen du CEESP et, en particulier, lorsque des modèles aux mesures de rendement semblables, produisent de grands écarts dans les prévisions pour 2007. Le sous-comité est d'avis que les prévisions avant la saison de l'abondance des saumons rouges et roses du Fraser sont hautement incertaines. Dans le cas de certains groupes de saumons rouges servant à l'étude du moment de remonte, les prévisions ont été faussées positivement au cours de ces dernières années de faible productivité. Les prévisionnistes devraient continuer de travailler à améliorer l'exactitude des prévisions. Le sous-comité souligne toutefois les conclusions d'une récente évaluation indépendante de modèles de prévisions, réalisée par des chercheurs de la SFU, selon laquelle on ne devait pas s'attendre à d'importantes améliorations des méthodes de prévisions, compte tenu de l'incertitude au sujet des conditions de survie.

INTRODUCTION

The PSARC Salmon Subcommittee met October 18, 2006 at the Pacific Biological Station in Nanaimo, British Columbia. External participants from industry, academia, and conservation groups attended the meeting. The Subcommittee Chair, K. Hyatt opened the meeting by welcoming the participants. During the introductory remarks the objectives of the meeting were reviewed, and the Subcommittee accepted the meeting agenda.

The Subcommittee reviewed one Working Paper which is summarized in Appendix 1. A Science Advisory Report on Fraser River sockeye was also reviewed. The meeting agenda appears as Appendix 2. A list of meeting participants and reviewers is included as Appendix 3

DETAILED COMMENTS FROM THE REVIEW

S2006-04: A simulation model used to investigate the impacts of marine and fresh water fisheries on the Thompson River steelhead trout population (*Oncorhynchus mykiss*)

R. Bison and M. Labelle

*Paper not accepted

Subcommittee Discussion

The Working Paper developed a simulation model designed to gain insight into the cumulative impacts of multiple commercial fisheries that sequentially intercept interior Fraser River steelhead populations along their migration routes. The model uses well-known run reconstruction and forecasting algorithms to determine cumulative losses due to immediate and long term fishing impacts. As input, the model uses the existing effort time series for commercial, native and sport fisheries and miscellaneous data from field studies, observer surveys, and mark-recapture operations. Model predictions were made for various fishery scenarios and sets of hypotheses concerning gear-specific mortality rates, fish movement rates, and migration patterns. Model limitations and shortcomings were identified, and recommendations given to improve the model and reduce the data gaps.

The authors relied on simulation model output to conclude that incidental exploitation rates on steelhead in 2004 and 2005 ranged between 9 % and 35 %. Moreover, they suggest there is a 0.8 probability that the maximum exploitation level (15%) set by the DFO for steelhead was exceeded in 2004, and a 0.5 probability that it was exceeded in 2005. As for the MoE target (10%), there is a 1.0 probability that it was exceeded in both seasons. Since the simulation model does not account for the impacts of all existing fisheries (several minor ones omitted), the authors concluded that the total induced mortality for steelhead is likely higher, and the probabilities of exceeding

steelhead exploitation targets are even greater. Accordingly, they advised consideration of implementation of further conservation practices by DFO to minimize the probability of exceeding the maximum annual exploitation rate previously recommended for steelhead.

Reviewers of this Working Paper noted that it represented an important contribution to defining the nature of the principal factors potentially controlling steelhead catch and associated mortality rates in commercial salmon fisheries. However, both reviewers took issue with the author's assertions that model results provide a reliable basis on which to formulate new recommendations for managing species and stock mixtures associated with commercial fisheries for Fraser River salmon. Major concerns raised by the reviewers and thoroughly discussed by the Subcommittee are as follows:

(1) Model assumptions and the origins of key parameter estimates are not adequately documented and in several instances involve considerable subjectivity.

(2) The error structure of parameter estimates adopted from other models (e.g. sockeye and chum exploitation rates) is not identified or fully expressed in the current model. Consequently, uncertainty surrounding model outputs, although admittedly already large, is certain to be underestimated.

(3) The current model is conditional on sockeye exploitation rates which are then "adjusted" without full documentation of a supporting rationale which clearly involves a cumulative set of unverified assumptions.

(4) Steelhead specific data are so limited in both quantity and quality that many key parameter estimates and calculations in the Working Paper are impossible to verify. Consequently, both reviewers and the Subcommittee rejected the assertion that model output constituted a reliable basis for management recommendations calling for more stringent harvest restrictions to reduce steelhead exploitation.

(5) One reviewer suggested an approach for testing the robustness of model outputs through completion of a supplemental analysis involving estimation of steelhead abundance in commercial fisheries based on reconstructions from terminal escapement estimates and run timing information at Albion as opposed to the current method involving forward projections from Johnston Strait test fisheries.

(6) Given the severe limitations of empirical data used in the model to estimate steelhead exploitation and associated mortality levels, the Subcommittee concluded that neither additional analysis nor development of alternate models would be productive in providing a reliable basis for new harvest management recommendations at this time.

(7) Divergent perspectives among STC members participating in the Subcommittee review regarding the utility and adequacy of the steelhead exploitation model as a basis for harvest management advice reflect the same sets of concerns raised by reviewers and thoroughly discussed among the broader membership of the PSARC Subcommittee. The absence of an effective steelhead assessment framework is a major concern. Agreement existed among all PSARC Subcommittee and STC participants that further progress to providing useful harvest management recommendations would be impossible until an effective steelhead assessment framework is implemented to remedy current data limitations on both analysis and associated advice.

Subcommittee Conclusions

The working paper was not accepted. The Subcommittee noted that:

1. The analysis and modeling approach used in the paper is a step forward but could benefit from alternate analyses and better documentation of both the model and its many underlying assumptions. Numerous constructive suggestions from both reviewers provide considerable guidance on major revisions which the authors may wish to consider.

2. Results and recommendations based on the model developed here are accompanied by very high uncertainty due to extreme limitations on the quantity and quality of available empirical data for steelhead and due to a failure to include the full range of uncertainty surrounding parameter estimates derived from other models and used as inputs in the current model.

3. Data limitations for Fraser and Thompson steelhead are so severe that, left unresolved, they will continue to limit the utility of all analytical and modeling approaches as a reliable basis for new advice regarding improvements to harvest management procedures that will sustain existing commercial fisheries without posing undue risk for steelhead.

4. In spite of several shortcomings, the model does provide a useful framework for generating hypotheses about the relative importance of various factors (e.g. annual to seasonal variations in diversion rates, peak run timing, migration rate etc…) controlling changes in steelhead interception rates. Generation of more certain information on this suite of potentially influential factors is a requisite for development of a more effective multi-species conservation and harvest management regime to sustain salmon and steelhead in the Fraser.

5. There is some urgency to move forward in decreasing uncertainties regarding an effective harvest management regime that will sustain commercial salmon fisheries and recreational fisheries for Fraser and Thompson River steelhead.

The Subcommittee notes that as of the 2004 return year, escapement estimates for the entire interior steelhead stock aggregate had apparently declined to only 1,854 spawners or roughly 50 % of the all year average abundance observed between 1984 and 2004.

Subcommittee Recommendations

1. The Subcommittee recommended that the DFO-MOE Steelhead Technical Committee (STC) be reconvened to develop and seek support to implement a steelhead assessment framework. The latter is required to remedy severe information limitations that frustrate the provision of reliable advice regarding practical steps to improve conservation and multi-species harvest management regimes affecting Fraser and Thompson River steelhead.

2. The Subcommittee also recommends that the STC pursues application of results from the current Working Paper and alternate model analyses suggested by reviewers as important sources of information to shape the design of an effective steelhead assessment framework.

3. The Subcommittee recommends that a steelhead assessment framework and associated analyses form the basis of a new working paper to be submitted to the PSARC Salmon Subcommittee for review in the spring or fall of 2007 given either consensus or majority approval by the STC to do so.

Science Advisory Report: Pre-season run size forecasts for Fraser River sockeye and pink salmon in 2007

S. Grant and A. Cass

*accepted with revisions

Subcommittee Discussion

A draft Science Advisory Report (SAR) with forecasts of 2007 Fraser River sockeye and pink salmon was tabled. The forecast methodology and data streams used to forecast Fraser sockeye were intensively reviewed and approved by PSARC in October 2005. Given that the methods were reviewed last year, the intent of the SAR was to update the data inputs and provide forecasts for 2007. The SAR expanded the number of candidate forecast models beyond those reviewed last year. The rules for selecting the “best” candidate model remained the same as in the report from last year. The steps in the selection of the best model include a retrospective evaluation of model performance based on two measures (mean absolute error and the root-mean-square-error). The best model is then selected based on the average rank for the two performance measures.

The authors' presentation to the Subcommittee identified two issues related to the accuracy of forecasts. In recent years, the forecast at the 50% probability level has consistently overestimated returns for some major stock groups (Early Stuart and Summer Run timing groups) as a result of a recent multi-year decline in productivity (i.e. recruits-per-spawner). The SAR included two new forecast models to assess whether models that include the most recent recruits-per-spawner data to predict returns can retrospectively out-perform other candidate models. The performance of those models was not superior to other models indicating that historical changes in productivity over time were not consistent enough to influence the retrospective analysis. The Subcommittee nevertheless expressed concern that the models have failed to account for the recent over-forecasts for the Early Stuart and Summer runs and asked the authors to include a summary of recent forecast performance by run timing group in the revised SAR. The authors' also reported that in some cases the performance measures based on the retrospective analysis are similar for some pairs of forecast methods but the latter result in relatively large differences in the 2007 forecasts. In the presentation, the authors indicated that this is the case for 2007 forecasts of Quesnel and Late Shuswap sockeye. The Subcommittee acknowledged that model selection is a rules-based process where only one model is chosen among all candidate models and is used to forecast next year's abundance.

Because the methods were extensively reviewed last year, there were no formal reviews of the paper. One participant, however, provided a review to the Subcommittee. His review also expressed concern for the recent trend to over-forecast returns for some sockeye stock groups and agreed that a summary of the forecast errors by timing group should be included in the revised SAR. The reviewer also thought that forecasts with similar model performance should be combined in some way that reflects model structural uncertainty and therefore could help reduce the bias in median forecast values based on a single model. At the very least, the reviewer thought that managers should be made aware of cases where there are significant differences between forecasts for models that perform similarly. The authors agreed to assess the magnitude of the problem in the 2007 forecasts. For those stocks where this is apparent they will consider a Bayesian-type approach for models with independent data sources, for example, when combining naïve and biological models.

The reviewer questioned the use of the retrospective method for selecting the "best" model for stocks with high inter-annual variance in returns (i.e. cyclic stocks) because it gives high weight to models that predict the largest returns best. Such models may not be the best for years when smaller or moderate returns are anticipated. The Subcommittee agreed that future analysts should explore alternative methods for assessing model performance and forecast models. The reviewer noted that age-4 returns in 2006 were not available and therefore sibling models that predict age-5 returns from age-4 cannot be used. The reviewer nevertheless suggested that the forecasts of age-5 sockeye returns in 2007 should be checked particularly for stocks with historically large contributions of age-5 (i.e. Pitt, Birkenhead, Stellako) in light of the poor returns of age-4s in 2006. Finally, the reviewer would like to see a broader

development in the SAR of factors not directly quantified in the forecast models such as environmental conditions (high flood conditions and marine climate impacts affecting the returns in 2007). Specifically, the forecast, where appropriate, should include a description of the direction of potential forecast bias created by these unquantified factors.

One participant suggested that an assessment of the autocorrelation in the forecast error over time potentially could be informative and help managers choose the forecast probability level given the current state of salmon productivity and therefore forecast bias. The Subcommittee agreed that this could be assessed in a future assessment.

Subcommittee Conclusions

1. The Subcommittee accepted the working paper subject to revisions that take into account the Reviewer and Subcommittee comments.

2. The Subcommittee agreed that pre-season abundance forecasts for Fraser sockeye and pinks are highly uncertain. For some sockeye timing groups, the forecasts have been positively biased in recent years of poor productivity.

3. Forecasters should continue to strive to improve forecast accuracy. The Subcommittee however recognizes that a recent independent evaluation of forecasting models by researchers at SFU concluded that significant improvements in forecast methods are unlikely given uncertainty about survival conditions.

Subcommittee Recommendations

1. Revisions need to include a summary of recent forecast errors by timing group.

2. Forecasts should be revised where appropriate based on the PSARC review and in particular where models with similar performance measures result in large differences in the 2007 forecasts.

APPENDIX 1: Working Paper Summary

S2006-04: A simulation model used to investigate the impacts of marine and fresh water fisheries on the Thompson River steelhead trout populations (*Oncorhynchus mykiss*)

R. Bison and M. Labelle

A simulation model was designed to gain insight on the cumulative impacts of the multiple fisheries that sequentially intercept the interior Fraser River steelhead populations along their migration routes. The model uses well-known run reconstruction and forecasting algorithms to determine cumulative losses due to immediate and long term fishing impacts. As input, the model uses the existing effort time series for commercial, native and sport fisheries, and miscellaneous data from field studies, observer surveys, and mark-recapture operations. Predictions are made for various fishery scenarios and sets of hypotheses concerning gear-specific mortality rates, fish movement rates, and migration patterns. The model limitations and shortcomings are identified, and recommendations are given on how to improve the model and reduce the data gaps. However, even after accounting for well-known sources of uncertainty, the simulation results suggest there was considerable variation in exploitation rates for two of the most recent fishing seasons (2004-2005). The simulation results suggest there is a 0.8 probability that the maximum exploitation level (15%) set by the DFO was exceeded in 2004, and a 0.5 probability that it was exceeded in 2005. As for the MoE target (10%), there is a 1.0 probability that it was exceeded in both seasons. Since the simulation model does not account for the impacts of all existing fisheries (several minor ones omitted), it is likely that the total induced mortality is higher, and the probabilities of exceeding the targets are even greater. In light of such facts, it would seem advisable to consider the implementation of further conservation practices to minimize the probability of exceeding the maximum allowable exploitation rates.

APPENDIX 2: PSARC Salmon Subcommittee Meeting Agenda, October 18, 2006

PSARC Salmon Subcommittee Agenda
October 18, 2006
Seminar Room, Pacific Biological Station
Nanaimo BC

Wednesday, October 18

9:00	Introductions and Overview of the agenda
9:30	Review of Working Paper –Interior Fraser Steelhead - review of harvest simulation model
11:00	Formulation of Subcommittee conclusions and recommendations
12:00	Lunch
1:00	Review of Science Advisory Report – Fraser River Sockeye and Pink Abundance Forecast
3:00	Formulation of Subcommittee conclusions and recommendations
4:00	Adjournment

APPENDIX 3: List of Attendees and Reviewers

Subcommittee Chair: Kim Hyatt
PSARC Chair: Al Cass

NAME
EXTERNAL PARTICIPANTS
Blackbourn, Dave
Bison, Robert
Bos, Chris
Gottesfeld, Allen
Harling, Wayne
Labelle, Marc
Starr, Paul
DFO MEMBERS
Cass, Alan
Cook, Roberta
Folkes, Michael
Grant, Sue
Hargreaves, Brent
Hop Wo, Leroy
Hyatt, Kim
Ionson, Bert
Riddell, Brian
Samaha, Cindy
Sawada, Joel
Scroggie, Jamie
Sullivan, Melanie
Thomas, Greg

Reviewers for the PSARC papers presented at this meeting are listed below, in alphabetical order. Their assistance is invaluable in making the PSARC process work.

Cox-Rogers, Steve	Fisheries and Oceans Canada
Starr, Paul	Canadian Groundfish Research Conservation Society