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

C S A S

Canadian Science Advisory Secretariat

S C C S

Secrétariat canadien de consultation scientifique

Proceedings Series 2004/002

Série des compte rendus 2004/002

Proceedings of the PSARC Groundfish Subcommittee Meeting of January 21-22, 2004

Procès-verbal de la réunion du Sous-comité sur le poisson de fond du CEESP, tenue les 21 et 22 janvier 2004

January 21-22, 2004
Nanaimo, B.C.

S. Romaine
Groundfish Subcommittee Chair

Fisheries and Oceans Canada
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, British Columbia V9T 6N7

March 2004

Canada

Proceedings of the PSARC Groundfish Subcommittee Meeting of January 21-22, 2004

Procès-verbal de la réunion du Sous-comité sur le poisson de fond du CEESP, tenue les 21 et 22 janvier 2004

January 21-22, 2004
Nanaimo, B.C.

S. Romaine
Groundfish Subcommittee Chair

Fisheries and Oceans Canada
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, British Columbia V9T 6N7

March 2004

ISSN 1701-1272 (Printed)

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:

Romaine, S. 2004. Proceedings of the PSARC Groundfish Subcommittee Meeting January 21-22, 2004.
DFO Can. Sci. Advis. Sec. Proceed. Ser. 2004/002.
Secr. can. de consult. sci. du MPO, Compte rendu. 2004/002.

PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)
GROUNDFISH SUBCOMMITTEE MEETING

SUMMARY

The Pacific Scientific Advice Review Committee (PSARC) Groundfish Subcommittee met on 21-22 January 2004 at the Pacific Biological Station, Nanaimo, BC to review two Working Papers:

Working Paper G2004-01: Sablefish (*Anoplopoma fimbria*) in British Columbia, Canada: Stock Assessment for 2003 and Advice to Managers for 2004.

- The Subcommittee accepted the Decision Table presented in the Working Paper as an appropriate basis for managers to select a 2004/05 sablefish TAC.
- The Subcommittee recommended that analyses be conducted to develop a decision rule for short-term management of sablefish fisheries and the implementation of multi-year TACs.
- The Subcommittee supported sharing of tagging data with U.S. fisheries agencies to improve estimates of immigration and emigration between Canada and US stocks.
- The Subcommittee endorsed research using length-frequency and age determination data to evaluate year-class strength and improve estimates of sablefish recruitment.

Working Paper G2004-03: Petrale Sole Stock Assessment for 2003 and Recommendations for Management in 2004.

- The Subcommittee agreed with the working paper conclusions that Petrale Sole abundance has increased since 1998 based on an increase in the available catch rate indices. The Subcommittee also agreed that the current biomass is likely at or near B_{msy}, rather than below it.
- A short-term increase of the Petrale sole TAC by 20-25% is appropriate given the stock status. This is considered an interim measure until the mortality rates used in the analysis can be confirmed by otolith ageing of selected historical samples (see following recommendation). Existing otolith samples need to be prioritized for future processing and this work should be expedited if the Petrale sole TAC is increased.
- The Subcommittee recommended a full review of the available information for Petrale Sole, prior to the 2006/07 fishing year if the TAC is increased in FY 2004/05.

SOMMAIRE

Le Sous-comité sur le poisson de fond du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) s'est réuni les 21 et 22 janvier 2004 à la Station biologique du Pacifique, située à Nanaimo (C.-B.), pour examiner deux documents de travail.

Document de travail G2004-01 : La morue charbonnière (*Anoplopoma fimbria*) en Colombie-Britannique (Canada) : évaluation du stock de 2003 et conseils pour les gestionnaires en vue de 2004

- Le Sous-comité approuve le tableau de décision présentée dans le document de travail et il reconnaît qu'elle constitue une base appropriée sur laquelle les gestionnaires peuvent se fonder pour établir le TAC de morue charbonnière pour 2004-2005.
- Le Sous-comité recommande la réalisation d'analyses afin d'élaborer une règle de décision pour la gestion à court terme des pêches de morue charbonnière ainsi que la mise en œuvre de TAC pluriannuels.
- Le Sous-comité est en faveur du partage de données de marquage avec les organismes de pêche des États-Unis afin d'améliorer les estimations relatives à l'immigration et à l'émigration entre les stocks du Canada et des États-Unis.
- Le Sous-comité appuie la recherche qui vise à évaluer l'abondance des classes d'âge et à améliorer les estimations du recrutement de la morue charbonnière à partir de données sur les fréquences des longueurs et sur la détermination de l'âge.

Document de travail G2004-03 : Évaluation du stock de plie de Californie de 2003 et recommandations pour la gestion en vue de 2004

- Le Sous-comité est d'accord avec les conclusions présentées dans le document de travail selon lesquelles la hausse des indices des taux de prises disponibles révèle que l'abondance de la plie de Californie a augmenté depuis 1998. Le Sous-comité reconnaît également que la biomasse actuelle est probablement égale ou près de B_{rms}.
- Compte tenu de l'état du stock, une augmentation à court terme de 20 à 25 % du TAC de plie de Californie est appropriée. Cette augmentation sera considérée comme une mesure provisoire jusqu'à ce que les taux de mortalité utilisés dans l'analyse puissent être confirmés par la détermination de l'âge à partir d'otolithes de certains échantillons historiques (voir la recommandation suivante). Les échantillons d'otolithes existants doivent être classés par ordre de priorité en vue de leur traitement, et ce travail devrait être effectué rapidement si le TAC de plie de Californie est augmenté.

- Le Sous-comité recommande la tenue d'un examen complet des données disponibles sur la plie de Californie. Si le TAC est augmenté pour l'année de pêche 2004-2005, cet examen devra être terminé avant 2006-2007.

INTRODUCTION

The PSARC Groundfish Subcommittee met 21-22 January 2004, at the Pacific Biological Station in Nanaimo, British Columbia. External participants from the Canadian Groundfish Research and Conservation Society (CGRCS), Sierra Club of BC, The David Suzuki Foundation, and the Canadian Sablefish Association attended the meeting. The Subcommittee Chair, S. Romaine, opened the meeting by welcoming the participants. During the introductory remarks, the objectives of the meeting were reviewed, the confidential nature of the discussion was highlighted, and the Subcommittee accepted the meeting agenda.

The Subcommittee reviewed two Working Papers. Summaries of the Working Papers are included as Appendix 1. The meeting agenda appears as Appendix 2. A list of meeting participants, observers and reviewers is included as Appendix 3.

DETAILED COMMENTS FROM THE REVIEW

Working Paper G2004-01: Sablefish (*Anoplopoma fimbria*) in British Columbia, Canada: Stock Assessment for 2003 and Advice to Managers for 2004.

V. Haist, A.R. Kronlund and M.R. Wyeth

Paper accepted subject to revisions

Subcommittee Discussion

The Reviewer complimented the Authors on a very comprehensive assessment and made several constructive suggestions for future work. The Reviewer also identified some technical issues and alternative management options. The Reviewer noted the main changes from previous PSARC sablefish assessments were upgrades to the biomass dynamics model and the tagging model.

The Subcommittee noted the relatively large increase in stock indices for the northern and southern stocks from record low levels in 2001 to high levels in 2003. The Authors pointed out that all stock indices were related to trap vulnerable biomass in offshore waters, excluding seamounts. The increase in stock indices was reflected in the estimates of trap vulnerable biomass derived from the production model. The Authors stated that it is not possible at this time to determine how much of the increase could be attributed to recruitment from BC waters or to immigration of sablefish from outside the trap vulnerable biomass, e.g., US waters. They noted that routine ageing of sablefish in BC was halted in 1997 due to concerns over the reliability of ageing methods, and that there had been no exchange of tagging data with the US that might assist the understanding of sablefish migration. The Authors also noted the possibility that the 2003 survey estimate may be biased high due to the relative absence of trap fishing prior to the 2003 survey. An External Participant noted that in the previous two years

there were 10 or more trap boats fishing in front of the charter boats and the reason that did not happen this year was the fishing was so good that everybody had caught their quota early in the year. The Authors reported that length-frequency analysis was not useful to determine relative year-class strength in Canadian sablefish fisheries because of the high variability in size at age. The Authors responded that although length-frequency analyses could be used, they would only provide reasonable age determination of fish from 0+ to 2+ years, but considerable overlaps existed for older fish. Additionally, the Authors noted that if there was a representative time series of juvenile data with reasonable spatial coverage, then they might be able to provide insight on 0-2+ age fish, but this was not the case. The Authors indicated recent Alaskan sablefish assessments reported a very strong 1997 year class in Alaskan longline fisheries, followed by an above average 1998 year class. The Authors pointed out that the assessment is dependent on short time series (15 years) of data compared to the longevity of Sablefish (>70 years).

The Subcommittee discussed factors affecting the population, such as low frequency climate regime effects, which appear to be important to the stock dynamics, but are not well understood. The Subcommittee noted that published research on climate regimes and the relative year-class success of sablefish in Canadian waters suggested that the recent regime shift in 1998 was consistent with oceanic conditions that historically were favourable for sablefish production and that it was likely that the 1998 and 1999 year classes in Canadian waters would be above average. Industry representatives noted that there was evidence in 2001 in the west coast Vancouver Island shrimp trawl survey of an increase in juvenile sablefish with lengths corresponding to the 1998/99 cohorts. In addition, the commercial trawl, halibut and sablefish fishing fleets reported increases in 2002 of sablefish in shallow waters near the coast by fishers.

The Subcommittee discussed the decision table (Table 1, below) presented in the Working Paper. Table 1 summarizes the probability of achieving selected performance measures for a range of total annual catches (0 t, 3,000 t, 4,000 t, 5,000 t and 6,000 t). When asked how the range of total annual catches were selected, the Authors responded that the catch levels were selected to assess changes in the performance measures over the range of historical annual catches. Table 1 indicates there is little probability the stock biomass will decline below the performance measure used as a proxy for a conservation limit, i.e., $P(B_{2009} > 19000$ t).

Table 1. Decision tables showing the values for four performance measures for projections at a range of future catch levels. Results are presented relative to current (2003) vulnerable biomass, and the "expectation" integrates over the range of current biomass levels.
"Low" integrates results across the lowest 25% of the estimates, "Average" integrates results across the middle 50% of the estimates, and "High" integrates results across the highest 25% of the estimates. The mean 2003 stock biomass within each of these categories is 39,300t, 61,500t, and 93,400t for low, average, and high, respectively. For consistency with the previous assessment, two performance measures are calculated relative to the 2002 vulnerable stock biomass. Two additional performance measures are calculated relative to the 5th percentile of the distribution of unfished vulnerable biomass ($B_{5\%}$=19,000 t):

1. The *probability* that vulnerable stock biomass is above 19,000 t at the end of the projection period, $P(B_{2009} > B_{5\%})$;
2. The *probability* that vulnerable stock biomass is above B_{2002} at the end of the projection period, $P(B_{2009} > B_{2002})$;
3. The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E(B_{2009} / B_{5\%})$, and
4. The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E(B_{2009} / B_{2002})$.

Total Annual Catch	$P(B_{2009} > B_{2002})$			
	Current Biomass			
2004-2008	Low	Average	High	Expectation
0	0.98	0.95	0.89	0.94
3000	0.95	0.92	0.85	0.91
4000	0.93	0.90	0.83	0.89
5000	0.91	0.88	0.80	0.87
6000	0.87	0.85	0.77	0.83

Total Annual Catch	$P(B_{2009} > 19000\ \mathrm{mt})$			
	Current Biomass			
2004-2008	Low	Average	High	Expectation
0	0.97	0.98	0.97	0.97
3000	0.94	0.95	0.96	0.95
4000	0.93	0.93	0.94	0.93
5000	0.90	0.92	0.93	0.92
6000	0.87	0.89	0.91	0.89

Total Annual Catch	$E\left(B_{2009} / B_{2002}\right)$			
	Current Biomass			
2004-2008	Low	Average	High	Expectation
0	3.35	2.81	2.33	2.83
3000	3.03	2.56	2.14	2.57
4000	2.91	2.47	2.06	2.48
5000	2.77	2.37	1.99	2.37
6000	2.62	2.26	1.90	2.26

Total Annual Catch	$E\left(B_{2009} / 19000\mathrm{mt}\right)$
	Current Biomass

2004-2008	Low	Average	High	Expectation
0	2.96	3.08	3.15	3.07
3000	2.68	2.81	2.89	2.80
4000	2.57	2.71	2.80	2.70
5000	2.45	2.60	2.69	2.59
6000	2.32	2.47	2.58	2.46

The expected change in vulnerable stock biomass over the projection period for a TAC for 3,000 t/year during 2004-2008, for example, is 2.57 times the 2002 biomass estimate (third panel in Table 1).

The Reviewer and the Authors both noted the large increase in expectation from the previous assessment based on one additional year of data. The Authors pointed out that the previous stock assessment included projections that were intentionally conservative, because the stock indices had just experienced a historic low point in 2001. There was significant evidence cited in the previous assessment to suggest that stock production would increase in the 2003 to 2007 projection period. However, the stock projections were based on production 1.0, 1.25, and 1.5 times the estimated 1996 to 2002 average production. Regardless of the causes of the biomass increase in 2003, the Subcommittee agreed with the Authors that one year of stock increase does not imply sablefish are entering a period of sustained high abundance, The Subcommittee noted however that American reports state that sablefish are entering a period of high abundance and that 2000 and 2001 have both had very strong year classes off the US mainland. In addition, the industry perspective paper noted that there have been increases in sablefish bycatch levels.

The Subcommittee discussed the implications of choosing a TAC near the upper end of the yield range given uncertainty in the data and model assumptions. The Subcommittee agreed with the Authors that, in the absence of management objectives, decision makers need to consider in an ad hoc way the trade-off between higher TAC's and increased variance in catch and stock biomass. The Subcommittee was encouraged by the Authors' comments that work to define management objectives and evaluate alternative management procedures has been initiated through collaborative work with the sablefish industry.

The Authors investigated suggestions identified by the Reviewer associated with the Bayesian MCMC chains for the tagging model. They concluded that the autocorrelation in the chains was likely attributable to poor estimates of certain elements of the Hessian matrix used by the MCMC algorithm, rather than to a parameterization problem. One Author agreed to contact the Reviewer regarding his comments on the interaction between commercial fishing effort and the fishery-independent survey catch rates and to integrate the reviewer's suggestion into future analyses if appropriate.

The Reviewer commented on the potential for finer scale spatial management in Canada noting one particular southern BC stock index (i.e., Barkley Canyon area) had not recently responded in the same way as more northern areas. An External Participant suggested that these fish were still in shallow depths, inside of the charter

survey range and that this was not an abnormal occurrence for the time of year the survey was conducted. The Authors indicated that while there is likely some mixing of sablefish from north and south stocks, there is little evidence of large scale exchange. The Authors stated that fine-scale spatial analysis of the tagging data is planned for the upcoming year.

Canadian Sablefish Industry Perspective

Eric Wickham, the Executive Director of The Canadian Sablefish Association (CSA), presented an industry perspective paper on behalf of "K" license holders. The document is available from the PSARC Secretariat. The primary objectives of the perspective paper were 1) to summarize on-the-grounds observations concerning stock size during the past two years, 2) to recommend a proposed Total Allowable Catch of 4,500 t and 5,000 t for the 2004/05 and 2005/06 fishing years respectively, and 3) to propose sablefish quotas be set on a multi-year basis. The CSA reported an increase in juvenile sablefish abundance that was first detected by the 2001 west coast Vancouver Island shrimp trawl survey. The commercial fishing fleet reported the increase in 2001 based on observations in shallow waters near the coast by trawl, halibut and sablefish fishers. The Industry Perspective reported that throughout 2002 and 2003 sablefish caught as bycatch also increased.

During Subcommittee discussions, an External Participant from the trawl fishery stated that the trawl industry is allocated a minor share of the TAC (8.75%) and this segment of the industry had difficulties remaining within their quota limits in recent years. The participant suggested that the 2004/05 quota be set greater than 4,500 t in anticipation of high sablefish abundance.

The CSA recommended that multi-year quotas be adopted for sablefish to increase the economic stability of the industry. They believe that a major sablefish stock assessment is not required every year and that other sablefish research could be pursued if stock assessment requirements were reduced. The Authors agreed in principle with the recommendation to move to a multi-year TAC recommendation, but suggested that work to identify criteria that would trigger a full stock assessment must be conducted. A sablefish decision rule (e.g., a procedure for setting longer-term TAC's) would need to be developed and reviewed prior to implementation.

Subcommittee Conclusions

- The Subcommittee accepted the working paper subject to revisions.

- The Subcommittee agreed with the decision table presented in the Working Paper and that this table should form the basis for choosing a TAC for the 2004/05 fishing year. The Subcommittee concluded there is a high probability that the stock biomass will remain above the level that the Working Paper suggests as a proxy for a sablefish conservation limit (The 5th quantile of the

Bayes posterior distribution of unfished stock biomass). From a statistical perspective, the stock is expected to fall below this level 1 year in 20 in the absence of fishing.

- The Subcommittee encouraged the ongoing development of management objectives for the BC sablefish fishery and noted the support of the CSA in working toward this goal. The Subcommittee concluded that the work to develop a decision rules (e.g., a specified multi-year TAC level with criteria for reverting to a full assessment) for sablefish should be conducted and documented for PSARC review next year, provided there are available resources to complete this task.

- The Subcommittee acknowledged the evidence for recent above average juvenile production. This was reported in the previous PSARC assessment, in a recent DFO publication on juvenile production (King et al. 2000), and in the 2002 and 2003 Industry Perspective papers. The Subcommittee agreed with the Authors, however, that the large positive shift in the stock indices from a very low level in 2001 to a very high level in 2003 is difficult to explain by growth, mortality and recruitment processes in a closed population within the Canadian zone. The Subcommittee encouraged continued discussion with US researchers and, in particular, encouraged the exchange of tagging information to help understand the dynamics of the sablefish off Alaska and northern BC. The Subcommittee also encouraged research that addresses the factors affecting the year-class success of sablefish.

Subcommittee Recommendations

- The Subcommittee accepted the decision table presented in the Working Paper as an appropriate basis for managers to select a 2004/05 sablefish TAC.
- The Subcommittee recommended that analyses be conducted to develop decision rules for short-term management of sablefish fisheries and the implementation of multi-year TACs.
- The Subcommittee supported sharing of tagging data with US fisheries agencies to improve estimates of immigration and emigration between Canada and US stocks.

Working Paper G2004-03: Petrale Sole Stock Assessment and Recommendations for Management in 2004.

J. Fargo and P. Starr

Paper accepted subject to revisions

Subcommittee Discussion

The Authors concluded that Petrale sole abundance had increased coastwide because three sets of survey abundance indices showed an upward trend in the most recent three to five years. The Authors also suggested that an increasing trend in CPUE for the commercial fishery supported their conclusion. Both Reviewers questioned whether the data and analysis were adequate for concluding that the population has increased. They suggested that the increasing trend in the National Marine Fisheries Service (NMFS) Triennial survey was probably not significant and the authors agreed. One Reviewer was concerned that the statistical significance was not adequately represented within the paper. The Authors disagreed and noted that error bars were supplied on most plots.

The Subcommittee concluded that indices from the three surveys had increased in the last few years but some Subcommittee members suggested that the recent increase was modest and within the range of observed survey data. Other Subcommittee members questioned whether shifts in the spatial distribution of Petrale Sole would account for the recent trends in the indices. However, one Author pointed out that the indices increased in all survey areas and therefore it was not likely that the increases were solely the result of distributional shifts.

The Authors noted that there had been an increase in small-sized sole in recent length frequency data which could be corroboration that the population was benefiting from improved recruitment. One industry participant reported a recent increase of small sole. The Subcommittee agreed, despite some differences among meeting participants about the significance of recent trends, that the analysis indicated the current biomass is likely to be near or above B_{msy} rather than below it. However, an accurate estimate of current biomass and stock status is unlikely without a time series of age composition data.

Previous analyses of Petrale Sole identified two separate stocks in British Columbia. However, because the trends in landings for the two stocks were similar and sample sizes were small in some years, biological samples were pooled. Additionally, research and commercial samples were pooled to avoid gaps by year. According to the Authors, catchability of this species was similar for both research and pre-sort commercial tows. The addition of clarifying text was requested by the Subcommittee.

The Subcommittee was concerned about the comparability of the pre- and post-observer catch and effort data sets, archived by the GFCatch and PacHarvTrawl databases, respectively. The standardised indices presented in the paper used both a binomial model for presence/absence and a lognormal model for positive catches. It was pointed out that positive catch data should be fairly comparable between the pre- and post-observer data sets, but that the presence-absence data would not be comparable because it was likely that the logbook data would not accurately record the presence of small amounts of Petrale Sole. The Subcommittee requested the authors redo the standardised analyses (GLMs) using the two data sets separately and the Authors agreed to include amended analyses in their revisions.

There was some general discussion on the biological parameter assumptions made in population dynamics models; a point made by the reviewers. The authors stated that they had explored the available data from different points of view before settling on the analyses presented. The Authors noted that the delay-difference modelling does include the best available biological information and explicitly considers the uncertainty in the data and surveys. The authors also noted that the assumption in the delay-difference model of knife-edged recruitment was not likely to be correct for Petrale Sole. However, they also noted that the model results were not sensitive to which age was used for the recruitment threshold and that a more realistic model would be required to incorporate a gradual recruitment hypothesis.

One Reviewer expressed concern that the value used for natural mortality used in the Working Paper, $M = 0.20$, had been adopted without sufficient supportive biological evidence. The Authors maintained that estimates of M for Petrale Sole were consistent with the known maximum ages of this species in British Columbia waters and noted that $M = 0.2$ was used in the US assessments of Petrale Sole populations. Some members of the Subcommittee thought that the analysis which estimated M based on the relationship described by Pauly (1980) was biased due to its reliance primarily on tropical fish species and the authors agreed to remove this analysis. The only available set of recent age data (from the Hecate Strait survey in 2000) indicated that an estimate of the instantaneous total mortality, $M+F$ or Z, of 0.22, is similar to this estimate of M. Both reviewers noted that such an analysis makes very strong assumptions and asked that these assumptions be more fully explained in the text.

There was discussion regarding model estimates of recruitment (Figure 48 in the Working Paper), shown below in Figure 1, which estimated a very strong year class in 1994 (corresponding to a 1998 recruitment to the fishery at age 4). Some Subcommittee members stated that a strong 1994 year class was consistent with strong year classes observed in other groundfish species.

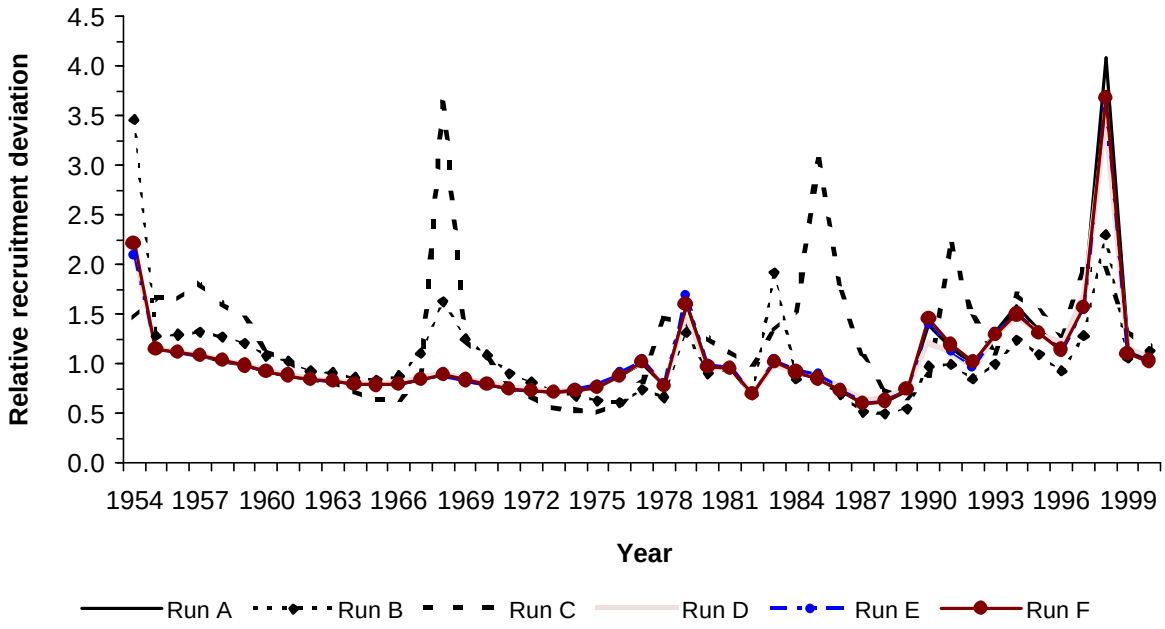

Figure 1. Model estimates of Petrale sole recruitment.

Industry representatives noted that they had observed an increase in the bycatch of Petrale Sole over the last 3-4 years and they emphasized that the current cap on the bycatch of this species was affecting all fishers. They reported that fishers have had to avoid more areas when targeting other species, especially in shallow waters during the summer because they are catching greater numbers of Petrale Sole. Traditionally, fishers would reach the Petrale Sole bycatch cap towards the end of the winter season, but are now filling their cap by the end of the summer. It was also noted that the Pacific cod closure in Hecate Strait has reduced the fishing mortality on Petrale Sole in that area.

There was general agreement that the representative samples of the age composition in the fishery should be obtained in the future. There was some discussion that the on-board observers could be used for this purpose. Existing otolith samples need to be prioritized for future processing. The Subcommittee asked that this work be expedited if the cap is raised for this species.

Subcommittee Conclusions

- Results from two of the three available trawl surveys (WCVI shrimp trawl, Hecate Strait groundfish trawl) indicate that there has been an increase in biomass in the most recent three to five years. Although the results from the US triennial survey suggest an increase, the confidence limits indicate no significant trend. The survey biomass estimates for Petrale Sole off the BC coast probably represents minimum values as the survey coverage is not optimal for Petrale Sole.

- The regression models fit to the commercial catch and effort data also show an increasing catch rate trend in the last three to five years (1996-2003) when there has been 100% observer coverage.
- Model runs indicate that current biomass is more likely to be above B_{msy} than below it. This result should be interpreted with caution because many of the input biological parameters are poorly known and a full range of possible models has not been investigated.
- Model runs and the empirical Z analysis indicate that fishing mortality rates appear to be low. This result seems to be robust even for models which estimate relatively small overall levels of biomass.
- All the delay-difference model runs indicate that the current TAC of 479 t is below what appears to be a safe level of harvest for the coming fishing year.

Subcommittee Recommendations

- A short-term increase of the Petrale sole TAC by 20-25% is appropriate given the stock status. This is considered an interim measure until the mortality rates used in the analysis can be confirmed by otolith ageing of selected historical samples (see following recommendation).
- Existing otolith samples need to be prioritized for future processing and this work should be expedited if the Petrale sole TAC is increased.
- Review fully the available information for Petrale Sole prior to the 2006/07 fishing year if the TAC is increased (i.e., two years after the cap increase).

APPENDIX 1. Working Paper Summaries

G2004-01: Sablefish (*Anoplopoma fimbria*) in British Columbia, Canada: Stock Assessment for 2003 and Advice to Managers for 2004.

V. Haist, A.R. Kronlund and M.R. Wyeth

Sablefish (*Anoplopoma fimbria*) stock status in British Columbia for 2003 was assessed and advice to managers provided for the 2004/2005 fishing year. Four stock abundance indices were evaluated: (1) 1990-2003 standardized trap survey catch rates, (2) 1992-2002 trap vulnerable biomass estimates derived from tag recovery data, (3) 1990-2003 standardized trap fishery catch rates based on logbooks, and (4) 1979-2002 nominal trap fishery catch rates based on logbooks. These indices apply to trap vulnerable biomass in the offshore B.C. waters; indices do not relate to sablefish at seamounts or those in Hecate Strait, Queen Charlotte Sound and inlets. A biomass dynamics model used to integrate stock indices allowed estimation of annual production parameters that represented the net changes in biomass resulting from fish growth, recruitment, immigration, emigration, and changes in trap vulnerability. Advice was presented in the form of decision tables that summarized results from forward simulations using the biomass dynamics model. The simulations were conducted for a set of total annual catches selected to span the range of historical catches. Performance measures evaluated in the simulations were related to biomass levels that should be avoided to ensure conservation concerns for sablefish do not arise.

There was substantial improvement in the standardized survey and commercial catch rates indices in 2003 (Figure A1) that followed the modest improvement observed in 2002 for the northern stock. General agreement among the time series of indices indicated that offshore sablefish vulnerable to trap gear experienced a decrease in abundance from higher levels in the early 1990s to low levels in the mid 1990s. The rate of decline slowed in the mid-1990s and remained at low but relatively stable levels until 2001. Historical lows were observed in 2001 for the times series of standardized trap fishery catch rates, standardized survey catch rates and for tagging estimates of trap vulnerable biomass (Figure A1). The significant improvement in 2003 was observed for the standardized survey coast wide and standardized trap fishery catch rates in the north. Index values for the southern trap fishery and tagging biomass could not be updated for 2003 since there was no trap fishing in the south and northern trap fishing was limited to January and February, respectively. A summary of biomass indices is provided in the following list:

Standardized trap survey (1990-2003). Coast wide results from the standardized trap survey show substantially increased catch rates (number per trap) in 2003 and reflect results in both the north and south stock areas. The historical trend for both north and south stock areas shows a general decline in catch rates from highs in the early 1990s. Beginning in the mid-1990s, the rate of decline generally decreased, and there was a period of relative stability through to 2000. The 2001 survey produced the lowest mean

and median catch rates observed in the times series, with marked reduction of the variance for the north stock area in particular. Catch rates for the north stock area improved in 2002 relative to 2001, and were comparable to those observed in the mid-1990s, but with higher variability. Catch rates in 2003 increased substantially to a historical high, with similarly high variability among sets for the north stock area. Catch rates in the south stock area exhibit a continuous decline from the mid-1990s to 2002, but show significant increases in 2003 largely due to improved catches in three shallower depth strata. Catch rates in 2003 were similar to those observed in 1992.

Tagging model estimates of trap vulnerable biomass (1992-2002). Trap vulnerable biomass estimated by the tagging model declined from a high in 1993 through to 1998. The estimated biomass remained at low levels from 1998 through 2002, with a historical low in 2001 in agreement with the standardized survey and commercial catch rates.

Standardized commercial trap catch rates (1990-2003). Trap fishery catch rates (kg/trap) for the north coastal area declined from 1991 to 1998 prior to the mandatory adoption of escape rings in the trap fishery. Subsequent to 1998 the four-year trend indicated a decline, with a low in 2001 and improvement in 2002 in agreement with the standardized survey trajectory. The index increased substantially (63 percent) in 2003 over the level observed in 2002 and is the highest value in the period after the adoption of escape-rings in traps. The south coastal area catch rates initially increased and then declined from 1992 through 1998. Subsequent to 1998, the four-year trend is relatively flat.

Nominal trap catch rates (1979-2002). Recent coast-wide catch rates (kg/trap) are at, or slightly below, levels experienced in the early 1980s. This time series is not standardized and coincides with a period of change in the fishery management regime and fishing practices. The timing of the peak of nominal trap CPUE during the early 1990s is consistent with a similar pattern observed for the Gulf of Alaska stock, though the timing is lagged in B.C. relative to Alaska.

Indicators that bear on stock status of B.C. sablefish were also evaluated:

Gulf of Alaska sablefish stock status. Gulf of Alaska abundance is now considered to be at a moderate level with the 1997 year class projected to comprise 31 percent of the 2004 spawning biomass. Relative abundance in 2003 is 10 percent higher than in 2000. The 1998 year class may be above average, though it is not expected to be as strong as the 1997 year class. Projected 2004 spawning biomass is 40 percent of unfished biomass, but is projected to fall to 33 percent by 2007 under the maximum permissible yield specified by the U.S. adjusted $F_{40\%}$ harvest policy.

Continental U.S. indicators. Relatively strong 1999 and 2000 year classes were observed by the triennial shelf survey, and the 2001 shelf survey results are the highest in the 1980 to 2001 series. These signs that the 1999 and 2000 year class might be very good in the waters off the continental U.S. follows poor recruitment through the

1990s and a concurrent decline in sablefish spawning stock biomass off the continental U.S. over the same period.

Catch of sablefish in the West Coast Vancouver Island Shrimp Survey (1979-2003). The west coast Vancouver Island shrimp survey is conducted at shallow depths (50 to 200 m) in areas 124 and 125, and catches juvenile sablefish. Sablefish catch rates showed a marked increase in 2001 and 2002, which then declined in 2003. These results are in agreement with sablefish catch rates from the continental U.S. shelf and slope surveys and bycatch rates in the U.S. Pacific hake (*Merluccius productus*) fishery, where the 1999 and 2000 year classes appear to be above average.

A Bayesian approach, based on the Markov Chain Monte Carlo (MCMC) algorithm was used to estimate the joint posterior distribution of the biomass dynamics model parameters. Distributions of the trap vulnerable biomass estimates and of the stock production estimates are shown as Figure A2. The biomass dynamics model was used to project trap vulnerable stock biomass and production trends over the 2003 to 2008 period for a range of potential future catch levels. Each simulation held the annual catch fixed over the projection period. Long term (1000 year) simulations were conducted for no-catch scenarios to provide estimates of the distribution of unfished trap vulnerable biomass. The long-term simulations suggested that if switching between equal-length periods of good and poor production occurred, the biomass would fall below 19,000 t about 5 percent of the time. This $B_{5\%}$ level was considered a reasonable proxy for a conservation limit because the stock is expected to fall below this level about 1 year in 20 even in the absence of fishing.

Two performance measures evaluated for this assessment are relative to the trap vulnerable biomass in 2002 for consistency with the previous assessment. Additionally, two performance measures related to the 5th percentile of the distribution of unfished trap vulnerable biomass, ($B_{5\%}$=19,000 mt) are evaluated:

1. The *probability* that vulnerable stock biomass is above 19,000 mt at the end of the projection period, $P(B_{2009} > B_{5\%})$;
2. The *probability* that vulnerable stock biomass is above B_{2002} at the end of the projection period, $P(B_{2009} > B_{2002})$;
3. The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E(B_{2009} / B_{5\%})$, and
4. The *magnitude* of the expected change in vulnerable stock biomass over the projection period, $E(B_{2009} / B_{2002})$.

Based on the stock indices, the model outputs suggest there is little risk that the TAC levels investigated with the biomass dynamics model will lead to a short-term conservation concern. However, the model projection outputs are strongly influenced by the substantial increase observed in the 2003 standardized survey and northern trap fishery indices relative to results in 2002. Support for sustained TACs at high levels requires the accumulation of stock index values that continue to provide evidence of

high abundance. The selection of a high TAC value in one year will increase the probability that a reduction will be required in the following year. The decision procedure was not intended to set harvest levels over the duration of the projection period. By necessity, frequent review of the stock indices and indicators will be required pending identification of fishery objectives and development of a satisfactory fishery operating procedure.

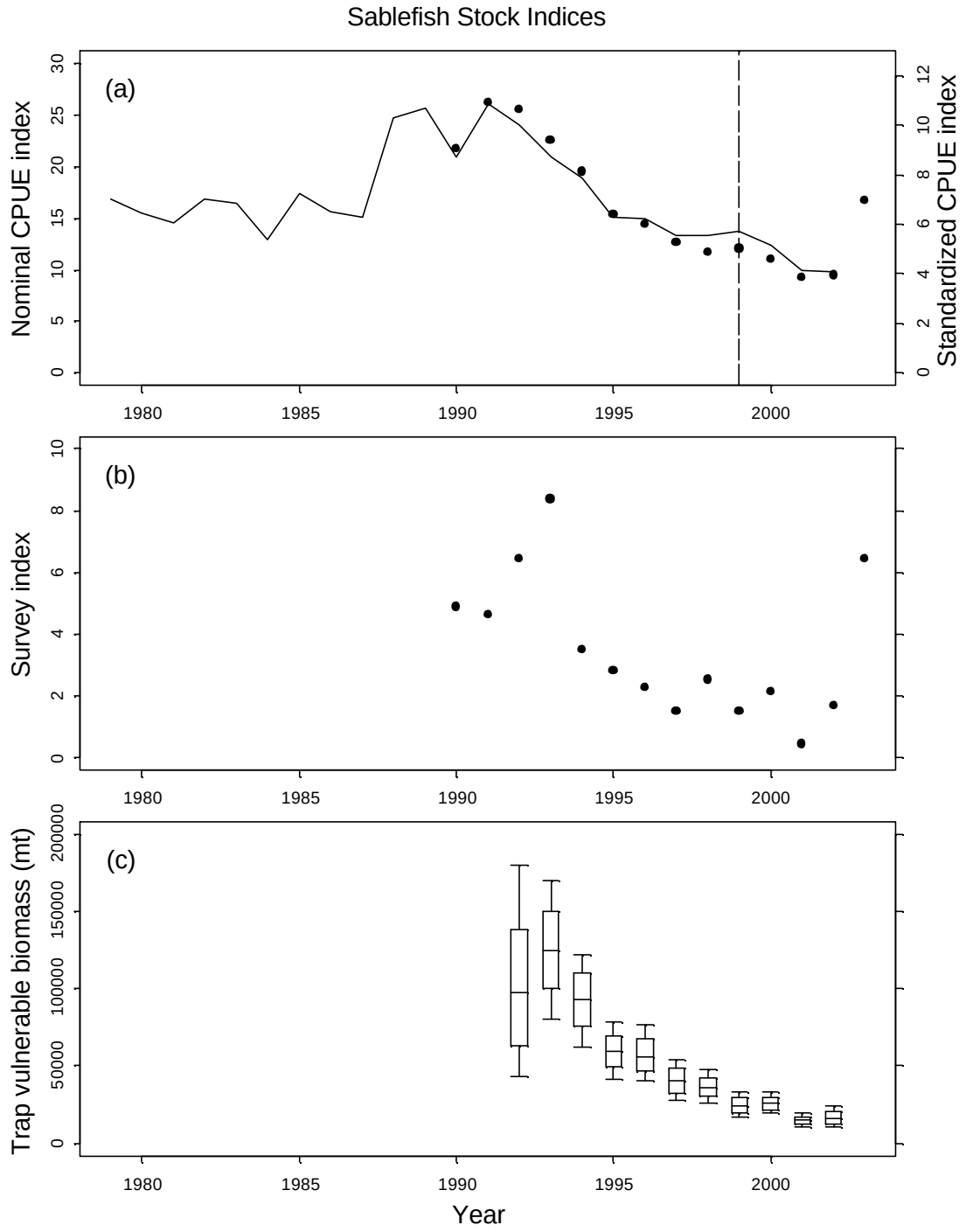

Figure A1 Coast wide stock indices: (a) nominal trap fishery catch rates (solid line) and standardized trap fishery index (filled circles), (b) standardized survey index abundance, and (c) tagging model marginal posterior distributions of trap vulnerable biomass (note no value for 2003 on this bottom chart). The dashed vertical line in panel (a) indicates the inception of trap escape rings.

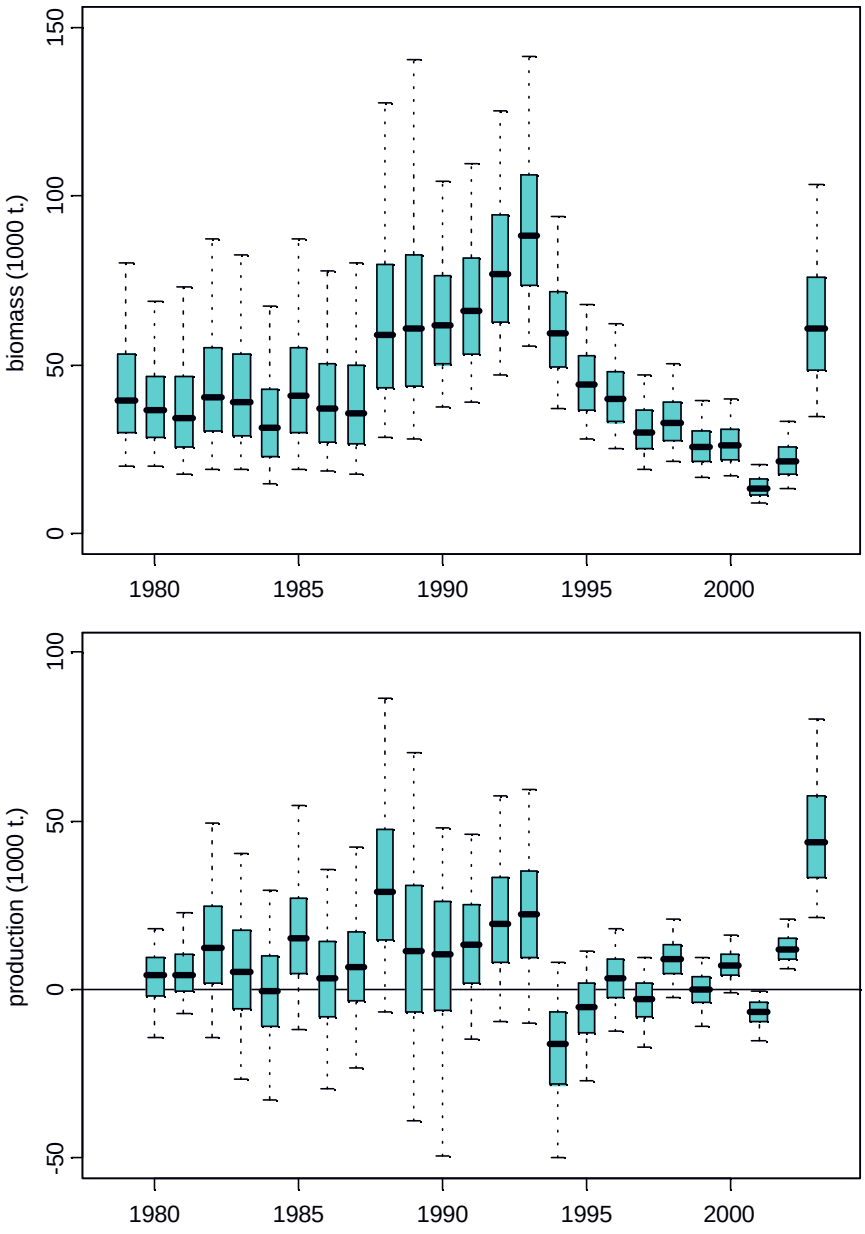

Figure A2 Quantile plots of the marginal posterior distributions of (a) trap vulnerable biomass (upper panel) and (b) stock production (lower panel). The median is shown by heavy horizontal lines, the inter-quartile range by the shaded boxes, and the 5th and 95th percentiles by the whiskers.

G2004-03: Petrale Sole Stock Assessment and Recommendations for Management in 2004.

J. Fargo and P. Starr

This paper summarises the results of analysis of biological data, research survey data and fishery observer data for Petrale sole (*Eopsetta jordani*). Size composition summaries suggest that the proportion of smaller fish entering the fishery has increased over the 1998-2002 period. The estimated instantaneous total mortality rate from survey data in 2000 was only slightly larger than the best estimate of the natural mortality rate. We conclude that the current fishing mortality rate for Petrale sole stocks off the West Coast of Canada is at or below the sustainable level. We present time series of previously unsummarised results for petrale sole from three sets of trawl surveys from the west coast of Canada, all of which show a generally increasing trend of biomass indices since the mid- to late-1990s, although the trend from the NFMS triennial survey is probably not significant. We present a series of general linear models for three areas of the coast: west coast Vancouver Island, Queen Charlotte Sound and Hecate Strait. Models are presented which explore the non-zero landings, the change in the proportion of zero landings and a model which combines the two sets of indices over a period 1996/97 to 2002/03. The non-zero models for WCVI and Queen Charlotte Sound do not show much change over this period, except for an increase in the most recent one or two fishing years, while the Hecate Strait non-zero model shows an increasing trend beginning in 1998/99. The binomial models are not greatly different from the lognormal models from the same area over the seven years modelled and the combined models indicate an increasing trend in CPUE in all three areas for the most recent three to four fishing years.

A delay-difference model was developed which uses the biological parameters for growth, the length/weight functional relationship, and six sets of data representing respectively the mean annual weight of petrale sole, the time series of catch and CPUE, and three sets of trawl survey indices. A model which combines all the available data sets estimates a large standing stock, low fishing mortality rates and a stock status above B_{msy}. One year catch projections based on this model predict that the stock size will remain above F_{msy} with catch levels up to about 2000 t. The only model which is somewhat pessimistic is the model which omits the weight data. This model also estimates that the current stock status exceeds B_{msy}, but predicts that the stock would fall below this level at a catch in 2004/05 of 400 t and the F in 2004/05 would drop below F_{msy} at 650 t.

Summary comments regarding stock status

Our analyses suggest that the west coast Canada petrale sole population has increased in abundance in the most recent three or four years. They also suggest that current stock status for petrale sole is at or above the level of maximum yield. We make these conclusions for the following reasons:

- Results from two of the three available trawl surveys indicate that there has been an increase in biomass in the most recent three to five years. The third survey

shows a non-significant increasing trend. The survey biomass estimates for petrale sole off the B.C. coast do not have optimal coverage for petrale sole and probably represent minimum biomass estimates.

- The regression models fitted to the commercial catch and effort data also show an increasing trend in the last three to four years.

- The estimate of total mortalities (Z) based on one recent (2000) sample from survey age composition information was only slightly larger than the best estimate for M (0.2).

- Model runs indicate that current biomass is at or above B_{msy}. This result should be interpreted with caution because many of the input biological parameters are poorly known and a full range of possible models have not been investigated.

- Model runs and the empirical Z analysis indicate that fishing mortality rates appear to be low. This result seems to be robust even for models which estimate relatively small overall levels of biomass.

- All the delay-difference model runs indicate that the current level of total removals of about 500 t (the total of the bycatch cap of 479 t set by DFO management and a small amount of discards) is well below what appears to be a safe level of harvest for the coming fishing year.

APPENDIX 2: PSARC Groundfish Subcommittee Meeting Agenda January 21-22, 2004

PSARC Groundfish Subcommittee
21-22 January 2004
Pacific Biological Station – Nanaimo, B.C.
Seminar Room

Wednesday 21 January

1. Opening remarks and introductions	9.00	Steve Romaine
2. Petrale Sole	9.30	
Lunch Break	*11.30*	
Petrale Sole (cont'd)	13.00	
3. Formulation of Subcommittee Conclusions and Recommendations	14.30	
Adjournment	*16.30*	

Thursday 22 January

4. Sablefish	9.00	
Lunch Break	*12.00*	
Sablefish (cont'd)	13.00	
5. Formulation of Subcommittee Conclusions and Recommendations	*14.30*	
Adjournment	*16:30*	

APPENDIX 3. List of Attendees

Date: 21 January 2004
Subcommittee Chair: Steve Romaine (RomaineS@pac.dfo-mpo.gc.ca)
PSARC Chair: Al Cass (CassA@pac.dfo-mpo.gc.ca)

Name	Affiliation
Ackerman, Barry*	Groundfish Management Unit, RHQ
Fargo, Jeff*	PBS Groundfish
Haigh, Rowan*	PBS Groundfish
King, Jackie*	PBS Groundfish
Krishka, Brian	PBS Groundfish
Kronlund, Rob*	PBS Groundfish
Macdonald, Al*	Groundfish Management Unit, RHQ
McFarlane, Sandy*	PBS Groundfish
Schnute, Jon*	PBS Groundfish
Sinclair, Alan*	PBS Groundfish
Stanley, Rick*	PBS Groundfish
Tanasichuk, Ron	PBS Pelagics
West, Kim	DFO Fish Management
Workman, Greg	PBS Groundfish

Name	Affiliation
Mose, Brian	Canadian Groundfish Research and Conservation Society
Starr, Paul	Canadian Groundfish Research and Conservation Society
Tank, Suzanne	David Suzuki Foundation
Turris, Bruce	Canadian Groundfish Research and Conservation Society
Wallace, Scott	Sierra Club of BC

Date: 22 January 2004
Subcommittee Chair: Steve Romaine (RomaineS@pac.dfo-mpo.gc.ca)
PSARC Chair: Al Cass (CassA@pac.dfo-mpo.gc.ca)

Name	Affiliation
Fargo, Jeff*	PBS Groundfish
Haggarty, Dana	PBS Groundfish
King, Jackie*	PBS Groundfish
Kronlund, Rob*	PBS Groundfish
Macdonald, Al*	Groundfish Management Unit, RHQ
McFarlane, Sandy*	PBS Groundfish
Perry , Ted	PBS Stock Assessment
Schnute, Jon*	PBS Groundfish
Sinclair, Alan*	PBS Groundfish
West, Kim	DFO Fish Management
Wyeth, Malcolm	PBS Groundfish

Name	Affiliation
Acheson, Chris	Canadian Sablefish Association
Gunderson, Arne	Canadian Sablefish Association
Haist, Vivian	Canadian Sablefish Association
Hilborn, Ray	Canadian Groundfish Research and Conservation Society
Mose, Brian	Canadian Groundfish Research and Conservation Society
Olsen, Erling	Canadian Sablefish Association
Starr, Paul	Canadian Groundfish Research and Conservation Society
Tank, Suzanne	David Suzuki Foundation
Wallace, Scott	Sierra Club of BC
Wickham, Eric	Canadian Sablefish Association

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.

Sean Cox	Simon Fraser University
John Holmes	Fisheries and Oceans Canada
Ron Tanasichuk	Fisheries and Oceans Canada