Review of Alaska Sablefish Stock Assessment

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Prepared for

Center for Independent Experts

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Contents

1. Executive Summary

This report constitutes an independent peer review of the scientific assessment (SAFE) of the Alaska sablefish stock that was conducted by staff of the Alaska Fisheries Science Centre in December 2008. The review took place at the AFSC laboratory at Juneau, from 17-19 March 2009. The sablefish assessment uses a statistical, forward-projecting age-structured model which estimates population numbers and mortality rates separately for male and female sablefish. The model is fitted using data on catches, length/age compositions and CPUE from the fisheries, and several series of abundance indices and associated age or length compositions from longline and trawl surveys. The 2008 model represents an incremental improvement over the one developed in the 2007 assessment, by making better use of survey age data and reducing the number of parameters describing fishery selectivity. The new model does not alter the perception of recent biomass trends given by the 2007 assessment.

The chosen form of assessment is appropriate for the types of data available. The input data having most influence on the assessment (mainly from the longline fishery and survey) appear to be derived from well-designed surveys and from fishery sampling schemes that have improved over time. Some other data sets, for example the trawl fishery length compositions, are based on more limited sampling. The domestic longline survey is particularly influential in the assessment model. Although its ability to provide indices directly proportional to fish abundance has been studied in relation to gear saturation or competition with other species, the assumption of constant catchability should be reviewed at intervals in the light of any substantive change in conditions that could affect catch rates independent of sablefish density.

The new assessment appears to adequately characterize the long-term trends in sablefish biomass. The model suffers from retrospective bias in estimates of recent biomass, although the bias is much reduced in the last two years. Although the retrospective bias could be eliminated by fixing catchability at the estimates from the most recent assessment, or allowing natural mortality to drift, the causes of the bias remain poorly understood. The raw longline survey and fishery CPUE trends do not suggest the trough in 4+ biomass estimates from the mid 1990s to the early 2000s given by the full assessment model. There are also some unusual trends in the relative abundance of males and females estimated by the split-sex model, suggesting that future assessments may benefit from including sex ratio in the estimation procedure. Fitting combined-sex length-based selectivity curves for the different fleets may also help.

Despite the bias issues, the current assessment model provides the most appropriate basis for determining stock trends, short-term projections and catch options for 2009 based on the existing biological reference points. The uncertainties around the projections are correctly characterised by the MCMC simulations that also capture the uncertainties in the historical assessment.

The assessment and forecasts would benefit from better information on abundance of more recent year classes recruiting to the fishery. The Gulf of Alaska trawl fishery data

should provide useful data although it is not annual and the length compositions are not well fitted in the assessment. Other sources of index data on young sablefish should be evaluated for possible inclusion in the assessment, and further work on climate and ecosystem related drivers of sablefish population dynamics should be pursued.

The effect of whale depredation on the longline survey indices and on catch apportionment calculations was of concern to stakeholders. Depredation is very regional, and although previous estimates of numbers of sablefish removed from the lines are relatively small, the incidence of sperm whale depredation has been increasing in the eastern GOA. Further work is needed to evaluate ways of quantifying and reducing whale depredation.

The AFSC has a substantial data base of conventional tagging results from releases carried out over many years, as well as a growing data set from archival tagging. The data appear to be under-utilised and there is considerable potential for incorporating the tagging data into spatial models of sablefish dynamics that could be used both for developing operating models to test assessment and management procedures, and for implementing a spatially resolved assessment model. If a spatially resolved model can be successfully fitted, with robust estimates of regional selectivity and catchability parameters, it would also provide a sounder basis for evaluating catch apportionment schemes.

2. Background

This report provides an independent review of the assessment of Alaska sablefish carried out by staff of the Alaska Fisheries Science Center (Hanselman *et al*. 2009). The Review Committee was provided with web access to stock assessment reports and background material prior to the meeting. I then participated in the review meeting at the AFSC laboratory at Auke Bay from 17-19 March 2009 to review the assessment. This report includes my own review of the Alaska sablefish assessment as well as required documentation including a bibliography (Appendix 1), the Statement of Work (Appendix 2), and Panel Membership and other pertinent information from the panel review meeting (Appendix 3).

3. Review activities

The Review Panel convened at the Auke Bay Laboratory of the Alaska Fisheries Science Center (AFSC) from 17-19 March 2009. The Panel comprised a chair and three panel members. Plenary sessions were open to the public, and were attended by several members of the fishing industry who contributed valuable information to the discussions.

The following Terms of Reference were addressed during the peer review meeting and in the present review report:

a. Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment.
b. Evaluation, findings, and recommendations on the level and adequacy of knowledge and incorporation of life history, ecology and habitat requirements.
c. Evaluation, findings, and recommendations of the analytical approach used to assess stock condition and stock status.
d. Evaluation, findings, recommendations of areal apportionment of harvest strategy as related to optimizing spawning stock biomass.
e. Recommendations for further improvements

A series of presentations was made by AFSC staff to the Panel to explain the data, assessment model and results relevant to the above Terms of Reference:

- Sablefish biology, fishery, and history of assessment by Jeff Fujioka.
- Fishery data including abundance indices, ages, lengths, logbooks and observer data, by Cara Rodgveller
- The Alaskan and West Coast surveys that capture Alaskan sablefish, by Chris Lunsford.
- A description of the proposed stock assessment model, and some results of archival tagging, by Dana Hanselman
- The assessment model results and options for catch apportionment, by Dana Hanselman
- Tagging data, migration and movement modelling, by John Heifetz
- Depredation by killer and sperm whales, by Chris Lunsford

- The results of requests for additional assessment model runs and data analysis, by Dana Hanselman.
- Ecosystem considerations for Alaskan sablefish, by Kalei Shotwell

The review panel members were then required to prepare a summary report of the review activities and outcome, as well as their independent reviews of the assessment, dealing with the above Terms of Reference. The reviewers discussed their independent views on each ToR even if these were consistent with those of other panel members, and especially where there were divergent views. The reviewers were also requested to elaborate on any points raised in the Panel's summary report that they feel might require further clarification, and to provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

4. Acknowledgements

I would like to thank all the AFSC members present at the meeting for their informative presentations of the Alaska sablefish assessment results and supporting material, and for providing helpful responses to the review panel's questions. Many thanks also to staff at the AFSC for their hospitality and help throughout the meeting. Many thanks also to the other members of the review panel for productive discussions on the assessments.

5. Summary of findings for each Term of Reference

5.1 Overview

My overall conclusion is that despite some issues with retrospective bias, the long term development of the stock is well captured by the assessment model, and the assessment provides an appropriate basis for calculating catch options in relation to the chosen biological reference points. Fishing mortality has been maintained at a low but fairly stable level since the late 1990s, and the low biomass experienced over the last 15 years or so appears to be a consequence of recruitment levels rather than overfishing.

The main uncertainties in the assessment and advice include:

- Retrospective model runs terminating in 2004 – 2006 have a tendency to over-estimate recent biomass compared to the runs terminating in 2007 and 2008. Although the retrospective bias could be eliminated by fixing catchability at the estimates from the most recent assessment, or allowing natural mortality to drift, the causes of the bias remain poorly understood. A better understanding of the causes of bias would help future development of the modelling approach.

- The data used in the assessment provide relatively poor information on recent year-class strength, which increases the uncertainty around the projected future trends in abundance. The GOA trawl survey catches younger fish than the long-line survey, but the survey length compositions are fitted poorly in the model indicating a lack of coherence with the year class signals from the long-line survey and the fishery.

The extent to which the assessment programme has addressed each of the Terms of Reference for the Alaska sablefish stock assessment review is evaluated below.

5.2 ToR a. Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment

The supporting material and the presentations at the meeting provided a comprehensive coverage of the amount and type of data available for the assessment, as well as the arguments for including or excluding particular data sets or for treating the data in a specific way in the assessment. The forward-projecting statistical model used for the assessment is capable of fitting to a wide variety of length-based and age-based data, disaggregated by fleet and by sex. The utility of the various data in the assessment had largely been evaluated by the stock assessors by viewing observed and fitted abundance indices and age or length compositions as well as looking at likelihood components and parameter CVs and correlations. In some cases the data fit poorly (e.g. the Gulf of Alaska trawl survey length compositions), and it is not quite clear if this is just due to noisy data or if there are conflicting year-class signals with other data or predominance of year effects over year class effects. Some independent data-screening of individual data sets would be informative, for example examining the internal consistency by fitting year-class curves or otherwise modelling the separable year- and year-class effects for individual survey or catch-at-age data sets.

Some comments on individual data sets are given below:

Alaska Longline survey

The domestic longline survey is the most influential tuning set in the assessment, and the additional model runs requested by the Panel showed that dropping the abundance indices for this survey from the assessment has a greater effect than dropping any other index data. The survey is well designed and appropriately executed and covers a large area of the stock distribution. The survey provides different regional trends in abundance, although the combined area-weighted index is used in the assessment model. On the basis of the available studies and evidence, the survey appears to provide valid data on trends in abundance and size/age composition of sablefish. Some of the evidence is reviewed below.

The ability of the long line survey to provide an index of abundance was examined in detail by Sigler (2000: *Abundance estimation and capture of sablefish (Anoplopoma fimbria) by longline gear*) who concluded that “Decreased encounter rate and the ability to locate baits efficiently imply that longline catch rates likely provide an accurate index of fish abundance if the on-bottom time is long enough to cover the period when most fish encounter the gear and the initial bait density is high enough that baits remain available throughout the soak; the weak link between catch rate and abundance is the unknown extent that factors such as temperature and food availability affect the proportion of fish caught." The paper by Rodgveller *et al* (Evidence *of hook competition in longline surveys*) showed opposite trends in abundance of sablefish and some other species such as grenadier in the longline survey but not in trawl surveys, suggesting effects of competition for hooks that may vary depending on the depth, area, and possibly the abundance of the species of interest as well as other species. Sablefish were considered relatively aggressive and likely to out-compete other co-occurring species. During discussions at the Review Meeting, it was stated that the gears were generally not saturated (i.e. a proportion of baits are not taken), suggesting that saturation and competition are probably not a major issue for the index. However, it might still be useful to consider how the index could be affected by variability in sablefish and competitor density at small spatial scales. The assumption of constant catchability should be reviewed at intervals in the light of any substantive change in conditions that could affect catch rates independent of sablefish density

Several other concerns were raised by industry and others concerning possible biases in the longline index. These included the decrease over time in survey-fishery interactions, the impacts of whale depredation, and the initial choice of station locations by Japanese skippers on the cooperative survey. Given the importance attributed to some of these issues at the meeting, they are considered in more detail below.

Survey-fishery interaction

Survey-fishery interactions during the longline survey appear to have decreased over time. If there were a localized depletion effect by fisheries prior to the survey lines being set, then accounting for fishery interactions would make recent abundances lower compared to earlier years than is shown by the current survey indices. However, the IPHC representative at the Review Meeting noted that results of experiments conducted by the IPHC in relation to their halibut longline survey showed that fishery interactions may not have a significant impact on the indices.

Killer whale depredation

The Alaska Longline Fishermen's Association had stated in a letter to AFSC (March 2009) that in the western management areas, (Bering Sea, Aleutian Islands, and Western Gulf), killer whale depredation began in the late 1980's. The whales have learned to strip most fish off the line as it is brought to the surface, and vessels have responded in some cases by switching to pot gear or by letting the gear soak in the water, for days if necessary, until the whale pod moves on. The amount of fish mortality caused by killer whale depredation on the commercial fleet is unknown.

The 2009 AFSC assessment of sablefish (Hanselman *et al*. 2009) records that from 1990-2007, an average of 23% of observed commercial fishing sets (total observed sets ranged from 1 – 37) in the Bering Sea were affected by killer whale depredation and were removed from CPUE analysis.

Killer whale presence was not recorded in logbooks prior to 2007 and therefore not corrected for in fishery CPUE analysis. In 2007, 107 commercial sets recorded killer whales, and were excluded from logbook CPUE analysis, but excluding these had no significant effect on CPUE (P=0.45).

Killer whale depredation has been a problem in the AFSC long line survey in the Bering Sea since the start of the series, mainly east of 170^{o}W in eastern Bering Sea and NE Aleutians from 170-175W. Killer whale depredation has been fairly consistent since 1990. The only notable trend has been an increase in the western GOA area since 2002 where 2-5 stations were affected compared with 0-2 prior to that. Killer whale depredation has not been observed in West and East Yukatat/SE, and at very few sets in Aleutians and Central GOA. Killer Whale depredated skates are excluded from survey analysis, and this appears to have only a minor effect on the index. Despite the latter observation, there may be merit in evaluating methods of "in-filling" the removed skates using a GLM or spatial modelling techniques, rather than just leaving them out. Simply leaving out the skates will only be unbiased if they are a random selection of all skates in a stratum.

Sperm whale depredation

Sigler *et al*. 2008 (Marine Mammal Science 24(1):16-27) recorded that sperm whales were observed at 16% of longline sampling days, with 95% of sightings over the continental slope. Most sightings were in central and eastern GOA (98%), occasional in western GOA and Aleutian Islands, and absent in Bering Sea. At 65% of stations where sperm whales were sighted, there was evidence of damaged fish. Presence of whales was unrelated to size of sablefish catch at the station level, but at a broader scale, the whales are most common in the central GOA, West Yakutat and Southeast areas, where sablefish catch rates are higher and sperm whales traditionally have fed. Presence of offal discarded from boats may be a factor in attracting whales.

The 2008 AFSC assessment of sablefish (Hanselman *et al.* 2009) note that sperm whale presence does not imply depredation and when it does occur, it is often minimal and difficult to quantify in comparison with killer whale depredation. It is also not known when measurable depredation began during the survey series. Therefore survey and commercial CPUE longline sets with recorded depredation are not excluded from observer data, logbook data or longline survey data. However, the assessment report indicates that most interactions with sperm whales are in the West Yakutat and East Yakutat/Southeast areas – the percentage of sampling days with sperm whales present and where depredation is observed appears to have increased from 2004 onwards, with a figure of about 90% for both being recorded in these areas in the 2008 survey.

The Alaska Longline Fishermen's Association (March 2009) suggests that sperm whale depredation has increased since the implementation of IFQ management (1995) resulted in an 8 1/2 month long season. They also state that the amount of mortality caused by sperm whales depredation on a set can range from 0 to 50% of the fish. Sigler et al. 2008 however state that neither sperm whale presence (P=0.71) or depredation rate (P=0.78) increased significantly from 1998-2004 and that catch rates at locations with whale depredation were 2% less than at locations with no depredation (not significant P=0.34). Out of 5 studies looking at depredation by sperm whales in longline fisheries for sablefish and Patagonian toothfish, only two reported a statistically significant effect of whale depredation on catches (although all show an effect – the issue is perhaps not one of statistical significance but rather the probabilities of different depredation rates occurring, since it does occur). Sigler *at al*. 2008 note that depredation may affect some fishermen more than others and that some fishermen are greatly impacted even though the average overall loss is small.

Taking the available evidence into account, I support the proposals developed during the Review Meeting that the AFSC should consider the potential utility of a range of operational procedures for reducing the bias caused by depredation, and analytical methods for dealing with the effects on the data. The Fishing Vessel Owner's Association (March 2009) cites studies indicating that the primary cue for sperm whales is the short bursts of propeller noise as the main engine is put in and out of gear to maintain the vessel position over the gear while hauling. They suggest that damping the propeller noise could reduce sperm whale depredation. Other methods discussed at the Review Meeting included acoustic techniques, hook monitoring, deterrents, set/skate classification (depredated or not), and innovative ways to compare between indices (e.g., parallel pot sets). A technically challenging approach could be to use some form of remote underwater camera system to monitor the occupancy of the hooks as the lines are being lifted off the seabed, before the whales have had their fill.

Station locations

At each station, a 16 km longline (7,200 hooks in total) is deployed on a variable track down the slope from 200 – 1000m depth. Stations are of 30 – 60km apart, but not located at random within strata. The locations were chosen by Japanese skippers on the cooperative survey, using knowledge of the spatial distribution of sablefish to set the lines in areas with the highest possible catch rates whilst spreading them out as much as possible along the coast. It was not clear from discussions at the Review Meeting if each station therefore represents a local "hot spot" that may persist over decades. If this was the case, the survey would provide an index of abundance trends on local hot spots, which could lead to bias if the population has a tendency to spread away from the hot spots when the abundance is increasing. The additional stations in gulleys, which are not used in the assessment, could provide a useful check on this, if the gulleys are less favourable habitats for sablefish than the original cooperative survey stations. An analysis to check for differences in inter-annual trends between the gulley and non-gulley stations, taking into account the larger scale distribution pattern, might provide a useful diagnostic as the series develop, although there may be statistical power issues for detecting significant differences given the typical variability between stations.

Other surveys/indices

Gulf of Alaska bottom trawl survey

The Gulf of Alaska bottom trawl survey uses a random stratified approach with short-duration tows. The survey covers shallower water (mostly <500m) than the longline survey, and in principle should be able to provide useful data on trends in abundance of the younger age classes of incoming year classes of sablefish, which occur in shallower water. However, the current assessment does not appear to fit this index well. The ability of this index to track the age structure of young fish should be further investigated, and the consistency of year class signals with the long line survey compared directly. A difficulty with such analyses is that survey is not annual. The overall survey trend is downwards, but there is very large variation in overall catch rates between surveys. It is important to know if this is due to year-class effects or if there are strong year effects affecting all ages, due to factors other than fish abundance.

Commercial longline fishery catch rates

Fishery CPUE data are used in the assessment despite *a priori* reservations by the stock assessors that the CPUE index could suffer from “hyperstability” i.e. vessels targeting sablefish in preferred habitats where densities may remain relatively high despite an overall spatial contraction of stock range when abundance is declining. It is not good practice to include indices that are known to be biased, even if they carry little weight in the model fitting, so it is important to know if there is likely to be a bias present. The main evidence presented for hyperstability is a relatively flat CPUE series from the longline IFQ fishery compared to the RPW indices from the longline survey, although both have similar short-term variability (Hanselman *et al*, 2009, page 319). The latter authors report the results of mapping exercises to examine changes in longline fishery patterns. They concluded that areas of high catch rates occur throughout the fishing area and do not appear to change over time. Overall, no substantial changes in the fishery were detected over time or on a seasonal basis. This could be considered an argument for using the longline fishery CPUE, but it would be wise to continue to monitor the spatial and temporal patterns of commercial fishing relative to the patterns observed in the longline survey, at least for the comparable periods of the year.

The practice of post-screening fishing operations to derive sablefish-specific effort may lead to bias in the CPUE trends, if there is a significant exclusion of lines that were set in sablefish habitats but caught mostly other species because sablefish abundance was low at that location. A better approach to evaluating the fishery CPUE would be to undertake a statistical analysis (GLM or other suitable form of modelling), including spatial and seasonal factors along with other factors that could significantly affect catch rates independent of fish density.

Fishery catch and length/age composition data

The current treatment of stock area and total catches appears adequate for the assessment and associated management. State catches are not included in the assessment but their exclusion is unlikely to alter the management advice for the stock as a whole.

Catch data

The accuracy of the historical catch data is a pertinent issue because the model is fitted in a way that fits the reported catch data almost exactly. Catches from the western Bering Sea in the earlier part of the time period are unknown and the overall catch figures for the earlier period when the fishery was open to international fleets is likely to be generally of poorer quality than in later years. The likely effect of inaccurate catch figures on the assessment results has not been evaluated. It is unlikely to have a major effect on the recent stock biomass estimates, but could impact the biomass estimates for earlier years relative to the more recent period. There is anecdotal information of high-grading during different years. It may be informative to investigate the sensitivity of the assessment to alternative plausible catch history.

Age-length sampling.

The adequacy of length-age sampling has improved in recent years. Vessels accounting for 30% of the catch are sampled, mostly by observers. This represents a high fraction of the trips and indicates that the effective sample size is high in the longline fishery that currently takes the bulk of the catch. However, the observer coverage is biased towards large vessels and the effect of this on age and length sampling is uncertain. The trawl fishery data are sparse, which is accounted for in the assessment by inputting a relatively small effective sample size. A more formal evaluation of fishery data quality would be valuable for future assessments and reviews, investigating the precision achieved in age compositions and the representativeness of the sampling schemes. In Europe, ICES is currently developing a fishery data Quality Assurance scheme using tools and protocols developed in the EU-funded COST project[1] and a number of ICES workshops including the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU: ICES, 2008[2]).

The difficulty in ageing sablefish is acknowledged, particularly for fish around 8 years or older. The assessment team has used appropriate procedures for evaluating the accuracy of age determination using validated known-age samples. The assessment model fits cohorts out to 29 years of age, therefore the cumulative effect of errors must be quite significant. The compilation of an age error matrix to allow for the errors when converting model estimates of age composition into length compositions is a sensible approach. However, the ageing errors mean there is a strong likelihood of smearing population estimates for each year class into the neighbouring year classes, which is

[1] http://wwz.ifremer.fr/cost

[2] http://www.ices.dk/workinggroups/ViewWorkingGroup.aspx?ID=281

likely to cause underestimation of large year classes and vice versa. Age composition data should be used in favor of catch-weighted length frequency data in years when both exist.

The move to random sampling by length for collecting age material (by sex) should provide unbiased age compositions, but could lead to reduced precision on the older (less abundant) age classes compared with the commonest ages in the most abundant length classes. However this effect is likely to be reduced because of the strongly asymptotic growth, and the benefits of a random scheme may outweigh any effects of variable precision of numbers at age.

Voluntary logbook scheme.

The voluntary logbook program is valuable for evaluating the under-60' fleet which is otherwise only monitored based on fish-ticket data. Some concerns were raised at the Review Meeting that the coverage for this fleet was very low historically. The implications of this low sampling level for this fleet component on the derived abundance index should be investigated.

*Data not currently included in current assessment***.**

A number of other data sources were identified that should be evaluated for their utility in future assessments:

- Combined-sex length composition data from early fishery
- Sex ratio data that may help in the fitting the model
- The time-series of sablefish cpue from IPHC longline surveys (potential additional indices for younger sablefish – results should be compared with the GOA trawl survey)
- Eastern Bering Sea Slope surveys, although there was concern expressed at the Review Meeting about skewed sex ratios and large size of males.
- State surveys (recognizing issues with applicability to the AK-wide stock)

5.3 ToR b. Evaluation, findings, and recommendations on the level and adequacy of knowledge and incorporation of life history, ecology and habitat requirements.

Stock structure, distribution and migration

There is strong evidence for two distinct North American populations of sablefish, based on differences in growth rate, size at maturity and consideration of tagging results. The Northern population extends from Alaska to northern BC. A comprehensive AFSC tagging programme involving 326,500 sablefish releases and over 27,000 recoveries since early 1970s indicates a small proportion of recaptures as far as the west coast and around 15% of recaptures in Canadian waters. Canadian tagging studies indicate some movement from Canadian to Alaskan waters. The extent of mixing between the two areas is unlikely to be sufficient to invalidate the results of the assessment model which treats the sablefish survey and fishery data as coming from a closed population. Future exploration of spatially explicit assessment models with migration components should however consider this issue further.

The overall distribution and habitat preferences of sablefish off Alaska during the fishing season are well understood from fishery and survey data. Distribution during the spawning season is less well understood as there are no surveys or sablefish fisheries during winter, although data on spawning distribution is available for the more southerly stock off California (see below under "Spawning sites").

There is a clear size-related distribution with younger sablefish occurring on the shelf and older fish occurring on the shelf slope. The occurrence of young-of-the year sablefish appears patchy in inshore waters and the distribution may be affected by year class strength and/or larval drift patterns. Differences in selectivity between longline fisheries or surveys, and shallower-water trawl fisheries and surveys, is to a large extent a reflection of size-related depth distribution.

Growth and age structure

The revised bias-corrected data and updated growth curves for 1981-1993, and the new growth curve from random otolith collections from 1995 onwards, represent an improved use of age data in the assessment. There is evidence for a change in growth rates over time. However a step change in growth parameters between the two periods is unlikely to be a reflection of temporal changes in growth, which are likely to be more gradual and possibly influenced by the size of year classes, particularly for very strong or very weak ones. I recommend an investigation of such effects and the benefits of incorporating any year- and year-class effects on length-at-age distributions for converting age compositions to length compositions into the model.

Although age data are collected from random samples of fish, selectivity effects will cause some bias in the length-at-age distributions. If future stock assessment models adopt the Panel recommendation of fitting selectivity by length, there could be potential for weighting individual-fish lengths at age by selectivity as part of the model fitting, to ensure that model-predicted length-at-age distributions (for converting from age to length) represent a consistent interpretation of selectivity and sample data.

Maturity

The use of separate maturity ogives for female and male sablefish represents the most appropriate use of maturity data for computing spawning biomass rather than the use of combined-sex population estimates and maturity ogives. The ogives currently used are from data collected prior to the mid-1980s. The more recently collected and histologically verified maturity data are available and should be used for future assessments. The new data indicate a slightly higher age at 50% maturity in females.

Temporal trends in maturity should be monitored, although there will be issues regarding the accuracy of historical data not subject to histological verification. However, given the observed changes in growth, it would be valuable to quantify the age and length dependence of maturation.

Sex-ratio

The Panel was presented with data indicating a predominance of males in trawl catches and a predominance of females in the longline catches (Fig. 1). There appeared to be temporal trends in the data for both fisheries, and the assessment model also generates a trend in proportion of males, increasing to just under 0.55 by the early 1990s followed by a decline towards a figure close to 0.50 in more recent years. It is not clear if this represents a true picture of changing sex ratios in the population or if it is an artefact of allowing the model to estimate population numbers separately for males and females without explicitly considering sex ratio in the fitting process. Depending on any prior knowledge of sex ratio at age in the population and feasible rates of drift over time in response to differential mortality, it may be preferred to include sex ratio explicitly in the model fitting process.

Fig. 1. Time series of proportion male in the longline survey and fishery and trawl survey, compared with the values in the population estimates from the split-sex assessment model.

Spawning sites and linkage with distribution of recruits

This aspect of sablefish dynamics in Alaskan waters is poorly understood. Moser *et a*l. (1994 CalCOFI reports vol. 35) show sablefish egg distributions from surveys conducted off California and to as far as 45^{o}30'N, with eggs found all along the shelf slope mainly at depths of 240-480m but with recently spawned eggs extending out to 150 nautical miles offshore. This suggests that spawning distribution off Alaska may also occur along the shelf slope and extending into deeper offshore waters. Results of archival data-storage tagging presented at the Review Meeting indicate seasonal changes in depth distribution of sablefish off Alaska. However further work on along-shore or depth related spawning movements would be needed to support the developing studies of effects of oceanographic processes on egg and larval transport and survival.

Natural mortality

The assumed value for natural mortality (M=0.1) appears appropriate for this stock and is supported by data on longevity of sablefish as well as the results of sensitivity analysis of the results of the assessment model to different values of M, requested by the Panel. Although values of $B_{40\%}$ and ABC catch vary with M, the likelihood profile values indicate that M=0.1 lies at around the middle of a range of values that provide a good fit to the data. Given the sexual dimorphism in sablefish, general life history theory would predict that males and females could have different natural mortality rates, although it would be very difficult to demonstrate this from modelling or tagging data unless the difference is large.

Sablefish ecology

Ecosystem aspects and predation levels that potentially impact sablefish stocks were presented and discussed at the Review Meeting. I support further efforts to quantify ecosystem effects on sablefish dynamics. In particular, studies on factors affecting conditions for pre-recruits would be useful to provide insights on medium-term future trends. Such studies would benefit from reliable data on abundance trends for young sablefish from suitable surveys.

Several comments were made at the Review Meeting concerning a possible environmental regime change affecting recruitment from the early 1980s, and also a perception from the fishing industry that sablefish recruitment has been failing in recent years. The time series of spawning stock biomass and subsequent recruitment from the final 2008 sablefish assessment indicates that recruitment estimates are much less variable since the 1990s. There have not been any of the very large year classes observed in earlier years (even when the SSB was low), but there have also been none of the extremely weak year classes (Fig. 2 – note log scale on recruits). To an extent this may be a result of the smoothing induced in the model through age errors and the fitting procedures. Also, many of the year classes since the 1990s have not yet passed fully through the fishery, due to the longevity of the fish, so the recruitment estimates are still subject to modification as the assessment series grows. Viewing the data as stock recruit plots for 1960-1982 and 1983 – the present (Fig. 2), there is a similar range of SSB values but an absence of very high recruitment in the second period. In both periods, the very weak year classes were less evident when female SSB was at the lowest values of around 100,000 t.

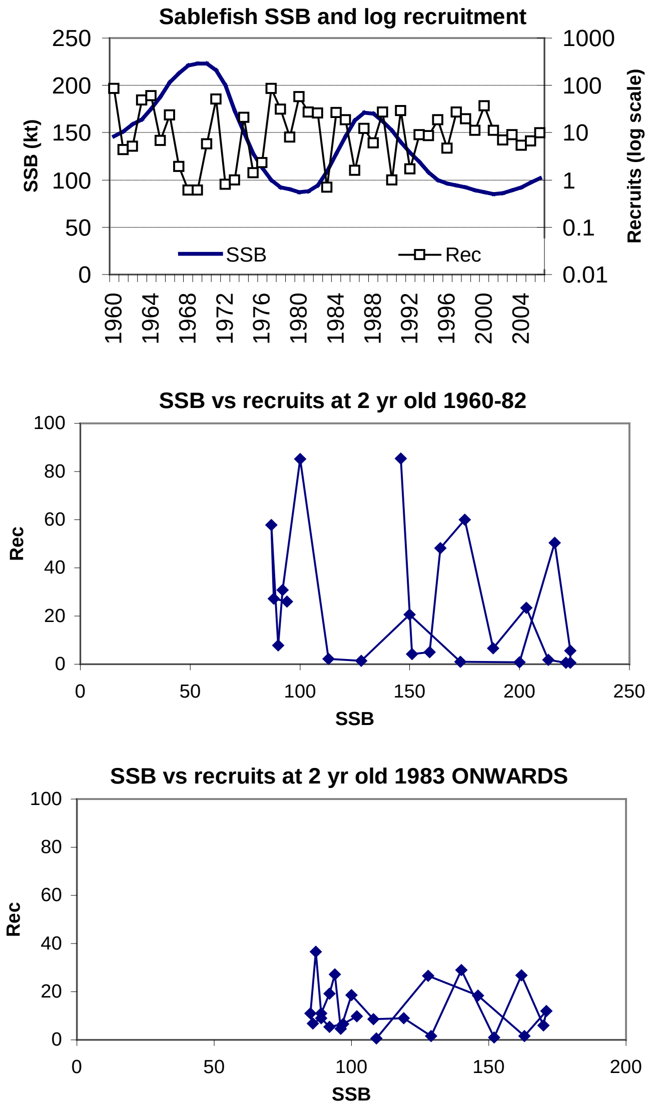

Fig. 2. Top panel: Time series of SSB and recruitment from the 2008 sablefish assessment; bottom panels: stock-recruit plots for two periods.

5.4 ToR c. Evaluation, findings, and recommendations of the analytical approach used to assess stock condition and stock status.

The statistical model for the 2008 Alaska sablefish assessment was an appropriate approach for incorporating the diverse range of fishery and survey length and age data, which are of variable quality. The long term development of the stock is well captured by the assessment model, and despite several issues discussed below, the assessment provides an appropriate basis for calculating catch options in relation to the chosen biological reference points.

Model formulation

The Panel was concerned about the double-use of longline survey data in fitting the model – the RPN data are the core data for the model fitting but the RPWs (basically RPN x mean weight) had also been included and effectively doubled the weight given to the survey. An additional model run was requested by the Panel, excluding the RPWs. The effect of this was to slightly deepen the recent trough in biomass estimates and scale up the historical estimates especially from the 1960s. The effect on current biomass was relatively small. A benefit of the removal of the RPW data was that it resulted in more comparable input and output CVs from the model.

The stock assessment team had put forward strong arguments for the further modifications to the split-sex model used in 2007, in order to reduce the number of selectivity parameters to be estimated and to allocate longline survey ages to their respective surveys. On the basis of the criteria they adopted for choosing a superior model (1: the best overall fit to the data in terms of negative log-likelihood, 2: biologically reasonable patterns of estimated recruitment, catchabilities, and selectivities, 3: a good visual fit to length and age compositions, and 4: lower correlation and higher precision of parameter estimates), the new model configuration represented an improvement over the 2007 model. The effect on all the likelihood components of the changes in the model structure were clearly presented in the assessment report, and the diagnostics supported the decisions made. The final model presented for the 2008 assessment removed a number of poorly estimated and correlated parameters, although very similar stock trends for recent years were obtained applying the 2008 and 2007 model formulations to the data available up to 2008.

Although the effects of different model structures were well presented by the stock assessment team, the sensitivity of the results to the different data sets and parameters was not sufficiently presented. The Panel requested some additional runs to examine the sensitivity to different values of M, and to removal of individual data sets. The likelihood profile is relatively flat for values of M between 0.08 and 0.12. The ABCs associated with M values in this range vary considerably, but the likelihood profile indicates that for the base model configuration, a value of $M = 0.1$ appears the most appropriate. When selectivity was held constant at base case estimates, the biomass trend was most sensitive to the removal of both series of domestic longline relative indices (biomass lower recently) and the RPW index (biomass higher historically). There was little sensitivity to removal of other indices. This confirms that the longline indices are an important driver of the assessment.

The selectivity in the longline fishery and survey is assumed to be asymptotic. However, a comment was made at the Review Meeting that tagging results indicate a domed selectivity for this gear. This should be investigated further, and future assessment models should include testing the sensitivity to domed vs. asymptotic selectivity for longlines.

Results

The model appears to fit well to the longline survey age compositions and the domestic fishery length compositions. It fits poorly to the trawl survey length compositions, and some non-random residual patterns are evident in the domestic longline survey indices (see below). There is a tendency for the model estimates of age compositions to under-represent the observed numbers at or near the modal age groups, possibly a consequence of the smooth selectivity functions. This may also be reflected in the apparent damping of recent recruitment variability (Fig. 2).

The current assessment has a retrospective bias where successive assessments revise the recent biomass estimates downwards, with the largest bias occurring for runs terminating up to 2006 (Fig. 3). The retrospective runs terminating in 2007 and 2008 give similar recent biomass estimates. The causes of this bias require further investigation, particularly in relation to the appropriateness of the current model configuration. The impact of the bias on calculating ABC estimates in relation to stock status relative to the biological reference points is uncertain, and also warrants further investigation. The most recent assessment does not necessarily give the most accurate historical biomass trends, if the bias is caused by unaccounted-for removals from the stock in the past (e.g. increased natural mortality, emigration, or under-estimated fishery catch). Unaccounted-for trends in selectivity could also have an effect. The stock assessment team attempted various analyses to see if the bias could be removed, including fixing catchability at the most recent model's estimates, or allowing natural mortality to drift. However, no firm conclusions could be drawn on an appropriate way forward other than to carry out more work on this before the next assessment.

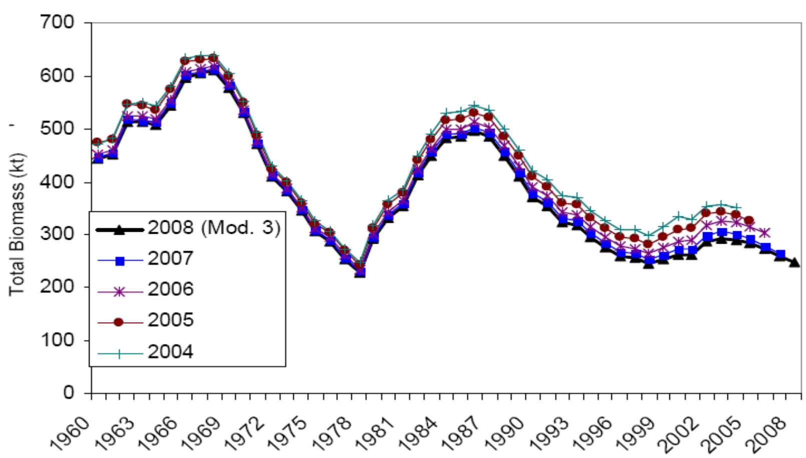

Fig. 3. Retrospective bias in 4+ biomass estimates from the final 2008 sablefish assessment (from Hanselman *et al*., 2009)

A very basic plot of the RPW and RPN indices of abundance from the longline fishery and surveys shows a more stable pattern over time than given by the assessment model, which generates a trough in the biomass estimates from the mid 1990s to the early 2000's (Fig. 4). The split-sex assessment model also shows unusual trends in proportion male in the population, increasing progressively up to the mid 1990s then declining sharply towards 50% (Fig. 1). There also appear to be fairly dynamic changes in the proportion of males in the trawl and longline surveys (Fig. 1). Given the very broad age composition and very low fishing mortality, changes in sex ratio of this magnitude might not be expected. These diagnostics suggest that the model may have too much freedom to fit data for males and females separately, and that some constraint on temporal changes in sex ratio (by age class) in the population estimates may be appropriate. This could possibly help with the retrospective problem. The Panel's suggestion to fit selectivity as a function of length may also help.

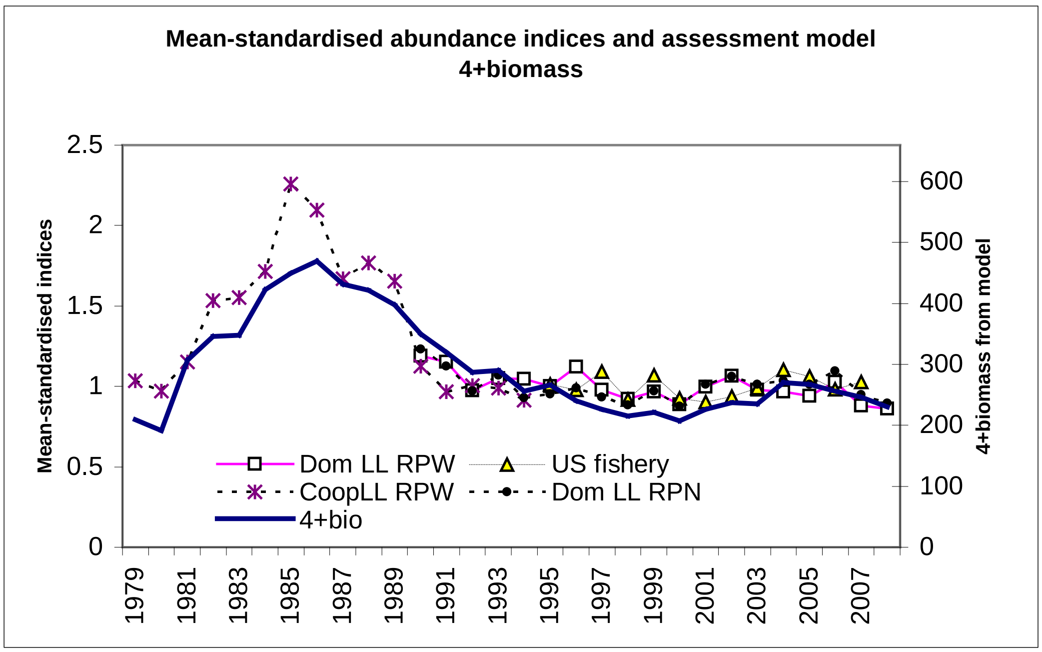

Fig. 4. Mean-standardised abundance indices from the cooperative and domestic longline surveys and the US longline IFQ fishery CPUE (post Derby fishery) in relation to the 4+ biomass trends from the final fitted assessment model (the cooperative survey has been rescaled to overlay the model trends).

Other model runs requested

The Panel requested some other standard assessment diagnostics and sensitivity analyses:

- A comparison of input and output CV for abundance indices. The base model configuration tended to produce larger output CVs than input CVs. Removal of the RPW indices resulted in more similar CVs.

- A comparison of input and effective sample sizes for compositional data. These indicate that the input N may be overestimated for the cooperative and domestic longline survey age data, and underestimated for other compositional data.

Projections

Standard stock projections were carried out encompassing seven harvest scenarios designed to satisfy the requirements of Amendment 56, the National Environmental Policy Act, and the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The projections appeared to be carried out correctly. The biomass is currently 38% of B_0, slightly below the target of 40%. Hence, under the Tier 3b harvest strategy, the ABC was derived from $F_{40\%}$ reduced to account for the current biomass being below the target. Projections indicate that the stock will decline until about 2012 and has a very high probability of falling below the overfishing limit of $B_{35\%}$ in the near term. A longer-term increase in biomass is forecast, but this is the result of assuming that recruitment varies around average values. The uncertainty around the longer term projections is however large. The stock assessment team presented two sets of results to characterise the uncertainty in the projections. The second set (Fig. 3.30 in Hanselman *et al* 2009), based on the posterior probability distributions of the MCMC simulations, reflects uncertainty in the full assessment and indicates relatively wide confidence intervals around medium-term projections

5.5 T0R d. Evaluation, findings, recommendations of areal apportionment of harvest strategy as related to optimizing spawning stock biomass

The reviewers were requested to evaluate the areal catch apportionment scheme in terms of optimizing spawning stock biomass, although it is not clear what is meant by "optimizing" in this context. Catch apportionment clearly has a range of possibly conflicting but un-stated socio-economic and biological objectives that could be evaluated, but this would require a clearer statement of the different objectives that need to be met, and the weightings for these.

The present scheme simply attempts to distribute projected catches in proportion to recent longline survey biomass indices and commercial CPUE for different regions, with a 2:1 weighting for surveys vs. fishery data on the basis that the fishery data are more variable. This scheme implicitly aims for a constant exploitation rate across different regions, but doesn't account for possible regional differences in catchability at age or sex of sablefish, or seasonal movements of fish between regions. The present apportionment system appears to be a reasonable approach given the available data, pending further analysis of the relationship between biomass and survey or fishery CPUE in the different regions, or an updated analysis of the implications of fish movements.

Giving more weight to the longline survey data than to fishery CPUE data in each region appears appropriate, even given factors such as trends in fishery interaction and whale depredation of survey catches. Although the longline survey covers only part of the fishing season, whilst the fishery CPUE data arises from information over the full 8-month season, the survey has the advantage of using a standardized design over the full area. Variation between areas and times in the fishery CPUE data may not fully reflect the pattern of abundance of sablefish due to targeting and differences in fishing gears. The use of region-specific selectivity/availability estimates as a possible modification to the allocation schemes could be explored, and could lead to better use being made of the fishery and survey data for apportionment. Projections taking such selectivity factors into account could be used to evaluate the performance of different allocation strategies. Movement estimates using results from the updated tagging model should also be used for evaluating the impact of different allocation schemes.

The impact of sperm whale depredation on apportionment values was perceived by the industry as a major issue in regions where catch rates are affected by the whales. Historically, the numbers of sablefish removed by sperm whales from the survey longlines was relatively small, but the incidence of depredation has recently increased particularly in the eastern Gulf of Alaska. The review comments that apply to the survey index under ToR 5.2 also apply to catch apportionment.

5.6 ToR e . Recommendations for further improvements

The 2008 assessment report (Hanselman *et al*, 2009) contains a section on data gaps and research priorities. These include:

- Better estimation of recruitment and year class strength
- Better fishery observer coverage in the Bering Sea and Aleutian Islands to monitor the emerging pot fishery in these areas and improve the fishery catch rate analyses and compare selectivity differences in gear types and spatial differences in fishing locations.
- Improve the coverage of trawl vessels catching sablefish to verify discard rates and obtain better information on size compositions of retained and discarded fish.
- Improve the knowledge of sperm whale depredation during the longline survey and its effect on survey catch rates.
- Update the maturity estimates from visual and histological methods.
- Evaluate the appropriateness of current variance assumptions about data components, including those used in the apportionment scheme.

I agree with these proposals, and include a number of additional recommendations for aspects of data collection and assessment modeling that could be improved in the future. These are listed below, and reflect proposals agreed by the Review Panel as a whole, with my own additional comments given in parenthesis:

(1) Data

Age and length data

Comparisons between the length frequency distribution of the age-samples and the overall length frequency samples should be undertaken as an internal consistency check for sampling bias. Furthermore, it would be desirable to develop age-length-keys (ALKs) and apply these to the observed length frequency distributions to compare the resulting raised age composition estimates with the randomly sampled age compositions.

Commercial longline fishery catch rates
Fishery catch and effort data should be screened using a statistical modelling (e.g. GLM) approach to evaluate and where possible correct for factors other than sablefish abundance affecting CPUE. (The spatio-temporal pattern of fishing should also continue to be monitored to evaluate potential hyperstability in the CPUE data.)

Fishery age-length sampling
The adequacy of existing sample sizes in terms of precision should be investigated.

Data sources not currently used in the assessment
The utility of a number of additional sources of data for the assessment should be investigated including combined-sex data from early fishery size composition data, sex ratio information from various sources, and abundance indices from IPHC surveys and EBS slope surveys.

(2*) Stock Assessment*

Size selectivity
Selectivity is currently modeled separately by sex, and the difference in the fitted selectivity curves appear to be largely due to growth differences by sex. It is recommended that size-based selectivity be implemented in future assessments, and that single combined-sex selectivity curves be tested for each fishery. This will potentially reduce the number of selectivity parameters used by the model.

Spatial structure
An area-disaggregated assessment approach should ideally be developed and may lead to improved management advice. Abundance trends and size/age composition vary by area, and spatially separable data and movement data from tagging are available. Such a model can also provide better insight on the impact of apportionment policies. Area-disaggregation options include:

- Treating areas as separate fisheries, fitting area-specific selectivity.
- Modeling movement between areas using tagging information.

Diagnostics
Standard assessment diagnostics should include plots of input and output CV for abundance indices, input and effective sample size for composition indices, and input and output CV for recruitment deviations. (Some basic screening of catch-at-age data and survey age compositions should be presented to evaluate internal consistency in tracking year classes, as well as consistency between data sets.)

Weighting of likelihood components
Iterative reweighting using input and output CVs, and input and effective sample size should provide default weightings for likelihood components in the assessment model.

Sensitivity analyses
Sensitivity of the assessment and associated catch projections to important fixed parameters should be shown.

Model building/specification
Assessment reports should contain a formal examination of the basis for decision making when building towards the final model configuration and adding, deleting or modifying individual data sets. (This was presented clearly for the decisions regarding changes to the 2007 model configuration, but the basis for other decisions regarding model configuration, parameters and input data should be more clearly identified).

The impact of "smoothing" factors (e.g., annual F, R) should be evaluated and avoided if unnecessary.

Growth parameter estimation
Growth parameters should ideally be estimated within the assessment model so that the impact of size-based selectivity is properly accounted for. The sablefish growth parameters have high t_0 values that may be symptomatic of not accounting for selectivity when fitting growth models. (Where appropriate, growth data in the model should reflect any year or year class effects in length-at-age rather than a simple step change in growth parameters presently used in the model).

Simulation testing
The current model should be validated by simulation testing using simulated data to ensure that biomass and recruitment trends are faithfully reproduced. (There is considerable potential for incorporating the tagging data into spatial models of sablefish dynamics that could be used for developing operating models to test assessment and management procedures and for implementing a spatially resolved assessment model.)

Retrospective pattern
The source of the retrospective pattern shown by the assessment requires further investigation, particularly if such a pattern re-emerges as the assessment evolves from year to year.

6. Critique of the NMFS review process, including suggestions for improvements of both process and products

The review process for Alaska sablefish was conducted by three independent reviewers who were provided with comprehensive documentation as well as an admirable level of support from AFSC prior to, during and after the meeting. The three reviewers brought different skill sets to the meeting, covering statistical modelling, knowledge of fish biology, fishery sampling and survey design/ analysis, and provision of scientific advice on fishery management. In this respect, the NMFS review process successfully ensured a balanced review for the sablefish assessment.

The organization of the meeting by CIE and AFSC was smooth and trouble-free, and the facilities at the AFSC lab at Juneau were conducive for a very productive meeting. The reviewers were provided with a mostly clear set of Terms of Reference, although the reference to "optimizing spawning stock biomass" in ToR 5d was not clear and the reviewers had some difficulty in establishing what exactly was required. It would be helpful to reviewers to ensure that any Terms of Reference are unambiguous.

The meeting was open to the public, and several members of the fishing industry provided valuable input to discussions. This can inevitably lead to lengthy discussions, but in this case the time available for the meeting was sufficient to accommodate this.

7. References

ICES 2008. Report of the Workshop on Methods to Evaluate and Estimate the Accuracy of Fisheries Data used for Assessment (WKACCU). ICES CM 2008/ACOM:32, 41 pp.

Appendix 1: Bibliography of materials provided for review

The following reports were made available on the sharepoint site for the Review Meeting, and were consulted in preparing for the meeting and in writing the CIE review report.

Title	Authors and year of publication
An independent review of sablefish assessment in 1996, includes notes	Pope 1996
The 2008 Alaska sablefish assessment for 2009	Hanselman et al 2009
Derivation of catchability priors for abundance indices	Hanselman 2007
Updated growth information analyses report	Hanselman and Howard 2007
Summary report from 2006 sablefish workshop	NPFMC 2007
Japanese sablefish studies	Sasaki 1985
Estimation of sablefish abundance from the longline survey	Sigler 2000
Estimates of sperm whale depredation	Sigler et al 2008
Movement dynamics of Alaska sablefish (From tagging)	Heifetz and Fujioka 1991
Choosing a harvest strategy for Alaska sablefish	Fujioka et al 1997
Geographic apportionment of sablefish harvest	Heifetz et al 1997
Population dynamics of sablefish migration for management	Heifetz and Quinn 1998
Alaskan sablefish longline survey protocol	Sigler and Lunsford 2003
Description and summary of sablefish tag releases and recoveries 1977-1983	Fujioka et al 1988
Estimation of tag reporting rates for sablefish in the North Pacific	Heifetz and Maloney 2001
Age validation and age error analysis from marked and recaptured sablefish	Heifetz et al 1999
Stock structure and movement of tagged sablefish in the North Pacific and ENSO effects	Kimura et al 1998
Standardizing sablefish long-line survey abundance indices	Kimura and Zenger 1997
Sablefish population on Gulf of Alaska seamounts	Maloney 2005
Age-specific movement patterns of sablefish in Alaska	Maloney and Sigler 2008
Maturity, fecundity, spawning, and early life history of sablefish off Pacific coast of Canada	Mason et al 1983
Evidence of hook competition in long-line surveys	Rodgveller et al 2008
Distribution, age, and growth of juvenile sablefish in Southeast Alaska	Rutecki and Varosi 1997
Estimation of sablefish abundance off Alaska with an age-structured population model	Sigler 1999
Young-of-the-year sablefish abundance, growth, and diet in Alaska	Sigler et al 2001
Effects of individual quotas on catching efficiency and spawning potential in Alaska sablefish fishery	Sigler and Lunsford 2001
2008_cruise_report_final	2008 cruise report final
2009_LL_Survey_Calendar_Final	2009 LL Survey Calendar Final

Appendix 2

Attachment A: Statement of Work for Dr. Michael Armstrong

External Independent Peer Review by the Center for Independent Experts

Review of Alaska Sablefish Stock Assessment

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: Multiple changes have been implemented in the Alaska sablefish (*Anoplopoma fimbria*) assessment in the period since the last independent review. There are stakeholder concerns over areal apportionment of harvest and depredation of survey catches by whales. Therefore, NOAA Fisheries' Alaska Fisheries Science Center (AFSC) requests a thorough review of the Alaskan sablefish assessment.

Sablefish are assessed as a single population in Federal waters off Alaska because northern sablefish are highly migratory for at least part of their life. Sablefish are then managed by discrete regions to distribute exploitation throughout their wide geographical range. There are four management areas in the Gulf of Alaska: Western, Central, West Yakutat, and East Yakutat/Southeast Outside, and two management areas in the Bering Sea/Aleutian Islands: the Eastern Bering Sea and the Aleutian Islands region. The assessment is a split-sex, age, and length structured model coded in AD Model Builder. Important data are an annual AFSC sablefish-specific longline survey, a biennial AFSC trawl survey, fishery CPUE, and age/length data from all three sources.

The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. CIE reviewers shall have the expertise, background, and experience to complete an independent peer review in accordance with the SoW and ToRs herein. CIE reviewer expertise shall have expertise and work experience in analytical stock assessment, including population dynamics, age/length based stock assessment models, uncertainty, survey design, and fisheries biology.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled during March 2009 in Juneau, Alaska.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering committee, the CIE shall provide the CIE reviewer information (name, affiliation, and contact details) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and information concerning other pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Foreign National Security Clearance: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., name, contact information, birth date, passport number, travel dates, and country of origin) to the NMFS Project Clearance for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations (available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send by electronic mail or make available at an FTP site the CIE reviewers all necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE on where to send documents. The CIE reviewers shall read all documents in preparation for the peer review.

AFSC will provide copies of the statement of work, stock assessment documents, sablefish longline survey reports, and other background materials to include both primary and grey literature.

This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: Each CIE reviewers shall conduct the independent peer review in accordance with the SoW and ToRs. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report. CIE reviewers are not required to reach a consensus, and should instead provide a brief summary of their views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review;
2) Participate during the panel review meeting at the Auke Bay Laboratories at the Alaska Fishery Science Center, Juneau, Alaska, from March 17-29, 2009, as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than April 2, 2009, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to David Die ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

February 10, 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
March 3, 2009	NMFS Project Contact sends the CIE Reviewers the pre-review documents
March 17-19, 2009	Each reviewer participates and conducts an independent peer review during the panel review meeting
April 2, 2009	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
April 16, 2009	CIE submits CIE independent peer review reports to the COTR
April 23, 2009	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards: (1) each CIE report shall have the format and content in accordance with Annex 1, (2) each CIE report shall address each ToR as specified in Annex 2, (3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:

William Michaels, Contracting Officer's Technical Representative (COTR)
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Alaska Fisheries Science Center
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Appendix 2 continued

Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR, and Conclusions and Recommendations in accordance with the ToRs.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including providing a detailed summary of findings, conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not they read the summary report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Appendix 2 continued

Annex 2: Terms of Reference for the Peer Review

Review of Alaska Sablefish Stock Assessment

CIE reviewers shall address the following Terms of Reference during the peer review and in the CIE reports.

f. Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment.
g. Evaluation, findings, and recommendations on the level and adequacy of knowledge and incorporation of life history, ecology and habitat requirements.
h. Evaluation, findings, and recommendations of the analytical approach used to assess stock condition and stock status.
i. Evaluation, findings, recommendations of areal apportionment of harvest strategy as related to optimizing spawning stock biomass.
j. Recommendations for further improvements

Annex 3: Tentative Agenda

Review of Alaska Sablefish Stock Assessment

Alaska Fisheries Science Center
Auke Bay Laboratories
Ted Stevens Marine Research Institute
17109 Pt. Lena Loop Rd.
Juneau, Alaska

March 17th – 19th, 2009

Contacts:
Security and check-in: Phil Rigby, Phillip.Rigby@noaa.gov, 907-789-6653
Additional documents, Dana Hanselman, Dana.Hanselman@noaa.gov, 907-789-6626

Tuesday, March 17th:
9:00 AM – 10:30 AM: **Introduction**
Topics:
Introductions and the agenda, overview of sablefish biology, fishery, and history of assessment.

10:30 AM – Break
10:45 AM – Discussions
12:00 PM – Lunch
1:00 PM -3:00 PM: **Input data**
Topics:
Survey data – abundance indices, ages, lengths, growth, ageing error
Fishery data – abundance indices, ages, lengths, logbooks and observer data

3:00 PM – Break
3:15 PM – **Discussions**
5:00 PM – Adjourn for day

Wednesday, March 18th:
9:00 AM – 10:30 AM: **Assessment model**
Topics:
Model structure, split-sex design, likelihood formulations, data weighting

10:30 AM – Break
10:45 AM – **Discussions**
12:00 PM – Lunch
1:00 PM -3:00 PM: **Parameters, priors, and ages**

Topics:

Catchabilities, selectivities, natural mortalities, recruitment variability, age reading

3:00 PM – Break
3:15 PM – Discussions
5:00 PM – Adjourn for day

Thursday, March 19th:
9:00 AM – 10:30 AM: **Current issues**
Topics:
Areal apportionment of catch, whale depredation

10:30 AM – Break
10:45 AM – Discussions
12:00 PM – Lunch
1:00 PM -3:00 PM: **Alternative model runs, further discussion as needed**
Topics:
TBA

3:00 PM – Break
3:15 PM – Further discussions and summarize
5:00 PM – Adjourn meeting

Appendix 3 Panel Membership and other pertinent information

CIE Members of the Review Panel
Mike Armstrong (CEFAS)
John Casey (CEFAS)
Neil Klaer (CSIRO)

Meeting Chair
Jim Ianelli (AFSC, Seattle)

NMFS scientific participants:
Dana Hanselman (AFSC/ABL)
Jon Heifetz (AFSC/ABL)
Chris Lunsford (AFSC/ABL)
Cara Rodgveller (AFSC/ABL)
Jane DiCosimo (NPFMC)
Jeff Fujioka (AFSC/ABL)
Kalei Shotwell (AFSC/ABL)
Phil Rigby (AFSC/ABL)
Dave Clausen (AFSC/ABL)
Cindy Tribuzio (AFSC/ABL)

Industry
Dan Falvey (ALFA)
Jack Knutsen (FVOA)
Nick Delaney (Alaska Leader)
Peter Hochstoeger (AK Glacier Seafoods)
Tory O'Connell (ALFA)
Chris McDowell (McDowell Group)

Non-NYMFS scientists
Juan Valero (IPHC)
Sherri Dressel (ADFG)
Dave Carlile (ADFG)