Center for Independent Experts (CIE) Independent Peer Review Report

Alaska Sablefish Assessment

Juneau, Alaska. May 10 –12, 2016

Dr. Noel Cadigan

Centre for Fisheries Ecosystems Research
Marine Institute of Memorial University of Newfoundland
St. John's, NL. Canada

Executive Summary

The quality of input data and methods used to process them for inclusion in the assessment were reviewed by the panel. The data are extensive and the methods were generally appropriate and competently applied, although, as usual, further improvements may be possible, particularly concerning the development of a recruitment index from the trawl survey, calculation of fishery CPUE, and the calculation of age-length keys with consideration of measurement error in length and age. The assessment model was appropriate and competently applied; however, a best-practice approach would involve a tag-integrated assessment model, possibly spatial, in which natural mortality rate (M) is treated as an unknown parameter to estimate. An analysis of time variation in growth and maturation should be done. The treatment of age and length composition information, and weighting of various sources of information, may be improved by using a different statistical modelling approach.

Strategies for accounting for whale depredation were reviewed. This is a somewhat unique stock assessment issue. It seems more appropriate to consider depredated fish as catch rather than M, and available adjustments should be applied to both indices and catches. The GLMM approach used to estimate sperm whale depredation in the longline survey should be extended to killer whales, and simulations should be conducted to evaluate the efficacy of proposed corrections for whale depredation on stock size indices and catches. Depredation should be included in the assessment, and ABC recommendations should account for depredation.

Areal harvest apportionment strategies were reviewed. A basic biological reason to adjust apportionment by area is to manage fisheries to maximize sustainable yield (MSY). This is relevant when there are multiple spawning components. However, in a highly mixed stock like sablefish, close alignment to areal abundance may be less important for biological productivity and economic considerations may take precedence. However, there is some uncertainty about sablefish sub-stock structure and it is precautionary to assume that this may exist at some level and that harvest strategies that avoid local depletions are preferred.

Background

The Stock Assessment Review Panel (RP) for Alaska Sablefish was held in Juneau, Alaska, from May 10-12, 2016. The purpose of the meeting was to provide technical review of potential changes to the Alaska sablefish assessment. These changes included development of a new fishery catch per unit effort (CPUE) index, incorporation of estimates of whale depredation, and alternatives to the methods for apportionment of catch by area. These changes could have a significant impact on the assessment and on stakeholders. The RP was request to review these potential new changes to the assessment and provide guidance on best practices for implementation.

The Panel was composed of three independently appointed Center for Independent Experts (CIE) reviewers (Dr. N. Cadigan, Canada; Dr. Neil Klaer, Australia; Dr. Tom Carruthers, Canada) and a chairperson, (Dr. Mike Sigler, NOAA/AFSC). Assessment documents were prepared and presented by Dr. Dana Hanselman (AFSC), Chris Lunsford (AFSC), Kari Fenske (University of Alaska Fairbanks), Megan Peterson (AFSC) and Kalei Shotwell (AFSC). The support of all of these scientists and staff to the RP process is gratefully acknowledged and contributed to a scientifically productive meeting.

The CIE reviewers were tasked with reviewing scientific information to ensure quality and credibility in accordance with the State of Work (SoW) and Terms of Reference (ToRs). The reviewers were required to conduct their peer reviews impartially, objectively, and without conflicts of interest. Each reviewer was required to be independent from the development of the science, without influence from any position that the agency or constituent groups may have.

The CIE reviewers were required to have working knowledge and recent experience in the application of 1) Stock assessment/Population Dynamics; 2) Generalized Linear Mixed Modeling/Generalized Additive Modeling/Generalized Linear Modeling; 3) Fisheries Management; and 4) Spatially-explicit assessment modeling. Each CIE reviewer's duties could not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Role of reviewer

All primary assessment documents and most supporting materials were made available to the Panel via an ftp server two weeks before the meeting. These documents are listed in Appendix 1. I reviewed the backgrounds documents I was provided. I attended the entire RP meeting in Juneau, Alaska during May 10-12, 2016. I reviewed presentations and reports and participated in the discussion of these documents, in accordance with the SoW, Office of Management and Budget (OMB) Guidelines, and the ToRs (see Appendix 2). I contributed text to the RP Summary report. After the meeting, I participated in email discussions dealing with the RP summary report. My individual CIE report is structured according to the required format and content described in Annex 1 of Appendix 2.

Summary of findings

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

A December 2015 document entitled 'Assessment of the sablefish stock in Alaska' described the input data to the stock assessment. This document provided:

- Summary of changes in assessment inputs.
- A description of early U.S. fisheries before 1957, foreign fisheries during 1958 to 1987, and U.S. fisheries during 1977 to the present. This included a description of changes in management measures. Discard information was summarized as a single amount for 1994 to 2004, and tabulated by gear and FMP area during 2007-2014. The overall percentages were low, ranging from 2.5-5.8% during 2007-2014. I would have liked some additional information on the size composition of discards and, in particular, potential differences in the kept and discard sizes. As I understand, the discards are combined with kept catches and the assessment model essentially assumes they have the same selectivity. Fishery catches were described well. Some catches probably were not reported during the late 1980s and the potential magnitude of this should be better described. Assessments now document all removals including catch that are not associated with a directed fishery. While these catches were considered to be small (~2%) they were not included in the assessment model and the rationale for this was not described. Good sex-specific length composition information was available for US fixed gear fishery since 1990, but trawl fisheries had much less length information available. The treatment of this information seemed appropriate. Age data were available annually since 1999. Sample sizes seemed low (~1200 otoliths per year), because of the difficulty of obtaining representative samples, and because only a small number of sablefish can be aged each year. Age compositions were raised by the catch in each management area to estimate total age compositions. No other details on this were provided in the main assessment document. It would be useful to provide additional information on this so that the quality of the age information could be better assessed. For example, time-series bubble plots of age compositions by management area, and the aggregated (i.e. raised) total age compositions, may provide insights into anomalous samples and measurements.
- The Longline fishery CPUE was briefly described. The CPUE series was started in 2000 although information has been collected since 1990. It was not clarified why the earlier data was not used. Catch rates were based on sets that were determined to have targeted sablefish. This data selection procedure may result in a CPUE series that is too focused on hot spots and may suffer from hyper-stability. Sets with evidence of killer whale depredation were excluded from the CPUE calculations. The total CPUE was area-weighted in five management areas. This seemed appropriate. Changes in the spatial or temporal patterns of the fishery were investigated and changes were apparent in the logbook or observer data.
- The AFSC longline survey was described. Japan-US cooperative longline survey was conducted in the GOA annually from 1978 to 1994, adding the AI region in 1980 and the eastern BS in 1982. Since 1987, the AFSC has conducted annual longline surveys of the upper continental slope designed to continue the time series of the Japan-U.S. cooperative survey. During 1979-1994 otolith collections were length-stratified, but since 1994 otoliths have been collected randomly. Prior to 1996, otoliths were not consistently aged from year to year, but since then about 1,000 have been aged annually and the assessment team considered that this was large enough to get a precise age composition for the whole survey area, but

may be too small to estimate the age composition in smaller areas by sex. The quality and consistency of age information (i.e. how well do strong cohorts track) was not described well and should be improved. Methods to derive relative population abundance indices were poorly described in the assessment document. Additional information was provided in the stock assessment presentation. However, because this is a major index in the stock assessment, more description should be provided in the future. This could include tables and figures of survey CPUE and CVs by strata and years. Methods to estimate total survey standard errors should be described. The assessment document described problems due to whale depredation and this is considered further under ToRc. The survey index was based on continental slope locations, but there are also gulley stations sampled that are not included in the index, because gully stations catch fewer large fish and more small fish than adjacent slope stations. The assessment document indicated that future research will be conducted to explore sablefish catch rates in gullies and their usefulness for indicating recruitment, which I encourage.

- Trawl surveys of the upper continental slope are conducted annually in the Bering Sea, but only biannually in the Aleutian Islands and Gulf of Alaska. These surveys usually only cover depths less than 500 m. This creates some difficulty in deriving a total stock size index or a recruitment index. The approach used to fill in missing areas was not described well in the document. It was indicated during the RP meeting that some type of interpolation was used, but this needs a more complete and written description. There may be better ways of dealing with missing regional trawl survey data, such as a temporal-spatial model with year, area, and year*area effects. If the interaction effects are either small, random, or have some type of predictable behavior, then this model could be used to deal with missing areas. The stock assessment would greatly benefit by having a more reliable recruitment index, especially for very recent cohorts that are basically not sampled in the longline survey, and an improved analysis of the trawl survey information could possibly provide this. I cannot be more specific here because I was provided little detail information on this survey.
- The IPHC longline survey differs from the AFSC survey in gear configuration and sampling design, but catches substantial numbers of sablefish. The IPHC survey samples the shelf consistently from ~ 10-500 meters, whereas the AFSC survey samples the slope and select gullies from 200-1000 meters. Hence, the IPHC survey may catch smaller and younger sablefish than the AFSC survey; however, lengths of sablefish are not taken on the IPHC survey. This seems to be a lost opportunity. Could length compositions be obtained from port sampling? If so, then the IPHC survey could potentially provide another recruitment index.
- The assessment team should provide a graph of mean standardized indices – all on one graph.
- The extensive tagging information for this stock was not directly considered in the stock assessment document. It should be.

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

The assessment document, 'Assessment of the sablefish stock in Alaska', described the stock assessment model. It is an age-structured and sex-specific model. The model appeared to be competently applied.

- Natural mortality was fixed at M = 0.1 for all ages and years. The assessment model is sensitive to this parameter, as usual, and more should be done. There is substantial tagging information available for sablefish which should provide some information about M that could easily be used in the stock assessment via an objective prior. A better approach (i.e. current best practise) is to include the tagging information directly in an integrated stock assessment model. Cadigan (2016) and Goethel et al. (2015) provide examples of this. Cadigan (2016) estimated M as an age- and year-specific stochastic process and this was possible because of the time-series of cod tagging information available, although not as extensive as for sablefish. The approach was further improved in Cadigan (2015a). Note that the publications dates do not correspond to the order of the research.
- Female maturity was fitted externally which makes sense. However, many east coast cod stocks have had substantial and possibly density-dependent changes in maturity schedules. It would be useful if the authors checked this for sablefish. I suggest fitting the maturity model as a Binomial logistic regression with year interactions in the slopes and intercepts. Even better is some type of model with time-series structure in the maturity ogive (e.g. Cadigan et al., 2013).
- Length and weight at age was fitted externally which also makes sense. These relationships were fitted in two time blocks (1960-1995, 1996-present) to account for differences in the sampling design. Similar to the preceding comment, it would be useful to check if growth rates have varied further over time. There are many examples of this, and sometimes variations appear to be density-dependent which may have implications for MSY reference points. The model we use for northern cod weights-at-age is Von Bertalanffy (weight version) with random walks over time (i.e. cohorts) in Winf and k (e.g. Cadigan, 2015b), which seems to provide reasonably smooth results that also fit the data well.
- There are undoubtedly between-individual variations in growth rates and this is the source of variability that we want to include via an age-length key in a stock assessment model. Measurement error in age and length are also important to properly account for because they are confounded with between-individual variation in growth rates. Hanselman et al. (2012) age-reading errors suggest that measurement error in age becomes substantial between ages 5 and 10. If the measurement error in age is only large at ages when body growth has largely concluded, then the error is not important when fitting growth models. However, sablefish are still increasing in size at ages 5-10, and I suspect that the measurement error in age is leading to an over-estimate of the VonB k parameters. It is well known in normal linear

regression that measurement error in covariates leads to bias attenuation in estimates of slopes (i.e. absolute values of estimated slope parameters are biased towards zero).

- The sablefish growth information is coming from size-selective gears for the ages in the assessment model and this will affect the growth data; hence, adjustments for selectivity are required when fitting growth models.
- For the early length-stratified growth data, the stratification scheme is important to account for. The Horvitz-Thompson sampling design adjusted approach that Echave et al. (2012) used for sablefish may not perform well in removing design bias with individual length-age data (Mohammed, 2015). Those results suggested over-estimation of Linf and under-estimation of k if the stratification was not taken into account (a result similar to Echave et al. 2012), but the sampling design adjusted approach led to over-estimation of k and under-estimation of Linf by similar magnitudes compared to the unadjusted estimators. Mohammed (2015) showed that an alternative approach (a model with between-individual variability) was much improved, but I suggest those results are preliminary. Nonetheless, this suggests the potential that the bias-corrected growth model estimators in Echave et al. (2012) are still biased but in the opposite direction (k too high, Linf too low).
- The preceding 3-4 comments suggest that further improvements in the age-length keys (i.e. Fig. 3.12 in main assessment document) may be possible. I am worried that 1) length-selectivity of the gear used to obtain growth samples and 2) measurement error in age may both lead to over-estimation of recent growth rates at ages 2-10. I also don't find that the age-length keys have adjusted for measurement error in length and age when inferring the distribution of length at age. This could possibly lead to under-estimation of fishing mortalities – but I am not sure about that.
- Recruitment variability was fixed at $\sigma_R = 1.2$. It should be checked if this is still appropriate, because this parameter is the main source of uncertainty in the stock assessment projections.
- The weighting of age and length composition information, and also abundance indices, is a complicated issue. The assessment team chose to not adjust weights for abundance indices, because they had external estimates of the sampling variances for these indices. However, there are reasons to expect that external variances may be too low (e.g. fish movements, random changes in catchability due to changes in stock distributions). Only 1) age components and 2) length components where no age data exists were reweighted. In the end, the AFSC Longline survey seemed to get too much weigh,t and the RP recommended reweighting to achieve a SDNR of about one. This seems to make sense. I agree with Francis (2014) that it is time to consider replacing the multinomial distribution for fitting compositional data in stock assessment models. Francis (2014) concluded that the [additive] logistic-normal distribution appeared "very promising". Cadigan (2015a) used a similar approach, the multiplicative logistic-normal distribution which has been recommended for ordinal compositional data. Cadigan (2015a) iteratively re-weighted all fishery age-compositions and survey age-based indices and the resulting weighting seemed reasonable. I have no reason to expect that an alternative approach to modelling age and length

compositions in the sablefish stock assessment model will produce difference stock status results, but I do suggest the assessment model process could be made simpler.

ToR c. Evaluation, findings, recommendations on estimation and strategies for accounting for whale depredation

Killer whale depredation is easily identified and is a problem in some regions. Sperm whale depredation also affects longline catches, but this source of depredation is not as easily identified as killer whale depredation.

a. Are the data and methods used in estimating depredation effects sufficient?

- Depredation is not a common stock assessment issue and therefore there are no standard solutions for this issue to my knowledge, although this review was the first time I dealt with this problem.
- Depredation affects fishery catches and surveys, and there is less information on depredation from the fishery than from surveys.
- Depredation in the fishery can be considered F or M; however, under the assumption that most depredated sablefish would not have been eaten by whales in the absence of a fishery, I suggest it is more appropriate to consider depredated fish as catch because these fish would have been caught in the absence of whales. Hence, depredated fish can be considered as unaccounted catch. This was also the approach advocated by the assessment team (Peterson and Hanselman. *In prep.*). They took a three step approach to estimate commercial sablefish fishery catch removals associated with whale depredation: 1) estimate whale effect on sablefish CPUE; 2) estimate the proportion of sets impacted by killer whales; 3) combine 1) and 2) to estimate catch removals due to whales.
- Whale depredation on the sablefish commercial fishery CPUE was estimated using NMFS observer data from 1995 to 2014. Sets with sablefish CPUE greater than zero and labeled as ‘no problem’ or ‘considerable sperm or killer whale predation’ as performance codes were selected for analysis. It seems likely that these indicators are measured with error, although I am not sure how one could measure the magnitude of the error. At least some sensitivity testing could be conducted. The whale effect on sablefish CPUE was estimated using GAMMs. The GAMM approach seemed reasonable and the modelling seemed competently conducted. I was somewhat concerned that there are no region*year interactions in Equations (1) or (2) in Peterson and Hanselman, but because the stock is well-mixed each year there may be no need for this interaction term. Because not all fishery sets that were depredated are recorded, Peterson and Hanselman estimated these using another GLMM. They used a zero-inflated Poisson distribution for this and I did not fully understand the motivation for it. I assume that the rationale was that some depredated sets may be recorded as ‘no problem’ but I was unsure if the reverse could occur (i.e. a false considerable whale predation

observation). I found the text on this model to be confusing. The Binomial and Poisson model structure should be clearly defined. I struggled with Equation (7) in Peterson and Hanselman. This should be more clearly defined and explained.

- For the longline survey the data used to estimate killer whale depredation effects seemed sufficient for the period 1998-present. At each station there were observations of whale presence and also evidence (e.g. straightened hooks) of depredation. Undetected presence did not seem to be an issue. Presence of sperm whales was not as reliable because they could be undetected.
- Killer whale depredation effects on survey longline catch rates were estimated by Peterson et al. (2013). This was a published paper that we did not review in much detail. We did spend more time on the submitted manuscript "Effects and implications of sperm whale depredation on longline surveys for Alaska sablefish". The data and methods seemed sufficient for estimating depredation effects. Pending the outcome of the manuscript submission I suggest the same modelling approach be investigated for killer whales, to replace the approach of Peterson et al. (2013).
- The above models used to estimate depredation effects are fairly complicated because the data are fairly complicated. Simulations were used in the sperm whale depredation submitted manuscript to examine the efficacy of the approach on the depredation parameter (λ) estimator. I suggest these simulations be extended to examine the effectiveness of the approach for correcting survey CPUE time series.

b. Should depredation estimates be used in the assessment model, and if so, how?

- Depredation should be accounted for in the stock assessment.
- The catch due to whales should be estimated and included in the assessment. Alternative whale catch streams should be considered.
- At the same time, survey and fishery CPUE indices should be adjusted for the loss due to whale depredations. The approaches proposed seemed reasonable. However, it was not clear to me why model-based depredation estimates were not used to adjust the longline survey CPUE to account for killer whale depredation. The approach taken was to simply drop depredated sets and I suspect that this will lead to a biased index if depredation is not spatially constant (or occurs randomly) or CPUE is not spatially constant. This need further research.

ToR d. Evaluation, findings, recommendations of areal harvest apportionment strategy as related to movement and optimizing spawning stock biomass

a. Are there biological reasons to adjust apportionment by area?

There can be biological reasons to adjust apportionment by area, and a basic one is to manage fisheries to maximize sustainable yield (MSY). If there are multiple spawning components in a stock and density-dependent processes in pre-recruit survival affect each component independently, or even approximately so, then it will be important to maintain all spawning components to maximize yield. Note that the sum of Beverton-Holt's is not the Beverton-Holt of the sum (or Ricker, etc.). Of course there are other reasons to maintain sub-stock structure and another biological reason to adjust apportionment by area is to avoid localized depletions.

However, in a well-mixed stock with little or no sub-stock structure then there is little biological justification to adjust apportionment by area. Tagging and other research indicate high sablefish movement rates throughout their lives which indicate a well-mixed stock. My reservation and uncertainty here is that little is known (or presented to RP) about the spatial spawning dynamics of this stock. Even though sablefish have high movement rates they could still behave something like salmon and return to discrete areas to spawn. I am aware that Tripp-Valdez et al. (2012) used geometric morphometrics and genetic analyses and found little difference between samples from the Bering Sea and Gulf of Alaska.

b. Is stability more important than close alignment to annual areal abundance changes?

In a well-mixed stock the spatial allocation of quotas may depend on socioeconomic considerations rather than biological ones. However, I consider that there is still uncertainty about sablefish substock structure and it is precautionary to assume that this may exist at some level and that harvest strategies that avoid local depletions are preferred.

ToR e. Recommendations for further improvements.

A session at the RP panel meeting, 'Recruitment, ecosystem considerations, future work', dealt with ongoing research, and I consider these under this ToR. Other recommendations were included throughout the previous ToRs and summarized in the next section.

The sablefish stock assessment produces very precise estimates of stock size but very imprecise median-term (4-10 years) projections because of uncertainty about recruitment. This has been highly variable for sablefish and the reasons for this are poorly understood. This uncertainty in recruitment is propagated into projections and creates substantial variability.

I am not a sablefish expert and I have no constructive criticisms for the ongoing research that was reviewed. However, the research programs that were outlined seemed extensive and I encourage them to continue.

There may be some benefit to modelling the time-series nature of recruitment to infer mean recruitment for projection purposes. There was no statistically significant autocorrelations or partial autocorrelations in the recruitment time-series in Table 3.14 in the sablefish assessment document (using years 1977-2015; see Figure 1 below), and temporal mean non-stationarity was only weakly significant . However, there may be evidence of non-stationarity in recruitment variance, with a reduction in time. Since 2002 there has been only one year with above average recruitment whereas this happened much more regularly before then.

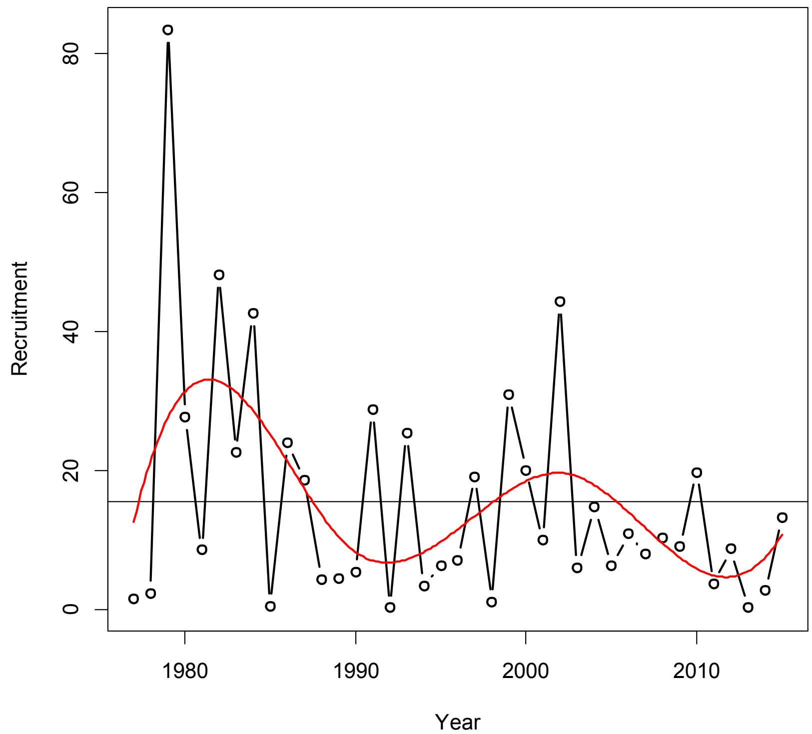

Figure 1. Sablefish recruitment time-series. The horizontal line indicates the series mean. The red line is a spline smoother based on 5 degrees of freedom. The ANOVA p-value for the spline smoother is 0.078.

Conclusions and Recommendations

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

Review panel Summary Recommendations

Short-term (next 2 years)

i) Develop alternative catch scenarios to provide bounds on uncertainty of historical catches for assessment model sensitivity testing.

ii) Use GIS-derived area by depth and region for calculations of stock indices, depredation and apportionment.

iii) Investigate if improved indices of juvenile fish abundance can be created from available survey data by selecting only stations <200m? Selectivity for such data may also be more clearly dome-shaped.

Longer term

i) Available IPHC and gully station indices should be considered for inclusion in the assessment.

ii) In the context of a single area model, consider Kriging or a spatio-temporal survey model (e.g. year + space + year*space) as an additional alternative for filling missing years of sampling in the domestic longline survey.

iii) Recent work to include killer and sperm depredation presence and evidence in the fishery logbooks is encouraged.

iv) Fishery CPUE standardization should be pursued further:
   a. Model based approach, standardizing for relevant factors affecting catch rates (season, location, etc.).
   b. Consider a stratified CPUE index if year*area interactions are important.
   c. Consider categorical rather than continuous variables for some factors (e.g. area-habitat definitions rather than continuous variables for longitude and latitude).
   d. Consider some factors as random-effects rather than fixed-effects.
   e. Consider a CPUE index workshop to evaluate and gain acceptance of proposed methods
   f. If continuing with the non-modelling framework:
      - Alternative methods for assignment of target species for multispecies fisheries are available e.g. based on species composition by trip or catch value among vessels fishing common areas/times. Maximum weight/numbers in the catch may not be the best available procedure. Consider possible bias in mis-specification of target species, and whether this procedure is useful or not in a detailed model context.
      - Data filtering may introduce bias and this should be considered in more detail. Factors used to filter could be accounted for in a standardization model.

v) Measurement error in age should be accounted for in growth model analyses and construction of age-length keys. Further consideration of the distribution of measurement errors (i.e. Geometric) is useful in the future.

vi) The current assessment is based on two time periods for growth (based on two temporally distinct sampling methods). Consider other growth models with time-varying parameters to assess if growth rates have changed over time.

vii) Continue work on skip-spawning and determine whether adjustment to the maturity ogive is required.

viii) Consider models of maturation data including time varying parameters.

ix) Use essential fish habitat (EFH) derived area, by depth and region, for calculation of relative abundance indices, depredation and apportionment (subject to validation of EFH).

x) Create a data document that summarises available data series and the methods used to create them. This would be valuable for review and as an archive (this would be useful, for example, for comparing indices of abundance and their modelling assumptions).

xi) The survey takes 80 days on average. Consider methods to address uncertainty due to fish movement within the time-frame of the survey, esp. in space-aggregated model.

xii) Account for AK sport fishery catches (these are increasing).

My additional Conclusions and Recommendations

1. Provide additional information on the size composition of discards and, in particular, potential differences in the kept and discard sizes.
2. Some catches probably were not reported during the late 1980's and the potential magnitude of this should be better described.
3. Assessments now document all removals including catch that are not associated with a directed fishery. While these catches were considered to be small (~2%), they were not included in the assessment model and the rationale for this was not described.
4. Provide additional information on fishery age composition sampling and analyses to raise samples to stock totals so that the quality of the age information could be better assessed. For example, time-series bubble plots of age compositions by management area, and the aggregated (i.e. raised) total age compositions, may provide insights into possible anomalous samples and measurements.
5. Longline fishery CPUE was based on sets that were determined to have targeted sablefish. This data selection procedure may result in a CPUE series that is too focused on hot spots and may suffer from hyper-stability.
6. Similar to point 4, provide additional information on survey age composition sampling.
7. The longline survey provides an important index in the stock assessment, and more description should be provided in the future on the survey results. This could include tables and figures of survey CPUE and CV's by strata and years. Methods to estimate total survey standard errors should be described.
8. There may be better ways of dealing with missing regional trawl survey data, such as a temporal-spatial model with year, area, and year*area effects. If the interaction effects are either small, random, or have some type of predictable behavior, then this model could be used to deal with missing areas.
9. The stock assessment would benefit by having a more reliable recruitment index, especially for very recent cohorts that are basically not sampled in the longline survey, and an improved analysis of the trawl survey information may provide this.
10. IPHC longline survey seems to be a lost opportunity for sablefish. Could length compositions be obtained from this survey using port sampling? If so, then the IPHC survey could potentially provide another recruitment index.
11. The assessment team should provide a graph of mean standardized indices – all on one graph.
12. The extensive tagging information for this stock was not directly considered in the stock assessment document. It should be.

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

Review panel Summary Recommendations

Short term

i) Model biomass estimates appear very precise due to the fixed M value, high precision on catch and reasonably consistent trends in available abundance indices. An important additional source of uncertainty may be the form of the stock-recruitment relationship.
   a. These could form the basis for major axes of uncertainty for sensitivity analyses that may be communicated to management.
   b. Consider placing a prior on M.

ii) Application of the calculated SNDR weighting to adjust the CV of the domestic longline survey should be considered for this assessment.

iii) Consider alternative time periods for the current regime of recruitment productivity and the effect on stock status and projections (e.g. the most recent 10 years). The choice of time period could be informed by recruitment covariates.

iv) Consider a sensitivity analysis with respect to Canadian landings in northern B.C. that assigns these to the most appropriate selectivity (e.g. longline).

v) Consider initializing the model from fishing rates estimated in the early time period of the model rather than an arbitrary rate.

vi) Additional model diagnostics should include tables (but possibly plots) of likelihood components for all sensitivities. Unweighted (via lambda) values subtracted from the base model are most useful.

Longer term

i) Explore replacement of sex-specific age-based selectivities with length-based selectivity to simplify the model.

ii) Develop an integrated spatial assessment model, including tagging data. In the interim, develop a prior for natural mortality rate (for example, based on tagging data).

iii) Include a Canadian component. All available evidence (tagging, comparison of abundance index trends) suggests that the Northern BC area also forms part of the assessed stock and efforts should be made to at least include appropriate BC catches in the assessment. Canada would then become an additional apportionment area for TAC calculations.

iv) External estimation of growth is subject to bias due to selectivity effects and is potentially best estimated in the model – particularly enabled by using available length at age data as a model input.

v) Use predictors of recruitment to define current regime (relevant historical recruitment period) for making projections. (see 2.1 iii)

vi) Investigate time-series models of recruitment to potentially improve short-term forecasting.
vii) Include a density-dependent stock-recruitment relationship in the assessment at least as a sensitivity scenario, and seriously consider the implications for current stock status and projections and bounds of certainty in the base assessment results.

Spatial model

i) It is important to define MSE performance measures that better indicate sociological and economic performance of the fishery including regional CPUE, catch/area of habitat, TAC variability, TAC underages, dollar yield, etc.
ii) Consider a spatially implicit model (i.e. areas as fleets). Since the stock is so well mixed, it may be simpler to model a single mixed population (no explicit spatial structure) and estimate area-specific selectivity and catchability by fleet (or potentially link these parameters by hyperpriors).
iii) Spatial modelling at the scale of the management areas (not just 3 coarse areas) could provide advice at a resolution appropriate to management.
iv) Update estimation of movement matrix using spatial model F's. Ideally, this would be done in a single model formulation.

My additional Conclusions and Recommendations

1. Examine for changes in maturity schedules. I suggest fitting the maturity model as a Binomial logistic regression with year factor interactions in the slopes and intercepts.
2. Similarly to the preceding comment, it would be useful to check if growth rates have varied further over time.
3. Investigate if measurement error in age is leading to an over-estimate of the VonB k parameter, and correct if necessary.
4. Adjustments for gear selectivity are required when fitting growth models.
5. Age-length keys have not adjusted for measurement error in length and age when inferring the distribution of length at age. This should be fixed.
6. Recruitment variability was fixed at $\sigma R = 1.2$. Check if this is still appropriate

ToR c. Evaluation, findings, recommendations on estimation and strategies for accounting for whale depredation

a. Are the data and methods used in estimating depredation effects sufficient?

Review panel Summary Recommendations

i) Available adjustments for killer and sperm whale depredation should be applied to both indices and catches.

ii) Develop alternative plausible depredation scenarios for model sensitivity testing (e.g. different plausible values for the depredation effect).

iii) Explore the relationship between the magnitude of survey CPUE and depredation by killer whales regarding the efficacy of deleting depredated sets. If killer whales target high CPUE stations, then simply deleting depredated sets may not adequately adjust for this effect.

<u>My additional Conclusions and Recommendations</u>

1. I suggest it is more appropriate to consider depredated fish as catch rather than M.
2. Whale depredation effects on the sablefish commercial fishery CPUE was based on a zero-inflated Poisson distribution for this, and I did not fully understand the motivation for this – in particular the zero-inflation part. The Binomial and Poisson model structure should be clearly defined. Equation (7) in Peterson and Hanselman should be more clearly defined and explained.
3. The GLMM approach used to estimate sperm whale depredation in the longline survey should be extended to killer whales.
4. Simulations should be conducted to evaluate the efficacy of proposed corrections for whale depredation on stock size indices and catches.

b. Should depredation estimates be used in the assessment model, and if so, how?

<u>Review panel Summary Recommendations</u>

i) Depredation should be included in the assessment.

ii) ABC recommendations should account for depredation.

<u>My additional Conclusions and Recommendations</u>

None

ToR d. Evaluation, findings, recommendations of areal harvest apportionment strategy as related to movement and optimizing spawning stock biomass

a. Are there biological reasons to adjust apportionment by area?

<u>Review panel Summary Recommendations</u>

The default biological objective of apportionment should be to achieve equal exploitation rate across the stock to maintain regional spawning biomass. In a highly mixed stock, apportionment may not have strong biological implications relative to the socio-economic implications. Therefore, apportionment strategies that emphasize stability are likely to be well suited to highly mixed stocks.

i) If spatial models are used for apportionment, alternative scenarios for movement should be considered (sensitivity analysis).
ii) Use MSE analyses to evaluate the performance of various apportionment strategies (e.g. regional economic performance).
iii) If apportionment is to be 'optimized' or evaluated in an MSE, explicit management objectives need to be provided.
iv) Investigate the implication of localized depletions for apportionment strategies.
v) Investigate whether certain areas disproportionately contribute to recruitment (e.g. higher recruits per spawner).
vi) Might consider apportionment by vulnerable biomass

My additional Conclusions and Recommendations

A basic biological reason to adjust apportionment by area is to manage fisheries to maximize sustainable yield (MSY). This is relevant when there are multiple spawning components.

b. Is stability more important than close alignment to annual areal abundance changes?

Review panel Summary Recommendations

In a highly mixed stock like sablefish, close alignment to areal abundance may be less important for biological productivity and economic considerations may take precedence.

My additional Conclusions and Recommendations

Tagging and other research indicate high sablefish movement rates throughout their lives, which indicate a well-mixed stock. My reservation and uncertainty here is that little is known (or presented to RP) about the spatial spawning dynamics of this stock. I feel there is uncertainty about sablefish sub-stock structure, and it is precautionary to assume that this may exist at some level and that harvest strategies that avoid local depletions are preferred.

ToR e. Recommendations for further improvements.

Review panel Summary Recommendations

Recommendations relating to recruitment and projections
Currently, the assessment is used to project abundance subject to highly uncertain recruitment. Additionally, sablefish recruitment has been relatively low over the most recent 15 years. There is the potential to improve the precision of short-term recruitment forecasts based on covariate data.

i) Continue to research predictors of recruitment including oceanographic conditions and early life survival, such as lipid density and isotope analysis.
ii) Include model structural uncertainty in management recommendations (e.g. high/low recruitment, high/low natural mortality rate scenarios)

iii) Continue to conduct ecosystem research that may be used to provide improved tactical fisheries management advice (e.g. definition of regimes, improved precision of short term recruitment forecasts, incorporation of environmental variables in long term recruitment forecasts, essential fish habitat).

iv) Continue research to improve understanding of spawning dynamics of sablefish (e.g. timing, location, its relationship with spatial distribution of recruitment).

<u>My additional Conclusions and Recommendations</u>

There may be evidence of non-stationarity in recruitment variance, with a reduction in time. Since 2002, there has been only one year with above average recruitment whereas this happened much more regularly before then.

Appendix 1: Bibliography of materials provided for review

Draft and Background Documents
Stock Assessment Review (STAR) Panel 2 for Bocaccio and China rockfish

Assessment reports and papers in progress:

CIE. 2009. Independent review reports, N. Klaer, M. Armstrong, and J. Casey.
https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Armstrong%20Alaska%20sablefish%20assessment%20review%20report.pdf
https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Klaer%20Alaska%20sablefish%20assessment%20review%20report.pdf
https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Casey%20Alaska%20sablefish%20assessment%20review%20report.pdf

Fenske, K., D.H. Hanselman, and T.J. Quinn II. *In prep.* A spatial assessment model for Alaska sablefish and the implications for the apportionment strategy.

Hanselman, D.H., C. Lunsford, and C. Rodgveller. 2009. Appendix 3C. Responses to CIE recommendations for the Alaska sablefish assessment. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., C. Lunsford, C. Rodgveller, and M. Peterson. 2014. Appendix 3C. Alaska sablefish research update. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., C. Lunsford, and C. Rodgveller. 2015. Assessment of the sablefish stock in Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., B. Pyper, and M. Peterson. *In prep.* Effects and implications of sperm whale depredation on longline surveys for Alaskan sablefish.
NPFMC 2015. Minutes from the November Groundfish Plan Team and the December Scientific and Statistical Committee relevant to sablefish.

NPFMC 2015. Minutes from the November Groundfish Plan Team and the December Scientific and Statistical Committee relevant to sablefish.

Peterson, M.J. and D.H. Hanselman. *In prep.* Estimation of the relative and absolute impacts of whale depredation on the Alaska longline fishery.

Shotwell, S.K., D.H. Hanselman, and I.M. Belkin. 2014. Toward biophysical synergy: Investigating advection along the Polar Front to identify factors influencing Alaska sablefish recruitment. Deep-Sea Res. II, http://dx.doi.org/10.1016/j.dsr2.2012.08.024.

Journal articles

Hanselman, D.H., J. Heifetz, K.B. Echave, and S.C. Dressel. 2015. Move it or lose it: Movement and mortality of sablefish tagged in Alaska. Canadian Journal of Fish and Aquatic Sciences. http://www.nrcresearchpress.com/doi/abs/10.1139/cjfas-2014-0251

Heifetz, J., J. T. Fujioka, and T. J. Quinn II. 1997. Geographic apportionment of sablefish, *Anoplopoma fimbria*, harvest in the northeastern Pacific Ocean. *In* M. Saunders and M. Wilkins (eds.). Proceedings of the International Symposium on the Biology and Management of Sablefish. pp 229-238. NOAA Tech. Rep. 130.

Peterson, M.J., F. Mueter, D.H. Hanselman, C.R. Lunsford, C. Matkin, and H. Fearnbach. 2013. Killer whale (*Orcinus orca*) depredation effects on catch rates of six groundfish species: Implications for commercial longline fisheries in Alaska. ICES J. Mar. Sci. doi: 10.1093/icesjms/fst045.

Background Materials

Coutré, K. M., A.H. Beaudreau, and P.W. Malecha. 2015. Temporal Variation in Diet Composition and Use of Pulsed Resource Subsidies by Juvenile Sablefish. Transactions of the American Fisheries Society, 144(4), 807-819.

Echave, K. B., D. H. Hanselman, M. D. Adkison, M. F. Sigler. 2012. Inter-decadal changes in sablefish, *Anoplopoma fimbria*, growth in the northeast Pacific Ocean. Fish. Bull. 210:361-374.

Echave, K. B., C. Rodgveller, and S. K. Shotwell. 2013. Calculation of the geographic area sizes used to create population indices for the Alaska Fisheries Science Center longline survey. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-253, 93 p.

Hanselman, D.H., W. Clark, J. Heifetz, and D. Anderl. 2012. Statistical distribution of age readings of known-age sablefish (*Anoplopoma fimbria*). Fish. Res. 131: 1-8.

Heifetz, J., D. Anderl, N.E. Maloney, and T.L. Rutecki. 1999. Age validation and analysis of ageing error from marked and recaptured sablefish, *Anoplopoma fimbria*. Fish. Bull. 97: 256-263.

Heifetz, J. and J. T. Fujioka. 1991. Movement dynamics of tagged sablefish in the northeastern Pacific Ocean. Fish. Res., 11: 355-374.

Kimura, D. K., A. M. Shimada, and F. R. Shaw. 1998. Stock structure and movement of tagged sablefish, *Anoplopoma fimbria*, in offshore northeast Pacific waters and the effects of El Niño-Southern Oscillation on migration and growth. Fish. Bull. 96: 462-481.

Kimura, D. K., and H. H. Zenger. 1997. Standardizing sablefish (*Anoplopoma fimbria*) longline survey abundance indices by modeling the log-ratio of paired comparative fishing CPUEs. ICES J. Mar. Sci. 54:48-59.

Lunsford, C. and C. Rodgveller. 2016. Cruise report OP-15-01. Longline Survey of the Gulf of Alaska and Eastern Bering Sea May 26-August 28, 2015.

Maloney, N. E. and J. Heifetz. 1997. Movements of tagged sablefish, *Anoplopoma fimbria*, released in the eastern Gulf of Alaska. *In* M. Saunders and M. Wilkins (eds.). Proceedings of the International Symposium on the Biology and Management of Sablefish. pp 115-121. NOAA Tech. Rep. 130.

Mateo, I., and D. H. Hanselman. 2014. A comparison of statistical methods to standardize catch-per-unit-effort of the Alaska longline sablefish. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-269, 71 p.

Rodgveller, C.J., J.W. Stark, K.B. Echave, and P-J. F. Hulson. 2016. Age at maturity, skipped spawning and fecundity of female sablefish (*Anoplopoma fimbria*) during the spawning season. Fish. Bull. 115: 89-102.

Rutecki, T.L. and E.R. Varosi. 1997. Distribution, age, and growth of juvenile sablefish, *Anoplopoma fimbria*, in Southeast Alaska. *In* M. Saunders and M. Wilkins (eds.). Proceedings of the International Symposium on the Biology and Management of Sablefish. pp 45-54. NOAA Tech. Rep. 130.

Sasaki, T. 1985. Studies on the sablefish resources in the North Pacific Ocean. Bulletin 22, (1-108), Far Seas Fishery Laboratory. Shimizu, 424, Japan.

Sigler, M. F. and J. T. Fujioka. 1988. Evaluation of variability in sablefish, *Anoplopoma fimbria*, abundance indices in the Gulf of Alaska using the bootstrap method. Fish. Bull. 86: 445-452.

Sigler, M. F. and C. R. Lunsford. 2001. Effects of individual quotas on catching efficiency and spawning potential in the Alaska sablefish fishery. Can. J. Fish. Aquat. Sci. 58: 1300-1312.

Sigler, M.F., C.R. Lunsford, J.M. Straley, and J.B. Liddle. 2007. Sperm whale depredation of sablefish longline gear in the northeast Pacific Ocean. Mar. Mammal Sci. doi:10.1111/j.1748-7692.2007.00149.

Sigler, M. F. 2000. Abundance estimation and capture of sablefish, *Anoplopoma fimbria*, by longline gear. Can. J. Fish. Aquat. Sci. 57: 1270-1283.

Additional references for this CIE report

Cadigan, N.G, J. Morgan, and J. Brattey. 2013. Improved Estimation and Forecasts of Stock Maturities using Generalized Linear Mixed Effects Models with Auto-correlated Random Effects. Fisheries Management and Ecology. 21(5), 343-356.

Cadigan, N.G. 2016. A state-space stock assessment model for northern cod, including under-reported catches and variable natural mortality rates." Canadian Journal of Fisheries and Aquatic Sciences 73(2), 296-308.

Cadigan, N. 2015a. Updates to a Northern cod (*Gadus morhua*) state-space integrated assessment model. DFO Can. Sci. Advis. Sec. Res. Doc. 2016/022. v + 58 p. available at http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2016/2016_022-eng.pdf

Cadigan, N. 2015b. Weight-at-age growth models and forecasts for Northern cod (*Gadus morhua*). DFO Can. Sci. Advis. Sec. Res. Doc. 2016/016. v + 19 p. available at http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2016/2016_016-eng.pdf

Goethel, D.R., Legault, C.M. and Cadrin, S.X., 2014. Testing the performance of a spatially explicit tag-integrated stock assessment model of yellowtail flounder (*Limanda ferruginea*) through simulation analysis. Canadian Journal of Fisheries and Aquatic Sciences, 72(4), pp.582-601.

Francis, R.C., 2014. Replacing the multinomial in stock assessment models: A first step. Fisheries Research, 151, pp.70-84.

Mohammed, Z. 2015. Modelling the Growth of Northern Cod. MAS thesis report. Memorial University of Newfoundland.

Tripp-Valdez, M.A., García-de-León, F.J., Espinosa-Pérez, H. and Ruiz-Campos, G., 2012. Population structure of sablefish Anoplopoma fimbria using genetic variability and geometric morphometric analysis. Journal of Applied Ichthyology, 28(4), pp.516-523.

Appendix 2: CIE Statement of Work

Statement of Work

National Oceanic and Atmospheric Administration (NOAA)

National Marine Fisheries Service (NMFS)

Center for Independent Experts (CIE) Program

External Independent Peer Review

Alaska Sablefish Assessment

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf). Further information on the CIE program may be obtained from www.ciereviews.org.

Scope

Potential changes to the Alaska sablefish assessment have been proposed. These changes include development of a new fishery catch per unit effort (CPUE) index, incorporation of estimates of whale depredation, and alternatives to the methods for apportionment of catch by area. These changes could have a significant impact on the assessment and on stakeholders. The authors request a review of these potential new changes to the assessment and guidance on best practices for implementation. The Terms of Reference (TORs) of the peer review and the tentative agenda of the meeting are below.

Requirements

NMFS requires three reviewers to conduct an impartial and independent peer review in accordance with the SOW, OMB Guidelines, and the TORs below. The reviewers shall have working knowledge and recent experience in the application of 1) Stock assessment/Population Dynamics; 2) Generalized Linear Mixed Modeling/Generalized Additive Modeling/Generalized Linear Modeling; 3) Fisheries Management, and 4) Spatially-explicit assessment modeling

Tasks for reviewers

- Review the following background materials and reports prior to the review meeting:

  NOAA. 2009. Independent review reports, N. Klaer, M. Armstrong, and J. Casey.

  https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Armstrong%20Alaska%20sablefish%20assessment%20review%20report.pdf

  https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Klaer%20Alaska%20sablefish%20assessment%20review%20report.pdf

  https://www.st.nmfs.noaa.gov/Assets/Quality-Assurance/documents/peer-review-reports/2009/2009_04_02%20Casey%20Alaska%20sablefish%20assessment%20review%20report.pdf

  Fenske, K., D.H. Hanselman, and T.J. Quinn II. *In prep.* A spatial assessment model for Alaska sablefish and the implications for the apportionment strategy.

  Hanselman, D.H., C. Lunsford, and C. Rodgveller. 2009. Appendix 3C. Responses to CIE recommendations for the Alaska sablefish assessment. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., C. Lunsford, C. Rodgveller, and M. Peterson. 2014. Appendix 3C. Alaska sablefish research update. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., C. Lunsford, and C. Rodgveller. 2015. Assessment of the sablefish stock in Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the GOA and BS/AI. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306 Anchorage, AK 99501.

Hanselman, D.H., B. Pyper, and M. Peterson. *In prep.* Effects and implications of sperm whale depredation on longline surveys for Alaskan sablefish.

NPFMC 2015. Minutes from the November Groundfish Plan Team and the December Scientific and Statistical Committee relevant to sablefish.

Peterson, M.J. and D.H. Hanselman. *In prep.* Estimation of the relative and absolute impacts of whale depredation on the Alaska longline fishery.

Hanselman, D.H., J. Heifetz, K.B. Echave, and S.C. Dressel. 2015. Move it or lose it: Movement and mortality of sablefish tagged in Alaska. Can. J. Fish. Aquat. Sci. 72(2): 238-25.

Heifetz, J., J. T. Fujioka, and T. J. Quinn II. 1997. Geographic apportionment of sablefish, *Anoplopoma fimbria*, harvest in the northeastern Pacific Ocean. *In* M. Saunders and M. Wilkins (eds.). Proceedings of the International Symposium on the Biology and Management of Sablefish. pp 229-238. NOAA Tech. Rep. 130.

Peterson, M.J., F. Mueter, D.H. Hanselman, C.R. Lunsford, C. Matkin, and H. Fearnbach. 2013. Killer whale (*Orcinus orca*) depredation effects on catch rates of six groundfish species: Implications for commercial longline fisheries in Alaska. ICES J. Mar. Sci. 70: 1220-1232.

Shotwell, S. K., D. H. Hanselman, and I. M. Belkin. 2014. Toward biophysical synergy: investigating advection along the Polar Front to identify factors influencing Alaska Sablefish recruitment. Deep-Sea Research Part II Topical Studies in Oceanography 107:40–53

- Attend and participate in the panel review meeting

- After the review meeting, reviewers shall conduct an independent peer review in accordance with the requirements specified in this SOW, OMB guidelines, and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus
- Each reviewer may assist the Chair of the meeting with contributions to the summary report, if required by the TORs
- Deliver their reports to the Government according to the specified milestone dates

Foreign National Security Clearance

When 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 reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact 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/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

The place of performance shall be at the contractor's facilities, and at the NOAA Fisheries Alaska Fisheries Science Center in Juneau, Alaska.

Period of Performance

The period of performance shall be from the time of award through June 30, 2016. Each reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Within two weeks of award	Contractor selects and confirms reviewers
No later than April 26, 2016	Contractor provides the pre-review documents to the reviewers
May 10-12, 2016	Panel review meeting
May 27, 2016	Contractor receives draft reports

June 10, 2016	Contractor submits final reports to the Government

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards:

(1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each TOR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract. Travel is not to exceed $23,000.

Restricted or Limited Use of Data

The contractors may be required to sign and adhere to a non-disclosure agreement.

1: Format and Contents of CIE Independent Peer Review Report

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether or not the science reviewed is the best scientific information available.

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs.

a. Reviewers must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

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

c. Reviewers should elaborate on any points raised in the summary report that they believe 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 report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The report shall represent the peer review of each TOR, and shall not simply repeat the contents of the summary report.

3. The report shall include the following appendices:

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

Annex 2: Terms of Reference for the Peer Review

Alaska Sablefish Assessment

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 of the analytical approach used to assess stock condition and stock status.

c. Evaluation, findings, recommendations on estimation and strategies for accounting for whale depredation

    a. Are the data and methods used in estimating depredation effects sufficient?

    b. Should depredation estimates be used in the assessment model, and if so, how?

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

    a. Are there biological reasons to adjust apportionment by area?

    b. Is stability more important than close alignment to annual areal abundance changes?

e. 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

May 10 –12, 2016

Contacts:
Security and check-in: Cara Rodgveller, Cara.Rodgveller@noaa.gov, 907-789-6052
Additional documents, Dana Hanselman, Dana.Hanselman@noaa.gov, 907-789-6626

Tuesday, May 10:
9:00 AM – 10:30 AM: **Introduction**
Topics:
Introductions, adoption of the agenda (and it's relation to TOR), industry concerns, overview of sablefish biology, fishery, history of assessment, prior CIE

10:30 AM – Break
10:45 AM – **Input data (TOR a**)
Topics:
Survey data – abundance indices, ages, lengths, growth, ageing error
Fishery data – abundance indices, ages, lengths, logbooks and observer data

12:00 PM – Lunch
1:00 PM -3:00 PM: **Current Assessment model (TOR b)**
Topics:
Model structure, likelihood formulations, data weighting

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

Wednesday, May 11:
9:00 AM – 10:30 AM: **Spatial issues (TOR c)**
Topics:
Tag data, areal apportionment of catch, movement, and spatially explicit models

10:30 AM – Break
10:45 AM – **Discussions**
12:00 PM – Lunch
1:00 PM – 3:00 PM: **Whale depredation (TOR d)**
Topics:
Estimates of depredation on the survey, fishery, and the effects on assessment

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

Thursday, May 12:
9:00 AM -10:30 AM: **Recruitment, ecosystem considerations, future work (TOR e)**
Topics:
Ecosystem considerations, recruitment research, others as requested

10:30 AM – Break
10:45 AM – Discussions
12:00 PM – Lunch
1:00 PM -3:00 PM: **Further discussion as needed**

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