Independent Peer Review Report

Henrik Sparholt

Dr.Sc. MSc.

Center for Independent Experts (CIE) Review of the Eastern Bering Sea Walleye pollock stock assessment

Henrik Sparholt
Dr.Sc. MSc.
Fredsvej 8a, 2840 Holte, Denmark
henrik.sparholt@gmail.com

Executive Summary

The Eastern Bering Sea Walleye pollock stock assessment is very data rich. It uses a "tailor"-made mathematical/statistical model of a very high quality. The assessment is a high quality basis for the scientific advice on management of the stock.

The data situation is unique on a global scale, because almost all commercial catch hauls are sampled (by two observers onboard). Thus, we have an almost exact knowledge of the catch. The Panel was considering whether an old-fashioned VPA in this particular case would actually be appropriate.

The new weight-at-age model put forward by the assessment team was basically sound, but the Panel questioned the precise structure of it, as it resulted in shrinking fish by cohort from 2014 (the last data year) to 2015 (the first forecast year) for the most important age groups in the fishery. This suggested shrinkage by age by the model was due to high recent weight-at–ages (in the years up to and including 2014) and the forecasted ones for 2015 using the mean year effect for the entire time series. Also, the forecasted weight-at-ages for 2016 and 2017 were low compared to the most recent years. It is suggested to model weight increments from one year to the next (by cohort) instead of just weight.

The stock definition seems largely right, although strong year classes seem (based on the bottom trawl survey data) now and then to enter the stock area gradually over several years, which might indicate that they are distributed outside the stock area in their early ages. Also the struggle in some years (e.g. 2011) of the commercial fleet to find the fish might indicate that there still are some issues with stock definition. A small part of the stock is in the Russian area and from a purely biological point of view should be included.

The bottom trawl survey and the acoustic survey are treated as two separate indices in the model. It might be useful to merge them somehow. Neither of them are covering the water column completely, but in a proper combination they might.

The model is built over many years of elaborations, and maybe therefore, not all parts of it were completely and precisely described in the provided documents.

As a medium-term future improvement of the assessment, it might be fruitful to include cannibalism explicitly in the model. For example, just a simple relationship between perhaps age 3+ biomass and natural mortality by ages 0, 1 and 2 would give a more precise recruitment series, which could be used to analyze climate effects on recruitment. Disentangling cannibalism from other factors influencing recruitment is regarded as useful. This might also improve the stock-recruitment model in the assessment.

Background

The Eastern Bering Sea pollock stock is one of the world's big commercial fish stocks, with stable catches of around 1.2 million tonnes per year over the past two decades. It is managed with a low fishing pressure to take special account of salmon bycatches and of providing food for sea mammals.

The stock assessment and management was last reviewed in 2010. The review then recommended that future reviews be more focused on specific issues rather than broad brush review of multiple topics. This time, the ToRs for the review were focused on specific issues (see ToRs in Appendix 2).

Description of the Individual Reviewer's Role in the Review Activities

The role of the reviewer is set out in the Center for Independent Experts (CIE) Statement of Work, attached here in Appendix 2, Attachment A. All three CIE reviewers were tasked with producing an independent report.

The meeting of the review was chaired by Anne Hollowed. Jim Ianelli was the lead scientist. It was held at the Alaska Fisheries Science Center (AFSC) at Sandy Point in Seattle, WA from May 16-19, 2016. Prior to this meeting the CIE reviewers were provided with a list of around 40 papers and reports, that represented the main work in regards to the assessment of the Eastern Bering Sea pollock. Most of these were previously published papers although some were new, being either in press or in review. Some of the documents were provided during the meeting. A number of presentations were given at the first two days of the meeting. These were focused on the issues mentioned in the ToRs and were:

- Introduction
- Background
- Observer Program
- Bottom trawl survey
- Acoustic-trawl survey and AVO
- Geostatistical applications of survey data
- Age and growth
- Council and management process
- Ecosystem modeling
- Assessment overview
- Stock structure
- Harvest strategy

The Panel asked questions and discussed each of these in relation to the ToRs. The third and fourth days were devoted to new assessment runs and specific topics discussed.

New analyses were done at the review meeting:

1. Mean age-at-length by area, NW vs SE, for bottom trawl survey data to see if one overall ALK is ok;
2. Standard deviation of the normalized residuals (SDNR) values were looked at for some alternative model runs;
3. Overfitting selectivity with hundreds of parameters was tested by bootstrapping basic data used to construct catch in numbers-at-age in order to isolate observation error and see if the process error left had realistic values;

4. M was estimated within the model (constant for age 3 and older) and it showed a much lower M (0.15 vs 0.30 used in the core model). For Bogolof Pollack – an unexploited stock since 1992 – Z (and thus M) is estimated to be 0.299; and
5. Re-weighting was analysed by the Panel. The weighting used in the core model is fairly reasonable maybe with a tendency that BTS and fisheries were underweighted each by a factor of about 2 and acoustic survey overweighed be a factor of about 2.

All discussions were conducted in a fruitful, open, direct and respectful way.

Summary of Findings for each ToR

Terms of Reference for the EBS pollock CIE review:

1. *Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment. In particular:*
    a. *Is the use of the index of acoustic backscatter from opportunistic (AVO) used appropriately?*
    b. *Is modeling observed numbers from surveys appropriate?*
    c. *How should data on mean body mass at age be best used for model projections?*
    d. *How should the various data sets be weighted?*
2. *Evaluate and provide recommendations on model structure, assumptions, and estimation procedures uses to assess stock status and condition. In particular:*
    a. *Are the selectivity approaches used for surveys and fishery appropriate?*
    b. *How should trans-boundary aspects of the resource be handled?*
    c. *What constraints, if any, should be placed on survey catchability?*
    d. *How should model projection alternatives be evaluated/presented?*
    e. *Anything else on which the reviewers care to comment.*
3. *Evaluate and provide recommendations on harvest recommendations provided by the NPFMC Tier system in the context of the 2,000,000 t BSAI cap and realized management recommendations*
4. *Evaluate the extent that ecosystem data are presently included in the assessment and recommend how and where improvements can be made.*

ToR 1

The scientists involved are to be commended for a very clear assessment report with very illustrative graphics that made it easy for the reviewers to learn the main features of the assessment. Details of the assessment model were mainly given in appendixes and were not always fully correct compared to the actual code of the program used (based implicitly on deduction and verbal statements by the experts behind it - the code itself was not made available to the Panel).

Generally, the input data for this assessment are very well sampled. The data are unique on a global scale in that there is an almost 100% sampling of the commercial catch, by the two observers on board almost every fishing trip. The assumption of perfect knowledge of the commercial catch in the old fashioned VPA type analysis might actually be almost fulfilled in this assessment. The Panel discussed whether it was still

appropriate to use process errors in the commercial catch data in this case, but without coming to a firm conclusion. Age determination and subsampling, however, still yield a small observation error. The many parameters used in the present model for selectivity, which might be seen as an over-parametrization, might be appropriate in this particular assessment.

There were some uncertainties about the time of the year represented in the weight-at-age in the stock data, whether it was at January 1st at spawning time or as a mean during the year. When these are multiplied with stock numbers at January 1st, at spawning time, or in the mid-year it matters. Ideally, these two types of data should match each other when combined. This is, however, a common pattern in fish stock assessment in general. Ideally, three matrices of weight-at-age should comprise the input data in assessment models: 1) w-at-age in the stock at January 1st, 2) w-at-age in the mature stock at spawning time, and 3) w-at-age during the year in the commercial catch.

ALKs are used by subarea for commercial catch, but not for the bottom trawl survey. This seems inconsistent. Some analyses were done with the survey data, which showed that average age-at-length in the survey differ between the NW and the SE area. The mean age-at-length were about 0.25 year higher in the NW than in the SE areas. Thus, it would seem prudent to use ALKs by subarea instead of a combined ALK for the total area for the bottom trawl survey data. This issue might also be important for future maturity-at-age estimations.

The index of acoustic backscatter from opportunistic vessels (AVO) is used appropriately. There is a good correlation with the acoustic survey, biomass-wise. The object function is described as comparing numbers. However, in the code it is biomass, which is also the best approach.

The new density dependent correction to the catchability in the BTS seems to have little implications for the model output, only a few percent changes to key parameters. However, the analysis behind it seems very sensible, and effects of density dependence seem to clearly be there. Maybe this is a rare case where we should go for a model simpler than our knowledge allows for – because the knowledge seems not to matter enough to justify the complication. However, the corrections are done outside the assessment model, and thus do not demand more parameters to be estimated by the model. It improves the survey biomass index, and that is valuable for the many other ways these surveys are used than in assessments, e.g. in catch curves analysis.

The acoustic survey has a dead zone of about 0.5m above the sea floor. The BTS trawl has a net opening of about 3 m, but due to the diving of pollock when herded, it seems to catch the pollock available in the water column from the sea floor and 15 m up. These two indices are used as separate indices. It might be useful to merge these indices so that they together cover the total water column, before putting them into the model. This will reduce the noise in the data due to changes in the annual mean distribution of pollock in the water column.

There might be an advantage in using biomass instead of numbers from the acoustic survey in the model, because it would avoid too much transformation back and forth between biomass and numbers. Each transformation adds noise to the model output. This could be examined in the future.

The ageing methods applied seem fine. Agreement in ageing between readers seems to be good for acoustic surveys and for commercial catches. For old fish, the bottom trawl survey age data seem more uncertain. This could be because the trawl survey goes into the “cool pool” areas with maybe more complicated growth patterns, and thus otolith readability problems. Variability of determining the first winter ring was mentioned as a problem. This could be investigated by looking at the otolith of age 1 fish caught at summer time where they easily can be identified by their length.

The modelled year and cohort effect on weight-at-age seems basically to be a good approach. However, probably due to good growth condition in recent years the weight-at-age in recent years were high. For the prediction years 2015 and 2016, this gave problems because the weight-at-age estimates for these years use the mean year effect from the whole time series and this resulted in fish shrinking in size from 2014 to 2015/2016 by cohort, for the most fished age groups. The Panel suggested that it would likely improve the modelled weight-at-age if weight increments from one year to the next (by cohort) was modelled rather than total weight.

Density dependent growth is normal in fish populations and this is how ecosystems generally function. In the material presented, there are cohort effects indicating density dependent effect, because abundant year classes have generally low weight. However, the year effect seems to not be related to stock biomass, so probably some environmental factors have over-shadowed the density dependent effects on a stock level. All this might be looked at further in the future. It might have implications for long-term simulations, and thus Fmsy calculations.

A constant by year maturity-at-age ogive is used. Time series of maturity-at-age would be useful to build up in order to improve the annual spawning stock biomass estimate and to link this to feeding condition and density dependent effects related to growth.

The weighting of the various data input to the model was analyzed by the Panel. It was found that the weighting used in the assessment is fairly reasonable, maybe with a tendency that BTS and fisheries were underweighted each by a factor of about 2 and acoustic survey overweighed by a factor of about 2.

It was mentioned that natural mortality maybe is increasing for older fish (spawning mortality like for Norwegian Spring Spawning herring from Beverton's old analysis), and the catch curves from surveys could tentatively indicate that occurrence, such that this might be the case for this stock.

ToR 2

The present assessment model has been around for several years, and various small changes have been made during that time. These are not always well described in the documentation presented.

Selectivity is allowed to be very flexible with many parameters involved. With so many selectivity parameters fitted, the model might be regarded close to a VPA type model, with the catch-at-age regarded as absolutely correct data. Overfitting might be an issue. It is, however, not the number of parameters that matters, but the "effective" number of parameters. A lot of Fs with low CVs does not influence the estimation of other parameters. With an almost complete sampling of the hauls of the commercial fishery, maybe it is actually appropriate to proceed with an old fashioned VPA type approach. However, there still are the subsampling and age determination uncertainties, which may lead to at least a small observation error. In conclusion, a closer analysis is needed to determine if the selectivity sub model can be improved. However, the current one seems to work quite well, so the potential for a further improvement to the overall model performance might be limited.

The trans-boundary aspects of the resource with the stock clearly occupying partly Russian areas would be good to improve. Had there been no international USA-Russia issue, the surveys would probably have expanded somewhat into the Russian zone, because the survey data for the few years where the Russian area was covered showed that this is a natural part of the distribution area of the stock. The fact that the Russian part is not included is, however, not a major problem for USA, because about 90% of the stock is in

USA territory. It is more of a problem for Russia, where sometimes only 25% of the “sub-stock” is in the Russian area. Obviously, the more cooperation with Russia on surveys, assessment, and management of this stock, the better.

The survey catchability by age or selectivity was forced to be sigmoid as large and old individuals were assumed to be well available to the trawl gear and distributed in the area covered by the survey. In case one would like to estimate natural mortality, as was done in some test runs made at the present meeting, it is very important to have a sigmoid curve and not “allow” the model to go for a dome shaped selection curve. However, this is a classic problem in modelling fish population that probably old experienced and fast swimming individuals have lower catchability than other individuals, but allowing models to estimate this generally make the models “drift” towards very low catchabilities of these old fish, and thus create a lot of them (so-called “paper fish”) in the virtual stock. Whether these many old fish really exist out there in the sea or not is difficult to determine, because due to the low catchability we should of course not see them in the catches. So the problem boils down to whether one believes there is a hidden pool of old fish in the sea or not. As we get more and more information from the sea by underwater cameras, etc. and still, to my knowledge, have never seen such hidden pools of old fish for any of the major commercial stocks in the temperate and boreal climate zone, the general tendency in fisheries science is to reject that hypothesis. Thus, the current model with its sigmoid selectivity curve lives up to that notion.

The Panel saw some potential in future analysis of considering a multi-fleet approach and a selectivity by season (A and B) for improving the commercial fishery selectivity part of the model.

The model projections presented various alternatives. Many of these were based on demands from the management advice guidelines and probably not up the Panel to evaluate. The diagram type approach used for the presentation of the alternatives seems very useful and gave a quick and clear impression of the results, probably easy for managers to work with.

According to the material presented to the Panel, cannibalism is very pronounced. MSVPA runs are available in the literature for this stock. Natural mortality (M) by age and year are available. These seem to provide useful knowledge, which could be dealt with specifically in the assessment. One way of doing this is to link predation M by age and year to the pollock spawning stock biomass, as done for Baltic cod (Fritz Köster, DTU AQUA, is a key scientist in this work). This relationship should then be used when making long term forecasts to estimate Fmsy and Bmsy. The S-R model might need to be revised and it would seem useful to consider R at the pre-cannibalism life stage (say at 5 cm length). In that way, climate and environmental influence on R can be disentangled from cannibalism. The present S-R model mixes the effect from cannibalism with any other factor influencing R. This might also be a way of seeing climatic influence on R more clearly than the present analysis presented to the Panel.

Fishing mortality is in the assessment given as F3-8. It was discussed whether it would be more appropriate with another way of expressing fishing pressure. One suggestion could be to use F5-9 as F on age 3 and 4 are very small in recent years, and thus not really recruited to the fishery. In cases like this where there is no juvenile fishery, one could also consider catch (in weight) divided by spawning stock biomass. There are also more sophisticated approaches around which could be looked into.

There is a quite strong retrospective pattern in the recent year’s assessments.

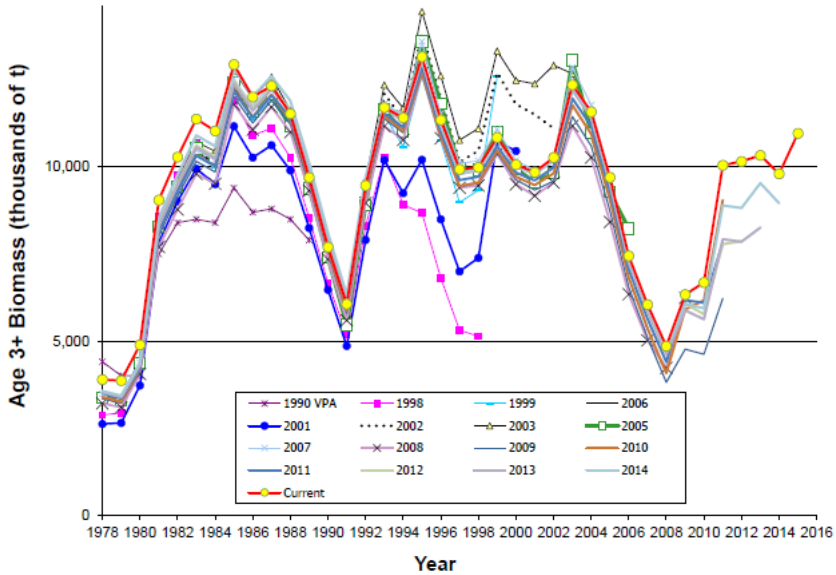

Figure 1.30. Comparison of the current assessment results with past assessments of **begin-year** EBS age-3+ pollock biomass, 1978-2015.

This retrospective pattern was consistent with the strong 2008 year class (y.c.) coming into the stock stronger and stronger by year, as mentioned under the stock definition section above. This 2008 y.c. is expected to influence the assessment only to a lesser extent in the future.

There were some discussions on the use and definition of the term B100% and why it was different from B0. The reason for the difference was because B100% is based on average recruitment observed in the past, while B0 is based on recruitment from the S-R model. The Panel questioned this definition of B100% (or BX% for that matter), as it seems to be an already "occupied" term and in the normal definition being equal to B0.

To base an S-R model estimation on the data for only a single stock is generally dangerous, because often there is not much information from a given stock to determine whether it is a B&H, Ricker, or Shepherd type curve. In the case of walleye pollock, there is some indication in the data that R is reduced at high SSBs, but there is also a lot of noise in the data. It is generally good to "borrow" knowledge from other stocks like done in meta-analysis in some of the famous papers by Ram Myers, and as done by ICES in its technical guidelines to good practice in choosing the S-R models in assessments. In the present assessment, a prior for steepness has been applied. However, it has been assumed that the curve is a Ricker one and steepness is not normally defined for Ricker curves. It was not completely clear to the Panel what definition of steepness was used in the present assessment. It was neither very clear where the exact prior value was origination from. The current Ricker prior used seems more as a penalty to prevent a too domed shaped S-R curve, and its basis was justified in an admitted slightly circular process looking at how it performs with the current data.

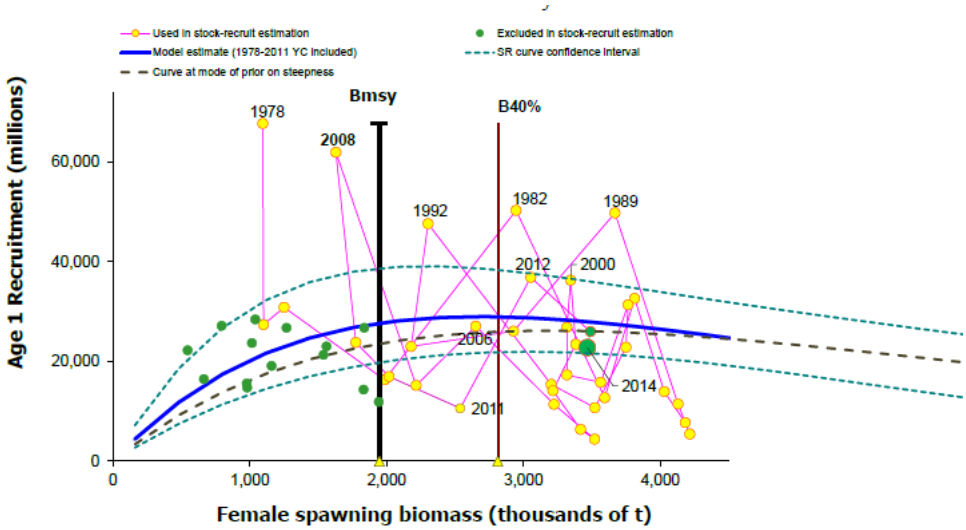

Figure 1.33. Year-class strengths by relative to female spawning biomass (thousands of t) for EBS pollock. Labels on points correspond to year classes labels (measured as one-year olds). Vertical lines indicate B_{MSY} and $B_{40\%}$ levels whereas the solid curve represents fitted stock-recruitment relationship (dashed lines represent estimated 90% credible intervals).

A run without this prior was presented in the assessment report. This resulted in much higher F_{MSY} values, near an F_{SPR} of about F18%, a value considerably higher than the default proxy of F35%. Obviously, this issue is of paramount importance to the advice given, because it influences the biological reference points used in the advice.

However, the resultant S-R model used seems quite sensible, given the data and knowledge available. The critical issue of how much recruitment reduces at high SSBs is well balanced (partly subjectively) against the general lack of clear evidence for any marine fish stock (to my knowledge) of a substantial Ricker type form of the S-R curve.

The suggestion above of including cannibalism directly into the assessment and look at R for stages prior to cannibalism might reveal more clearly what the S-R model should be, and thus resolve some of the current problems with the uncertainty in the S-R model.

ToR 3

A NPFMC Tier system considers whether a reliable pdf of Fmsy is available or not. In order to be a tier 1 stock, this pdf needs to be available. The Panel was not clear on what "reliable" precisely means in this context. The assessment did provide a pdf of Fmsy, but its reliability was questioned due to the uncertainty of the S-R model and the lack of cannibalism included (which could be regarded as a part of the S-R modeling). Density dependent growth, as well as the uncertainty about residual natural mortality, might further put the reliability of the pdf into question.

The assessment report presents projections corresponding to the needs for a tier 3 stock. These seem to be appropriate and done correctly, given the assessment model. Here it might be worth noting that due to the weight-at-age sub-model issues mentioned above, the biomasses forecasted for both yield and stock is probably underestimated.

ToR 4

Sea lions and salmon by-catch are taken into account in the management of this pollock stock. Therefore, the exploitation is substantially lower than that which results in maximum sustainable yield. It might be interesting for managers to see the "cost" in terms of foregone yield due to this deliberate "under-exploitation".

Generally, the fishery is a very "clean" fishery, with very low by-catches. Salmon seems to be the only problem, because even a small by-catch in the percentage of the pollock catch might mean quite a substantial take compared to the stock size of salmon. The peak by-catch of Chinook salmon has been 7% of the run to the coastal west Alaskan rivers, but it has been below 2% since 2011. This would probably, in most parts of the world, seem as a very low impact compared to the magnitude of the pollock fishery in the East Bering Sea ecosystem, but it is of course a political issue and not scientific one.

This pollock stock has the highest intensity of cannibalism I have ever seen for a marine fish stock. It is stated in the material provided that cannibalism is 2.5 – 5 million t per year, and that it constitutes about 1/3 of the food consumption of pollock. Atlantic cod is known for a high intensity of cannibalism, but cannibalism is only rarely above 1/20 of the food consumption of cod. Clearly, for pollock cannibalism must be a major population regulatory mechanism in the East Bering Sea ecosystem.

The time series of Euphausiids, an important food item for pollock, shows a peak in 2009 and this coincides roughly with a low stock size of pollock at the same time. This might indicate a top-down influence, and might thus contribute to the understanding of the density dependence in growth of pollock. This was not further considered in the material presented to the Panel. In the assessment report, it is speculated that this high Euphausiids abundance in 2009 could be the reason for the large 2008 year class of pollock, as this year class would have plenty of food. There is not much data to substantiate this notion. The BTS time series keeps increasing the estimate of the size of this y.c. even after the Euphausiid abundance has returned to normal levels, and there is no information presented about precisely at which life stage the pollock year class strength normally is determined.

Conclusions and Recommendations in accordance with the ToRs.

The Eastern Bering Sea Walleye pollock stock assessment is very data rich. It uses a "tailor"-made mathematical/statistical model of a very high quality. The assessment is a high quality basis for the scientific advice on management of the stock.

The only point which seems to need a careful consideration at this point in time is the weight-at-age prediction for 2015, 2016 and 2017.

There are some "low hanging fruits" which seem worth pursuing in the coming few years, around the stock-recruitment model and incorporation of cannibalism explicitly in the modelling and in the forecasting. Disentangling cannibalism from environmental and climate effects on recruitment hold the most potential for improving knowledge of the stock and the ecosystem functioning.

A longer term topic of importance relates to density-dependent growth. The observed lower growth of strong year classes and the inverse relationship between pollock stock size and abundance of Euphausiids, indicate scope for improvements of the assessment. Building up a time series of maturity at age to reveal density dependence could add knowledge to the ecosystem functioning.

The meeting was conducted in a very fruitful, open, direct, and respectful way.

The material presented both verbally at the meeting and in the provided documents were very clear and of a very high quality. The only slight exception being the technical description of the model, which was not in all parts complete and precise. Technical parts were quite extensively discussed at the meeting and potential issues resolved in a satisfactory way.

The NMFS review process

The NMFS review process is very well structured and effective. The documents provided and the presentation given were of a very high quality. The key scientists involved in the assessment were available and could answer the questions put forward by the Panel to a very satisfactory level. It was good that the ToRs were focused on specific issues. This helped the discussions on new and important aspects, and meant that the Panel was able to get to the "bottom" of the issues. At the same time, it did not prevent the Panel to raise other issues that were considered important.

The only area where I see a potential need for improvement is regarding the forecast scenarios and management advisory part. The guidelines for this were very complex, a bit opaque, and not very extensively described in the Summary report or in the documents provided. This part of the science basis of the management should probably have a review of its own, and not be part of a specific stock assessment. Alternatively, it could be made clearer to review Panels for individual stock assessments, where their responsibility in terms of review ends and "others" take over.

Appendix 1: Bibliography of materials provided for review

Draft agenda

EBS pollock 2015 assessment

Appendix 1.1: Stock structure of EBS pollock presented in September 2015

Overview: Harvest Specification and Inseason Management

Other background documents

Dec 2015 SSC Minutes on EBS pollock (Starts on page 9)

Nov 2015 Plan Team Minutes on EBS pollock (but see their Introduction to SAFE report for their summary)

SAFE report including other chapters/stocks from past assessments

2015 Recruitment Processes CIE review

Drinkwater, Fernandes, Simmonds, Smith

Management, observer program, etc

North Pacific observer program's 2016 Observer Sampling Manual.

Cahalan, J., J. Gasper, and J. Mondragon. 2014. Catch sampling and estimation in the federal groundfish fisheries off Alaska, 2015 edition. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-286, 46 p. Document available online

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NPFMC Fisheries management plan. http://www.fakr.noaa.gov/npfmc/fmp/bsai/BSAI.pdf

Survey documents

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2010 CIE reviews

Darby, Smith, Stokes

Appendix 2: A copy of the CIE Statement of Work

Statement of Work

External Independent Peer Review by the Center for Independent Experts

Assessment of the pollock stock in the Eastern Bering Sea

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The annual assessments of the pollock stock in the EBS have used similar model configurations for a number of years now. Review is needed to identify areas where the assessment can be improved and aspects that would lead to best-practices for near term catch recommendations. The SSC has requested evaluation of environmental covariates for relative cohort strength, and temperature effects on survey catchability and/or selectivity. Other evaluations on the effect of alternative catch scenarios (i.e., if the catch was equal to the ABC) would be useful to help provide context to the current management practices (in which catches are in most years constrained by a 2 million t limit for all groundfish in the BSAI region). 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. CIE reviewers shall have working knowledge and recent experience in the application of stock assessment methods in general, and preferably Stock Synthesis in particular. Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting ***scheduled in Seattle, WA during May 16-19, 2016 (or one of the subsequent weeks).***

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 (full name, title, affiliation, country, address, email) 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 other information concerning 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., 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/

http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or online) to the CIE reviewers the 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 Lead Coordinator on where to send documents. 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. The CIE reviewers shall read all documents in preparation for the peer review.

Assessment of the walleye pollock stock in the eastern Bering Sea (~100 p.), including a stock structure evaluation provided as an appendix)

CIE review of the recruitment processes group conducted June 2015

Comments on the final 2015 EBS pollock assessments by the Plan Team and SSC

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs cannot 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 herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can

contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

The review meeting will include three main parts:

1. A series of presentations with follow-up questions and discussions by CIE reviewers, to be chaired by an AFSC scientist.
2. Any real-time model runs and evaluations conducted in an informal workshop setting, as proposed by the CIE reviewers.
3. Initial report writing by the CIE reviewers, with opportunity for additional questions of the assessment author.

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 may assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. Each CIE reviewer is not required to reach a consensus, and should provide a brief summary of the reviewer's 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 ***scheduled at the Alaska Fisheries Science Center in Seattle, WA during May 16-19, 2016.***
3) Participate at the peer review meeting ***tentatively scheduled at the Alaska Fisheries Science Center in Seattle, WA during May 16-19, 2016*** as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
4) No later than ***June 3, 2016***, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Dr. Manoj Shivlani, CIE Lead Coordinator, via email to mshivlani@ntvifederal.net, and CIE Regional Coordinator, via email to Dr. 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**.

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

April 4, 2016	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
April 25, 2016	NMFS Project Contact sends the CIE Reviewers the pre-review documents
May 16-19, 2016	Each reviewer participates and conducts an independent peer review during the panel review meeting
June 6, 2016	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
June 20, 2016	CIE submits CIE independent peer review reports to the COTR
June 27, 2016	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: This 'Time and Materials' task order may require an update or modification due to possible changes to the terms of reference or schedule of milestones resulting from the fishery management decision process of the NOAA Leadership, Fishery Management Council, and Council's SSC advisory committee. A request to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent changes. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on changes. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not 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 and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (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) The CIE report shall completed with the format and content in accordance with **Annex 1**,

(2) The 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 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 CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

Allen Shimada
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
Allen Shimada@noaa.gov Phone: 301-427-8174

Manoj Shivlani, CIE Lead Coordinator
Northern Taiga Ventures, Inc.
10600 SW 131st Court, Miami, FL 33186
mshivlani@ntvifederal.com Phone: 305-968-7136

Key Personnel:

NMFS Project Contact:

James Ianelli, Alaska Fisheries Science Center
NMFS/NOAA Building 4
7600 Sand Point Way NE
Seattle WA 98115
Jim.ianelli@noaa.gov

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, and specify whether the science reviewed is the best scientific information available.
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 in which the weaknesses and strengths are described, 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 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, 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 weaknesses and strengths of the science reviewed, 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 the following appendices:

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.

Annex 2: Terms of Reference for the Peer Review

Assessment of Walleye pollock in the Eastern Bering Sea

5. Evaluation, findings, and recommendations on quality of input data and methods used to process them for inclusion in the assessment. In particular:
    a. Is the use of the index of acoustic backscatter from opportunistic (AVO) used appropriately?
    b. Is modeling observed numbers from surveys appropriate?
    c. How should data on mean body mass at age be best used for model projections?
    d. How should the various data sets be weighted?
6. Evaluate and provide recommendations on model structure, assumptions, and estimation procedures uses to assess stock status and condition. In particular:
    a. Are the selectivity approaches used for surveys and fishery appropriate?
    b. How should trans-boundary aspects of the resource be handled?
    c. What constraints, if any, should be placed on survey catchability?
    d. How should model projection alternatives be evaluated/presented?
    e. Anything else on which the reviewers care to comment.
7. Evaluate and provide recommendations on harvest recommendations provided by the NPFMC Tier system in the context of the 2,000,000 t BSAI cap and realized management recommendations
8. Evaluate the extent that ecosystem data are presently included in the assessment and recommend how and where improvements can be made.

Annex 3: Tentative Agenda

CIE Review of the Eastern Bering Sea Walleye pollock stock assessment

Alaska Fisheries Science Center

7600 Sand Point Way NE, Seattle, WA 98115

May 16-19, 2016

Building 4; Room 2143 (or TBD)

Review panel Chair/facilitator: Anne Hollowed (Anne.Hollowed@noaa.gov)

Lead assessment author: Jim Ianelli (Jim.Ianelli@noaa.gov)

Security and check-in: Jim Ianelli

Sessions will run from 9 a.m. to 5 p.m. each day, with time for lunch and morning and afternoon breaks. Discussion will be open to everyone, with priority given to the panel and senior assessment author.

Monday, May 16

Preliminaries:

0900 Introductions and adoption of agenda	Chair

Data sources (current and potential):

0910 Overview of data types used in the assessments	Jim I.
0920 Catch accounting system and in-season management	AKRO SF Division
0950 Observer program	Observer program
1020 Break	
1030 EBS trawl survey	Stan Kotwicki
1115 Acoustic trawl survey	Chris Wilson
1200 Lunch	
1300 Age determination	Tom Helser
1330 Age composition and mean-weight-at-age data	Jim I.

Assessment models:

1400 Assessment details	Jim I.
1500 Break	
1510 Management background and issues (ToR 3)	Diana Stram (NPFMC)
1610 Ecosystem application in assessment (ToR 4)	TBD
1640 Discussion	Panel

Tuesday, May 17

0900 Assessment model review Jim

1000 Topics as needed, discussion and model clarifications

1300 Presentation of model updates, further requests and discussions

1700 Adjourn

Wednesday, May 18

Review of models assigned the previous day

Discussion, real-time model runs

Assignments for models to be presented the following day

Thursday, May 19

Review of models

Discussion, real-time model runs

Report writing (time permitting)

Appendix 3: Panel Membership or other pertinent information from the panel review meeting

Name	Organization	e-mail
Stan Kotwicki	NMFS – AFSC	Stan.Kotwicki@noaa.gov
Martin Dorn	NMFS – AFSC	Martin.Dorn@noaa.gov
Diana Stram	NPFMC Staff	Diana.Stram@noaa.gov
Kirstin Holsman	NMFS – AFSC	Kirstin.Holsman@noaa.gov
Darin Jones	NMFS – AFSC	Darin.Jones@noaa.gov
James Thorson	NMFS – AFSC	James.Thorson@noaa.gov
Ed Richardson	At Sea Processors Assoc.	erichardson@atsea.org
Chris Wilson	NMFS – AFSC	Chris.Wilson@noaa.gov
Steve Barbeaux	NMFS – AFSC	Steve.Barbeaux@noaa.gov
Craig Faunce	NMFS – AFSC	Craig.Faunce@noaa.gov
Steve Martell	Sea State	Steve@seastateinc.com
Sandi Neidetcher	NMFS – AFSC	Sandi.Neidetcher@noaa.gov
Jim Ianelli	NMFS – AFSC	Jim.Ianelli@noaa.gov
Alex De Robertis	NMFS – AFSC	Alex.DiRobertis@Noaa.gov
Nate Lauffenburger	NMFS - AFSC	Nate.Lauffenburger@noaa.gov
Kresimir Williams	NMFS – AFSC	Kresimir.Williams@noaa.gov
Robert Lauth	NMFS – AFSC	Bob.Lauth@noaa.gov
Anne Hollowed	NMFS – AFSC	Anne.Hollowed@noaa.gov
Chris Francis	CIE	chris.francis@clear.net.nz
Henrik Sparholt	CIE	henrik.sparholt@gmail.com
Patrick Cordue	CIE	plc@isl-solutions.co.nz