Reviewer Report to the Center for Independent Experts on the Gulf of Alaska Pollock Stock Assessment

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Prepared for:
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Executive Summary

This report is an independent review of the assessment of Gulf of Alaska walleye pollock conducted for the Center for Independent Experts (CIE). My review including the documents and presentations that were submitted for review prior to and during the meeting held on May 22-25, 2017, in Seattle, Washington, at the Alaska Fisheries Science Center (AFSC).

I have a high degree of confidence in the model, with the available data, to produce reliable estimates of stock status. My degree in confidence is based on several factors: 1) there are a large amount of high quality data being collected with good scientific rigor (fisheries data, survey data, fish, lengths, ages), 2) the model is a standard separable catch at age model, and therefore contains reasonable and commonly held assumptions for fisheries models, and 3) the model fits the data well. I conclude that the science reviewed meets a high standard, incorporates the best scientific information available, that the assessment team made considerable effort to make the best use of the data available, and in my opinion, the results provide a sound basis for management advice.

The report outlines a few concerns and makes several recommendations for future research. The Terms of Reference (ToR) 1, 2 and 4 were met. ToR 3 (spatial GLMM) was not fully met as tentative results were presented. A separate stand-alone document written as a technical report or primary publication would be needed to fully meet ToR 3. ToR 5 was partially met, but a more rigorous comparison should be made to fully meet this ToR, and before the assessment and management team should consider switching model platforms. At this time I do not recommend changing model platforms. I encourage a deeper consideration of vision, assessment research and development, and mentorship at the AFSC. In my view, scientists which have built a custom assessment model have a great ability to critique work and develop new methods.

My greatest concern is the decrease in the weight at age of pollock in the past 3 to 4 years. This decrease has big implications for estimates of spawning stock biomass, recommended harvest levels, and the future productivity of the population. I urge the assessment team to research the potential of any sampling bias, and if this can be ruled out, further research on what may be causing the decrease in weight at age. It is too easy to say it is due to density dependence or some change in the environment without digging deeper to find the correlations and explore possible mechanisms.

I suggest that two new sections be added to future assessment reports, a section on the history of the fishery (data collections and how data has been treated, dropped or added), and a section on uncertainty which discusses all types of uncertainty in the assessment (e.g. data collection, model assumptions). Much of this information is present in the current report, but I think collating it into a separate section is warranted. I also suggest that the Ecosystem considerations be broadened to consider the effects of environmental change, and that changes in the food web and environment be more fully integrated into

the assessment report with a better introduction and discussion of impacts on management advice and risks to the stock.

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1.0 Background

This document contains my independent review of the assessment of Gulf of Alaska walleye pollock. A Center for Independent Experts (CIE) review meeting was held May 22-25, 2017, in Seattle, Washington, at the Alaska Fisheries Science Center. Prior to the meeting, the review committee was provided with a Statement of Work (Appendix 2), including the Terms of Reference (ToR). Assessment documents (Appendix 1) and background material were provided via Google Drive during the two weeks before the meeting. During the meeting there was a general consensus among the CIE reviewers that the assessment was done with a high level of professionalism and care. As noted in my comments on the review process, the meeting was more casual in nature, which had the positive effect of creating a collegial environment for discussion often found in working groups. This is in stark contrast to the way some CIE reviews of National Marine Fisheries Service (NMFS) assessments are conducted in other regions. The Terms of Reference are for my report and its content and not for the assessment scientists, which is sometimes the case in other reviews and an important distinction. In the sections that follow, I outline my positive and negative impressions and critique the detail and scope of the science to date. Where possible, I offer suggestions and areas of future thought and research.

2.0 Individual Reviewer Activities

Prior to the meeting, I reviewed the assessment and background documents provided for the review. All three reviewers equally shared the responsibility of a complete, thorough and independent review of the Gulf of Alaska walleye pollock (hereafter referred to as pollock). I participated in the review meeting in Seattle, Washington, from May 22-25, 2017, at the Alaska Fisheries Science Center. The other two CIE reviewers were Cynthia Jones from Old Dominion University, and Yong Chen from the University of Maine. The assessment was led by Martin Dorn with co-authors K. Aydin, B. Fissel, D. Jones, W. Palsson, K. Spalinger and S. Stienessen. Review panel membership and a list of participants are listed in Appendix 3. During the meeting, the Panel asked questions of clarification and critiqued the work. Panel members were required to prepare their individual, independent reports after the meeting addressing the ToRs as outlined in Appendix 2.

3.0 Review of the Gulf of Alaska Pollock Stock Assessment

Overall the quality of the data flowing into the current model is high, the model structure and treatment of the data is standard, and the model diagnostics do not have any major ‘alarm bells’ or ‘red flags’, leading me to conclude that the assessment meets a high scientific standard. The quality of the assessment is in part due to the interest, willingness, time and support the assessment team has to pursue research questions which are directly related to data quality inputs and new techniques in data analyses. This point

cannot be overemphasized. If the Alaska Fisheries Science Center (AFSC) wishes to produce world-class stock assessments, research plays an important part and should continue to be supported. Most of my recommendations and concerns are strategic as opposed to tactical. It appears that the process of data collection and stock assessment are in good hands, so I have few concerns in that area. Therefore, I take the opportunity to step back and make a few comments on the bigger picture.

History of assessment

Pollock of the Gulf of Alaska (GOA) have been commercially exploited since the 1970s. Stock assessment progressed through several stages starting with simple analyses of survey trends and CPUE (1977-1981), then several catch at age models first with CAGEAN (1982-1988), stock synthesis (1989-1998), and ADMB (1999-present). There are a large amount of high quality data and a fairly long history of assessment, which have led to the current assessment, and to questions about what the future assessment of the Gulf of Alaska pollock should look like (ToR 5).

Stock assessment typically takes as much data as is available (meeting some minimum standard of quality) into a model to produce an estimate of stock status with appropriate estimates of uncertainty. There is often a focus on terminal stock status, which is justifiable, as this is what is used for management advice, but the historical trends, and by extension, how the data have been treated are also of great importance affecting such things as reference points, the identification of productivity regimes, etc. This brings me to my first point. The history of the fishery, data collection and stock assessment deserves a bit more attention in the report. As a stock assessment matures, I think more attention should be given to its history. The reason is that at various points decisions were made about the data, about the fishery, about surveys, vessels, etc. A reviewer, such as myself, does not want to question all the decisions of the past, but rather have access to key decisions, so that if and when detective work is required then past decisions can be reevaluated in the context of new data. I appreciate “historical retrospective analysis” (a laying over of SSB trends for each assessment cycle; figure 1.36), and I am a bit concerned there is an upward trend in terminal estimates of biomass. I do not wish to be prescriptive, but I think adding a section on the assessment history which includes a discussion of changes in the fishery and how data have been treated in the past. This new section could include the current *Data sets considered but not used* section.

Density dependence and demography

At the very heart of fisheries science is the concept of compensation. If the population density is low, then growth and survival should be high and conversely when densities are high then growth should slow and per capita survival rate should decrease. The state of the environment, that is, both the physical environment and the food web also affects these factors making it all difficult to untangle. There appears to be a large year-class of pollock in 2012, which is likely affecting the current dynamics of the stock, the fit of the model and harvest projections. I encourage looking for evidence of detecting density dependence within the data. This line of inquiry may lead to an understanding of *why* weights at age are decreasing, or *what* is causing variation in maturity at age and length.

Simple graphs of a given demographic variable, such as weight at age in the survey, versus an estimate of population size (numbers or SSB) would be interesting. Is there a negative correlation? Is this variation more explained by changes in the environment (e.g. sea surface temperature in March) or the density of pollock? One could argue that this only tests for density dependence between cohorts and not within a cohort, which is true, but I would still say it is useful to know. I am happy to see that the assessment team is exploring different patterns in natural mortality across age and propose to estimate changes in natural mortality over time. Could some of the annual variation in natural mortality be attributed to changes in these vital rates? I admit it is a hard nut to crack, but I encourage further research in this area. A multitude of time and age varying functions of natural mortality can be fitted to the data, but unless we can tie those changes back to some process, be it predators, environment or demography, it doesn't help a lot in terms of projections and management advice.

Environmental change and assessment

I am not sure that scientists and managers fully appreciate how the calendar affects what we do, the data we collect, and the decisions we make. Spring came late in Vancouver, BC, and I have no idea of its timing in the Gulf of Alaska. Dealing with long term changes in the ocean due to climate forcing will be the great challenge of future fisheries science and management. We are using long term averages of recruitment, and weights at age and often use reference points like MSY that we assume are "stable". Predicting even the near term future in fisheries is a great challenge. So in this section I encourage a deeper exploration into what environmental factors may be affecting key data inputs into the model. Specifically, I am concerned about the phenology of the GOA system (e.g. temperature, algal blooms) relative to the timing of peak spawning and bottom trawl and acoustic surveys. My biologist's intuition leads me to think that a shift of a few weeks in any of these factors would have large effects on data inputs like lengths or weights at age and possibly survival. To tie this back to the previous section, are recent decreases in the weights at age due to density dependence or to a shift in the timing of spawning? Should we be examining the variation in the timing of the bottom trawl survey and its potential impact on the data in the absolute (relative to the calendar) or relative to the timing of some other oceanographic or biological factor (e.g. temperature or spawning)? Statements in the assessment report like: "Changes in the timing of spawning could also affect maturity at age estimates", and "Changes in weight-at-age have potential implications for stock determination and harvest control rules" (first and last paragraphs on page 61), and "Due to recent and relatively rapid changes in environmental conditions affecting growth" (first full paragraph on page 64), indicate that the assessment team is already considering such issues. I encourage them to dig deeper into the data they have and utilize auxiliary data to examine correlations between environmental factors and key demographic parameters.

Changes in variables like pollock growth, maturity, and recruitment might be driven by other environmental variables (e.g. PDO, SST, timing of the algal bloom). This type of research is at the intersection of stock assessment science and fisheries oceanography, and I think it is an important area for future research, especially as scientists and

managers face climate change. What is the autocorrelation in a time series like recruitment (6-year lag?), or weight at age? Can this be correlated with other oceanographic signals? Perhaps a fast Fourier or wavelet analysis could be done. The key, of course, is to link any correlation or trend back to a demographic variable in the population (e.g. length at age). A quick look at the Eastern Bearing Sea pollock assessment shows that some good work is being done in this area (Wespestad et al. 2000; Mueter et al. 2006; Mueter et al. 2011). I have not read these, but appreciated Clark and Hare (2002), and think it is an important step in the right direction.

Assessment research and development

The section on model development and comparison is useful. It demonstrates that the assessment team is continually developing new methods and techniques to treat the data better. I do not comment on the benefits and disadvantage of specific model formulations, as that appears to be done in other parts of the assessment review process, by the SSC in particular. The random effects model for weights at age, described by Ianelli et al. (2016) and applied to this stock, looks like a useful improvement. If the assessment team chooses to continue to model weights at age this way, a section similar to Appendix 1a of Ianelli et al. (2016) should be added to the main body of the assessment report for GOA pollock. The use of a delta-GLM method for estimating pollock biomass from the ADFG trawl survey also seems like a good improvement to the assessment. Understanding net selectivity of the acoustic biomass and age composition estimates is an important research area, and I agree with the tentative use of the results (i.e. not incorporated directly into the current assessment).

I appreciate the work done on a spatial GLMM of the bottom trawl survey. This looks like an important area of research, however, I would like to interject a note of caution. Design based statistics, like stratified mean numbers per tow, area-swept biomass estimates and their associated variances are straight forward to calculate, understand and carry forward into an assessment model. The assumptions are clear and the statistics simple. The same cannot be said for a spatial GLMM. I am left wondering to what degree the assumptions in the analysis remain with the separate spatial GLMM model external to the assessment model (e.g. knots and the like), and what is carried forward. The lines have always been a little blurry between what is data preparation or “massaging”, and the incorporation of data and analyses which are fully integrated into the model – thus carrying forward the full set of variation *and* assumptions to the parameters, state variables, recommendations, decisions, and the evaluation of risk. The general philosophy should be maximizing the signal to noise ratio, while incorporating as much of the uncertainty (and assumptions) as possible so that decisions can be made with a thorough analysis of risk. Enough said, I think a spatial GLMM is generally a good idea, I am just trying to fully think through the consequences.

I am a bit confused about how the conversion from length to age is handled. I understand there are several age-length keys for different regions and seasons, but I am under the impression that the length to age conversion is done without error. Any fish which is aged has an associated error which is incorporated into the model (Table 1.13), but is there a

similar transition matrix applied to all the samples where you only have length? If not, this would add a lot of uncertainty to the numbers at age and the final model estimates of state variables, which could be good as there is some concern about the potential impacts of the food-web and environment on growth. I didn't have a chance to look at the code.

Stock Synthesis (SS3) and ADMB model comparison

Comparing models and model output is always a good idea, because it causes a deeper examination of the assumptions of the model and how the data are treated. So I commend the assessment team for this work. Concordance between models, does not, of course, guarantee accuracy or "truth", but it is comforting and perhaps indicates robustness to assumptions. As modelers, we tend to think and, to some extent, fool ourselves into believing the model is data driven, and to some extent this is true. However, a balance between data and assumptions exists, and we gain a better understanding about how our assumptions are affecting our perception of stock dynamics when we apply different model structures to the same data. I think the assessment team can do more here, particularly examining assumptions and then comparing and contrasting residual patterns. My guess is that most age-structured assessment models will give similar results, but the differences can be illuminating. I encourage a deeper consideration of vision, assessment research and development and mentorship at the AFSC. The current model could be rewritten in another language or platform (R, TMB) by another scientist and in the process many assumptions would be questioned and reevaluated. In my view, scientists which have built a custom assessment model have a greater ability to critique work and develop new methods. In short, what does the future of assessment science look like at the AFSC?

Ecosystem considerations

I appreciate the work done on understanding the GOA ecosystem. It is, of course, a daunting task for such a large and variable system, but one which must be undertaken with increasing rigor. The "Ecosystems considerations" section in the assessment report currently reads as an appendix or an afterthought. I would like to see more of an integration of the purpose of this section and how ecosystem changes can affect pollock assessment and management advice. I also think it should be raised to the level of a future ToR. The first step is describing the ecosystem, the second is understanding the dynamics of the relationships, and third is understanding the consequences. To this end, I think an introduction about the relevance of ecosystem research to fisheries management is very important. How are results from an ecosystem analysis typically used? Does it add context and perhaps a cautionary note to advice typically based on single species stock assessments? Or do people just look at the results and say, "yes, thanks" and move on? In my experience it has been more the latter, but a good introduction might convince otherwise. The single species model is very tactical, in that it provides next year's advice. Ecosystem models, of all shapes and sizes and styles, can help develop long term strategies for both research and management (e.g. how would we adjust management if the PDO switches?).

What was presented was diet data, the population trends of several predators, a mass-balance ECOPATH model, and some ECOSIM results. While this is a step in the right direction, there is a lot more that could and should be done. I don't think ECOPATH holds the corner on the market, and because it requires a lot of data and is highly parametrized, I often feel it will never do more than provide context. There is a lot of territory to be explored between a full ecosystem model and a single species model. A four or five species stock assessment model linked with predation functions as in Hollowed et al. (2000) should be done again, with perhaps some more bells and whistles in terms of estimating functional responses from diet data. What is the difference in SSB, F and reference points when compared with a single species model? Now *that* provides some information about whether tactical advice (harvest levels) should be altered given ecosystem changes. If they are the same, then maybe we don't need to be so worried about the effects of predators. But, we have to keep considering and testing these assumptions.

I am a food-web ecologist, and am very much interested in trophic interactions and the flow of energy through the system, but I think a lot more work can be done at a lower level of complexity which could have a greater impact on management advice. I encourage exploring how environmental drivers are affecting the stock of interest (pollock). Actually these two approaches go hand in hand. One might argue that if we see large temporal changes in natural mortality (maybe start by trying a random walk in M), then predation and changes in the food web are implicated. I am a bit confused as to the state of the diet data. What has been collected? What remains to be processed? Can an ECOPATH model parametrized with 1990s data be compared with a model parameterized with data from the 2010s?

Uncertainty

Overall, I find that data and model uncertainty are handled pretty openly and honestly throughout the report. The previous CIE reviewers suggestion to drop data with "inconsistent" responses is concerning. This is a type of 'data cleaning' I don't fully agree with. It is better to understand *why* differences exist and whether it is bias or signal. If the data is just too noisy, then that seems more justifiable, but also easily dealt with in the assessment model. This relates back to my earlier comments on the need for a history section. So here, I stress the need for an uncertainty section. Uncertainty is dealt with in bits and pieces in most sections, but to have its own section is to promote a discussion about the current state of uncertainty (data, model, structural assumptions, etc.) which can help prioritize research and can be discussed when making management decisions. What is considered to be the biggest source of uncertainty? Is it fully incorporated into the model and/or decision process? As it stands, there is a lot of hope in the 2012 cohort showing up in the fishery. What if it doesn't? What if they are smaller?

Comments on the review process

This review was different from other CIE reviews I have been involved in (e.g. SARC at the Northeastern Fisheries Science Center in Woods Hole). This is not bad and is probably a result of the history and scientific culture developed at the AFSC. In fact, I preferred this review style. The other CIE reviewers had similar questions about what our

roles were and how we fit into the process. It was particularly enlightening when the chair, Dr. Ianelli, said this is not a STAR or SEDAR panel. Ok, but if it is not that, what exactly is it? What do you want from us? So as I noted earlier, the Terms of Reference were turned around and focused on us as reviewers and what the agency wanted of us and our report as opposed to whether we thought the assessment met certain standards. This is not a problem, but it is a mental adjustment that we needed to make. To facilitate a better understanding of the CIE review process at the AFSC, I recommend a flow chart be created and presented in the opening statements by the chair. Some excellent flow charts of when data are collected and processed were presented at the meeting, a similar flow chart could point out when the assessment is done, reviewed internally, revised, and reviewed by the SSC. When do research workshops and CIE reviews typically occur in this cycle? There is obviously some very good work being done at the AFSC and I think there is probably much more that is right than wrong from what I understand of the assessment and review process. I hope that my review and those of my fellow CIE reviewers provide some critical feedback and both impetus and direction for future work so that the AFSC can continue to maintain a high standard in fisheries stock assessment science.

ToR 1

Evaluation of the ability of the stock assessment model, with the available data, to provide parameter estimates to assess the current status of pollock in the Gulf of Alaska.

The stock assessment team presented the stock assessment model in both written form and oral presentations in such a way as to facilitate the review. I have a high degree of confidence in the model, with the available data, to produce reliable estimates of stock status. My degree in confidence is based on several factors:

1. There are a large amount of high quality data being collected with good scientific rigor (fisheries data, survey data, fish, lengths, ages, etc.). Any compromise in the data stream would reduce my confidence in the current status.
2. The model is a standard separable catch at age model. So I have a high degree of confidence in the model, because its structure and assumptions fit the data and stock well and are common assumptions for fisheries models.
3. The model fits the data well and there are no alarming patterns in the residuals and by and large, no major conflicting signals in the data.

ToR 2

Evaluation of the strengths and weaknesses in the stock assessment model for GOA pollock.

There is no reason for a major revision of the current stock assessment model at this time. My larger concern, as noted in the comments above, is that the assessment team continue to explore and develop the best and most current methods in stock assessment science. Model development is an important and ongoing process. The acoustics team has developed this research philosophy, which is commendable. I encourage the lead author

to imagine what future models for this stock might look like and build a vision to achieve those longer-term goals.

ToR 3

Review of the use of indices from spatial delta-GLMM models rather than area-swept estimates as abundance indices for the bottom trawl survey.

This ToR was met, but needs a lot more work and review before it should be considered as a replacement for area-swept and design based indices of abundance. Dr. Jim Ianelli presented the work as tentative and a work in progress. I am glad it was included in the review as it is an example of potential ways that the assessment could be improved. Maybe I should pause to emphasize that, it is good to present tentative and new ideas during the CIE review process. It is a great moment to get feedback on future directions, and is not typically done in other reviews I have been involved with. There is, however, a tendency to think that new and flashy techniques are better. I encourage further research and development on this topic, but also that it not be used as a replacement for a design based estimate of abundance until there has been a full (and documented) discussion of the assumptions involved.

ToR 4

Review of the use of biomass and size composition estimates from the acoustic survey that have been corrected for net selectivity.

The acoustic survey research team did an excellent job explaining the survey and their research projects. I will state my bias openly, I have always mistrusted acoustic survey data. While I remain cautiously skeptical, I must admit I have a much higher degree of confidence in this type of data after the excellent presentations by the research team. The clear presentation slides, the thorough and honest acknowledgement of issues (e.g. how trawl samples are conducted), and the ways that issues were being addressed (e.g. target strength, trawl pocket analysis) impressed me. So given the effort and amount of research and results, I have some confidence in the biomass and size composition estimates from the acoustic survey, but still not at the level I have for the bottom trawl survey. Despite this world-class research, I would be hard pressed to say this data is critical to the assessment model and the final estimate of stock biomass. Such a question could be evaluated within a Management Strategy Evaluation (MSE) framework.

ToR 5

Potential evaluation of an equivalent walleye pollock assessment model in Stock Synthesis

Dr. Dorn presented the results of a Stock Synthesis model using the same data inputs as into his custom built ADMB model. The comparison was a bit cursory, the selectivity patterns were similar as were the trends in SSB and F, but diagnostics of model fit

(residual patterns) were not compared. So the overall impression was that either model was adequate and sufficiently similar, and that the choice between the two was a matter of taste. While this could be true, I think a bit more rigorous comparison would be needed before drawing this conclusion. At this time, I do not recommend changing model platforms.

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4.0 Appendices

Appendix 1: Bibliography of Materials Provided for Review

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Presentations at the reivew:

- "Overview: Gulf of Alaska Pollock" presented by Dr. Martin Dorn:
- "Gulf of Alaska Bottom Trawl Survey" presented by Dr. Wayne Palsson:
- "Gulf of Alaska Acoustic-Trawl Surveys Overview" presented by Dr. Chris Wilson:
- "Development and applications of bottom-moored echosounders" presented by Dr. Alex De Robertis:
- "Ecosystem Considerations Report" presented by Kerim Aydin
- "GOA Walleye Pollock (*Gadus chalcogrammus*) Age Determination at the Alaska Fisheries Science Center" presented by Delsa Anderl
- "Gulf of Alaska pollock assessment" presented by Martin Dorn
- "GOA pollock: ADMB vs SS smackdown" presented by Martin Dorn
- "Dynamic changes in eastern Bering Sea groundfish stocks and relative impacts of growth and recruitment and consequences for fisheries management" presented by Jim Ianelli
- "Spatio-temporal index standardization for survey data" presented by Curry Cunningham and Jim Ianelli

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

Fisheries Stock Assessment for Walleye Pollock in the Gulf of Alaska

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. 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

The Alaska Fisheries Science Center's (AFSC) Resource Ecology and Fisheries Management Division (REFM) requests an independent review of the integrated stock assessment that has been developed for Gulf of Alaska walleye pollock. The fishery for these species is managed by the North Pacific Fisheries Management Council. The ABC for pollock in the Gulf of Alaska is 203,769 t in 2017. The catch limits are established using Automatic Differentiation (AD) Model Builder software that uses survey abundance data and survey and fishery age and length composition data with a harvest control rule to model the status and productivity of these stocks and set quotas. Having these assess-

ments vetted by an independent expert review panel is a valuable part of the AFSC's review process. The Terms of Reference (TORs) of the peer review and the tentative agenda of the meeting are below.

Requirements for CIE Reviewers

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 fisheries stock assessment processes and results, including population dynamics, separable age-structured models, harvest strategies, survey methodology, and the AD Model Builder programming language. Experience with the Stock Synthesis Assessment Model would also be helpful. They should also have experience conducting stock assessments for fisheries management.

Statement of Tasks

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

Dorn, M.W., K. Aydin, B. Fissel, D. Jones, W. Palsson, K. Spalinger, S. Stienessen. 2016. 1. Assessment of the walleye pollock stock in the Gulf of Alaska. In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska. pp. 45-174. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510. https://www.afsc.noaa.gov/REFM/stocks/assessments.htm

NPFMC. 2017. GOA Introduction. *In* Stock Assessment and Fishery Evaluation Report for the Groundfish
Resources of the Bering Sea/Aleutian Islands Regions. North Pacific Fisheries Management Council, Anchorage, AK.
https://www.afsc.noaa.gov/REFM/stocks/assessments.htm

Other materials relevant to the review of the pollock assessment will be made available by May 8, 2017, such as working documents, publications, and similar material.

- Attend and participate in the panel review meeting
    - The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers
    - The review meeting is a public meeting and stakeholders that attend may provide perspectives and information relevant to the pollock assessment.
- 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 Alaska Fisheries Science Center, Seattle, Washington.

Period of Performance
The period of performance shall be from the time of award through July 14, 2017. 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 May 8, 2017	Contractor provides the pre-review documents to the reviewers
May 22-25, 2017	Panel review meeting
June 16, 2017	Contractor receives draft reports
June 30, 2017	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 $10,000.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact:
Martin Dorn
Martin.Dorn@noaa.gov
National Marine Fisheries Service,
7600 Sand Point Way, NE, Bldg. 4,
Seattle, WA 98115-6349
Phone: (206) 526-6548

Peer Review Report Requirements

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.

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.

Terms of Reference for the Peer Review

1. Evaluation of the ability of the stock assessment model, with the available data, to provide parameter estimates to assess the current status of pollock in the Gulf of Alaska.
2. Evaluation of the strengths and weaknesses in the stock assessment model for GOA pollock.
3. Review of the use of indices from spatial delta-GLMM models rather than area-swept estimates as abundance indices for the bottom trawl survey.
4. Review of the use of biomass and size composition estimates from the acoustic survey that have been corrected for net selectivity.
5. Potential evaluation of an equivalent walleye pollock assessment model in Stock Synthesis

Appendix 3: Panel membership and participants

Participants of the CIE review of the Gulf of Alaska pollock stock assessment, May 22-25, 2017

Name, Affiliation
James Ianelli, AFSC, Chair
Martin Dorn, AFSC, Lead assessment author
Kresimir Williams, AFSC
Alex De Robertis, AFSC
Patrick Ressler, AFSC
Sarah Stienessen, AFSC
Abigail McCarthy, AFSC
Wayne Palsson, AFSC
Delsa Anderl, AFSC
Craig Faunce, AFSC
Jennifer Cahalan, AFSC
Kerim Aydin, AFSC
Ernie Weiss, Aleutians East Borough
Austin Estabrook, At-Sea Processors Association

Remote:
Jim Armstrong, North Pacific Fisheries Management Council
Katy McGauley, Alaska Groundfish Data Bank

CIE reviewers:
Yong Chen, School of Marine Sciences, University of Maine
Cynthia Jones, Old Dominion University
Kurtis Trzcinski, University of British Columbia

AFSC: Alaska Fisheries Science Center

Appendix 4: Review Panel Meeting Agenda

Review Panel Meeting on Gulf of Alaska Pollock Stock Assessment Draft Agenda

May 22-25, 2017
Room 2039
Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle, WA 98112

Monday, May 22, 2015

9:00 a.m.	Welcome and Introductions, Adopt Agenda	Jim Ianelli
9:15 a.m.	Overview of biology, surveys, fishery, management system	Martin Dorn
10:00 a.m.	Gulf of Alaska bottom trawl survey	Wayne Palsson 1 hr
11:00 a.m.	Acoustic surveys in the Gulf of Alaska	Chris Wilson 1 hr
12:00 p.m.	Lunch	
1:30 p.m.	Acoustic survey research projects	Kresimir Williams and Alex DeRobertis 1 hr
2:30 p.m.	Fishery monitoring of the GOA pollock fishery	Craig Faunce and Jennifer Cahalan 1 hr
3:30 p.m.	Age reading	Delsa Anderl 1 hr
4:00 p.m.	Role of pollock in the GOA ecosystem	Kerim Aydin or designee 1 hr
5:00 p.m.	Meeting adjourns for the day	

Tuesday, May 23, 2017

9:00 a.m.	Morning welcome and announcements	
9:15 a.m.	Pollock stock assessment model	Martin Dorn 3 hrs
12:00 p.m.	Lunch	
1:30 p.m.	Pollock stock assessment model (continued)	
3:30 p.m.	Discussion of proposed assessment model changes	
5:00 p.m.	Meeting adjourns for the day	

Wednesday, May 24, 2017

9:00 a.m.	Morning welcome and announcements	
9:15 a.m.	Evaluation of alternative model configurations	
12:00 p.m.	Lunch	

1:30 p.m. Continued evaluation of alternative model configurations

Thursday, May 25, 2017

9:00 a.m. Report writing. AFSC analysts will be available to respond to requests and to answer questions

12:00 p.m. Meeting adjourns