Report on the Gulf of Alaska walleye pollock (*Theragra chalcogramma*) assessment

17-20 July 2012

National Marine Fisheries Service, Alaska Fisheries Science Center, Seattle, WA

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1 Executive Summary

During 17-20 July 2012, a CIE panel review meeting was held at the Alaska Fisheries Science Center in Seattle, WA, to review the Gulf of Alaska walleye pollock assessment. I participated as one of three CIE reviewers.

The Gulf of Alaska walleye pollock stock has declined from a peak biomass in the early to mid-1980's despite generally declining Total Allowable Catches since the late 1980's. Although the past 13 years of the fishery having been marked by a relatively stable stock size, stock status and current ecosystem information suggests that the fishery has only a small influence on pollock stock dynamics. Ecosystem interactions in the form of predation mortality and environmental forcing on recruitment dynamics may have a larger influence on recent and future pollock stock dynamics. This is a concern as the current assessment does not account for such external influences on the stock, although substantial ecosystem-level data is being collected.

The assessment is quite mature, using a fairly standard statistical catch-at-age model coded in ADMB and fitting to a relatively large number of data sources. The management strategy is precautionary, using reference fishing mortality rates based on spawning biomass per recruit (Tier 3b of the NPFMC harvest guidelines).

The review panel made several suggestions that, on the basis of results from requested model runs during the meeting, appear to improve the fit of the model to the available data. Several of the suggestions involved modification to the data inputs and their relative weightings (see Table 1 for details), in particular the acoustic survey inputs have been modified to now include only a spawning stock biomass index and an age-1 biomass index. Further work should be done to more systematically explore the relative contributions of the various data inputs, any residual data conflicts, and the stability of the model under alternate reasonable parameterizations. Ideally, such explorations should be conducted on a periodic, on-going basis so that the assessment team can stay on top of potential changes to input data and/or conflicts between data sources as they arise.

The biggest challenge facing the assessment team is to incorporate information on predation mortality of pollock by a suite of predators whose own population dynamics have been undergoing considerable change in the Gulf of Alaska over the past 20-30 years. It is likely that predation mortality patterns and environmental effects on recruitment are the biggest drivers of GoA pollock dynamics, so the importance of accounting for these drivers in the assessment with the best available data and insight can not be understated. Fortunately, the assessment team has access to substantial relevant data and expertise within the AFSC and at the nearby University of Washington so that this task is not entirely intractable.

2 Background

The Gulf of Alaska (GoA) walleye pollock stock has declined from a peak biomass in the early to mid- 1980's despite generally declining Total Allowable Catches (TAC's) since the late 1980's. Since the late 1990's, biomass has fluctuated at roughly 30% of that in the mid-1980's with some

indication of a small increase during the past 3-4 years (2008-2011). Although the past 13 years of the fishery having been marked by a relatively stable stock size, stock status and current ecosystem information suggests that the fishery may have little influence on pollock stock dynamics. Ecosystem interactions in the form of predation mortality and environmental forcing on recruitment dynamics may have a larger influence on recent and future pollock stock dynamics. This is a concern as the current assessment does not account for such external influences on the stock. The assessment team is well aware of this concern as evidenced by the reference and background documents provided (see Appendix 1), meeting presentations, and ensuing discussion highlighted herein.

The assessment model essentially is a standard statistical catch-at-age model fit to several data sources with varying spatial and temporal coverage. Primary among these are the fishery catch and catch-at-age data, NMFS summer bottom trawl survey, ADF&G crab/groundfish trawl survey, the Shelikof Strait acoustic survey, Shelikof Strait egg production survey, and a reconstruction of historical (1960 to 1983) bottom trawl surveys. The management strategy is based on reference mortality rates based on the spawning biomass per recruit (Tier 3 of the North Pacific Fishery Management Council, NPFMC, harvest guidelines).

3 Review Activities

The review consisted of three sequential tasks: (1) a review of the assessment and background documents; (2) a panel review meeting; (3) completion of an individual report. The CIE panel review meeting was held between 17-20 July 2012, at the National Marine Fisheries Service, Alaska Fisheries Science Center (AFSC), Seattle, WA. The review took a format of presentations by various contributors to the GoA pollock assessment, followed by questions and discussion. The meeting agenda, which was generally adhered to (evaluation of alternative model forms extended into Friday), was:

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

July 17-20, 2012
Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle, WA 98112

Tuesday, July 17, 2012

9:00 a.m.	Welcome and Introductions, Adopt Agenda	Anne Hollowed
9:15 a.m.	Overview of biology, surveys, fishery, management system	Martin Dorn
10:00 p.m.	Gulf of Alaska bottom trawl survey	Michael Martin 1 hr
11:00 p.m.	Acoustic surveys in the Gulf of Alaska	Mike Guttormsen/Chris Wilson 1 hr
12:00 p.m.	Lunch	
1:30 p.m.	Evaluation of net selectivity in acoustic surveys	Kresimir Williams 1 hr
2:30 p.m.	Fishery monitoring of the GOA pollock fishery	Martin Loefflad or alternate 1 hr
3:30 p.m.	Role of pollock in the GOA ecosystem	Kerim Aydin 1 hr
5:00 p.m.	Meeting adjourns for the day	

Wednesday, July 18, 2012

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.	Management Strategy Evaluation of GOA pollock assessment	Teresa A'mar 2 hr
3:30 p.m.	Discussion of proposed assessment model changes	Martin Dorn 2 hr
5:00 p.m.	Meeting adjourns for the day	

Thursday, July 19, 2012

9:00 a.m.	Morning welcome and announcements
9:15 a.m.	Evaluation of alternative model configurations
12:00 p.m.	Lunch
1:30 a.m.	Continued evaluation of alternative model configurations

Friday, July 20, 2012

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

I participated as one of 3 CIE reviewers. This report presents my review findings and recommendations, adhering to the review meeting Terms of Reference (ToRs - see Appendix 2, annex 2).

4 Summary of Findings

I have arranged my review findings in the order of the ToR they are associated with, except where noted.

4.1 Evaluate and provide recommendations on data collection procedures and analytical methods used to develop assessment model input

The assessment model is fit to a variety of catch-at-age data and biomass time series indices, covering a period from present and stretching back to the early 1960's.

4.1.1 Fishery Data

The fishery catch and catch-at-age data are obtained from at-sea observers and from port-based sampling. The observer coverage of the GoA pollock fishery is reasonably high at 30%. The fishery is dominated by trawl vessels between 60 and 125 feet, but 2 larger processor vessels apparently are allowed to fish for pollock in the GoA. Currently, these vessels account for a small portion (roughly 10%) of the landings and the assumption of a single size-selectivity across the fishery is reasonable. However, if these vessels account for a greater portion of the catch in future years, the assessment team may want to determine whether these larger vessels have a different size-selectivity compared to the rest of the fishing fleet.

In general, there seemed to be some discrepancies between the assessment team's understanding of the fishery and fishery data and what was presented by the Fisheries Monitoring and Analysis Division. Given that there appear to be impending changes to the monitoring of GoA fisheries that may affect the quality of GoA pollock fishery data, the assessment team should ensure that all relevant aspects of the fishery are accurately reflected in the assessment.

4.1.2 Historical Trawl Surveys

Prior to 1984, a reconstruction of historical 400-mesh eastern trawl surveys and an egg production survey are the only biomass time series inputs. The reconstructed historical survey time series represents a somewhat disparate collection of individual surveys with varying spatial coverage and sample size. A Poisson GLM was used to construct a index of pollock abundance by modelling pollock CPUE at four index sites, using year, site, depth and site x depth interaction as model terms. The approach generally seems reasonable, although a Gamma error distribution would seem more appropriate for CPUE data (or negative binomial errors; zero-inflated/hurdle model approach if low or zero catches were prevalent), but it is not clear that the index contributes much to the current biomass estimates and there may be no need to include this series in on-going assessments.

4.1.3 NMFS Bottom Trawl Survey

From 1984 - 1999, the NMFS bottom trawl survey was conducted triennially, and biennially from 2001 onward. The contemporary survey (1996 onward) uses chartered commercial fishing vessels, typically 3 vessels per survey. The survey group aims to minimize among survey variability by imposing stringent survey protocols and using a variety of tow monitoring devices (e.g., bottom contact sensors, warp measurement and monitoring, wing tip spread measurements). Prior to 1996, the survey protocols, objectives and coverage underwent a number of considerable changes. Surveys in 1984 and 1987 were conducted jointly with Japanese commercial vessels using different

fishing gear and potentially different survey objectives. Surveys in 1990 and 1993 were conducted by the Auke Bay Lab, focusing primarily on rockfish. From 1996, tow duration was reduced from 30 min to 15 min. A study was conducted to examine the effect of this change, but it is unclear whether the potential effects on the walleye pollock index were specifically examined (the document was not available).

Despite the changes highlighted above, the contemporary survey appears to be conducted in an appropriate manner and is able to track pollock year classes reasonably well (considering the earlier 3- and more recent 2-year survey intervals). My concerns about this survey pertain to how the data are incorporated in the assessment model; I will highlight these concerns in section 4.2.

4.1.4 Shelikof Strait Acoustic-Trawl Survey

Acoustic surveys have been conducted in the Shelikof Strait annually since 1981, with the exception of 1982, 1999 and 2011. Various echo sounder equipment and two different vessels have been used during this time series, but appropriate steps have been taken to account for these changes. The survey provides both a biomass time series and the main source of fishery-independent age composition for the assessment model.

A major discussion during the review meeting (re-visited on multiple occasions over the 4 days) focused on the appropriateness of the acoustic survey as a source of age 2+ biomass and age composition, given the inherent difficulties associated with determining the size composition of pollock aggregations detected by the acoustic gear. Patrick Cordue felt that it was impossible to accurately determine length frequencies of these aggregations due to the limited calibration trawls conducted and the inability to trawl in the densest parts of the aggregations (because the trawl net would blow out). If pollock spawning aggregations have spatial variability (ie. from the margins into the centre and/or from top to bottom) in length frequency then it will be impossible to properly stratify the calibration tows and this, in turn, will impose a bias on the survey size composition and the survey biomass estimates. Additional concerns are the apparent varying timing of the survey relative to peak spawning in Shelikof Strait and the potential inter-annual variation in the proportion of spawners in Shelikof Strait relative to other unsurveyed (or less intensively surveyed) spawning areas. Information about the latter is not incorporated in the assessment model.

All of these factors call into question the quality of the acoustic survey inputs to the assessment model. Cordue advocated dropping the age composition data and age 2+ biomass index in favour of a spawning biomass index and an age 1 recruitment index. I am less convinced that such a strong alteration is necessary (but see comments re: requested model results under ToR 2, below). Most stock assessments must deal with data of varying, and sometimes questionable, quality and the approaches used to calibrate the acoustic backscatter data to length composition and biomass are consistent with acoustic surveys conducted elsewhere. Indeed the acoustic survey team has a considerable body of research on these and other survey issues, as evidenced by the documentation provided during the meeting (see Appendix 1), and is continuing to improve their survey methods. The acoustic survey team has used a geostatistical approach (Walline 2007) to estimate sampling uncertainty, but the CV's reported in the meeting of approximately 2-4% seem far too small. In contrast, the assessment model assumes acoustic survey biomass CV's of about 25%, which is probably more realistic but is really just a guess. Ideally, the survey and assessment

groups should focus on obtaining more realistic, time-varying CV estimates so that at least the acoustic survey biomass series is more appropriately weighted in the assessment model.

Regarding the acoustic survey data, it might be useful to search across all years of the survey for situations where mid-water and bottom trawls were conducted on the same aggregation and examine the length frequencies from these tows to see how much they differ. This is a relatively simplistic comparison but it can be used to gauge the extent to which length frequency tends to be similar throughout a spawning aggregation (as is claimed by the survey group).

4.2 Evaluate and provide recommendations on model structure, assumptions, and estimation procedures

The assessment model is essentially a standard statistical catch-at-age model coded in ADMB. Complexity in the model comes from the variety of data inputs the model attempts to fit: 4 age composition sources (fishery, NMFS trawl survey, Shelikof acoustic survey, ADF&G trawl survey); 5 biomass time series (historical trawl index, NMFS bottom trawl index, Shelikof acoustic index, ADF&G bottom trawl index, Egg Production-based spawning biomass index); the fishery catch. The model assumes that the NMFS survey catchability is a constant 1.0 across all years, natural mortality is fixed at a constant 0.3 for all ages, the proportion mature is constant across all years, and selectivity to the fishery is assumed to be dome-shaped and to follow a random walk through time. Selectivity to the NMFS trawl survey is also assumed to be dome-shaped.

Chief among concerns about the model parameterization presented were the fixed trawl survey catchability, fixed natural mortality of 0.3 for all ages, and the merits of fitting to all of the available biomass indices and age composition data. Below, I will summarize the findings of alternate model parameterizations conducted at the request of the CIE panel during the meeting and provide my own recommendations for improving the assessment model.

The rationale presented for fixing the NMFS trawl survey q at 1.0 was for precautionary reasons, however, this is at odds with a generally held view that an assessment model should be neutral and precaution should only enter in the harvest rules and advice. The requested model runs during the meeting revealed that under a range of alternate parameterizations, the model generally estimates a very low trawl survey q and much higher biomass than suggested by the default model (presented in Dorn 2011). Profiles of the individual likelihood components indicated a strong conflict between the fishery age composition and the acoustic biomass index. Prior to viewing these new results, Carmen Fernandez suggested the model appeared to over fit the fishery catch-at-age data, and it was subsequently agreed that the sample size in the multinomial likelihood for the fishery age composition should be reduced to down weight its influence. The final requested model with down weighted fishery age composition and a prior on the NMFS trawl survey q (see Table 1 for a full description of the parameterization) seemed to produce reasonable, albeit substantially higher, biomass estimates - relative to the default model. Notably, even when the prior on the NMFS trawl survey q (a quadratic prior centered on 0.75) was removed, the model estimated this q at 0.73.

The down-weighting of the fishery catch-at-age data along with the removal of the acoustic survey full biomass (replacing with acoustic age-1 and spawning biomass indices), historical survey

Table 1: Description of final requested model parameterization in comparison with the default parameterization

Final requested model	Default model
Ages 1-13 (13 is + group)	ages 1-10 (10 is + group)
Estimate NMFS trawl q	Fix NMFS trawl q at 1.0
Mean-unbiased log Normal NMFS survey likelihood	log Normal NMFS survey likelihood
Drop 1984 & 1987 NMFS trawl surveys*	Include 1984 & 1987 surveys*
Block fishery selectivity into 3 distinct periods that coincide with known changes in fishery	Random walk on fishery selectivity
Drop acoustic age/size composition data	Include acoustic age/size composition data
Include an acoustic-based SSB index and an acoustic-based age-1 index	Include acoustic age 2-10 biomass index
Drop historical trawl survey biomass series	Include historical trawl survey biomass series
Drop egg production-based SSB series	Include egg production-based SSB series

* These surveys were conducted jointly with commercial Japanese vessels and in a less systematic fashion than in subsequent years

biomass, and egg production biomass indices appear to deal with the apparent data conflicts. Additional effort needs to be put into exploring additional model runs to ensure that biomass estimation and projections are stable under a range of alternate, but reasonable, model parameterizations. For example, it is not obvious that the ADF&G survey data (biomass and age/size composition) contribute much additional information to the assessment and these might be removed altogether. Little information on this survey was available for this review (a single survey report from 2003 was provided during the meeting; Appendix 1) and it was apparent that the assessment team is much less familiar with the details of this survey compared to NMFS surveys.

Previous and ongoing GoA ecosystem research (e.g., Hollowed et al. 2000, Gachias et al. 2011) suggests that: (1) predation mortality on pollock is substantial relative to fishing mortality, so much so that the fishery appears to have little influence on stock dynamics; (2) pollock natural mortality has changed over the time period considered by the assessment model; (3) pollock natural mortality is not constant with age. All of these findings are inconsistent with the model assumption of a time- and age-constant natural mortality. The assessment team is well aware of this inconsistency; the issue is how best to incorporate ecosystem effects into an operational assessment model.

The volume of ecosystem research presented during the review indicates the assessment team has access to considerable data and expertise that should facilitate incorporation of ecosystem effects in some manner into the assessment model. Given that some of the research on incorporating predation mortality into GoA pollock stock assessments (Hollowed et al. 2000) occurred over 10 years ago, it is somewhat surprising that the assessment team have not made further advances. The appropriate starting place would be a model that includes the (relatively comprehensive) available data on predation mortality in a parsimonious fashion, making as few assumptions as possible. Hollowed et al. (2000) used the approach of treating 3 key predators (arrowtooth flounder, Stellar sea lion, and Pacific halibut) as fisheries and making assumptions about the predators'

consumption rates on pollock. Other approaches (Lindegren et al. 2009, Lindegren et al. 2010) model lagged correlations in the biomass time-series of multiple species via a community matrix of species interactions and a suite of potential covariates. Alternatively, if energetics and diet information is also available for these predators, consumption of pollock could be estimated (Mohn & Bowen 1996, Trzcinski et al. 2006).

Currently, the ecosystem information is provided in the assessment document, but there is no apparent input to the assessment model or harvest advice. I expect that a number of candidate models will need to be developed and explored and this should be conducted in parallel to the single-species assessment model currently used to provide harvest advice, rather than attempting an abrupt switch to a multi-species assessment model some time in the future. The parallel multi-species model development should be included in annual stock assessment reports, taking the place of (or substantially augmenting) the current presentation of ecosystem research results. This approach would allow for consistent review of the multi-species model development, providing valuable feedback to the assessment team, and allow for a potential phased transition from a single-species to a multi-species assessment.

4.3 Evaluate and provide recommendations for the reporting of assessment results and characterization of uncertainty

In some ways the assessment document provided (Dorn 2011) was the wrong document for the CIE review. Dorn (2011) presents the pertinent information for an annual stock assessment review, but was generally lacking in detail regarding model development (ie. how did we arrive at the current model parameterization? What alternate parameterizations (or different models) have been considered?) and performance diagnostics. During the review meeting I obtained a better sense of alternate parameterizations that have been attempted in the past, but this information should have been available in the document.

Diagnostic plot(s) providing a sense of the model's predictive ability were generally missing. A plot (or table) of 1 (or 2)-year ahead biomass predictions compared with the corresponding estimates using (1) the data up to and including that year and (2) the full data series would provide a sense of the model's predictive accuracy. Additionally, comparisons of biomass estimates from alternative models (if any exist) would give some sense of the potential magnitude of model uncertainty in the assessment. At some point the multi-species assessment model (discussed above in ToR 2) could be used in this evaluation.

4.4 Evaluate and provide recommendations on $F_{35\%}$ spawning biomass per recruit as an appropriate proxy for F_{MSY} under non-stationarity in vital rates. Also evaluate and provide recommendations on the $B_{35\%}$ biomass reference points as a proxy for B_{MSY}

To the best of my recollection, there was no discussion during the review meeting of the harvest control rules applied to GoA pollock. Instead, the review panel focused primarily on the model's

ability to fit effectively the main data inputs. Moreover, given the presentations and discussion of ecosystem and environmental influences on pollock natural mortality and recruitment, it appears that the fishery has little influence on GoA pollock stock dynamics. The $F_{35\%}$ and $B_{35\%}$ are reasonable proxies for F_{MSY} and B_{MSY}, and the management strategy adhered to in the Tier 3b guidelines is precautionary, but perhaps too precautionary if the fishery has little influence on stock dynamics. Greater effort should be placed on understanding how natural mortality and recruitment may be changing as a function of ecosystem/environmental factors that are currently external to the assessment.

4.5 Recommendations for further improvements.

The series of model runs requested by the review panel (summarized in Table 1) went some way toward resolving the apparent conflict between the fishery age composition data and the acoustic survey data, however more work is required to determine appropriate relative weighting of data inputs to the assessment model. Exploration of the model at the review meeting suggested that some data inputs could be dropped (Egg production index, historical trawl index, acoustic age composition and age 2-10 biomass index), but a more comprehensive series of model evaluations should be considered.

4.6 Brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

The key panel review discussions focused on: (1) the acoustic-trawl survey and the appropriateness of the age composition data and age 2-10 biomass index derived from this survey as an input to the assessment; (2) the role of ecosystem-level information, vis-a-vis predation mortality and environmental drivers of recruitment, in the assessment; (3) exploring alternate model parameterizations that minimized data conflicts. Each of these discussions and associated recommendations are highlighted in the earlier sections of this report.

5 Comments on the NMFS review process

My one criticism of review process is that the CIE review appears to have no closed feedback loop. There appears to be no formal mechanism for response to the CIE reviewers' comments. There are two key reasons for creating this mechanism: (1) ensure that CIE reviewer recommendations are followed up and that there is a tangible plan for addressing longer-term recommendations; (2) the assessment team would have an opportunity to place on the public record a rebuttal of reviewers' comments, indicating where misunderstandings or oversights have occurred and also where the reviewers' comments have helped (or could help) improve the assessment.

6 Conclusions and Recommendations

6.1 Conclusions

The GoA pollock assessment makes use of a relatively large number of input datasets and not surprisingly there are some apparent conflicts between these data. Although the assessment is quite mature, my impression is that more effort needs to be put into examining the data inputs on a periodic, on-going basis to examine potential conflicts among the data sources and seek to resolve these as much as possible. The additional model runs requested by the CIE panel during the review meeting went some way toward identifying a more stable model with fewer conflicting data inputs and a more defensible, estimated NMFS trawl survey catchability parameter (rather than a fixed survey q=1.0). Clearly, more systematic work needs to be done to determine how sensitive the model is to reasonable alternate parameterizations. When this work is completed, I expect the assessment will be on very solid ground and this will only help in making the (likely gradual) transition from a single-species assessment to an ecosystem-based assessment that appears to be very much required given seemingly weak influce of the fishery on stock dynamics.

6.2 Recommendations

Here I reiterate the main recommendations, discussed in previous sections of the report, for potential further work.

- There seemed to be some discrepancies between the assessment team's understanding of the fishery and fishery data and what was presented by the Fisheries Monitoring and Analysis Division. The assessment team should ensure that all relevant aspects of the fishery are accurately reflected in the assessment.
- The landings of the 2 large processor vessels allowed to fish for GoA pollock should be monitored annually by the assessment team. If landings increase substantially beyond the current (roughly) 10%, the team may want to assess the selectivity of these vessels separate from the rest of the fleet.
- It is not clear that the historical trawl survey index contributes much to the current biomass estimates and there may no longer be a need to include this as a data input to the model.
- The 1984 and 1987 NMFS trawl surveys were conducted jointly with Japanese commercial vessels and in a less systematic fashion compared to more recent years. Either these years should be removed from the index or a separate catchability parameter should be estimated for these two years.
- The Shelikof Strait acoustic survey biomass index could be converted into a SSB index and an age-1 index as inputs to the model. In addition, further work on estimating realistic annual CVs for these indices needs to be done.
- If the acoustic survey full biomass index is to be retained as a model input then it would be useful to examine situation where mid-water and bottom survey tows

were conducted on the same spawning aggregations to get a better sense of the likely spatial variability in length frequencies within aggregations.

- In addition to the changes to the assessment model requested during the review meeting (highlighted in Table 1), effort should be put into exploring additional model runs to ensure that biomass estimates and projections are relatively stable under alternate reasonable model parameterizations. For example, the ADF&G trawl survey data may not contribute much additional information to the assessment and could be dropped if there is little or no impact on the model. A systematic exploration of model results by alternately dropping (or down weighting) various data inputs could help determine where the main sources of information come from.
- A concerted start needs to be made imminently on incorporating predation mortality information into the assessment model. Clearly, much of the relevant data is being collected and analyzed at the AFSC. A variety of approaches could be taken, some of which have been explored by the assessment team or by others at the AFSC. The team may wish to look at the approaches used by Lindegren et al. (2009) or Mohn & Bowen (1996) for ideas.

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Appendix 2: CIE Statement of Work for Dr. Ian Jonsen

Attachment A: Statement of Work for Dr. Ian Jonsen

External Independent Peer Review by the Center for Independent Experts

Gulf of Alaska (GoA) walleye pollock stock Assessment Review

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 Alaska Fisheries Science Center (AFSC) requests a Center of Independent Experts (CIE) review of the stock assessment for Gulf of Alaska (GOA) walleye pollock. The walleye pollock stock in the Gulf of Alaska is important to local fishing communities and is a key component of the GOA ecosystem. Walleye pollock stock assessments routinely undergo review by the AFSC, the North Pacific Fisheries Management Council's Groundfish Plan Team and Scientific and Statistical Committee. The assessment model for pollock has been stable for some time, and several significant changes are being contemplated for the 2012 assessment. In addition, the pollock stock assessment has not had the benefit of a CIE review since 2003. Therefore, a CIE review in 2012 would be timely. 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 must be thoroughly familiar with various subject areas involved in stock assessment, including population dynamics, survey methodology, and estimation of parameters in complex nonlinear models. Reviewers must also have experience conducting stock assessments for fisheries management. Expertise would be desirable in several other areas. First, since the pollock assessment uses AD Model Builder (ADMB) software, expertise in using this software would be desirable. Second, changes being considered for the 2012 assessment include adding ecological interactions and environmental forcing to the assessment model, so expertise in these areas would also be desirable. It is not expected that all three of the reviewers have these specialized areas of expertise, rather that at least one of the three reviewers should be knowledgeable in these areas. 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, Washington with dates July 17-20, 2012.

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 make available at an FTP site) 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.

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 can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified 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.

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.

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

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting at the Seattle, Washington during July 2012 (dates to be determined by Project Contact no later than 15 April 2012).
3) In Seattle, Washington during 17-20 July 2012 as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).

4) No later than **August 3, 2012,** each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to 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 schedule.

18 June 2012	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
3 July 2012	NMFS Project Contact sends the CIE Reviewers the pre-review documents
17-20 July 2012	Each reviewer participates and conducts an independent peer review during the panel review meeting
3 August 2012	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
17 August 2012	CIE submits CIE independent peer review reports to the COTR
24 August 2012	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:

William Michaels, Program Manager, COTR
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Key Personnel:

NMFS Project Contact:

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

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

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR 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 shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   d. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed.

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 Peer Review of the

Gulf of Alaska Walleye Pollock Stock Assessment

1. Evaluate and provide recommendations on data collection procedures and analytical methods used to develop assessment model input.
2. Evaluate and provide recommendations on model structure, assumptions, and estimation procedures.
3. Evaluate and provide recommendations for the reporting of assessment results and characterization of uncertainty.
4. Evaluate and provide recommendations on F35% spawning biomass per recruit as an appropriate proxy for FMSY under non-stationarity in vital rates. Also evaluate and provide recommendations on the B35% biomass reference point as a proxy for BMSY.
5. Recommendations for further improvements.
6. Brief description on panel review proceedings highlighting pertinent discussions, issues, effectiveness, and recommendations.

Annex 3: Tentative Agenda

Review of the Gulf of Alaska Walleye Pollock Stock Assessment
Alaska Fisheries Science Center, NOAA
7600 Sand Point Way N.E., Building 4
Seattle, Washington 98115
Phone: 206 526-4000
17-20 July 2012

The final meeting agenda has not yet been drafted, but will be forwarded by the project contact as soon as it becomes available.

17 July 2012	Presentations by survey and fishery data collection scientists
18 July 2012	Presentation by assessment scientists, Panel discussion and requests
19 July 2012	Panel discussion and requests, Begin drafting reviewer reports
20 July 2012	Draft reviewer reports

Appendix 3: Review Meeting Participant List

Anne Hollowed, Chair	NMFS AFSC
Martin Dorn, Assessment lead	NMFS AFSC
Chris Wilson, Acoustic survey group	NMFS AFSC
Mike Guttormsen, Acoustic survey group	NMFS AFSC
Paul Walline, Acoustic survey group	NMFS AFSC
Kresimir Williams, Acoustic survey group	NMFS AFSC
Michael Martin, Trawl survey group	NMFS AFSC
Lisa Thompson, Fisheries Monitoring & Analysis Division	NMFS AFSC
Kerim Aydin, Ecosystem research	NMFS AFSC
Jim Ianelli, Research Biologist	NMFS AFSC
Teresa A'mar, Fisheries research	NMFS AFSC
Patrick Cordue	CIE Reviewer
Carmen Fernandez	CIE Reviewer
Ian Jonsen	CIE Reviewer