Independent peer review of the stock assessment update for the main Hawaiian Islands Deep7 bottomfish complex through 2013 with projected Annual Catch Limits through 2016

Review Meeting, December 9 - 12, 2014
Honolulu, Hawaii

Prepared for:
Center for Independent Experts

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1. EXECUTIVE SUMMARY

This report presents results of an independent peer review of the 2014 main Hawaiian Islands Deep7 bottomfish complex stock assessment, conducted for the Center for Independent Experts (CIE). The primary activity of the review was participation in the December 9 – 12, 2014 Western Pacific Stock Assessment Review (WPSAR) process in Honolulu, Hawaii.

The WPSAR review process was thorough, effective, and resulted in a comprehensive review of the main Hawaiian Islands Deep7 bottomfish complex stock assessment. The WPSAR panel reached consensus on all assessment Terms of Reference. This report, prepared for the CIE, reflects my own views, which are consistent with the panel's conclusions on all substantive issues.

A previous (2009) WSPAR review of the Hawaiian Islands deep slope bottomfish stock assessment concluded that problems with the input data rendered the assessment results unsound as a basis for management decisions. While there have been significant improvements to the stock assessment and major recommendations from the 2009 review have received attention, there are still issues that have not been fully resolved.

The methods used for the 2014 main Hawaiian Islands Deep7 bottomfish complex stock assessment were appropriate and, in general, were applied properly. However, I do not believe the primary data used in the assessment is reliable and therefore assessment results are also not reliable. Uncertainty in the magnitude and trends in historical catch and issues with the CPUE time series, which likely invalidate the assumption that CPUE is proportional to stock abundance, limit the reliability and hence utility of assessment results.

I do not consider the 2014 main Hawaiian Islands Deep 7 bottomfish complex stock assessment to represent the best scientific information available as there appears to be additional information that may be useful to improve the reliability and to quantify the uncertainty in the catch and CPUE data that is integral to the assessment.

2. BACKGROUND

This document reports on an independent peer review of the 2014 stock assessment of the main Hawaiian Islands (MHI) Deep7 bottomfish complex, conducted for the Center for Independent Experts (CIE). The primary activity of the review was participation in the December 9 - 12 Western Pacific Stock Assessment Review (WPSAR) process in Honolulu, Hawaii.

The CIE *Statement of Work* (Appendix 1) defines the scope of this review which includes participation in the review meeting, pre-review of assessment documents and other pertinent background materials, and preparation of this report summarizing review findings relative to the Terms of Reference (ToR) for the review.

The first review of the Hawaiian Islands deep slope bottomfish stock assessment, which included CIE participation, was conducted in 2009. That review concluded that while the assessment methods were appropriate, problems with the input data rendered the assessment results unsound as a basis for management decisions. A number of issues identified through that review were dealt with in the 2011 benchmark stock assessment of the deep slope bottomfish complex. The benchmark assessment was also reviewed through the CIE, but used desktop reviews so there was no summary report of findings. The 2014 Hawaiian Islands Deep7 bottomfish complex stock assessment under review here is an update and contains only minor changes from the 2011 benchmark assessment.

3. DESCRIPTION OF REVIEW ACTIVITIES

The activities undertaken for this review included; 1) pre-review and assimilation of background material and reports provided by the NMFS Project Contact prior to the WPSAR meeting, 2) active participation in the panel review meeting, 3) contribution to the panel summary report, and 4) preparation of this report.

The materials provided to prepare for the panel review meeting included (Appendix 2); the 2014 MHI Deep7 bottomfish complex stock assessment document, the 2011 benchmark stock assessment document for the MHI Deep7 species complex, the 2009 CIE review document, and other background documents pertaining to the data and biology of the Deep7 complex species. Additional materials provided during the review meeting (Appendix 2) were: a report summarizing a 2008 Hawaiian bottomfish CPUE workshop and the 3 CIE desktop reviews of the 2011 benchmark stock assessment.

The primary focus for review panel members (Appendix 3) during the December 9 - 12, 2014, meeting included:

- Determining whether data were adequate and used properly, the analyses were carried out correctly, and conclusions were reasonable and consistent with the analyses presented.
- Determining whether the scientific assessment was adequate to serve as a basis for developing fishery management advice.
- Determining whether the science reviewed could be considered the best scientific information available.

A panel summary report, summarizing the panel's views and conclusions relative to the meeting ToR, was prepared by the panel chair and panel members during and after the meeting. This report, prepared for the CIE, reflects my own views, which are consistent with the panel's conclusions on all substantive issues.

4. SUMMARY OF FINDINGS

4.1 OVERVIEW

Significant progress was made from the 2009 Hawaiian Island's bottomfish stock assessment to the 2011 benchmark assessment, addressing a number of issues identified in the 2009 WPSAR review. In particular: the number of species in the bottomfish complex was reduced to a group of 7 (the Deep7 group which includes 6 snappers and 1 grouper) that have greater consistency in their life history characteristics; the areal extent of the stock complex was reduced, excluding the areas of the Northwestern Hawaiian Islands that had recently been closed to bottomfish fishing; estimates of unreported catch were developed; and alternative assumptions regarding the effect of changes in fishing power on standardized CPUE indices were explored.

The 2014 MHI Deep7 bottomfish complex stock assessment is an update from the 2011 benchmark assessment, and as such there is little change from the methods and data processing approach used in 2011. Although this review focusses on the 2014 stock assessment update, it also considers the 2011 benchmark assessment as that assessment and the associated documentation is considerably more comprehensive.

The 2014 WPSAR review panel reached consensus on all review ToR, and concluded that problems and uncertainties with the catch and effort data limit the utility of the stock assessment and projections as a basis for management decisions.

4.2 FINDINGS RELATIVE TO TOR

1. *Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.*

The Bayesian surplus production model used to assess the MHI Deep7 bottomfish stock complex is adequate and appropriate for this species complex. The primary data available for the assessment, catch and commercial fishery effort data, are used to develop a catch rate (CPUE) index that is assumed to be proportional to stock abundance. With only commercial fishery data, it is not possible to develop more complex analytical models. The Bayesian implementation of the model allows incorporation of prior information about model parameters and examination of the effect of their uncertainty on quantities of management interest.

In general, the assessment model was properly applied and surplus production models can provide reliable estimates of stock abundance when the assumptions underpinning the model are met. However, for the MHI Deeep7 bottomfish stock assessment the primary data used in the surplus production analysis is not considered reliable and therefore assessment results are also not reliable. Uncertainty in the historical removals (catch) and issues with the CPUE time series, which are likely to invalidate the assumption that CPUE is proportional to stock abundance, limit the utility of assessment results. This is discussed in greater detail under ToR 2.

2. *Evaluate the implementation of the assessment model: configuration, assumptions, and input data and parameters (fishery life history); more specifically determine if data are properly used, if choice of input parameters seem reasonable, if models are appropriately specified and configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.*

The Bayesian surplus production model was fitted to time series of catch and CPUE data (1949 – 2013) for the Deep7 bottomfish stock complex. Catch was separated into reported and unreported components, and a quasi-prior used to account for uncertainty in the unreported catch. Separate CPUE time series were developed for 1949–1957 and 1994–2013, a major change from the 2011 benchmark stock assessment where the CPUE data were treated as a single index.

In general, the surplus production model was configured and applied correctly. The convergence diagnostics presented were appropriate and indicated model convergence to the posterior distribution. However, there were issues with the primary data inputs (catch and CPUE) which limit the reliability of model results.

Catch data

The amount of unreported catch for Deep7 species is high and highly uncertain, particularly for the earlier part of the time series. Unreported catch is mostly comprised of recreational and unreported commercial catch.

The assessment team endeavoured to create the best possible time series of catch estimates, but there are very little actual data on which to base the estimates. The only data on unreported catches are available via the following efforts: a well-designed small-boat survey conducted on Oahu in 1990/91; a Hawaii Marine Recreational Fisheries Survey (HMRFS) in 2003-2005; and a 2005 recall survey of registered fishers.

The 1990/91 Oahu survey results, which indicated that the unreported catch was almost double the reported catch, were extrapolated to the entire MHI area based on species-specific unreported to reported catch ratios. Results from this survey were also assumed to reflect constant unreported to reported catch ratios for the 1948 to 1997 period.

Results from the HMRFS and recall surveys, were averaged and assumed to reflect constant species-specific reporting rates for 2002 to present. The HMRFS and recall survey estimates of unreported to reported catch ratios were quite different. For example, for opakapaka, which accounts for more than 80% of the unreported catch, the ratio of unreported to reported catch was 3.8 and 0.15 for the HMRFS and recall surveys, respectively. Clearly, given the limited data available both the magnitude and trends in unreported catch are highly uncertain.

The base model catch time series reflects unreported catch decreasing from about 1.8 times the reported catch for 1945-1997, to 1.08 times the reported catch for 2002 and onward. The assessment model will interpret the unreported catch as part of the stock productivity, and when the unreported catch suddenly decreases this production becomes available to the reported catch. If the unreported catch did not actually decline, the model would tend to overestimate current productivity and sustainable harvest levels. An alternative model run that assumed constant rates of unreported catch throughout the fishing history was requested during the review. This run resulted in a different conclusion about the current status of the fishery, that is overfishing was occurring even though the estimate of current abundance relative to B_{MSY} increased.

Uncertainty in the unreported catch was dealt with through a “prior” on this component of the catch data. The error in the unreported catch was assumed to follow a uniform distribution that ranged from minus to plus 20% of the point estimate. These errors were assumed to be independent. That is, for each simulation and each year, a random draw was made from the unreported catch distribution to calculate the total catch fitted in that simulation. The problem with this approach is that it does not capture the true uncertainty in the catch data. Given the differences between the HMRFS and recall surveys, the magnitude of

uncertainty is certainly much higher than plus/minus 20%. Also, the trend in the unreported catch is highly uncertain. Modelling year-to-year variability in the unreported catch does not address the true uncertainty about its magnitude or trend.

CPUE data

Standardization of the CPUE data was done separately for data prior to 1949 and for data from 1994 to 2013. This is a major improvement over the single-series standardization used in the previous assessment as it allowed inclusion of fisher (license) effects in the standardization for the later series resulting in a much greater proportion of the variation in the CPUE observations being accounted for.

There are a number of issues with the effort data used in the CPUE standardizations that likely result in indices that are not proportional to stock abundance. These include: the effort associated with each data record (a trip), although ostensibly representing one day, is variable; effort may be associated with pelagic or reef fishing as well as bottom fishing; technology changes are not accounted for; and fisher effects are not accounted for prior to 1994.

Historically, catch-effort data reports were submitted monthly. In theory, catches from individual trips were reported on these forms. However, trips could comprise multiple days fishing, and in some instances the records represent a full month's fishing activity. To limit the number of records representing multiple days of effort, all records with greater than 1500 lbs of catch are excluded from the CPUE standardization. This approach is *ad hoc* and will only eliminate some multiple-day fishing records. Time trends in the proportion of multiple-day fishing records or in the average number of days fishing represented by the multiple-day fishing records, will result in bias in the CPUE indices. A potential way to remove records that represent an entire month's fishing activity, is to remove all records where only one record exists for a vessel/month/year combination. However, this would not resolve issues related to multiple day fishing trips.

Data records used in the CPUE standardization may include ones where little fishing effort was directed at capturing the Deep7 bottomfish species (i.e. primarily a bycatch). Previous assessments set an arbitrary threshold for the proportion of total catch comprised of Deep7 species, which was then used to restrict the data records to ones likely to represent targeted Deep7 bottomfish fishing. For the 2011 assessment, a methodology was developed to determine what an "appropriate" threshold would be. Although the method involved maximizing an objective function (including terms for the proportion and variability of catch and catch value in the selected records), it still results in an arbitrary selection of records to include in the CPUE data set. An alternative approach, which accounts for some of the effort during a fishing trip being directed at non-Deep 7 species, would be to include the catch of non Deep7 species as a covariate in the CPUE standardization. This would eliminate the need for an arbitrary basis for selecting a subset of records.

Over the history of the fishery, technology changes have certainly affected the catchability (q) associated with a unit of fishing, as was concluded by the 2008 CPUE workshop tasked with reviewing data used in bottomfish CPUE standardizations (Moffitt et al. 2008). The 2014 assessment allowed for technology changes by modelling separate q's for the early and late CPUE series, however many of the technology advances would have occurred prior to 1994. Future stock assessments of the MHI Deep7 species complex should allow for additional technology change, though I disagree with the 2009 review panel conclusion that technology effects should be included in the CPUE standardizations (Stokes 2009). That approach assumes the effect of the technology change is known, whereas if it is included in the assessment model it can be treated as an unknown (possibly with a prior).

The inclusion of license (fisher) effects in the post-1993 CPUE standardization represents a substantial improvement in that time series. It may be possible to include similar effects in the earlier CPUE series,

using the Hawaiian Islands Vessel Registration Number or Vessel Name which appear to be reported beginning in 1960.

It would have been useful to have more statistical and graphical outputs for the CPUE standardizations. For example, the influence plots of Bentley (2012) would be useful to understand the standardization effects of explanatory variables. The large number of parameters associated with license effects (i.e. 1984) suggests that all licenses were included in the standardization and that many of these had few associated records. Selection of a "core" fleet of licenses, that have relatively high and longer-term activity in the fishery, may be preferable to including all licenses in the CPUE standardization.

Model Priors

Priors were specified for each model parameter, and included both informative and uninformative priors. Priors for the catchability, observation error and process error parameters were relatively uninformative, so unlikely to have much influence on model results. Although the mean of the observation error prior was an order of magnitude higher than that for process error, which seems unrealistic, it is not likely that this affected results (though, this was not examined during the review).

The prior on the intrinsic growth rate parameter, r, was based on life history characteristics of the Deep7 species which suggest these species have low productivity. While the mean of the prior seems appropriate, the c.v. of the prior (0.25) seems too small given the published range of r for low productivity species that the prior was based on (Musick 1999). Also, the value of natural mortality (M) implied by the maximum observed age for the Deep7 species (which suggest a $Z<0.1$, hence M likely <0.05) may indicate very low productivity for the species complex, which is at an extreme of the specified prior.

The priors for the initial population size and carrying capacity parameters were based on the posterior distribution of these parameters from the 2011 stock assessment. This approach is not appropriate as it essentially uses the same data to estimate the prior as is used in fitting the model (using the same data twice). If this approach is to be used, only data new to the 2014 assessment (i.e. not used in the 2011 assessment) should be fitted.

Uncertainty

The uncertainties in key quantities of management interest were estimated through their Bayesian posterior distributions and through sensitivity analyses. While the approach is appropriate, I do not feel that the application in the 2014 assessment captured the true uncertainty in assessment results. This update assessment only investigated uncertainty in some of the model priors, and did not consider uncertainty in the data inputs.

Uncertainty in the key (informative) model priors was investigated through sensitivity analyses, by changing the prior means by either plus or minus 25%. This amount of change is not large, and does not reflect the actual uncertainty in the parameter values (e.g. see comment about r prior above). A more reasonable approach would be to specify the informative priors for the base model such that they actually capture the full uncertainty in their values.

A major issue with the 2014 MHI Deep7 bottomfish assessment update is that the primary sources of uncertainty, related to the catch and CPUE time series, was not considered.

Process Errors

Model outputs associated with process error estimates were not presented, probably because they are not readily available given the model parameterization. However, during the review meeting one of the panel members did a series of calculations to approximate the process errors. These indicated substantial

autocorrelation in the process error time series, indicating a strong declining trend in the estimates. This pattern could result from a decline in productivity over time, from model misspecification, or errors in the data series.

3. *Comment on the scientific soundness of the estimated population benchmarks and management parameters (e.g. MSY, Fmsy, Bmsy, MSST, and MFMT) and their potential efficacy in addressing the management goals stated in the relevant FMP or other documents provided to the review panel.*

The Federal Magnuson-Stevens Reauthorization Act appears to be the primary basis for guiding management of the Hawaiian Deep7 bottomfish fishery. Although the fisheries are predominantly in State regulated waters, State and Federal agencies work together to achieve annual catch limits (ACLs) that should allow sustainable catches while avoiding overfishing and maintaining stock abundance above critical levels.

Under the Fisheries Management Plan, overfishing is defined as fishing in excess of the Maximum Fishing Mortality Threshold (MFMT) which is set equal to F_{MSY}. The critical stock abundance, Minimum Spawning Stock Threshold (MSST), is set at $B_{MSY}(1\text{-}M)$ where M is the natural mortality rate. ACLs are reductions from the Over Fishing Limit (i.e. fishing at MFMT), where the amount of the reduction is based on uncertainties in the stock assessment and other biological considerations and on accountability measures.

The theoretical basis for determining ACLs is sound and should provide an effective process to meet the management goal of sustainable fishing. The caveat is, of course, that the process requires unbiased and relatively precise estimates of the management benchmarks (MFMT and MSST) as well as current population status relative to the benchmarks. Given the concerns with the reliability of the catch and CPUE data used in the assessment and hence the results of the assessment, the quantities required for management are also unreliable.

The current value for MSST is based on an assumed *M* of 0.25, whereas recent ageing validation work suggests a much lower value for *M* (in the order of 0.05) for key species in the Deep7 complex. However, it is worth noting that the surplus production model estimate of B_{MSY} is relatively high at greater than 50% of the estimated carrying capacity. Estimates of B_{MSY} from age-structured models that employ explicit stock-recruitment functions are generally much lower relative to the unfished or carrying capacity level, even for low productivity stocks.

Although the stock assessment is not considered a reliable basis to inform fisheries management, the stability in the recent standardized CPUE series (1994-onward) may provide a basis for management decisions, along the lines sometimes used in data poor situations. The recent CPUE series is considered much more reliable than the earlier series (fisher effects are accounted for, there is less technology creep over that period, and the effort information is more reliable), and the relative stability in the CPUE series suggests that average catches over that 20-year period are sustainable.

4. *Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.*

In general, the method used to project the MHI Deep7 bottomfish complex was appropriate and applied correctly, although the value of results is limited by the data issues described above.

Stochastic projections of the Bayesian state-space model were used to evaluate future stock status under alternative assumptions about current and future (2015 & 2016) catches. The projections appropriately accounted for uncertainty in model parameters, and uncertainty in unreported catches were consistent with those assumed in the assessment. Time trends (autocorrelation) in process error estimates, as described under TOR 2, were not accounted for in the projections and will result in overestimation of stock productivity, although this effect is likely minor given stock projections are only for 3 years.

Ultimately, the rejection of the stock assessment on the basis that the catch and CPUE data are unreliable limits the utility of the stock projections.

5. *Determine whether the science reviewed is considered to be the best scientific information available.*

Although there has been considerable progress since the 2009 and 2011 Hawaiian Islands bottomfish stock assessment, I do not consider the assessment reviewed in 2014 to represent the best scientific information available. This is largely due to incomplete consideration of the uncertainties and potential biases in the catch and CPUE data. Additional work is required to determine whether the uncertainty in these two data series can be adequately estimated so that the longer time series can be used in assessment models. If not, analyses based on shorter more reliable time series may be more appropriate.

6. *Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices. Comment on alternative data sources and modeling, including any potential fishery independent data sources that could be used to supplement fisheries data. Include guidance on single species models, and whether this is possible given the current nature of this multispecies fishery, and difficulties in partitioning fishing effort between species.*

The following suggestions regarding research priorities are organized into a short-term and mid- to long-term list. The short-term list includes projects related to data that is currently available, which could help inform decisions about the structure of the next stock assessment for the Deep7 species complex. The mid- to long-term list includes projects that would allow alternative approaches to the stock assessments in the longer term.

Short term:

Unreported Catch
Differences in results between the 2003-2005 HMRFS survey and the 2005 recall survey should be investigated with the objective of determining whether differences between the two sets of estimates are reconcilable. Also, these data should be used to determine differences between reporting rates for Oahu and other islands to assess whether the extrapolation of the 1990/91 Oahu survey to other islands was appropriate. Ultimately, the goal of this work should be to estimate the uncertainty in unreported catch estimates.

There were suggestions during the review meeting that the HMRFS survey has been (is being) reintroduced. The requirement for complete catch information is integral to the ability to conduct analytical stock assessments, so ensuring an adequate design for this program should be a high priority.

CPUE data
It appears that there is vessel identification information (vessel name since 1948 and HI vessel registration number and U.S.C.G vessel number since 1960) on the catch-effort data records that could substantially improve the quality of a CPUE index. CPUE standardizations could be based on a subset of all vessels ("core fleet"), where vessels are selected on the basis that they appear to have filled out forms consistently. This could resolve much of the single-day versus multiple-day fishing effort issues, if individual vessels tend to fish in a consistent pattern. Possibly, within-year variability in CPUE could be a basis for selecting appropriate vessels to use in the standardization. A primary consideration is that there is reasonable overlap in the "core fleet" over time.

Life-history characteristics
Recent ageing validation research has indicated much higher maximum age for many of the Deep7 bottomfish species, suggesting that on the basis of longevity these species fit into the very-low fish stock productivity category (Musick 1999). However, based on older growth and age-at-maturity information, the Deep7 species appear fit into the medium productivity category. It is likely that with the revised estimates of maximum age, growth and maturity estimates may change and the overall assessment of productivity of the species complex may also change (i.e. from low to very low productivity).

Catch bio-sampling
The current catch sampling program appears to be opportunistic in terms of how fishing events are selected for sampling. If data from these samples are intended for use in future stock assessments, for example in data-poor length-based methods, it is important that they are representative of the catch. Given, exploitation rates appear to be variable among fishing area, it would be expected that length frequency distributions also differ among the fishing areas. A properly designed bio-sampling program could ensure that samples collected are representative of the fishery. If it is not feasible to sample the entire fishery, it would be better to focus sampling on some subset of areas, and ensure a proper design for those.

Alternative methods
There may be additional information available that could be used to investigate alternative approaches to assess stock status. These include: species-specific length frequency data; a long time series of species-specific mean weight-at-age data; and mark-recapture data. The potential utility of these data to help inform the stock assessment should be investigated.

Mid to long term:

Fishery Independent Surveys
Generally, stock assessments that use fishery independent data are more reliable than those based only on fishery dependent (CPUE) data. NMFS has been doing research on fishery independent surveys for the Deep7 species, using a variety of survey approaches. This work should be continued, as ultimately it will provide a much more reliable basis for stock assessments.

Single species assessments
The stock assessment team expressed an interest in moving towards single species stock assessments. Although this direction should be encouraged, issues with developing reliable time series of catch and CPUE data for the Deep7 bottomfish complex will be exasperated for single species.

BRAFs
In 1998, the State established 19 Bottomfish Restricted Fishing Areas (BRAFs) with the objective that these would reduce the overall effort directed at bottomfish fisheries. The number and location of the BRAFs were later (2007) redefined so that they better encompass prime bottomfish habitat. It is unclear if

the BRAFs have been an effective tool in reducing overall fishing effort, and what their impact has been on the overall conservation of the resource. Continuation of the research to investigate the effect of the BRACs on the Deep7 resource should be encouraged.

7. *Draft a report of the WPSAR Panel conclusions and findings, addressing each Term of Reference.*

A WPSAR summary report has been prepared, and represents consensus opinion on all the Terms of Reference.

5. CONCLUSIONS

The WPSAR review process was thorough, effective, and resulted in a comprehensive review of the main Hawaiian Islands Deep7 bottomfish complex stock assessment. The STAT team was helpful and willing to undertake additional analyses, and there was adequate time during the review process to conduct the extra model explorations requested by the review panel. The WPSAR panel reached consensus on all assessment Terms of Reference.

In some areas the assessment documentation was incomplete (e.g. description of model process errors, how unreported catch priors incorporated in model) or additional outputs would have been useful (e.g. posterior/prior plots, influence plots for CPUE standardization, plots of process errors). Guidelines that prescribe standards for content of stock assessment documents would be useful.

There were significant improvements to the Hawaiian Islands deep slope bottomfish stock assessment between the 2009 WPSAR review and the 2011 benchmark stock assessment. The 2014 stock assessment is an update, with only minor change from the 2011 approach. While the major recommendations from the 2009 review have received attention, there are still issues that have not been fully resolved.

The methods used for the 2014 main Hawaiian Islands Deep7 bottomfish complex stock assessment were appropriate and, in general, were applied properly. However, I do not believe the primary data used in the assessment is reliable and therefore assessment results are also not reliable. Uncertainty in the magnitude and trends in historical catch and issues with the CPUE time series, which are likely to invalidate the assumption that CPUE is proportional to stock abundance, limit the reliability and hence utility of assessment results.

I do not consider the 2014 main Hawaiian Islands Deep 7 bottomfish complex stock assessment to represent the best scientific information available as there appears to be additional information that may be useful to improve the reliability and to quantify the uncertainty in the catch and CPUE data that is integral to the assessment.

6. REFERENCES

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Appendix 1: Statement of Work

Attachment A: Statement of Work for Vivian Haist

External Independent Peer Review by the Center for Independent Experts

Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016

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: A stock assessment update of the Main Hawaiian Islands (MHI) Deep7 bottomfish complex was conducted through fishing year 2013. This update used the previous benchmark assessment data analysis, modeling, and stock projection approaches with one minor improvement in CPUE standardization. This update was conducted using up-to-date re-audited bottomfish catch and effort data from Hawaii state commercial catch reports for the years 1948-2013. Unreported catch was estimated and included in the model using catch and effort data from the deep-water bottomfish handline fishery. Model selection techniques were applied to select the best structural form to standardize CPUE. An important improvement to this stock assessment model is the inclusion of information on individual fishermen's skill, or license effect, to standardize CPUE from 1994-2013; this resulted in a significant increase in the explanatory power of the CPUE standardization model but did not have a substantial effect on the estimated trend in CPUE. CPUE in the model was split into two time series (1949-1993, and 1994-2013) in order to accommodate the inclusion of license effect, which could only be tracked starting in 1994 when licenses became uniquely assigned to a fisher/vessel through time. A Bayesian production model was used to estimate time series of Deep7 bottomfish exploitable biomasses and harvest rates and was also used to conduct stochastic short-term projections of future catches, stock status conditions, and associated risks of overfishing in 2015-2016. These projections explicitly included uncertainty in the distribution of estimated bottomfish biomass in 2014 and population dynamics parameters. Results of the catch and CPUE analyses, production modeling, and stock projections are summarized and are used to characterize uncertainty of Deep7 ACLs for fishing years 2015-2016 assuming alternative commercial catch amounts in 2014. Overall, the Deep7 complex in the Main Hawaiian Islands is not currently experiencing overfishing and is not currently depleted relative to the best available information on biological reference points.

The scientific information and assessment to be reviewed have not undergone independent peer review and there is a need to evaluate the data and assessment methods to improve the scientific basis for management. Further, the scientific information to be reviewed has a large potential impact on a valuable fishery important to commercial and recreational fishers in Hawaii and fish consumers in the state. It will

be the foundation of bottomfish management decisions by the Western Pacific Regional Fishery Management Council (WPFMC), NMFS, and the State of Hawaii.

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 as part of a panel review under the auspices of the Western Pacific Stock Assessment Review (WPSAR) process, and in accordance with the SoW and ToRs herein. CIE reviewers shall have excellent oral and written communication skills in addition to working knowledge in fish population dynamics, with experience in the application of stock assessment models in data poor situations sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference.

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 Honolulu, Hawaii during 9-12 December 2014.

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, including:

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2011. Bomb radiocarbon and lead-radium dating of opakapaka (Pristipomoides filamentosus). Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822- 2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-07, 58 p. + Appendices.

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2012. Comprehensive validation of a long-lived life history for a deep-water snapper (Pristipomoides filamentosus) using bomb radiocarbon and lead-radium dating, with daily increment data. Can. J. Fish. Aquat. Sci. 69:1-20. doi:10.1139/f2012-109.

Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. 2011. Stock assessment of the Main Hawaiian Islands Deep7 bottomfish complex through 2010. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM- NMFS-PIFSC-29, 176 p. + Appendix.

Brodziak, J., A. Yau, J. O'Malley, A. Andrews, R. Humphreys, E. DeMartini, M. Pan, M. Parke, and E. Fletcher. 2014. Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016. 59p.

Courtney, D. and J. Brodziak. 2011. Review of unreported to reported catch ratios for bottomfish resources in the Main Hawaiian Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-017, 45 p.

Hospital, J., and C. Beavers. 2013. Catch shares and the Main Hawaiian Islands bottomfish fishery: Linking fishery conditions and fisher perceptions. Marine Policy http://dx.doi.org/10.1016/j.marpol.2013.08.006.

Stokes, K. 2009. Report on the Western Pacific stock assessment review 1 Hawaii deep slope bottomfish. Center for Independent Experts, stokes.net.nz Ltd., Wellington 6035, New Zealand, 27 p.

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.

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 at the Honolulu Service Center, NOAA Fisheries Pier 38, Honolulu Harbor, 1139 N. Nimitz Hwy, Suite 220, Honolulu, HI 96817 during 9-12 December 2014, as specified herein, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 2 January 2015, 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.com, and Dr. David Die, CIE Regional Coordinator, via email to 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.

1 November 2014	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
21 November 2014	NMFS Project Contact sends the CIE Reviewers the pre-review documents
9-12 December 2014	Each reviewer participates and conducts an independent peer review during the panel review meeting
2 January 2015	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
12 January 2015	CIE submits CIE independent peer review reports to the COTR
16 January 2015	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:

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Key Personnel:

NMFS Project Contact:
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Stock Assessment Program Leader
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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, 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

Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016

1. Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.

2. Evaluate the implementation of the assessment model: configuration, assumptions, and input data and parameters (fishery life history); more specifically determine if data are properly used, if choice of input parameters seem reasonable, if models are appropriately specified and configured, assumptions are reasonably satisfied, and primary sources of uncertainty accounted for.

3. Comment on the scientific soundness of the estimated population benchmarks and management parameters (e.g. MSY, Fmsy, Bmsy, MSST, and MFMT) and their potential efficacy in addressing the management goals stated in the relevant FMP or other documents provided to the review panel.

4. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.

5. Determine whether the science reviewed is considered to be the best scientific information available.

6. Suggest research priorities to improve our understanding of essential population and fishery dynamics necessary to formulate best management practices. Comment on alternative data sources and modeling, including any potential fishery independent data sources that could be used to supplement fisheries data. Include guidance on single species models, and whether this is possible given the current nature of this multispecies fishery, and difficulties in partitioning fishing effort between species.

7. Draft a report of the WPSAR Panel conclusions and findings, addressing each Term of Reference.

Annex 3: Tentative Agenda

Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016

Honolulu Service Center, NOAA Fisheries Pier 38, Honolulu Harbor, 1139 N. Nimitz Hwy, Suite 220, Honolulu, HI 96817

9-12 December 2014

Tuesday December 9

1. Introduction
2. Background information - Objectives and Terms of Reference
3. Fishery
    - Operation (presented by PIFSC)
    - Management (Council and PIRO)
4. Data
    - State of Hawaii System
    - Biological data
    - Other data

Wednesday December 10

5. Review of Stock Assessment

Thursday December 11

6. Continue Assessment Review (1/2 day)
7. Panel discussions (Closed)

Friday December 12

8. Panel Discussions (1/2 day)
9. Present Results (afternoon)
10. Adjourn

Appendix 2: Bibliography

Materials provided prior to review:

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2011. Bomb radiocarbon and lead-radium dating of opakapaka (Pristipomoides filamentosus). Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822- 2396. Pacific Islands Fish. Sci. Cent. Admin. Rep. H-11-07, 58 p. + Appendices.

Andrews, A. H., R. L. Humphreys, E. E. DeMartini, R. S. Nichols, and J. Brodziak. 2012. Comprehensive validation of a long-lived life history for a deep-water snapper (Pristipomoides filamentosus) using bomb radiocarbon and lead-radium dating, with daily increment data. Can. J. Fish. Aquat. Sci. 69:1-20.

Brodziak, J., D. Courtney, L. Wagatsuma, J. O'Malley, H. Lee, W. Walsh, A. Andrews, R. Humphreys, and G. DiNardo. 2011. Stock assessment of the Main Hawaiian Islands Deep7 bottomfish complex through 2010. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM- NMFS-PIFSC-29, 176 p. + Appendix.

Brodziak, J., A. Yau, J. O'Malley, A. Andrews, R. Humphreys, E. DeMartini, M. Pan, M. Parke, and E. Fletcher. 2014. Stock Assessment Update for the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2013 With Projected Annual Catch Limits Through 2016. 59p.

Courtney, D. and J. Brodziak. 2011. Review of unreported to reported catch ratios for bottomfish resources in the Main Hawaiian Islands. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-017, 45 p.

Hospital, J., and C. Beavers. 2013. Catch shares and the Main Hawaiian Islands bottomfish fishery: Linking fishery conditions and fisher perceptions. Marine Policy http://dx.doi.org/10.1016/j.marpol.2013.08.006.

Stokes, K. 2009. Report on the Western Pacific stock assessment review 1 Hawaii deep slope bottomfish. Center for Independent Experts, stokes.net.nz Ltd., Wellington 6035, New Zealand, 27 p.

Materials provided during review meeting:

Chen, Y. 2011. Stock Assessment of the Main Hawaiian Islands Deep7 Bottomfish Complex Through 2010 **,** Center for Independent Experts, 26 p.

Klaer, N. 2011. CIE Reviewer's External Independent Report on the assessment of Hawaii deepslope bottomfish. Center for Independent Experts, 26 p.

Moffitt, R., G. DiNardo, J. Brodziak, K. Kawamoto, M. Quach, M. Pan, K. Brookins, C. Tam, and M. Mitsuyatsu. 2011. Bottomfish CPUE standardization workshop proceedings August 4-6, 2008. Pacific Islands Fish. Sci. Cent., Natl. Mar. Fish. Ser., NOAA, Honolulu, HI 96822-2396. Pacific Islands Fish. Sci. Cent. Internal Rep. IR-11-003, 17 p.

Smith, S. 2011. Report on Hawaii Deepslope Bottomfish, Center for Independent Experts, 20 p.

Appendix 3: Review Panel Members

John Neilson, Center for Independent Experts chair
Panayiota Apostolaki, Center for Independent Experts reviewer
Noel Cadigan, Center for Independent Experts reviewer
Vivian Haist, Center for Independent Experts reviewer