Report on the
Western Pacific Stock Assessment Review 1 Hawaii Deep Slope Bottomfish
(WSPAR 1)

Prepared for
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EXECUTIVE SUMMARY

This is the report of the CIE appointed member of the WSPAR 1, review of Hawaii Deep Slope Bottomfish. The report is an individual report prepared for the CIE. The CIE reviewer also contributed to the WSPAR 1 panel report. The findings of the two reports are convergent.

Whilst the Bayesian stock production model and projection methods used in the 2008 stock assessment of Hawaiian bottomfish are regarded as appropriate, shortcomings are identified with key input data. Those shortcomings, especially in the standardized CPUE index, render the stock assessment unsound as a basis upon which to make management decisions.

The data underpinning the assessment have been collected since 1948 and in principle represent a sufficient basis for the development of a credible CPUE index – an essential ingredient of the modelling approach used. However, the data were not collected for the purpose of stock assessment and need further careful exploration and analysis, drawing also on qualitative information as to fishery history and on external data sources, in order that an index of CPUE can be derived as input to the stock assessment. In addition, careful analysis of species composition data and life history information is necessary either to redefine species complexes for analysis, definition of viable single species assessments or justification of the species complex currently assessed. Other issues identified that need further exploration are catch histories, area definitions and various priors used in the assessment.

The documentation of the assessments and supporting analyses, especially CPUE filtering and standardization, needs to be more comprehensive and it is suggested this be accomplished whilst new analyses are undertaken in the coming year. Although shortcomings are found with the data inputs, and hence quantities of interest to management output by the assessment, it is suggested that these can be dealt with effectively by appropriate collaboration between analysts and those familiar with the history of the fishery. Suggestions for ways to progress the CPUE analysis are provided. If resources are committed, it is anticipated that a robust assessment sufficient to guide management decision making for the MHI bottomfish resource could be ready within one year.

BACKGROUND

The Western Pacific Stock Assessment Review (WPSAR) process is a recent, collaborative initiative of the Pacific Islands Fisheries Science Center (PIFSC), the Western Pacific Fishery Management Council (WPFMC), and the NOAA Pacific Islands Regional Office (PIRO), started in response to various legislative and policy drivers. WSPAR is designed to be an independent peer review process with the intention of improving the quality and reliability of stock assessments and the data they are based on. The intention of the WSPAR initiative is to ensure that the best scientific information is available for management purposes.

The review of Hawaii Deep Slope Bottomfish is the first to be conducted under the WSPAR initiative. As the Hawaiian bottomfish are managed under the Magnuson Stevens Act, the review panel is required to consist of those with expertise in stock assessment and fisheries data, with at least one reviewer being from the Center for Independent Experts (CIE). Other reviewers are drawn from the WPFMC SSC and other organizations. To ensure independence, none of the reviewers can have had any involvement in conducting the stock assessment being reviewed. The review of the Hawaiian bottomfish stock assessment, WSPAR 1, was held from 15-19 June 2009 at the Hawaii Tokai International College, Honolulu, Hawaii. Panel members were Milani Chaloupka (SSC), Cathy Dichmont, Robert Skillman (SSC and chair), David Somerton, and Kevin Stokes (CIE) (see appendix 3 for affiliations).

This is the report of the CIE reviewer. By design, the separate report of the review panel is similarly structured. As the review panel reached consensus on all issues, with some matters overwhelmingly important, this report and that of the review panel are very similar in content.

DESCRIPTION OF CIE REVIEWER ROLE AND COMMENTS ON THE REVIEW PROCESS

ROLE

The role of the CIE reviewer as stated in the SOW (Appendix 2) was to participate in the WSPAR 1 Panel Review meeting held at Tokai International College, Kapiolani Rd, Honolulu, from 15th to 19th June 2009, to contribute to the Report of the Panel Review, and to provide an independent report to the CIE. The SOW for the CIE reviewer is somewhat ambiguous, stating on the one hand that all reviewers are expected to contribute to the WSPAR 1 Review Panel Report, documenting the panel's findings, whilst on the other hand stating that there was no requirement for the CIE reviewer to reach consensus with other WSPAR 1 Panel members, instead providing a brief summary of views on the panel's findings and conclusions. In practice, there was no difficulty as the panel reached consensus on all issues.

WSPAR PROCESS

The WSPAR 1 was the first review to be organised by the NOAA Pacific Islands Fisheries Science Center (PIFSC). It is pertinent to make comments on a number of issues, including timing with respect to other activities, documentation and materials, confusion as to the panel reporting process, and facilities.

The review was of the stock assessment and supporting information of the Hawaiian bottomfish resources. In particular, the review had to consider a 2008 stock assessment "update" (Brodziak *et al*, 2009) of an earlier assessment (Moffitt *et al*, 2006). The update had already been presented to the Scientific and Statistical Committee (SSC) of the Western Pacific Regional Fishery Management Council (the Council) in October 2008, leading to a recommendation to increase the TAC for Hawaiian bottomfish. Implicitly, therefore, the assessment and update had already been accepted as a sufficient and sound basis to inform management. As will become clear from this report, the WSPAR 1 panel, and the CIE reviewer, do not consider the 2008 assessment (nor the 2006 assessment used as a foundation for earlier advice) sufficient basis to underpin sound management advice. In reporting this, the panel and the CIE reviewer are aware that the SSC and Council will need to think carefully about how to react to the reviews. It was clear during the review process, especially a final feedback session, that this could be problematic and of some concern.

The 2006 and 2008 assessments, and their consequent soundness to underpin management decision making, quite clearly depend on the way in which catch rate data are analysed and interpreted before being input to the stock assessment. The assessment and advice also depend on a number of other inputs and assumptions. It is therefore very surprising that a review was not held in advance of the assessments being presented to the SCC and used to underpin advice to the Council. This is especially the case as other work had already been contracted by NMFS on the issue of Hawaiian bottomfish stock assessment (Martell *et al*, 2006) and that work clearly indicated the issues that the panel has now discussed and found problematic. That earlier work was not made available to the panel in advance, nor by the review organisers during the review meeting. The panel was only made aware of the earlier contracted work because one of the panellists (Chaloupka) is an SSC member and had previously seen the report.

This highlights another issue relevant to effective review processes – availability of materials and documentation. The Martell et al (2006) report is an excellent first consideration of data sources, data interpretation and stock assessment for Hawaiian bottomfish. It was contracted by NMFS yet not made available to the WSPAR 1 review even though it is highly pertinent. Published work of relevance flowing from the Martell et al study (Zeller *et al*, 2008) was also not pointed to or made available. The documentation that was provided was in many instances incomplete or inadequate to fully understand issues. Often during the review, attempts to understand why decisions had been taken were thwarted due to lack of data or ability to refer to analyses or personnel. This was very frustrating and needs to be attended to in future WSPAR reviews.

This criticism should not be interpreted to imply that all materials were poor or presenters and observers unhelpful – that was not the case. Indeed, presenters and observers (see appendices 1 and 3 for details) were generally very helpful and attempted to aid the panel to consider issues. It was clear

also that if time had been available, many observers could have contributed much more usefully. Frustrations arose mostly because it seems that many analytical or data input decisions were made in the past without clear records being made as to how and, in particular, why, and that in some important cases (for example, discussion on the technology change parameter, C) it was now not possible to recreate the reasoning or to provide supporting analyses.

There is a need to improve documentation and especially explanations as to how and why decisions have been made. This is not difficult but it can be time consuming and needs to be committed to. It is important to commit now to explain and justify past decisions to ensure that important data treatments and assessment might be deemed credible. This should lead either to improved credibility of existing models or perhaps more likely to changes in understanding and hence changes to interpretation and future assessments.

The review panel has made a specific recommendation regarding future stock assessment documentation. The recommendation is to consider the framework recently developed for the Bering Sea and Aleutian Islands Crab SAFE Report chapters. The understanding of the CIE reviewer is that that report will in any case likely form the basis for developing National Standard Guidelines and that the recommendation is therefore fully consistent with NMFS intentions in this regard. Use of these guidelines should help greatly in the future production of comprehensive bottomfish reports.

There was a sense at the meeting that a number of observers, and likely non attendees, have considerable experience that would be of great value in disentangling some of the many key problems regarding catch rate interpretation and catch histories. Only one commercial fisherman was present as an observer and his presence was much appreciated. It was disappointing that more fishers (commercial and non-commercial) were not available to provide insight in to the history of the fisheries and interpretation of catch and effort data. Given that the overwhelming problem with the bottomfish assessment lies with understanding and developing a credible index of catch per unit of effort, it is essential to include such people directly in future workshops. The need is to link qualitative information to quantitative models and future efforts need to include people able to contribute to forming that link.

A problem for the review panel was lack of access to data and dependence on analyses being undertaken away from the venue. Holding the review meeting away from the NMFS Pacific Islands Fisheries Science Center meant that any requests for analyses could not be completed on site. There were difficulties also apparently regarding access to statistical software and documentation of past analyses. For ease of review and especially interactive analyses to aid exploration it is preferable that data can be available directly to reviewers and that there should be direct and ready access to involved analysts and facilities. In terms of availability of personnel, authors of neither the 2006 stock assessment nor the 2008 “update” were available on the first day of the review. The author of the 2006 paper, and architect of at least one key data input, was unavailable for the duration of the meeting. It is unavoidable that personnel will sometimes be unavailable but more thought needs to be given in future review organisation to ensure key people are available as required.

The foregoing is critical. This should not detract from the generally good job done by the review organisers and PIFSC personnel who participated in the review meeting. The criticism is offered in order that future reviews might be even more effective. From the perspective of the CIE reviewer, the review was interesting, as thorough as possible given time, materials and review panel composition, and a good step towards improving the bottomfish stock assessment and basis for advice. Progress could not have been made without the input of PIFSC staff and other participants to all of whom thanks are due.

SUMMARY OF FINDINGS BY TERM OF REFERENCE

1. Review the adequacy and appropriateness of data sources used for the stock assessment, including current research data collection to improve bottomfish stock assessment.

Data sources were reviewed based on a comprehensive presentation by Reginald Kokubun on day 1, discussions with observers and presenters and in the context of analyses conducted and data inputs used to date for stock assessment (reported in other sections of this report).

Starting in 1948 and still ongoing, the State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources (HDAR) has collected a variety of fisheries related data. However, the data were not collected from the outset with the intention of supporting stock assessment. Rather, over time, data were collected for a variety of changing purposes and within a changing data management culture.

A number of problems were identified with the data collected between 1948 and 2002. These included the re-issuing of licenses annually, leading to inability to track vessels or individuals through the time series; poor species identification; lack of specific gear definitions; complexity/difficulty of form filling leading to fishers treating the forms as "trip sales reports" and consequently missing important data entries; and lack of quality assurance on data processing (many missing zeros, range problems, impossible ratios, etc.). In the period 1948 to the mid 1960s, there was either no zero trip reporting or zero trips were apparently not processed. HDAR has been attempting to correct many of the problems with the historic database. This has been done to the extent possible for data from 1989 onwards but it is too large a job to clean the database back to 1948.

The issue of non-reporting (or "delinquency") seems profound. From 1994 onwards it was reported that annual non-reporting varied between about seven and fifteen per cent, averaging about ten per cent. Only since March 2006 has non-reporting led to a legislated refusal to reauthorize licenses. Although this should help reduce non-reporting, other problems still remain, for example with the licensing of dealers. It is clear that even now the estimated commercial landings underestimate commercial catch, perhaps substantially. How that underestimation proportion may have varied through time is unclear. In any case, estimates of non-commercial catch (Zeller *et al*, 2008; Hamm and Lum, 1992, cited in Moffitt *et al*, 2006) suggest total catch estimation may be a much greater problem.

It is clear that HDAR is well aware of the many problems with the existing database, has been working to improve the quality and utility of fisheries data, is concerned to ensure future data collection is more robust, and is keen to enable the best use possible of the existing data for stock assessment purposes. Nevertheless, problems with the database as it exists constrain catch rate analyses and hence data availability for stock assessment.

The database cannot identify multi-day trips prior to 2003. This means it is necessary to filter the data by catch per trip to remove trips likely to be of more than a single day. This is not a major problem in itself and is likely minor compared to other issues. Trips with zero catch were inconsistently reported from 1948 to at least 2006. For much of the time zero catch trips were not reported or processed at all. This means it is necessary to filter the catch per trip data to remove all zero catch trips. Again, of itself, this may not be a major problem in deriving a CPUE index as a proxy for biomass to be used in the stock assessment. It is unfortunate that there is no ability to analyse changes in zero catches but, in general, signals from non-zero catch rates dominate in CPUE analyses which attempt to account for zero catches.

From 1948 to 2002 the HDAR database is of commercial landings rather than catches. Even now, commercial landings underestimate true catch due to remaining problems at least with dealer coverage. If the landings to catch ratio has been constant and the ratio not substantially different to unity, this should not be a problem in interpreting catch and effort data or for the stock assessment. However, it is likely that the landings to catch ratio has varied through time and this could be problematic. It would be useful in future discussions with commercial fishers to try to estimate even qualitatively how the ratio may have changed through time. Of far greater potential importance is the problem associated with unknown and possibly varying non-commercial catches. Estimates of non-commercial catch double the commercial take in the period 1989-1991 (Hamm and Lum, 1992, cited by Moffitt *et al*, 2006) or approaching four times the commercial catch overall (Zeller *et al*, 2008) are disturbing. Even if not trending, a multiplier of two to four does matter in stock assessment terms, especially for yield estimates.

Other issues of note relate to poor documentation not of the HDAR database but more generally to allow interpretation of the data. For example, there is a major change in CPUE starting in 1948. This is due primarily to a big reduction in effort in the period, for which no explanation has been provided. It is possibly associated with a post war increase in effort followed by a quick winnowing of the less successful fishers, but this is speculation. In the period 1958 to 1960 there is a dramatic decrease then recovery in CPUE. This could not possibly reflect a real change in a multispecies complex biomass; during the meeting an HDAR observer noted there were likely data handling problems in this period. In the stock assessment, coefficients are used to reflect technological change. There is no documentation detailing the variety of technological developments and how these relate to the data in the HDAR database. Generally, there is a need to think not just about numbers in the database but also about the many other factors that need to be taken in to account when analysing and interpreting data.

Overall, therefore, there are some serious problems with the catch and effort data available for analysis and that drive the stock assessment outcomes. Nevertheless, the data are what they are and, in the

view of the WSPAR panel and the CIE reviewer, can with appropriate care be used to develop an index of abundance to be used in the stock assessment process. More detail as to how this might be done is included below.

The review concentrated on catch and effort data and the ability to model CPUE. However, data and potential information are available from other sources, most notably fishery independent research, dockside monitoring and sampling, studies of the same or related species in similar areas, as well as environmental monitoring. In general, little attention seems to have been paid to these other sources of information but there is potential to use them. For example, priors on assessment inputs (e.g. R_{max}) could be developed from meta-information as contained in *FishBase* (Froese and Pauly, 2000) and environmental data could be used in CPUE exploration and fitting.

Of specific note was the reported decline in intensity and quality of market sampling for length composition of landings. There is a need to strengthen such sampling to allow species specific monitoring, for example using spawner recruit ratios (SPR).

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

The stock assessment methods applied (Bayesian stock production model fit using WinBUGS software (Lunn *et al*, 2000), and projections) are appropriate and could in principle provide a sound basis for the provision of management advice for the BMUS and/or Deep 7 complex. However, the outputs of the assessment model that inform management are driven by assumptions and data as presented to the model, those data inputs, in turn, being influenced by assumptions and decisions made when analysing raw data. The raw data available are of variable pedigree and quality and it is hard to be convinced that the analyses conducted to date are appropriate or of sufficient rigour to provide confidence in stock assessment inputs, consequent model outputs or resulting management advice. The problem is compounded by limited stock assessment diagnostics and appropriate sensitivity testing (of quantities of interest to management given alternative structural assumptions).

The catch rate analysis is intended to provide as clean as possible an index of year effects which are then interpreted by the assessment as a biomass index which is scaled by the estimated catchability, q, to provide a biomass estimate. Important parameters in the assessment are the prior on q which is highly informative and scales the catch rate index to estimate absolute biomass; the prior on B_{init}, which together with the scaled catch rate index provides an overall, scaled absolute biomass trend; the prior on R which together with the catch rate index (especially the post 1948 rapid increase) informs the model estimate of R; the prior on K which together with B_{init}, the catch rate index and R, inform the model estimate of K; the observation error τ^2 which determines the degree of smoothing in the fit of biomass to the catch rate index; the process error term σ^2 which is aliased with q; the technology change fixed coefficients C which effectively multiply the catch rate index in given periods; and the fixed value habitat proportions which effectively determine the archipelagic status.

The purpose of the CPUE standardisation is to remove variance due to catchability changes through time to leave as clean as possible a signal on the year effects. The resulting index of year effects is then taken in the stock assessment model to approximate annual relative biomass. In the assessment, that relative index is then scaled by *q* to inform absolute biomass trends. The CPUE standardisation is therefore the key element in the entire process. The resulting index is the key determinant of stock status and consequent advice. It is imperative that the index be the best possible and that it is credible. If the CPUE index is not credible, neither is the assessment nor the advice.

The effect of alternative CPUE inputs to the stock assessment can clearly be seen by looking at the difference in outputs between the 2006 assessment and the 2008 "update". The two assessments differ in the methods used but both at heart do the same thing – they convert a CPUE index to a biomass trend, estimate production, R, and other parameters and derive parameters of interest to management (F_{status} and B_{status}). The two assessments, using different CPUE inputs, provide very different derived parameters and management implications.

The current "standardised" series is seriously tainted by catchability variation and trends which need to be removed or at least minimised. The necessary task therefore is to examine in detail the catch and effort data, and any ancillary data and qualitative information of relevance, and to explore alternative CPUE models to derive as clean a year-effect signal as possible.

Issues concerning the appropriateness of the assessment for the species complex are dealt with under Term of Reference 3.

3. 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.

CPUE Standardization

As noted already, CPUE standardization is the overwhelmingly important issue in the bottomfish assessment. Together with modifications introduced through technology change coefficients (the C parameter introduced originally in the 2006 assessment (Moffitt *et al*, 2006)), the standardized index is the primary determinant of perceived MHI stock status.

The Review Panel discussed standardization at length, both from the perspective of what might be done to progress the development of a credible index, and from the perspective of how status and projected catches might be affected depending on analytical decisions. The panel had a common understanding of CPUE standardization as the statistical process of identifying as clear a signal as possible of pure year effects which could be interpreted as a proxy for biomass. The usual standardization approach is to use Generalized Linear Models (GLMs) or variants thereto that allow more flexibility either by admitting

non-linear predictors (GAMs) or the inclusion of random effects models in to the predictor (GLMMs or GAMMs).

Before embarking on the statistical exploration and standardization it is of course necessary first to filter (or "groom") the dataset. Because of the difficulties identified with the HDAR dataset, some filtering is unavoidable. The removal of zero trip records is essential because of the inconsistent recording of zero catch trips. Removal of multi-day trips is also essential due to recording ambiguities. This is done by the simple approach of removing trips with unreasonably large single day trip catches.

Both of the filters are necessary and the panel agreed that they should be used. Both of these filters were used when preparing CPUE for use in stock assessment both by Moffitt *et al* (2006) and Brodziak *et al* (2009). Moffitt *et al* applied a further filter – removal of records where the BMUS catch formed less than 90% of the total catch. Brodziak *et al* applied a different filter – removal of records where the BMUS catch formed less than 50% of the catch. The effect of applying the different filters can be seen in Figure 6 of Brodziak *et al*. Unlike Moffitt *et al*, Brodziak *et al* also applied a simple GLM to standardize the CPUE. That standardization, fitting only year, month and area effects, together with the different catch ratio filter, led to a very different CPUE series being input to the stock production model (see Figure 11 of Brodziak *et al*).

During the review, the panel requested and were supplied a simple plot of the nominal CPUE with different BMUS catch ratios applied ranging from zero to 90% (as used by Brodziak *et al*), and including 50% (as used by Moffitt *et al*). There is a clear change in the nominal CPUE series that occurs somewhere between application of the 80% and 90% filters. During the review, on request, a plot of the species composition by decade was provided that clearly shows the change in proportions of key species (especially Kahala, Taape and possible Uku). It is not surprising that changing the filter from 50% to 90% makes such a difference, especially given the changes in catch composition that have occurred through time. What is surprising, given the clear change caused by filtering and the clear dependence of status determination on CPUE index input to the assessment, is that no explorations were apparently made or justifications given for the choice of filters used in the 2006 and 2008 assessments.

This is not a criticism of the change in filter from 90% to 50% for the 2008 assessment. If a filter is to be applied, the choice of 50% is preferable as it retains far more of the data for the standardization process (see Figure 5 of Brodziak *et al*). It is debatable, however, whether any filter is necessary and a preferable approach is to use all available trips (filtered just for zeros and multi-day trips) and to model explicitly changes in catch ratio. During the review, a simple GLM standardization models was fit to all day trip data (i.e. 0% filter) and to that data set with a simple, linear catch ratio variable. The standardized index fit to all trip data was similar to the 50% filtered index used in the 2008 assessment but did differ somewhat between 1960 and 1980. The fit explained a similar amount of variance (17%) as the 50% filtered index. When standardized to include a catch ratio effect, but still with no ratio filter, 32% of the variance was explained and the index showed a more dramatic decline from 1980 onwards.

A further exploratory analysis was requested and performed during the meeting. In the 2006 and 2008 assessments a 4 level coefficient, C, representing technological change in catchability, was used. This has the effect of changing the CPUE index as "seen" by the production model, effectively reducing recent CPUE relative to early CPUE by a factor of 0.7/1.2 = 0.58. This is not an appropriate way to introduce changes in catchability in to the assessment. The preferred way to treat changes in catchability is in the standardization process, the obvious mechanism being to use the OFFSET function available in many software packages (or to use dummy variables). A simple GLM run for the panel using the C parameter values as an offset increased the variance explained from 17% to 23%. Importantly, the fit also changed the contributions of the different effects in the model, in particular markedly reducing the mean square contribution from the year effect.

The panel did not discuss how better to incorporate the changes in technology in to analyses. A CPUE workshop (Moffitt *et al*, 2008) was reported on that has made a start to progressing understanding of changes in the fishery through time and how these may have affected catchability. However, there was no connection made in the review between the discussions in the workshop and analyses that might be contemplated to explore the development of a credible CPUE index. Instead of using the C coefficients reported in Moffitt *et al* (2006) and Brodziak *et al* (2009), one way forward might be to use a workshop approach to develop informed priors on C as a function of time (as combinations of multiple factors separately considered). In principle these could be incorporated in the Bayesian production model but a better approach would be to use those time varying priors to bootstrap a standardized CPUE index for use in the assessment model. Doing this would provide a more credible and transparent index but would also help better to define the real uncertainty associated with the CPUE index (input in the assessment as observation error, τ^2).

The review panel did not discuss at length the definitions of area used in the CPUE standardization. The definitions were described but there was no opportunity to delve in to the implications of alternative definitions. From the few minor exploratory runs undertaken during the review, it is clear the standardized CPUE will be affected in detail by the form of the model and which variables are included. If interaction terms are used, especially with area, it should be expected that the specific area definition used will matter.

Changes in catchability through time can be due to technological advances but also environmentally driven changes in species composition, spatial distribution or productivity. The panel could not explore the relationship between CPUE and possible environmental correlates but it is clear that some consideration of this is necessary in any analysis. Obvious candidate variables to be investigated include sea surface temperature (SST) and height (SSH).

The minor explorations during the meeting did not lead to any definitive conclusion as to a "best" CPUE index. They did, however, clearly demonstrate the need for a more careful exploration of the catch and effort data and development of a credible CPUE index. In doing this, it is important also reasonably to characterise errors associated with that index. Currently, the CPUE index is presented to the model with assumed observation error, τ^2. Sensitivity tests to observation error (Figure 26 of Brodzial *et al*)

demonstrate the importance of correct error characterisation. In the extreme, if observation error is "too big", the model fits breaks down.

Overall, whilst the foregoing is somewhat critical of the CPUE filtering and standardization to date, it seems that with due care and attention and input from those familiar with the datasets and history of the fishery, it should be possible to develop a credible CPUE index as input to the assessment. A credible model is likely to require either Generalized Linear Mixed Models (GLMMs) or Generalized Additive Mixed Models (GAMMs) formulated to include spatial and temporal effects, technological changes, and other quantitative and qualitative factors affecting catchability. This is because a mixed model will allow investigation of correlation structure in the year effects as well as interactions, not just main effects of Year, Month, and Area. Some concern was noted in the review that attempts to include interactions, especially with area, would lead to unbalanced models. The simple way to deal with this issue, if it is important, is to bin data differently by area or, for example, to bin by quarter instead of month. Exploration is required.

The review panel, including the CIE reviewer made some specific recommendations as to future CPUE analysis. These are repeated here for completeness.

- Data set creation
  - Create a data set with catches > 0 and < 1500 lbs (as currently filtered).
  - Compute the ratio $Catch_{BMUS}/Catch_{all\ species}$ as a possible index of targeting and add to data set.
  - For the assessment catch, remove ta'ape, kahala, armorhead and any non-BMUS.
- Data exploration
  - Explore all data comprehensively using for example regression trees to help identify factors that could be included in the data standardization model.
  - Possible factors might include depth (inshore/offshore), targeting, technology changes, spatial variability due to aggregating statistical fishing areas, and environmental effects.
- Standardization model
  - Use Fishing Year, Month, and some scientifically defensible definition of fishing area and interactions between those factors.
  - Investigate aggregating the HDAR statistical areas into 4 main MHI island groups.
  - Further explore the potential use of the BMUS ratio ($Catch_{BMUS}/Catch_{All\ species}$)
  - If using the C parameter for technological changes in catchability, use this as an offset in the standardization.
  - Preferably put factors/variables for fishing power directly in the CPUE standardization model even if applied to all records in a year.
  - Investigate various environmental factors, for example SST and SSH.
  - Flag the years 1958-1960 inclusive as bad due to data errors and treat as outliers (i.e., fit dummy variables [1,0] to identify bad years).

Sensitivity Testing

Issues with the stock assessment model relate wholly to the data inputs and assumptions, the primary issues of concern being the CPUE index (and lack of confidence that it represents biomass, as assumed in

the stock assessment) and the lack of insight into or account taken of potential unreported catches. As noted above, unreported commercial and non-commercial catches might be substantial.

The stock assessment outputs of interest to management (F_{status}, B_{status}, yield estimates are sensitive to model inputs. In particular, as can be seen by comparison of the Moffitt *et al* (2006) and Brodziak *et al* (2009) assessments, or through tests conducted during the review, quantities of interest to management are affected by the filters applied to and standardization of CPUE data (impacting the MHI status), the assumed proportion of the habitat in the MHI, Mao and Ho'omalu zones (which affects archipelagic status but will become less of an issue from June 2011 – see Term of Reference 4), and the quantum of total catch assumed (which affects potential yields). The latest assessment includes some within-model characterisation of uncertainty (though probably an underestimate) but provides no insight as to the uncertainty created in management advice by the primary sources of uncertainty (CPUE, including accounting for technology change; habitat proportions; and total catch).

Species complex

The Fishery Management Plan (FMP) for Bottomfish and Seamount Groundfish Fisheries in the Western Pacific Region seeks to manage a wide range of bottomfish (the so called Bottomfish Management Unit Species or "BMUS") and it is natural therefore to attempt to assess the BMUS species complex as a whole unit. The assessment implicitly assumes that it is a reasonable to model the total catches of the BMUS complex even though that complex comprises a range of species with quite different life histories (*inter alia* fast and slow growing snappers, jacks, an armorhead and a grouper). To be managed as a whole, the species complex would ideally consist of species with similar life histories, reasonable stability in biomass proportionality and consistent proportionality in catchability. All of these conditions seem to some degree not to be met. The review panel has noted some of the issues and comments are made in various sections below. It would be reasonable, whether managing or assessing BMUS, the so called Deep 7 complex (six eteline snappers and an hermaphroditic grouper, hapuupu) or any other combination of species to fully explain and justify the rationale and limitations on the complex definition. This is especially the case given that two species (onaga and ehu) have previously been viewed as overfished.

In line with the panel recommendations, it is suggested that consideration be given to whether it is feasible to undertake separate assessments (including relevant CPUE analyses) of species most likely to be overfished (onaga and ehu). Alternatively, or possibly in addition, an assessment of the deep 7 complex could be attempted to set a Deep 7 TAC directly, rather than by taking a multiplier from the BMUS assessment derived catch limit. It is not at all clear that working directly to derive a Deep 7 TAC would result in a higher or lower TAC. Alternative assessment splits might also be explored based on life history and fishery characteristics as well as data availability. As previously done, even while managing a complex based on a combined assessment, use of species specific SPR could still be used to inform management. As noted under Term of reference 1, this would require reinvigorated market sampling programmes.

The issue of modelling the species complex is non-trivial but does require careful consideration. The FMP may require management of the BMUS complex but it is difficult to have confidence that the science currently lends adequate support to that aim. An exploration of the reasonableness of the approach may provide confidence or alternative species splits might be feasible, as suggested above. What is clear is that the current stock assessment model does not explicitly address issues related to modeling a species complex.

The review panel considered this potentially to be a major deficiency in the current stock assessment. Specific problems associated with this issue but not attended to in the model include the use of a single parameter R_{max} that does not adequately reflect the individual species life histories but also does not reflect changes in a composite R_{max} that would have occurred through time as the species composition changed. Some ways of dealing with this were suggested by the review panel, including with reference to relevant published work (Jiao *et al*, 2008). The suggestions include the use of a multi-level and/or a time-varying prior for R_{max}. While these approaches are well worthy of investigation, they should not be afforded the highest priority.

Model Diagnostics

For the 2008 assessment, regardless of issues raised above relating to credibility of the CPUE index and other input data, the main assessment document (Brodziak *et al*, 2009) does not contain diagnostics sufficient to make a judgment as to model convergence. The limited diagnostics presented at the review meeting did not convince that convergence had been achieved.

Both in the assessment documents and presentations, only limited diagnostics were provided on CPUE standardization or the stock assessment. For the future, it is essential to see good diagnostics of both the CPUE standardization and the Bayesian stock assessment. For the assessment, it is important to see how the likelihood components are affected by model assumptions and parameterisation; to compare directly posterior and prior distributions (graphically on the same plots); and convergence performance, graphically as multiple traces and as standard convergence statistics. It is always useful to see the convergence diagnostics not just for main parameters but also for the derived parameters (F_{status} and B_{status}). These issues are not dwelt on here as it is anticipated that future documentation (see below) will be more comprehensive.

Documentation

During the review, the panel had difficulty evaluating much of the stock assessment and related work because of insufficient documentation. To be clear, the issue is not bad documentation *per se*, just insufficient. Documentation was insufficient in many respects as commented on by the panel report and throughout this review. Generally, although the primary documentation was deemed insufficient, attempts were made in the presentations to fill gaps. This was especially the case for the very extensive presentation on the stock assessment itself by Jon Brodziak, to whom thanks are due. If Jon Brodziak had been available on the first day of review, many questions might more readily have been answered.

The panel noted that there is no pre-specified format to guide the content and structure of documents submitted for formal consideration by the SSC and the WPFMC. Developing this thought, the panel recommended that documentation for the next stock assessment should be comprehensive, specifically suggesting that it follow a similar format to the recently developed framework for the Bering Sea and Aleutian Islands Crab SAFE Report chapters. The panel also noted the need for future assessment document to be more explicit in a variety of respects (descriptions of equations; detailed convergence diagnostics; and detailed rules for data filtering).

It is very difficult generally for stock assessment practitioners to cover all bases as fully as reviewers might like. From fishery regime to fishery regime the standard expected or required varies. The documentation supplied for this review, though deemed insufficient to allow a full evaluation during WSPAR 1, was no more or less comprehensive than many other cases. What stood out in this case, however, perhaps because of the requirement for review, was that many of the analytical decisions taken could not readily be explained or justified. This highlights the need for comprehensive documentation to underpin credible analyses but also to provide a sound basis for future analyses. The lack of explanation may have stood out in this case not just due to lack of comprehensive documentation of the latest assessment, but because of previous lack of comprehensive documentation of decisions carried through to the latest assessment combined with lack of personnel at the review who were previously involved.

There is a need to improve documentation. This needs to be done in conjunction with new analyses. It is not clear how much time the assessment team has to work on the bottomfish compared to other stocks but there is a clear need to commit time in this area if recommended analyses and comprehensive documentation are to be delivered. With respect to the panel recommendation to follow the format of the Bering Sea and Aleutian Islands Crab SAFE Report chapters, this reviewer also agrees, though noting the intention to use that report to develop National Standard Guidelines for assessment reporting. The intention is therefore already clear and the recommendation is simply to follow emerging NSG or work to that end regardless.

Overall

Overall, the Bayesian stock production model used to assess the BMUS complex is appropriate in principle as a means of providing management advice. Further, as reiterated by the review panel, the assessment team is highly competent. There can be little doubt that if the major sources of uncertainty are explored and adequately accounted for using appropriate priors and sensitivity tests, then future assessments will be sufficient to inform sound management decisions.

4. 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.

In line with comments on data inputs and the stock assessment, above, because of the sensitivity of the stock assessment to input data it is not possible to conclude that the estimated management benchmarks are sound for management purposes.

This is not a reflection on the stock assessment methodology or ability of the involved scientists to deliver a robust stock assessment in the future. Rather, it is a reflection on the difficulties of interpreting and analysing data collected for purposes other than stock assessment. If issues relating to data interpretation and analysis are resolved (which is possible within the next year) then it will be possible to use the assessment methods already developed to estimate robust population benchmarks and management parameters.

The assessments to date have included data for the Ho'omalu Zone and Mau Zone in the NWHI region, and for the MHI. The MHI fishery has been the primary catching area with substantial commercial and non-commercial effort at least since 1948 (and likely earlier) while the NWHI region has had a much smaller scale, predominantly commercial fishery. In June 2011, fishing will stop completely in the NWHI region under jurisdiction of the Papahanaumokuakea Marine National Monument. Future fishery management focus will therefore be on the MHI. Although there is demographic connection between the NWHI and MHI, there is no information to parameterise a complex assessment model allowing for movement between the regions. The simplest approach to future assessment and management is to regard the NWHI stocks as separate from the MHI and to concentrate assessment efforts solely on the MHI.

Although the 2009 stock assessment does not provide a sound basis for decision making, it is likely the MHI region may be overfished, or at least that some areas or species within the MHI area may be. While analysing data to develop a credible CPUE index, it would be worthwhile exploring in detail whether it is possible reasonably to disaggregate data by area sufficient to develop area specific CPUE and assessments.

Although this would be a useful exploration, the priority should be on development of a credible single area MHI. Coupled with judicious use of species specific SPR, this should be sufficient to ensure credible management.

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

The methods used to project future population status are appropriate and technically well applied. However, the caveat as to their use to inform management decision making is as for the stock assessment itself, that the primary driver of stock status perception and potential yields is the

standardized CPUE index which is not credible. Just as the use of the CPUE index undermines the soundness of the stock assessment outputs, so too are the projected outputs undermined.

In line with comments on the stock assessment, therefore, if issues relating to the CPUE index (and other assessment inputs) are resolved, use of the current projection methods would be appropriate to inform decision making. In making future projections, and in line with comments above, it is important to characterise as fully as possible uncertainty in future estimates of status and future projections. That uncertainty needs to reflect not just within model errors that affect probabilistic statements, but also model (structural) uncertainty introduced through use of alternative CPUE indices (and technology change coefficients), perhaps habitat ratio assumptions, and catch histories.

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 panel was provided late in the week with a brief overview of intended NOAA Fisheries market sampling and a possible attempt to develop fishery independent surveys. There was little opportunity to explore these plans in detail. The reinvigoration of the market sampling is good news and should be encouraged. Whatever progress is made in developing a BMUS (or similar) stock assessment, market sampling provides one direct means (SPR estimation) of monitoring individual stocks.

It is easy to see problems, and hard to see light, with all survey methods available to estimate biomass or develop a relative biomass index. The bottomfish terrain and complex spatial distribution of multiple species make surveying exceptionally difficult. Line surveys for even single species are problematic and conventional tagging to estimate biomass (as opposed to movement) is expensive. Acoustic methods are fraught with problems (species identification, species target strength relationships, shadow zones, etc). It was not possible in the limited time available and with no documentation provided to consider the many issues. If it is logistically possible to develop a fishery independent index for the Hawaiian bottomfish, of course this should be encouraged. It is not possible in this review to comment further.

From the review of the stock assessment, the panel made a number of recommendations for future work. These are repeated with slight changes below and in order of priority as judged by the CIE reviewer.

Immediate (within the year)

1. Comprehensively explore MHI CPUE data and qualitative information in close collaboration with HDAR and fishers throughout the process. Develop credible CPUE standardization, including if appropriate alternative indices.
2. Attempt to reconstruct non-commercial catch histories, possibly in the same collaborative process used for (1).

3. Consider using meta-data to develop informative prior on R_{max}. Develop prior for B_{init} in collaborative process above (1).
4. Assess MHI as single stock to develop population benchmarks and management parameters. Ensure appropriate sensitivity testing to CPUE uncertainty.

Short term

5. In order to monitor the status of individual species in the complex, undertake length frequency sampling to calculate species specific SPR (or proxy).
6. Consider other single species indicators that might be used to monitor the status of individual species.

Medium term

7. Implement improved non-commercial catch data collection system.
8. Investigate the utility of a metapopulation assessment model, with a spatially resolved island-specific structure (Hawaii, Maui complex, Oahu, Kauai), to better address island-specific fisheries risk as well as local and regional management options.
9. If the management measures are shown to be sensitive to dispersal rate, then get better species dispersal information to support the potential use of meta-population assessment model.

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- Jiao, Y., Hayes, C., Cortés, E. 2008. Hierarchical Bayesian approach for population dynamics modelling of fish complexes without species-specific data. ICES Journal of Marine Science, 66: 000–000.
- Lunn, D.J., Thomas, A., Best, N., Spiegelhalter, D. 2000. WinBUGS -- a Bayesian modelling framework: concepts, structure, and extensibility. Statistics and Computing, 10:325--337.
- Martell, S.J.D., Korman, J., Darcy, M., Christensen, L.B., Zeller, D. 2006. Status and Trends of the Hawaiian Bottomfish Stocks: 1948–2004. University of British Columbia. Contractors Report to NMFS.
- Zeller, D., Darcy, M., Booth, S., Lowe, M.K., Martell, S. 2008. What about recreational catch? Potential impact on stock assessment for Hawaii's bottomfish fisheries. Fisheries Research 91: 88–97.
- Hammond, T.R., Trenkel, V.M. 2005. Censored catch data in fisheries stock assessment. ICES Journal of Marine Science 62:1118-1130.

APPENDIX 1

Bibliography of Material Provided for the Review

The following documents were received before the review:

1. Agenda for WPSAR 1 – Hawaii Deepslope Bottomfish Review. (Agenda-04June.doc).
2. WPSAR Hawaii Bottomfish Assessment Review Terms of Reference (WPSAR Terms of Reference.doc)
3. Brodziak, J. 2007. An Investigation of Alternative Production Models to Assess the Hawaiian Bottomfish Complex. Administrative Report H-07-01. (PIFSC_Admin_Rep_07-01.pdf).
4. Brodziak, J. 2008. An Assessment of the Risk of Archipelagic Overfishing for Alternative Total Allowable Catches of Deep-7 Bottomfish in the Main Hawaiian Islands. Administrative Report H-08-03. (PIFSC_Admin_Rep_08-03.pdf).
5. Brodziak, J., Moffitt, R., DiNardo, G. 2009. Hawaiian bottomfish assessment update for 2008. Administrative Report H-09-02. (PIFSC_Admin_Rep_09-02.pdf)
6. Humphreys, R.L., Uchiyama, J.H. 2009. Hawaiian life history parameters. NOAA Pacific Islands Fisheries Science Center draft document distributed for review purposes. (Hawaii_Bottomfish_Life_History_Tables.pdf)
7. Kawamoto, K, Field guide for the Hawaiian Islands botoomfishing vessels and gear. (Bottomfish Fishing Boats and Gear v5.pdf)
8. Moffitt, R.B., Kobayashi, D.R., DiNardo, G.T. 2006. Status of the Hawaiian Bottomfish Stocks, 2004. Administrative Report H-06-01. (PIFSC_Admin_Rep_06-01.pdf).
9. Moffitt, R.B., DiNardo, G., Brodziak, J., Kawamoto1, K., Quach, M., Pan, M., Brookins, K., Kokubun, R., Tam, C., Mitsuyasu, M. 2008. CPUE Standardization Workshop Proceedings August 4-6, 2008. NOAA Pacific Islands Fisheries Center draft document for review purposes only. (Hawaii Bottomfish CPUE Workshop Proceedings_DRAFT_28 April2009.pdf)

The following presentations, in order, were made during the meeting and hard copy and/or electronic versions distributed.

1.	Kurt Kawamoto	Field Guide for the Main Hawaiian Islands Bottomfishing Vessels and Gear
2.	Reginald Kokubun	Commercial Fisheries Dependent Data
3.	Paul Dalzell	History of management of bottomfish fishing in Hawaii
4.	Robert Humphreys	HAWAII DEEPSLOPE BOTTOMFISH Life History of “Deep 7” Species
5.	Gerard diNardo	CPUE Standardization Workshop and Fisherman Interviews
6.	Jon Brodziak	Hawaiian Bottomfish Assessment Update for 2008
7.	Jon Brodziak	WSPAR Request 1
8.	Jon Brodziak	WSPAR request 2

APPENDIX 2

Attachment A: Statement of Work for Dr. Kevin Stokes (stokes.net.nz Ltd)
External Independent Peer Review by the Center for Independent Experts
WPSAR 1 – Hawaii Deepslope Bottomfish

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract to provide external expertise through the Center for Independent Experts (CIE) to conduct impartial and independent peer reviews of NMFS scientific projects. This Statement of Work (SoW) described herein was established by the NMFS Contracting Officer's Technical Representative (COTR) and CIE based on the peer review requirements submitted by NMFS Project Contact. CIE reviewers are selected by the CIE Coordination Team and Steering Committee to conduct the peer review of NMFS science with project specific Terms of Reference (ToRs). Each CIE reviewer shall produce a CIE independent peer review report with specific format and content requirements (**Annex 1**). This SoW describes the work tasks and deliverables of the CIE reviewers for conducting an independent peer review of the following NMFS project.

Project Description: WPSAR 1 will be an assessment review of the Hawaiian multispecies, deepslope bottomfish resource. This will be the first review conducted under the WPSAR (Western Pacific Stock Assessment Review) process. The WPSAR peer review panel will be composed of one chair, one CIE reviewer, one WPRFMC, SSC (Western Pacific Regional Fishery Management Council, Scientific and Statistical Committee) representative, and two additional peer reviewers. Bottomfish are an important commercial and recreational resource in Hawaii. Although the resource is managed as a single archipelagic multispecies stock, the fishery itself is divided into three separate geographical zones. The most recent assessment conducted in 2008 with data through 2007 reported that, although resources in the Main Hawaiian Island zone are greatly depleted, that the archipelagic stock is neither overfished nor experiencing overfishing.

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: One CIE reviewer shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. The CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein. The CIE reviewer shall have the expertise, background, and experience to complete an independent peer review in

accordance with the SoW and ToRs herein. CIE reviewer expertise shall include fish stock assessment, mathematical modeling, and statistical computing.

Location of Peer Review: The CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled in Honolulu, Hawaii during 15-19 June 2009.

Statement of Tasks: The CIE reviewer 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 (name, affiliation, and contact details) 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 reviewer with the background documents, reports, foreign national security clearance, and information concerning other 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., name, contact information, birth date, passport number, travel dates, and country of origin) to the NMFS Project Clearance 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/sponsor.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 the CIE reviewer all 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 on where to send documents. The CIE reviewer shall read all documents in preparation for the peer review.

This list of pre-review documents may be updated up to two weeks before the peer review. Any delays in submission of pre-review documents for the CIE peer review will result in delays with the CIE peer review process, including a SoW modification to the schedule of milestones and deliverables. Furthermore, the CIE reviewer is responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein.

Panel Review Meeting: The CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs. **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.** The 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 in the contract SoW. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The

CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

All reviewers are expected to review documents prior to the workshop, participate in panel discussions critiquing and evaluating the assessment, and contribute to preparation of the Review Panel Report documenting the panel's findings for each Term of Reference. The review process will be run by a chair who may also serve in a limited review capacity and will prepare an executive summary for the workshop panel report.

The Review Panel Chair is responsible for compiling, editing, and submitting the Review Panel Report to the WPSAR Coordinator by a deadline specified in the assessment schedule. At the start of the review process the Chair will assign each panelist specific duties, such as rapporteuring or drafting specific Review Panel Report sections.

Contract Deliverables - Independent CIE Peer Review Reports: The CIE reviewer shall complete an independent peer review report in accordance with the SoW. The CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. The CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to Summary Report: The CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report. CIE reviewers are not required to reach a consensus, and should instead provide a brief summary of their 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 the 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 in Honolulu, Hawaii, from June 15-19, 2009, as called for in the SoW, and conduct an independent peer review in accordance with the ToRs (Annex 2);
3) No later than July 6, 2009, the 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, David Die, 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;
4) CIE reviewers shall address changes as required by the CIE review in accordance with the schedule of milestones and deliverables.

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

11 May 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact

1 June 2009	NMFS Project Contact sends the CIE Reviewers the pre-review documents
15-19 June 2009	Each reviewer participates and conducts an independent peer review during the panel review meeting in Honolulu Hawaii
6 July 2009	CIE reviewer submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
20 July 2009	CIE submits CIE independent peer review reports to the COTR
27 July 2009	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be made through the Contracting Officer's Technical Representative (COTR) who submits the modification for approval to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the CIE within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and Terms of Reference (ToR) of the SoW as long as the role and ability of the CIE reviewer to complete the SoW deliverable in accordance with the ToRs and deliverable schedule are not adversely impacted. The SoW and ToRs cannot be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review report by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, this report shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (the 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 have 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 report shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon notification of acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE report in *.PDF format to the COTR. The COTR will distribute the approved CIE reports to the NMFS Project Contact and regional Center Director.

Key Personnel:
William Michaels, Contracting Officer's Technical Representative (COTR)
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NMFS Project Contact:
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Pacific Islands Fisheries Science Center
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808-983-5373

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, 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 detailed summary of findings, 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 proceedings and findings of the meeting, 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 as separate appendices as follows:
   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

WPSAR 1 – Hawaii Deepslope Bottomfish

10. Review the adequacy and appropriateness of data sources used for the stock assessment, including current research data collection to improve bottomfish stock assessment.
11. Review the assessment methods used: determine if they are reliable, properly applied, and adequate and appropriate for the species, fisheries, and available data.
12. 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.
13. 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.
14. Evaluate the adequacy, appropriateness, and application of the methods used to project future population status.
15. 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.
16. Draft a report of the WPSAR Panel conclusions and findings, addressing each Term of Reference, for presentation to the Council's Scientific and Statistical Committee's 101st meeting, and the Western Pacific Council's 145th meeting in July 2009.

Annex 3: Tentative Agenda
WPSAR 1 – Hawaii Deepslope Bottomfish
Location pending, Honolulu, Hawaii
15-19 June 2009
9:00 am – 5:00 pm

Monday – Introduction

Background information - Objectives and Terms of Reference

Fishery – Operation (presented by PIFSC)

Management (Council (and PIRO?))

Data – State of Hawaii System

CPUE Workshop

Biology – PIFSC

Tuesday – Finish Introduction (1/2 day)

Start Assessment Review (1/2 day)

Wednesday – Continue Assessment Review

Thursday – Q&A if needed

Write Report

Friday - Finish Report

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APPENDIX 3
Review Meeting Participants

Review Panel

Milani Chaloupka	Ecological Modeling Services, Australia
Cathy Dichmont	CSIRO, Australia
Robert Skillman	Chair of Review Panel
Dave Somerton	Alaska Fisheries Science Center, NOAA Fisheries, U.S.A
Kevin Stokes	stokes.net.nz Ltd, New Zealand (and CIE Reviewer)

Observers (* denotes also presenter)

Jon Brodziak*	Pacific Islands Fisheries Science Center, NOAA Fisheries
Kark Brookins	Department of Land and Natural Resources, State of Hawaii
Paul Dalzell*	Western Pacific Fishery Management Council
Gerard DiNardo*	Pacific Islands Fisheries Science Center, NOAA Fisheries
Robert Humphreys*	Pacific Islands Fisheries Science Center, NOAA Fisheries
Kurt Kawamoto*	Pacific Islands Fisheries Science Center, NOAA Fisheries
Donald Kobayashi*	Pacific Islands Fisheries Science Center, NOAA Fisheries
Reginald Kokubun*	Department of Land and Natural Resources, State of Hawaii
Leonard Kyamada	Commercial fisherman
Jarad Makaiau	Pacific Islands Regional Office, NOAA Fisheries
Ryan Nichols	Pacific Islands Fisheries Science Center, NOAA Fisheries
Dan Polhemus	Department of Land and Natural Resources, State of Hawaii
Samuel Pooley	Pacific Islands Fisheries Science Center, NOAA Fisheries
Clay Tam	Department of Land and Natural Resources, State of Hawaii
Brett Wiedoff	Pacific Islands Regional Office, NOAA Fisheries