

**Assessment Methods for Data-Moderate Stocks 2012: An Independent Peer
Review Report and Summary**

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Executive Summary

A data-poor and data-moderate workshop was held at the Alaska Fisheries Science Center (AFSC) in Seattle Washington, in June 2012. The objectives of the workshop were to examine a number of different data-moderate analytical methods and discuss their weaknesses and strengths; and attempt to recommend appropriate approaches if possible. Another objective was to define and evaluate if refinements to DB-SRA or DCAC could be to improve performance of each. This report reflects my individual thoughts on that process and summary of the meeting in general.

The objectives of the workshop centered around 1) refinements to current methodologies used for Category 2 stocks, 2) Strengths, weaknesses, and technical evaluation of methods for Category 3 stocks, and 3) Progress on evaluation of uncertainty for each of the three stock categories. In all the objects were met very well and the TOR for the entire workshop were also met. All of the goals of the meeting were accomplished as far as practical; with the exception of deciding which methods would be most appropriate in any given situation. This goal may only be known after more though testing of the methods reviewed here are conducted.

For the refinements to data-poor methods, the panel examined B_{MSY}/B_0 ratio, F_{MSY}/M ratio, M/k ratio, Natural Mortality, and Delta. Of these only the M/k ratio and Natural Mortality analysis seem feasible at this time, as more work is needed in the others. For Delta, the Panel suggested the use of bins to inform the priors, which seems to be a reasonable choice given the analysis presented

For evaluation of the data-moderate methods, it became clear early on that simulation testing was not available to see how these methods compared with a “true” answer for a stock. In some cases the methods were improvements over data-poor methods, but off were different markedly from the full SS3 assessments. Clearly more work is need and a number of recommendations for simulation testing were made.

For incorporation of index and length data, the Panel, and I, agreed that indices must be treated with caution in their application. Because the status hinges on the index data, conflicts with catch data can be difficult to resolve. Length data however, was not found to be useful, given the assumptions on selectivities that had to be made to incorporate them fully.

While the analysts and organizers functioned well and proved highly useful, I noted a number of concerns. Chief among these was a lack of global approach to the problems of data-poor and data moderate stocks. Analyzes focus almost exclusively on Pacific Groundfish, with little thought of pelagics, or the work accomplished by others outside the region on this topic. Much of the meeting was spent trying to understand many of the nuances and issues specific to this regional Council and this SSC.

To that end I made a number of recommendations. Most of these recommendations surround better communication between this regions assessment activity and other US NMFS Science Centers. Additionally I made other recommendations pertaining to how the methods could be explored further, and what should be done in the meantime for the next assessment cycle.

Background

Since adoption of the Magnuson-Stevens Act (2007), The Region Fishery Management Councils have been struggling with the adoption of appropriate Over-Fishing Limits (OFLs) for a number of different stocks. Generally, the lack of data to run sophisticated assessments and projections with measures of uncertainty has hampered progress. Because a number of stocks lack basic information for full age structured or length structured assessments, many Councils, like the Pacific Fishery Management Council (PFMC), have adopted a tiered approach defining stocks by data category (See Table 1). It is important to note that the distinction between data-poor and data moderate lies in the availability of fishery independent or dependent trend information.

In recent years a number of analytical methods have been developed to address the data-poor and data-moderate category. These methodologies are thought to provide at least some management advices, and allow for the setting of precautionary OFL with some measures of uncertainty. However it is unknown how these methods would perform in real world situations

To that end a review held in April 2011 that examined some newly developed methods for data-poor (Category 3, Table 1) stocks, but did not endorse methods for the Category 2 stocks, which are data-moderate. These methods included DB-SRA, DCAC and have been applied with good success in fisheries both in the North West and elsewhere.

Because the prior review panel did not address the Category 2 stocks, review of data-moderate assessment methods was conducted by a Methodology Review Panel (Panel) at the Alaska Fisheries Science Center, Seattle, WA, during 26-29 June 2012. The objective of this workshop was to examine a number of different data-moderate analytical methods and discuss their weaknesses and strengths; and attempt to recommend appropriate approaches if possible. Another objective was to define and evaluate if refinements to DB-SRA or DCAC could be to improve performance of each.

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

As a CIE independent reviewer my role was to provide an "outside" perspective at the workshop. While less formal than a typical species or stock review, workshop reviews and attendance by outside reviewers are important. Often workshops can tend to focus exclusively on the projects and tasks at hand. Outside reviewers can inject and stimulate more general discussion. In addition, they can provide unique advice as their backgrounds and difficulties they face in assessment science are often quite different.

More specifically my role was to serve as an outside reviewer, and to comment on the technical merits or deficiencies of the methods proposed. Refinements to the data-poor methods approved in the last Panel were also an important part of the workshops agenda as outlined below.

"The objectives of the methodology review meeting are 1) evaluate inclusion of trend information into simple assessment methodologies and validate model performance by providing examples for assessed stocks or operating models for which the assumptions of the simpler models are not met; and 2) provide a list of endorsed methods for use on data-moderate stocks in Pacific Fishery Management Council's Groundfish FMP. This workshop would also provide opportunity to refine methods used for category 3 stocks,

and review progress on evaluating methods for determining uncertainty (σ) for each of three categories of stock assessment uncertainty used by the Council.

It is anticipated that reviewers will provide endorsement of specific data-moderate methodology so that a number of candidate category 2 stock assessments using simple assessment models can be conducted and reviewed during the 2013 stock assessment cycle for use in 2015-16 management cycle.”

Summary of Findings

The objectives of the workshop centered around 1) refinements to current methodologies used for Category 2 stocks, 2) Strengths, weaknesses, and technical evaluation of methods for Category 3 stocks, and 3) Progress on evaluation of uncertainty for each of the three stock categories. This report will first outline my findings to those and then follow with a discussion of the ToRs by CIE

Refinements to Catch-Only Methods for Category 3 stocks

B_{MSY}/B_0 ratio

It seems clear that varies with size within taxonomic groupings; Clupeiformes tends to be lower while it is higher for Scorpaeniformes. There is also a significant correlation between B_{MSY}/B_0 and maximum body size both within and among taxonomic orders. There overall “average” from the stocks examined suggests that the current council assumptions of 40% are valid, and there weren’t compelling reasons to change them.

The Panel did not recommend using the results of the analysis presented to inform the prior distribution for B_{MSY}/B_0 , due to insufficient information; and I agreed. I also agreed strongly with the Panel to encourage further efforts in examining the ratio fully.

F_{MSY}/M ratio

A presentation of a meta-analysis of bony and cartilaginous fish stocks produced interesting results. The estimated of mean ratio was 0.41 for cartilaginous fish and about 0.86 for bony fish. Using the delta-method) yielded an estimate of F_{MSY}/M of 0.97 for bony fishes and 0.46 for cartilaginous fishes; only dissimilar for some of the bony fishes. A request to limit the analysis to only the stocks in the NW pacific and Alaska was not met due to unavailability of the analysts.

As such there wasn’t a good opportunity to explore the differences presented and why they differed from the currently assumed values for DB-SRA and DCAC. Therefore, I agreed with the rest of the Panel and I did not recommend using results of the analysis presented to inform the prior distribution for F_{MSY}/M , but do encourage further efforts further exploration. The expected F_{MSY}/M value currently assumed for DB-SRA and DCAC is 0.8, and seems in-line with these preliminary results.

M/k ratio

A Meta-analysis using Stock Assessment Software (MESAS) for M/k using Stock Synthesis software and inputs was presented for 11 stocks peer reviewed stocks on the in the NW pacific region of the US.

The Panel indicated that this approach uses the available data in a more appropriate matter, but the coefficient of variation for M given k was not lower than those for other methods which have been used in Council assessments.

Natural Mortality

A presentation on developing a prior distribution for natural mortality (M) was made without the author present. This approach uses meta-analytical to generate a prior for M. And though it has been used in several assessments used by the Council it has not gone through formal peer-review or review by the Council's Statistical and Scientific Committee.

Complete details of this approach were not available and as such we were unable evaluate the details of the method and were unable to recommend it as a tool. The Panel recommended, and I agreed, that this analysis be brought for SSC review for the next assessment cycle.

Delta

Productivity-Susceptibility Analysis (PSA) vulnerability score and depletion were shown to have a relationship for NW Pacific US fish stocks. As such this relationship can be used to inform priors with regards to depletion for many stocks in data-poor and even data-moderate categories. However while the relationship seemed to hold for less depleted stocks, for highly depleted stocks the current fixed values already in use had better performance.

The Panel recommended, and I agreed to instead bin the priors into three vulnerability bins with breaks at PSA scores of 1.8 and 2.2. This will allow for some response to a relationship, while not fixing the prior to respond entirely to that relationship particularly at low values of delta.

Evaluation of methods for Category 3 stocks

Stock Synthesis using only Catch and Index Time Series (SS-CI)

The new exSSS extends SSS (already in use) by incorporating index data for parameter estimation. It differs from SSS as it's based on either based on maximum likelihood or Bayesian (MCMC) methods. Both SSS and exSSS assume that recruitment is related deterministically. The outputs from SSS and exSSS include biomass trajectories, OFL, and uncertainty.

It is noted that some assessments are already based loosely on the exSSS concept, and that they have already been used to management advices. So while the conceptual framework seems appropriate, the difficulty (as with any stock assessment) will be the inclusion on index data and its appropriateness.

Overall I agreed with the Panel that the method seems sound. And I also agree that that if measures of uncertainty were examined for exSSS-based assessments, they should be based on the Sample Importance Resample (SIR) algorithm.

Extended Depletion-Based Stock Reduction Analysis (XDB-SRA)

XDB-SRA uses a Bayesian framework and incorporates index data from multiple sources to help inform the parameters and outputs. Like with the ex-SSS index data are integral to this improvement and as such should be scrutinized. Moreover, the method gives an estimate of catchability (or "q") and an estimate of variance ("a") which is also helpful.

We noted that it is important to show the transition from the priors for the parameters to the posteriors and the restriction that constraints them such that the biomass was not negative

historically. Additionally the fits to the index data are also an important consideration, as they will indicate which index data are followed, and which others are down-weighted in the method. The difficulties were that in some cases inclusion of index data improved outputs (got them closer to the full SS3 assessment), but not in other cases. Further that the index fits did not always predict when that might occur.

Progress on evaluation of uncertainty

During the workshop a presentation on a proposed project was made. The proposed project is to explore the performance of management strategies based on data-moderate (Category 2) and data-poor (Category 3) assessment methodologies. The intent is to evaluate SSS, DB-SRA, DCAC and XDB-SRA to document how they perform and under which parameters choices are they similar or different.

After discussion we made a number of recommendations including

- Report the bias of the estimates of the OFL.
- Report the probability of the stock dropping below the overfished threshold.
- Explore control rules which set the OFL based on the maximum of the default choice for σ and the amount of uncertainty inferred from the methods such DB-SRA.
- Consider management strategies which set the ACL using a control rule such as 40-10. This will permit an exploration of the ability of methods such as XDB-SRA to estimate stock status.
- Report the multi-year probability of overfishing.
- Report cumulative catches.
- Consider an estimation method which bases the prior for current depletion on a vulnerability score. Testing of such of a method would need to account for the error about the PSA-depletion relationship.
- Consider combining data-moderate methods using model averaging.

Summary of findings recommendations and conclusions

We, as a Panel, made a number of recommendations and comment on some of the unresolved problems including;

- The methods being developed for data-poor and data-moderate assessments assume known historical catches, but there is considerable uncertainty in the catch estimates. This uncertainty has not been measured, and tools for incorporating this uncertainty in assessments are not well developed.
- Further work is necessary to improve inputs used in data-poor and data-moderate assessments, such as B_{MSY}/B_0 and F_{MSY}/M .
- The Panel endorsed two assessment approaches for data-moderate assessments, XDB-SRA and exSSS. However, since their performance was only evaluated by comparing the results with outputs from full assessment, the question remains of how these methods compare in real applications. Work involved simulated population dynamics might help answer this question.

- Because of their simple model structure, data-moderate assessments may appear to be more precise than full assessments, though they are unlikely to be so in reality. Further work is needed on how to treat uncertainty in data-moderate assessments.
- At this point, it is unclear how to best use data-moderate assessments in the Council process.

At this point it is useful to sum up my overall conclusions and recommendations apart from what was agreed to at the Panel. Overall many of these points are reiterated elsewhere, but nonetheless some may find it useful.

For the improvements to data-poor methods, the recommendations outlined by the panel are technical correct (see above), feasible and in my opinion appropriate. I would however caution on limiting any meta-analysis to West Coast US groundfish stocks. These methods are brilliant in their simplicity and have broad reaching applications in many different situations. While focusing meta-analysis to this region is good for the tasks at hand, I strongly recommend the analysts think in broader terms and incorporate other life histories and data than the focus of the workshop.

In going forward with the data-poor and data-moderate methods, currently only comparisons among these have been done. I agree with the Panel's recommendation that simulation testing of DBSRA, SSS, DCAC and their extensions be undertaken. It is only by this sort of simulations testing, that the true behavior of these methods, and their potential biases, can be examined.

Further, and while I agree with the Panel that analysts are not required to bring more than one analysis to a data moderate peer review, I would strongly encourage them to look at multiple methods prior to review. While the work-load seems onerous, examination of all of these methods prior to a peer review can allow for insight into how these methods work, and more importantly what tradeoffs are important. For example using XDB-SRA and exSSS might yield very different results, and it will be important for the peer review panel to understand why this might be the case; and ultimately provide guidance on which is more appropriate. Further, while not required, there are a number of other data moderate methods being used around the world. And it might be important to explore those; to provide insight into these extended methods reviewed by this Panel. Some of these differences maybe life-history or stock specific, and simulation testing may not be able to uncover these differences a priori.

Of the above recommendations made by the Panel:

Because of their simple model structure, data-moderate assessments may appear to be more precise than full assessments, though they are unlikely to be so in reality. Further work is needed on how to treat uncertainty in data-moderate assessments.

is of prime importance in my view. It needs to be reiterated that the uncertainty of these methods in potentially under-estimated. As such in setting ABCs Councils should understand that being in the Category 2 or 3 Tier necessitates more precaution, in my view, than what maybe specified by the methods estimate of uncertainty.

List of requests and responses

Request A: For B_{MSY}/B_0 analysis (presented by Dr. Thorson), show the fits of outputs from random effect and meta-analytic models presented to data for West Coast rockfish.

Rationale: To better interpret results of the analysis and further evaluate their utility for catch-only methods.

Response: The numbers generated using global assessment database were found to be different from estimates produced when the database was limited to West Coast and Alaskan species only, which is probably due to decrease in sample sizes when using only a subset of species.

Request B: Provide summaries of B_{MSY}/B_0 for West Coast and Alaska stocks, grouping species into rockfish, flatfish, elasmobranchs, others.

Rationale: To better interpret results of the analysis and further evaluate their utility for catch-only methods.

Response: see response to *Request A*.

Request C: Provide summary of F_{MSY}/M for West Coast and Alaska stocks, grouping species into rockfish, flatfish, elasmobranchs, others.

Rationale: To better interpret results of the analysis and further evaluate their utility for catch-only methods.

Response: The database assembled by Zhou et al. does not designate data by region, and, therefore, the request could not be fulfilled.

Request D: Calculate OFL distributions for 31 stocks, compare OFLs generated by DB-SRA with assessment results (by species), create bias correction distributions by PSA species groups, apply these bias-correction distributions to each species, generate a distribution of the absolute value of $x-1$ (where x is a draw from bias corrected distribution), and compare the results for all four DB-SRA versions presented and discussed: (1) original DB-SRA (with delta of 0.6); (2) version with M correction applied (with delta of 0.6); (3) version with M correction and with three vulnerability bins (as identified in Cope et al. (2011)) used to inform delta; (4) with M correction and delta informed by depletion-vulnerability regression.

Rationale: To further evaluate the modifications proposed to the original DB-SRA, and particularly the use of vulnerability bins (rather than the depletion-vulnerability regression) to inform delta.

Response: The results of the requested runs were presented (Table 2). These results demonstrated that the version of DB-SA with vulnerability bins (version 3) outperformed the other two versions. The Panel recommends that future applications of DB-SRA should include the correction for M as well as distributions for delta by PSA vulnerability bin.

Developing standardized time series index methods

Part of the Workshop was dedicated to development of index based time series for use in data moderate assessments. While not part of the overall tasks, this is an important subject that needs further work. The inclusion of index information is, by definition, what moves an assessments from data-poor to data-moderate. For many assessments this can be a dramatic improvement in the estimated status, particularly when catch data are circumspect. However it should be noted that index based methods are time consuming, and their development require many iterations. Ultimately their inclusion in an assessment can make or break its utility; and therefore needs to be handled carefully.

Much of the focus traditionally had been on the independent indices, the bottom trawl survey information available in this region. Methods develop here using GLMM and GLMs and can be further strengthen with the use of additive models (GAMs). This work is already underway.

Recreational fisheries and CPUE indices are also a potential data source. This type of data stream is notoriously difficult to deal with for an analyst, given their nature. Methods developed in other regions of the US can be helpful in guiding this region on the appropriate use, stratifications in standardization in this region. Again this work is already underway.

Incorporation of length data in data-moderate assessments

Another potential source of information is the inclusion of length data. Length data can be relatively easy to get, and are generally a good measure of stock dynamics when the samples are applied correctly to an overall catch. However their use requires some assumptions on selectivities. That, and the fact that length data is only as good as the sampling scheme that collects it, suggest that the use of the data may be more complex than first apparent. Also, the data's inclusion requires another level of assessment complexity. The examples shown did not substantial improve with their inclusion. Given that, and the other factors with length we recommended that length data not be included in data moderate assessments.

Apart from that recommendation I do wonder if there may be some utility in length data. Both the East Coast of the US and the EU have been examining using length data as an index of abundance; which is an interesting development. While it is still in its infancy as a methodology, this region might wish to monitor that work to see if it develops to a point of utility here.

Terms of Reference for the Center

ToR 1 – Review documents detailing data-moderate and data-poor methodologies according to the PFMC’s ToR for the Methodology Review Process for Groundfish and Coastal Pelagic Species. Document the meeting discussions and contribute to a summary panel report. Evaluate if the documented and presented information is sufficiently complete and represents the best scientific information available.

The materials presented beforehand were organized and very complete (See Bibliography), with one exception, that being some background information on how the PFMC deals with the management of these stocks and how OFL and ABC are derived. From discussions at the meeting it seemed clear that those deviations in OFL and ABCs were still a work in progress. Nonetheless, such information should have been spelled out beforehand. Additionally there was some confusion on which documents were with which agenda items, but that was quickly and efficiently resolved.

Overall, the documentation was either already peer reviewed, was in the process of review, or was otherwise scheduled to be reviewed by the SSC. This actually is a very well done and an important part of this term of reference. At no time was there any confusion as to the validity of the materials, or their appropriateness. These represented the best information available and as such met this ToR completely

ToR 2 – Evaluate the technical merits and deficiencies of the proposed method(s) taking into consideration the data requirements of each method, the conditions under which the method is applicable, the assumptions of each method, and the robustness of model results to departures from model assumptions and atypical data inputs. Recommend alternative methods or modifications to the proposed methods, or both, during the panel meeting. Recommendations and requests for additional or revised analyses during the panel meeting must be clear, explicit, and in writing. Comment on the degree to which the methods describe and quantify the sources of uncertainty in the results.

Much of this information is outlined above. Generally, the proposed methods are simply brilliant in their design mathematically. Their simplicity and ability to operate for stocks with less than perfect data makes them applicable to a wide variety of problem species.

With that having been stated, it is important to understand the limitations of these methods. the methods cannot be fully evaluated until rigorous and detailed simulation testing is done. As important as it is to determine that the methods “work”, it is equally important to determine when they will not; more specifically, when the diagnostics tell you when to not pursue them. That simply cannot be accomplished without more testing.

Overall there is a high degree of uncertainty associated with these methods in general. Much of the information that goes into these methods are derived from catch and/or what fishery independent or depend indices are available. As such the treatment of this input data is of critical importance, as these are the only sources of information. Therefore it will be important for these data to be treated appropriately prior to use in these methods. Moreover the resulting estimates of uncertainty that come out of these methods should be viewed as an underestimate of the true

uncertainty. This underestimation should be taken into account when setting precautionary harvest control rules.

ToR 3 – Evaluate and provide recommendations for the application of these methods for their utility in stock assessment and for their ability to monitor trends at the population level. Methods that have a flawed technical basis, or are questionable on other grounds, should be identified so they may be excluded from the set upon which stock assessments and other management advice is to be developed. Provide recommendations regarding what level of review is appropriate for assessments conducted using these methodologies.

It is the application of these methods that may prove vexing. Overall the methods seemed to work for the stocks examined. However, some performed better than others in certain situations when measured against full SS3 as a yard stick, for which the reasons were not quite clear. More troubling was that in the extended versions, diagnostics did not always indicate when problems were occurring.

Additionally it is important to understand the limitations of the data-poor and data-moderate approach reviewed here. Uncertainty in the catch, particularly discards, is a major concern. Also, index data and their treatment must be fully evaluated. In these cases the only information is either the catch, or the catch and indices. As such the data must be “better” than is needed in full assessments as they are the ONLY source of information here.

Because of this, and the lack of simulation testing prior to the Panel, it is impossible to state with any certainty that these methods have broad based applicability, even to the West Coast of the US. Simulation testing is required to understand the behavior of these methods, how accurately they portray the stocks, and what diagnostics are important. This is a important point that should not be overlooked

Further testing is indeed needed and warranted before they are used in an actual assessment. Alternatively, these methods can be brought forward on a case-by-case basis, if the analysts are willing and able to test the methods and show extensive diagnostics and/or comparisons. As such acceptance of these methods should also be on a case-by-case basis, until a thorough review and simulation testing can be accomplished. It is my understanding that the time constraints prevent such a board review of methods. As such I agreed with the rest of the Panel (and after lengthy discussion) to the following:

4-6 stocks should be identified from the list for developing data-moderate assessments. The Panel had extensive discussion regarding the number of stocks that should be reviewed during a STAR panel. Arguments for keeping the number low focused on the fact that these assessments are based on new approaches, and there will be some learning involved both in developing the assessment and reviewing it. Arguments for a higher number of assessments included that more assessments are likely to be rejected or not even carried forward for review due to insurmountable difficulties. In addition, there would be more opportunity in learning from a higher number of assessments with contrasting features. Perhaps the best way to deal with this issue is to identify an initial list of six stocks, but plan to drop the two most dubious assessments before the STAR panel review.

While I do not disagree given that I am not a member of this particular SSC, I would still caution on review of any assessments using these methods by the SSC alone. Until there is more rigorous simulation testing, the behavior of these methods will not be fully understood. Therefore, their application to other stocks may be questionable in certain unforeseen circumstances.

ToR 4 – Decide through Panel discussions if the ToRs and goals of the peer review have been achieved. If agreement cannot be reached, or if any ToR cannot be accomplished for any reason, then the nature of the disagreement or the reason for not meeting all the ToR must be described in the Summary Panel Report and CIE Reviewer's report. Describe the strengths and weaknesses of the review process and Panel recommendations.

Again, much of this information can be found in other areas of this report. It is important, however, to stress that the major goals and objectives of this workshop were met. But, full support of these methods cannot be given to any of these methods at this time (see above).

Otherwise there were no major areas of disagreement. All of the ToRs were well met. And the information presented were the best possible given the time constraints involved. Overall it was very well done.

As far as the process, the material as presented was well thought out and well done. The analysts were helpful, informative, professional, and very amendable to recommendations and requests. That said, the discussions during the meeting were somewhat frustrating. Often it seemed I was in the middle of a PFMC SSC meeting, as many of the discussions didn't seem very relevant to the tasks at hand. Often the nuances of those SSC deliberations became the focal point. It was difficult to follow some of these, as they were inter-twined with relevant discussion couched in regional jargon. Often it felt like the independent reviewers were merely there to lend credibility, rather than input. This was somewhat valid as I, in particular, was not very familiar with the ongoing discussion concerning OFL setting in data-poor and data-moderate stocks for this region. And in the future it might be best if reviewers were common among workshops.

It is important for all to understand that many independent reviewers are not familiar with the management regimes, jargon, and the discussions that go on in a particular SSC or at that particular Council. It is critical, therefore, to keep discussions relevant to the task at hand and avoid digressing into regional side-line issues and discussions. Often request for additional background on those discussions were met with less than helpful responses, if not a hint of indignation.

Overall, there was a general attitude of disdain for methods developed outside this particular region. The idea that other production based methods were useful, or that other approaches might be requested by a peer review panel was met with distaste. Many, many different regions of the US, and around the globe struggle with setting appropriate fishing levels for data-poor or data moderate stocks. Some of those methods developed might prove useful, or at least can contrast the approaches as reviewed here.

Given all of this I have the following recommendations

- 1) That the Panel's recommendations outlined in our report be carried out as practical.
- 2) That extensive simulation and relational testing occur for each of the Category 2 and 3 methods as developed. If such cannot be accomplished prior to the next review cycle, that analysts be prepared to justify and where possible compare these methods. This includes methods which are formulated outside this region.
- 3) That where possible outside reviewers be chosen that are familiar with data-poor and data-moderate methods in this region and elsewhere.
- 4) That discussions during that review be more formal, and on task.
- 5) That better background information on how data-poor and data-moderate methods translate to fishing levels set by the Council, be provided
- 6) That if meta-analysis are conducted for priors, that the analysis first be examined in region, but then for stocks with dissimilar life-histories. It is critically important to understand when these methods shouldn't be applied. That remains somewhat mysterious at this point.
- 7) That Councils be informed that the uncertainty associate with these methods may be larger than estimated given the inputs; clearly and concisely.
- 8) That data workshops be implemented to solidify input data and the appropriateness of use in these methods
- 9) That those data workshops also contain external reviewers with the experience in survey design and catch analysis. Clearly the "devil is in the details" and adequate accounting of catch, discards, and a full treatment of indices is going to be required for these methods to function properly.
- 10) That NMFS holds a data-poor and data-moderate methods workshop with participants from all US regions, and potentially DFO. This will help inform others about the wonderful methods developed here, as well recognition that there are other approaches outside this region that are useful under certain situations.

Overall Conclusions and Recommendations: A personal prospective

The meeting in general was in a comfortable location. By and large the format was well organized and the agenda was clear. The objectives of the meeting seemed relatively nebulous at first, but that issue was quickly resolved with the first presentation. The workshop was made more interesting by student participation and presentation. It was good to see the work of students, even if it was only proposed projects, on the table.

Despite the comments under ToR 4 it is important to understand the context of how this particular region operates as far as fishery management. Without a doubt these methods represent the “cutting edge” of our field with respects to data-poor and data moderate assessments. However, this region could benefit greatly, in my opinion, from a more collaborative approach with other science centers and other regions. There is much to learn, and much to relay to others struggling with these same issues.

Table 1. Categories of assessments types based on available information

| | | |
|--|----------|--|
| <p>Category 3: Data poor. OFL is derived from historical catch.</p> | a | No reliable catch history. No basis for establishing OFL. |
| | b | Reliable catches estimates only for recent years. OFL is average catch during a period when stock is considered to be stable and close to BMSY equilibrium on the basis of expert judgment. |
| | c | Reliable aggregate catches during period of fishery development and approximate values for natural mortality. Default analytical approach DCAC. |
| | d | Reliable annual historical catches and approximate values for natural mortality and age at 50% maturity. Default analytical approach DB-SRA. |
| <p>Category 2: Data moderate. OFL is derived from model output (or natural mortality).</p> | a | M*survey biomass assessment (as in 1996). |
| | b | Historical catches, fishery-dependent trend information only. An aggregate population model is fit to the available information. |
| | c | Historical catches, survey trend information, or at least one absolute abundance estimate. An aggregate population model is fit to the available information. |
| | d | Full age-structured assessment, but results are substantially more uncertain than assessments used in the calculation of the P* buffer. The SSC will provide a rationale for each stock placed in this category. Reasons could include that assessment results are very sensitive to model and data assumptions, or that the assessment has not been updated for many years. |
| <p>Category 1: Data rich. OFL is based on F_{MSY} or F_{MSY} proxy from model output. ABC based on P* buffer.</p> | a | Reliable compositional (age and/or size) data sufficient to resolve year-class strength and growth characteristics. Only fishery-dependent trend information available. Age/size structured assessment model. |
| | b | As in 1a, but trend information also available from surveys. Age/size structured assessment model. |
| | c | Age/size structured assessment model with reliable estimation of the stock-recruit relationship. |

Table 2. Comparison of four DB-SRA versions conducted per *Request D, Section 2.1.6*: (1) original DB-SRA (with delta of 0.6); (2) version with M correction applied (with delta of 0.6); (3) version with M correction and with three vulnerability bins (as identified in Cope et al. (2011)) used to inform delta; (4) with M correction and delta informed by depletion-vulnerability regression.

| Summaries of relative bias-corrected OFL, X | | | | |
|--|------------------------|---------------------|-----------------------|-----------------|
| Percentile | no M correction | M correction | PSA regression | PSA bins |
| 2.5% | 0.086 | 0.085 | 0.069 | 0.114 |
| 25% | 0.475 | 0.482 | 0.427 | 0.538 |
| 50% | 0.999 | 1.000 | 1.007 | 1.006 |
| 75% | 2.111 | 2.083 | 2.383 | 1.881 |
| 97.5% | 11.600 | 11.431 | 14.934 | 9.056 |
| Summaries of abs(X-1) | | | | |
| Percentile | no M correction | M correction | PSA regression | PSA bins |
| 2.5% | 0.033 | 0.032 | 0.039 | 0.028 |
| 25% | 0.329 | 0.323 | 0.381 | 0.281 |
| 50% | 0.650 | 0.641 | 0.717 | 0.568 |
| 75% | 1.111 | 1.083 | 1.383 | 0.932 |
| 97.5% | 10.828 | 10.431 | 13.934 | 8.056 |

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Appendix 2: A copy of the CIE Statement of Work

Attachment A: Statement of Work for Dr. Matthew Cieri

External Independent Peer Review by the Center for Independent Experts

Review of Assessment Methods for Data-Moderate Stocks

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. The CIE reviewer is 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. The CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: The requirement in the re-authorized Magnuson-Stevens Act (2007) to set annual catch limits (ACLs) based on science recommendations implies some kind of basic assessment is required for all stocks in Fishery Management Plans (FMPs). This mandate has lead to an increased focus on assessing "data-poor" stocks. Many data-poor stocks are of minor economic importance and assessing all of them using size/age structured models would be difficult given data limitations as well as cost-prohibitive. Simple assessment methods that use historical catches and available trend or size-composition information could potentially be applied to many data-poor or data-moderate stocks. These methods could be used to set ACLs, and to identify stocks which may be at risk of depletion that would be elevated to high priority for more detailed assessments. At the September Council meeting, the Pacific Fisheries Management Council (PFMC) approved a data-poor/data-moderate species assessment workshop to be held in June of 2012 in Seattle. The workshop is a follow-up to the review panel meeting held in April 2011 that reviewed assessment methods for data-poor stocks. At that meeting, the panel endorsed the use of Depletion-Corrected Average Catch (DCAC) methods AC and Depletion-Based Stock Reduction Analysis (DB-SRA) for category 3 stocks, but did not endorse any new assessment method for data-moderate category 2 stocks. The defining distinction between category 3 and category 2 stocks is that trend information is incorporated in the assessment for category 2 stocks. Several methods for category 2 stock were proposed, but these methods were not sufficiently developed to be endorsed by the review panel. The panel recommended the following:

"To continue the progress that has been made, the Panel recommends that a similar off-year STAR Panel review be scheduled to further develop and finalize methods and to review example applications. The Panel suggests a few common data sets be used across all candidate methods.

The meeting would involve participants from at least the NWFSC, the SWFSC, and various academic institutions. Methods should be sufficiently developed by the 2015-16 groundfish management cycle that it would be reasonable to bring forward a number of candidate category 2 stock assessments using simple assessment models for review at a STAR Panel in 2013.”

The objectives of the methodology review meeting are 1) evaluate inclusion of trend information into simple assessment methodologies and validate model performance by providing examples for assessed stocks or operating models for which the assumptions of the simpler models are not met; and 2) provide a list of endorsed methods for use on data-moderate stocks in Pacific Fishery Management Council’s Groundfish FMP. This workshop would also provide opportunity to refine methods used for category 3 stocks, and review progress on evaluating methods for determining uncertainty (σ) for each of three categories of stock assessment uncertainty used by the Council.

It is anticipated that reviewers will provide endorsement of specific data-moderate methodology so that a number of candidate category 2 stock assessments using simple assessment models can be conducted and reviewed during the 2013 stock assessment cycle for use in 2015-16 management cycle.

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 Reviewer: Two CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. The CIE reviewers shall have working knowledge and recent experience in the application of fishery stock assessment methods, especially for data-moderate or data-limited stocks. 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 tentatively scheduled in Seattle, Washington during 26-29 June 2012.

Statement of Tasks: The 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 reviewer with the background documents, report, 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 the 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 each CIE reviewer if a non-US citizens. For this reason, each CIE reviewer 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/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) to each CIE reviewer the necessary background information and report 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. Each 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. Each CIE reviewer shall read all documents in preparation for the peer review.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewer 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 Report: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewer: The following chronological list of tasks shall be completed by the CIE reviewers 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 report provided by the NMFS Project Contact in advance of the peer review.
- 2) Participate during the panel review meeting in Seattle, WA during 26-29 June 2012.

- 3) During the review meeting in Seattle, WA during 26-29 June 2012 as specified herein, and each CIE reviewer shall conduct an independent peer review in accordance with the ToRs (**Annex 2**).
- 4) No later than 13 July 2012, each CIE reviewer shall submit an independent peer review report addressed to the “Center for Independent Experts,” and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, via email to David Die ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

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

| | |
|------------------------|--|
| 30 May 2012 | CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact |
| 12 June 2012 | NMFS Project Contact sends the CIE Reviewer the pre-review documents |
| 26-29 June 2012 | The reviewer participates and conducts an independent peer review during the panel review meeting |
| 13 July 2012 | The CIE reviewer submits draft CIE independent peer review report to the CIE Lead Coordinator and CIE Regional Coordinator |
| 27 July 2012 | The CIE submits CIE independent peer review report to the COTR |
| 3 August 2012 | The COTR distributes the final CIE report to the NMFS Project Contact and regional Center Director |

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR 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 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 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 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 report) 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 reports shall be completed with the format and content in accordance with **Annex 1**,
- (2) the CIE reports 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.

Key Personnel:

William Michaels, Program Manager, COTR
NMFS Office of Science and Technology
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
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Stacey Miller (NMFS Project Contact)
NMFS Northwest Fisheries Science Center,
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Jim Hastie
NMFS Northwest Fisheries Science Center,
2725 Montlake Blvd. E, Seattle WA 98112
Jim.Hastie@noaa.gov Phone: 206-860-3412

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. The reviewer 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. The reviewer 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. The reviewer should elaborate on any points raised in the Summary Report that they feel might require further clarification.
 - d. The reviewer 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 of Assessment Methods for Data-Moderate Stocks

The reviewers will participate in the Panel review meeting to conduct independent peer reviews of the data-moderate and data-poor assessment methods to apply to groundfish stocks managed by the Pacific Fishery Management Council. The review solely concerns technical aspects of the methods, and addresses the following ToR:

ToR 1 – Review documents detailing data-moderate and data-poor methodologies according to the PFMC’s ToR for the Methodology Review Process for Groundfish and Coastal Pelagic Species. Document the meeting discussions and contribute to a summary panel report. Evaluate if the documented and presented information is sufficiently complete and represents the best scientific information available.

ToR 2 – Evaluate the technical merits and deficiencies of the proposed method(s) taking into consideration the data requirements of each method, the conditions under which the method is applicable, the assumptions of each method, and the robustness of model results to departures from model assumptions and atypical data inputs. Recommend alternative methods or modifications to the proposed methods, or both, during the panel meeting. Recommendations and requests for additional or revised analyses during the panel meeting must be clear, explicit, and in writing. Comment on the degree to which the methods describe and quantify the sources of uncertainty in the results.

ToR 3 – Evaluate and provide recommendations for the application of these methods for their utility in stock assessment and for their ability to monitor trends at the population level. Methods that have a flawed technical basis, or are questionable on other grounds, should be identified so they may be excluded from the set upon which stock assessments and other management advice is to be developed. Provide recommendations regarding what level of review is appropriate for assessments conducted using these methodologies.

ToR 4 – Decide through Panel discussions if the ToRs and goals of the peer review have been achieved. If agreement cannot be reached, or if any ToR cannot be accomplished for any reason, then the nature of the disagreement or the reason for not meeting all the ToR must be described in the Summary Panel Report and CIE Reviewer's report. Describe the strengths and weaknesses of the review process and Panel recommendations.

Annex 3: Tentative Agenda

Review of Assessment Methods for Data-Moderate Stocks

Alaska Fisheries Science Center
7600 Sand Point Way NE, Seattle, WA 98115
Phone: (206) 526-4000
26-29 June 2012

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

| | |
|----------------------------|--|
| <i>26 June 2012</i> | Presentations by technical teams |
| <i>27 June 2012</i> | Continuation of presentations, Panel requests to technical teams |
| <i>28 June 2012</i> | Panel requests, Assignments for drafting panel report |
| <i>29 June 2012</i> | Panel requests, Finish draft panel and reviewer reports. |

Appendix 3: Panel Membership :

Methodology Review Panel Members:

Mathew Cieri, Center for Independent Experts (CIE)

Martin Dorn (Chair), Scientific and Statistical Committee (SSC), NMFS, AFSC

Vladena Gertseva, SSC, NMFS, Northwest Fisheries Science Center

Cynthia Jones, CIE

André Punt, SSC, University of Washington

Panel advisors:

John DeVore, PFMC Staff

Corey Niles, Groundfish Management Team

Gerry Richter, Groundfish Advisory Panel

Technical Team:

Emil Aalto, University of California, Davis

Linsey Arnold, Oregon State University

Jason Cope, NMFS, NWFSC

Edward Dick, NMFS, SWFSC

Kristen Honey, Stanford University

Alec MacCall, NMFS, SWFSC

James Thorson, NMFS, NWFSC

Chantel Wetzel, NWFSC, University of Washington