Chair's Summary Report
of the NWFSC Science Program Review of
the California Current Groundfish Stock Assessment Process

Northwest Fisheries Science Center
2725 Montlake Blvd. East
Seattle, WA 98112

Review Panel Members

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I. Background and Overview of the NWFSC Science Program Review Meeting

The NOAA Fisheries Northwest Fisheries Science Center in Seattle, Washington conducted a program review to examine the direction and quality of its California Current Groundfish Stock Assessment Process. The review was conducted over a four-day period from June 10 – 13, 2014.

The objective for this review was to examine and evaluate the Center's fishery stock assessment program that is conducted pursuant to the Magnuson-Stevens Act (2006) and comparable international agreements. Stock assessments are demographic analyses designed to provide particular scientific advice to living resource managers. Fishery, survey and biological data for stock assessments were reviewed in 2013. In 2014, the review focus shifted to the overall program of assessment modeling, approach, review process and communication. The Panel was not asked to provide an in-depth review of any particular stock assessment. Rather, the members considered presentation content, background materials provided by the Center and points raised during discussions to comment on seven themes that define the stock assessment program:

1) Does the Center apply a suitable scientific/technical approach to fishery stock assessment modeling?

2) Is the assessment process efficient, effective and clearly described, including terms of reference for assessment reports?

3) Does the Center, in conjunction with other entities such as the Council's Scientific and Statistical Committee (SSC), have an adequate peer review process?

4) Is the Center's program organization effective at accomplishing needed assessments according to a set of assessment priorities? Include program structure, staffing, and funding; include prioritization of stocks for assessment.

5) Does the Center achieve adequate assessment accomplishments relative to mandates particularly with respect to the number of Fishery Management Plan (FMP) species assessed?

6) Does the assessment program adequately communicate their results, needs, and research?

7) Are there opportunities for improving stock assessments and the stock assessment process?

The review panel was comprised of six members with fisheries science and management familiarity or expertise. Each panel member was encouraged to ask questions throughout the presentation, then together with all other forms of input draft independent reports identifying strengths, challenges and recommendations to address major issues. In addition, the panel chair prepared this summary, compiled over the course of the week during closed panel discussions. The summary highlights several recurring themes but also underscores points considered particularly critical by individual or multiple panel members. This information does not represent a consensus opinion by the Panel.

General Observations

The Northwest Fisheries Science Center has developed considerable science expertise and employs processes necessary to provide a firm foundation for managing west coast groundfish fisheries. The growth and expansion of NWFSC capabilities appears to have been successfully leveraged through ongoing partnerships, including those with academia, the fishing industry and a variety of other fisheries related entities. Through outstanding science expertise, and open communication with the Council, industry and other partners, the Center has grown its assessment capabilities and is currently striving to assemble and refine them to meet current and future fisheries and resource stewardship demands. The presentations offered by Center staff and partners clearly demonstrated a commitment to provide best available science with as much rigor as available resources will allow.

The Center noted that one of its primary goals was to retain core staffing function that allows not only ongoing stock assessment efforts but provides a path forward to increasingly better predictive capability and treatment of uncertainty. This was especially true with reference to those stocks with moderate data availability. Various members of the panel embraced and agreed with the overall wisdom of this direction but it was also noted that the underlying rationale and logic for prioritization are opaque at best. This presents both concerns and opportunity. Concerns are warranted if effort in disparate directions leaves acute needs unmet. Likewise, throughput is impacted where full assessments are considered higher priorities than updates. Opportunity lies in the fact that many of the tools, talent and scientific building blocks are within the Center's grasp. A clearer, better-articulated vision of how priorities are established, both across the biennial cycle and in the long term is warranted. Finally, how the choice of priorities are linked to the anticipated increases in the quality and utility of the affected stock assessments need to be expressed in a framework that better reveals the underlying rationale.

While prioritization emerged as the predominant concern, a wide variety of observations were noted and considered important enough to pass along in this report. In total, nearly two dozen recommendations are underscored in the Chair's Report, recognizing that some are related, while a few are largely endorsements of current directions. The following sections describe the predominant overarching strengths, challenges and associated recommendations. Individual panelist reports are included in the latter sections.

Stock Assessment Process

Strengths

- High priority stocks have high quality, rigorous assessment approaches
- Substantial progress on developing efficient tools for data processing
- Multiple-author assessment teams provide needed redundancy
- Young, capable cohort doing excellent work

Challenges

- Unclear on how assessment frequency relates to the species generation time and recruitment variability
  --Prioritization needs to be defined/articulated
- Timeliness of most recent survey data relative to OFL/ACL specification longer than at other locations
- In-season delays in receiving survey data. (Not delivered until spring while other places get it in the fall)
- Stock structure is not being addressed for many stocks (e.g. multiple stocks, transboundary stocks)
- Maintaining adequate staffing levels in the face of predictable turnover as well as unanticipated staff departures

Recommendations

- Reconsideration of what is being done in the "even" and off years of the biennial cycle
  - Between-year data preparation could be more explicit part of the process
- Consider evaluating more explicit front-loaded approach which anticipates more recent data (in future) to reflect possible "new data outcomes" (e.g., when new data available, respond accordingly depending on where it falls within discrete bounds)
- Continuing utilizing students to augment the scientific staff
- Some succession planning needed (predictable) but replacement (e.g. software support).

Scientific and Technical Approach

Strengths

- Standardized tools for assessments (e.g., SS and rebuilding projection software)
- The staff are making improvements to the underlying processes / methods for many assessments

Challenges

- Attempts to adhere to discrete categorization scheme when reality more continuum of data (why break points?)
- Current methods and approach under-represent structural uncertainty. This will have implication for the sigma passed on and estimation of trends.
- Innovation may be limited in using standardized tools
- Innovation in data-moderate and data poor methods may be stifled by lack of flexibility in the review process

Recommendations

- Continue to support the development of these standardized tools including increasing the base of developers and making them more open source.
- Continue to support efforts to advance data moderate methods with clear definition of what they do (break out of the current hierarchal definition of their assessment tools).
- Continue to improve the efforts toward capturing various sources of uncertainty (e.g. the random effects model).
- Improve on data poor methods by collecting data to form an abundance index or using size composition to index replacement (for appropriate stocks).

Peer Review Process

Strengths

- Extremely rigorous peer review through STAR panel CIE process and protocols
- Separation of science and policy
- Transparency in that all aspects are generally public (historically some CIE reports were unavailable)

Challenges

- Limited universe of qualified reviewers (including SSC members)
- Retaining high quality reviews more efficiently. Current STAR panel costs relative to benefits difficult to assess. There is a need to balance quality of review with fishery management importance/priority
- SSC capacity is limited under the biennial management cycle

Recommendations

- Consider reviewing data-moderate assessments using mechanism other than the STAR panels
- Consider focusing a portion of the STAR panels on methods and data source reviews
- Consider developing an alternative panel to help with peer review that is between the intensity of the STAR and SSC.

Organization and Priorities

Strengths

- The Centers are very responsive to the Council needs and the breadth of research being conducted addresses a wide range of pertinent fishery issues

- The Centers do a good job of evaluating a prioritized portfolio of baseline assessments for all managed stocks (including data-poor) and full assessments for important stocks since most of the landings and species are covered (In 2010 – the number doubled by adding data-poor analyses)
- Assessment scientists from the Centers engage in research that results in many publications in peer-reviewed journals and these enhance the national efforts to improve stock assessments
- The Centers have balanced Council, other domestic and international stock assessment needs as well as additional analytical and review demands very well, hake is exemplary

Challenges

- Timeliness–lag time between survey and assessment and application in management
- Some important recreational stocks may be under-represented in data-collection and assessment considerations
- The national prioritization scheme and protocol may be inconsistent with other needs and missions of the centers and the PFMC process
- Prioritization protocols are unclearly articulated and could be made more transparent and formalized
- The current process lacks flexibility that can affect throughput, for example the rigors of conforming to the STAR panel process

Recommendations

- A clear relationship needs to be developed which evaluates what is being assessed versus the level of effort. We recognize that the prioritization scheme is in development but several things could be added to the matrix or scored differently
- Procedures for the process need to be articulated and be transparent and avoid concerns about unclear motives for stocks being selected
- Consider moving toward updates (as opposed to data moderate) after important benchmarks are completed to provide efficient use of resources
- Panel encourages the Centers to use MSEs as a means to help define research and data collection needs and assessment complexity relative to the core mission

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Accomplishments Relative to Mandates

Strengths

- In general, FMP stocks have an OFL based on stock assessments. The number of assessments doubled in 2010 primarily due to the addition of data-poor methods.
- Current and planned fishery stock assessments meet regional, national, and international expectations in terms of quality, quantity and timeliness in general.
- Centers are engaged in ecosystem research.

Challenges

- Incorporating ecosystem data / information into the assessment is still in development and the utility of this remains uncertain.
- The current process lacks structure to fully address broader ecosystem concerns
- Current FSSI stocks may not correspond well to PFMC and centers-priority stocks.

Recommendations

- Develop protocols for reconsidering data-poor stocks in light of their potential vulnerability. This should ensure consistency with national standards to avoid overfishing
- Regarding treatment of ecosystem and environmental factors affecting fish stocks and their assessments the panel suggests following the general steps: (1) identifying factors; (2) showing their importance (tactical and strategic) and (3) incorporating them within the assessment as appropriate
- Keep in mind improvement of stock assessment is not the only reason for considering ecosystem effects; also effects of fishing on the structure and function of the ecosystem.
- Changing climate effects should be monitored and evaluated for strategic considerations (e.g., biological reference points).

Communication

Strengths

- The centers genuinely attempt to engage stakeholders and do so in a way that improves the quality of the assessments
- Hake assessment as the prime example for good communication (with stakeholders)

Challenges

- Travel restrictions have constrained critical communication
- Ensuring that the Council and fishery managers understand important assessment issues

Recommendations

- Consider recruiting people to fill the analytical gap between the data collection and analysis for input into stock assessments and provide a bridge of communication between the data collection process and stock assessment analysts.
- Pre-assessment workshops should be re-established
- The centers should increase the priority of face-to-face meetings and venues that encourage increased collaborations internally and externally
- Make a more focused effort to promote understanding of assessments by target audience, especially when new assessment methods are introduced

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Opportunities for improving stock assessments

Strengths

- The Centers appear to be committed to developing a workforce plan.
- The centers are clearly seizing opportunities to conduct research that is within reach, particularly given the talented professional staff

Challenges

- Research needs are often in reaction to comments and reviews and less on research into factors that could improve the assessment for management advice
- Aspects of basic biology for many groundfish species are poorly understood

Recommendations

- Encourage Center to establish their vision and needs to influence the development of a workforce plan.

- Do a portfolio analysis, what capabilities align with missions, then can make informed judgments—currently lacking a rationale and road map
- The centers should actively pursue developing partnerships

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Panel member 1

The National Marine Fisheries Service Northwest Fisheries Science Center conducted a review of its groundfish management on June 10-13, 2014. The reviewers were asked to examine and evaluate the fishery stock assessment program that is conducted pursuant to the Magnson-Stevens Act (2006) and comparable international agreements. My comments are focused on my area of expertise, population dynamics.

I think that the research and analysis being done in groundfish management is of the highest quality. However, I believe that the stock assessment scientists could improve on their foray into a new area, data-limited management, and could communicate the technical aspects of their analyses more clearly, thus enhancing transparency.

Scientific and Technical Approach

I am concerned that while the rapid development of data poor methods has served as a means of increasing number of stocks assessed, it has done so by relaxing the rigor in assessments. Data poor methods will not provide the protection against overfishing, and the degree of optimality of yield that data rich methods do, of course, but the sacrifices of each data poor method need to be explained clearly as a qualification.

Accomplishments Relative to Mandates

I presume that two of the mandates are: 1) to provide assessments of as many stocks as possible, and 2) to adhere to the National Standards, including National Standard 1 which calls for the prevention of overfishing. NMFS increased their focus on preventing overfishing in the 1990s based on new research findings regarding the importance of replacement (the idea that populations will persist if each individual reproduces enough in their lifetime to replace themselves). The outcome of this was that some measure of abundance or biomass, and some measure of replacement were included in control rules for management (SPR, F_{35}, etc.). From the point of view of population dynamics, management can protect against a population going to the zero state (overfishing) by keeping track of those two variables (i.e., the state variable and its rate of increase/decrease). If a data-poor model only includes one of these variables it will generally not do as good a job protecting against overfishing. If a data poor model includes neither of these it will not be directly protecting against overfishing because it will be tracking neither the state of the population (e.g., biomass) nor whether the state is increasing or decreasing (i.e., replacement). Not doing that calls into question whether it is meeting National Standard 1.

Methods that use only catch data do not include either of these. Some of them could possibly be brought up to this standard by the development of effort data to form an index of abundance or biomass.

Data poor methods exist for tracking replacement based on age and size-structured data (e.g., O'Farrell and Botsford 2006), and they should be evaluated for use.

Communication of assessment results and data needs

There is a need to communicate to managers the mechanistic function of stock assessments in terms of how they act to prevent overfishing, why that is so difficult, and what the key unknowns or uncertainties are.

There is an even greater need to communicate the differences between the data poor methods and the data rich methods, in terms of how they sacrifice the ability to avoid overfishing.

Opportunities

There is a need for further research on data-poor stocks and data-poor methods.

Conclusions

The research and analyses in stock assessment are of high quality; they need to be communicated with greater clarity.

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Panel Member 2

June 10 – 13, 2014

I. Background and Overview

The National Marine Fisheries Service's Northwest Fisheries Science Center (NWFSC) conducted an external review of the California Current groundfish stock assessment program from June 10-13, 2014. The purpose of the review was to evaluate the quality, relevance, and performance of science and research conducted at the NWFSC and strategically position the Center in planning future science and research.

The review included a series of presentations by scientists at the NWFSC and Pacific Fishery Management Council followed by question and answer periods between the presenters and the review panel. Extensive background materials were provided to the panel before and during the review. This review report provides a brief assessment of the strength and weaknesses of the stock assessment program (focusing on the topics outlined in the Terms of Reference) as well as some recommendations for potential improvements that the NWFSC may consider.

II. General Observations and Recommendations

The scientists and staff at the NWFSC are to be commended for providing the panel with an excellent set of presentations along with a very manageable volume of helpful background material. Throughout the review, it was obvious that the NWFSC has an incredible collection of amazingly talented scientists who are doing a superb job of fulfilling NWFSC's mandate to provide stock assessments in support of groundfish management while also performing cutting-edge research into areas that will improve stock assessment science throughout the US, and I dare say the world. The NWFSC is clearly taking advantage of their close connections with academia, and in many ways the Center should be viewed as a model for other science centers.

There are, however, some broad areas within the Center that could use some greater attention and consideration. The Center could benefit from taking time to outline its vision for its role in the future. It was clear during discussions of assessment and research prioritization as well as regarding personnel

and staffing that the Center does not have a clearly articulated set of goals for the stock assessment program that are specific, measurable, attainable, realistic and time-bound (aka S.M.A.R.T goals). Many of my recommendations will relate back to this. The biennial assessment / management specification process set by the PFMC along with the incredibly rigorous review process is creating many challenges for the Center that could be alleviated by a reconsideration of the biennial cycle as well as exploring whether the current stock assessment review process strikes the best balance between efficiency / throughput and rigor, especially given the demand of the STAR panels and the increased demands that will be placed on the PFMC's Science and Statistical Committee (SSC). The current categorization of stock assessments into benchmark, update, data-moderate, and data-poor is also causing challenges, and the NWFSC should undertake some strategic analysis to examine the best way balance assessment complexity with needs of management, both in terms of output and as well as in terms the frequency with which they will be undertaken. Finally, it also became clear that the current travel budget and cap restrictions are inflicting considerable harm on the NWFSC's ability to collaborate with outside researchers and present both their assessment and research findings to the broader scientific community as well as to managers and the public. Additional, more specific recommendations are made in the sections below.

III. Key Findings and Recommendations

III.a. Stock Assessment Process

The NWFSC is currently doing a very admirable job of assessing the large suite of stocks under their purview. The majority of catch in terms of value and tonnage come from stocks that have been assessed using state-of-the-art methods. The Center uses a team-based approach to assessments which improves the quality of the assessments, assists in training younger assessment scientists, and provides some level security in case the lead scientist becomes unavailable.

That said, there is currently a rather long delay between the time data are collected and assessments are performed, assessed, and acted upon by the PFMC. It was our understanding that management measures are generally based on data that is four years old. It is unclear where exactly the bottleneck is, but it was clear that the biennial assessment cycle played some role. This is one reason why I recommend the biennial assessment cycle should be reconsidered.

The NWFSC, and NMFS at the national level, is currently updating their stock assessment prioritization protocols, and I recommend that this proceed with great care and consideration. A great deal of information goes into the current NWFSC prioritization scheme as evidenced by the vast Hastie Table, but it was difficult to tell how this information currently gets weighed and whether, in fact, there is even a consistent, though subjective, weighting scheme. It was also unclear as to how much control NWFSC was exerting on setting assessment priorities as opposed to relying on a consensus approach between the NWFSC and the PFMC. A consensus approach is admirable – so long as the main priorities of the Center are still being addressed. But again, without clearly articulated goals, it is hard to determine the degree to which the Center may be forgoing their own priorities for the sake of consensus.

Another issue that arose during the discussion of the stock assessment process is that of personnel. As stated above, the NWFSC has an incredibly talented pool of Ph.D.-level stock assessment scientists. However, a fair bit of their time is dedicated to rather mundane activities such as developing inputs to the assessment model (e.g., GLMM standardization of surveys) or stock assessment updates in which the assessment model is held fixed and only additional years of data are added to the data streams. Such activities may be better-suited to lower-level assessment scientists, such as those with only a Master's degree who could work under the supervision of a Ph.D.-level scientist. Such a role could also be undertaken by current graduate students as part of their graduate training. This would allow the Ph.D.-level scientist more time to pursue the more complex research projects and assessments, give the Ph.D.-level scientist greater opportunity to develop supervisory skills, and provide experience to lower-level scientists that may one day undertake Ph.Ds. As one reviewer put it, in many instances, the NWFSC is driving a space shuttle to the grocery store. In a similar vein, a previous report said something along the lines that the NWFSC stock assessment program was one bad cold-and-flu season away from catastrophe, and I agree with this statement. The Center appears to have just enough stock assessment personnel to meet its current assessment and research needs. However, the loss of just one individual (whether through illness or change in career) can and has had major ramifications on the entire assessment cycle. The NWFSC needs more assessment scientists. Period.

III.b. Scientific and Technical Approach

The scientific and technical approach undertaken by the NWFSC is world-class and to be commended. Their assessments generally pass the highest levels of peer-review and are cutting-edge. The NWFSC, along with their Southwest Fisheries Science Center couterparts, is also responsible for many of the recent innovations in data-moderate assessment methods.

The currently strict classification of assessments into benchmark (and updates) versus data-moderate versus data-poor, may be causing problems for the NWFSC. This categorization appears to be largely a result of the review process, but it has created some path dependency in the development of "data-moderate" methods – with most of them building directly on the relatively shaky foundation of the "data-poor" methods. And by "shaky" I mean that these methods were developed as place-holders for setting OFLs and ABCs; ones that would be improvements upon using average catch over a subjective time period. The complexity of assessment models falls along a very rich continuum based largely on the quality and quantity of data, along with the desired outputs. The NWFSC should encourage its scientists to base the complexity of their assessments on that continuum (and develop the appropriate methods, when necessary), rather than on strict categorizations that do not encompass the range of data sources currently available.

The NWFSC's use of Stock Synthesis has allowed it to develop assessments using well-tested code and its use of R4SS has allowed it to create standardized presentations of assessment results. However changes and improvements to Stock Synthesis rely essentially on Dr. Methot's time and availability. We were informed that he now has the assistance of a computer programmer and that there is a desire to make Stock Synthesis a more open-source program so that others could contribute. I think this is

essential. If anything were to affect Dr. Methot's availability for Stock Synthesis maintenance and improvement, much of the development of that code would grind to a halt. As experience with the ADMB Foundation has shown, turning such complex code into a modular, open-source platform take considerable resources and dedication, and NMFS should be encouraged to follow this path. The NWFSC's stock rebuilding tool, known colloquially as the Puntalyzer, suffers from even greater exclusivity. NMFS should make every effort to recode the Puntalyzer into a more accessible form that allows both for improvement and greater peer review.

III.c. Peer Review Process

The peer review process for the stock assessments produced by the NWFSC is extremely rigorous, open, and transparent. The STAR panels with their representatives from the Center for Independent Experts is one of the most rigorous in the nation, and those assessments that do not go through the STAR process (e.g., data-poor and updates to benchmarks) are still rigorously reviewed by the SSC. However, it is uncertain whether the review process best balances efficiciency / throughput and rigor. In fact, it may be that the current review process is too focused on rigor, and some efficiencies might be gained without loss of assessment quality by reconsidering the current peer review system.

The STAR panels are chaired by an SSC member and must also have one other person familiar with West Coast groundfish. The number of SSC members qualified to chair a STAR panel is quite limited, and we were told the list of people who could fill the role of someone "familiar with West Coast groundfish" contains only about 30 names. This puts some pretty severe limits on the number of STAR panels that can be held each year. This is in addition to the incredibly complex logistical gymnastics it appears to take to squeeze these STAR panels into the calendar given the SSC's and PFMC's schedule. The limited pool of qualified individuals and the scheduling issues are definitely limiting the ability of NWFSC assessments to be peer reviewed and incorporated into management. The Center and PFMC should explore ways to expand this pool of potential reviewers, and this is yet another reason to re-evaluated the current biennial cycle.

However, as more and more assessments move from being benchmarks and first-time data-moderate assessments to being updates, the STAR panel bottleneck might ease. That's assuming that updates can be undertaken for data-moderate assessments – a question that has yet to be resolved. However, under the current system, updates are reviewed by the SSC, which already has rather large workload and it is uncertain as to whether the SSC would be able to handle an increase in their assessment review responsibilities, especially if the SSC gets responsibility for reviewing all data-moderate assessments. Of course, all this could change if, as I suggest, the NWFSC and PFMC move away from their current, highly constrained hierarchical structure of benchmark / data-moderate / data-poor assessment. The NWFSC, along with the PFMC and the SSC, need to undertake some strategic planning to determine how the large volume of assessments that the Council desires can be adequately reviewed. I fear that the current system may buckle under the shear volume of work being asked of it, and a piecemeal approach to solving individual issues may fail to adequately improve the situation.

Two solutions to help balance the throughput – rigor trade off were discussed during the review, and I endorse the exploration of each of them. One idea was to dedicate one STAR panel each cycle to the assessment of either specific methods or data packages. For example, once a STAR panel has determined that the xSSS is reliable, then assessments based on this code would no longer need to go through the STAR panel process, and could go through a more expedited process. Similarly, data packages like multi-species catch reconstructions could reviewed at a STAR panel such that each assessment that wishes to use that data would not have to go through a new benchmark process in order to include it. A second idea was to develop a review body that was intermediate between a 5-day STAR panel and an SSC review. Such a body might be able to handle the data-moderate assessments and relieve some of the pressure from the SSC.

Again, the main goal should be balancing the efficiency / throughput of the review process with the necessary level of rigor. The review process evolved into its current form based on very particular circumstances, and it is worth reconsidering whether the current system is properly balanced given the current level of checks and balances (and the reliance on standardized code).

III.d. Organization and Priorities

The current structure and priority setting protocols of the NWFSC has served it, and its scientists, quite well. The team-based approach to assessments appears to have helped create a very congenial, cooperative atmosphere within the assessment group. They are meeting the assessment demand of the PFMC as well as their international obligations, and NWFSC scientists are producing a huge volume of very high-quality research. So, on the one hand, if it ain't broken… On the other, there is room for some reconsideration to help improve an already good system.

As stated above, it is difficult to determine whether the NWFSC is achieving its goals, and whether it's assessment and research prioritization scheme is in line with these goals, because these goals have not been clearly laid out so that they are specific, measurable, attainable, realistic and time-bound (aka S.M.A.R.T. goals). Are the correct stocks being assessed or assessed frequently enough? Is the balance of assessment production and peer-reviewed research appropriate? Without S.M.A.R.T. goals, it is very difficult to say. The NWFSC should work to produce a vision with associated S.M.A.R.T. goals to help ensure that current prioritization efforts are properly aligned. Once such goals are developed, the stock assessment prioritization process should become more formalized and transparent with explicit processes or weights used to determine how the vast array of information is distilled into decision-making. Such a prioritization scheme can only get you so far – in the end, prioritization will require discussion of non-quantifiable issues. The current prioritization scheme currently appears to rely upon a great many subjective and undocumented decisions (even if it has worked well so far).

Another concern that was raised was whether the national stock assessment prioritization protocol will be flexible enough incorporate more regional concerns to adequately prioritize NWFSC assessments. It appeared as if the current list of FSSI stocks may not be in line with current NWFSC priorities even though progress on the FSSI can influence funding. Given the currently levels of funding given to the

NWFSC for stock assessment, I honestly wonder whether NMFS understands what a valuable resource this particular stock assessment program is for the nation. The NWFSC stock assessment program appears woefully underfunded relative to the huge impact they are having on stock assessment methods throughout the world. Not only just the funding of the NWFSC be increased, but the stock assessment program should be given greater access to cutting-edge computer technology in the terms of high-performance desktops and laptops as well as computer clusters / servers that can handle the higher computational loads. In addition, the assessment scientists should be freed from the overly heavy-handed approach to computer security and given administration rights to their machines so that they may install new programs and R packages as they become available.

The NWFSC might benefit from taking some concerted time to develop just a few MSE case studies to explore how different factors should be weighted in a prioritization scheme. This could explore the importance of assessment frequency relative to generation time and recruitment variability. It could also explore the predictive power of PSA scores to adequately capture risk. In either case, it will be important to adequately measure not just the benefit of assessing a stock earlier rather than later, but also the costs of delaying the assessment of a stock. As with the concepts of willingness-to-pay versus willingness-to-accept in economic valuation studies, the benefits of earlier assessment may not be symmetric to the costs of delayed assessment.

III.e. Accomplishments Relative to Mandate

The NWFSC appears to be meeting all their mandated objectives. One area the could use further consideration is the incorporation of ecosystem concerns into both stock assessment models and into fishery management. Right now, it appears that there is some frustration on the part of assessment scientists that the peer review process is not allowing assessment scientists to include ecosystem considerations even when the peer-reviewed literature suggests they exist. I think the issue here is one of strategic thinking. Just because an ecosystem process explains some variability does not mean that the tactical advice from a stock assessment model is improved by including it. The yardstick by which model complexity is evaluated is very different in the world of fisheries management and OFLs than in the general scientific community. If including complexity does not improve decision-making (even if it does explain past variability), then it is debatable as to whether such a process should be included. The NWFSC might want to use an MSE-like approach to help it prioritize which ecological processes should be explored for tactical stock assessment models. For example, is it more important to be able to explain variability in past recruitment variability or past variability in natural mortality? Current assessment methods are actually pretty good at estimating past recruitment variability in the absence of ecosystem drivers; however, they are notoriously bad at estimating past mortality variability without some kind of covariate.

That said, understanding ecosystem-level processes and environmental drivers is crucial in order for managers to really understand the long-term risks associated with their management actions. Just

because something does not improve an assessment model designed to calculate OFLs for the next 5 years does not mean its unimportant in the longer term, more strategic thinking. The NWFSC should continue to emphasize research into biological processes and ecosystem drivers to help improve our understanding of long-term risk.

III.f. Communication

The NWFSC appears to have strong lines of communication with the PFMC, stakeholders, and collaborating scientists. However, travel budget restrictions and travel caps have decreased the NWFSC's ability to maintain those ties. This is already starting to have an effect as public and stakeholder input into stock assessments have been greatly curtailed due to lack of in-person pre-assessment meetings. The near-complete lack of any NWFSC presence at regional, national, and international conferences is also notable. Webinars and conference calls can not make up for the level of communication that can be achieved through in-person meetings. So much of the real communication goes on outside of the formal meeting structures, and this is completely eliminated by moving to electronic communication. NMFS needs to decrease these travel restrictions and put a much greater priority on in-person communication between the NWFSC scientists and their consituents and collaborators. It was also noted that the lower-level assessment scientists mentioned above could play a role for communication within the NWFSC between the survey teams and the assessment teams.

III.g. Opportunities for Improvement

I found it quite telling that the NWFSC took the original TOR for this section "Are there <u>opportunities</u> for improving stock assessments and the stock assessment process?" and turned into a discussion of opportunities for improving the technical aspect of stock assessment models – an area where the NWFSC already excels. I think the NWFSC already has an excellent handle on how assessment models could be improved. The largest area of opportunity lies within determining the Center's goals and then aligning its workforce to best achieve this goal. I think more use could be made of lower-level (e.g., non-Ph.D. scientists) in the assessment process as well as greater use of students for these more mundane assessment tasks. The NWFSC has worked hard to cultivate collaborations with other institutions, and these efforts should be continued if not enhanced.

IV. Conclusions

It is clear that the NWFSC has an exceptional group of scientists who are producing very high quality assessments and research. The Center is to be commended for these accomplishments and deserves far more resources than currently allocated to it. The recommendations made here will hopefully assist the Center in balancing its many competing needs while continuing its fantastic track-record of exceptional science.

Reviewer's Report
The NWFSC Science Program Review of the California Current Groundfish Stock Assessment Process

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Panel Member 3

I. Background and Overview

The National Marine Fisheries Service conducted an external review of the California Current groundfish stock assessment process during June 10-13, 2014. The goal of the review was to evaluate the quality, relevance, and performance of science and research being conducted by the Northwest Fisheries Science Center (NWFSC) and Southwest Fisheries Science Center (SWFSC) in support of groundfish management.

The review included a series of presentations by Center and PFMC staff followed by question and answer periods between Center scientists and the 6-member review panel. Members of the public in attendance provided comment as well. Extensive background materials were provided to the panel before and during the review. Supplementary materials were provided promptly when requested by panelists. The following observations and recommendations are provided with the intent of helping improve groundfish assessment and management on the West Coast.

II. General Observations and Recommendations

California Current groundfish stock assessments are conducted by scientists located at both the NWFSC and the SWFSC. This groundfish assessment team has been assigned the herculean task of providing regular assessments that are adequate for use in the management of over 78 groundfish stocks. Despite the low ratio of assessors to species, limited data availability, and decreased assessment support from other fishery management agencies in the region, the team has recently produced, high-quality, independently peer-reviewed assessments for a suite of species representing 95% of the commercial fishery's value and 56% of the recreational fishery's value. The quality and quantity of assessments produced in recent years is impressive and the research being conducted to improve assessments is of the highest caliber. The NWFSC groundfish

assessment scientists and their colleagues at the SWFSC should be commended for their dedication to addressing NMFS's core stock assessment mission.

The Centers' major challenges moving forward will be to obtain sufficient data to improve existing stock assessments and to establish a realistic and timely schedule for updating and enhancing all assessments in order to ensure that California Current groundfish stocks are being fished in a sustainable manner.

Overall recommendations are as follows:

1. Formalize an explicit and transparent stock assessment prioritization process that addresses the mission of groundfish management. This may require restructuring the current PFMC cycle and specification-setting process to increase the timeliness and quality of assessment advice for management.
2. NMFS should better align the level of funding and staff support with the quantity and quality of the work being conducted at the NWFSC.
3. Make communication opportunities such as pre-assessment meetings and Council assessment briefings a high funding/travel priority.
4. Increase emphasis on performing and efficiently reviewing updates and continue research on the benefits of data-moderate methods, including MSEs, to improve throughput without sacrificing management utility.
5. Enhance efforts to pursue all available avenues of data collection for poorly monitored stocks, especially stocks with a large nearshore and recreational fishery component.

III. Panel Member's Major Observations and Recommendations

Stock Assessment Process

Observations

Strengths

Management of most stocks in the groundfish complex are supported by a well-defined, transparent, and scientifically rigorous stock assessment process. TORs are well defined and regularly updated, as needed. The NWFSC's highly talented staff consistently produce well documented, thorough, state-of-the-art benchmark/full assessments for use in fisheries management. NWFSC staff also support coding of standardized stock assessment modeling and diagnostic tools (Stock Synthesis and R4SS) that are used worldwide. Weekly assessment team meetings encourage the sharing of ideas, latest methods, and overall collaboration among members of the assessment team. Multiple-authors are assigned to each assessment, providing opportunities for collaboration and continuity in the face of staffing changes.

The NWFSC staff take full advantage of the close ties they have fostered with regional university resources through the involvement of faculty in SSC activities and STAR panel reviews, and through the utilization of students in conducting stock assessments.

Last, but not least, support staff time is devoted to the often overlooked, yet extremely important, task of archiving old assessments such that they are 100% replicable.

Challenges

The utility of the stock assessment advice for management of groundfish stocks could be improved by shortening the interval between the terminal year for data used in the assessment and the setting of specifications. In some cases, the terminal year of survey data used in an assessment is up to 4 years old. The processing of commercial age samples is also backlogged for many species. Although data processing improvements are underway, some data are not available until early spring, resulting in quick turn-around of models in preparation for STAR panel reviews. The use of older data lessens the impact of assessment advice. Also, hurried assessments schedules have the potential to result in assessor error.

Great strides have been made in assessing most stocks at the data-poor or data-moderate levels. Although new procedures for prioritizing stock assessment in the biennial cycle are in development, the current procedure is undefined and potentially inefficient. Over 20 stocks in the complex have the potential to be raised to a Tier 2 level given available data; however, many of these stocks are rarely caught and may be of management concern only because they are bycatch in other fisheries. Moving forward, the NWFSC will need to balance the need for adequate science to manage each stock with the need to maintain reasonable assessment team workloads.

Recommendations to Address Issues

- Consider revision of the stock assessment work schedule and associated specification-setting timetable to make the process more efficient and useful for management.
    - Data preparation and model building in odd years of the biennial cycle may make the process more efficient and improve morale by avoiding the compression of all assessment activities into a short time period.
    - Recruiting of additional support staff, utilization of student assistance, and streamlining of data processing could improve the throughput of stock assessments and allow assessors to focus more on benchmark/full assessments and conducting stock assessment improvement research.
- As planned, conduct management strategy evaluations (MSEs) to determine the level of assessment complexity necessary to provide reliable management advice for each species group. MSEs should include evaluation of the current biennial specification-setting and assessment cycles relative to the life span and recruitment variability of the species.
- Continue to provide annual funding to regional universities with stock assessment expertise to support student assistance with assessments and to encourage faculty to participate in the assessment process. In particular, data-poor and data-moderate assessments hold great potential for student involvement.

- Begin to develop a transition plan for support of NWFSC modeling tools (SS and R4SS). Continue to pursue efforts to make all software open source.

Scientific and Technical Approach

Observations

Strengths

The work being conducted by the NWFSC and SWFSC staff who support groundfish assessments is of the highest caliber as evidenced by the high quality of benchmark/full assessments passing independent peer review and the large number of peer-reviewed articles published in top fisheries journals, presentations at national and international conferences, and other professional service activities performed. The NWFSC is a world leader in assessment methods and performance testing.

Much of the assessment methodology and research produced by groundfish assessors is being used to set best practices both nationally and internationally. In addition, the coding platforms developed and maintained by Center staff are used by assessment scientists worldwide.

Assessments are responsive to past peer review (STAR and SSC) comments and concerns. The groundfish assessment team should be commended for constantly striving to improve upon existing methods and for testing ways to increase throughput without sacrificing the quality of advice for management produced. Significant assessment improvements have resulted in better management of data-poor and data-moderate stocks (e.g., use of DCAC and DBSRA results vs. average catch*multiplier)

The Stock Synthesis (SS) and R4SS common platform enhances communication with reviewers/SSC/Council, facilitates staff transitions, and helps ensure continuity between assessments. The STAR panel and SSC in particular can provide greater throughput once they are familiarized with SS.

Challenges

Although the use a common coding platform may help to prevent coding errors, it has the potential to stifle innovation. Continued efforts to increase flexibility within SS is encouraged.

The assessment of stocks with limited data (especially nearshore/recreational species) will be an ongoing challenge to the groundfish team in light of current budget and interjurisdictional constraints. Many of the current data-poor and data-moderate assessments may be improved with the incorporation of additional data; however, the strict limits set on the STAR/SSC review process may hinder such advances.

Communicating the uncertainty and potential bias in data poor and data moderate methods to managers is critical. Current sigma levels (i.e., incorporation of uncertainty in OFL-setting) may not properly account for bias in data poor and moderate approaches. Also, structural uncertainty in all models is currently described through sensitivity analyses and decision tables. A formal method for evaluating alternative models in management decision has yet to be developed. One area that would benefit from alterative model consideration is the issue of stock structure; treating most stocks as discrete units could have important consequence to management advice for many groundfish species. New/ongoing genetic work at NWFSC may help address this issue.

Recommendations to Address Issues

- Continue to prioritize regular updating and thorough testing of all aspects of SS.
- Develop ways to incorporate advances in data-poor and data-moderate methods more quickly and smoothly in the STAR/SSC review process. In the meantime, provide managers with trends in all available, reliable, fishery-independent and/or biological data for data poor/moderate stocks that could provide information about changes in trends and structure (similar to the use of ancillary data as "rumble strips" by the MAFMC).
- Explore methods development for incorporation of alternative model structures in advice to managers.
- Explicitly communicate uncertainties in stock structure and their potential consequences to managers. As new genetic data become available, follow up with changes to model structure as needed.
- Continue to evaluate performance of assessment models and resulting reference points, including the use of proxies for MSY-based OFLs for all categories of assessments.

Peer Review Process

Observations

Strengths

The STAR process for independent peer review of benchmark/full assessments and methods development is rigorous and transparent. The number of assessments reviewed per STAR panel (max two) is adequate for obtaining a thorough review. The incorporation of fresh insight from two CIE independent panelists from outside the region is an essential part of the process.

The SSC provides a thorough review of all data poor and update assessments; the SSC also reviews all STAR panel reports and serves as the final arbiter when disputes arise between STAR panelists and assessors. This is appropriate given that the SSC is ultimately responsible for setting OFLs. The SSC is highly qualified, engaged, and supportive of efforts to provide sufficient review of data poor and data moderate assessments.

Challenges

With recent increased throughput by the Centers, the number of assessments reviewed by the SSC high and increasing. Given many of the groundfish subcommittee and overall SSC members are not federal employees, this could pose a problem if the time commitment becomes too burdensome during a compressed assessment cycle. Without adequate review time and assessment capacity on the SSC, problems and mistakes may not be identified and stocks/fisheries could suffer as a result. All but two of the potential reviewers (CIE reviewers on STAR panels) come from a limited pool of qualified candidates. This could lead to both regional bias in assessment advice and burn out from excessive workload during assessment years.

Recommendations to Address Issues

- Consider creating additional venues for assessment review. Creation of an additional review body may help alleviate some of the high workload during assessment years. However, if the SSC will still need to review (at some level) all assessments up for consideration in a given cycle. The Center and Council should re-evaluate the biennial assessment and review cycle and identify ways to lessen the alternate-year burden on assessors, data providers, and the SSC.
- Consider dedicating at least one STAR review per cycle to new methodological developments and model inputs that are broad in scope and cover many assessments. This may help alleviate the review burden on the SSC and other STAR panels.
- Identify a wider range of qualified SSC groundfish subcommittee members and potential (non-CIE) STAR panelists. Consider broadening geographic scope of search, if needed.

Organization and Priorities

Observations

Strengths

The NWFSC appears to be highly responsive to meeting the assessment needs and addressing requests from the PFMC. Groundfish team research is focused on improving the quality and throughput of assessments. The assessment science, assessment improvement research, and software development conducted by groundfish assessors at the NWFSC and SWFSC benefits local, national, and international fisheries management.

The groundfish program is in the process of formalizing their stock assessment prioritization process such that it is more transparent, efficient, and useful to managers.

Challenges

Out of the ~$15 million dedicated to the entire groundfish monitoring and assessment program, less than $2 million is dedicated to assessment science. Given the regional, national, and international importance of the assessment work being conducted by the groundfish team, this assessment program is grossly underfunded,

especially considering the fact that assessment support from regional agencies and student involvement has been dramatically reduced in recent years.

Management constraints on the groundfish fisheries have resulted in reduced availability of fishery-dependent data. Efforts are underway to make up this deficit with new collection of fishery-independent; however, funding and staffing may not be adequate. Also, recreational fisheries are difficult to value. The level of funding and effort assigned to collection of data for groundfish of recreational importance may not be in alignment with their true socio-economic importance.

National efforts to provide council-specific stock assessment prioritization schemes has the potential to be morphed by the needs of other regions and could stray away from the critical mission of the groundfish and PFMC process. An additional complication is that FSSI species selection may not align with any new prioritization scheme.

Recommendations to Address Issues

- Increase emphasis on performing restrained (not constrained) updates and continue research on the benefits of data-moderate methods, including MSEs, to improve throughput with sacrificing management utility.
- NMFS should better align the level of funding and staff support with the quantity and quality of the work being conducted at the NWFSC. In light of the fact that little to no help is provided by other agencies in the region due to budget constraints, NMFS should at least provide funding to hire additional staff to make up this deficit in stock assessment support.
- Formalize an explicit and transparent stock assessment prioritization process that addresses the mission of the groundfish management process. This may require restructuring the current PFMC cycle and specification-setting process to increase quality and quantity of assessment advice for management. Reconsider recommended FSSI species to align with new priorities, as needed.

Accomplishments Relative to Mandates

Observations

Strengths

The groundfish assessment team has recently produced, high-quality, independently peer-reviewed assessments for a suite of species representing 95% of the commercial fishery's value and 56% of the recreational fishery's value. The quality and quantity of assessments produced in recent years is impressive. In response to the hefty MSA mandate to set catch limits for all fisheries, the groundfish team responded by enhancing data-poor and data-moderate methods to produce better management advice (than average catch) and increase throughput. Twice as many adequate assessments were completed as compared to ten years ago. In particular, DCAC and DB-SRA were used to assess 50 species/stocks and other data-moderate approaches were used to assess an additional seven species.

Assessments and assessment-related research conducted by the NWFSC contribute greatly to the building of assessment capacity at other NMFS science centers, state Commissions, and other fishery management agencies nation- and worldwide. In addition, the software platforms developed and maintained by the NWFSC are used by stock assessors worldwide.

Challenges

Groundfish fisheries with large nearshore and/or recreational components are generally data-poor; in addition, their value and socio-economic importance is hard to quantify. The current prioritization scheme may undervalue such species.

As an economically important species with a high recruitment variability, hake deserves more attention than other stocks in the complex. However, care should be given to make sure this species does not consume a disproportionate amount of Center time and resources such that other fisheries and stocks suffer as a result.

The assessment methods development and coding platform services that the NWFSC is providing to the broader stock assessment community is undervalued by NMFS.

Recommendations to Address Issues

- Determine what can be done to improve assessments with the data already available (in digital format or in need of preparation).
- Enhance efforts to pursue all available avenues of data collection for poorly monitored stocks, especially stocks with a large nearshore and recreational fishery component.
- Continue efforts to develop a transparent and balanced approach to prioritizing stock assessments and data collection.
- Provide necessary funds, support staff, and research time to allow NWFSC assessors to continue assessment methods and software development.

Communication of assessment results and data needs

Observations

Strengths

Until recently, the groundfish assessment team has regularly communicated data needs and received feedback from data collectors, species experts, and industry representatives at pre-assessment and GMT/GAP meetings. These activities are vital for keeping the assessors up to date on data collection issues, at sea observations about changes in the stock, and changes in the fishery. In addition, assessors have historically provided briefings on the results of their assessments to PFMC members. These briefings helped to maintain lines of communication with regional partners and build trust in the assessors and the assessment process.

Challenges

Pre-assessment meetings and briefing sessions with PFMC members have been curtailed due to budget constraints. These meetings are essential steps in the assessment process without which vital information about groundfish stocks and their associated fisheries could fail to be incorporated into the assessment. Without such interactions with species and fisheries experts, data patterns and model results could be misinterpreted by assessors.

It appeared that no regional partners (e.g., PMFC members, GAP members, WA/OR/CA marine fisheries staff) were asked to present on the NWFSC's communication skills at the review. Only one PFMC Council staff member gave a presentation at the meeting (on a different topic) and only two stakeholders spoke during the public comment sessions. It is possible that other individuals were invited to speak but were unable to attend the review; however, if that was the situation, it was not communicated to the review panel. If the Center did not think to invite regional partners to the review, communication lines are likely unidirectional. In the absence of independent testimony that communication is satisfactory, it may be surmised that the NWFSC is highly insular and that groundfish stock assessment process could benefit from more regular and formal interactions between the Centers and their regional partners.

Recommendations to Address Issues

- Make pre-assessment meetings and Council briefings a high funding/travel priority. Encourage (by personal invitation, if necessary) regional partners, stakeholders, and managers to attend pre-assessment meetings. Webinars and conference calls should not replace in-face interactions.
- Connect regularly with regional partners to ensure genuine, two-way interactions are occurring.
- Consider recruiting additional support staff who would be dedicated to understanding and preparing survey/biological and fishery data. Responsibilities for these individuals would include maintaining solid lines of communication between assessors, data collection units (e.g., survey team, PacFIN), state biologists/managers, and GAP/industry members.

Opportunities

Observations

Strengths

The NWFSC and SWFSC are producing a large volume of high-quality research to support and improve stock assessments. In particular, they are making significant progress in ecosystem data collection and identification of research that supports better management of groundfish stocks. The assessment team should be applauded for thoroughly testing and trying to understand the mechanism behind ecosystem effects before incorporating new ecosystem data streams into their assessments.

Challenges

It is clear that much of the research being done at the Centers has direct bearing on groundfish stock assessments and will lead to improved scientific advice for management; however, that message may be lost in translation to people without stock assessment training given the highly technical nature of the work being conducted.

The long-term effects of changing ecosystems (e.g., range shifts in response to climate change, higher/different recruitment variability, etc.) will be a major challenge to data collection planning, assessment, and management.

Recommendations to Address Issues

- Consider explicitly testing and tracking the ways in which Center research directly affects and improves stock assessment. Package that information in an understandable way for presentation to NMFS and the Council on a regular basis.
- As planned, conduct MSEs to demonstrate how ecosystem components improve performance of single species models.
- Consider ways to incorporate demonstrated ecosystem effects in advice development (e.g., brief Council on how ecosystem considerations could be incorporated in risk policies). Begin to introduce the concept that ecosystem-based management will have to involve multispecies goal-setting and a series of trade-off decisions made by the Council.

Conclusions

The California Current groundfish assessment team is exemplary in the quantity of assessments produced for management and the quality of science being conducted. NMFS should recognize the outstanding level of stock assessment science and assessment development support provided by the NWFSC to the local groundfish program and the international stock assessment community. Moving forward, the Centers and PFMC should focus on finding creative new ways to increase data collection and maintain high throughput and timeliness of assessments without sacrificing the quality of critical management advice provided. This may require additional support for research to improve assessment science and restructuring of the management process.

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Panel Member 4

Background and Overview of the NWFSC (and SWFSC) Science Program Review Meeting

The National Marine Fisheries Service is conducting an agency-wide review of science center programs. The National Marine Fisheries Service's Northwest Fisheries Science Center (NWFSC) in Seattle in conjunction with colleagues from the Santa Cruz lab of the SWFSC, hosted an external review from June 10-13th 2014, to evaluate characteristics of the stock assessments conducted by the Centers. The public were sitting in during the presentations, and were given the opportunity to ask questions at the end of each day. To supplement the on-site presentations, the reviewers were provided web-based access to extensive supplemental reports that described aspects of the assessment program at the Northwest and Southwest Fishery Science Centers (hereafter referred to as "the Centers").

General Observations and Recommendations

Firstly, I have some familiarity with the background and evolution of the Centers work on groundfish research and assessments due to the fact that a large part of the responsibility was conducted by AFSC scientists and included surveys. I was lead author or main model-developer on a number of the stock assessments throughout the 1990s (Pacific ocean perch, yellowtail rockfish, and shortspine thornyheads). Since this time, a number of important events have occurred in the interim. Namely:

1) that there were concerted efforts to remove fishing capacity through buyouts,
2) resource conservation areas (e.g., Rockfish Conservation Areas) were established as additional management tools,
3) several stocks (in addition to POP) were declared overfished and placed under rebuilding plans
4) regular surveys which cover more area with better protocols are now the norm (previously only sparse surveys were run over irregular space and time frames),
5) involvement of state biologists from CA, OR, and WA has dropped considerably with only one or two remaining that are conducting (or able to conduct) stock assessments
6) University involvement through students and professors has increased (though in the last few years students have been less commonly involved with assessments)

7) An effective observer program was established (which helped resolve discard estimates among other issues)
8) The use of SS3 (written in the ADMB software created by Dave Fournier; previously SS assessments for the west coast were based on FORTRAN code) as a core assessment package has facilitated analyses and reviews
9) A cadre of young scientists have been successfully recruited which contribute to software development (e.g., R4SS)

It is worth noting that with the exception of hake, the result of 1) - 3) has effectively reduced demands to have assessments which provide timely ACL and OFL specifications since most species are harvested well below these limits (sablefish and petrale sole are the only other ones that appear to be harvested above 0.5xOFL). That is, due to the multispecies nature of the directed fisheries, many catch limits arising from the assessments have limited direct impact on actual fisheries (most available quotas result in fish "being left in the water"). This is important to note since it may be that viable fishing opportunities are being missed (and poorly addressed) and that these should be weighed relative to the obvious benefits of having extra protection and conservation measures.

The analysis going into the assessments are world class and given the extensive review process and strong adherence to the assessment framework and reporting guidelines, are among the highest quality I've seen. The weakness of the process is that relatively few assessments are conducted (slightly more than 1 per scientist every two years). Also, the review process seems to be overly onerous, especially now that the FRAM division and staff have matured and have a good data collection system and a great team of excellent scientists that are well suited to the task and their time might be more efficiently spent in doing more analysis under a slightly less constraining review system. Additional FTEs for the stock assessments would help improve the throughput and conduct of assessments but it's unclear if more could be accomplished given constraints of the current STAR-panel review process.

The following comments follow the order of the presentations given by the Centers during the review.

Stock Assessment Process

As noted above, the overall process for conducting assessments is top quality. The main trade-off seems to be at the expense of covering more stocks and having the perception that it's tortuous, particularly in the review system.

Strengths

- High priority stocks have high quality, rigorous assessment approaches
- Substantial progress on developing efficient tools for data processing
- Multiple-author assessment teams provide needed redundancy

Challenges

- Timeliness of most recent survey data relative to OFL/ACL specification longer than at other locations
- In-season delays in receiving survey data. (Not delivered until spring while other places get it in the fall)

- Stock structure evaluations are difficult to address for so many stocks
- Maintaining adequate staffing levels in the face of predictable turnover as well as unanticipated staff departures

Recommendations

- Reconsideration of what is being done in the "even" and off years of the biennial cycle
- Make between-year data preparation an explicit part of the process
- Consider evaluating more explicit front-loaded approach which anticipates more recent data (in future) to reflect possible "new data outcomes" (e.g., when new data available, respond accordingly depending on where it falls within discrete bounds)
- Continue to engage students to assist in assessments
- Consider a staged stock-structure evaluation system similar to that used in the NPFMC

Scientific and Technical Approach

The Center is using an appropriate suite of analytical methods to meet the regional fishery stock assessment objectives. These cover considerations for all levels of data availability. Much is made about the capability of the assessments to consider possible ecosystem effects and the centers work as clearly demonstrated the ability to do this. However, I think the importance of having a tactical assessment model that features explicit ecosystem attributes is overstated. Ecosystem aspects may more logically be considered in strategic decision processes (e.g., should the reference points be modified in El Niño years etc).

The Centers scientists continue to enhance analytical methods in a variety of ways, mainly through scientific publications and this is exemplary. Assessment scientists are heavily involved in preliminary data preparation and analysis based on their statistical expertise. This adds some burden but the benefit of better understanding more aspects of the assessment data outweigh this, especially given the relatively light load of assessments conducted by the centers. Protocols for conducting sensitivity analyses and evaluation of risk, as with all fisheries stock assessments, could be improved. Those conducted for the PFMC are excellent but some ad-hoc appearances of the P* approach and application should top the list for considering ACLs.

Strengths

- Standardized tools for assessments (e.g., SS and rebuilding projection software)
- The staff are making improvements to the underlying processes / methods for many assessments
- Scientists at the centers are very capable of contributing to software development

Challenges

- Representing structural uncertainty appropriately
- Innovation may be limited in using standardized tools
- Innovation in data-moderate and data poor methods may be stifled by lack of flexibility in the review process

Recommendations

- Move towards better ways to include sources of uncertainty (e.g. the random effects model) within assessment models
- Continue to support efforts to advance data moderate methods

- Continue support of developing software useful for assessments

Peer Review Process

The peer review process at the centers is unparalleled for stock assessments. The terms of references are very clear and well defined prior to the assessment but arguably are overly excessive both in the structure and in their conduct. In terms of balance, thoroughness has restricted throughput and I feel that the process for STAR Panels could be relaxed somewhat, especially for assessments that are full updates but not entirely "new".

Strengths

- Extremely rigorous peer review through STAR panel CIE process and protocols
- Separation of science and policy
- Transparency in that all aspects are generally public (historically some CIE reports were unavailable)

Challenges

- Limited universe of qualified reviewers (including SSC members)
- Retaining high quality reviews more efficiently. Current STAR panel costs relative to benefits difficult to assess. There is a need to balance quality of review with fishery management importance/priority
- SSC capacity is limited under the biennial management cycle

Recommendations

- Consider reviewing data-moderate assessments using mechanism other than the STAR panels
- Consider focusing a portion of the STAR panels on methods and data source reviews
- Consider developing an alternative panel to help with peer review that is between the intensity of the STAR and SSC.

Organization and Priorities

The priorities for stock assessments could use a more clearly laid out logic approach and the centers might borrow some in-house expertise from social scientists on how to be "value" and prioritize assessments. The centers might consider pooling stocks that are similar in character, not targeted, unlikely to have differential mortality etc. Managing "complexes" has a long history and done appropriately can provide some efficiencies. In fact, there are good analytical studies evaluating which stocks tend to have similar characteristics (e.g., Heery and Cope 2014).

One could perceive from the outside that fish stewardship is the main focus of the centers and that **fisheries** management priorities play a secondary role. Further, if a stock lacks an assessment there may be a perception that it's likely to be heavily impacted by fishing by default. Such objectives and determinations may be justified and acceptable, but could be more clearly articulated and discussed.

The centers recognize that developing MSEs are an important research area and are presently pursuing them (in particular for hake). For other species, I think it would be important to pursue them as a means for: improved data collection, evaluating the potential to manage within complexes, and streamlining assessments. It is important to recognize that MSEs are meant to make the process of management

more transparent and geared to objectives that involve all stakeholders. Perhaps, completing a single multi-species MSE in an off-year would be worthwhile rather than treating MSEs at a stock-specific level.

Strengths

- The Centers are very responsive to the Council needs and the breadth of research being conducted addresses a wide range of pertinent fishery issues
- The Centers do a good job of evaluating a prioritized portfolio of baseline assessments for all managed stocks (including data-poor) and full assessments for important stocks since most of the landings and species are covered (In 2010 – the number doubled by adding data-poor analyses)
- Assessment scientists from the Centers engage in research that results in many publications in peer-reviewed journals and these enhance the national efforts to improve stock assessments
- The Centers have balanced Council, other domestic and international stock assessment needs as well as additional analytical and review demands very well, hake is exemplary

Challenges

- Timeliness–lag time between survey and assessment and application in management
- Some important recreational stocks may be under-represented in data-collection and assessment considerations
- The national prioritization scheme and protocol may be inconsistent with other needs and missions of the centers and the PFMC process
- Prioritization protocols are unclearly articulated and could be made more transparent and formalized
- The current process lacks flexibility that can affect throughput, for example the rigors of conforming to the STAR panel process

Recommendations

- Leadership should acknowledge and support training and software development, in particular contributions to projects such as ADMB and R4SS. Presently, important contributions to ADMB by center scientists go unrecognized as an important activity
- A clear relationship needs to be developed which evaluates what is being assessed versus the level of effort. We recognize that the prioritization scheme is in development but several things could be added to the matrix or scored differently
- Procedures for the process need to be articulated and be transparent and avoid concerns about unclear motives for stocks being selected
- Consider moving toward updates (as opposed to data moderate) after important benchmarks are completed to provide efficient use of resources
- The Centers are encouraged to continue to use MSEs as a means to help define research and data collection needs and assessment complexity relative to the core mission

Accomplishments Relative to Mandates

The centers are responsible for a large number of species with something like 148 “in the FMP”. Most of these are categorized as outside the focus of directed fisheries. Recently such “data poor” stocks were evaluated using a series of alternative models. These models are an active and appropriate area of research by the groups and they are to be commended in that they have become world leaders in this type of research (e.g., the Carruthers et al. 2013 paper). The centers’ prioritization issues are discussed above. Ecosystem and environmental factors are regularly evaluated and the centers play a key role in

developing the appropriate level of monitoring for this type of work (e.g., involvement in the FATE program).

Strengths

- In general, FMP stocks have an OFL based on stock assessments. The number of assessments doubled in 2010 primarily due to the addition of data-poor methods.
- Current and planned fishery stock assessments meet regional, national, and international expectations in terms of quality, quantity and timeliness in general.
- Centers are engaged in ecosystem research.

Challenges

- Incorporating ecosystem data / information into the assessment is still in development and the utility of this remains uncertain.
- The current process lacks structure to fully address broader ecosystem concerns
- Current FSSI stocks may not correspond well to PFMC and centers-priority stocks.

Recommendations

- Develop protocols for reconsidering data-poor stocks in light of their potential vulnerability. This should ensure consistency with national standards to avoid overfishing
- Regarding treatment of ecosystem and environmental factors affecting fish stocks and their assessments the panel suggests following the general steps: (1) identifying factors; (2) showing their importance (tactical and strategic) and (3) incorporating them within the assessment as appropriate
- Keep in mind improvement of stock assessment is not the only reason for considering ecosystem effects; also effects of fishing on the structure and function of the ecosystem.
- Changing climate effects should be monitored and evaluated for strategic considerations (e.g., biological reference points).

Communication

Communication of assessment data needs requires those conducting the assessments to actively engage survey scientists and those involved with obtaining fisheries-dependent data collections. The centers' scientists appear to have a good working relationship but this could be improved. The "data throwdown" approach is particularly appealing as (in my experience) adding formality to the process can create more unneeded administrative overhead. Having said that, a clear record should be made in some form (meeting minutes or whatever) to ensure that expectations are met. Relative to fishery managements and the affected public, the centers actively engage in outreach and appear to regularly report and inform the PFMC and other stakeholders.

It was clear that all lines of communication have been hampered by restrictions in travel in recent years. Some of this (even with the restrictions) may be rectified by placing higher priority for communication opportunities, especially for stakeholders.

Internationally, communication with Canadians (on issues unrelated to hake) has decreased in recent years. This is partly due to reductions at DFO and the lack of coordinated surveys that covered more of the continuous range for some important fish stocks.

Recent improvements with "google drive" adoption has improved the ability to communicate and collaborate with other scientists on mission critical tasks. However, allowing greater flexibility for the Centers' scientists in running and maintaining their computers could improve conditions.

Strengths

- The centers genuinely attempt to engage stakeholders and do so in a way that improves the quality of the assessments
- Hake assessment as the prime example for good communication (with stakeholders)

Challenges

- Travel restrictions have constrained critical communication
- Unclear that the efforts of IEA are being embraced in a practical way for fisheries management (they seem to be disconnected)
- Ensuring that the Council and fishery managers understand important assessment issues

Recommendations

- Consider recruiting people to fill the analytical gap between the data collection and analysis for input into stock assessments and provide a bridge of communication between the data collection process and stock assessment analysts.
- Pre-assessment workshops should be re-established
- The centers should increase the priority of face-to-face meetings and venues that encourage increased collaborations internally and externally
- Make a more focused effort to promote understanding of assessments by target audience, especially when new assessment methods are introduced

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Opportunities for improving stock assessments

Probably the strongest aspect of the centers research teams is that they are **very** actively conducting analyses and publishing papers focused on a variety of aspects geared toward improving stock assessments. They participate broadly nationally and internationally in related work. Collaboration with the AFSC could be improved. Presently AFSC scientists contribute regularly to the NWFSC and SWFSC work (e.g., through SSC membership and STAR panels) yet the NPFMC could certainly benefit by having a couple of appointments to the groundfish Plan Teams or other review activities on a more regular basis.

Strengths

- The Centers appear to be committed to developing a workforce plan.
- The centers are clearly seizing opportunities to conduct research that is within reach, particularly given the talented professional staff
- The centers' scientists are capable and willing to commit their creativity towards improved software development

Challenges

- Research needs are often in reaction to comments and reviews and less on research into factors that could improve the assessment for management advice
- Aspects of basic biology for many groundfish species are poorly understood
- Software development for fisheries modeling purposes requires commitments of time and resources

Recommendations

- Acknowledge and encourage assessment scientists to engage in contributing to software development including high-level packages (e.g., R4SS) but also for improving the fundamental open source libraries that NOAA has supported over the years (e.g., ADMB and new developments)

Conclusions

The Centers provide world class assessments for managers through a team of excellent scientists and a rigorous process.

Going forward, prioritization and improved information on ways to balance conservation objectives with better (non-hake) fisheries production should be recognized as a high priority. Evidence of good interaction among other ecologists and researchers was evident. However, the interaction with the economics and social scientists within the centers was less clear. In particular, consideration of fishing fleet capacity seemed to be missing, particularly in the prioritization of assessments.

Reviewer's Report
The NWFSC Science Program Review of the California Current Groundfish Stock Assessment Process

Northwest Fisheries Science Center
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Panel Member 5

I. Background and Overview of the NWFSC Science Program Review Meeting

The Program Review for the NWFSC was conducted over 10-13 June, 2014. Reviewers received a comprehensive set of background materials prior to the meeting, and detailed presentations on the major aspects of stock assessment planning, execution, review, and subsequent integration of results into management. These presentations were well-organized, and allowed the review to efficiently focus on a few key themes of particular importance. Where needed, staff provided additional information on request to address a wide-range of questions regarding all aspects of the assessment process. It was clear that groundfish stock assessment is the core mandate/function for the NWFSC.

II. General Observations and Recommendations

The historical legacy of the West Coast groundfish fishery and its management is very important to the data, models and process currently applied. Assessments recognize changes in data collection and availability from survey and fishery-dependent sources over time, as well as regulatory milestones related to the Magnuson-Stevens act, various permit programs, overfishing declarations, the vessel buyback, RCAs, gear restrictions, the trawl ITQ program, and others.

The NWFSC is applying an effective array of analyses for conducting stock assessments and supporting management activities. The peer-review process including STAR panels and the SSC is extremely rigorous, which has provided tangible benefits in terms of quality and trust in the products. However, the overhead of the current peer-review process creates considerable lags in data usage and demands resources (staff, resources and time) that could be focused on other efforts. Determining whether this approach is 'striking the right balance' requires a more fully codified prioritization approach. Current and probable future staffing for the assessment program will not allow rigorous stock assessment for all stocks included in the PFMC's FMP. Therefore, prioritization of assessments, including which stocks to assess, how often to assess them, and what type of model(s) to use is a fundamental input to all aspects of this program.

The products from stock assessment analyses can be only be as good as the input data upon which they are built. Although a previous program review specifically addressed data sources,

it is important that NWFSC assessment planning continue to recognize the importance of high-quality and timely data collection and processing; data processing in particular can be a significant bottleneck for assessment throughput. Deficiencies in underlying data can never be remedied through modelling.

III. Panel Member's Major Observations and Recommendations

Stock Assessment Process

Observations

Strengths

- Efficient tools for data processing are being used to reduce the time required for many tasks in preparation for assessments.
- Multi-authored assessments are a very valuable approach for many reasons, including error checking, standardization of approaches, skill/workforce redundancy, and reduction of specific analyst effects on assessment results.

Challenges

- Several key data sets are currently incomplete.
- Rigid categories for assessment models may be influencing rather than just summarizing which models are being selected for use.
- Currently available staff is fully subscribed with regard to assessment and research output.

Recommendations to Address Issues

- Making the RecFIN data system reliable and completing the coastwide historical catch reconstruction should be high priorities.
- Continue to utilize students via: the Pathways program, NMFS Population Dynamics fellowship, and direct recruiting from the UW (and perhaps other academic institutions). Contractors, post-docs, visiting scientists, and other avenues for additional staff should also be explored.

Scientific and Technical Approach

Observations

Strengths

- The use of the standardized and widely available tools including Stock Synthesis, the rebuilding software, and r4ss make current analyses very efficient.

Challenges

- Balancing the extensive use of standardized tools with innovation and exploration of new methods will require some staff time (or some dedicated staff) engaged pursuing alternative approaches and models.
- Support for these tools currently relies on a very limited number of individuals, which is undesirable over the long run.
- Uncertainty in biomass is being used a proxy for uncertainty in the OFL; this is an underestimate and should be addressed along with the defaults used for σ values.
- Structural uncertainty is largely under-represented in recent analyses.

- The trans-boundary nature of many stocks is being ignored (with the exception of hake); the biological and management consequences of this are unknown but could be considerable.

Recommendations to Address Issues

- Continue to support development of standardized tools. This includes documenting and communicating these products outside the NWFSC and increasing the base of contributing developers (make them all open-source).
- Data-poor methods are 'better than guessing' but have been shown to perform poorly in simulation experiments. These should be replaced with better (higher category) methods where possible in future analyses for stocks of potential importance. The shortcomings of these methods should be made clear to stakeholders.
- Continue to improve methods for estimating and reporting uncertainty in stock assessment results, particularly structural uncertainty (alternate models). This has very large implications for the σ used in setting ACLs, regardless of the default minimum, and is relevant even for data-rich assessments.
- The default σ values used to account for scientific uncertainty need to be updated to reflect the results from more recent stock assessment cycles, and the approach refined to explicitly include the age of the assessment.
- Work toward collaboration on trans-boundary stocks and consideration of how results from such analyses could be accommodated in the PFMC's management process.

Peer Review Process

Observations

Strengths

- The PFMC's two-layer approach of STAR panels and SSC reviews represents an extremely rigorous process that appears to promote confidence in the science and meets all national mandates.
- The delineation between the scientific analyses and the setting of catch limits is a very positive aspect of this process.

Challenges

- The review process has a very finite throughput, and consumes many more resources to support it than comparable approaches.

Recommendations to Address Issues

- Continue to explore ways to expedite review of updates and data-poor/moderate assessment products without using STAR panels for these analyses. Updates could be done much more frequently; the TOR may need to be revised to reduce the burden of reporting for updates.
- Consider using STAR panels to conduct a smaller number of full/new assessments, and more methods reviews where they may be subsequently applicable across groups of assessments.

- The rationale for assessment model category determination (by the SSC) should be formalized, documented, and communicated to stakeholders such that the offset in ACLs (due to the differing σ values) is clearly justified.

Organization and priorities

Observations

Strengths

- The NWFSC is producing a broad array of assessment-related research, which is promoting improved assessments and west coast groundfish management.

Challenges

- At current staffing levels, loss of 1-2 assessment positions (even temporarily) is likely to have pronounced effects on the short-term delivery of the products required by management.
- Delays in data processing appear to be much longer than those for comparable processes elsewhere.
- Delays due to the management process result in dated information (currently up to 5 years) informing ACL decisions.
- The current approach to assessment prioritization is difficult to evaluate.

Recommendations to Address Issues

- The NWFSC should work toward streamlining the hiring process so that vacant or new positions can be filled in a timely manner.
- Explore new avenues to reduce the large lags associated with data processing and use.
- In addition to better documenting the prioritization framework, additional metrics should include at least recent survey trends, desired assessment frequency (based on biology), and improved metrics of fishery (commercial and recreational) importance.

Accomplishments Relative to Mandates

Observations

Strengths

- The status of groundfish stocks has improved dramatically since 2001.
- ACLs based on some type of assessment analysis are in place for FMP species.
- Based on landed value, contribution to the ACLs, and other metrics, the important stocks are currently covered by adequate recent assessments.

Challenges

- Recreationally important species are less well-represented in current assessment efforts and methods for effective prioritization of these stocks (e.g., pounds) need development.
- Current FSSI stocks may not correspond well to PFMC priority stocks.

Recommendations to Address Issues

- Continue assessment coverage of high-value and constraining species, while adding full assessments for new species where possible.

- Dialog may be needed in the future to make sure FSSI stocks are consistent with PFMC prioritization.

Communication of assessment results and data needs

Observations

Strengths

- The hake process is a model for successful collaboration and communication. Very strong communication efforts have built considerable involvement and trust from stakeholders.

Challenges

- The effort required from analysts for effective communication to all participants is considerable.
- New assessment methods (and even existing ones) may be particularly challenging to communicate to a diverse audience. Specifically, the limitations of simpler approaches may not be readily appreciated.

Recommendations to Address Issues

- The NWFSC should make effective communication a high priority through adequate funding for travel to engage stakeholders and other scientists at council events, scientific conferences and related assessment activities. Even 'non-essential' outreach (captain's meetings, direct interaction with data collection programs, port visits, etc.) can be extremely valuable.
- Physical presence at council meetings and assessment activities should not be replaced with electronic participation - this does not achieve the same type of personal interaction with stakeholders and consumers of assessment products.

Opportunities

Observations

Strengths

- The NWFSC's assessment program has a diverse research program which is making incremental progress on a large number of aspects of biology, modelling and management.

Challenges

- Many aspects of basic biology and ecology for West Coast groundfish species remain poorly understood.

Recommendations to Address Issues

- The NWFSC should continue to support broad range of data collection, research and publication that is not assessment-specific.

Conclusions

The NWFSC stock assessment program is producing high-quality products for groundfish management as well as cutting-edge research in fisheries science.

Given limited and fully utilized resources, the primary planning tool for future efforts is the prioritization of stock assessments and supporting analyses. Prioritization of assessments is currently based on a detailed information matrix including assessment history, fishery relevance, data availability and other factors. This represents an excellent framework, but needs further development both in terms of content and communication to all participants. The prioritization process should be codified and documented to allow transparency, and stakeholder evaluation of decisions. In contrast, extensive prioritization of non-assessment research, an important component in the NWFSC's program, could limit innovation and exploration of novel approaches.

Structural assessment model uncertainty (i.e., competing models, averaged/blended models, ensembles) is largely absent from current assessment results (rebuilding analyses excepted). The PFMC process should engage in further efforts to better include structural uncertainty in point estimates, time-series and σ values (not just in the decision table).

Management Strategy Evaluations for a small number of important stocks could be a very helpful tool to test the performance of reference points, harvest policies, stock assessment models and data collection programs. This could also be a productive avenue for evaluating the role of ecosystem considerations in management; research models and hypotheses could be explored before they are directly included into tactical analyses (stock assessments). It seems more important for the NWFSC to continue learning about a small number of the most important stocks and fisheries than to 'fill out' assessment tallies of minor species with relatively simple (and poor-performing) models.

The NWFSC's current level of assessment output may be enough: resources (staff, money, time) appear fully subscribed, PFMC needs seem to be generally satisfied, national standards/mandates are largely being met, new species are still being added, and FSSI scores and other performance metrics are consistent with (or ahead of) those in other regions. Perhaps the focus of future efforts should be on the maintenance of current output levels, with improvement in quality: better data, better models, more detailed analyses such as MSEs for important stocks, rather than quantity: more or more frequent data-moderate/poor analyses of minor stocks.