

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

The species listed under FMP, FEP, and international agreements present significant challenges for stock assessment modeling.

Species covered under international agreements are highly migratory with sub-basin to basin-scale distributions, good-to-fair fishery-dependent information and life-history data but very limited fishery-independent information. Annual catch limits are allocated among members of RFMOs. While PIFSC assessment scientists provide important contributions to several of these HMS assessments, in most cases, U.S. fishermen account for a small fraction of total removals and thus management of U.S. catches has limited influence on stock trajectories. Nevertheless, the stock assessments for these species are more mature than models for other PIFSC region stocks. Primary limitations for these models include an observer program designed around monitoring prohibited species interactions rather than stock assessment, a backlog of unprocessed biological samples (size-age compositions from tuna purse-seine fishery), uncertainty about spatial structure in the population, and limited fishery-independent information. The analytical methods employed by Center scientists are appropriate but more could be done to explore possible environmental effects on CPUE, catch composition, recruitment, and stock distribution.

The MHI deep-7 bottomfish complex assessment suffers from limited contrast over the time series of observed catches and the presence of a monotonic trend over the time series. These limitations reduce the number of independent parameters that can be reliably estimated from the time series. While auxiliary information may improve model fit, it is possible that the apparent model dynamics are an artifact of particular values of the auxiliary information. This assessment is hampered by a lack of fishery-independent data, a lack of a detailed time series of age-compositions, and a lack of life-history information for some species in the complex. In addition, the time series of catch, effort, and average landed size does not seem consistent with exploitation rates implied by the model. The model used in this assessment should be more fully examined in a simulation context to elucidate the extent to which imposed auxiliary information drives model dynamics. While the nascent fishery-independent assessment work may be useful, it would be prudent to use a value of information analysis to explore potential return on investment in the four proposed methods (cooperative research fishing, botcam surveys, AUV camera surveys, and acoustic surveys), additional size-length compositions, aging of otoliths, tag-recapture studies, and increased accuracy in estimates of non-commercial catches. Because fishery-dependent information will likely remain vitally important to this assessment, it could be advantageous to encourage Center social scientists to assist in gathering information from the fishermen that may help contextualize the commercial fishery dependent data and improve/validate the accuracy of estimates of non-commercial catches. For example, social scientists may be able to help identify how changes in fishing technology and participation rates influence observed trends in catch and effort. One possible approach (suggested by PIFSC assessment scientists) is to develop a time series of catch and effort data for a subset of licensed fishermen (highliners)—these records might provide a more informative index of changes in the underlying stock and a better indicator of the possible role of environmental drivers and grounds congestion. Alternatively, key informants—individuals widely recognized as knowledgeable about the fishery and its history—could be identified and interviewed. Not only might these approaches (subsampling of catch records and key-informant interviews) lead to improved stock assessments, they would build on existing strengths of the social science group and could provide an intellectually stimulating opportunity to explore the use of local knowledge as a source of information to provide context for

fishery-dependent data. The influence of such data might be particularly helpful for this stock assessment because the time series is monotonic and exhibits low contrast and because the fact that even though the modeled exploitation rate is low and effort has increased and technological change has likely increased the technical efficiency of effort, fishermen have consistently failed to harvest the TAC in recent years. This outcome is not intuitive. It is possible that we have failed to correctly model behavioral decisions by fishermen. Another possibility is that the model underestimates fishing mortality. It would be nice to be able to confidently reject the latter hypothesis. Additional effort should be put into developing individual stock assessments for principal species in this stock complex. The fact that commercial landings are (largely) sold through a central auction should facilitate sampling for size-length compositions and otoliths, especially for members of the complex for which the existing number of biological samples limits confidence in estimates of life-history parameters and of trends in size-length and age compositions. The intent of modeling individual species in the Deep-7 complex is not to move towards ACLs for individual species, but to provide a better basis for setting an ACL for the complex as a whole and to guard against unsustainable harvests of less productive species.

The Reef fish assessment faces challenges of representing lots of species distributed across a vast region with incomplete data on catches and limited information on life-history characteristics. Moreover, because these stocks are largely associated with fringing reefs, their fisheries are mostly in state or territorial waters and consequently not fully subject to federal management. The assessment makes creative use of limited information on lengths observed in dive and creel surveys and derived from commercial sales. Together with available life-history data and life-history parameters reported for related species, the assessment provides estimates of SPR that can be used to indicate stock status. This is an innovative and pragmatic approach to providing the WPFMC with a provisional assessment of stock status for these species. Nevertheless, there are many species for which there is, as yet, too little information to support status determination.

- a. Is the Center using an appropriate suite of analytical methods to meet the regional fishery stock assessment objectives?  
Yes, but see comments above.
- b. Does the suite of assessment models cover considerations from data-poor to data-rich?  
Yes, but see comments above.
- c. Are assessments capable of considering possible ecosystem effects?  
Yes, but see comments above.
- d. Does the Center work on enhancing and testing these analytical methods? Are they keeping with and contributing to the state-of-the-science nationally and internationally?  
Yes, but data availability constrains analytical methods. Alternative approaches to modeling the MHI Deep-6 bottomfish should be explored.

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

The assessment process could benefit from clearly articulated terms of reference that identify the scope of analysis for benchmark assessments and assessment updates. These TOR should specify a general outline for stock assessment documents, a standard timeline for completion of the assessment, a description of internal and external review processes and guidelines for response to review comments. The PIFSC and PIRO directors and the WPFMC executive director should establish a multi-year schedule for each assessment. That schedule should be reviewed annually but should be finalized at least two years ahead of a planned assessment review to allow for timely decisions on

planning, budgeting, and staff tasking. At the time the schedule is finalized, the specific scope of the assessment and a listing of specific deliverables and model scenarios should be agreed to in writing by the PIFSC and PIRO directors and the WPFMC executive director. For HMS species, the assessment schedule should also consider management needs of respective RFMOs. Each new (or updated) assessment should include comments from the most recent reviews (SSC, WPSAR, CIE, etc.) as well as a brief responses (actions taken or not taken and why) to those comments. This section should appear immediately following the executive summary of the assessment report.

- a. Is there an explicit terms of reference for conducting and reporting assessments?

No. Consider adapting the NWFSC stock assessment TOR to meet PIFSC needs. Clear TOR help define endpoints within a given review cycle and are especially helpful to young assessment scientists who might otherwise have a difficult time saying no to requests for analyses beyond those included in review requests.

- b. Do reports provide a complete description of the work and a concise summary?

Yes.

- c. Do assessments adequately and incrementally build upon past assessments and reviews?

There are plans for this to occur but some stock assessments have not yet undergone multiple review cycles.

- d. Are there clear protocols for delivering draft assessment products to peer reviews?

Yes, for delivery to the SSC. The process for deciding to submit an assessment to WPSAR or CIE review does not seem to be fully settled.

- e. Is involvement of assessment scientists in preliminary data preparation and analysis sufficient to utilize their statistical expertise, but not burdensome?

Stock assessment scientists currently take the lead in data preparation. This reduces the amount of time available for conducting assessments or for developing assessments for additional stocks. PIFSC may want to consider hiring a few data/sample specialists (as is common in other Centers) to support preparation and processing of data needed for stock assessments.

- f. Are there protocols for consistently dealing with technical issues, as appropriate to the stock, for example: calibration of catchability, consideration of dome-shaped and time-varying selectivity, natural mortality, estimation of stock productivity, characterization of uncertainty, etc.?

These protocols are not yet firmly in place for each assessed stock.

- g. Are there protocols in the assessment process for conducting sensitivity analyses and evaluation of risk?

Sensitivity and risk analyses are not yet fully developed for the assessed stocks.

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?

The basic structure of the peer review process is sound but parts of it are not very seasoned. As the stock assessment review process moves through additional cycles, it will be increasingly important for the assessments to clearly report comments provided in prior reviews and responses to those review comments.

- a. What is the relative role of the Center and the SSC in organizing and conducting the peer review?

The Center does not seem to have a formal internal peer review process. This may be an artifact of the team-approach used for stock assessments. If the Center moves towards smaller teams or individual lead authors for each major stock group, development of a formal internal peer review

process could help develop capacity and may help polish analyses before they are sent out for external review.

- b. Are TORs for assessment reviews clear and well defined prior to the assessment? Are they focused on key issues needing review? Are they appropriately, but not excessively, broad in scope? Do they focus the review on key, answerable questions?

No. See above.

- c. Are major data collection programs and modeling methods reviewed separately from the final review of assessments?

Yes.

- d. Are there clear protocols for considering and including input from scientists not on the agency assessment team?

Yes (WPSAR and CIE reviews)

- e. Does the regional peer review process achieve an appropriate balance between transparency, thoroughness, and throughput?

The peer review process is fairly transparent and thorough however the response to review comments could be made more transparent, particularly for SSC and CIE reviews. The WPSAR process seems well organized but it has, this far, only been implemented once.

- 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.

There does not seem to be a formal process or agreed-to criteria for prioritizing the development of new assessments, updates of existing assessments or for balancing assessment efforts between species that are largely contained in the EEZ (3-200 nm), species that mostly occur under the authority of international agreements, and fisheries that are largely restricted to state and territorial waters. Once there is agreement on the criteria (e.g., economic, cultural, or ecological significance, vulnerability, likelihood that improved assessment could lead to management action to improve stock status, analytic tractability, etc.) to be weighed in a prioritization scheme, the Center should consult with PIRO, WPFMC, and RFMOs to set a schedule for refreshing established assessments, overhauling existing assessment models, developing assessments for species included in species complex assessments, and developing assessments for unassessed stocks. The lack of clear priorities makes it difficult to judge the adequacy of funding/staffing to support stock assessments.

- a. Does the Center/Region schedule stock assessments in a manner that meets national standards and regional needs?

For the most part, with caveats noted above.

- i. What protocols are used to prioritize need, frequency and appropriate level of stock assessments?

Processes for prioritizing and scheduling stock assessments have not been formalized. (See above.)

- ii. Has the Center reasonably balanced Council, other domestic and international stock assessment needs as well as additional analytical and review demands?

The Center has responsibility for a diverse array of resident and highly migratory stocks. For some of these stocks, data limitations reduce the utility of investment in complex assessment methodologies. In other instances, e.g., the MHI Deep-6 bottomfish, there appears to be information that is not incorporated in assessment models because the current model is not

designed to use some of that information.

- iii. How well does the Center involve internal and external clients and stakeholders in priority setting and the assessment process?

Although the Center has good working relationships with the WPFMC, PIRO, territorial fisheries authorities and RFMOs, there is no clear process for establishing assessment priorities.

- iv. Are the Center's scheduling and scale (e.g., benchmark vs. updates) for individual fishery stock assessments balanced with Center resources, and regional, national and international needs?

The Center has sufficient stock assessment capacity to meet needs for benchmark and update reviews for stocks for which assessment model exist. There are many species within the Pacific Islands region that treated as components of fish complexes; some of these species might benefit from assessments conducted at a finer taxonomic scale. As noted above, the Center helps with assessments of HMS, the costs of which have reduce the amount of funding available to support assessment of EEZ stocks.

- v. What steps are the primary bottleneck in the number and timeliness of stock assessments each year: surveys, input data processing and management, assembly of assessment reports, ability to address questions from previous assessment, availability of assessment scientists, and review scheduling? Are any excessively limiting?

Data limitations seem to present the principle bottleneck to the development of additional stock assessments. The coral Reef fish stock assessment demonstrates that innovative modeling approaches may help analysts to explore stock assessments for a wide range of data-limited species.

- b. Is the Center prioritizing the appropriate initiatives and research areas to address current and anticipated stock assessment needs, including connection of stock assessments to broader ecosystem investigations?

The Center is exploring methods that facilitate representation of spatially structured populations. Stock assessment scientists are encouraged to explore possible mechanisms for integrating stock 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?

- a. How many FMP and non-FMP stocks are being assessed?

The Center conducts 2-3 stock assessments per year. While this seems like a small number of assessments, the coral reef assessment involves over 100 species and the MHI and territorial bottomfish assessments involve stock complexes. The current review schedule aspires to a 3-year cycle.

- b. Do current and planned fishery stock assessments meet regional, national, and international expectations in terms of quality, quantity and timeliness?

Yes and no. See notes, above, that speak to model weaknesses.

- c. How well does the Center attain a prioritized portfolio of baseline assessments for all managed stocks (including data-poor) and full assessments for important stocks?

There is no ranked list of species for which assessments should be developed.

- d. How well does the Center consider ecosystem and environmental factors affecting fish stocks and

their assessments?

Ecosystem and environmental factors are not well-integrated into the current stock assessment models. This is, in part, due to limitations of the models being used for assessment. It is also due, in part, to a lack of process models. There may be opportunities to leverage the Center's expertise in ecosystem models as a means of integrating environmental factors and ecosystem properties into stock assessment models.

6. Does the assessment program adequately communicate their results, needs, and research?
  - a. Are assessment data needs being communicated to survey scientists, advanced technology experts, and fisheries-dependent data sources; and have improved data resulted from these efforts?  
Yes.
  - b. Are assessment process and results adequately communicated to fishery managers, affected public and the scientific community?  
Yes.
  
7. Are there opportunities for improving stock assessments and the stock assessment process?

See above.

  - a. Is the Center conducting the research necessary to improve stock assessments and produce timely and assessment-relevant scientific research products?  
Yes and no. See above.
  - b. Do assessment scientists engage in research published in peer-reviewed journals?  
Yes.
  - c. Are there areas of expertise that could be added in the future to strengthen the ability of the Center to meet its management and research objectives?  
An additional senior stock assessment scientist would help address mentorship needs and could reduce turnover.
  - d. Should the Center be taking greater advantage of opportunities for collaboration in conducting fishery stock assessments and related research, including shared approaches with other Centers, regional academic partners, other government agency partners, and stakeholders?  
Taking greater advantage of such opportunities could help expand the breadth of analytic approaches being considered and could help with training and mentorship needs.