Center for Independent Experts (CIE) Independent peer review report --- 2020 Benchmark stock assessment for Main Hawaiian Islands uku (*Aprion virescens*)

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EXECUTIVE SUMMARY

Activities

The 2020 stock assessment of the Main Hawaiian Islands (MHI) uku snapper (*Aprion virescens*) was reviewed by a CIE stock assessment review panel. The review is one of the Western Pacific Stock Assessment Reviews (WPSAR). The review panel aims to review uku stock assessment documents and to produce a consensus panel report that can be used by the Western Pacific Regional Fishery Management Council (WPFMC) and other interested persons for developing management recommendations for the uku fishery in the MHI. The review took place at the WPFMC, Honolulu, Hawaii, during Feb 24 - 28, 2020. The stock assessment done by the Pacific Islands Fisheries Science Center (PIFSC) stock assessment team was presented publicly to the review panel and the validity of the data, assessment procedures, and results as to the recommended base model and sensitivity model scenarios were discussed. All the models were processed using SS3.30, and the likelihood approach was used to estimate parameters (Methot et al. 2018). The WPFMC and PIFSC assessment team provided all the background information, documents, and further data and model configuration explorations that were requested by the CIE review panel.

The WPSAR review panel discussed all the terms of references (TORs) adequately and provided a panel consensus summary report with statements on the recommended model scenario for management considerations. The panel summary report also suggested future improvement on data processing, potential efforts for new data collection and alternative model structures.

Main review processes and findings

The recommended pre-review base model by PIFSC in the draft report is a newly developed integrated age-structured stock assessment, and is the first integrated stock assessment of a domestic stock in the U.S. Pacific Region. The previous stock assessment for uku was conducted in 2017 and a data-limited length-based approach was used (Nadon 2017). The base model has a time series from 1948 to 2018 and utilized four fishery-dependent catch-per-unit-effort (deep-sea handline 1948-2002; deep-sea handline 2003-2018, inshore handline 2003-2018, trolling 2003-2018; and other gears 2003-2018) and one fishery-independent survey (diver observations 2005-2016) to calibrate population dynamics. The corresponding weight compositions from the deep-sea handline fishery (1948-2018) were also used in model calibration. The parameters of natural mortality *M* and the stock-recruitment steepness *h* and recruitment variability σ_R were fixed. The deep-sea handline fishery selectivity was modelled as length-specific, while all the other fishery specific selectivities including recreational fishery selectivity and the diver fishery-independent survey were fixed in the SS3 model but were derived from a LBSPR approach (Length Based Spawning Potential Ratio, Nadon et al. 2015).

There were some concerns in the assessment, mainly arising from the fishery-dependent CPUE data, the recreational catch history reconstruction from 1948-2002 based on the average catch of 2003-2007, the habitat limitation of the fishery-independent diver survey for uku, the use of fixed selectivities from the LBSPR approach based on the cumulated length compositions, and the likely changing fishery catchability in the past 70 years because of the use of new technologies and gear evolution. The review panel suggested a series of explorations both on data process and alternative model assumptions through Requests (See Requests to the PIFSC by the review panel, Appendix 4). Such requests helped the PIFSC assessment team and WPSAR review panel to recommend the base model to be used for management purposes and future research recommendations.

Although there are quite some concerns on the data used and the model assumptions, the assessment team proved that the assessment model is very robust to data uncertainty and model assumptions shown as robust fishery and population status through a set of sensitivity runs (Table 1). The review panel recommended extra potential base model which may be considered in the future assessment update for management purposes.

Given the data available and the stock assessment developed by the assessment team, I support the recommended base model scenario as the best available science and its projected biomass for management consideration.

Main recommendations

There are no disagreements on comments and recommendations between the WPSAR panel and me. Below I include both the major recommendations that I agree with the WPSAR panel, and extra comments and recommendations from myself.

- The current assessment relies on the fishery-dependent CPUEs heavily. I would suggest that fishery-dependent CPUEs being investigated further, especially for the influence of reported effort unit, whether or not to break the long time series into two series, and the convergence of the CPUE analysis.

- I strongly suggest that more potential reasonable scenarios on reconstructing historical recreational catch be explored. The most recent newly developed recreational survey for effort can be integrated into the historical recreational construction. The current base scenario is based on the average recreational catch during 2003-2007 and MHI human population changes over time to construct historical catch.

- Future exploration on the changes in catchability because of new technology and fishing gear evolution is suggested, which may be explored by combining with historical record of gears used and management policy

changes. Stakeholder knowledge may be considered through surveys and workshops with fisherman representatives.

- Ideally, a full Bayesian approach should be developed in the near future (Punt and Hilborn 1997; Jiao et al. 2012; Hooten and Hobbs 2015). The uku assessment used fixed *M* and *h* that are derived from meta-analysis based on life history traits. I support development to use biologically meaningful priors for uku stock assessment in the future.

- Biological data collection should be extended in space and time if possible based on the spatial distribution of uku. Potential life history changes of uku may be explored through time with frequent biological data collection if possible, and such research can be done by combining with the recently developed fishery-independent surveys.

- I recommend the WPMFC and its SSC take into account the uncertainties listed in the findings, and the extra sensitivity runs done during the review week, when considering management decisions for uku.

1. BACKGROUND

The 2020 stock assessment of uku snapper (*Aprion virescens*) was reviewed by a Western Pacific Stock Assessment Review (WPSAR) panel. The panel was expected to review MHI uku stock assessment and to produce a panel report that can be used by the Western Pacific Regional Fishery Management Council (WPFMC) and other interested persons for developing management recommendations for the uku fishery in the MHI. The review took place at the WPFMC, Honolulu, Hawaiian, during Feb 24 - 28, 2019. The assessment review panel met at Western Pacific Regional Fishery Management Council, Honolulu, Hawaii during Feb 24 - 28, 2020. The review panel chair was Dr. Eric Franklin, and the other panel members included Drs. Yong Chen and Yan Jiao (me).

The uku WPSAR review process was coordinated by Dr. John Syslo from PIFSC and Dr. Marlowe Sabater from WPFMC. The stock assessment documents for uku snapper were prepared by the PIFSC team and were presented at the meeting mainly by Drs. Marc Naddon, Michelle Sculley and Felipe Carvalho.

According to the CIE scope description, "… Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role or represent any of their organizations in this capacity. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the TORs. … Each CIE reviewer will assist the Chair with contributions to a Summary Report that will describe the majority or consensus findings, based on the TORs of the review." As a review panel member, I was provided with a draft stock assessment report and google drive access to relevant files and documents, such as the previous reef fish stock assessment and peer review report (see Appendix 1 for a full list of documents) and participated in the Stock Assessment Review Meeting. During the review, the assessments of the uku snapper were presented and the validity of the data, assessment models and procedures, and results were discussed (see Agenda in Appendix 2). Extra documents and model runs were provided upon requests from the WPSAR panel. Discussions on the quality of the data including the data standardization or synthesis, the appropriateness of the model assumptions, equations, parameterizations, estimation algorithms and strategies to improve model fitting, and appropriate model projections for management purposes were made throughout the review.

During the review meeting, the PIFSC assessment team was always available when required for further discussion, additional data and model exploration and clarification, and clarification of how each TOR was addressed.

As a CIE reviewer, my duty was to evaluate the stock assessments of uku snapper with respect to their TORs (in Appendix 2), and work with the WPSAR panel to prepare a panel summary report. This report provided the findings and

recommendations of the independent review that is undertaken by me in accordance with the CIE Statement of Work (SOW).

2. ROLE OF INDIVIDUAL REVIEWER IN THE REVIEW ACTIVITIES

My role as a CIE independent reviewer was to conduct an impartial and independent peer review in accordance with the SOW and the predefined TORs herein.

About two weeks before the review meeting, the assessment documents and supporting materials were made available to the review panel via Google Drive by Dr. John Syslo. I read all the documents that I received prior to the review.

The MHI uku snapper 2020 WPSAR meeting followed the "tentative agenda (Appendix 2)" of the CIE review. The meeting was open to the public and was organized constructively. On the morning of Feb 24 before the meeting, the PIFSC assessment team and WPSAR panel met to discuss the meeting agenda and WPSAR process, reporting requirements and meeting logistics. During the meeting, all the documents were accessible online through Google Drive.

Presentations were given during the review according to the agenda to provide the WPSAR panel the background information on WPFMC's management control rule, the population characteristics of the species, the data used in the stock assessment models, and the newly developed integrated stock assessment model. I was actively involved in the discussion during the presentations by 1) listening to the presentations carefully, taking notes on the points that were not included or not clearly stated in the documents provided prior to the meeting; 2) asking questions for clarification on the data usage and model development; 3) making comments and providing possible alternative solutions to questions arising during the meeting; and 4) discussing agreement on each model scenario and stock assessment TOR with the other review panel members.

At the last day of the peer review meeting, WPSAR panel chair Dr. Eric Franklin put the panel summary report together, which summarized the panel's views, requests and conclusions; all panel members commented on it. The draft panel consensus report was communicated to the PIFSC and WPFMC before the end of the review. This report reflects my summarized findings and recommendations according to the predefined TORs. This review report is formatted according to my interpretation of the required format and content described in Appendix 2.

3. SUMMARY OF FINDINGs relative to TORs

MHI uku snapper is a long-lived coastal semi-pelagic species with their depth ranging from around 20-200 meters and can live up to 32 years. They can reach

maturity at around age 4. Data limited approaches have been used for this species in the past 2 stock assessments: catch-only approach in 2013 and LBSPR approach (Length Based Spawning Potential Ratio) in 2017. The fishery-independent diver survey in the MHI available for this species did not start until 2005, so fishery-dependent CPUEs are used heavily instead when developing this integrated assessment model. In the current new assessment, commercial catch traced back to 1948 and recreational catch of 1948-2002 was reconstructed based on recreational catches of 2003-2007 and human population changes in the MHI. The weight-compositions of 1948-2018 from the deep sea handline fishery were used to calibrate the population structure over time to allow an age-structured model possibly being developed.

Below I provide the summary of findings for uku review, in which the weaknesses and strengths are described in accordance with the TORs.

3.1. Of the data considered for inclusion in the assessment, were final decisions on inclusion/exclusion of particular data appropriate, justified, and well-documented?

Yes with caveats, the data included were appropriate, justified, and well documented. The assessment team did an excellent job in filtering, documenting, and synthesizing datasets included in the assessment.

The commercial catch records are from logbooks as in other fisheries, and treated as appropriate to be used for the assessment of this fishery. There are four fleets of commercial fishery used in the assessment: deep-sea handline, inshore handline, trolling and other commercial fisheries. Among them, the proportion of catch from deep-sea handline is much higher than the other commercial fisheries with the inshore and trolling fishery increased after the mid-1990s.

The recreational fishery data pre-2003 was reconstructed based on average recreational catch during 2003-2007 and MHI human population changes over time. At the same time, correction factors of 2.89 and 2.33 were applied to 2017 shore- and boat-based recreational efforts but not for years pre-2017. Such correction factors were based on a 2017 mail-based survey comparing with phone-based surveys, which matches the recent MRIP changes along the Atlantic coast (Papacostas and Foster 2017). Both the reconstruction of pre-2003 recreational catch and the application of correction factor to 2017 only brought high concerns due to the strong fluctuations in the time series between 2003-2018, and the high percentage of contribution to the total catch in recent years (~73% in 2018). The WPSAR panel feels that the provided approach used to reconstruct historical recreational catch pre-2003 is questionable given the possible changes in the fishery over such a long time period, but the panel cannot offer a better alternative. I would suggest that further rationale is needed to apply correction factor only to 2017 but not 2003-2017, and also the use of 2003-2007 year average to construct historical catch needs to be addressed further. The most recent newly developed

recreational survey for effort can be integrated into the historical recreational construction rather than just 2017. Further mail-based survey on recreational effort will provide more information on the correction factors. I suggest that historical records of recreational effort may be secured, although likely sparse, combining with the human population changes. Also, it seems the fishery catch changes are not regulated by quota, so further exploration based on relationship with commercial fishery is still usable.

The fishery-independent diver survey data provides limited influence on the overall stock assessment results because of the short time series (2005-2016). Its depth limitation (around 30 meters) also brings concerns on its utility to calibrate uku population size. Overall, the WPSAR and the PIFSC both feel it useful to include this dataset as an alternative relative abundance index especially as the only fishery-independent data sources.

The fishery-dependent CPUEs demonstrated a noticeable shift in the trend trajectories at a time point that coincided with a change in the definition of effort from fishing days to fishing hours in 2003. The deep-sea handline commercial fishery CPUE was standardized based on two separated time periods, 1948-2002 and 2003-2018, and their corresponding effort used in the standardizations are day-based and hour-based separately. The inshore handline commercial fishery CPUE and CPUEs of trolling fishery and other gears were all standardized based on effort of hours and with the start year of 2003. The coincidence of the increasing in CPUE trends and the estimated population dynamics trend brought attention. Upon request from the WPSAR panel, the scenarios with one time series of 1948-2018 of deep-sea handline and 1992-2018 of inshore handline fishery-dependent CPUEs were explored.

The life history information for age/growth and maturity were derived from local studies. No obvious spatial differences in growth between MHI and NWHI are detected based on a most recent study. There are no studies to address whether there are changes in growth and maturity over time.

3.2. Is the CPUE standardization properly applied and appropriate for this species, fishery, and available data?

Yes, this TOR was addressed adequately in general, although further exploration and documentation are suggested.

The CPUE standardization was generally properly applied and appropriate. Because of high percentage of zeros in all the commercial fishery-dependent CPUEs, a delta-lognormal approach with mixed effect model was used to standardize CPUE. Among the variables, principle components of catch species compositions, year, month, areas, wind, fisher ID and fishing experience were considered in the CPUE standardization process. I personally feel a concern of the changes on the percentage of zeros from 39% (1948-2002) to 79% (2003-2018)

with the CPUE showed an increasing trend after 2003 in the deep-sea handline fishery and the lack of convergence for some of the model scenarios with fisher ID as random effect. The WPSAR panel also suggested to further explore the relationship between PCs derived from species composition with month based on the hypothesis that species composition varies cross seasons.

The panel initially had concerns about the effects of the change on the effort definition because the time break point (2003) in the fishery-dependent time series coincided with the change of the trends in CPUEs. But that appeared to have a limited impact in the overall stock assessment and do not seem to influence the estimated population status and fishery status. The WPSAR panel then suggested in future CPUE standardization to include the inshore handline data from 1992-2002 to extend the duration of this time series. I personally suggest that a scenario of CPUE standardization of using same effort treatment from 1948-2018 for deep-sea handline is included and to be compared with the scenarios with the two time series (1948-2002, 2003-2018) treatment in the CPUE standardization section; the same for the inshore handline CPUE tracing back to 1992 when the percentage of inshore harvest increased to a degree.

3.3. Are the assessment models used reliable, properly applied, adequate, and appropriate for the species, fishery, and available data?

Yes, the assessment models are reliable, properly applied, adequate, and appropriate although further exploration and documentation are suggested.

The base model framework is an integrated statistical age-structured model, which was processed using SS3.30, and the likelihood approach was used to estimate parameters (Methot and Wetzel 2013; Methot et al. 2018). Comparing with the past stock assessments for this species, the change of the basic assessment model structure is substantial. The PIFSC assessment team fully utilized the fishery-dependent data sources to make this happen. Fish growth and maturity submodels are adequate, although further biological data collection and monitoring are encouraged in the future. The use of the LBSPR model to estimate selectivities outside of SS3 is a reasonable alternative approach for the fleets with limited sparse size composition data (i.e., recreational, inshore, trolling, other gears). The model uses the deep-sea handline fishery catch weight-composition data to calibrate population structure. The panel suggested that a dynamic binning may be considered to better handle the long-tailed distributions presented in the annual weight composition data. The model diagnostic analyses were comprehensive and well-presented both for catch rate standardization and for the statistical catch-at-age models.

Recruitment variation and steepness were both fixed based on published meta-analysis, which are reasonable for such a species but such parameterization including fixed natural mortality and LBSPR estimated selectivities decreases the estimated uncertainty of population size. The uncertainty estimation and

exploration were done through likelihood profile, sensitivity analysis, retrospective analysis and convergence diagnostics of each model run.

3.4. Are decision points and input parameters reasonably chosen?

Yes, the decision points and input parameters were reasonably chosen although further exploration and documentation are suggested.

The assessment report and the PIFSC assessment team provided a clear description and justification for the values used in the input parameters. The life history inputs were selected based on studies performed locally on the assessed species, with growth data from a recent growth study. The use of the LBSPR model to estimate selectivities outside of SS3 is a reasonable alternative approach for the fleets with limited sparse size composition data (i.e., recreational, inshore, trolling, other gears). I have concerns about the parameterization of the fishery-independent diver survey selectivity which is much smaller than inshore handline fishery and recreational fishery, but the diver survey spatial coverage is limited and its overall influence to the stock assessment is limited. Recruitment variation and steepness were both fixed based on published meta-analysis, which are not uncommon for such a species.

The panel initially had concerns about the effects of the change on the effort definition because the time break point (2003) in the fishery-dependent time series coincided with the change of the trends in CPUEs (See TOR 2). This concern was addressed through sensitivity analysis and was found that the assessment model is not sensitive to the break point and effort treatment.

The assessment model assumed a constant catchability which is not uncommon for most stock assessments. However, fisherman representatives during the meeting demonstrated gear evolution in the past 20-30 years and suggested that future exploration on the changes in catchability because of new technology and fishing gear evolution is needed. Such exploration may be combined with historical record of gears used and management policy changes. Stakeholder knowledge can be integrated in such processes.

3.5. Are primary sources of uncertainty documented and presented?

Yes. The primary sources of uncertainty are documented and presented. The uncertainty estimation was done through likelihood profile, but extra uncertainty was explored through sensitivity analysis, retrospective analysis and convergence diagnostics of each model run. Aspects of uncertainty pertaining to data were addressed in the response to TOR 1. A series of sensitivity runs with alternatives on CPUE treatment, model starting year, parameter values on recruitment and catchability submodel were explored, and the estimated population status and fishery status were robust to these alternative assumptions (see Table 1). The fixed selectivities for gears other than the deep-sea handline fishery (determined

outside of SS3 using LBSPR) and the long time series of catch (1948-2018) and deep-sea handline fishery CPUE may have contributed to this stability.

The WPSAR panel suggested the examination of temporal changes in catchability and I agree with it. A quick run with catchability of deep-sea handline fishery selectivity from 2003-2018 following a random walk process was done during the review and the model results are robust to this model configuration. I would suggest further exploration of changes in catchability from 1948-2018 in the future, including the potential increasing trend. The panel also suggested that the fishery weighted selectivities be considered in the population projection, which should be reflected in the final stock assessment report.

3.6. Are model assumptions reasonably satisfied?

Yes, the model assumptions were reasonably satisfied. The WPSAR panel recommended an addition of a table to include key biological and statistical assumptions for the model to better organize a summary of the information in a single location, which is likely an extended Table 1 in the draft assessment report. The model assumed fixed constant natural mortality, recruitment steepness and variation of recruitment, constant catchability and selectivity with many fleet fishery selectivity and diver survey selectivity estimated externally through a LBSPR approach (see TORs 3 and 4). These assumptions were addressed through sensitivity analyses (see Table 1).

3.7. Are the final results scientifically sound, including but not limited to estimated stock status in relation to the estimated overfishing and overfished status determination criteria (SDC)?

Yes, the final results are scientifically sound, including the estimated fishery status and population status. The review team requested extra model scenarios in both CPUE time series treatment and in stock assessment model scenarios. The assessment team was always collaborative and finished the runs/requests that could be done during the review and explained some of the runs that needed a longer time to diagnose. The fishery and population status are both very robust to data and model scenarios. The WPSAR panel considers the base model scientifically appropriate for uku fishery management. The panel agrees that the population is not overfished and overfishing is not happening. To simplify the comparison of model outputs, we suggested a summary table of results of the biological references points for the base-case and the sensitivity runs (Table 1).

Table 1: Description of sensitivity runs and their corresponding model results of management interests. (prepared by the assessment team)

Model configuration	F_{2018}	F_{msy}	F_{2018}/F_{msy}	SSB_{msy}	SSB_{2018}	SSB_{2018}/SSB_{msy}	$Catch_{msy}$
Base case	0.08	0.16	0.50	180	445	2.47	97
Nat Mort 0.09	0.08	0.15	0.53	179	404	2.26	90
Nat Mort 0.11	0.07	0.17	0.41	181	478	2.64	103
Linf 68.9	0.07	0.18	0.39	203	582	2.87	105
Linf 84.2	0.20	0.15	1.33	140	176	1.26	80
Lmat 40.3	0.08	0.17	0.47	188	459	2.44	97
Lmat 49.3	0.08	0.16	0.50	164	411	2.51	95
SigR 0.35	0.08	0.16	0.50	178	425	2.39	96
SigR 0.43	0.07	0.16	0.44	180	459	2.55	97
Steep 0.73	0.08	0.14	0.57	196	447	2.28	92
Steep 0.89	0.08	0.19	0.42	163	439	2.69	100
Rec Catch using Ratios	0.04	0.17	0.24	177	466	2.63	98
Rec Catch Phone Corrected	0.07	0.16	0.44	189	479	2.53	101
Rec Catch -30%	0.09	0.16	0.56	156	395	2.53	84
Rec Catch +30%	0.07	0.16	0.44	202	496	2.46	109
Orig CPUE CVs	0.08	0.16	0.50	167	415	2.49	90
CPUE DSH+DSH	0.09	0.16	0.56	177	362	2.05	95
CPUE DSH+ISH	0.08	0.16	0.50	179	416	2.32	96
CPUE DSH+TROL	0.09	0.16	0.56	176	353	2.01	95
SizeFreq Lambda=0.1	0.10	0.16	0.62	169	360	2.13	91
ISH 1992-2018 single q	0.07	0.16	0.44	181	465	2.57	97
M from Lorenzen	0.07	0.18	0.39	176	465	2.64	101
DSH 1948-2018 single q	0.08	0.16	0.50	178	410	2.30	95
ISH 1992-2018 two qs	0.08	0.16	0.50	180	448	2.49	96
Long DSH+ISH and M Lorenzen	0.08	0.18	0.44	174	439	2.52	99
Model start 1970	0.07	0.16	0.44	208	482	2.32	112
Estimated Sigma R	0.06	0.16	0.38	188	529	2.81	101
Timevarying q	0.08	0.16	0.50	179	444	2.48	96
Effective N from SS	0.07	0.16	0.44	180	453	2.52	97
Exclude Divers surveys	0.08	0.16	0.50	180	448	2.49	97

Note: DSH: deep-sea handline; ISH: inshore handline; TROL: trolling.

3.8. Are the methods used to project future population state adequate, including the characterization of uncertainty, and appropriately applied for implementation of overfishing limits (OFL)?

Yes, with caveats. The methods used to project future population state are adequate and appropriately applied. The peer review panel requested that the assessment team look into the uncertainty related to recruitment, weighted composite selectivity after integrating all fleets/fisheries together. All these requests were done during the review week. The final projections are based on the recommended base model with the uncertainty of biomass in 2018, size frequency in 2018 and the selectivity and recruitment uncertainty considered in the projection. The probability of overfishing at different levels of annual catch for 2020-2026 was provided for management purposes. The WPSAR panel also recommended the inclusion of an additional projection that represents a "worst case" scenario that utilizes the fishery weighted selectivity and the lowest 25th percentile of recruitment to determine the probability of overfishing at various levels of catch. Although the projections extend to 2026, the panel suggested that this fishery conduct an update assessment in three years especially given the recent increasing fishery dependent CPUEs and SSB trends. Recruitment variation and steepness were both fixed based on published meta-analysis, which are reasonable for such a species, but such parameterization including fixed natural mortality and LBSPR estimated selectivities decrease the estimated uncertainty of population size. Such underestimation of uncertainty may not influence OFL estimation, but may be considered when recommending ABC based on WPFMC's control rule.

3.9. Can the results be used to address management goals stated in the relevant FEP or other documents provided to the review panel? If any results of these models should not be applied for management purposes with or without minor short-term further analyses (in other words, if any responses to any parts of questions 1-8 are "no"), indicate: Which results should not be applied and describe why, and Which alternative set of existing stock assessment results should be used to inform setting stock status and fishery catch limits instead and describe why.

Yes, the results can be used to address management goals. See TOR 10 for short-term recommendations that should be incorporated into the final version of the stock assessment. The assessment team provided the results that are management related, which included the estimated MSY, F_{MSY}, SSB_{MSY}, F/F_{MSY}, SSB/SSB_{MSY}, and the fishery and population status based on the control rule plot used by the WPFMC.

3.10. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid-term (3-5 years) and long-term (5-10 years). Also indicate whether each recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.

Yes, this TOR was completed successfully. The peer review panel and the assessment team discussed and recommended short-, mid- and long-term recommendations that should be addressed for uku snapper stock assessment with the contributions of fishery representatives, uku biologists and council staffs attended the meeting. The discussion and recommendations here considered needs and applicability of uku stock assessment and management. Below please find my view on the recommendations.

Recommendations should be addressed within 2 months:

WPSAR panel determined that all short-term recommendations are of **HIGH** priority and I agree with it. The short-term recommendations are very specific and are expected to be included or addressed in the final stock assessment report.

- I suggest that a section to address previous recommendations from the 2016 assessment and how they were incorporated into this assessment be added. If the assessment team do not think the implementation of the recommendations was needed, please explain the reason.
- Figures to include:
    1. Catch time series by fleet/gear for 1948-2018.
    2. Fishing mortality time series by fleet/gear for 1948-2018.
    3. Growth model with colored markers for samples from MHI and NWHI separately.
    4. Standardized CPUE gear comparison (DSH, ISH, Troll) between fishing day and fishing hours for 2003-2018; standardized CPUE of deep-sea handline fishery using fishing days for 1948-2018; standardized CPUE of inshore handline fishery using fishing days for 1992-2018.
    5. Include Mohn's Rho value for biomass, recruitment and fishing mortality in the retrospective figures.
    6. Diver survey locations for each survey year.
- Tables to include:
    1. Biological and statistical assumptions with key to sections of the report.
    2. Summary table for management statistics for base-case and sensitivity runs that includes SSB_{2018}, SSB_{MSY}, F_{2018}, F_{MSY}, Catch of 2018 at F_{MSY}. See list of sensitivity runs below.
- Sensitivity runs to include:
    1. Using Lorenzen M.

2. Using a single deep-sea handline CPUE from 1948 - 2018 with the same effort standardization.
3. Using extending inshore handline CPUE to 1992 – 2018.
4. Sensitivity runs that combines all three of above 2 and 3, and 1-3.
5. Start model from 1970.
6. Estimating SigmaR instead of fixing it.
7. Use of iterative effN estimation.
8. Time-varying catchability (2003-2018), and 1948-2018 with a non-negative trend.

- Projections to include:
    1. Base-case projection should use a composite fishery weighted selectivity in the projection instead of only using deep-sea handline selectivity.
    2. Include a worst-case projection with composite selectivity and 25th percentile lowest recruitment to provide an alternative scenario to consider poor recruitment situations. This is not a replacement for the base-case scenario.

Recommendations which should be addressed in 3-5 years:

The following ones are of high priority:

- Perform a simulation study to examine the potential uncertainty sources in recreational fisheries data and identify an optimal survey design.
- Continue with the direct involvement of MRIP survey statisticians for stock assessments to assist with inclusion of high quality recreational fishery data.
- Explore the potential to include the fishery-independent survey from the BFISH program as a relative abundance index for uku.
- Explore possible inclusion of the following elements for future base-case scenarios:
    - Using Lorenzen M.
    - Using a single deep-sea handline CPUE from 1948 - 2018 with same effort standardization.
    - Using inshore handline CPUE extended to 1992 – 2018.
- Explore the differences in selectivity between using LBSPR and SS3 estimated when multiple fisheries are ongoing at the same period.
- Since this is a species that was historically treated as data-limited and this is the first time that the assessment for this species is done using an integrated model, the assessment model may consider using Bayesian approach and integrating life history related priors and expert knowledge both from fishermen and biologists.
- Explore model configurations of changing q (e.g., an increasing trend or a random walk model), but with informative priors on trend from stakeholder knowledge.

The following ones are of medium priority:

- Examine changing fleet dynamics with new technologies and gear evolution to better estimate catchability changes over time.
- Further investment in life history with a focus on updating the reproductive and maturity studies that include an examination of sex ratio and fecundity-at-size.

The following ones are of low priority:

- Continue collecting otolith samples for future growth studies.

Recommendations which should be addressed in 5-10 years:

- The WPSAR panel recommends that examination of dynamics and distribution of spawning aggregations for uku in MHI and NWHI is of high priority in the long run.
- The panel thinks that it is of high priority to continue to improve data quality of both fishery-dependent and independent sources. The possibility of including gear information in the logbook report and phone/mail survey may be considered as high priority.
- The recommendation of better understanding population structure, connectivity and adult movement using genetics and tagging experiments seems important to consider, and can be of medium propriety.

3.11. Draft a report (individual reports from each of the panel members and an additional Summary Report from Chair) addressing the above TOR questions.

Yes, this TOR was completed successfully. The review panel chair Dr. Eric Franklin led the writing. Both review panel members Dr. Yong Chen and me, contributed to TORs discussions and the overall report review. The summary report from the chair was successfully presented on Friday morning by the end of the review week.

4. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS RELATIVE TO TORs

The WPSAR panel recommended the base model after comparing all the model scenarios explored. Given the data available and the life history of uku, I support the accepted base model as the best available science and its projected biomass with fishery weighted selectivity used for management consideration.

My conclusions and recommendations are consistent with those from the WPSAR Panel. There is no disagreement between the WPSAR panel comments/recommendations and mine. Because TOR 10 is about research recommendations, I here reorganize my recommendations based on uku data

collection, stock assessment model configurations and management considerations.

Recommendations for future uku data collection or synthesis

To further improve data quality, I would like to echo previous suggestions by WPSAR panel that explore methods to improve survey biomass estimates for fisheries-independent data for depth ranges beyond diver depths using advanced technologies such as U/W camera or videos (Franklin 2016). Biological data collection should be extended in space and time if possible based on the spatial distribution of uku. Potential life history changes of uku should be explored through time with frequent biological data collection if possible, and such research can be done combining with the recently developed fishery-independent surveys.

I would like to suggest extra studies on fisheries dependent CPUE, especially the deep-sea handline and inshore handline CPUE, for which their time series can trace back to 1948. I have concerns on the conflict that the percentage of zeros increases in recent years while CPUE increases, and on the reality that some of the model scenarios with random effect cannot converge. Such concerns deserve further exploration given the heavy usage of the fishery-dependent CPUEs.

As in many other fisheries, the recreational fishery recalibration based on mail survey resulted in higher recreational harvest estimate than from previous phone surveys. Methodology to consider to extend the study back to 2003 when phone survey started is suggested (Papacostas and Foster 2017). Also alternative potential scenarios to reconstruct recreational catch pre-2003 is encouraged.

The stock structure and connectivity of HMI uku with NWHI uku population are still open questions as stated in the assessment report. Existing research suggests that MHI and NWHI reef fishes form different stocks with limited larval and adult exchanges because of dominant current directions and large distances (Wren et al., 2016). There are also studies that indicate migration from NWHI is likely during unusually cold temperature years (draft report). Studies on potential mixing of the stocks help to interpret the dynamics of the population and overall management.

The assessment team used a broad range of approaches in the uku assessment including data poor approaches. For example, for the fisheries and surveys without enough fish size samples, the all-year combined length frequencies are used to derive selectivities for multiple fleets including the recreational fishery selectivity, inshore handline and the fishery-independent diver survey selectivity. The length frequency for each fleet was used to estimate selectivity through a LBSPR approach. I find this reasonable given the limited sample sizes, but at the same time would like to encourage the team to look at the performance of LBSPR approach when multiple fleets are harvesting the same population.

Recommendations for future uku assessment model

The new assessment model developed by the PIFSC assessment team is a NEW integrated statistical age-structured model. The assessment used fishery-dependent CPUEs, reconstructed history recreational fishery and historical commercial fishery weight-composition to calibrate the population dynamics. This is a big step beyond the previously used data-poor approaches for the stock assessment of this species, which certainly facilitates better management of this species by the WPFMC. Although I recommend revisiting the fishery-dependent CPUE standardization as shown in the above data synthesis recommendation, I highly appraise the effort from PIFSC assessment team to synthesize historical fishery-dependent data, which is critical in this stock assessment.

I would suggest that potential fishery catchability changes, because of new technology and fishing gear evolution being explored, be studied by combining with historical record of gears used and management policy changes. Stakeholder knowledge may be secured from fisherman representatives through workshops and surveys. Very limited trend, if any, in catchability, can substantially change the estimated population size. A simulation or extra model scenarios based on catchability changes used in some other fisheries may help to understand the influence of potential catchability changes. Certainly, submodel construction of using time-varying catchability from 1948-2018 can be further explored.

Ideally, a full Bayesian approach may be developed in the near future to explore uncertainty (Gelman et al. 2014a). Uku stock assessment used life history information and published meta-analysis to find reasonable parameter values for natural mortality, steepness and variance of recruitment variation etc., but fixed values for these parameters are used and a likelihood approach is used to estimate parameters. This is not unusual in stock assessments, but since the parameter values for the species in the same family can vary substantially, it would be more reasonable to use biologically meaningful priors in the future stock assessment. A full Bayesian approach is ideal, which not only considers uncertainty of these parameters but also further helps to understand the robustness of the parameters, and is convenient in comparing models through both model goodness-of-fit and model predictive ability (Punt et al. 1997; Patterson et al. 2001; Gelman et al. 2014b).

Recommendations for uku management considerations

The uku assessment results for fishery status and population status are very robust to alternative model scenarios. I echo the recommendations from the WPSAR panel that the fishery weighted selectivity in the population projection should be used.

I recommend the WPMFC and its SSC take into account the uncertainties listed in the findings, and the extra sensitivity runs done during the review week, when considering management decisions for uku.

5. COMMENTS ON THE NMFS REVIEW PROCESS

I find the WPSAR process effective, clear and meaningful. This specific review done for Main Hawaii Island uku was exceptionally organized both in the conduct of the meeting and in presentations of the assessment. The PIFSC assessment team has been very patient and cooperative in dealing with requests, which likely made them work overnight during the review. I have no further recommendations about the review process.

6. ACKNOWLEDGEMENTS

I would like to thank all the PIFSC Stock Assessment Team members contributing to the meeting for their informative presentations on the stock assessments of Main Hawaii Island uku, and for their hard work and willingness to provide helpful responses to the review panel's questions and requests. I also would like to thank the WPSAR coordinating committee and WPFMC who facilitated the review process and made it enjoyable and productive. Special thanks also go to other members of the review panel, Drs. Eric Franklin, and Yong Chen for their respectful and productive discussions on the assessments.

7. REFERENCES

Nadon MO. 2017. Stock assessment of the coral reef fishes of Hawaii, 2016. Page 212. NOAA Tech. Memo. NOAA-TM-NMFS-PIFSC-60.

Nadon MO, Ault JS, Williams ID, Smith SG, DiNardo GT. 2015. Length-based assessment of coral reef fish populations in the Main and Northwestern Hawaiian Islands. PLoS ONE 10:e0133960.

Gelman, A., Carlin, J.B., Stern, H.S., and Rubin, D.B. 2014a. Bayesian Data Analysis. 3rd edition. Chapman & Hall, London, UK. 667 pp.

Gelman, A., Huang, J., and Vehtari, A. 2014b. Understanding predictive information criteria for Bayesian models. Statistics and Computing. 24:997-1016.

Hooten, M.B., and Hobbs, N.T. 2015. A guide to Bayesian model selection for ecologists. Ecological Monographs. 85: 3-28.

Jiao, Y., Smith, E., O'Reilly, R., and Orth, D. 2012. Modeling nonstationary natural mortality in catch-at-age models: an example using the Atlantic weakfish (*Cynoscion regalis*) fishery. ICES Journal of Marine Science. 69:105-118.

Methot, R.D., and Wetzel, C.R. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142:86–99.

Methot, R.D., Wetzel, C.R., and Taylor, I. 2018. Stock Synthesis user manual. Model Version 3.30.12 (August 2018). NOAA Fisheries, Seattle, WA. 229 p.

Papacostas, K.J. and Foster, J., 2017. NOAA-NMFSNational Marine Fisheries Service's Marine Recreational Information Program Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort. 84p.

Patterson, K., Cook, R., Darby, C., Gavaris, S., Kell, L., Lewy, P., Mesnil, B., Punt, A., Restrepo, V., Skagen, D.W. and Stefansson, G. 2001. Estimating uncertainty in fish stock assessment and forecasting. Fish and Fisheries. 2:125-157.

Punt, A.E. and Hilborn, R. 1997. Fisheries stock assessment and decision analysis: the Bayesian approach. Reviews in Fish Biology and Fisheries. 7:35-63.

APPENDIX 1: BIBLIOGRAPHY OF REVIEW MATERIALS

Benchmark stock assessment for review (not to be distributed beyond reviewers):

Nadon, M.O., Sculley, M., and Carvalho, F. 2020. Stock assessment of uku (*Aprion virescens*) in Hawaii, 2020. (DRAFT). U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service. 105 p.

Background material provided for* uku stock assessment review*:

Franklin, E. 2016. Benchmark Review of the 2016 Stock Assessment of the Main Hawaiian Islands Reef-Associated Fish - Consensus Review Panel Report. 27p.

Methot, R.D., and Wetzel, C.R. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142:86–99.

Nadon, M.O. 2017. Stock assessment of the coral reef fishes of Hawaii, 2016. Page 212. NOAA Tech. Memo. NOAA-TM-NMFS-PIFSC-60.

Winker, H., Kerwath, S.E., and Attwood, C.G. 2014. Proof of concept for a novel procedure to standardize multispecies catch and effort data. Fisheries Research 155:149–159.

WPRFMC. 2009. Western Pacific Fishery Management Council [WPRFMC] - Fishery Ecosystem Plan for the Hawaii Archipelago. Available at: http://www.wpcouncil.org/fishery-plans-policies-reports/hawaii-fishery-ecosystem-plan.

APPENDIX 2: PERFORMANCE WORK STATEMENT

Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards. (http://www.cio.noaa.gov/services_programs/pdfs/OMB_Peer_Review_Bulletin_m05-03.pdf). Further information on the CIE program may be obtained from www.ciereviews.org.

Scope:

A single species stock assessment of the uku snapper (*Aprion virescens*) was conducted for the Main Hawaiian Islands and presented in an assessment report. A previous stock assessment for uku was conducted in 2017 using a data-limited length-based approach. The 2020 benchmark assessment diverges significantly from this previous work as it implements the first integrated stock assessment of a domestic stock in the U.S. Pacific Region. This integrated assessment uses the Stock Synthesis (v 3.30) framework to integrate CPUE indices, size frequency, diver survey, and catch data into a single age-structured model. This integrated model was used to estimate biomass and stock status through time, and stock status was evaluated against MSY-based reference points described in the Fishery Ecosystem Plan for the Hawaii Archipelago. Projections were provided to inform management setting of acceptable biological catch and annual catch limits. The specified format and contents of the individual peer review reports are found in **Annex 1**. The Terms of Reference (TORs) of the peer review are listed in **Annex 2**. Lastly, the tentative agenda of the panel review meeting is attached in **Annex 3**.

Requirements:
NMFS requires two reviewers who are external to PIFSC, Pacific Islands Regional Office (PIRO), and the Western Pacific Regional Fishery Management Council and its affiliated bodies to conduct an impartial and independent peer review in accordance with this PWS, OMB Guidelines, and the TORs in Annex 2.

CIE reviewers shall have:

- Working knowledge and recent experience in the application of stock assessment models, including integrated models, sufficient to complete a thorough review;
- Knowledge of integrated assessment models, more specifically Stock Synthesis;
- Expertise with measures of model fit, identification, uncertainty, forecasting, and biological reference points;
- Familiarity with federal fisheries science requirements under the Magnuson-Stevens Fishery Conservation and Management Act;
- Familiarity with local Pacific Islands fisheries as well as artisanal fisheries and fishing practices;
- Excellent oral and written communication skills to facilitate the discussion and communication of results.

Tasks for Reviewers:
Each of the CIE reviewers shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables.

Pre-review Background Documents: No later than two weeks before the peer review, the NMFS Project Contact will provide reviewers the necessary background information and reports for the peer review. The reviewers shall read all documents prior to the peer review in accordance with the PWS scheduled deadlines.

Required pre-review documents:

- DRAFT 2020 uku assessment: Nadon *et al*. Stock assessment of uku in Hawaii, 2020. NOAA Tech Memo.
- Previous reef fish stock assessment: Nadon, M. O. 2017. Stock assessment of the coral reef fishes of Hawaii. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-PIFSC-60, 212p. (focus on sections pertaining to uku)
- Independent peer review report for Nadon (2017) stock assessment: Benchmark review of the 2016 stock assessment of the Main Hawaiian Islands Reef-associated Fish. Consensus Review Panel Report. 27 p.
- Hawaii Fishery Ecosystem Plan: Western Pacific Regional Fishery Management Council. 2009. Fishery Ecosystem Plan for the Hawaii Archipelago. Only section 5.2 (p. 133-138) and section 5.3 (pp 138-143).

- Methot, R.D. and Wetzel,C. 2013. Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. *Fisheries Research* 142: 86-99.
- Winker et al. 2014. Proof of concept for a novel procedure to standardize multispecies catch and effort data. *Fisheries Research* 155: 149-159.

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the PWS and TORs, and shall not serve in any other role or represent any of their organizations in this capacity. Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the TORs. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). NMFS will provide a Chair for this in-person panel review. The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers.

Contract Deliverables - Independent Peer Review Reports: Each reviewer shall complete an independent peer review report in accordance with the PWS. Each reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each reviewer shall complete the independent peer review addressing each TOR as described in Annex 2. Reviewers are not required to reach a consensus.

Other Tasks – Contribution to Summary Report: This Benchmark Review consists of two CIE reviewers and one review Chair which is not provided by the CIE. Each CIE reviewer will assist the Chair with contributions to a Summary Report that will describe the majority or consensus findings, based on the TORs of the review. Each individual CIE reviewer is not required to report a consensus finding. Reviewers should provide a brief synopsis of their own views on the summary findings and conclusions reached by the review panel in accordance with the TORs.

Foreign National Security Clearance

When reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 50 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/ and http://deemedexports.noaa.gov/compliance_access_control_procedures/noaa-foreign-national-registration-system.html. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance:

Each reviewer shall conduct an independent peer review during the panel review meeting scheduled in Honolulu, Hawaii at the Finance Factors Building, 164 Bishop St #140, Honolulu, HI 96813, during **February 24– 28, 2020**.

Period of Performance

The period of performance shall be from the time of award through **April 2020**. Each reviewer's duties shall not exceed 14 days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Schedule	Milestones
Within two weeks of award	Contractor selects and confirms reviewers
No later than two weeks prior to the review	Contractor provides the pre-review documents to the reviewers
February 24 – 28, 2020	**Panel review meeting**
Within three weeks of the panel review meeting	Contractor receives draft reports
Within 2 weeks of receiving draft reports	Contractor submits final reports to the Government

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content; (2) The reports shall address each TOR as specified; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel
All travel expenses shall be reimbursable in accordance with Federal Travel Regulations (http://www.gsa.gov/portal/content/104790). International travel is authorized for this contract.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

Annex 1: Peer Review Report Requirements

1. The report must be prefaced with an Executive Summary providing a concise summary of the findings and recommendations.

2. The report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR, in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs.

3. Reviewers must describe in their own words the review activities completed during the panel review meeting, including a brief summary of findings, of the science, conclusions, and recommendations.

4. Reviewers should discuss their independent views on each TOR even if these were consistent with those of other panelists, but especially where there were divergent views.

5. Reviewers should elaborate on any points raised in the summary report that they believe might require further clarification.

6. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

7. The report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the summary report. The report shall represent the review of each TOR by each individual reviewer, and shall not simply repeat the contents of the summary report.

8. The report shall include the following appendices:

Appendix 1: Bibliography of materials provided for review
Appendix 2: A copy of this Statement of Work
Appendix 3: Panel membership or other pertinent information from the panel review meeting.

Annex 2: Terms of Reference for the Peer Review

Terms of Reference for the Peer Review

*2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku (*Aprion virescens*)*

External Independent Peer Review under the Western Pacific Stock Assessment Review framework: 2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

For questions 1-8 and their subcomponents, reviewers shall provide a "yes" or "no" answer and will not provide an answer of "maybe". Only if necessary, caveats may be provided to these yes or no answers, but when provided they must be as specific as possible to provide direction and clarification to NMFS.

1. Of the data considered for inclusion in the assessment, were final decisions on inclusion/exclusion of particular data appropriate, justified, and well-documented?

2. Is the CPUE standardization properly applied and appropriate for this species, fishery, and available data?

3. Are the assessment models used reliable, properly applied, adequate, and appropriate for the species, fishery, and available data?

4. Are decision points and input parameters reasonably chosen?

5. Are primary sources of uncertainty documented and presented?
6. Are model assumptions reasonably satisfied?
7. Are the final results scientifically sound, including but not limited to estimated stock status in relation to the estimated overfishing and overfished status determination criteria (SDC)?
8. Are the methods used to project future population state adequate, including the characterization of uncertainty, and appropriately applied for implementation of overfishing limits (OFL)?
9. Can the results be used to address management goals stated in the relevant FEP or other documents provided to the review panel? If any results of these models should not be applied for management purposes with or without minor short-term further analyses (in other words, if any responses to any parts of questions 1-8 are "no"), indicate:

    Which results should not be applied and describe why, and

    Which alternative set of existing stock assessment results should be used to inform setting stock status and fishery catch limits instead and describe why.

10. As needed, suggest recommendations for future improvements and research priorities. Indicate whether each recommendation should be addressed in the short/immediate term (2 months), mid-term (3-5 years) and long-term (5-10 years). Also indicate whether each

recommendation is high priority (likely most affecting results and/or interpretation), mid priority, or low priority.

11. Draft a report (individual reports from each of the panel members and an additional Summary Report from Chair) addressing the above TOR questions.

Annex 3: Tentative Agenda

External Independent Peer Review under the Western Pacific Stock Assessment Review framework:

2020 Benchmark Stock Assessment for Main Hawaiian Islands Uku

Western Pacific Regional Fishery Management Council Office
1164 Bishop St., Suite 1400; Honolulu, HI 96813
February 24 - 28, 2019, 9am - 5pm

Day 1, Monday February 24

1. Welcome and Introductions
2. Background information – Objectives and Terms of Reference
    a. Fishery Operation
    b. Fishery Management
3. History of stock assessments and reviews
4. Data
    a. Hawaii Division of Aquatic Resources Fishing Report System (FRS) and Hawaii Marine Recreational Fishery Survey (HMRFS)
    b. Life history information
    c. Other
5. Presentation and review of stock assessment

Day 2, Tuesday February 25

6. Continue presentation and review of stock assessment

Day 3, Wednesday February 26

7. Continue review of stock assessment

Day 4, Thursday February 27

8. Continue review of stock assessment
9. Public comment period
10. Panel discussions (closed)

Day 5, Friday February 28

11. Continue panel discussions (closed, morning)
12. Present panel results (afternoon)
13. Adjourn

Order of agenda items may change. Meeting may run late if needed to accommodate all agenda items.

APPENDIX 3: PANEL MEMBERSHIP OR OTHER PERTINENT INFORMATION FROM THE PEER REVIEW MEETING

WPSAR panel:

- Erik Franklin, Chair, (WPRFMC SSC and University of Hawaii),
- Yong Chen (UM), Center for Independent Experts (CIE)
- Yan Jiao (VT), Center for Independent Experts (CIE)

WPSAR Coordinating Committee:

- Marlowe Sabater (WPRFMC),
- Bret Schumacher (NOAA PIRO),
- John Syslo (NOAA PIFSC),

Stock Assessment Team:

- Marc Nadon (NOAA PIFSC),
- Michelle Sculley (NOAA PIFSC),
- Felipe Carvalho (NOAA PIFSC),

Other participants and their affiliation and contacts:

- Joe O'Malley (NOAA PIFSC),
- Hongguang Ma (NOAA PIFSC),
- Roy Morioka (public, fisher),
- Bryan Ishida (Hawaii DAR),
- Beth Lumsden (NOAA PIFSC),
- Todd Jones (NOAA PIFSC)

Abbreviations:

- CIE – Center for Independent Experts
- DAR – Hawaii Division of Aquatic Resources
- NMFS – National Marine Fisheries Service (NOAA)
- NOAA - National Oceanic and Atmospheric Administration
- PIFSC – Pacific Island Fisheries Science Center (NMFS/NOAA)
- PIRO - Pacific Islands Regional Office
- SSC - Scientific and Statistical Committee (of the WPFMC)
- UM – University of Maine
- VT - Virginia Polytechnic Institute and State University
- WPFMC – Western Pacific Regional Fishery Management Council

APPENDIX 4: PANEL REQUESTS FOR INFORMATION AND ADDITIONAL ANALYSES

A. Presentation of information:

1. Estimate of mortality for each fleet
2. Growth data - Plot growth curve with NWHI vs MHI indicated. How does growth curve change with only MHI data?
3. Figure of diver survey locations through time
4. Add BMSY/FMSY reference lines to sensitivity plots(?)
5. Mohn's rho for recruitment
6. Plot observed vs expected catch by fleet

B. Further Analyses:

1. Look at the effect of removing diver data from the model
2. Important to compare CPUE using old vs new method for >=2003 time period (impact of new effort calculation [hrs vs reporting days]). Compare CPUE from all sources (for >=2003) in single reporting days.
3. Calculate CPUE time series for inshore handline from 1990-2018
4. Start the model with more recent year to see effect on model scaling - 1970
5. Investigate calculation of MSY. Is it exact or proxy?
6. Incorporate iterative effN estimation
7. Estimate sigma_R within the model
8. Include age-specific natural mortality

C. Scenarios of Projections:

1. Weighted selectivities
2. Empirical resampling of bottom 25th percentile for recruitment