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# WESTERN PACIFIC STOCK ASSESSMENT REVIEW

## Stock Assessment of uku (*Aprion virescens*) in Hawaii, 2020

Panel Summary Report

Prepared by
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Prepared for
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Pacific Islands Regional Office, National Marine Fisheries Service, NOAA
Western Pacific Regional Fishery Management Council

**Background**

This document provides a panel summary report of the Western Pacific Stock Assessment Review (WPSAR) by panelists E. Franklin (chair), Y Chen, and Y Jiao to the Terms of Reference for the "Stock assessment of uku (*Aprion virescens*) in Hawaii, 2020" by M. Nadon, M. Sculley, and F. Carvalho. This WPSAR addresses a set of eleven (11) Terms of Reference (TOR) for the review of a benchmark stock assessment of the green jobfish or uku (*Aprion virescens* Valenciennes, 1830) in the main Hawaiian Islands, following guidelines established in the WPSAR framework. The WPSAR framework identifies a peer review process for the scientific information used to advise the Western Pacific Regional Fishery Management (WPRFMC) Council about the conservation and management of fisheries in the region. The review was held February 24, 2020 through February 28, 2020 in the Western Pacific Regional Fishery Management Council Office, Suite 1401, Finance Factors Building, 1164 Bishop Street, Honolulu, Hawaii 96813. A draft version of these responses was presented publicly to the stock assessment team, WPSAR principals, and stakeholders on the final day of the review.

**Responses to the Terms of Reference for the WPSAR**

Note that for questions 1-8 and their subcomponents, the reviewers provided a "yes" or "no" answer and did 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?

**Yes, with caveats**, the data included were appropriate, justified, and well documented. The assessment team did an excellent job in the documentation, filtering, and quality control of the data sets included in the assessment. The recreational (i.e., non-commercial) fishery data represents the information of greatest concern due to the strong fluctuations in the time series and large proportional contribution to the fishery (~73% in 2018). The model approach used to estimate past recreational catch for 1948-2002 is unsatisfactory given the possible changes in the fishery over such a long time period, but we can not offer a better alternative. The commercial catch records are provided directly by fisherman so may contain some inaccuracies or misrepresentations, but the data set is appropriate to use for the assessment of this fishery. The CPUE abundance indices demonstrated a noticeable shift in the trend trajectories at a timepoint that coincided with a change in the definition of effort from fishing days to fishing hours. A comparison of 'fishing day' versus 'fishing hour' standardized CPUE during overlapping time periods suggested that the trajectory change was not overly influenced by a change in the units of effort. We also recommended that the inshore handline time series has sufficient data to start at 1992 (rather than 2003) and the deepsea handline has a single CPUE for 1948-2018 but sensitivity analyses performed during the review suggested that these changes would have minimal impact to the current assessment results relative to status determination. Although the diver survey data provides limited information, it is useful to include this data set as an alternative to the fishery catch records. The life history information for age/growth and maturity were derived from local studies.

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

**Yes**, the CPUE standardization was properly applied and appropriate. The assessment explored a reasonable set of variables that may influence the CPUE indices for the uku fishery using standard modeling approaches (i.e., delta-lognormal GLMMs) and statistical diagnostic tools. The panel initially had concerns about the effects of the change on the effort definition but that appeared to have a negligible impact. We recommend that you add an expanded section explaining why some of your CPUE models didn't converge. We also suggest in future CPUE standardization to include the inshore handline data from 1992-2002 to extend the duration of this time series as well as an interaction between Month:PC (catch composition) in future CPUE indices.

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. The central model used in the assessment, Stock Synthesis (v 3.30), is a standard integrated statistical catch-at-age model. The model diagnostic analyses were comprehensive and well presented. The models capture the life history of the target species and incorporate all available CPUE indices. The choice of life history models for age/growth and maturity were adequate to model those processes. The use of the LBSPR model to estimate selectivities outside of SS3 was a reasonable approach for the gears with minimal size composition data (i.e., inshore, recreational, trolling, other gears). Future assessments could consider dynamic binning to better capture the long tail distributions present in the annual size composition data.

4. Are decision points and input parameters reasonably chosen?

**Yes**, the decision points and input parameters were reasonably chosen. There was a good inclusion of multiple CPUE indices to examine the dynamics of the fishery and the approach utilized in this assessment can provide a framework for future efforts. The assessment provided a clear description and justification for the values used in the input parameters. For example, the life history inputs were selected based on studies performed locally on the assessed species, with size-at-age data from a recent growth study. There was also a reasonable explanation provided for values determined by LBSPR for fixed parameters for selectivities. The use of fishing days and then fishing hours as a unit of effort was demonstrated to be relatively consistent as an index.

5. Are primary sources of uncertainty documented and presented?

**Yes with caveats**, the primary sources of uncertainty are documented and presented. A series of sensitivity models demonstrated a considerable stability in model results across a range of scenarios. The fixed selectivities for some gears (determined outside of SS3 using LBSPR) may have contributed to this stability. We suggested the examination of temporal changes in catchability and weighted selectivities based on catch to be considered for sensitivity runs or future assessments. Aspects of uncertainty pertaining to data were addressed in the response to TOR 1.

6. Are model assumptions reasonably satisfied?

**Yes**, the model assumptions were reasonably satisfied. We recommend the addition of a table of key biological and statistical assumptions for the model to better organize a summary of the information in a single location. It was unclear how catchability (q) and selectivity evolved through the time series with the changing fishery gear and technology but a sensitivity analysis demonstrated negligible change to model results while modeling catchability as a random walk.

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 for status determination criteria. We accept the base-case model for making uku fishery management decisions relative to SDC. Model outputs are robust to a variety of sensitivity analyses suggesting a high confidence that the results can be used to determine fishery status relative to overfishing and overfished status. To simplify the comparison of model output, we suggest a summary table of results of the biological references points for the base-case and the sensitivity runs that include the $F_{msy}$, F2018, $F_{2018}/F_{msy}$ ratio, $SSB_{msy}$, $SSB_{msst}$, $SSB_{2018}$, $SSB_{2018}/SSB_{msst}$, and $Catch_{msy}$.

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 characterization of uncertainty is appropriate and a table is provided to evaluate the probability of overfishing at different levels of annual catch for 2020-2026. To improve this approach, we recommend that the base-case projection utilizes a composite selectivity that is weighted by catch contribution of each gear type. We also recommend the inclusion of an additional projection that represents a “worst case” scenario that utilizes the compositive selectivity and the lowest $25^{th}$ percentile of recruitment to determine the probability of overfishing at various levels of catch. Although the projections extend to 2026, we suggest that this fishery has an update assessment in three years especially given the recent increasing CPUE and SSB trends.

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.

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.

**<u>Short/immediate term</u>**

Panel determined that all short term recommendations are HIGH priority.

-Add a section that addresses prior recommendations from 2016 assessment and how they were incorporated into this assessment. If not, then why not?

-Create a supplementary technical memo of all analysis code and data to facilitate reproducibility of results.

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 dots for MHI and NWHI
(4) Standardized CPUE gear comparison (DSH, ISH, Troll) between fishing day and fishing hours for 2003-2018
(5) Include Mohn's Rho value for biomass, recruitment and fishing mortality in retrospective figure
(6) Diver survey locations for each survey year

Tables to include:

(1) Biological and statistical assumptions with key to sections of report
(2) Summary table for management statistics for base-case and sensitivity runs that includes stats from Table 12. Use base-case and scenarios as rows in table. See list of sensitivity runs below.

Sensitivity runs to include:

(1) Using Lorenzen M
(2) Using a single DSH CPUE from 1948-2018 with same effort standardization
(3) Using extending ISH to 1992 to 2018
(4) Sensitivity run that combines all three of (1), (2), (3)
(5) Start model 1970
(6) Estimating SigmaR
(7) Iterative effN estimation
(8) Time-varying catchability (2003-2018)

Projections to include:

(1) Base-case projection should use a composite selectivity (weighted by catch for the different gears).
(2) Include a worst-case projection with composite selectivity and 25th percentile lowest recruitment to provide an alternative scenario to consider under poor recruitment. This is not a replacement for the base-case.

**Mid-term**

(1) Perform a simulation study to examine the potential sources of uncertainty in recreational fisheries data and identify an effective and optimal survey design. (HIGH)
(2) Continue with the direct involvement of MRIP survey statistician for stock assessments to assist with inclusion of highest quality recreational fishery data. (HIGH)
(3) Incorporate the fishery-independent survey results from the BFISH program as a relative index of abundance for uku. (HIGH)
(4) Explore possible inclusion of the following elements for future base-case scenarios (HIGH)
    a. Using Lorenzen M
    b. Using a single DSH CPUE from 1948-2018 with same effort standardization
    c. Using extending ISH to 1992 to 2018
(5) Examine changing fleet dynamics with new technologies and gears to better estimate temporal variability of catchability. (MID)
(6) 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. (MID)
(7) Continue collecting otolith samples for future growth studies. (LOW)

**Long-term**

(1) Examine the dynamics and distribution of spawning aggregations in Hawaii. (HIGH)
(2) Better understand stock structure, population connectivity, and adult movement of fishes using genetic analysis and tagging experiments. (MID)
(3) Continue to improve data quality from fisheries-dependent and -independent sources. (HIGH)

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

This report is the Summary Report from Chair.