WESTERN PACIFIC STOCK ASSESSMENT REVIEW

"Stock Assessment of Uku (*Aprion virescens*) in Hawaii, 2024 Update"

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

A Western Pacific Stock Assessment Review (WPSAR) of the 2024 Main Hawaiian Islands (MHI) Uku (*Aprion virescens*) Stock Assessment Update was conducted in Honolulu, HI on September 8-9, 2024. Stock assessment updates incorporate additional data collected since the prior assessment (Nadon et al. 2020) and use the same methods of the prior assessment to update the status of the fishery. A three-person WPSAR panel comprised of Western Pacific Regional Fishery Management Council Scientific and Statistical Committee members (i.e., Erik Franklin (Chair), Milani Chaloupka, Jason Helyer) was tasked with the evaluation of the update assessment data sources, filtering, and documentation, and if the methods of CPUE standardization, assessment models, and future projections were the same as those used for the prior assessment. The panel identified if the assessment results estimated MHI Uku stock status in relation to reference points and management goals. The WPSAR panel also provided recommendations to improve future benchmark stock assessments of MHI Uku. The Terms of Reference list, participant list, and meeting agenda are in the Appendices. Panel summary responses to the Terms of Reference follow below.

Panel Responses to the Terms of Reference for the WPSAR

TOR 1. Are input data sources and filtering methods well documented and the same as those used in the 2020 benchmark assessment?

Panel Response: Yes

The input data sources for the update assessment were the same used for the benchmark assessment. All methods were well documented. Data for the update assessment included (1) catch series, (2) abundance indices, and (3) size frequency data. Data were included in the assessment update for 5 additional years of commercial catch, CPUE, and size from the Hawaii State Fisher Reporting System (FRS) and non-commercial catch from the Hawaii Marine Recreational Fishing Survey (HMRFS), and one additional year of relative abundance from NOAA PIFSC fisheries-independent diver surveys.

The HMRFS non-commercial catch data was corrected with a linear factor for 2003-2017 to reflect the decline in landline telephones (Ma 2023). This correction method was previously used for the benchmark assessment of MHI bottomfish (Syslo et al. 2024) and WPSAR approved that assessment (Martell et al. 2024). The panel concluded that the approach was an acceptable correction to the data for the assessment update and did not warrant a negative response to this TOR.

TOR 2. Is the CPUE standardization methodology the same as those used in the 2020 benchmark stock assessment?

Panel Response: Yes

CPUE standardization methods used were the same as those used for the benchmark assessment.

CPUE indices were standardized using generalized linear models and generalized mixed-effects models. The GLMM regression modelling approach used separate binomial and Gaussian likelihoods and a log-transformed response variable with fisher ID as an intercept-only random effect. Changes in trip catch composition was accounted for using a principal component approach (Winker et al 2014) for data reduction (1000s of trip effects) of all gear types and to identify a small number of latent predictors for the regression standardization models. Recommendations (TOR 6) are provided improvements to the CPUE standardization of future benchmark assessments.

TOR 3. Are the assessment model and methodology the same as those used in the 2020 benchmark stock assessment?

Panel Response: Yes

The update model was the same integrated statistical catch-at-age model used for the benchmark assessment with the Stock Synthesis 3.30 (SS3) software (Methot and Wetzel 2013) used for model fitting and results. The assessment uses a state-space age-structured (2-stage VBGF function) population model without sex-specific structure for the time series from 1948-2023 and include lognormal observation error for the abundance indices input to the model. Model diagnostics were thorough and appropriate, following methods used from the prior assessment. The Length-based Spawning Potential Ratio (LBSPR) method (Hordyk et al. 2016) was used to generate selectivity parameters for commercial fishing gears (inshore handline, trolling, and "others") and the recreational sector.

TOR 4. Are methods used to project future population state the same as those used in the 2020 benchmark stock assessment?

Panel Response: Yes

The future population state projection used the same single sex age-structured projection model in the AGEPRO software (Brodziak et al. 1998) as the benchmark stock assessment. Results coupled with Monte Carlo simulations and 3 stock recruitment scenarios to estimate the probability of overfishing ($F>F_{msy}$) given 7 fixed-catch scenarios for 7 fishing years from 2025 to 2031.

TOR 5. Do results include estimated stock status in relation to the estimated biological reference points, and other results required to address management goals stated in the relevant FEP or other documents provided to the review panel?

Panel Response: Yes

The update assessment includes MHI Uku stock status relative to reference points for spawning stock biomass and fishing mortality as well as the probability of overfishing for future years. Extensive and thorough sensitivity analyses were undertaken including the potential impact of the linear correction for phone-landline surveys in non-commercial catch. The results address management goals

for the MHI Uku stock which is not overfished, nor experiencing overfishing.

TOR 6. For consideration in future benchmark assessments, suggest and prioritize recommendations for improvements and research. For each recommendation, prioritize to three categories (high, medium, low) dependent on importance to interpretation of this and future assessment results.

High Priority

- Use a single model likelihood for the data standardization component (such as hurdle-lognormal, hurdle-gamma) rather than the 2-stage so-called delta modelling approach.
- Use posterior predictive check tests to evaluate data standardization model performance in addition to the standard residuals-based diagnostic checks used.
- Expand data collection to improve understanding of non-commercial uku catch including performing surveys of non-commercial fishing effort and catch data to supplement information currently collected for HMFRS.
- Explore model-based non-commercial catch expansions that incorporate variables such weather, holidays, weekends, etc.
- Explore different geographic scales (island, coastline, etc.) for the AREA variable in CPUE standardization to address model convergence issues.

Medium priority

- Efforts to promote dialogue between fishers and relevant science agencies are encouraged to integrate these fisher observations of biological and fishery phenomena throughout the stock assessment process.
- Explore other fisher ID random effect structures in the GLMMs including reclassifying fishers as high-catch fishers versus the rest and use that variable as the fisher ID.
- Explore alternative classifications for fishers reporting commercial uku catch such as cumulative fishing events over a lifetime or more flexible classifications that utilize socio-economic info from dealer reports/small boat surveys to improve differentiation between high and low CPUE fishers.
- Deploy software systems that facilitate the automation and streamlining of the stock assessment process to contribute to more frequent update stock assessments, with a goal toward annual assessments, and standardized outputs.
- NOAA Fisheries is in the process of developing FIMS software to replace SS3 to perform stock assessments. If a future PIFSC benchmark assessment (for any species or complex) will use FIMS, it should include a side-by-side comparison of SS3 and FIMS outputs to evaluate the level of correspondence between modeling frameworks.

Low priority

- Explore regional environmental drivers of recruitment for the MHI uku stock rather than focus solely on a Beverton-Holt stock recruitment curve.
- Develop a spatially explicit uku capture-mark-recapture program in the MHI to derive estimates of dispersal and survival (mortality) rates in additional to an alternative fishery-independent estimates of island-specific population size.

- Basic research is needed on biological and fishery characteristics of Uku spawning aggregations in Hawaii.
- Perform a pilot study to evaluate if the single Uku catch trips provide a representative size structure for all Uku catch. Dealer reports should be considered for this study.

Public Comment

Ed Watamura (Oahu fisher) expressed concerns about shark depredation and the accuracy of data inputs to the assessment.

Nathan Abe (Kona bottomfish fisher) raised concerns about the apparently high number of shark interactions (depredation) in the Main Hawaiian Islands uku fishery and its effects on uku CPUE.

Clay Tam (Pacific Islands Fisheries Group) also raised concerns about the high apparent level of shark depredation in Hawaiian waters and attributed some cause for increased depredation on shark feeding tours.

References

Brodziak, J., Rago, P., & Conser, R. (1998). A general approach for making short-term stochastic projections from an age-structured fisheries assessment model. In F. Funk, T. Quinn II, J. Heifetz, J. Ianelli, J. Powers, J. Schweigert, P. Sullivan, & C. Zhang (Eds.), *Fishery Stock Assessment Models* (pp. 933–954). Alaska Sea Grant, University of Alaska Fairbanks. https://doi.org/10.4027/fsam.1998.52

Hordyk AR, Ono K, Prince JD, Walters CJ (2016) A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. CJFAS 73: 1787-1799.

Ma, H. (2023). *Non-commercial catch estimation for Deep-7 bottomfish in the main Hawaiian Islands*. https://doi.org/10.25923/2MBE-XH91

Martell, S., Dichmont, C., & Jiao Y. (2024) WPSAR Panel Review of Benchmark Stock Assessment for the Main Hawaiian Islands Deep 7 Bottomfish Complex in 2024, with Catch Projections Through 2029. Prepared for Pacific Island Fisheries Science Center, NOAA/NMFS, Pacific Islands Regional Offices, NOAA/NMFS, Western Pacific Fisheries Management Council. 8 pp.

Methot, R. D., & Wetzel, C. R. (2013). Stock Synthesis: A biological and statistical framework for fish stock assessment and fishery management. *Fisheries Research*, *142*, 86–99. https://doi.org/10.1016/j.fishres.2012.10.012

Nadon MO, Sculley M, Carvalho F. 2020. Stock assessment of uku (*Aprion virescens*) in Hawaii, 2020. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-100, 120 p. doi:10.25923/57nb-8138

Syslo J, Oshima M, Ma H, Ducharme-Barth N, Nadon M, Carvalho F (2024). Benchmark stock assessment for the main Hawaiian Islands Deep 7 bottomfish complex in 2024 with catch projections through 2029 U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-157

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

Appendix 1. Terms of Reference for Peer Review

Terms of Reference for the Peer Review

*2024 Stock Assessment Update for Main Hawaiian Islands Uku (*Aprion virescens*)*

Peer Review under the Western Pacific Stock Assessment Review framework: *2024 Stock Assessment Update for Main Hawaiian Islands Uku (*Aprion virescens*)*

For questions 1-4 and their subcomponents, reviewers shall provide a "yes" or "no" answer. If they answer "no", they must explain if a specific change was justifiable, and if not, which alternative set of existing information/results should be used to inform fishery management and why. Each panel member will provide a report based on their answers to these questions, and the Chair will provide a report summarizing the answers to these questions across the review panel.

1. Are input data sources and filtering methods well documented and the same as those used in the 2020 benchmark assessment?

2. Is the CPUE standardization methodology the same as those used in the 2020 benchmark stock assessment?

3. Are the assessment model and methodology the same as those used in the 2020 benchmark stock assessment?

4. Are methods used to project future population state the same as those used in the 2020 benchmark stock assessment?

5. Do results include estimated stock status in relation to the estimated biological reference points, and other results required to address management goals stated in the relevant FEP or other documents provided to the review panel?

6. For consideration in future benchmark assessments, suggest and prioritize recommendations for improvements and research. For each recommendation, prioritize to three categories (high, medium, low) dependent on importance to interpretation of this and future assessment results.

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

Appendix 2. Panel Meeting Participants and Agenda

WPSAR panel: Chair Erik Franklin (WPRFMC SSC and University of Hawaii), Milani Chaloupka (WPRFMC SSC, Ecological Modelling Services Pty Ltd, and University of Queensland), and Jason Helyer (WPRFMC SSC and Hawaii State Division of Aquatic Resources)

WPSAR Coordinating Committee: Mark Fitchett (WPRFMC), Brett Schumacher (NOAA Fisheries PIRO), Marlowe Sabater (NOAA Fisheries PIFSC)

Stock Assessment Team: Marc Nadon (NOAA Fisheries PIFSC), Felipe Carvalho (NOAA Fisheries PIFSC)

Attendees: Jarad Makaiau (NOAA Fisheries PIRO), Hongguang Ma (NOAA Fisheries PIFSC), Katherine Papacostas (NOAA Fisheries Office of Science and Technology), Sarah Lazo (NOAA Fisheries OST) Clay Tam (Pacific Islands Fisheries Group), Ed Watamura (public, fisher), Nathan Abe (public, fisher)

Meeting was held at NOAA Honolulu Service Center at Pier 38 at 1139 N. Nimitz Hwy, Suite 220. Honolulu, HI 96817 with a hybrid online video option for remote participants.

Day 1, Monday September 9

1. Introduction (Franklin)
2. Review objectives and terms of reference (Franklin)
3. Presentation of stock assessment updates (Nadon)
4. Summary of comments and analysis during desktop phase (Panel)
5. Questions to presenters (Panel)
6. Public comment

Day 2, Tuesday September 10

7. Panel presentation on the review results and recommendations (Franklin)
8. Questions to reviewers (Nadon, Carvalho)
9. Public comment
10. Closing comments and adjourn (Franklin)