Summary Report

Western Pacific Stock Assessment Review for Data Relevant to the Guam Bottomfish Management Unit Species

8-12 July 2024
Tumon, Guam, USA

Dr Milani Chaloupka [1,2,3]
Chair — WPSAR-CIE Review Panel

1. Ecological Modelling Services Pty Ltd, Australia
2. Marine Spatial Ecology Lab, School of the Environment, University of Queensland
3. WPRFMC Scientific and Statistical Committee

Dr Matthew Cieri [4]
WPSAR-CIE Review Panel

4. Center for Independent Experts reviewer (USA)

Dr Paul Medley [5]
WPSAR-CIE Review Panel

5. Center for Independent Experts reviewer (UK)

Supported by:

NOAA Fisheries
Pacific Islands Fisheries Science Center
Pacific Islands Regional Office
Western Pacific Regional Fishery Management Council
(WPSAR Coordinating Committee)

Executive Summary

In March 2024, the 198th Council Meeting recommended that the WPRFMC[1] convene a WPSAR panel comprising 3 members to review the data sources to be used by NOAA Fisheries in future Guam BMUS[2] benchmark stock assessments — the panel comprised one WPRFMC SSC member as the panel Chair and 2 independent reviewers provided by the US-based Center for Independent Experts (CIE).

The current Guam BMUS stock status update based on 42-year times series of catch and CPUE concluded recently that the Guam BMUS complex was **not overfished nor experiencing overfishing** (Bohaboy & Matthews 2024). Importantly, the 2024 update stock assessment found evidence for the partial rebuilding of the 13-species Guam BMUS complex that was attributable to reduced catch[3] from 2017-2020 — the catch has since increased. A summary of the Guam Bottomfish Management Unit Species complex assessment history since the 2005 benchmark assessment is shown below (includes the upcoming benchmark assessment).

Future stock assessments could now be based on single-species rather than the aggregate 13-species complex as undertaken in the previous assessments.

Guam BMUS stock assessment history

Assessment type	Status year	CPUE data series	Overfished	Overfishing	Rebuilding	Annual catch limit
benchmark (2007)	2005	1982-2005	no	no	no	NA
update (2012)	2010	1982-2010	no	no	no	NA
update (2016)	2013	1982-2013	no	no	no	NA
benchmark (2019)	2017	1982-2017	yes	no	no	31k lbs
update (2024)	**2023**	**1982-2023**	**no**	**no**	**yes**	**31-33k lbs**
benchmark (2025)	2024	TBD	TBD	TBD	TBD	TBD

Note: annual catch limit = projected catch corresponding to a median overfishing probability of 40% in any year. NA = not comparable as used a Schaefer surplus production functional form whereas the 2019 benchmark and the 2024 update used a Pella-Tomlinson function form.

[1] WPRFMC = Western Pacific Regional Fishery Management Council, WPSAR = Western Pacific Stock Assessment Review, SSC = Scientific and Statistical Committee

[2] BMUS = Bottomfish Management Unit Species

[3] Catch lower that the prescribed catch limit.

The WPSAR-CIE 3 review was convened on July 8-12 (2024) in person at the Guam Hilton (Tumon, Guam) supported by the WPRFMC and NOAA Fisheries.

The review focussed on the 4 NOAA Fisheries Guam BMUS-related data documents (catch, CPUE standardization, length composition, life history attributes) within the context of the 8 Terms-of-Reference (ToRs) provided by the WPRFMC/NOAA Fisheries Review Coordinating Committee (*see Appendix 1*). ToRs 1-7 dealt specifically with the adequacy of the 4 data sources for future benchmark stock assessments. ToR 8 dealt with suggested future improvements and research priorities to improve the collection of catch, length data, and life history data.

The WPSAR-CIE 3-person review panel membership is given in *Appendix 2*.

The NOAA Fisheries presenters of the 4 BMUS data documents are shown in *Appendix 3*. A tabular data summary of those 4 data documents sourced from Bohaboy & Matthews (2024) is shown below.

BMUS data overview from NOAA Fisheries (see Bohaboy & Matthews 2024)

Summary of the data available for 13 BMUS in Guam.

BMUS	Criteria				
	1) Historical Landings Recorded at species level	**2) Recent Landings** CV over years | years with group-identified > 10% total	**3) Species Occurrence** % BBS interviews	**4) Size Observations** Average per year | years with > 50 samples	**5) Life History** Location | sample size | A_{max} % global
Aphareus rutilans	Yes	0.95 | 7	6.1	20 | 1	Mariana | 26 | 44
Caranx ignobilis	No	1.9 | 16	1.9	11 | 0	MHI | 180 | 100
Caranx lugubris	Yes	1.25 | 6	3.8	24 | 2	Mariana | 25 | 100
Etelis carbunculus	Yes	0.86 | 5	9.3	70 | 7	Mariana | 62 | 7
Etelis coruscans	Yes	1.39 | 10	5.6	42 | 4	Okinawa | 768 | 100
Lethrinus rubrioperculatus	No	0.83 | 13	24.4	590 | 11	Mariana | 275 | 100
Lutjanus kasmira	No	0.65 | 13	13.3	99 | 8	Mariana | 33 | 100
Pristipomoides auricilla	Yes	0.79 | 5	12.6	277 | 12	Mariana | 295 | 100
Pristipomoides filamentosus	Yes	1.06 | 5	3.4	21 | 2	Mariana | 217 | 47
Pristipomoides flavipinnis	Yes	1.06 | 5	5.8	51 | 5	Mariana | 57 | 21
Pristipomoides sieboldii	No	2.48 | 13	0.8	31 | 2	Okinawa | 371 | 100
Pristipomoides zonatus	Yes	0.76 | 3	11.9	73 | 8	Guam | 317 | 100
Variola louti	No	0.99 | 4	10.2	88 | 7	Guam | 287 | 93

The Panel considered all substantive comments provided at the 5-day review by members of the public responding to the data review and material presented each day. Each of the 3-person review panel completed their own independent evaluation report and these 3 reports have then been attached to this overall Summary Report (*see Appendix 7*).

Main finding — the WPSAR-CIE review panel found that the 4 data sources (catch, CPUE standardization, length composition, life history attributes) compiled for the **Guam BMUS 13-species complex** were well documented and appropriate for consideration in future benchmark stock assessments.

The Review Panel further notes that the quality and quantity of species-specific catch, length and life history data was variable with some species quite data-limited – which presents challenges for any future species-specific benchmark stock assessment.

The WPSAR review panel also made the following key [4] recommendations for consideration in the upcoming Guam BMUS benchmark stock assessment comprising single-species models:

Recommendations —

Short term (12 months) —

- Conduct a simulation-based evaluation of the comparative efficacy of the 3 weighting schemes to account for unbalanced time-area sampling should be undertaken in the near future (ca 12 months) to determine whether habitat area-based weighting is indeed suitable for adjusting recorded BMUS species length data

- Bootstrap catch estimates to bracket their uncertainty range for use in stock assessments

Medium-term (12-18 months) —

- Use a single model likelihood for the data standardization component (such as hurdle-lognormal) rather than the 2-stage so-called delta modelling approach

- Consider alternate selectivity models and their potential impact on the data. Most fish are caught using hook and line, which may well have dome-shaped selectivity. Where size observations are used from this source, size-based estimates may be biased

Longer term (24 months) —

- Consider using fishery independent surveys for deepwater bottomfish, similar to the diver surveys used on shallow reefs. This could include, but not be limited to, remote camera and video for visual bottom surveys which may provide length and species abundance

[4] This is not an exhaustive list of all the panel recommendations that can be found in the 3 individual reports and listed further below.

information. Using methods that will have different selectivity to the fishery would provide improved estimates for some parameters.

Specific proposed edits or amendments to the current data reports reviewed:

The WPSAR-CIE review panel suggests that the following edits or minor amendments be considered when revising the current version of the CPUE data standardisation report:

- some extra text be added to the draft NOAA Tech memo (Bohaboy & Matthews 2024b) on the methods used for combining the 2 separate GAMM model components of the delta-type regression model used for the species-specific CPUE data standardisations

Background

In March 2024, the 198th Council Meeting recommended that the WPRFMC[5] convene a WPSAR panel comprising 3 members to review the data sources to be used by NOAA Fisheries in future Guam BMUS[6] benchmark stock assessments — the panel comprised a WPRFMC SSC member as panel Chair and 2 independent reviewers from the US Center for Independent Experts (CIE).

Terms of Reference

See Appendix 1 for the full list of the WPSAR-CIE Panel Review Terms-of-Reference determined by the WPRFMC/NOAA WPSAR Coordinating Committee.

Documentation and Review presentation

The WPSAR-CIE Review Panel evaluated the following 4 NOAA Fisheries data reports:

Matthews T, Bohaboy E (2024) Catch of Bottomfish Management Unit Species of Guam, 1982–2023. Pacific Islands Fisheries Science Center, National Marine Fisheries Service pp 25

Bohaboy E, Matthews T (2024b) Standardized Catch Per Unit Effort Indices for Bottomfish Management Unit Species of Guam, 1982–2023. Pacific Islands Fisheries Science Center, National Marine Fisheries Service pp 206 https://repository.library.noaa.gov/

Matthews T, Bohaboy E (2024b) Catch Length Composition of Bottomfish Management Unit Species of Guam, 1982–2023. Pacific Islands Fisheries Science Center, National Marine Fisheries Service pp 43

Matthews T, Bohaboy E (2024c) Life History of Bottomfish Management Unit Species of Guam. Pacific Islands Fisheries Science Center, National Marine Fisheries Service pp 49
https://repository.library.noaa.gov/

The NOAA Fisheries authors of those 4 documents presented these during the in-person review.

[5] WPRFMC = Western Pacific Regional Fishery Management Council, WPSAR = Western Pacific Stock Assessment Review, SSC = Scientific and Statistical Committee

[6] BMUS = Bottomfish Management Unit Species

Participants

See Appendix 2 for the WPSAR Review Panel membership. See Appendix 3 for the list of NOAA Fisheries (Honolulu, Hawaii) presenters on the 4 data review documents. See also Appendix 4 for a list of the NOAA Fisheries (Guam) participants.

Addressing specific terms of reference (ToR 1-8)

ToR 1: Are the catch time-series from creel surveys and other sources well-documented and appropriate to use in stock assessments?

Yes, the Guam BMUS catch time-series derived from creel surveys (primarily from the boat-based creel surveys) were well documented and appropriate for use in the next benchmark stock assessment — especially, given that the assessment will also be based on other evidence sources such as length-based data and life history attribute data. So, the catch data would supplement the length-based data and life history attribute data to support an informed stock assessment.

The Review Panel noted that: ca 96% of the catch data is sourced from the boat-based creel surveys designed to estimate total catch since 1982. Importantly, all 13 BMUS species have been recorded in the boat-based surveys. The Review panel also noted, nonetheless, there was considerable annual variability in the estimated catch for some species and that remains a challenge for using these data series in an informed manner.

It was also noted that the data imputation approach used in the creel data expansion for year 2012 and the COVID-19 pandemic year of 2020 is somewhat limited but adequately explained — a machine learning based approach to multiple data imputation with chained equations with predictive mean matching might be more appropriate (see Mayer 2021).

It was also pointed out that it might be better to use the delta method to combine the catch series including variances (see Jackson 2011) rather than just summing the confidence interval limits.

Background —

Reliable data are the foundation of fisheries stock assessments. The focus for future Guam BMUS benchmark assessments is now open to single-species assessments as opposed to the prior approach based on multi-species complexes. Around 96% of the catch data is sourced from the boat-based creel surveys designed to estimate total catch since 1982. Importantly, all 13 BMUS species have been recorded in the boat-based surveys (see Appendix 5 for our summary overview).

Side comments —

There is ca 80% voluntary interview response rate for the boat-based surveys to collect trip-level information, the total weight of the catch and the species composition of the catch. Multilevel regression modelling with post-stratification (Authier et al 2021, Kennedy & Gelman 2021) could be explored to address the apparent 20% non-response rate to perhaps increase the precision of the catch estimates.

The data imputation approach used in the creel data expansion for year 2012 and the COVID-19 pandemic year 2020 is somewhat limited but adequately explained — a machine learning-based approach to multiple data imputation with chained equations with predictive mean matching might be more appropriate (see Mayer 2021).

ToR 2: Are the filtering and data quality criteria used to select the creel survey interviews that will be used to develop the CPUE indices for each BMUS well-documented and appropriate?

Yes, data filtering and quality criteria for the creel survey interviews were well documented and appropriate for use in the next benchmark stock assessment.

We queried whether there was any pattern in the filtered-out records given there is information about the fish, the vessel etc — limited filtering out and patterns not explored, which we consider was a reasonable response.

Background —

Minimal data filtering was used that resulted in 6062 records (bottomfish fisher interviews). Some evidence that more fishers going bottomfishing since the COVID-19 pandemic, with improved gear encouraging deeper fishing practices.

ToR 3: Are the covariates considered in the CPUE standardization appropriate?

Yes, the covariates used in the CPUE standardisation models were appropriate. Noting, nonetheless,

(1) some concerns from the review panel about using ordinal categorical predictors as nominal categorical predictors (for example: number of gears used category) and …

(2) functional form of some effort predictors such as “hours fished”

So, to check these effects, the Review Panel requested the assessment team to apply the following 2 additional CPUE models and report back the following day ...

i. the same model used for *Lethrinus rubrioperculatus* but using “ln(hours fished)” instead of “hours fished” and …

ii. the same model used for *Variola louti* but using “ln(hours fished)” instead of “hours fished” AND “number of gears” as an ordinal categorical variable

These changes to these 2 specific models were inconsequential but indicate what should be considered in future CPUE models.

Background —

Inclusion of covariates depended on the completeness of the interview record. Most covariates were boat/trip based other than the environmental variables such as moon phase. Most trips were shallow fishing trips – especially in the 1990s.

ToR 4: Is the CPUE standardization correctly applied and are the resulting abundance indices appropriate to use in stock assessments?

Yes, the CPUE standardization was correctly applied for the 11 of 13 BMUS species assessed and with the derived abundance indices appropriate for use in future benchmark stock assessments.

Nonetheless, the Review panel proposed a reduced list of BMUS species to focus on given the species-specific data limitations based on catch, CPUE standardization length composition and life history data (*see Appendix 5*). The panel also requested that extra text be added to the draft paper on the methods used for combining the two separate model components of the delta-type regression model used for the species-specific data standardisations.

The Panel also queried:

(1) why use a quasi-lognormal or log-linear likelihood model (Gaussian with log-transformed response variable) for catch standardisation instead of a lognormal likelihood? The reason is that the `mgcv` R package they used for modelling does not have this model likelihood, so the log-linear approach was used as a proxy of a lognormal likelihood …

(2) why were nominal categorical predictor form used when some of those predictors (hours-fished-category) are ordinal categorical — the models were re-run with ordinal predictors where appropriate and similar CPUE trends were derived

Given the above issues, we consider that the CPUE standardization was correctly applied for the 11 of 13 BMUS species assessed AND with the derived abundance indices appropriate for use in stock assessment models for the following 7 BMUS species (4 deep and 3 shallow):

Deep: *Etelis coruscans, Pristipomoides auricilla, Pristipomoides flavipinnis, Pristipomoides zonatus.*
Shallow: *Lethrinus rubrioperculatus, Lutjanus kasmira, Variola louti*

Side comment —

Pleasing to see that some posterior predictive checks are now part of the modelling workflow as previously suggested in addition to using standard residual diagnostics. Closer examination of the CPUE standardisation methods proposed here with an eye to the expected use — for instance as an input into an analytical model such as SS3 or other approaches as opposed to say being used in LB-SPR calculations.

ToR 5: Are the selected data sources of length observations appropriate for inclusion in the stock assessments?

Yes, the length composition data sourced from (1) a commercial fisheries biosampling program (2009-2023) and (2) the Guam DAWR boat-based creel surveys (1982-2023) were well documented and appropriate for inclusion in future stock assessments.

Background —

The length data sourced from the BBS program tend sto be more representative of interval-type data due to how the data collectors recorded the length data on the data sheets. Two spatial zones were used (combined nearshore areas and combined outer banks area) because there was insufficient spatial data for lengths to do otherwise.

ToR 6: Are the approaches for weighting length-composition data to account for uneven length observations over space and time well documented and appropriate?

Yes, the approaches used for weighting length-composition data to account for uneven length observations over space and time were well documented and appropriate.

Nonetheless, catch-based weighting instead of habitat area-based weighting could be appropriate for subsequent age-based stock assessment modelling using SS3 for some[7] of the 13 BMUS species — for other stock assessment approaches assuming flat selectivity such as length-based LB-SPR then habitat area-adjusted might be appropriate.

Background —

The pros and cons of 3 potential weighting schemes to account for unbalanced time-area[8] sampling coverage were considered: (1) catch- (2) CPUE- or (3) habitat area-based. Here, Guam BMUS species-specific length composition was weighted by the assumption that abundance is proportional to habitat area — weighting by CPUE would be hard due to CPUE data uncertainty.

Side comments —

Simulation-based evaluation of the comparative efficacy of the 3 weighting schemes to account for unbalanced time-area sampling should be undertaken as soon as possible (ca 12 months) to determine if habitat area-based weighting is more suitable for adjusting BMUS species length data.

ToR 7: Are the selected biological parameter values and variances well-documented and appropriate (growth, maturity, longevity, natural mortality, stock-recruitment steepness)?

Yes, the 8 biological parameter values and variances were well-documented and appropriate for consideration in development of future Guam BMUS stock assessment models.

---

[7] *Etelis coruscans, Pristipomoides auricilla, Pristipomoides zonatus, Lethrinus rubrioperculatus*

[8] Area is now the 2-zone structure outlined in the response to ToR 5 (combined nearshore, combined outer banks)

Background —

Comprehensive primary life history values were assembled for 12 of the 13 BMUS. Three primary data sources were used to derive the life history attributes: local, non-local (regional) and StepwiseLH (Nadon & Ault 2016: specific for data-poor reef fish species). There are 8 growth, length-weight, maturity and longevity parameters. Parameter-specific variance estimates were sourced directly from the original documents or publications when available. Moreover, BMUS species-specific values derived using StepwiseLH provides a parameter-specific distribution of plausible values and so supports estimating variance for each parameter. The main use of these data would be for deriving potentially informative priors for future benchmark stock assessments such as a surplus production model or for application in length-based SPR assessments.

Side comment —

Two other parameters were not derived directly — natural mortality (M) and stock-recruitment steepness (h). Natural mortality is readily derived from other life history parameters including via StepwiseLH. Stock-recruitment steepness will be estimated within the various stock assessment modelling approaches to be used with particular attention to developing informative priors for estimating this challenging parameter.

ToR 8: As needed, suggest recommendations for future improvements and research priorities to improve collection of catch and length data, and life history information for stock assessments of Guam BMUS. 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).

The WPSAR review panel also made the following recommendations for consideration (a shorter list is presented in the Executive Summary):

Short term (12 months) —

- Conduct a simulation-based evaluation of the comparative efficacy of the 3 weighting schemes to account for unbalanced time-area sampling should be undertaken in the near-future (ca 12 months) to determine whether habitat area-based weighting is indeed suitable for adjusting recorded BMUS species length data

- Bootstrap catch estimates to bracket their uncertainty range for use in stock assessments

Medium-term (12-18 months) —

- Use a single model likelihood for the data standardization component (such as hurdle-lognormal or Tweedie) rather than the 2-stage so-called delta modelling approach

- Explore latent structure and common trends in the catch and CPUE time series using Dynamic Factor Analytic approaches (Ward et al 2022) to better support the identification

of common underlying species-specific trends in the current Guam BMUS multi-species complex to perhaps better account for the time-varying species composition in the catch

- Consider alternate selectivity models and their potential impact on the data. Most fish are caught using hook and line, which may well have dome-shaped selectivity. Where size observations are used from this source, size-based estimates may be biased

- For the purposes of data collection and to improve stakeholder engagement, develop a voluntary self-reporting "reference fleet" of fishers to provide more detailed fisheries data. The objective would be to secure a more complete longitudinal data set to supplement the creel surveys

- For currently active vessels, record information on the equipment that may enhance fishing power to include in standardisation. Information might be available from a vessel register or might perhaps need to be gathered through interviews. Fishers would be able to provide information on any equipment that might potentially increase catchability for different species

- Consider a bounty program for the capture and biological sampling of large fish across all species from both the nearshore and outer banks. This will help determine the biological characteristics of fish not normally found in fishery-dependent sampling

Longer term (24 months) —

- Explore model-based approaches for survey-based catch surveys such as multilevel modelling with post-stratification (Kennedy & Gelman 2021, Authier et al 2021, Broniecki et al 2022)

- Consider using fishery independent surveys for deepwater bottomfish, similar to the diver surveys used on shallow reefs. This could include, but not be limited to, remote camera and video for visual bottom surveys which may provide length and species abundance information. Using methods that will have different selectivity to the fishery would provide improved estimates for some parameters

- Explore dispersal using tagging or similar approaches to determine if there is adult movement between inshore and outer banks to help resolve any spatial population structure

- Continuation and increase in the fishery-independent data gathering efforts. Such things could include harvester/scientist cooperative research to develop a fishery-independent index for multiple species

The WPSAR-CIE review panel commends this review report[9] of the Guam BMUS data review to the SSC and Council for further consideration of these specific findings.

[9] The 3 individual reports are also attached to this summary report.

Public Comment

Manny Dueñas (President, Guam Fisherman's Cooperative Association) provided several comments regarding the stock assessment. In particular, he highlighted issues concerning the quality of the creel survey data since 2000 and encouraged greater emphasis on improving the bio-sampling program. He also raised issues about the creel data expansion procedures. Raised issues about age determination from otolith studies. And advised that ca 85% of the Guam bottomfish catch comes from the outer banks and not from nearshore Guam. He also provided a 6-page written comment and statement to the WPSAR-CIE review panel — a copy of that statement is presented in *Appendix 6*.

Michael Dueñas (Fishery Supervisor — DAWR) provided further comment on recent improvements to the voluntary fisher interviews. He also informed the panel about the important change from 2-stoke to 4-stroke motors for vessels used for bottomfishing and the effect on fisher decisions. He also had similar comments to James Borja below on selective fishing choice behaviours affecting CPUE estimates. He further noted that the WPSAR review provided extra opportunity beyond outside of standard workday hours to cater to fisher schedules. Miscellaneous comments included: fishing locations are chosen based on accessibility and opportunity, there is little control over selectivity, there is little bottomfishing off exposed Guam shore, mostly banks and there are no price differences by size.

James Borja (Guam bottomfish fisher) raised concerns about using single species and CPUE as not all fishers bottomfish the whole day and this could affect the CPUE estimates. Moreover, fishers are highly selective about the days that they go bottomfishing when they think that the chance of catching fish is higher. So, this selective type of fisher-behaviour he believes affects the CPUE estimates. Miscellaneous comments included: sizes of fish have been stable over time, there is targeting of species, there are no price differences by size.

Michael Gawel (Cultural & Natural Resources Manager - Retired**,** US National Park Service) raised a concern about using nonlocal data and life histories as proxies for missing Guam data (such as using Hawaii sourced fisheries data instead for Guam).

Ken Borja (Guam bottomfish fisher) expressed appreciation for the opportunity to work with scientists and felt positive about the direction of the surveys and research moving forward.

Audrey Toves (Guam fisherwoman, charter captain) wanted to attend more of the WPSAR meetings but was conducting research surveys. She wants to participate in future workshops and would like to discuss the scheduling so that it does not conflict with other projects.

Conclusion

Bottomfishing might not be the main fisher focus in waters around Guam — trolling for pelagics apparently is. But bottomfishing is important for the socio-economic wellbeing of Guam and it is an iconic fishing practice that underpins local cultural identity. Getting responsible bottomfishing management in place is crucial, hence reliable informative data sources are needed to support evidence-informed management — which was the main concern of the Guam BMUS data review.

The Review Panel found that comprehensive and informative documentation was provided for all 4 data sources (catch, CPUE, length and life history parameters). All documentation was well supported by online material and a Shiny app provided to evaluate various parameter-specific functions such as the StepwiseLH Shiny app.

Based on review of all 4 sources of data presented, the Review Panel has concluded that the materials provided to address the 7 ToRs were … "**well documented and appropriate for use in future benchmark stock assessments for the Guam BMUS fishery".**

The 3 WPSAR-CIE Review Panel Individual Reports shown in Appendix 7.

References

Authier M, Rouby E, Macleod K (2021) Estimating cetacean bycatch from non-representative samples (I): a simulation study with regularized multilevel regression and post-stratification. Frontiers in Marine Science 8: 719956

Bohaboy E, Matthews T (2024) Stock Assessment Update of the Bottomfish Management Unit Species of Guam, 2024. NOAA Technical Memorandum NMFS-PIFSC-###, pp 53

Broniecki P, Leemann L, Wüest R (2022) Improved multilevel regression with poststratification through machine learning (autoMrP). The Journal of Politics 84: 597–601

Kennedy L, Gelman A (2021) Know your population and know your model: Using model-based regression and poststratification to generalize findings beyond the observed sample. Psychological Methods 26: 547–558

Nadon M, Ault J (2016) A stepwise stochastic simulation approach to estimate life history parameters for data-poor fisheries. Canadian Journal of Fisheries and Aquatic Sciences 73: 1874-1884

Ward E, Anderson S, Hunsicker M, Litzow M (2022) Smoothed dynamic factor analysis for identifying trends in multivariate time series. Methods in Ecology and Evolution 13: 908–918

Acknowledgements

The WPSAR Review Panel gratefully acknowledges the review support provided by Marlowe Sabater (NOAA Fisheries — PIFSC), Keith Kamikawa (NOAA Fisheries — PIFSC) and Mark Fitchett (WPRFMC). We thank Dean Szumylo (Lynker Technologies LLC) for maintaining the record of review proceedings.

Appendices

Appendix 1:

Terms of Reference for the External Independent Peer Review by the Center for Independent Experts under the Western Pacific Stock Assessment Review framework:

Review of the data available for future Guam Bottomfish Management Unit Species (BMUS) benchmark stock assessments

For questions 1-7, reviewers shall provide a "yes" or "no" response with explanations to provide clarification. Only if necessary, caveats may be provided to these yes or no responses, but when provided, they must be as specific as possible to provide direction and clarification.

1) Are the catch time-series from creel surveys and other sources well-documented and appropriate to use in stock assessments?

2) Are the filtering and data quality criteria used to select the creel survey interviews that will be used to develop the CPUE indices for each BMUS well-documented and appropriate?

3) Are the covariates considered in the CPUE standardization appropriate?

4) Is the CPUE standardization correctly applied and are the resulting abundance indices appropriate to use in stock assessments?

5) Are the selected data sources of length observations appropriate for inclusion in the stock assessments?

6) Are the approaches for weighting length-composition data to account for uneven length observations over space and time well documented and appropriate?

7) Are the selected biological parameter values and variances well-documented and appropriate (e.g. growth, maturity, longevity, natural mortality, stock-recruitment steepness)?

8) As needed, suggest recommendations for future improvements and research priorities to improve collection of catch and length data, and life history information for stock assessments of Guam BMUS. 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).

9) Draft a report (individual reports from each panel member and a Summary Report from the Chair) addressing the above TOR questions.

Appendix 2: WPSAR-CIE Review Panel

Milani Chaloupka (Chair of Review Panel)
Ecological Modelling Services Pty Ltd
Marine Spatial Ecology Lab, University of Queensland, Australia
SSC: Western Pacific Fishery Management Council

Matthew Cieri
Center for Independent Experts reviewer (USA)

Paul Medley
Center for Independent Experts reviewer (UK)

Appendix 3: NOAA Fisheries Presenters

Erin Bohaboy
Research Fish Biologist
NOAA Fisheries, Pacific Islands Fisheries Science Center
Honolulu, USA

Toby Matthews
NOAA Fisheries, Pacific Islands Fisheries Science Center
Honolulu, USA

Marc Nadon
Research Fish Biologist
Pacific Islands Fisheries Science Center
Fisheries Research and Monitoring Division
Honolulu, USA

Eva Schemmel
Supervisory Fish Biologist
Pacific Islands Fisheries Science Center
Fisheries Research and Monitoring Division
Honolulu, USA

Felipe Carvalho
Supervisory Research Mathematical Statistician
Stock Assessment Program Leader
NOAA Fisheries, Pacific Islands Fisheries Science Center
Honolulu, USA

Appendix 4: NOAA Fisheries (Guam) participants

Felix Reyes
WPRFMC Guam Island Coordinator, Guam, USA

Eric Cruz,
NOAA/NMFS Guam Field Office, Guam, USA

Appendix 5: BMUS species data overview

(E. carbunculus, P. sieboldii were not included in the 11—species CPUE standardization report) …

species	habitat	sufficient data for stock assessment	comment
Aphareus rutilans	deep	maybe	
Etelis carbunculus	deep	no	uninformative trend
Etelis coruscans	deep	yes	
Pristipomoides auricilla	deep	yes	
Pristipomoides filamentosus	deep	no	uninformative trend
Pristipomoides flavipinnis	deep	yes	
Pristipomoides sieboldii	deep	no	uninformative trend
Pristipomoides zonatus	deep	yes	
Caranx ignobilis	mid	no	uninformative trend
Caranx lugubris	mid	maybe	
Lethrinus rubrioperculatus	shallow	yes	
Lutjanus kasmira	shallow	yes	
Variola louti	shallow	yes	

Appendix 6: Manny Dueñas Statement to the WPSAR-CIE Review Panel

Manny Dueñas (President, Guam Fisherman's Cooperative Association) provided the following written statement to the WPSAR-CIE Review Panel …

Appendix 7; WPSAR-CIE Review Panel Individual Reports

Placeholder for the 3 individual reports (Panel Chair individual report attached, CIE reviewer reports to follow).…

Guam Fishermen's Cooperative Association

P.O. Box 24023; Barrigada, Guam 96921
E-mail: gfcaguam@gmail.com; Tel: 671-472-6323
Since 1977

WPSAR Panel and the Pacific Islands Fishery Science Center:
July 12, 2024

Thank you for due diligence in reviewing research methodologies conducted by the Pacific Islands Fishery Science Center.

There are several concerns regarding the data assessment. Particularly the inference that most is deemed fully analyzed. The following points of consideration should have been obvious indicators to ensure some form of confidence. The points are:

1. The CREEL surveys have always been poorly and subjectively collected.
    a. Through the last forty years fishers have been subject to interviews (paperwork).
    b. Based on a snapshot of the forty-year-old survey the fishers with over thirty years of fishing experience averaged a once a decade interview.
    c. As a result, the so-called catch recording based on forty-year collections gives rise to the efficacy of the data collected.
    d. The community is now impacted by a Gross Analysis of the Fishery. Had the data collection program had been forth coming and presented with some semblance of a time series public document demonstrating real time information then the Fishers would have been able contribute as to its efficacy.
    e. The PIFSC analysis should have been broken into increments or time periods (decade) for the analysis with a graphic illustration for each time series. Again, a more inclusive fishers public discussion should have been the first step in this process in an informal setting.
    f. The time series graphics would provide a trend in the fisheries. Having an analytical for over a ten-year period provides for visual clarity and not obscurity...color blindness.
    g. In so far as accrued fish catch data (size and weight) has not been given a plausible sampling. To be fair that there was some

measurement in the late 80s to mid-90s. However, be cognizant that no other measuring device was utilized (no scale). Catch estimates was the subjective visual norm.

2. The issue is based on length and weight comparison for size assessment qualifiers; based on a maximum age distribution seems rather a moot analysis for the following reasons:
    a. Size of large species is not in the ecology of Guam's tropical waters. Recognize that large fish especially with higher fat levels need much cooler waters to thrive. This is unlikely to be present in our warm temperate zone as compared to the cooler Hawaiian waters.
    b. Large groupers; 8 banded are caught nearly in the 150 lb. or less size and are found in the thousand-foot depths. However, this extreme size is rarely found. The norm is actually ranges between 20 to 100 pounds are more common.
    c. The large skipjack above 30 to 60 pounds are occurrences during the seasonal runs of the big eye scads (mackerel).
    d. The green sea-turtle population around Guam are primarily juveniles or young adults. Adults are found also but only during nesting returns. Appearances are otherwise a truly a rare occurrence.
    e. The comparison of fish life history from other places is extremely and objectively an exercise in futility. Even the Napoleon Wrasse who changes from female to male at approximately 70 pounds loses its higher fat levels when near 100 pounds. Optimum reproduction size for females is common between 25 to 50 pounds class.
    f. In thoroughly understanding Guam's waters temperature, latitude and spawning contribution; not a habitat for large fish. Guam is in an area where most large fish will just do a pass through to spawn and not stay.
    g. Much comparison is given from places such as Hawaii whereby larger specimens are the norm. From the pelagic to the bottom fish species. Marlins, tunas and so forth in the Marianas's averages one-third the size; perhaps is that Guam has decimated the entire grander population. The giant trevally itself are two to three times bigger in Hawaii. Hence due to the cooler waters. So, the comparative maximum size threshold comparison is ludicrous perhaps hysterical.

h. The comparative maximum size structure is an apparent qualitative assessment based on research from other jurisdictions. Obviously not based on the 15-year-old Marianas Life History Program.
i. Recognize that the impetus for the Marianas life history program is based on the difference in the SPR. Hawaii after just 10 years of research identified the SPR of the Onaga was only during the summer and at 7 pounds. Guam's SPR is year-round and as small as 2 pounds. A Lehi at one pound caught in 150 feet certainly not its habitat depth range which is 550 feet demonstrated reproduction occurring.

3. The Guam Bio-Sampling Program (Life-History) should be applied and utilized as a specie bench mark. Imagine within ten years of research on the Onaga a scientific conclusion was exclaimed.
    a. Understand that no conclusive SPR report has been generated. The discerning research on the otolith measurement needed to add caveats to include another growth rate strategy to add fish eyeballs. The carbon dating is deemed too expensive. As it seems the possibility that our fish grow twice as fast as any other region must be dismissed. All one needs is a small sample to cross verify. This is the same concept whereby the Marianas Green Sea Turtles are a Distinct Population Segment but hidden are the satellite tags that demonstrate these turtles travel to Japan, Philippines, Australia and other places which leaves us questioning the departure from the standard.
    b. Recognize that the Bio program was a market-based fishery which demonstrated a more concise desired harvestable size and frequency. The concern that such information is incomplete and not worth much is ludicrous. Understand that should a specie not be marketable it is either too small or unsafely too large.
    c. One must understand the dynamics of each specie. There are those with limited consumer base and there are those that pose a threat to Human Life.
    d. Let us examine the limited consumer base. Just for better understanding depending on where you live on Guam. If you are from the north you prefer reef fish and if you are from the south you

prefer bottom fish (red gilled snapper). If you are having a large family gathering and then large fish come to play.

e. On the issue of certain large fish not being caught is the stigma of Ciguatera and Histamine. Only certain areas around the Island are deemed safe to consume due to the issue of ciguatera. Large groupers, snappers and even barracudas are cautiously avoided. If caught in unsafe areas they are almost not kept. The banks are the exception however large size fish are still avoided.
f. The second safety concern is the Histamine issues. Most coastal fishers may not have the ability to properly handle and care for large fish. In quite a number of cases they have small coolers and little ice. Usually in such cases the fish becomes hazardous. Understand that even pelagic fish such as Mahi-mahi being not the targeted fish has a histamine incident level of as much as 60 percent in Hawaii.
g. Technically the Guam Fishermen's Cooperative Association developed a full 10-year research on these two safety concerns and has developed a safety standard as to the appearance and weight limits for all marine species of concern to ensure safety is at the forefront. In other words, larger size species are not accepted,
h. The Bio-sampling program is the best example of data collection from 2009 to 2020 since it collects data on all species consumable. Measurement, weight, otolith collection and even reproduction assessment.
i. Lastly understand that the new Bio-sampling program is not market based whereby much of the samples are somewhat small or considered not the size for consumer desires. Too often when the GFCA tries to market the undersize fish there is much negative feedback by that we are killing the babies...sadly we cannot hide from the truth.

Much more can be said. However, we would like to thank all the people and parties involved in this extremely valuable analytical exercise. We certainly appreciate the opportunity to share our concerns in this process and only hope for additional time and opportunity to contribute more.

Fostering user engagement is not just a novel concept and must include much needed dialogue in order to assure the user and beneficiaries are not unjustly impacted. Kindly understand that there are issues that must be resolved in the assessment; which are:

j. The life history of the fish species in Guam's waters must be expanded and used as a bench mark for all future assessments and a comparative analysis with other jurisdictions or research. Hence ensure proper depiction is a clear and quantified structural analysis complete with SPR, growth rate and Habitat assessments. Recognize that despite Guam having the smallest EEZ it possesses a multitude of un-impacted fishery resources. Unlike most fisheries we are purely artisanal without any recognizable commercial fishery.
k. The species grouping must best reflect the harvesting strategies for either a single or similar complex. Understand that different gears and harvest effort are key factors and motivators.
l. Further through the WPRFMC we have already place safety measures to protect our off shore resources by:
    i. Limiting vessel size through the fifty for fifty exclusion zone. Whereby vessels greater than 50 feet are not allowed to fish within 50 miles of our seamounts and island.
    ii. No anchoring of vessels over 50 feet. Knowingly the GFCA 60-foot fishing vessel would be disqualified.
    iii. The GFCA prohibits any of our harvested products to be exported. All only for local consumption.
    iv. Lastly, recall that the people of the Pacific have had a highly successful 4,000-year-old run with managing our marine resources and this prescriptive exercise only demonstrates a discourteous reflection as a callous community out to decimate and destroy our resources. As the old adage says "do not judge us before getting to know and understand us". God Bless everyone for your due diligence.

Should the Panel or the Pacific Islands Fishery Science Center have any questions or concerns please feel free to contact us at 671-727-5440. Until then, we remain

Co-operatively yours,

Manuel P. Duenas II
President

Individual Panelist Report (Chaloupka)

Western Pacific Stock Assessment Review for Data Relevant to the Guam Bottomfish Management Unit Species

8-12 July 2024
Tumon, Guam, USA

Dr Milani Chaloupka [1,2,3]

WPSAR-CIE Review Panel

1. Ecological Modelling Services Pty Ltd, Australia
2. Marine Spatial Ecology Lab, School of Environment, University of Queensland
3. WPRFMC Scientific and Statistical Committee

Terms of Reference Responses[1] for the WPSAR & CIE Review of data inputs for future benchmark stock assessments for the Guam BMUS

[1] For questions 1-7 and their subcomponents, reviewers shall provide only a "yes" or "no" answer. 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. 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. **See Appendix 1 for the full list of ToRs.**

ToR 1: Are the catch time-series from creel surveys and other sources well-documented and appropriate to use in stock assessments?

Yes, the Guam BMUS catch time-series derived from creel surveys (primarily from the boat-based creel surveys) were well documented and appropriate for use in the next benchmark stock assessment — especially, given that the assessment will also be based on other evidence sources such as length-based data and life history attribute data. So, the catch data would supplement the length-based data and life history attribute data to support an informed stock assessment.

The Review Panel noted that: ca 96% of the catch data is sourced from the boat-based creel surveys designed to estimate total catch since 1982. Importantly, all 13 BMUS species have been recorded in the boat-based surveys. The Review panel also noted, nonetheless, there was considerable annual variability in the estimated catch for some species and that remains a challenge for using these data series in an informed manner.

It was also noted that the data imputation approach used in the creel data expansion for year 2012 and the COVID-19 year of 2020 is somewhat limited but adequately explained — a machine learning based approach to multiple data imputation with chained equations with predictive mean matching might be more appropriate (see Mayer 2021).

It was also pointed out that using the delta method to combine the catch series including variances that were just summed in the current report using the confidence intervals (see Jackson 2011).

Background —

Reliable data are the foundation of fisheries stock assessments. The focus for future Guam BMUS benchmark assessments is now open to single-species assessments as opposed to the prior approach based on multi-species complexes. Around 96% of the catch data is sourced from the boat-based creel surveys designed to estimate total catch since 1982. Importantly, all 13 BMUS species have been recorded in the boat-based surveys.

Side comments —

There is ca 80% voluntary interview response rate for the boat-based surveys to collect trip-level information, total weight of the catch and species composition of the catch. Multilevel regression modelling with post-stratification (Authier et al 2021, Kennedy & Gelman 2021) could be explored to address the apparent 20% non-response rate to perhaps increase the precision of the catch estimates.

The data imputation approach used in the creel data expansion for year 2012 and the COVID-19 year of 2020 is somewhat limited but adequately explained — a machine learning based approach to multiple data imputation with chained equations with predictive mean matching might be more appropriate (see Mayer 2021).

Use the delta method to combine the catch series including variances that were just summed using the confidence intervals (see Jackson 2011).

ToR 2: Are the filtering and data quality criteria used to select the creel survey interviews that will be used to develop the CPUE indices for each BMUS well-documented and appropriate?

Yes, data filtering & quality criteria for the creel survey interviews were well documented and appropriate for use in the next benchmark stock assessment. Queried whether there was any pattern in the filtered-out records given there is information about the fish, the vessel etc — limited filtering out and patterns not explored, which was a reasonable response.

Background —

Minimal data filtering used that resulted in 6062 records (bottomfish fisher interviews). Some evidence that more fishers going bottomfishing since the COVID-19 pandemic, with improved gear encouraging deeper fishing practices.

ToR 3: Are the covariates considered in the CPUE standardization appropriate?

Yes, the covariates used in the CPUE standardisation models were appropriate.

Noting, nonetheless,

(1) some concern from the review panel about using ordinal categorical predictors as nominal categorical predictors (for example: number of gears used category) and …

(2) functional form of some effort predictors such as "hours fished"

So, to check these effects, the Review Panel requested the assessment team to apply the following 2 additional CPUE models and report back the following day ...

i. same model used for *Lethrinus rubrioperculatus* but using "ln(hours fished)" instead of "hours fished" and …

ii. same model used for *Variola louti* but using "ln(hours fished)" instead of "hours fished" AND "number of gears" as an ordinal categorical variable

These changes to these 2 specific models were inconsequential but indicate what should be considered in future CPUE models.

Background —

Inclusion of covariates depended on the completeness of the interview record. Most covariates were boat/trip based other than the environmental variables such as moon phase. Most trips were shallow fishing trips – especially in the 1990s.

ToR 4: Is the CPUE standardization correctly applied and are the resulting abundance indices appropriate to use in stock assessments?

Yes, the CPUE standardization was correctly applied for the 11 of 13 BMUS species assessed and with the derived abundance indices appropriate for use in future benchmark stock assessments

Nonetheless, the Review panel proposed a reduced list of BMUS species to focus on. The panel also requested that extra text be added to the draft paper on the methods used for combining the two separate model components of the delta-type regression model used for the species-specific data standardisations.

The Panel also queried:

(1) why using a quasi-lognormal or log-linear likelihood model (Gaussian with log transformed response variable) for catch standardisation instead of a lognormal likelihood. The reason being that the `mgcv` R package they used for modelling does not have this model likelihood, so the log-linear approach was used as a proxy of a lognormal likelihood …

(2) why were nominal categorical predictor form used when some of those predictors (hours-fished-category) are ordinal categorical — the models were re-run with ordinal predictors where appropriate and similar CPUE trends were derived

Given the above issues, I consider that the CPUE standardization was correctly applied for the 11 of 13 BMUS species assessed AND with the derived abundance indices appropriate for use in stock assessment models for the following 7 BMUS species (4 deep and 3 shallow):

Deep: *Etelis coruscans, Pristipomoides auricilla, Pristipomoides flavipinnis, Pristipomoides zonatus.*
Shallow: *Lethrinus rubrioperculatus, Lutjanus kasmira, Variola louti*

Side comment —

Pleasing to see that some posterior predictive checks now part of the modelling workflow as previously suggested in additional to the use of residual diagnostics.

ToR 5: Are the selected data sources of length observations appropriate for inclusion in the stock assessments?

Yes, the length composition data sourced from (1) a commercial fisheries biosampling program (2009-2023) and (2) the Guam DAWR boat-based creel surveys (1982-2023) were well documented and appropriate for inclusion in future stock assessments.

Background —

The length data sourced from the BBS program tend to be more representative of interval type data due to how the data collectors recorded the length data on the data sheets. Two spatial zones used (combined nearshore areas and combined outer banks area) because there was insufficient spatial data for lengths to do otherwise.

ToR 6: Are the approaches for weighting length-composition data to account for uneven length observations over space and time well documented and appropriate?

Yes, the approaches used for weighting length-composition data to account for uneven length observations over space and time were well documented and appropriate.

Nonetheless, catch-based weighting instead of habitat area-based weighting could be appropriate for subsequent age-based stock assessment modelling using SS3 for some[2] of the 13 BMUS species — for other stock assessment approaches such as length-based SPR then habitat area-adjusted is appropriate.

Background —

The pros and cons of 3 potential weighting schemes to account for unbalanced time-area[3] sampling coverage were considered: (1) catch-based, (2) CPUE-based and (3) habitat area-based. Here, Guam BMUS species-specific length composition was weighted by the assumption that abundance is proportional to habitat area — weighting by CPUE would be problematic due to high uncertainty in the CPUE data.

Side comments —

Simulation-based evaluation of the comparative efficacy of the 3 weighting schemes to account for unbalanced time-area sampling should be undertaken in the near-future (ca 12 months) to determine whether habitat area-based weighting is indeed suitable for adjusting recorded BMUS species length data.

ToR 7: Are the selected biological parameter values and variances well-documented and appropriate (growth, maturity, longevity, natural mortality, stock-recruitment steepness)?

Yes, the 8 biological parameter values and variances were well-documented and appropriate for consideration in development Guam BMUS stock assessment models.

Background —

Comprehensive primary life history values were assembled for 12 of the 13 BMUS. Three primary data sources were used to derive the life history attributes: local, non-local (regional) and StepwiseLH (Nadon & Ault 2016: specific for data-poor reef fish species). There are 8 growth, length-weight, maturity and longevity parameters. Parameter-specific variance estimates were sourced directly from the original documents or publications when available. Moreover, BMUS species-specific values derived using StepwiseLH provides a parameter-specific distribution of plausible values and so supports estimating variance for each parameter. The main use of these data would be for deriving potentially informative priors for future benchmark stock assessments such as a surplus production model or for application in length-based SPR assessments.
Side comment —

---

[2] *Etelis coruscans, Pristipomoides auricilla, Pristipomoides zonatus, Lethrinus rubrioperculatus*
[3] Area is now the 2-zone structure outlined in the response to ToR 5 (combined nearshore, combined outer banks)

Two other parameters were not derived directly — natural mortality (M) and stock-recruitment steepness (*h*). Natural mortality is readily derived from other life history parameters including via StepwiseLH. Stock-recruitment steepness will be estimated within the various stock assessment modelling approaches to be used with particular attention to constructing informative priors for estimating this challenging parameter.

ToR 8: As needed, suggest recommendations for future improvements and research priorities to improve collection of catch and length data, and life history information for stock assessments of Guam BMUS. 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).

Short term (12 months) —

- Conduct a simulation-based evaluation of the comparative efficacy of the 3 weighting schemes to account for unbalanced time-area sampling should be undertaken in the near-future (ca 12 months) to determine whether habitat area-based weighting is indeed suitable for adjusting recorded BMUS species length data

Medium term (12-18 months) —

- Use a single model likelihood for the data standardization component (such as hurdle-lognormal) rather than the 2-stage so-called delta modelling approach

- Explore latent structure and common trends in the catch and CPUE time series using Dynamic Factor Analytic approaches (Ward et al 2022) to better support the identification of common underlying species-specific trends in the current Guam BMUS multi-species complex to perhaps better account for the time-varying species composition in the catch.

Longer term (24 months) —

- Explore model-based approaches for survey-based catch surveys such as multilevel modelling with post-stratification (Kennedy & Gelman 2021, Authier et al 2021, Broniecki et al 2022).

Conclusion

Comprehensive and informative documentation was provided for all 4 data sources (catch, CPUE, length and life history parameters — ***see Appendix 2 sourced from Bohaboy & Matthews 2024***). All documentation well supported by online material and a Shiny app provided to evaluate various parameter-specific functions such as the StepwiseLH Shiny app. Based on review of all 4 sources of data presented I have concluded that the 7 ToRs were adequately addressed as … **"well documented and appropriate for use in future benchmark stock assessments for the Guam BMUS fishery".**

References

Authier M, Rouby E, Macleod K (2021) Estimating cetacean bycatch from non-representative samples (I): a simulation study with regularized multilevel regression and post-stratification. Frontiers in Marine Science 8: 719956

Bohaboy E, Matthews T (2024) Stock Assessment Update of the Bottomfish Management Unit Species of Guam, 2024. NOAA Technical Memorandum NMFS-PIFSC-###, pp 53

Jackson C (2011) Multi-state models for panel data: the msm package for R. Journal of Statistical Software 38(8): 1-29

Kennedy L, Gelman A (2021) Know your population and know your model: Using model-based regression and poststratification to generalize findings beyond the observed sample. Psychological Methods 26: 547–558

Mayer M (2021) missRanger: Fast Imputation of Missing Values. R Package Version 2.1.3. https://CRAN.R-project.org/ package=missRanger

Nadon M, Ault J (2016) A stepwise stochastic simulation approach to estimate life history parameters for data-poor fisheries. Canadian Journal of Fisheries and Aquatic Sciences 73: 1874-1884

Ward E, Anderson S, Hunsicker M, Litzow M (2022) Smoothed dynamic factor analysis for identifying trends in multivariate time series. Methods in Ecology and Evolution 13: 908–918

Acknowledgements

I thank members of the WPSAR-CIE Guam BMUS Coordinating Committee: Marlowe Sabater (PIFSC), Keith Kamikawa (PIFSC) and Mark Fitchett (WPRFMC). I also thank the CIE members of the WPSAR-CIE review panel: Matthew Cieri and Paul Medley.

Appendix 1:

Terms of Reference for the External Independent Peer Review by the Center for Independent Experts under the Western Pacific Stock Assessment Review framework:

Review of the data available for future
Guam Bottomfish Management Unit Species (BMUS) benchmark stock assessments

For questions 1-7, reviewers shall provide a "yes" or "no" response with explanations to provide clarification. Only if necessary, caveats may be provided to these yes or no responses, but when provided, they must be as specific as possible to provide direction and clarification.

1) Are the catch time-series from creel surveys and other sources well-documented and appropriate to use in stock assessments?

2) Are the filtering and data quality criteria used to select the creel survey interviews that will be used to develop the CPUE indices for each BMUS well-documented and appropriate?

3) Are the covariates considered in the CPUE standardization appropriate?

4) Is the CPUE standardization correctly applied and are the resulting abundance indices appropriate to use in stock assessments?

5) Are the selected data sources of length observations appropriate for inclusion in the stock assessments?

6) Are the approaches for weighting length-composition data to account for uneven length observations over space and time well documented and appropriate?

7) Are the selected biological parameter values and variances well-documented and appropriate (e.g. growth, maturity, longevity, natural mortality, stock-recruitment steepness)?

8) As needed, suggest recommendations for future improvements and research priorities to improve collection of catch and length data, and life history information for stock assessments of Guam BMUS. 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).

9) Draft a report (individual reports from each panel member and a Summary Report from the Chair) addressing the above TOR questions.

Appendix 2:

BMUS data overview from NOAA Fisheries (see Bohaboy & Matthews 2024)

Summary of the data available for 13 BMUS in Guam.

BMUS	Criteria				
	1) Historical Landings Recorded at species level	**2) Recent Landings** CV over years | years with group-identified > 10% total	**3) Species Occurrence** % BBS interviews	**4) Size Observations** Average per year | years with > 50 samples	**5) Life History** Location | sample size | A_{max} % global
Aphareus rutilans	Yes	0.95 | 7	6.1	20 | 1	Mariana | 26 | 44
Caranx ignobilis	No	1.9 | 16	1.9	11 | 0	MHI | 180 | 100
Caranx lugubris	Yes	1.25 | 6	3.8	24 | 2	Mariana | 25 | 100
Etelis carbunculus	Yes	0.86 | 5	9.3	70 | 7	Mariana | 62 | 7
Etelis coruscans	Yes	1.39 | 10	5.6	42 | 4	Okinawa | 768 | 100
Lethrinus rubrioperculatus	No	0.83 | 13	24.4	590 | 11	Mariana | 275 | 100
Lutjanus kasmira	No	0.65 | 13	13.3	99 | 8	Mariana | 33 | 100
Pristipomoides auricilla	Yes	0.79 | 5	12.6	277 | 12	Mariana | 295 | 100
Pristipomoides filamentosus	Yes	1.06 | 5	3.4	21 | 2	Mariana | 217 | 47
Pristipomoides flavipinnis	Yes	1.06 | 5	5.8	51 | 5	Mariana | 57 | 21
Pristipomoides sieboldii	No	2.48 | 13	0.8	31 | 2	Okinawa | 371 | 100
Pristipomoides zonatus	Yes	0.76 | 3	11.9	73 | 8	Guam | 317 | 100
Variola louti	No	0.99 | 4	10.2	88 | 7	Guam | 287 | 93