WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

147th Meeting of the Scientific and Statistical Committee
March 14-16, 2023
Hybrid Meeting

FINAL REPORT

4. Pacific Islands Fisheries Science Center Director Report

T. Todd Jones provided the Pacific Islands Fisheries Science Center (PIFSC) Director's report on behalf of Acting Director Tia Brown. He highlighted several PIFSC program initiatives, including their efforts to continue improving their methods of fisheries stock assessments. The first Guam Bottomfish Management Unit Species (BMUS) Data Workshop was held in collaboration with Council and DAWR Staff from January 17-19, 2023. This workshop was part of a larger overall effort to engage with fishing communities in the region and enhance inclusion, transparency, and partnership in the stock assessment process for the US Territory of Guam. The purposes of the Guam workshop were to initiate an 18-month process of developing the 2024 benchmark assessment and allow local stakeholders to aid in the identification and review of data. These local perspectives gave PIFSC staff additional context in terms of the data collected during creel surveys, including the stratification of the fishery in terms of target species (e.g., exclusively shallow vs. exclusively deep-bottom targeting vessels) and the prevailing triggers behind these decisions. Jones also reported that the draft American Samoa BMUS Western Pacific Stock Assessment Review (WPSAR) report (Feb 2023) is being prepared for review, preliminary results of which suggest that the fishery is neither overfished nor experiencing overfishing. The full WPSAR report and final stock assessment is expected to be available for the June 2023 SSC meeting.

Jones provided updates on several protected species projects, including the Northwestern Hawaiian Islands monk seal and sea turtle assessment and recovery camps research objectives for 2023. The marine turtle research objectives are to count and tag basking females, deploy temperature loggers in nests and conduct sampling to determine the resulting sex ratio of hatchlings on Tern Island. The PIFSC cetacean research group has a new package for auto tracking and localization of cetaceans using hydrophone array data with the goal of employing the array to survey these species. PIFSC staff spent 12 days in the Solomon Islands engaging stakeholders for leatherback turtle conservation, and tagged 7 leatherbacks to study how they migrate into the high seas and interact with fisheries. Local team members were also trained in egg relocation techniques. Finally, the second NOAA Ship Rainier Integrates Charting, Hydrography and Reef Demographics (RICHARD) mission of cruise began in March and will be operating around American Samoa through September, where they will continue mapping and coral reef ecosystem monitoring.

An SSC member inquired regarding nesting recovery on East Island, and was informed that nesting females have only recovered to about 1/3 of historical values. Jones responded with the caveat that although there are some nesting activities, storm surge and other weather-related issues are still causing difficulties in terms of the longevity of these nests coming to term.

The SSC thanked Jones for his report.

5. Island Fisheries

A. Western Pacific Bottomfish Fisheries

1. American Samoa Bottomfish Management Unit Species (BMUS) Stock Assessment and WPSAR Update

Erik Franklin, WPSAR Chair, presented an update of the Western Pacific Stock Assessment Review (WPSAR) of the American Samoa bottomfish stock assessment held in February 2023. A new benchmark stock assessment was developed and reviewed for the bottomfish fishery in American Samoa with a new model and more informed results. He provided a brief review of the Terms of Reference (TOR) in the WPSAR and the preliminary results and recommendations from the review.

The WPSAR panel made a preliminary determination that the draft stock assessment met the Terms of Reference, albeit with caveats. The panel made several recommendations to improve the assessment, including adding bridging text to better understand the changes in stock status between the current and previous assessment. Recommendations to improve future assessments included ensuring the reliability of creel survey data, especially length-frequency data, and conducting more life history analyses of American Samoa Bottomfish Management Unit Species (BMUS). The panel specifically recommended prioritizing the life history of Savane (*Lutjanus kasmira*) given its influence in the previous assessment.

An SSC member asked for more detail on the CPUE standardization methodology; however, Franklin asked to reserve that question until the report is finalized in June 2023. Another member asked if there was sufficient information in size composition of BMUS to estimate time-varying trends in selectivity. Franklin noted that different selectivity functions (flat vs. dome-shaped) were considered, but time-varying selectivity appeared to have little influence on the outcome of the assessment based on sensitivity analyses.

The final report and consensus recommendations will be completed in March 2023, then presented to the SSC and Council in June 2023 for further action.

The SSC thanked Franklin for his informative presentation.

2. Guam Bottomfish Data Workshops

Marlowe Sabater, NMFS PIFSC, provided a report of the Guam Bottomfish Data Workshops held in January 2023. These workshops were part of the new PIFSC Stock Assessment Improvement Plan (SAIP) and involved meetings with two groups of fishermen and the Guam Department of Agriculture to interpret historical catch data prior to developing the next bottomfish stock assessment for Guam.

In response to an SSC question regarding effort triggers, Sabater commented that social and religious events were important triggers of effort, although fishermen indicated this effect has been decreasing over the years. He also commented that there were commonalities between the fishing groups regarding where and when to fish, although each of the two groups targeted shallow and deepwater stocks to different degrees. Sabater also reported that 18 fishers participated in the meetings and recommended that future workshops should seek greater participation from the fishing community.

The next step in the SAIP is to update the data evaluation report to include insights from workshop participants. PIFSC is planning to return to Guam later this year to solicit feedback from the fishing community on how their information was used.

The SSC thanked Sabater for his informative presentation.

B. Establishing Status Determination Criteria for Kona Crab Fisheries

Thomas Remington, Lynker, presented options for determining the Status Determination Criteria (SDC) for the Kona crab stock in the main Hawaiian Islands. The Council's Hawaii Archipelago Fishery Ecosystem Plan (FEP) is currently missing SDC, resulting in an "unknown" stock status despite the completion of a stock assessment for the species. To remedy this situation, Remington provided draft alternatives that would amend the Hawaii FEP to establish SDC for Kona crab fisheries. These alternatives were: 1) no action, 2) utilizing SDC from the most recent stock assessment (Kapur et al. 2019)[1] and Council fisheries, or 3) using SDC from other crab fisheries outside of the Pacific Islands (including international spanner crab fisheries or other domestic crab species). Previously, the Archipelagic Plan team reviewed the proposal and recommended Alt. 2.

The SSC recommends Alternative 2 to establish the same SDC for Kona Crab as other Council fisheries.

C. Gold Coral Management

Council staff presented options for managing gold coral in the Western Pacific region. The gold coral fishery is currently dormant and under a region-wide moratorium that expires in June 2023. The moratorium was issued due to uncertainty in the growth of gold corals when new research discovered that gold coral grew much more slowly than previously known. He provided options to the SSC to continue the moratorium, remove the moratorium, or implement an overall prohibition of gold coral harvest.

The SSC considered the different management options and noted that there are substantial research gaps for this stock. For example, the next NMFS survey of these beds is not scheduled until 2025. Also, while there is a moratorium for gold coral, this species can also grow on bamboo coral, which can be harvested under a permit.

The SSC recommends the Council extend the Gold Coral moratorium for another 5 years until June 30, 2028.

D. NWHI Fishing Cost Recovery Analysis

Council staff presented the options for cost recovery in the Monument Expansion Area (MEA) of the Northwestern Hawaiian Islands (NWHI). The Council took final action in December to include cost recovery in the regulations for the Native Hawaiian Subsistence Fishing Permit with an amount of $15,000 in fishing costs that may be recouped. Since then, additional research was

[1] Kapur MR, Fitchett MD, Yau AJ, Carvalho F. 2019. 2018 Benchmark Stock Assessment of Main Hawaiian Islands Kona Crab. NOAA Tech Memo. NMFS-PIFSC-77, 114 p.

done to estimate the costs involved in fishing the MEA in order to provide a more accurate number. Staff provided an overview of PIFSC research as well as fishermen interviews to provide a look at what range of cost estimates may look like, given that fishing is not currently occurring in the NWHI.

An SSC member commented that cost recovery is a matter of equity and environmental justice (EEJ) and that without some form of cost recovery it will be impractical for people to go there. The SSC also discussed the costs associated with fishing in the different zones of the MEA and noted that these estimates should also consider labor/crew costs, among other factors. While SSC members supported sale as a means of cost recovery, there was also concern about creating a fixed schedule of costs that fail to keep pace with inflation. Finally, SSC members also emphasized that permitted fishing in the MEA would provide valuable fishery information, and encouraged monitoring and reporting of all catch from the area along with economic and non-monetary cultural factors associated with fishing.

The SSC recommends data collection, reporting, and monitoring be required for subsistence fishing activities in the MEA.

E. Public Comment

There was no public comment.

6. Protected Species

A. EBFM Turtle Model Workshop Report

Zachary Siders, University of Florida, presented the report on a joint Ecosystem Based Fishery Management (EBFM) workshop convened by PIFSC, Council and University of Florida on November 21, 2022, to discuss a case study to explore the effects of spatial decision making by fishers in the Hawaii shallow-set longline fishery (SSLL) on protected species interactions and catch of target species. The case study focused on scenarios of SSLL fishers avoiding loggerhead sea turtles in the first or fourth quarter of the year either by using the TurtleWatch product (based on 17.5–18.5ºC sea surface temperature band) or areas identified by the Protected Species Ensemble Random Forests (PSERF) model based on the probability of loggerhead interactions. The model results were summarized as the amount of effort that would need to avoid one of the spatial avoidance areas, the percent change in swordfish catch, the change in the number of loggerhead sea turtle interactions, and the change in the number of leatherback sea turtle interactions from avoidance. The tool identified that no matter how the avoidance area was defined, there was a strong chance that avoiding loggerhead interactions by the SSLL fishery would result in increasing the leatherback interactions in at least of the months in quarters 1 and 4. Workshop discussions included participant feedback on the tool, factors influencing fishery participants' spatial decisions, utility of the tool for avoiding sea turtle interactions in the SSLL fishery, and potential broader utility of the spatial tool to the SSLL fishery and the Hawaii deep-set longline (DSLL) fishery.

SSC inquired whether the EBFM Turtle Model project team has considered including explicit spatial structure in the random forest assessment model, and exploring other machine learning (ML) algorithms such as extremely randomized trees, gradient boosting, extreme gradient boosting and stacked ensembles of ML algorithms rather than the random forest approach currently used. Siders indicated that some of the other ML approaches tested did not show substantial changes in the performance, but noted that the team was keen to explore both suggested developments in ML modeling approaches.

The SSC commended the work done by the team, noting that the model provides a good application to look retrospectively at fishery performance.

The SSC recommends further application of the Protected Species Ensemble Random Forests model to the Hawaii deep-set longline fishery data and continued exploration of alternative Machine Learning modeling approaches.

The SSC thanked Siders for his presentation.

B. Review of the Hawaii Deep-set and American Samoa Longline Fishery Draft Biological Opinions

1. Updated Assessment of Population-level Impacts of Leatherback Turtle Interactions in the Hawaii Deep-set Longline Fishery

T. Todd Jones, PIFSC, and Siders, University of Florida, presented an updated assessment of population-level impacts of leatherback turtle interactions in the Hawaii deep-set longline fishery. The assessment is based on the model developed for the Hawaii shallow-set longline fishery, which the SSC at its 134th Meeting endorsed as best scientific information available

(BSIA) for evaluating population-level effects of the fishery, and later applied to the Hawaii deep-set longline fishery as presented at the 135th SSC meeting. The DSLL assessment presented at the 135th SSC meeting included interaction data through 2017. The updated analysis incorporates the latest interaction data from the DSLL fishery through 2022. No new nesting beach data were available at the time this update was conducted. Additional methodological updates to the model include updates to fishery-dependent demographic parameters, an improvement treatment of uncertainty in maturity schedule, and treatment of the mixture of juvenile and adult survival rates.

The updated analysis estimates 0.37 western Pacific leatherback nester equivalent mortalities per year in the DSLL fishery. Continued fishing results in very slight decreases in the number of years to reach critical population thresholds. For example, continued fishing could result in reaching the 50% threshold 0.53 years sooner than a no-fishing scenario (7.85 years), 2.11 years sooner to the 25% threshold (19.24 years without fishing), and 4.59 years sooner to the 12.5% threshold (30.48 years without fishing).

An SSC member noted that the parameter update was consistent with a signal being driven by a pulse or cohort of individuals and inquired whether the size or age frequency distribution supported this notion. Siders indicated the analysis fit a cohort-effect model which confirms this observation and that the multivariate model is easy to run and could be used to monitor developments over time.

The SSC inquired into the assumed population rates of change (6% decline) used in the analysis, noting that results are dependent on these assumptions and whether trends have changed in recent years. The SSC noted that the analysis extended the population trends from the previous analysis as the most recent nesting data showing a stable trend referenced in the draft BiOp were not available at the time of the update.

To improve the underlying statistical framework for deriving the anticipated take levels (ATLs) used in the model, an SSC member suggested PIFSC use the mean parameterized form of the Conway-Maxwell Poisson (CMP) likelihood[2] readily available in TMB (see glmmTMB) to derive the ATLs rather than the unstable mode parameterized form of the CMP likelihood that is currently used.

The SSC commends the work done by the modeling team, and noted the team has done the best job possible considering the data available.

The SSC determines that the updated analysis represents the best scientific information available (BSIA) for evaluating population-level effects on leatherback turtles from the Hawaii DSLL fishery.

The SSC thanked Jones and Siders for the informative presentation.

[2] Huang A, Kim A (2021) Bayesian Conway–Maxwell–Poisson regression models for overdispersed and underdispersed counts. Communications in Statistics - Theory and Methods 50: 3094-3105

2. Review of the Draft Biological Opinions

Melissa Snover, PIRO Protected Resources Division (PRD), presented the overview of the draft Biological Opinions (BiOp) for the Hawaii deep-set longline fishery (DSLL) and American Samoa longline fishery (ASLL), which the Council received on March 8 and 9, 2023, respectively. These draft BiOps included all applicable ESA-listed species that may be impacted by the respective fisheries, and concluded that the two longline fisheries are not likely to jeopardize the continued existence of listed species. Both draft BiOps include Reasonable and Prudent Measures (RPMs) that require NMFS to 1) release incidentally caught ESA-listed species from fishing gear in a manner that minimizes injury and increases post-release survivorship; and 2) ensure that the fisheries have monitoring and reporting programs sufficient to confirm the extent of take is not exceeded.

SSC members acknowledged the considerable work in the past six months to complete the BiOps and thanked PIRO for the opportunity to review and comment on the draft documents.

SSC members inquired into the intent behind the insular false killer whale (IFKW) RPM in the draft DSLL BiOp, how it would be implemented, and the implications of this measure on industry flexibility. The primary issues from SSC members related to questioning the assumption of the percent of habitat in the "overlap" area, and whether a requirement to notify NMFS in advance of fishing in the "overlap" area could result in a de facto fishery closure.

The SSC requests NMFS provide an overlay map of the area including satellite tracking data and the "overlap" area to better understand the amount of habitat usage that occurs in the overlap area.

The SSC thanked Snover for the informative presentation.

The SSC formed a working group to provide a detailed review of the draft DSLL and ASLL BiOps. The Working Group presented findings to the SSC and recommended adoption of its review. **The SSC adopts the Working Group report (Appendix A) and supports the working group's finding that the no-jeopardy conclusions are adequately supported by the information presented in the draft BiOps.**

The SSC recommends that the Council consider the findings of the SSC working group report in its response to the draft BiOps for the Hawaii deep-set longline fishery and American Samoa longline fishery.

C. A Potential New Assessment Approach for Hawaii Pelagic False Killer Whales

Erin Oleson, PIFSC, presented an overview of a potential new assessment approach for Hawaii pelagic false killer whales that accounts for their occurrence and overlap with U.S. fisheries outside the U.S. EEZ. The new approach leverages the predictive habitat model-based density estimation that has been used for management of this stock since the 2020 Stock Assessment Report, where the abundance of false killer whales within the EEZ around the Hawaiian Islands was extracted from the larger central Pacific modeled area, and the stock status is based on the potential biological removal derived from this estimate. Oleson presented two alternatives under consideration for defining the management area to be included in the new assessment: 1) using

the fishery area defined as the 95% kernel density estimation of the Hawaii deep-set longline fishery effort from 2017-2021; and 2) using a combination of fishery area and EEZ. Oleson noted that the abundance and potential biological removal (PBR) estimates will be sensitive to the area selected, and neither area alternatives account for fishing effort by foreign fleets operating on the high seas.

The SSC inquired about the truncation of model-based density surfaces used in the abundance data at 132W, and Oleson noted that not enough sighting data were available.

The SSC also asked about the magnitude of change in the abundance estimates resulting from using the different management areas for the assessment. Oleson stated that the resulting abundance estimates were not presented as the goal was to seek input on which area to use based on the appropriate approach rather than the resulting number.

The SSC inquired whether the actual geographic distribution of the pelagic stock extends beyond the proposed analysis area. Oleson stated that it would be speculative since it is difficult to determine where a population ends and new ones begin considering the possibility of overlap between pelagic populations, but noted that genetic data show similar haplotypes across a much broader area of the Pacific.

The SSC thanked Oleson for her informative presentation.

D. Review of Potential Measures for the False Killer Whale Take Reduction Plan Modifications

Elena Duke, PIRO PRD, and Council staff presented on the preparations for the False Killer Whale Take Reduction Team (TRT) meeting scheduled for March 28-31, 2023. The Council has a seat on the TRT, which is established under the authority of the Marine Mammal Protection Act (MMPA). The TRT operates on consensus to develop recommendations to NMFS on the False Killer Whale Take Reduction Plan (FKWTRP) and modifications thereof to reduce the level of mortality and serious injuries to below the potential biological removal (PBR).

Duke presented an update on the deliberations of the TRT work teams, which were formed to further explore potential measures identified at the November 2022 TRT meeting. Council staff provided an overview of the Council's previous positions going into the November 2022 TRT meeting, a recap of the SSC's prior recommendations to the Council on this issue, and additional considerations on work team discussions since the last meeting.

The SSC noted that weighted branchlines (a seabird bycatch mitigation tool) make it difficult to straighten hooks from FKW interactions and reduce trailing fishing gear from species of concern (e.g. FKWs, turtles and oceanic whitetip sharks). The SSC also noted the lack of distinction in the Serious Injury (SI) criteria for the length of trailing gear or presence of weighted swivel disincentivizes crew attempts to cut the line below the swivel.

The SSC recommends the Council take into account the following considerations in refining its position for the upcoming FKWTRT meeting:

- **The use of longline fisheries data to make inference on shortline fisheries should be cautionary.**

- **The observer program should record the use and outcomes of the fighting line device to allow evaluation of the effectiveness of the device(s) chosen for implementation.**
- **Incentives are needed to encourage crew to cut the line close to the hook, including consideration of the SI criteria.**

The SSC thanked Duke for the detailed presentation.

E. Draft Recovery Plan for Oceanic Whitetip Sharks

Chelsey Young, PIRO PRD, presented on the draft Recovery Plan for the ESA-listed oceanic whitetip shark. NMFS published the draft plan on January 24, 2023, and is accepting public comments through March 27, 2023. The draft plan contains the following three components: (1) a description of site-specific management actions necessary for the conservation and survival of the species (recovery actions); (2) objective, measurable criteria that, when met, will allow the species to be removed from the endangered and threatened species list; and (3) estimates of the time and funding required to achieve the plan's goals. The draft Recovery Plan is accompanied by two supporting documents, the Recovery Status Review and the Draft Recovery Implementation Strategy. The draft recovery plan was informed by two expert workshops convened in 2019, one of which was in Honolulu with a focus on Pacific populations of oceanic whitetip sharks.

The SSC recommends the Council consider the following in the response to the Draft Recovery Plan:

- **Monitoring the interaction rates is especially important in light of non-retention measures and should be highlighted.**
- **The basis for recommended recovery targets, especially the quantitative criteria, should be clearly described. In particular a description of how these criteria relate to ESA recovery criteria should be included.**
- **Delisting criteria 1d should not prescribe any particular model and remove reference to Bayesian State Space model.**
- **In order to assist agencies in prioritization of oceanic whitetip research, the activities highlighted as Priority 2 should be assessed with respect to expected impact (e.g. low, medium, and high) and likely timeframe to achieve this benefit.**

The SSC thanked Young for her presentation.

F. Public Comment

Eric Kingma, Hawaii Longline Association, acknowledged work of PIRO Protected Resources Division and PIFSC in the draft BiOp for the Hawaii deep-set longline fishery. Kingma agrees with the no-jeopardy conclusion, but noted there are conservative assumptions that are made throughout the BiOp. Kingma expressed concern about the RPM regarding the IFKW overlap area, noting that defining the overlap zone in regulations and requiring the vessels to declare fishing in that area would result in a de facto closed area for their fleet. Regarding the FKW assessment, Kingma expressed concern that it seems arbitrary to delineate the DSLL fishery area as a management area for the pelagic stock area. HLA hopes to promote the release of more FKWs with straightened hooks through the fighting line device, and is also working to secure funding to support crew training.

7. Pelagic and International Fisheries

A. 2022 Longline Reports

1. Hawaii Longline Fishery

Russell Ito, PIFSC, provided the 2022 annual report for the Hawaii longline fishery (deep-set (DSLL) and shallow-set (SSLL) components). The report covered fishery statistics including participation, effort, and catch. 147 vessels fished in 2022, of which 125 were exclusively targeting tuna, with the remainder fishing in the SSLL swordfish and DSLL tuna sector. A similar proportional pattern was seen in the number of sets made in 2022. Sixty four million hooks were set in the 2022 fishing year, 75% of that effort (hooks) in 2022 was set outside the Hawaii EEZ, with deep-set effort concentrated south of the EEZ compared to historical patterns. Shallow-set effort was concentrated between 30-35 degrees North, further north compared to historical patterns. Bigeye tuna (BET) remained the key species caught, but the level of catch had declined over the last 4 years, commensurate with an increase in yellowfin tuna (YFT) catch in the last 2 years, to a record catch in 2022 of 85,036 individual fish. BET CPUE has declined since 2014, while YFT CPUE increased. In 2022, 15 bluefin tuna were caught in the fishery, an increase from 7 in 2021. Swordfish catch in the SSLL fishery has increased from a relatively low level in 2018, while deep-set catches decreased over the same period. Marlin catches declined from peaks in 2018 and 2019 to historical levels. Catches of other pelagic management unit species (PMUS) have tended to decline in recent years, with the exception of mahimahi that had increased slightly after a long-term decline between 2010 and 2020. External influences on the fishery in the first quarter of 2022 included bad weather and rough seas, increases in fuel and supply costs, and high fish prices were noted.

An SSC member noted the contraction in area fished compared to previous years, and asked whether this was a reflection of increased fuel costs, and whether this might contribute to the changes seen in catch species composition. Ito noted that the historical plots showed the spatial pattern of fishing summarized over a 10 historical year period. Ito noted that the shift in fishing to the south of the EEZ might indeed relate to higher YFT levels. An SSC member noted the declining pattern in other PMUS catch, and wondered whether this was also influenced by shifts in the location of fishing, with fishing for BET and YFT being further away from seamounts. Ito noted that fishermen do recognize this declining pattern in other PMUS, although the cause is not clear.

An SSC member asked whether milkfish were still being used for bait, and whether bait type could affect catch species composition. Ito responded that catch composition is likely confounded with a number of factors, including monofilament leader material, but milkfish is indeed predominantly being used in DSLL fishery (but not in the SSLL fishery where mackerel is commonly used).

An SSC member noted the increasing trend in hooks per set over time. Ito noted this may reflect the shift toward DSLL fishing.

Ito noted reports from fishermen that the use of mono-leaders has led to a loss of larger fish from the line. This might have implications for changes in catch size frequency over time.

The SSC recommended that trends in hooks per set over time be included in future annual longline reports.

The SSC thanks Ito for the informative presentation.

2. American Samoa Longline Fishery

Keith Bigelow, PIFSC, provided the 2022 annual report for the American Samoa longline fishery. The report covered fishery statistics including participation, effort, and catch. The number of vessels and overall effort has declined since 2000. The first half of 2022 demonstrated an increase in South Pacific albacore CPUE to almost 15 fish per thousand hooks, which was a significant increase over the previous decade. Yellowfin catch and CPUE were, however, down in 2022. At present, 9 out of 11 vessels have electronic reporting capability.

Council Executive Director Simonds raised a question on progress in international management of South Pacific albacore to support the viability of the American Samoa fishery. Bigelow noted the recent stock assessments and activities within the WCPFC, including the South Pacific Albacore Roadmap Intersessional Working Group. Council Staff also noted that finding captain and crew for vessels has also become an issue, which may have also limited fishing.

The SSC thanked Bigelow for the informative presentation.

B. International Billfish Biological Sampling Research Update

Michael Kinney, PIFSC, presented on the International Billfish Biological Sampling Program (IBBS). IBBS Program was initiated through the Billfish Working Group of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean (ISC), to improve understanding of the life history of key billfish species in the North Pacific. This was in recognition of the need for coordinated billfish biological sampling across nations and fisheries in this region in order to improve stock assessments. A sampling plan was developed to statistically optimize the collection of data, and a standardized approach developed across regional project partners. A secure cloud-based regional project database (IBBS) was established in June 2022. Data analysis approaches are currently being established to examine spatial-temporal growth patterns, and age validation. Project progress within the US was summarized, with 1129 billfish sampled by all partners (U.S., Japan, and Chinese Taipei) across the North Pacific.

An SSC member asked about the basis of the pattern of growth assumed across the North Pacific within the simulation model. Kinney responded that the pattern matched those identified in the literature. However, the causal factors behind that pattern (temperature, mixed layer depth, etc.) are still unclear. An SSC member questioned how the results would feed into regional stock assessments, given that existing assessment model software generally treats growth as constant across space and time. Kinney noted that most models being put forward need to be spatial in nature.

SSC members asked whether the project will expand the number of regional partners to get better spatial sampling coverage of the region. Kinney noted that given the logistical challenges experienced within the project development, expansion was not planned in the current work.

SSC recommended, in order to enhance further outreach, that PIFSC provide the

information on the project to the WCPFC Scientific Committee.

The SSC requests an update from the PIFSC Life History Program on progress for all pelagic and insular species to the SSC.

The SSC thanked Kinney for the informative presentation and looks forward to future presentations on progress.

C. Multi-Year Territorial Bigeye Tuna Catch & Allocation Specifications (Action Item)

Council staff presented on the possibility of amending the bigeye tuna catch and allocation limit framework, and presented options for specifying multiyear allocation limits without the need for a catch limit for each of the territories. These allocations would transfer catch from the territories to Hawaii-based U.S. longline vessels.

Western and Central Pacific Ocean (WCPO) bigeye tuna comprise a stock that is internationally managed and assessed by the Western and Central Pacific Fisheries Commission (WCPFC). The 2020 assessment indicated that the bigeye tuna stock is not subject to overfishing, nor overfished. Council staff presented analyses from stock projections that demonstrate the low impact of possible allocation limits on the WCPO stock. The tropical tuna conservation and management measure (CMM) 2021-01 assigned longline bigeye limits of six countries, including the U.S, which has the lowest limit of 3,554 mt. CMM 2021-01 does not establish a limit for Small Island Developing States and Participating Territories, including American Samoa, Guam and the CNMI. CMM 2021-01 will expire at the end of 2023.

The current domestic management framework requires catch limits applicable to the U.S. Participating Territories in order to establish allocation limits on a single-year basis. The Council previously recommended removing catch limits for the U.S. Participating Territories and establishing allocation limits for 1,500 mt per territory for 2020-2023, based on their marginal impact on the bigeye stock and the fact the stock is no longer experiencing overfishing. A new WCPO bigeye tuna stock assessment is expected in August 2023.

SSC members Graham Pilling and Shelton Harley recused themselves from the discussions on this agenda item.

An SSC member noted the Council imposed catch limits on the territories raised issues of Equity and Environmental Justice.

Bigelow noted that the suggestion for multiple U.S. vessels to have concurrent agreements with a U.S. Participating Territory would be complex to implement. Bigelow also noted Guam and CNMI longline catches were zero in recent years.

The SSC noted that under all catch options presented, there appeared to be no increase in fishing mortality on or depletion risk to the bigeye population.

D. Bayesian meta-synthesis of shark bycatch mortality to support evidence-informed hazard mitigation policy

Milani Chaloupka, SSC member, presented on a recent publication "Phylogeny explains capture mortality of sharks and rays in pelagic longline fisheries: a global meta-analytic synthesis" published by Gilman et al in late 2022. Apex and mesopredators such as elasmobranchs are important for maintaining ocean health and are the focus of conservation efforts to mitigate exposure to fishing and other anthropogenic hazards. Quantifying fishing mortality components such as at-vessel mortality (AVM) is necessary for effective bycatch management. Gilman et al (2022) assembled a database for 61 elasmobranch species and conducted a global meta-synthesis to estimate pelagic longline AVM rates. Evolutionary history was a significant predictor of AVM, accounting for up to 13% of variance in Bayesian phylogenetic meta-regression models for *Lamniformes* and *Carcharhiniformes* clades. Phylogenetically related species may have a high degree of shared traits that explain AVM. Model-estimated posterior mean AVM rates ranged from 5% (95% HDI 0.1%–16%) for pelagic stingrays and 76% (95% HDI 49%–90%) for salmon sharks. Measures that reduce catch, and hence AVM levels, such as input controls, bycatch quotas and gear technology to increase selectivity are appropriate for species with higher AVM rates. In addition to reducing catchability, handling-and-release practices and interventions such as retention bans in shark sanctuaries and bans on shark finning and trade hold promise for species with lower AVM rates. Robust, and where applicable, phylogenetically-adjusted elasmobranch AVM rates are essential for evidence-informed bycatch policy.

An SSC member asked whether species-related results were notably different. Chaloupka noted that results for related species were unsurprisingly similar, and that phylogenetic patterns definitely need to be incorporated within analyses.

Council staff noted the recent NMFS analyses on the impact of approaches to mitigate oceanic whitetip shark mortality. Chaloupka noted that this was based upon the result of a single study. Chaloupka recommended incorporating as much information as possible from multiple studies. The SSC noted that meta-analytical approaches provide a transparent, repeatable, and quantitative framework to bring together relevant information to allow inferences consistent with BSIA principles.

The SSC recommended that the Council should encourage the use of approaches such as meta-analyses, when available, to support assessment of bycatch mitigation policies.

The SSC thanked Chaloupka for the informative presentation.

E. Area-Based Management Issues

1. Limited Conservation Efficacy of Large-Scale Marine Protected Areas for Pacific Skipjack and Bigeye Tunas

John Hampton, SPC, presented a paper of the same title published with SPC colleagues[3] earlier this year. Large-scale, no-take marine protected areas (MPAs) have been established in several locations in the Pacific and expansion of such areas to reach 30% of the ocean area is actively

[3] Hampton J., Lehodey P., Senina I., Nicol S., Scutt Phillips J., and K. Tiamere. 2023. Limited conservation efficacy of large-scale marine protected areas for Pacific skipjack and bigeye tunas. Front. Mar. Sci. 9:1060943. doi: 10.3389/fmars.2022.1060943

promoted in some quarters. Justification for the establishment of large oceanic MPAs often includes the conservation benefits that they would bring for tuna stocks, which are the subject of important commercial fisheries in the Pacific. The aim of this paper was to evaluate the conservation efficacy of an existing MPA, the Phoenix Islands Protected Area (PIPA) and a series of large hypothetical MPAs each constituting approximately one third of the western and central Pacific Ocean, for two important and contrasting tuna species, skipjack and bigeye tuna. The evaluation was conducted by comparing control and counterfactual simulations in which the estimated population and fishery dynamics of the species were modeled using a high-resolution framework known as SEAPODYM (Spatial Ecosystem And POpulation DYnamics Model). Hampton et al (2023) found that stock-wide conservation benefits of the PIPA for these species, assuming that total fishing effort is maintained, to be weak to non-existent, and only modest increases in spawning biomass of both species occur within and in the near vicinity of the PIPA itself. For the larger 33% hypothetical MPAs, changes in stock-wide spawning biomass were estimated to be -0.1% to +5.8% for skipjack tuna and +4.8% to +12.0% for bigeye tuna. Conservation efficacy of MPAs for species such as tropical tunas is limited by their wide larval dispersal and high mobility of later life stages, which spatially dissipate the protective effects of MPAs. Also, the displacement of fishing effort from MPAs to areas remaining open can have negative consequences for stocks and fisheries performance in those areas. Hampton et al (2023) conclude that large oceanic MPAs are not likely to be effective frontline management tools for tropical tunas and other species having similar life history characteristics.

An SSC member inquired about the spatial resolution of the SEAPODYM model and the potential to run these models for non-target species. Hampton noted that the model was Pacific-wide at 2 degree monthly resolution from 1997-2021, which does have implications for computational load. For bycatch species, Hampton noted this was a non-trivial exercise, with a paucity of data for longline-caught bycatch species and tagging information, as well as understanding of their biological processes.

The SSC thanked Hampton for the informative presentation.

2. CCC Area-Based Management Subcommittee Manuscript

Council staff provided an overview of the recently convened UN Intergovernmental Conference on Marine Biodiversity on Areas Beyond National Jurisdiction (BBNJ) which concluded a final meeting of its fifth session earlier this month. Text for a new BBNJ agreement was passed and will go to the UN General Assembly for ratification. While it does not supersede RFMOs on authority to regulate fishing, it does provide the first framework to establish marine protected areas on the high seas, with a Scientific and Technical Body under BBNJ to work closely with RFMOs in order to make decisions on implementation..

Council staff presented updates of the Council Coordination Committee (CCC) Area-Based Management (ABM) Subcommittee. The CCC ABM subcommittee has been indexing and evaluating existing Fishery Management Council actions throughout the US in a draft manuscript. In terms of the types of restrictions on fishing activity, bottom trawling and/or dredging is prohibited in 75% of the EEZ, all bottom tending gear (including trawls, dredges, bottom longlines, and pots) in 57% of the EEZ, and 55% of the EEZ has prohibitions on pelagic fishing gear (pelagic longlines, pelagic gillnets, rod and reel, and spears). Thus, a majority of the U.S. EEZ is conserved relative to environmentally adverse fishing activities. The CCC ABM

subcommittee also developed a web atlas portal, which was shared with SSC members.

An SSC member asked about the structure of the subcommittee. Council staff clarified that this included members from all Councils, as well as NOAA. An SSC member asked the definition of 'year round management' in the Fishery Management Conservation Portal. Council staff noted this represented areas that have gear closures throughout the year, in Hawaii this would be seamount closures and longline exclusion zones. Council staff noted that multiple categorizations are not well visualized (i.e., multiple color shades might be stacked). SSC members noted the need to differentially highlight areas with both ecosystem and year round management measures in place on the charts. SSC also suggested that the proportion of the total EEZ under management be presented on the chart.

3. Updated Analyses of Papahānaumokuākea Marine National Monument Expansion Spillover

Ray Hilborn, University of Washington, presented on a technical comment submitted as a rebuttal to Medoff et al (2022) which estimated that the Papahānaumokuākea Marine National Monument (PMNM) MPA caused an increase in abundance of tuna, increasing the catch-per-hook of longline fisheries. However, there was an increase in yellowfin tuna abundance throughout its Western and Central Pacific (WCPO) stock and sub-regionally that began before the MPA was expanded. Further analyses show that catch-per-hook in areas close to the reserve increased proportionally no more than areas distant from the reserve. The 2020 stock assessment for yellowfin and bigeye tuna in the WCPO demonstrated increases in vulnerable biomass in the region around the PMNM MPA, which was likely driven by stockwide recruitment increases. The portion of catch biomass 'protected' by the PMNM expansion is less than 60 mt per year, unlikely to have any appreciable impact on a large prolific yellowfin tuna stock.

The SSC concurred with Hilborn that proportional differences in CPUE are more suitable for considering PMNM expansion impacts rather than the absolute differences used in the original paper. An SSC member noted that in a situation where the stock was exhibiting density dependence, increases in CPUE might be proportionally greater further away from the closure in areas where less favorable habitat was present. Hilborn noted that this was seen in the results.

SSC member Martell presented a visual from his further analyses[4] that indicated the finding in the paper can also be explained by movement of the fleet further to the southeast of the Hawaiian Islands.

Hilborn noted a need for mechanisms and approaches to raise the profile of the issues raised in theses presentations to the SSC within the global community.

The SSC thanked Hilborn for the informative presentation.

F. Updating the Council's Pelagic Fisheries Research Plan

Council staff provided an overview of the existing Council Pelagic Fisheries Research Plan and a checklist of previous programmatic objectives and research conducted to date. PIFSC staff have

[4] https://www.linkedin.com/pulse/does-worlds-largest-fully-protected-mpa-provide-benefits-martell/

begun assisting in accounting for priorities, however, the Council and its advisory bodies will need to develop priorities as part of the five year research plan by September 2023.

Areas of concern raised by territories have included shark bycatch mitigation and reduction of depredation, which have been identified as high priority research and development areas.

The volunteers for the Council's small working group are to revise and draft the newest iteration of the Council's Pelagic Fisheries Research Plan were identified.

The SSC recommends a working group comprised of members Itano, Harley, Camacho, Ochavillo, Severance, Kobayashi, and Hospital work with Council staff, AP members, and the Pelagic Plan Team to revise the Council's Pelagic Fisheries Research Plan and report back to the SSC at its June 2023 meeting.

The SSC thanked Council staff for the informative presentation.

G. WCPFC Tropical Tuna Scientific Requests

Council staff reviewed outcomes of the first informal Western and Central Pacific (WCPO) Tropical Tuna Longline Workshop held in November 2022, anticipated issues and outcomes of a second informal workshop to be held at the end of April 2023, and described the possibility of zone-based management options for longline fisheries within the WCPFC. A new stock assessment for WCPO bigeye tuna and yellowfin tuna is expected in August 2023. Council staff went over scientific needs for a series of informal longline management workshops and formal WCPFC tropical tuna workshops in 2023. Scientific information is needed in 2023 for the revision of a new tropical tuna conservation and management measure.

SSC member Pilling presented bigeye tuna and yellowfin tuna projection results. The 'nuclear grid' outcomes table shows the tradeoff between levels of stock depletion (bigeye tuna or yellowfin tuna) under alternative fixed future levels of fishing in the purse seine and longline fishery sectors. These results can be used to identify levels of fishing in both sectors simultaneously that might achieve fishery objectives.

Bigelow inquired on the workings of the Parties of the Nauru Agreement zone-based management scheme for longline fisheries. Pilling described the fishing effort metrics currently in place within that scheme, and noted challenges within the data that need to be considered within analyses.

An SSC member asked if linear programming optimization exercises were implemented.

The SSC recommends a working group examine the availability of vessel specific information to support linear programming or other forms of optimization to develop an analytical relationship between longline effort (fishing days) and catch.

The SSC thanked Graham Pilling for providing information.

H. Public Comment

There was no public comment.

Appendix A

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

SSC Working Group on Draft Biological Opinion Review
FINAL REPORT

Adopted by the SSC at its 147th Meeting
March 14-16, 2023

The Scientific and Statistical Committee (SSC) of the Western Pacific Regional Fishery Management Council convened a Working Group consisting of SSC Members Milani Chaloupka, Shelton Harley, Ray Hilborn, Jim Lynch, and Steve Martell to review the draft Biological Opinions (BiOps) for the Hawaii deep-set longline fishery (DSLL) and American Samoa longline fishery (ASLL).

The Working Group was asked to address the following three questions:

1. Does the draft BiOp accurately assess the effects (direct and indirect) of the DSLL and ASLL fisheries on ESA-listed species?
2. Are the scientific or commercial data or information presented in the draft BiOps accurately interpreted and provide support for the discussion, findings, and conclusions made in the document?
3. Do the scientific or commercial data and information presented in the draft BiOps provide support for the Reasonable and Prudent Measures (RPMs) and associated Terms and Conditions as well as Conservation Recommendations?

Working Group members reviewed the draft BiOps in an effort to determine if the BiOps make use of the best available scientific and commercial information, including the use of appropriate scientific methods and statistical models. Information developed by the Working Group is intended to assist the SSC in determining if the information and conclusions contained in the BiOps constitute the Best Scientific Information Available (BSIA) under National Standard 2.

Technical Review of the Draft BiOps

As an initial matter, the draft BiOps reflect years of discussion and coordination between the Council and NMFS. The BiOps have been under development for over 4 years. During that time, the SSC has commented extensively on the use of statistical models to determine the conservation status of listed turtle species. The Working Group notes that the BiOps are sufficiently consistent with SSC comments provided in the past regarding interpretation of model results, particularly as these results relate to rare events, such as incidental capture of loggerhead and leatherback sea turtle species in the DSLL and ASLL fisheries.

The Working Group notes that NMFS has produced several technical and internal review reports evaluating the population-level effects of DSLL and ASLL on loggerhead and leatherback turtles over the past 4 years that have been reviewed favorably on several occasions by the SSC (see table below). The SSC at its 134th Meeting in October 2019 endorsed the original Hawaii shallow-set longline assessment model as best scientific information available (BSIA) for evaluating population-level effects of the fishery, and reviewed all subsequent updates to the model that evaluated the population-level effects of the DSLL and ASLL fisheries. At this meeting (147th meeting, March 2023), the SSC

found that the latest model update continues to represent BSIA. These models indicate that take in these fisheries has no discernable difference between the trends for the no-take and take scenarios for the leatherback and loggerhead turtle population projections. While the Working Group acknowledges that alternative statistical models exist that could be used to assess population trends and population-level impacts to ESA-listed species, such alternative models are not likely to change the conclusions contained in the draft BiOps. The Working Group, having considered this matter, concludes the statistical models applied in the BiOps produce results we would anticipate given the limited impacts attributable to the DSLL and ASLL fisheries.

The draft BiOps incorporate these population models in their effects analysis. The Working Group concludes that the draft BiOps use the best available scientific and commercial data to assess the effects of the fisheries on ESA-listed species. The Working Group also concludes the no-jeopardy conclusions for ESA-listed species are well supported by the scientific information contained in the draft BiOps.

The Working Group further concludes that the RPMs and Terms and Conditions contained in the draft BiOps are adequately supported by the best available scientific and commercial data. We note that the Conservation Recommendations, while broad, should contribute to species conservation. The Working Group encourages NMFS initiatives to support quicker reporting of fishery interaction data to facilitate timely reporting requirements in RPM T&C 2.c.

With respect to RPM Terms and Conditions 2.b.i regarding observer coverage for the 'overlap area' for insular false killer whales (IFKW), the Working Group believes that the risk of IFKW interactions with the DSLL fishery is likely low in the overlap area (as described in further detail below). **The Working Group therefore recommends that RPM Terms and Conditions 2.b.i include a provision to reevaluate the risk of IFKW fishery interaction in the overlap area using updated satellite tagging data to determine whether mandatory observer coverage is warranted in the overlap area.**

Table 1. Summary of peer review on technical and internal review reports evaluating the population-level effects of DSLL and ASLL on loggerhead and leatherback turtles

Report	Review
Assessing the population-levels of North Pacific loggerhead and Western Pacific leatherback turtle interactions in the Hawaii-based shallow-set longline fishery (February 2020; TM-NMFS-PIFSC-95)	NOAA Internal, 3 external reviewers, components and results presented to SSC at the 134th Meeting (October 2019)
Update: Inclusion of the Hawaii-based deep-set and American Samoa-based longline fisheries (May 2020; TM-NMFS-PIFSC-101)	NOAA Internal, 2 external reviewers, results presented to SSC at the 135th Meeting (March 2020)
Update: Combined effects of U.S. longline fisheries (2020; PIFSC-IR-20-014)	Results presented to SSC at the 135th Meeting (March 2020)
Update to the DSLL assessment: Incorporating uncertainty in maturation and latest fishery takes	Results presented to the SSC at the 147th Meeting (March 2023)

Additional background on DSLL RPM Terms and Conditions 2.b.i:

The draft DSLL BiOp indicates that the area of overlap between the IFKW stock boundaries and the DSLL fishery outside the longline fishery exclusion zone (4,200 square miles) represents 5.4% of the stock range. RPM 2.b.i requires vessels to be observed when fishing in the overlap area and vessels would be required to declare trips in this area before leaving port. The Working Group understands that the level of DSLL fishing effort in the overlap area has been historically low (i.e., 19 sets between 2011 and 2021, or less than 2 sets per year), which is much less than 0.01% of the total effort in the DSLL.

The IFKW stock boundary is based on Bradford et al. (2015)[5], which was based on a minimum convex polygon around available satellite tag data through 2013 with a 20-km buffer in part to account for the uncertainty in the spatial use of two of the three known social clusters. The updated satellite tag data through August 2021 reported in Figure 29 of the draft DSLL BiOp show similar spatial extent covered by the IFKW as the data used in Bradford et al. (2015). This suggests that IFKW habitat usage is likely minimal at the outer edges of the IFKW boundary where the overlap area is located, and a reevaluation of interaction risk at the overlap area is warranted.

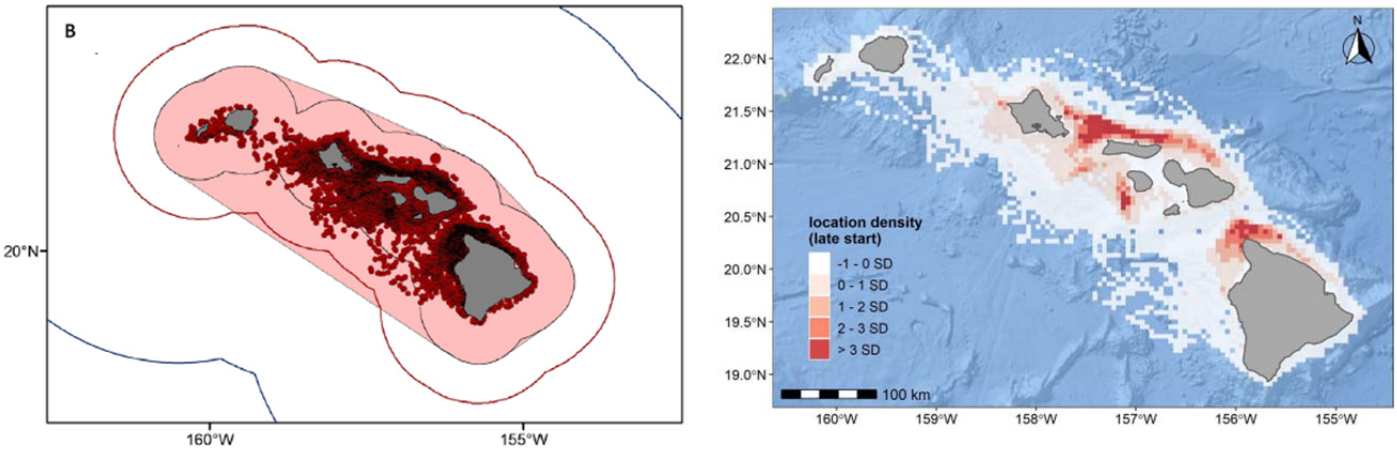

Figure 1. *Right panel:* IFKW stock boundary (pink polygon), based on a minimum convex polygon of a 72-km radius that includes a 20-km buffer. The red points show the IFKW satellite telemetry data through 2013 (*source*: Bradford et al. 2015). *Left panel:* IFKW density with satellite tag data updated through August 2021 (*source:* draft DSLL BiOp, Figure 29).

[5] Bradford, A. L., E. M. Oleson, R. W. Baird, C. H. Boggs, K. A. Forney, and N. C. Young. 2015. Revised stock boundaries for false killer whales (*Pseudorca crassidens*) in Hawaiian waters. U.S Dep. Commerc. NOAA Tech Memo., NOAA-TM-NMFS-PIFSC-47. 29p.