



157th Meeting of the Scientific and Statistical Committee

September 9-11, 2025

Council Office, Honolulu HI

FINAL REPORT

4. Pacific Islands Fisheries Science Center Director Report

A. Pacific Islands Fisheries Science Center Director Report

T. Todd Jones presented the Pacific Islands Fisheries Science Center (PIFSC) Director's report on behalf of Director Charles Littnan. He highlighted underwater coral reef health and condition surveys, the Marianas Archipelago bottomfish survey, marine turtle research updates, and Main Hawaiian Islands (MHI) insular false killer whale abundance estimates.

An SSC member asked if the genetic analysis of Kaneohe Bay green sea turtles was available and if there are other known nesting sites in the MHI. Jones responded that the samples were sent to the Southwest Fisheries Science Center and can present the results at the December meeting if it is available. He added that there are some nesting on the Big Island, Maui, Oahu and Kauai but in very low numbers compared with the much higher numbers in the Northwestern Hawaiian Islands.

Another SSC member asked if the green sea turtle sampling in the French Frigate Shoals is currently undertaken only during the day. Jones said that at East Island, sampling is done during the day because there is no place yet to camp overnight, while Tern Island has both day and night sampling.

An SSC member asked if the Marianas bottomfish survey included video camera work. Jones said that it was hook and line only, similar to the approach taken for the MHI bottomfish survey.

Another SSC member asked if there could be a report on the Badger et al 2025 paper. Jones said that the SSC could make a request to PIFSC.

The SSC requests PIFSC provide a full presentation on the MHI IFKW abundance estimate publication (including information on evidence of fishery interactions) at the December meeting. The SSC further requests an update on the genetic sampling of the green sea turtle nesting population at Marine Corp Base Hawaii Kaneohe when the information becomes available.

B. Technical Review of the Fisheries Integrated Modeling System Stock Assessment Model

Kelli Johnson, NMFS Office of Science and Technology, provided an overview of NMFS' next generation stock assessment model, the Fisheries Integrated Modeling System (FIMS). The project now includes several examples with comparisons to core outputs from existing stock assessments. NMFS is preparing to have this work reviewed and will be convening a Center for

Independent Experts (CIE) virtual panel to conduct that review. The CIE review is planned for November 4–6, 2025 in a virtual venue.

NMFS is inviting each Council to send a member of the SSC to attend the review and provide feedback. SSC members from each Council are intended as representatives of their respective regional situation, and not as full reviewers from whom individual review reports are expected. The participating SSC members will be provided an opportunity for their questions and NMFS will welcome their comments.

An SSC member had concerns about repeatability. Johnson said that FIMS sets up a default environment but users can change anything they want. John Brodziak, PIFSC, said that reproducibility is guaranteed and not platform dependent.

An SSC member asked about the types of economic models and potential predictions being considered for FIMS. Johnson said on the input side, it would be for standardizing things like CPUE indices; the output side would ensure that it has all the information that downstream models need.

Another SSC member asked for an expansion on the spatial component and how it will be done. Brodziak said that different options could be implemented and provided an example of how there are multi-area models for tropical tunas that are used for assessments.

An SSC member encouraged NMFS to take into account the Western Pacific time zone so that the SSC can participate in the review.

The SSC nominated Milani Chaloupka to represent the Western Pacific Regional Fishery Management Council at the CIE review.

5. Program Planning and Research

A. SSC Special Projects Working Group (WG) Reports

1. Integration of biological, economic, social, and cultural considerations

The SSC integration working group (Carothers, Leon Guerrero, Hunt, Waples, Lynch) provided a presentation on the integration of biological, economic, social, and cultural considerations. Following up on the special projects discussion from the March and June 2025 meetings, the working group reviewed case studies on SSC's integration of various information and developed a draft list of considerations to guide the SSC recommendation process.

Examples from other SSCs and past Council processes illustrated opportunities to better integrate multidisciplinary information into assessments, risk analyses, harvest strategies, ecosystem plans, performance monitoring, and allocation decisions. Members agreed that integration requires structured approaches that account for uncertainty, meaningful engagement with affected communities and industries, and recognition of cultural context.

SSC members noted the strengths and limitations of “likelihood points”. While this method was seen as a way to capture variability and uncertainty, some members expressed concern about the potential for gaming the process and noted their preference for consensus-based advice, or majority recommendations accompanied by a clear description of dissenting views. Members agreed that any approach must not confuse the decision-making process and would require careful operationalization before being applied.

The working group provided some general principles on ecological, social, economic, and cultural issues to guide deliberations for the SSC to review:

- **Holistic Data & Expertise:** Ensure all recommendations are based on a holistic understanding of issues by considering not only biological, ecological, & economic data but also social and cultural aspects.
- **Integrate Diverse Knowledge Systems:** Consider Indigenous, fishers', and local knowledge alongside formal scientific studies (e.g., Charnley et al. 2017)
- **Meaningful Engagement:** Verify that direct and meaningful engagement with affected communities, cultures, fishers, and industry has occurred; and if not, flag that for recommendations without these considerations.
- **Respect & Address Disciplinary Differences:** Acknowledge and respect the differing approaches of various scientific disciplines. Workshops or collaborative sessions may help build a shared understanding and develop integrated frameworks (e.g., Caribbean SSC), as this helps bridge gaps and unify scientific basis for recommendations.
- **Leverage machine learning based approaches:** Explore using machine learning to integrate and analyze diverse data sources, including social, cultural, and economic information.

The SSC adopts the following guiding principles for developing SSC recommendations:

- **As a general rule, the SSC will strive to develop consensus-based recommendations to the Council;**
- **When the SSC does not reach consensus, the SSC will present majority recommendations in its report accompanied by a clear description of dissenting views;**
- **SSC recommendations should be based on a holistic understanding of issues,**

- **incorporating biological, ecological, economic, social, and cultural information; and SSC recommendations should explicitly flag situations in which meaningful engagement with affected communities, cultures, fishers, and industry is lacking or insufficient.**

2. Integration of climate information into decision making

The SSC climate working group (Suca, Pilling, Roberts and Cabrera) provided a presentation on integrating climate information into decision making. This working group is focused on two parts 1) informing a Scenario Planning project for Hawaii and American Samoa longline fisheries and 2) integrating climate change into informative stock assessments. For the Scenario Planning projects, the working group is distilling likely changes to fishery resources distributions under varying climate conditions into the future based on widely accepted climate scenarios based on atmospheric and oceanic temperature changes in the archipelagic areas of Hawaii and Johnston Atoll, American Samoa, and the Mariana Islands.

Four pathways of climate influence were highlighted—recruitment, growth, mortality, and index standardization—with recruitment and index standardization viewed as the most feasible for current applications. Examples included the use of sea surface temperature as a recruitment covariate in New Zealand crayfish assessments and potential applications to Pacific pelagic species such as bigeye tuna. Members emphasized the need to distinguish between changes in biomass and catchability, improve understanding of spawning locations and timing, and explore machine learning approaches for bycatch risk and CPUE standardization under climate scenarios.

For bottomfish, evidence of climate-driven recruitment effects remains limited, suggesting that climate considerations are best advanced for pelagic species at this stage. Nonetheless, vulnerability grids developed for pelagic and protected species—highlighting risks such as albatross habitat loss and feminization of turtle populations—could be expanded to bottomfish in the future. Members also noted socioeconomic considerations, including fuel costs, fleet composition, and carbon credit schemes, which may shape sector resilience, with small-scale fleets more vulnerable to local conditions.

The working group will complete for the March 2026 meeting and expand the climate risk grids, refining the briefing document, to inform scenario planning projects, and the applications of simulation-based calibration approaches to evaluate the potential predictive performance of model-based CPUE data standardizations. Collaboration with PIFSC and partner projects, such as OPAL, was encouraged to support spatially explicit modeling of catchability and recruitment.

3. BMUS multispecies complex

The SSC Bottomfish Management Unit Species (BMUS)/multi-species complex working group (Hilborn, Chaloupka, Itano, Dichmont, Camacho, Harley, Franklin, Ochavillo, Helyer and Jones) provided a report on 1) PIFSC's plan/workflow for stock assessment strategies and the working group's review of the plan; and 2) working group plans for next steps to develop different modeling approaches for PIFSC to consider in further stock assessment.

Since June 2025, the bottomfish working group has commented on the regional framework for BMUS stock assessments. PIFSC presented an updated workflow outlining a phased process for American Samoa's MUS list as an example, where Phase 1 would be expected to conclude by

year's end and subsequent phases leading into WPSAR review. The framework leaves open whether species should be assessed individually, by complexes, or as a group, and emphasizes iterative community engagement throughout the process. Members noted lessons from the Caribbean, where limited communication hindered progress, and highlighted the need for early and sustained involvement of fishing communities.

Recognizing that the U.S. system was not designed for multispecies, multi-fleet, and data-poor contexts like the Pacific, the group discussed complementary approaches to augment the PIFSC framework. One proposal would identify a reduced set of representative species to streamline assessment, using latent class or species distribution modeling, with hierarchical dynamic GAMs in a Bayesian framework to account for environmental variability, species interactions, and spatial dynamics. Another proposal focused on developing a dynamic bioeconomic-based CPUE standardization, linking fisher behavior, costs, and processing capacity to catch outcomes. Embedding these models in a Bayesian framework would provide more realistic forecasts to support BMUS assessments and ACL setting.

The SSC endorses the proposed updated framework for work to be undertaken by our Region (Appendix A).

The SSC endorses the proposed additional projects and recommends that the Council explore funding for one or both of these SSC-led projects in collaboration with PIFSC and the applicable state and/or territorial agencies.

(1) MULTISPECIES COMPLEX EVALUATION: identifying a subset of BMUS, as a case study, that could then be used for either a single assessment of that reduced-set complex or individual assessment for each species identified in that reduced-set complex. It is proposed that this would be well suited to applying hierarchical dynamic generalized additive models estimated within a fully Bayesian framework to support both hind-cast and near-cast forecasting. Such an approach can account for nonlinear environmental effects, multiple temporal lags, species interactions and spatial effects — along with a multivariate response structure and a framework for robust model evaluation. Hence leveraging the multispecies forecast would provide a robust foundation for BMUS stock assessment and setting of ACLs.

(2) DYNAMIC BIOECONOMIC-BASED STANDARDIZATION: assuming either individual BMUS species for a reduced-set BMUS and also assuming adequate data availability. The WG proposed a nonlinear structural equation-based modelling approach within a fully Bayesian framework to standardize CPUE times series coupled with equations defining the socioeconomic drivers of fisher behavior including effort investment, fish processing, vessel operating costs. Most CPUE standardization are single equation models that do not expose what is driving the effort to fish and how that affects catch. Hence leveraging the forecasts derived from this more robust CPUE standardization approach for either individual species of a reduced-set would support robust BMUS stock assessment and setting of ACLs.

4. Review and Update of the SSC Special Projects List

The SSC reviewed the special projects list and discussed plans for the December 2025 and future meetings.

For the Protected Species group, members considered the scope and objectives, particularly with respect to alternative risk assessment approaches for false killer whales and other protected species, and mechanisms for improving SSC engagement with NMFS on protected species assessments. Members emphasized the importance of clarifying the objectives of the group, including how its work fits into existing processes and where SSC engagement could provide added value.

The Electronic Monitoring (EM) group was directed to focus on human dimensions and impacts of EM. An SSC member suggested having a standing SSC agenda item to review the progress of the implementation of EM by NMFS, PSMFC, and General Counsel.

The updated special project list is included in Appendix B.

B. Overview of Machine Learning and Artificial Intelligence Tools

SSC Member Milani Chaloupka provided an overview presentation on Machine Learning (ML) and Artificial Intelligence (AI), and their applications to fishery science and management. This presentation was in response to discussions from the June 2025 SSC meeting about integrating ML/AI tools into the SSC special project considerations.

With the growth of sensors and large datasets, these approaches are becoming increasingly important. Methods such as physics-informed ML and integration with Bayesian frameworks were highlighted as tools to improve predictive power while remaining grounded in known processes.

The SSC discussed the importance of clear communication, reproducible workflows, and informed interpretation of ML outputs. Members emphasized distinguishing between data science, ML, and AI, and noted the role of techniques in improving interpretability. Case studies demonstrated applications ranging from shark and ray mortality modeling to predicting tuna catch rates and coral bleaching outcomes, underscoring the need for rigorous validation across space and time.

The SSC agreed that while ML offers valuable predictive capabilities, robust applications must address missing data, spatial structure, and algorithm selection, and ensure outputs remain interpretable and scientifically meaningful. Members noted that many EM efforts already rely on ML, and stressed the importance of strong workflows to guide this work.

The SSC thanked Chaloupka for the informative presentation.

C. SEEM Process Review Report

Adam Ayers presented the report of the Council's Social Science Planning Committee (SSPC) working group's review of the SEEM (Social, Economic, Ecological and Management Uncertainty) process and options for improving the process. The SSPC working group conducted a review in early 2025, and identified numerous benefits to the existing SEEM Process including its ability to identify issues of concern, promote dialogue, build trust, and allow the fishing community to have a voice in the ACL-setting process. The SSPC working group also identified issues that complicate the existing SEEM Process including concerns of potential overlap with the P* process (accounting for scientific uncertainty), utility and effectiveness of the current

scoring methodology, varying community representativeness across SEEM applications, and acknowledgment of the time commitment required for the community to participate. The SSPC working group developed a menu of options for SEEM process revisions intended to sustain the benefits of the SEEM while minimizing current issues. The Council at the 203rd meeting in June 2025 received an update from the SSPC on the SEEM review, and directed the SSPC to solicit feedback from the advisory groups including the SSC on the working group report.

The SSC was asked to review the working group report and provide feedback to the SSPC on the options for improving the SEEM process. The SSPC will consider the feedback from the advisory groups and is anticipated to present the final report to the Council in December 2025.

SSC members expressed that, although the SEEM process intended to engage fishing communities and improve trust, the experience is one-sided since outcomes usually result in catch reductions, creating a perception that input is punitive rather than collaborative. Concerns were raised about overlap with the P* process, which can lead to “double penalization” of ecological risks, and about the lack of balance in weighing the social and economic costs of underfishing against the risks of overfishing. Discussions focused on clarifying SEEM’s purpose, integrating it earlier in the stock assessment process, and reducing overlap with scientific adjustments. Overall, the discussion emphasized the need for structural reforms to make SEEM more transparent, balanced, and genuinely collaborative.

The SSC recommends the Council review the ACL process and consider revising the SEEM scoring method to 1) avoid double counting of the same uncertainties between P* and SEEM; and 2) allow positive and negative scores within each SEEM factor.

The SSC thanked Ayers for the informative presentation.

D. Council IRA Project Updates

1. Scenario Planning

Mark Fitchett, Council staff, provided an overview and updates on the Council’s IRA Scenario Planning Project. The goal of the Scenario Planning Project is to identify and develop adaptive fishery management strategies that support resilient and productive fisheries in the region. Two scenario planning efforts will be conducted, one of the Hawaii and American Samoa longline fisheries, and another for the small-boat fisheries across the region. Currently, the Scenario Planning project has consulted with its Steering Committees to develop materials for anticipated workshops in November 2025. Project themes that are affecting future scenarios include: 1) climate change and changes to the natural environment, including distribution of fishery resources, 2) changes in political and governance affecting fishery management, 3) markets, 4) availability and development of fishery sector labor, 5) infrastructure changes, and 6) supplies to sustaining the fisheries.

An SSC member inquired about the idea of moving beyond one-time exercises toward developing a larger-scale Management Strategy Evaluation (MSE) for the area. It was noted that while prior work on international pelagic fisheries has touched on this, expanding into a more model-based approach could make outcomes more comparable and objective.

2. Protected Species Workshops

Thomas Remington and Paul Duffy provided an update on the IRA Protected Species Project. The Council will convene two workshops to improve understanding of how climate and ecosystem drivers may impact protected species interaction rates in our region's fisheries, explore potential scenarios in which climate change impacts protected species interactions in fisheries, and identify potential strategies and frameworks for addressing those impacts. Specifically, the workshops will explore: management responses to potential changes in interaction rates, methods for evaluating associated population risks and the prediction of the magnitude of future interactions, and strategies for managing interactions into the future while balancing the mandates of MSA, ESA, MMPA, and other applicable law.

The project will primarily focus on the Hawaii and American Samoa longline fisheries, for which significant components of their management under the Council's Pelagic Fishery Ecosystem Plan (FEP) are associated with monitoring and reducing impacts to a broad range of protected species including sea turtles, seabirds, marine mammals, sharks and rays. The first workshop is tentatively scheduled for October 2025, and the second workshop is anticipated to occur in early 2026.

An SSC member noted that the workshop focus seemed vague and asked how the project fit alongside other ongoing work on climate change and protected species. Council staff explained that all eight councils received IRA funding to strengthen fisheries governance in the face of climate change. For this region, scenario planning for longline fisheries was prioritized, with protected species considered separately to ensure discussions could also focus on markets, costs, and broader industry issues.

SSC thanked Remington and Duffy for the informative presentation.

3. Regulatory Review and Community Engagement

Josh DeMello, Council staff, provided an overview of the IRA Regulatory Review Project, which aims to conduct a comprehensive analysis of existing regulations and associated management systems (including reporting and monitoring) within the state/territories and the federal fishery regulations to determine how responsive the regulatory framework is towards climate change. The review will look for areas within existing plans that limit or prevent adaptability/flexibility in times of sudden changes in climate or impacts to fisheries (e.g. shifts in stocks, change in water temperatures, introduction of new species, increases in top level predators, etc.). Additional reviews with the community will determine how the existing plans and regulations coordinate with how the fishery is actually being conducted to determine if more or less management is needed. Outcomes from this review will identify gaps in management, inefficient regulations, and potential regulatory conflicts that would inhibit climate resiliency in the FEPs and its regulations. The plan for review is to complete a draft review by the end of 2025 and to take the draft findings to the community in 2026 in order to receive comments on potential changes that could be incorporated to the FEPs.

SSC inquired about the review of non-federal fishery regulations. Emphasis was made on the need to review not only federal FEP regulations, but also state and regulations, particularly related to coral reefs.

Mark Mitsuyasu, Council staff, provided an overview and update of the IRA Community Engagement Project, which aims to leverage the Council's consultation processes to listen, learn and understand the impacts and issues communities face as they adapt to evolving ecosystems and changing climate. This project builds on the Council's consultation efforts to empower communities and provide them the knowledge, tools and resources to participate in their fisheries and engage in the federal management process. The first round of community engagement meetings were held between February and June 2025, and the second round of meetings were initiated in August 2025.

SSC highlighted community engagement as essential, with outreach efforts producing a rich set of qualitative data and insights from multiple island groups. Meetings in places like Kona and Hilo revealed local priorities, including concerns about shortline fishing, shark interactions, infrastructure losses, and shifts in ahi availability. SSC appreciated that feedback was being documented and used to guide discussions, though some noted the challenge of delays between community observations, scientific analysis, and management responses.

E. Status of Shark Depredation Research

Kim Holland and Carl Meyer, Hawai'i Institute of Marine Biology (HIMB), presented on the background of the HIMB Shark Lab and experiments to investigate possible shark deterrent strategies. These efforts have been enhanced with a recent grant specific to investigating shark deterrents. Currently, HIMB scientists are leading several efforts to address shark depredation in fisheries and human safety. Stimuli that impede shark behavior are species-specific, thus effective mitigation measures are dependent on what species of sharks are involved in depredation events. HIMB scientists are developing mitigation strategies in a multi-year project that requires intensive lab and field studies with three components: improving human safety, reducing shark depredation and reducing shark bycatch (e.g. on longline gear).

Their research efforts will emphasize the biology and physiology of sharks and how they respond to a variety of deterrent strategies. The basic approach is to test existing commercially available devices and then transition to prototypes designed in house or by colleagues. The intention is to focus the research in a scientifically rigorous manner to investigate the physiological basis of deterrent devices. The research involves both at-sea and in controlled laboratory experiments. Emphasis will be placed on electromagnetic stimuli (electricity, magnetism, light) with publication of results in the peer reviewed literature.

The SSC notes that the current work done through the HIMB Shark Lab is focused on deterrents, and does not appear to directly address the depredation in fisheries.

The SSC thanked Holland and Meyer for the informative presentation.

F. Review and Update of Research Priorities

Council staff provided an overview of research priorities for the western Pacific region. Reducing shark depredation and the development of cost-effective, practical and effective deterrents is a clear national priority as evidenced by the passage of the SHARKED Act and is a clear priority in the Territories. Expanded approaches to stock assessment of false killer whales

and assessing the impact of spatial closures and large scale marine protected areas on regional fisheries and communities were also considered high priority areas of research. The importance of assisting the economic viability of US fisheries such as by re-opening the 50-200 nm waters surrounding Johnston and Jarvis Atolls was noted as consistent with Executive Order 14276 for Promoting U.S. Seafood Competitiveness.

An SSC member noted the importance of developing effective shark deterrent strategies and suggested the testing of modified fishing gear as a possible solution. An SSC member noted the most significant constraint to small boat fisheries is fuel cost and other members noted that basic infrastructure needs in the territories (fishing gears, ice machines, docks, cold chain) inhibited fishery development. Council staff noted that the ex-vessel price of albacore at the cannery was a major factor in the profitability of the American Samoa longline fleet. It was suggested that additional economic studies would be useful.

SSC members noted the importance of developing programs to train youth to become commercial fishermen and become familiar with coastal navigation. It was noted that the Council is supporting a pilot vocational training program with participation from six fishermen in the region. The program will also conduct training in marketing and small business administration.

SSC members noted the importance of operating in productive areas and times as close to port as possible and to explore opportunities to market their catch more directly to the public including the adoption of freezing technologies. Forming and joining cooperatives was suggested as a well-established solution used in the dairy industry for turning raw product into time-stable products. SSC members also supported fishery development projects as possible solutions to changing fishery conditions and scenario planning.

An SSC member noted the Social Science Planning Committee has formed a separate working group (Hospital, Ayers, Severance, Cabrera) to look at Research Priorities related to Human Communities. Non-substantive changes were made to language to meet the administration's executive orders and priorities. The changes are being circulated to the full SSPPC.

The SSC recommends that the Council identify, among the 2025-2029 MSRA Research Priorities Plan, as the highest priorities for 2026 for NMFS and other entities:

- (1) Mitigation of depredation to reduce incidental interactions in U.S. Pacific Island fisheries (PF5). The SSC notes this priority should also include fishery operational characteristics that could reduce depredation. NMFS could improve information on depredation events for incorporation in stock assessments;**
- (2) Improved pelagic false killer whale assessments on the high seas with a focus of delineating full stock range based on robust biological data (PS2.2.1). Inclusion of other available data, including tagging and acoustic data can fulfill this priority to better discern information beyond the EEZ and among the range of the species where it overlaps with U.S. fisheries; and**
- (3) Understanding the effects of spatial closures and large-scale marine protected areas on fisheries, island communities, and population dynamics on target and non-target species (PF2); which complements the priority to *Assess the human dimensions of US Pacific Marine managed areas (such as area closures or marine protected areas) regarding procedural and distributive justice, transferred economic, social and ecological effects, and safety. (HC 3.1.2)***

The SSC recommends that the Council work to amend the Five Year 2025-2029 MSRA Research Priorities Plan in 2026, to consider and focus on:

- (1) Research to facilitate fishery development and capacity-building for Pacific Island fisheries;**
- (2) Evaluation of the efficacy of MMPA Import Provisions on conservation and economic impacts to U.S. fisheries;**
- (3) Research to improve efficiency of Western Pacific fisheries noting current challenging economic conditions; and**
- (4) Research needs emerging from Council IRA Projects.**

The SSC recognizes the following other research priorities by program area among the Five Year 2025-2029 MSRA Research Priorities Plan as notable priorities, while not the highest priorities for 2026:

Pelagic Fisheries

- (1) Improving knowledge on stock structure, distributions, and life history of pelagic management unit species and their responses to environmental factors (PF3)

Island Fisheries

- (1) Perform resource assessments including growth and recruitment, estimates of unreported catch, etc. to determine life history, population dynamics and connectivity information on MUS (IF2.1.2)

Protected Species

- (1) Development of tagging and other innovative approaches for improving species-specific post-release mortality estimate for false killer whales that interact with the Hawaii longline fishery (PS2.2.6)
- (2) Develop and test mitigation methods to reduce post-release mortality of oceanic whitetip shark and false killer whale interactions in small-boat fisheries (PS4.1.1); noting the urgency with oceanic whitetip sharks especially.

Human Communities

- (1) Characterizing non-commercial vessels, participants, motivations, catch and effort (HC 1.1.2.); and
- (2) Improving estimations of the relative proportionality of commercial and noncommercial catch and effort (HC1.1.3)
- (3) Understand product flow, price determination, demand structure, consumer preferences and non-market channels of fish distributions relationships with formal markets (HC 1.1.4), including origin of products,

G. Public Comment

There was no public comment.

6. Pelagic and International Fisheries

A. Deep-Sea Mining

1. State of Knowledge on Deep-Sea Mining Impacts

Jeff Drazen, University of Hawaii Manoa, provided an overview on the status of deep-sea mining in the Pacific, particularly in the Clarion-Clipperton mining zone (CCZ) southeast of Hawaii. Following the issuance of Executive Order (EO) 14285, *Unleashing America's Offshore Critical Mineral Resources*, the US government tasked NOAA to review and revise its permitting process to expedite deep sea mining. Mining will occur on the seafloor and its activities may release plumes of sediments and metals into the deep midwater so baselines and risk assessment, though data limited, will be shared for both habitats.

Seabed mining is currently a “potential industry,” with no commercial mining activities yet undertaken. While seabed mining can refer to a variety of mining activities (at hydrothermal vents, seamount crusts, abyssal plain, etc.), the focus in this discussion is on collection of seabed nodules composed of cobalt, copper and nickel from the abyssal plain. Seabed mining has been characterized by collection vessels that pass nodules to an attending ship via a riser column, and then returning water and sediment to the ocean via pipe to the midlayer of the oceanic water column. There are various challenges associated with this mining approach, including:

- a. Noise: Operations of the riser column and the collector vehicle will propagate noise through the water column.
- b. Sediment suspension: Sediment plumes are generated at the collector and dewatering reinjection point. Much of this sediment comprises very small particles that are nutritionally poor and that may stay in suspension for a long time.
- c. Metal toxicity: Metals within sediment that is stirred up can dissolve in seawater and enter the seafood chain. Evidence suggests that mercury is an increasing problem at the bottom end of the oceanic water column. Because life at each band of the seawater column is connected, metals at one level will eventually affect other levels. Between 1% and 12% of caught fish comes from currently-licensed mining zones. Further, if the mining ships act as a fish aggregating device, they may draw fish into the waters affected by metal toxicity, thus exacerbating the problem.
- d. Seafloor life damage: The recovery vehicle affects the seafloor in ways that can take at least 50 yrs to recover. More importantly, life that exists on the seafloor is destroyed by the process of being vacuumed up the riser pipe and put through nodule processing. While seafloor life is not dense, it is highly diverse, with more than 6,000 currently undescribed species.

The SSC discussion that followed Drazen's presentation expressed a desire to see research funded as part of the up-front licensing process on such topics as long-term accumulation of minerals and/or metals (and related toxicity, potentially) over time as mining continues. A need was expressed for research on seawater at mid-depths to establish baselines against which future post-mining observations can be compared. Additional discussion addressed the difficulty of tracking suspended sediment because it can stay in suspension for a long time and move around quite a bit before eventually settling out.

Discussion further expressed concern at the sheer magnitude of proposed seabed mining activities (plumes that are half the volume of Lake Superior for just the Clarion-Clipperton zone alone), and the appropriateness of extrapolating from <36hr tests to the consequences of 24/7

mining operations over many years.

In response to a call for further study of toxicity effects on deep-water marine life, Drazen noted that it is difficult to study deepwater sealife, given that deepwater sealife cannot be kept alive very long in a laboratory because they do not survive long outside of a cold, high-pressure environment.

In response to a query regarding the international legitimacy of the International Seabed Authority (ISA), Drazen noted that the ISA feels like a “fully international” consultative process that is funded by the UN and license applicants.

In discussion it was suggested that it could be valuable to examine and analyze the Bureau of Ocean Energy Management’s (BOEM) 76,000 public comments. Discussion concluded with a broad encouragement for the fishing industry and fisheries management to be represented at future ISA meetings.

The SSC thanked Drazen for the informative presentation.

2. Impossible Metals Eureka

Oliver Gunasekara, Impossible Metals, provided an overview on their proposed deep-sea mining operation in American Samoa. On May 20, 2025, the Bureau of Ocean Energy Management (BOEM) announced the initiation of the process to evaluate a potential mineral lease sale in American Samoa following an unsolicited request for a lease sale in the waters offshore American Samoa by Impossible Metals. Impossible Metals has developed an autonomous underwater robot for selective harvesting using advanced robotics, artificial intelligence and a buoyancy engine to hover over the seabed to have the lowest environmental impacts on the sea floor.

Gunasekara noted that by the year 2040 demand will almost double for critical metals required by alternative energy. He noted that currently 75% of global nickel demand is met by land-based Indonesian mining, with substantial negative environmental impacts. While the abyssal plain biome is diverse, it is not equivalent in scale or diversity to that of an Indonesian rainforest.

The robotic approach to seabed nodule mining that is proposed by Impossible Metals has the following advantages relative to the mining approach of using dredging tractors with riser systems that was described by Drazen.

- a. No tractor tracks, so only disturbance to seabed sediment occurs due to picking up nodules
- b. No midwater column plume because there is no dewatering process and therefore no reinjection of waste water and sediment.
- c. 60% of nodules are left undisturbed (% taken can be specified in robotic software)
- d. Lower noise impact because there is no riser column.
- e. Carbon neutrality (via purchased offsets)

Gunasekara further noted that licensees are required to collect and make available 5yrs of data. He further noted that animal life 4 km below sea level does not typically comprise human seafood stocks.

The total cost of mining via undersea robots (accounting for byproduct metal credits) is an order of magnitude lower than for land-based mining, and undersea robot mining is half the cost of alternative deep sea dredging alternative methods. If robot mining gets established as a low-cost and less polluting method, it will be difficult to get approval for tractor dredging methods.

An SSC member asked if there is a possibility of applying bonds through a bonding company to acquire seabed access in the deep-sea mining industry. Gunasekera said that there are insurance policies that cover impacts to the seafloor, but the requirement to post a bond could prohibit this industry from developing. Gunasekera said that substantial investments were being made to support research on reducing impacts from seabed mining.

An SSC member asked about the size of the nodules and the autonomous multi-armed robots used to collect them while hovering just above the seabed. The Eureka III is the size of a 20 ft shipping container, with aspirations to move to hundreds of robots, starting from 5 to 10. Collectable nodules are typically 3-12 cm in diameter.

An SSC member asked for a comparison of extraction costs using the new technology compared to tractors and if the ISA would favor that approach. Gunasekera said the operational cost for undersea tractor mining is \$2,569/ton relative to \$1,284/ton when taking into account the value of byproduct metals. In the draft exploitation regulations, there is consideration for the best technology with the lowest impacts, but there has not been a full mining agreement to do that.

An SSC member asked about the associated uncertainties with cost and if there are limitations to expansion. Gunasekera said there is +/- 25% uncertainty with the previous Eureka II, which is smaller. Collection capabilities are 40% of an area due to the seabed landscape, but since they are using a hovering device, it has less limitations than other approaches. The use of collection devices is scalable and can utilize multiple ships.

An SSC member inquired if the mining is focused on abyssal plain or could be applied to a seamount. Gunasekera said that abyssal plains are the focus and potentially other technologies would be needed for seamounts. He further noted that dredging tractors can only operate on surfaces with less than a 4-degree slope, whereas the Eureka robot could operate on diverse topography. Drazen added that crust mining had been tested in 2022-2023 and it is being evaluated, but it is much harder to pick up nodules and there is some limited interest.

An SSC member asked if using undersea robot mining obviates the need for land-based mining or would it continue, with environmental effects continuing in the deep sea and on land. Gunasekera said it could stop land mining, but noted the example that less expensive mining operations in Indonesia led to mining closures in Australia. Land based operations will close over time. It could take decades for undersea mining (and recycling) to replace terrestrial mining.

The SSC thanked Gunasekera for the informative presentation.

B. Design- and Model-based Approaches for Shark Bycatch Estimation

Rob Ahrens, PIFSC, presented on PIFSC's current approach to bycatch estimation and the underlying assumptions for the Horvitz-Thomson estimators & generalized ratio estimators (McCracken 2019) as well as some diagnostics of the logbook and observer spatial-temporal distributions to explore if and when assumptions underlying the current approach may be violated. Focus will be given to the ESA-listed oceanic whitetip shark (OWT) for which the Hawaii deep-set longline fishery had significantly higher interactions in 2024. PIFSC has been exploring the suitability and utility of model-based approaches (Long et al. 2024). The SSC previously reviewed a preliminary analysis evaluating the use of machine learning algorithms for estimating protected species interactions at the 145th SSC meeting in September 2022.

Ahrens described some standard approaches for estimating total bycatch using observer data, noting that the generalized ratio estimator (GRE) is a design-based approach and that the resulting estimates can be sensitive to biases in observer coverage. The degree of overlap between observer-reported and logbook effort data was assessed on a quarterly basis using multiple approaches. Of these, only 'Ripley's L' flagged a significant difference and this was interpreted as observer coverage not reaching the latitudinal extremes of the logbook data. The overall percentage of logbook events observed was relatively consistent over time. However, there was a spatial mismatch comparing observer and logbook effort in Q3 of 2024, with lower coverage in much of the south where OWT catch rates are relatively high, necessitating the use of model-based approaches to predicting catch.

Two approaches were used for imputing catch, which gave similar estimates of OWT catch over time to the GRE approach, with a major increase in estimated catch in 2024. In 2024, there were more trips with relatively high catch rate of OWT and fewer trips with zero catch. In addition, the median latitude of fishing effort has shifted southward considerably since 2018 and was furthest south in 2024. Therefore, the increase in catch was interpreted as the center of fishing effort moving southward into OWT habitat. Furthermore, the estimated increase in OWT catch appears to be real and representative.

An initial model-based exploration was shown for OWT using an ensemble random forest model, which indicated that the fishery and SST effects were most influential of those offered. Model predictions were not shown at this early stage.

There was endorsement from the SSC regarding a preference for model-based approaches for estimating bycatch, given probable biases in observer coverage and given the current pace of change in fisheries monitoring that is likely to continue. There was discussion of extended model-based approaches for estimating bycatch, including more spatially resolved temporal structure. Ahrens noted that their model outputs have tended to be insensitive to the approach used. The selection of modelling approach matters more for species with very low encounter rates.

An SSC member queried the best place to allocate resources for refining bycatch estimates. Ahrens and Jones indicated that the integration of AI into the EM program with respect to monitoring bycatch is a high priority (that NOAA is committed to). An SSC member noted that interactions with certain large species such as leatherback turtles that are not easily brought on to deck, are less reliably monitored using EM given the current EM setup.

An SSC member noted that vessel and observer-reported catch rates have converged following the implementation of EM in Australia (because vessels do not know if they will be audited). There was clarification that vessel-based reporting of protected species interactions is also required in Hawaii. However, there is no focus yet on using logbook catch rate data to estimate total interactions, due to discards not being well-reported by logbook data. It is hoped that EM will improve logbook reporting of discards.

An SSC member queried how protected species capture estimates from design- and model-based approaches will be reported in future SAFE reports and recommended a period of overlap to facilitate comparison. Ahrens indicated that design-based approaches would continue to be used on one portion of the fleet and model-based approaches on another portion, to facilitate this comparison.

The SSC thanked Ahrens for the informative presentation.

C. Multi-species Impact Considerations for the Southern Exclusion Zone Closures

Jacey Van Wert, University of Florida and PIFSC Affiliate, presented on a recently published paper entitled “Hawaii’s pelagic longline fishery demonstrates the need to consider multispecies impacts in blue water time-area closures.” The paper assessed how the Southern Exclusion Zone (SEZ) closure impacted fishing effort as well as bycatch of false killer whales (FKW), elasmobranchs and sea turtles. The results indicate that the SEZ closure concentrated effort outside of the eastern and southern edge of the SEZ. There was no clear evidence for negative or positive impact on FKW bycatch, but the fishing effort changes indicate concentrated risk for the pelagic stock. Interaction risk with other protected species increased as a result of the SEZ closure, especially for species such as oceanic whitetip sharks and olive ridley turtles that have higher densities to the south of the SEZ.

Council staff clarified that although the Main Hawaiian Islands insular population of FKW is ESA listed as endangered, the SEZ is designed to reduce harm to the pelagic population under the MMPA.

SSC members noted that very limited information about spatial distribution considerably limited conclusions about quantitative effects on many species. For at least some of these species (oceanic whitetip sharks being a good example), spatial distribution varies seasonally.

The SSC endorsed the approach of assessing the potential unintended effects of effort displacement (arising from spatial management) on protected species captures, noting that this should ideally commence during the design of such measures. It was also suggested that the presented analysis could be extended through to assessing the effects of SEZ closures on estimated captures (in addition to changes in overlap), to determine whether the design of the SEZ has contributed to an overall increase/decrease in captures of the respective species.

This study, now peer-reviewed and published, addressed a previous recommendation (145th SSC meeting) for PIFSC to evaluate consequences of closures in the SEZ. **The SSC concludes that this study provides empirical evidence that SEZ closures can have potential unintended effects of effort displacement on protected species interactions. The SSC recommends that**

the analysis be expanded to determine whether SEZ closures have contributed to a change in total interactions for the respective species. The SSC further recommends future spatial measures include a prospective evaluation of potential unintended impacts on protected species at the time that such measures are designed.

The SSC thanked Van Wert for the informative presentation.

D. WCPFC Science Committee

1. Science Committee Report

Felipe Carvalho, PIFSC, presented on the outcomes of the 21st WCPFC Scientific Committee (SC21), held August 13-21, 2025, in Tonga. At SC21, a new stock assessment for skipjack tuna was presented, which indicates that the stock is not overfished nor experiencing overfishing. Further, the stock's management procedure (harvest control rule and target reference point) were evaluated and found to be performing well. Candidate South Pacific albacore management procedures were evaluated for managers to consider at the September workshop and by the WCPFC for adoption at its annual meeting in December. SC21 also endorse operating models and MSE frameworks for bigeye and yellowfin tuna for consideration by the WCPFC in 2026.

In 2024 the value of the WCPFC skipjack catch rose by 8% representing 57% of the total tuna catch value resulting from a record skipjack harvest. In contrast, the value of the other major species declined. YFT catch showed a slight decrease from 2023 levels but have been relatively stable over the past decade. BET catches indicate high inter-annual variability while South Pacific albacore catch increased in 2024 and has been increasing since 2021. Overall, 2024 was a new record year for tuna catches in the WCPFC driven by the high skipjack catch. Longline fishery catch was highest in the last 5 years with SKJ catch unusually high in 2024 for longline fishery. The trend in BET catch has continued to decline in the WCPFC region.

Overall, skipjack and swordfish stocks are healthy. Striped marlin are overfished but not experiencing overfishing under the Council's Pelagic FEP. Oceanic whitetip sharks are depleted but some recovery is apparent. Recent close-kin mark-recapture analyses suggest that the south Pacific albacore stock comprises 3 distinct genetic substocks.

The SSC thanked Carvalho for the informative presentation.

2. Oceanic Whitetip Shark Stock Assessment

Phil Neubauer, Dragonfly Data Science, presented the latest stock assessment for the oceanic whitetip shark (OWT) in the Western and Central Pacific Ocean. The stock biomass has increased from 4% to 6% unfished biomass since 2019, with expected increases in future biomass due to non-retention measures in place since 2014 and prohibitions of wire leaders in longline fisheries in 2022. Fishing mortality was found to have dramatically declined to levels associated with MSY. OWTs are assumed to mature at 6 years and reductions in fishing mortality are assumed to affect sub-adults, with spawning biomass responding 6 years later.

Two single-area stock assessment approaches were used: (1) a surplus production model and (2) a SS3 model using mainly longline fishery observer data (including length composition data) but not logbook data that have spatial reporting biases. No length data were used for the surplus

production model. Missing hooks-between-floats data were imputed to support a more complete data set as this predictor is known to affect OWT catch rates.

Previous assessment suggested that the stock was overfished and experiencing overfishing while projections indicated some stock recovery. There is very limited information on stock structure, so the single stock structure assumption was used for the current assessment. Estimates of (medium to high live) discards as model-supported were used in the current stock assessment. Higher observed coverage has improved OWT capture estimates but conflict between CPUE and length frequency still exists. Current stock assessment shows recovery and more optimistic stock status and apparent rebuilding due to effective management measures as OWT are increasingly cut-free from the gear and released, although there is still high post-release handling mortality. There is some ongoing concern that CPUE might no longer be proportional to abundance since the retention ban ceased in 2013 — and the current modelling approach assumes this proportionality constraint.

The SSC suggests evaluating hyperstability given emphasis on CPUE. An SSC member suggested continued efforts to require longline fishermen to haul sharks close to the vessel to facilitate species level ID useful for stock assessment and to cut the leader close to the hook to minimize trailing gear thus improving post-release condition. The SSC member noted that the stock assessment assumes a single WCPO stock, which would not inform sub-regional management.

The SSC recommends that the Council work with the US delegation to include spatial stratification as a condition of the next OWT stock assessment.

The SSC thanked Neubauer for the informative presentation.

E. IATTC Science Committee Report

Council staff presented on the outcomes of the IATTC Science Committee and meetings of the U.S. Science Advisory Subcommittee. Total catches of IATTC tunas in 2024 reached an all-time high, with a 40% increase in 2024 from the previous decadal average. However, catches of bigeye tuna (BET) have declined. Improved stock assessments for BET and yellowfin tuna, plus a new assessment for skipjack tuna were provided by the IATTC. These improved and new assessments found these tropical tuna stocks to not be overfished nor experiencing overfishing. Additionally, individual vessel thresholds (IVT) were shown to have decreased catches of BET in the eastern Pacific purse seine fisheries. It is speculative if those catch decreases in juvenile BET over the last few years have materialized into improved recruitment, but the IATTC noted increases in CPUE for Japanese and Korean longline fisheries that target BET since implementation of the IVT.

The U.S. has a current longline limit of 750 mt for the large vessel fleet (>84ft LOA) which was not changed at this year's IATTC meeting. The SAS had recommended that combined observer and complementary electronic monitoring (EM) coverage be increased to 20%, but a proposal to increase that combined coverage to 15% was not adopted by the IATTC this year.

F. Public Comment

There was no public comment.

7. Island Fisheries

A. Setting Acceptable Biological Catch (ABC) for the CNMI Bottomfish Fishery (Action Item)

Zach Yamada, Council staff, presented options for specifying the CNMI BMUS ABC for fishing year 2026-2029. At its 156th meeting, the SSC received the 2025 stock assessment update and deemed the assessment as the best scientific information available. The stock assessment update found that the stock was neither overfished, nor was overfishing occurring. The average catch in fishing years 2021 to 2023 was 44,054 pounds, which is 67% of the ACL.

The SSC was presented with the following options:

- Option 1: No action - Do not set an ABC
- Option 2: Status quo - Set ABC at 84,000 lb based on the 2019 benchmark stock assessment
- Option 3: Set ABC based on revised P* and 2025 stock assessment update
- Option 4: Set ABC lower than revised P* and 2025 stock assessment update

SSC members discussed the P* and SEEM analyses conducted in 2020. An SSC member noted that caution must be exercised when undertaking the P* and SEEM analyses to avoid double counting (e.g., for stock assessment uncertainty). Furthermore, it was suggested that the SEEM analysis might be more useful if it was conducted earlier in the assessment process, such as during the data workshop or WPSAR phases.

SSC members noted that average catch levels have generally been much lower than the proposed ABC of 72,000 lbs (P*=40%). Thus, there is a low risk of exceeding an ABC of 72,000 lbs. if the fishery continues to catch at those historical levels.

The SSC recommends Option 3: Set ABC based on revised P* and 2025 stock assessment update.

B. Public Comment

There was no public comment.

157th SSC Report: Appendix A

Proposal:

Workflow for Selecting Stock Assessment Strategies in the Pacific Islands Region

Introduction

The Pacific Islands region faces significant challenges in conducting resource-intensive stock assessments for every species listed in the Federal Fishery Ecosystem Plans. A major challenge is the high demand placed on stock assessment scientists and the time-consuming processes of peer review and management uptake. Further, stock assessments are constrained by limited data quality and quantity, owing primarily to the multi-species and decentralized nature of the fisheries. The predominant federally managed fisheries in the US EEZ of the Pacific Islands region are the bottomfishes (bottomfish management species, BMUS), which have historically been both assessed and managed as a single aggregated multi-species group in each jurisdiction (7 species in Hawai'i, 11 species in American Samoa, and 13 species in each Guam and CNMI). However, BMUS have a diversity of life history strategies, such as long-lived/slow-growing deep snappers and other shorter-lived/faster-growing species (e.g., *Caranx* sp.). Dissimilar life histories and habitats may make species-aggregated stock assessments and management less reliable. For example, group-level catch limits based on aggregate assessments may lead to depletion of some species while unnecessarily limiting catch of other species.

A first option is to run individual stock assessment models on some of the key species with sufficient data. However, the overall number of bottomfish species (6-13 per jurisdiction) and issues of data quantity/quality will leave many species unassessed. For these, another option is to split the current larger species group into smaller, more homogeneous groups. These groups could then be assessed either as aggregates or using indicator species within the groups. A few disadvantages of the data-aggregated approach include 1) continued reliance on surplus-production models and the weaker CPUE data, 2) the lack of proper integration of the more reliable life history/length composition data, and 3) continued use of species-aggregated data that can be dominated by 1 or 2 species (e.g., opakapaka in the Hawaii Deep 7 group). In the second approach, an indicator species is assessed individually and used as a proxy for the sustainability of the rest of the group (i.e., if an indicator species is determined to be overfished, the other unassessed species will be assigned this status as well).

In this proposal, we outline a workflow that can guide fisheries scientists and managers in selecting the most appropriate approach for performing stock assessments and providing reliable catch advice. We suggest a transparent, defensible, and repeatable process for assigning each species into three potential groupings: 1) individual species (managed and assessed as such), 2) species groups assessed and managed using indicator species, and 3) aggregated species groups (managed and assessed as such).

This proposal describes the rationale, proposed framework, implementation steps, and anticipated benefits of developing this decision support workflow.

This assessment strategy does not include redefining or revising the management unit species lists (MUS). We recognize that a separate process is currently underway to review and update those lists, but that effort is independent of the current proposal. Here, the focus remains solely on selecting appropriate stock assessment approaches for species already identified as management unit species.

Rationale

The need for a formalized decision framework has become increasingly clear through recent experiences with species like the Main Hawaiian Islands Deep7 bottomfish and territorial BMUS. Stakeholders, scientists, and Council members have all called for a more objective, consistent process for determining when single-species assessments are feasible and when group-based assessment is more appropriate. This proposal provides an organized and transparent framework for both the identification of assessment approaches and a management strategy evaluation of candidate assessment approach performance to guide management.

Lessons from the Caribbean

The Caribbean Fishery Management Council adopted a structured process to reform their Fishery Management Plans (FMPs). Their approach featured:

- Rigorous data triage to assess data sufficiency for assessment, including landings, size composition, and life history information.
- Use of Vulnerability-Susceptibility analysis (VSA) and formal criteria for grouping species based on ecological, fishery, and data characteristics.
- Participatory validation through advisory panels and scientific review committees.

Proposed Framework for the Pacific Islands

The proposed workflow will follow a stepwise process, adapted from the Caribbean example but tailored to the unique characteristics of Pacific Island fisheries and data systems (Fig. 1). The workflow is intended to be iterative, with a possibility for previous steps to be revisited and updated as needed. During Phase I, PIFSC scientists compile data and prepare analyses that will be used by a working group in Phase II to complete a VSA for each species and formulate a set of candidate species groupings and assessment approaches. In Phase III, the working group will review the performance of each candidate approach, refine management procedures, and select a limited number of viable approaches for management and assessment. In the final fourth phase, the working group will run a cost-benefit analysis of the approaches identified in Phase III, select a preferred candidate, and present this proposed new approach to stakeholders for further reviews and recommendations, where appropriate. This workflow is outlined in Figure 1 and detailed in the sections below.

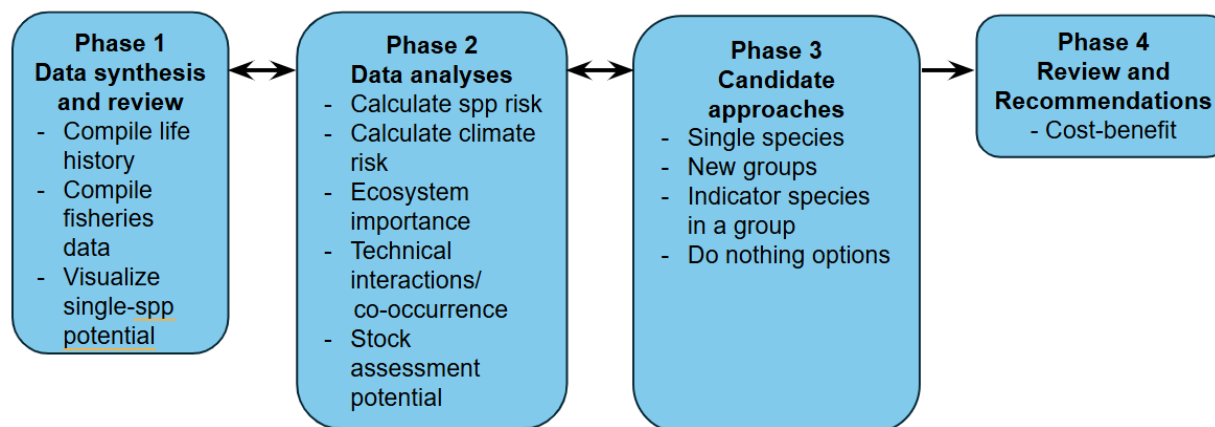


Fig. 1. Conceptual schematic of the workflow.

Phase I. Data compilation and initial analyses

During the first phase of the workflow, PIFSC scientists will compile all available data sources that provide information on the catch, catch rates, size composition, and life history parameters of all bottomfish species. These sources may include fishery-independent surveys (e.g., BFISH, published field studies), creel surveys (e.g., HMRFS, Guam DAWR boat-based creel survey), commercial catch records (e.g., vendor receipts or logbooks), or life history studies (e.g., estimates of growth, natural mortality, maturity, longevity, spatial connectivity of the stock, etc.). In addition, where feasible, socio-economic information such as market value, cultural significance, or community dependence on particular species should be documented to provide important context. Catch time-series figures and tables of life history parameters will be prepared to assist the working group in Phase II.

Assessment scientists will evaluate the sample size and level of information of the compiled data for each species following established criteria to provide a preliminary indication of whether single-species stock assessments are feasible. For example, Bohaboy and Matthews (2023) used five criteria to characterize the overall amount and quality of available data for each BMUS: (1) availability of historical catch estimates, (2) variability and uncertainty in recent catch estimates, (3) species occurrence in the most likely source of abundance indices, (4) number of individual size observations, and (5) relevance and dependability of life history studies. For each criterion, values (e.g. sample size, variance, or years with data) or qualitative characterizations (location and methodology of published life history studies) were used to categorize the level of information or usefulness in the available data as either low (red), moderate (yellow), or high (green) (for details, see Table 10-1 in Bohaboy and Matthews 2023). BMUS that had multiple criteria evaluated in the high level of information were deemed more likely to be accessible using single-species stock assessments.

When grouping species together for either assessment or management, it is necessary to understand which species co-occur within the fishery. A possible quantitative approach is to analyze catch composition data, for instance trip-level creel survey interviews, using primary component analyses and other clustering routines, as in Winker et al. (2014). These approaches have been used to differentiate intended fishing targets within multi-species fisheries. Special consideration will need to be given to the varying resolution levels of the different catch data sets when analyzing co-occurrence (e.g., creel interviews may aggregate multiple gears, depths, and areas into a single “trip”). A more qualitative approach to inferring species co-occurrence may be to consider published depth and habitat preferences, trophic levels, etc. For instance, based on feedback from fishermen in Guam (Iwane et al. 2024), the BMUS can be qualitatively separated into 3 or 4 groups based on the depths they are commonly caught at.

Phase II. Working group to complete VSA and identify candidate approaches

The second phase of the workflow is the convening of a collaborative working group that includes a range of people with knowledge of the fish and fisheries, including fisheries scientists, SSC members, fishermen, and other community members. The working group is tasked with formulating candidate assessment approaches with all species classified into groups of three possible types: 1) Single-species, 2) multiple species groups with one assessed species serving as the indicator for the other unassessed species in the group, and 3) aggregated multi-species groups that are assessed and modeled as such.

The first tool to indicate how species may best be grouped and assessed is a vulnerability-susceptibility analysis. Vulnerability-susceptibility analysis (VSA, also sometimes called productivity-susceptibility analysis, PSA) is a semi-quantitative approach used to categorize species' risk to adverse impacts, especially in data-poor contexts. There is a diversity of characteristics to include in a VSA, and there are no established thresholds to delineate different levels of risk, hence, a specific table of classification guidelines would have to be established for the Pacific Region species.

In the first segment of a VSA, a species' inherent vulnerability to disturbance is assessed based on biological/ecological characteristics (e.g., longevity, growth rate, age at maturity, reproductive strategy, spawner-recruit steepness, susceptibility to climate variations, etc.). Each characteristic is scored on a scale of 1 to 5. Then, for each species, an overall vulnerability score is calculated across all characteristics.

In the second segment of a VPA, a species' susceptibility to risk from fishing is assessed based on fishery or stock characteristics (e.g., exploitation history, stock availability to the fishery, nuanced spatial structure such as sensitive nursery areas or predictable spawning aggregations, signs the stock is depleted, e.g., constant effort and falling CPUE). Again, each characteristic is scored on a scale from low to high. Then, for each species, an overall susceptibility score is calculated across all characteristics.

Overall vulnerability and susceptibility scores are combined for each species, for example, by multiplication (Newman et al. 2018). The final VSA scores can be used to categorize species into common groups. Again, the numeric thresholds used to assign species to "moderate" vs. "low" vulnerability-susceptibility categories are objective during the analysis, but must be established a priori by agreement.

Together with the VSA results, the working group will consider the results of the co-occurrence analysis and advice from PIFSC on which species have sufficient data for an assessment to suggest a small number (e.g., 3) of candidate species groupings and assessment approaches. The working group must also consider how management will be implemented for each group. For example, for groups containing an indicator species, an annual catch target is applied to the indicator species, with the understanding that fishing effort on all species in the group occurs in proportion. If applied in-season, this means that once the catch target is harvested, then fishing for the other species within the group is prohibited. In instances where unassessed species within a group have a higher vulnerability-susceptibility score than the assessed indicator, it may be prudent to consider setting catch targets for the indicator species at a lower probability of overfishing to reduce risk to the unassessed species in the group.

Phase III. Candidate approaches

In Phase III, the working group will review the Phase I and II results to identify a limited number of the most effective and viable stock assessment strategies. Emphasis will be placed on strategies that allow for biologically meaningful assessments while minimizing the risk of overfishing unassessed species.

During this phase, the working group will:

- Evaluate groupings based on indicator species when appropriate, with justification based on fisheries characteristics, life history similarity, and co-occurrence
- Evaluate aggregated groupings based on similar justifications as above and additional considerations (e.g., dominance of certain species in the data, availability of length and life history data, etc.)
- Evaluate single-species assessments where data are sufficient and species have high ecological or cultural significance
- Identify a limited list of viable candidate approaches
- Identify key data gaps and prioritize research needed to support future transitions from indicator-based to single-species assessments

Phase IV. Review and Recommendations

In the final fourth phase, the working group will focus on conducting cost-benefit analyses, selecting a preferred candidate approach based on this, and presenting this candidate approach to stakeholders (fishers, SSC, Council, etc.) for further review and recommendations.

Project Timeline and Activities (tentative, using Guam as an example)

Phase I (August 2025 – January 2026):

- Compile life history data
- Visualize catch over time
- Evaluate single-species potential
- Analyze species co-occurrence

Phase II (February 2026 – September 2026):

- Complete VSA analysis
- Propose new species groupings classifications with fishing community and SSC
- Identify potential stock assessment strategies

Phase III (September 2026 – January 2027):

- Select proposed new species groupings classifications with fishing community and SSC
- Select proposed stock assessment strategies

Phase IV (2027)

- Present and decide on new species groupings classifications with fishing community, SSC, and Council
- Present and decide on stock assessment strategies

Conclusion

The proposed decision-making workflow will enable Pacific Islands fisheries managers and scientists to make informed, transparent, and efficient decisions about assessment strategies. By adapting proven methodologies from the Caribbean and integrating them with Pacific-specific data systems and cultural considerations, the workflow will improve resource stewardship, scientific integrity, and public confidence in management decisions.

Table 1. Example vulnerability analysis guidelines, partially adapted from Newman et al. (2018).

Score	Maximum age	Growth (von Bertalanffy K)	50% Maturity	Spawner-recruitment
1	<10 yr	> 0.25	<2 yr	Extended spawning, high fecundity, environmental var. drives S-R
2	10-20 yr	0.20-0.25	2-4 yr	Season and fecundity less, $h > 0.90$
3	20-30 yr	0.15-0.20	4-8 yr	Periodic strategist, occasional very strong year classes, $h = 0.80-0.90$
4	30-40 yr	0.10-0.15	8-12 yr	Periodic/equilibrium strategist, occasional very strong year classes, $h = 0.70-0.80$
5	40+ yr	<0.10	>12 yr	Equilibrium life history, low fecundity, $h < 0.70$

Table 2. Example susceptibility analysis guidelines.

Score	Catch history	Selectivity	Signs of depletion	Nuanced spatial structure
1	long history of steady catches	> size at maturity	No concern	Fishery is geographically limited relative to probable range
2	boom and bust	intermediate	history of low CPUE following high catch periods	Fishery and stock are widespread
3	Catch declined from early highs	All sizes, including immature	Constant effort, decreasing CPUE / fisher concern	Fishery focuses on spawning aggregations or migrations

Appendix: A Hypothetical Example

In this example, we consider a hypothetical BMUS group of 11 species.

Phase I. Compile data and do preliminary analyses

After compiling and analyzing all available fisheries and life history information for the 11 species, scientists score each of five criteria (on a 3 point scale) to characterize the overall amount and quality of available data for each BMUS. Considered together, the criteria suggest that 5 species are likely assessable with a single-species model.

Table 3. 11 hypothetical species scored across 5 criteria to indicate whether single-species stock assessments are likely based on available data.

Species	Data Information Criteria					Single-species assessment likely?
	Historical Landings	Recent Landings	Species Occurrence	Size Observations	Life history	
1	yes	most years	common	none	good	yes
2	uncertain	most years	common	none	good	yes
3	none	infrequent	rare	some	excellent	yes
4	uncertain	absent	absent	none	no	no
5	yes	most years	common	many	good	yes
6	yes	infrequent	rare	some	no	no
7	uncertain	infrequent	rare	none	no	no
8	yes	infrequent	rare	none	no	no
9	yes	most years	common	many	excellent	yes
10	none	infrequent	rare	none	no	no
11	none	infrequent	rare	none	no	no

A scatterplot showing the first 2 principal components for the species composition from creel survey interviews, overlaid with the eigen vectors for each of the 11 species shows varying levels of uniqueness among each species.

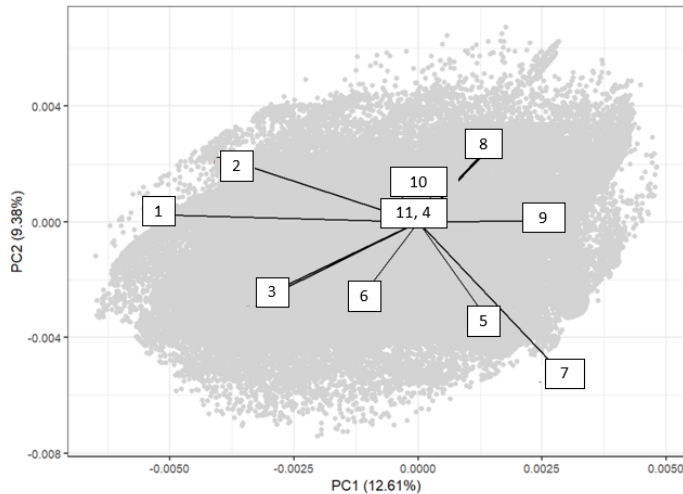


Figure 2. An illustrative example of a principal component analysis of species composition catch from creel survey interviews (gray dots, each representing a trip) with the orientation of each of 11 species plotted.

Phase II. Vulnerability-Susceptibility Analysis and Formulation of Candidate Assessment Approaches

The working group convenes and considers the compiled life history information, catch history, and their combined knowledge of the fishery to score each of the 4 vulnerability criteria on a scale of 1 to 5, and each of the 4 susceptibility criteria on a scale of 1 to 3. For example, species 3 is long-lived (37 years max age), and several local life history studies suggest the von Bertalanffy growth coefficient is as low as 0.10 and the species doesn't mature until 5 years of age. Little is known about the spawner-recruit relationship, but expert opinion suggests this is likely an equilibrium life history strategist. Considered together, species 3 is assigned a value of 4 on the overall vulnerability analysis. Regarding susceptibility, the catch history shows a sharp decline in catches over time, sexually immature fish appear in the catch, and the working group has concern that the biomass of this species may be depleted. Considered together, species 3 is assigned a value of 3 on the overall susceptibility analysis, with a final VSA score of $4 \times 3 = 12$, which can be categorized as high vulnerability and high susceptibility.

Table 5. A hypothetical example of a vulnerability-susceptibility analysis for 11 species using the criteria described in tables 1 and 2.

Sp	Vulnerability					Susceptibility					VSA score	VSA group
	Max Age	VonB K	50% Mat	S-R	Overall	Catch history	Selex	Deplet.	Spatial	Overall		
1	3	3	2	3	3	2	2	2	1	2	6	M
2	5	4	3	4	4	3	2	3	2	3	12	H
3	4	4	3	4	4	3	2	4	2	3	12	H
4	3	3	4	3	3	2	2	1	1	2	6	M
5	1	1	2	1	1	1	1	2	2	2	2	L
6	2	3	2	2	2	1	1	1	1	1	2	L
7	4	4	4	4	4	3	3	3	2	3	12	H
8	2	2	2	2	2	1	1	3	1	1	2	L
9	2	3	1	1	1	1	1	1	1	1	1	L
10	3	2	3	4	3	2	1	1	2	1	3	L
11	2	3	3	2	3	1	2	1	1	1	3	L

The working group then creates a graphical combination of the information from the Phase I analyses (single-species assessment possibilities and PCA) and the VSA.

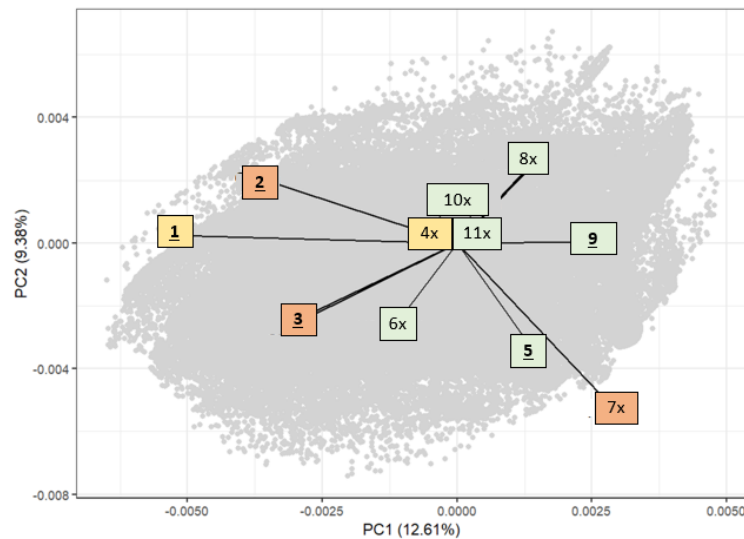


Figure 3. An illustrative example of principal component analysis of species composition with each of 11 species plotted and color coded for VSA score (red- high, yellow- medium, and green- low) and sufficiency of data to allow a single-species assessment (**bold underlined- yes**, x- no).

SSC Special Projects (2025)

Updated: September 11, 2025

Topic	Deliverable	Members	SSC Meeting	Work Products
1. SSC Process	Presentation on methods to communicate and integrate biological, economic, social, and cultural considerations into recommendations.	Members: Waples, Hunt, Carothers, Leon Guerrero, with Severance advising PIFSC and PIRO subject matter experts (SMEs) invited as needed.	March 2025 Completed	Presentation
2. Human Dimensions and Social Science	Presentation on how cultural and social information has been obtained and integrated into recommendations; proposals for next steps to improve process.	Cabrera, Carothers PIFSC and PIRO SMEs invited as needed.	March 2025 Completed	Presentation
3. Integration of biological, economic, social, and cultural considerations	Develop presentation (and possible paper) communicating technical information (synthesizing economic/social/cultural information) providing essential information to Council members for management decisions. Final deliverable will be a framework for incorporating competing objectives and considering weights for those objectives. The framework will be presented as a diagram and presentation.	Members: Hunt (lead), Waples, Carothers, Leon Guerrero, Lynch Staff: Ishizaki PIFSC SMEs: Marlowe Sabater, Justin Hospital	June 2025 + September 2025 (Carothers and Leon Guerrero to co-lead) Completed	Decision-making diagram to guide SSC recommendation process List of key points to consider in making recommendations to Council. Describe if and how AI/ML can be used to integrate analysis into recommendations.

Topic	Deliverable	Members	SSC Meeting	Work Products
4. Integration of climate information into decision making	Initial presentation synthesizing available information linking to IRA project; identifying next steps for integration.	Members: Roberts, Suca (co-lead), Cabrera, Pilling (co-lead) Staff: Fitchett	June 2025 + September 2025 + Final in March 2026	List of recommendations to incorporate into stock assessments; life history observations. Integrate the information relevant to management into table for stakeholders Describe if and how AI/ML can be used to help integrate analysis into recommendations.
5. BMUS / multispecies complex	Develop the general framework and process for decision matrix on single-species, indicator species, and use of a complex - including monitoring through catch composition or other indices. Hold as a topic at an SSC meeting with invited experts from other SSCs/Science Center (e.g., SEFSC / Caribbean Council/SSC) as they have similar issues on data-limited approaches, to talk about general framework or process to deal with current situation with complex of species. Final deliverable will be a framework to apply to the State and jurisdictions on how to manage Species complex.	Members: Chaloupka, Itano, Dichmont, Hilborn (lead), Jones, Harley, Camacho Franklin, Ochavillo, Helyer Staff: Yamada PIFSC SMEs: Felipe Carvahlo, Rob Ahrens, Marc Nadon, Marlowe Sabater PIRO SMEs: Brett Schumacher	Initial presentation at June 2025; Main presentation at September 2025 Follow-up analysis TBD	Describe short-term work product that can be used to inform SSC actions. Describe longer-term work products that can be used to inform SSC actions. Describe if and how AI/ML can be used at points in decision making process.

Topic	Deliverable	Members	SSC Meeting	Work Products
6. Protected species	Presentation on alternative risk assessment approaches for FKW and other protected species, and mechanisms for SSC engagement with NMFS on protected species assessments.	Members: Roberts (lead), Jones, Suca, Harley, Hilborn, Waples, Helyer, Leon Guerrero Staff: Ishizaki PIFSC and PIRO SMEs invited as needed.	<u>December 2025</u>	Presentation and document summarising alternative methods for risk assessment of priority marine protected species. Also a short summary of options for engagement between SSC and NMFS.
7. Efficacy of MPA/closed areas for HMS conservation	Presentation on how closed areas have affected catch and catch rates of a number of target, non-target, and bycatch species in the Hawai'i longline and a discussion on the available information concerning climate[1] impacts to fixed area management.	Members: Hilborn, Camacho, Suca, Carothers, Harley, Hunt, Pilling, Franklin (lead) Staff: Fitchett PIFSC and PIRO SMEs invited as needed.	Scope and timing to be revisited in December 2025	
8. EM	Develop advice on minimization of regulatory burden on participating fishers with Vessel Monitoring Plans and implementation process	Members: Itano, Harley (lead), Courtney, Hunt, Cabrera, Lynch, Jones Staff: Fitchett PIFSC and PIRO SMEs invited as needed.	<u>December 2025</u>	Standing item for EM on SSC agendas; Develop focus questions on human dimensions relating to EM implementation to be answered intersessionally