WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

WP SSC Delegation's Report of
the 7th National Scientific Coordination Subcommittee Meeting

The 7th National Scientific Coordination Subcommittee (SCS; also known as the National SSC) Meeting was convened August 15-17, 2022, in Sitka, Alaska. The SCS is a subcommittee of the Council Coordination Committee. The function of the SCS is to plan and conduct meetings or workshops to discuss scientific issues of national importance based on terms of reference or topics set by the CCC. Recommendations and outputs from the SCS may inform and guide development of future national guidelines for emerging management topics.

The overarching theme of SCS7 was *Adapting Fisheries Management to a Changing Ecosystem*, with the following three theme topics:

1. How to incorporate ecosystem indicators into the stock assessment process
2. Developing information to support management of interacting species in consideration of ecosystem-based fishery management (EBFM)
3. How to assess and develop fishing level recommendations for species exhibiting distributional changes

For each of the thematic sessions, case studies from different regions were presented, followed by breakout sessions that addressed a suite of trigger questions. Each breakout session consisted of five teams of participants, comprised of SSC members and council staff from the various regions. Following each breakout session, there was a recap and synthesis of the discussions presented to the entire body. The summary of breakout sessions and the overall discussion summaries generated during the meeting are appended to this report.

Meeting materials (case study abstracts and presentations) and recording of the plenary sessions are available at: https://meetings.npfmc.org/Meeting/Details/2945

Meeting Highlights and Considerations for WP Council

The WP delegation to SCS7 was represented by SSC members Frank Camacho, Erik Franklin, and Shelton Harley, with Council staff Asuka Ishizaki also attending. Key takeaways and next steps identified by the WP delegation for SSC and Council consideration are listed below, followed by meeting highlights from each of the SSC members.

Key Takeaways and Next Steps for WP SSC and Council Consideration:

- The meeting reinforced that there will be "winners" and "losers", both in terms of species but also in terms of fishery sectors, as climate change and other factors drive distributional shifts in species. Non-stationarity is likely to become an increasingly important concern for the region.
- One of the best monitored and assessed fisheries in the world (i.e, North Pacific) could not adequately predict a catastrophic decline in a fishery (i.e., snow crab) so data limited situations like the WP should probably focus on a reactive (not proactive) management approach to dealing with ecosystem considerations

- Councils, SSC, and Science Centers need tools to be able to handle changes in abundance related to changing environmental conditions. We also need to both improve and enhance the data collection as well as begin to explore the utility of incorporating ecosystem indicators into our assessments. Do we have our key data collection systems (both fishery dependent and fishery independent data) in place? What resources do we need to get there?
- We need more frequent collaboration between regions in order to improve co-management as well as to share ideas with those regions that have similar issues as the WP. For example, is there an opportunity to collaborate with the Caribbean SSC – their fisheries and data 'status' is most similar to ours. But note that their focus is on coral reef stocks which are now ecosystem components species (i.e., not federally managed with a catch limit) in the WP
- We should support wider efforts to build flexibility into the key stock status, reference points, and rebuilding guidelines, especially with respect to incorporating ecosystem considerations.
- For our more data-rich stocks (e.g. tuna and billfish) we should carefully consider whether current reference points were appropriate and also be mindful of climate-related changes in abundance which could impact on allocations and/or the ability to take them.
- Identify scenarios where Management Strategy Evaluation (MSE) or Models of Intermediate Complexity for Ecosystem assessment (MICE) could help improve our understanding of the WP region. Interactions between protected species taken in our longline fisheries, and our current management approaches, seems like a great place to start. For archipelagic stocks, are there ways to incorporate ecosystem considerations into bottomfish assessments and reference points?

SSC Member Highlights: Frank Camacho

Session 1: How to incorporate ecosystem indicators into the stock assessment process?

An underlying theme in the case studies from this session was how to deal with shifting stock distributions and non-stationarity. A particular concern was the potential role of climate change in driving those changes. Some options that were proposed to deal with these changes include a dynamic B0 approach and time-varying catchability.

Breakout sessions explicitly addressed practical issues related to EBFM. In my group, the consensus was that candidate ecosystem indicators for including in an assessment should have a strong mechanistic bias. There was also strong opposition by the group to developing a formal, national framework for ecosystem indicator selection. But there was support for cross-collaboration and communication between regions in order to better inform the selection process within a given region.

A challenge for shifting distributions and ecosystem variables is that it is initially impossible to determine whether an anomaly is part of a larger trend. Thus, there is a need for managers and assessment scientists to have a suite of tools to respond rapidly and flexibly to sudden changes to the fishery.

The need to increase stock assessment capacity by recruiting, training, and retaining more stock

assessment scientists into academia.

Session 2: Developing information to support management of interacting species in consideration of EBFM

Case studies and breakout sessions were focused on identifying ecosystem indicators and providing some examples of modeling approaches that could be used to better inform management. These include considering MICE models, which may have some potential use in the WP region. That said, there were also indicators that are being considered that are not being explicitly used in the WP, such as forage fish and whole ecosystem productivity. How informative these would be for improving the current generation of WP stock assessment is uncertain. A key takeaway from my breakout session was that these approaches have data requirements (i.e., sources of data) that are either not being considered or monitored (e.g., forage fish) for WP management schemes.

Session 3: How to assess and develop fishing level recommendations for species exhibiting distributional changes?

This session focused on how to deal with species whose distributions are shifting across domestic and international boundaries. An interesting case study was from the southeast and mid-Atlantic council in which blueline tilefish stocks began appearing in catch north of their historic distribution. This resulted in the need for cross-jurisdictional management in which two councils had to work together to split the ABC for this stock in an ad hoc process.

Breakout sessions discussed the P* process, which dominated the discussion in my group. Perhaps not surprisingly, a P* approach was found to be used in regions that tended to have a large number of data-limited stocks, such as in the WP, SA, GC. Whether a P* process could be used to address uncertainty in resulting from shifting stock distributions was unclear.

SSC Member Highlights: Erik Franklin

Over 10 years ago, the Western Pacific region adopted the first Fishery Ecosystem Plans in the US so the SCS7 meeting isn't the first time that the region has considered the interconnectedness of ecosystems, fisheries, and fishing communities. Other regions (e.g., Alaska, West Coast, Gulf Coast) have significantly more diverse and abundant data sets for incorporating and validating ecosystem considerations into fisheries management, but it is not yet a common element in assessments. A stronger connection between stock assessments and oceanographic/climate modeling needs to occur to incorporate the effects of the anticipated changes into harvest strategies (Hollowed). A range of model complexities and MSE should be considered when incorporating ecosystem effects into stock assessments (Plaganyi keynote).

A major concern with variable future environmental conditions is the violation of the assumption of non-stationarity in assessments which would require inclusion of time-varying parameters and possibly control rules (Punt keynote).

For multiple species fisheries, the use of ecosystem model-based indicators to update single-species target reference points may be an option (Howell et al. 2021. *Front. Mar. Sci.* 7:607831). While the meeting discussed numerous examples of large scale and economically valuable

commercial fisheries, the Western Pacific region has significant data-limited and non-commercial fisheries that present different challenges due to limited resources for assessment. Looking beyond just the status of commercial stocks, a broader consideration of the resilience and sustainability of fishing communities to the effects of climate change is critical for the Pacific Islands region (and, similarly, the Caribbean region).

The data-limited situation in the Western Pacific region means that any national guidance on climate informed ecosystem considerations for assessment and management should be flexible enough to allow the delegation of detailed decision making to be made at regional levels with sufficient funding provided to implement the guideline.

Unlike regions with long continuous north-south coastlines, changes in species distribution ranges for nearshore stocks are not a significant concern in the Western Pacific region but there has been some evidence of interannual shifts in the distributions of highly migratory species based on geographic patterns in catch.

For tropical regions, management unit species and ecosystem component species in coral reef ecosystems experience a strong immediate threat from climate change through habitat degradation and loss. Recent declines in north Pacific stocks (e.g., snow crab) suggest that similar declines may be driven by climate effects such as marine heatwaves.

SSC Member Highlights: Shelton Harley

With a focus on multiple species and climate-related impacts on fisheries science and management, this meeting was always going to have a focus on data rich systems. The most telling observation for me was that time and time again, those people with the most data were coming across situations of large changes in productivity or spatial distribution that were materially impacting on stock assessments and often flowing through to impact reference points and management action.

The shifts were not all in one direction – while there were plenty of fish stocks that just 'wouldn't recover' there were also several instances where fish stocks had greatly increased in abundance – either moving into new areas – or as large stock wide increases in abundance (e.g. sablefish).

It seems that the more data you have, the more likely that you will find that your 'long-term average' or stationarity assumptions were not being met for key species being assessed and managed. It seemed that only for the most data-rich situations (e.g. Bering Sea pollock) that they had the systems in place to properly track changes and incorporate them into the science and management processes. What does this mean for the rest of us?

This recognition that non-stationarity might be more common than stationarity led to a call that guidelines around assessing fish stock status and developing rebuilding plans needed more flexibility to reflect the climate and ecosystem driven changes in productivity and distribution already being seen. This is good.

Allocation across states and councils came up as a challenge arising from changes to fish distributions – this is something that we don't need to worry about for many of our stocks, but it

could become an issue for allocation of highly migratory resources which are important to our council.

Management Strategy Evaluation (MSE), the focus of SCS6 in 2018, came up often as a tool to help both develop alternative 'states of nature' that could reflect ecosystem and climate-related impacts, and assess different management approaches.

There was a growing call for 'Models of Intermediate Complexity for Ecosystem assessment' (MICE) to help better understand and investigate ecosystem and climate-related impacts. There was a sense that there is a pragmatic 'middle-ground' in the ecosystem modelling space which I think would appeal to SSCs and Councils.

Appendix: Summary of breakout sessions and the overall discussion summaries generated during the meeting

1. Breakout Session 1 Recap
2. Breakout Session 2 Recap
3. Breakout Session 3 Recap
4. Draft overall discussion summary

Appendix 1: Breakout Session 1 Recap

Session 1 Recap

How to incorporate ecosystem indicators into stock assessments

Trigger Question Categories:

- **Indicator selection for assessments and model improvements**
- **Responsiveness/Ability to address environmental anomalies**
- **Adaptivity of management framework**

Appendix 1: Breakout Session 1 Recap

Summary Points: RED Group [Auditorium]

- **Indicator selection for assessments and model improvements**
  - Accept balance between model fit improvement and mechanistic understanding.
  - Periodic, if not regular, renewal of indicator validity is required.
  - Adequate prediction requires mechanistic understanding and some statistical relation.
  - Thresholds are case specific; framework could be standardized.
- **Responsiveness/Ability to address environmental anomalies**
  - Modeling vs management alternatives time dependent. Repeatability/frequency further determines tool used to incorporate an event.
  - Multiple methods for incorporating (mort, growth, rep) time blocks situation dependent.
  - Short term predictions should be done (MSE) ideally modeling event process.
- **Adaptivity of management framework**
  - Provide alternatives (flexible) for non-traditional, data limited, multi-spp complex/fisheries.
  - Stationarity still assumed in most (all?) regions because understanding ecosystem variability vs production shift takes time. Precautionary approach followed by assuming changing conditions persist.

Summary Points: BLUE Group [Raven]

- Indicator selection process: **Strong mechanistic basis is most important**, forecasting least. Need to be able to connect indicator to biology of stock for **communication and buy-in** from Council members, stakeholders
  - Cast a wide net early on for potential new indicator ideas, from scientists, assessment authors, and stakeholders. Helps with buy in and credibility. Ok to discard an indicator if not proving to be a driving factor for assessment. Most Councils do not use for forecasting; difficulties predicting episodic events.
- Responsiveness to envtl anomalies: hard to tell in real time whether short term or regime shift. **Need tools in place to buy time** to evaluate, respond.
  - Post assessment adjustments to harvest levels, MSEs (but labor intensive and need to prioritize), also need avenue (and monitoring) for assessment authors to elevate concerns outside of typical cycle
- Adaptivity: **Regional process critical;** opposed to national requirements but guidance, best practices, communication and crossover among scientists, regions
  - Vast differences by Council in assessment frequency, capacity, data quality, trust and credibility.
  - Concerns about capacity limitations; especially **need more stock assessment authors** and those who train them, and **better data systems** and handling practices to increase efficiency

Appendix 1: Breakout Session 1 Recap

Summary Points: GREY Group [Raven]

- **Indicator selection for assessments and model improvements**
  - Can it easily be communicated? Should be transparent and inclusive
  - Incorporate LKTK where appropriate
  - Different indicators in data rich vs. data poor systems--challenges for different Councils/regions based on data availability and number of species to manage
  - Indicators can be useful for decision processes outside of stock assessments--even if not useful in the assessment model can be informative e.g. useful for assessment of risk.
- **Responsiveness/Ability to address environmental anomalies**
  - When it's happening you don't know if short-term or start of something longer
    - How do you determine when a regime shift has occurred?
  - Matching time series to life history of species- (e.g. short term data useful for short-lived species)
    - Doesn't have to be time series can be a state (high/low)
  - Environmental factors have economic and operational impacts and may be more common in future - hurricanes/typhoons, HABs, etc
- **Adaptivity of management framework**
  - Any national guidance needs to take into account regional differences
    - Different regions have differing data availability, are at different starting points and have different current issues (e.g. Climate change impacts/warming (so far) have been more impactful in northern regions
  - MSA says in multispecies fishery, manage to the least productive stock- but sometimes don't have data to determine which species is more vulnerable than others
    - In areas with higher diversity and more specialization are species more at risk managed as complex than they would be elsewhere with less diversity/less specialization.

Summary Points: GREEN Group [Pink Salmon]

We ended up primarily approaching the question of how to effectively incorporate ecosystem indicators into stock assessments from the perspective of scientists engaged in the RFMC process and communicating the science to stakeholders.

- **Mechanism matters—especially for stakeholder buy-in. Reducing variance might not resonate with many stakeholders, but many more people will understand, for example, the relationship between predator and prey abundance driving good and bad years.**
- **Engagement of stakeholders can bring a lot of empirical data to the table. Their observations could be compelling to scientists who are exploring mechanistic relationships, and there is often increased stakeholder satisfaction when their ideas are explored by scientists.**
- **Ideas were explored for how best to formally engage stakeholders, from MSEs to Fishery Performance Reports. Effectively communicating tradeoffs of different management strategies can result in stakeholder understanding and buy-in.**

Appendix 1: Breakout Session 1 Recap

Summary Points: YELLOW Group [Eagle]

- **Indicator selection for assessments and model improvements**
  - **Criteria for inclusion of indicators in an assessment may vary based on the reviewer**
  - **Further focus could also be given to the downstream effects of incorporating an indicator in terms of its effects on management decisions.**
  - One method to assess the value of an indicator being considered may be the degree to which its inclusion improves model fits to other data
- **Responsiveness/Ability to address environmental anomalies**
  - short-term economic anomalies, such as those lasting for one year or less, would be expected to have long-term consequences for a stock.
  - MSEs useful to accommodate expectations of assessment frequency, while also allowing for consideration of exceptional circumstances
  - social and economic drivers that could influence the desire to change status determination criteria
- **Adaptivity of management framework**
  - Regional differences make national guidelines complicated
  - Focus should be on stocks that are doing well rather than all efforts on overfished stock non responsive to rebuilding plans
  - However some defensible definitions of terms like “environmental anomaly” or “exceptional circumstances” should be discussed, such that risk management can be appropriately applied considerate of Council and SSC requirements under the Magnuson-Stevens Act

Overall Session Findings: Indicator selection for assessments and model improvements

- Mechanistic basis highlighted
- Communication with stakeholders is extremely important both for information exchange and trust in the process and the science
- Model fit important criteria
- Indicators will vary with data availability
- Region/stock variability but framework needed?

Overall Session Findings: Responsiveness/Ability to address environmental anomalies

- Difficult to determine if it is a short-term anomaly or a recurring event
  - How to determine if it is in fact a regime shift?
- Data collection and time series should be matched to life history of species
- MSEs useful but also labor intensive and should be prioritized; communication of results is key

Overall Session Findings: Management Framework

- Need additional flexibility in management framework
  - data limited situations
  - multi-species fisheries
  - smaller scale fisheries
  - ability to respond to climate change
- Regional versus national focus important but with communication and coordination across regions
- Regional differences in assessment frequency, data availability and capacity

Appendix 2: Breakout Session 2 Recap

Session 2 Recap

Developing information to support management of interacting species in consideration of ecosystem-based fishery management (EBFM)

Trigger Question Categories

- Use of ecosystem models to inform management
- Non-target considerations in harvest control rules
- Management framework and system-level considerations

Appendix 2: Breakout Session 2 Recap

Summary Points: RED Group [Auditorium]

- Use of ecosystem models to inform management
  - Many examples across country of using ecosystem information, model components
  - Need to recognize that application and utility of multi-species/ecosystem models does not need to be just for setting TAC – lots of other benefits and values::
    - Inform changing reference levels/points and total system productivity
    - Time- and age-dependent mortalities developed because of these approaches
    - Assess Climate risks
    - As a cross-check or validation of single species assessments and management advice
- Non-target considerations in harvest control rules
  - No specific examples
    - Spatial management for protected species more common than HCR development
  - Protections to limit forage fisheries
  - This might be a place for the use of MSEs to see which HCRs might be robust to this issues
- Management framework and system-level considerations
  - Limited use of system level caps - more of system of a weakest link under a stock complex that can constrain landing across a complex
  - Use of OFL buffering (e.g., P*, risk assessment) approach to account for multi-species/ecosystem considerations
  - Engaging stakeholders and management in the development of these approaches (MICE examples) can help get buy-in, "peer review", and integration of information into decisions

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Summary Points: BLUE Group [Raven]

Use of ecosystem models to inform management

- No examples of tactical management using ecosystem models / multispecies models
  - We can do EBFM well without directly using ecosystem models
- Modeling predator-prey interactions to determine prey harvest levels to meet predator needs (herring, menhaden) (MICE)
- Concern that we may not even be including the right species in ecosystem models due to shifting populations

Non-target considerations in HCRs

- Protected species – WPFMC uses envtl covariates to identify / manage spatial interactions (reduce interactions through avoidance bulletins to fleet, spatial mgmt), NPFMC and PFMC reduce harvest levels to accommodate prey concerns for Steller Sea Lions and So. Resident killer whales
- Forage species – some regions have bans (move to Ecosystem Category, monitoring only, often data-limited)

Management framework and system-level considerations

- Very few system caps; need to assess ecosystem productivity based on Prim. Prod. & transfer efficiency (large shelf systems / offshore systems) or estimates of total biomass (e.g. multispecies MSY for coral reef systems).
- Alternative management framework for tropical systems with high diversity to use multivariate reference points or 'regions' to define and manage for a desirable state (inability to assess every landed species).
- Adjusting ACLs for 'additional' ecosystem uncertainty (not captured in assessments) using CVs or buffers (risk framework). Currently based on expert judgement, could derive more formal links between risks & size of buffer
- In some cases, ability to implement ecosystem approach affected by multiple management jurisdictions

Appendix 2: Breakout Session 2 Recap

Summary Points: GREY Group [Raven]

Use of ecosystem models to inform management

- Using ecosystem models more as strategic planning tools than tactical management tools
- Some examples of using ecosystem model to derive natural mortality estimates and then plug into stock assessment--no regions really incorporating predation mortality in assessments-
  - Data limitations-very little diet data and when collected not always processed quickly,
  - How much diet data do you need to say anything? Ideally, have time-series, seasonal data but with limited resources is it a priority?
- Ecosystem status reports provide major environmental context for stock assessments in North Pacific
- Difficulty in matching models to management questions

Non-target considerations in harvest control rules

- Protected species - Steller sea lion closures in Aleutians
- Accounting for whale depredation in sablefish assessment

Management framework and system-level considerations

- OY cap in Bering Sea
- Utility of a regular forum for regional information exchange of SSC members or Council staff (not just in neighboring Councils) to foster exchange of ideas/methodologies and help bridge information gaps

Summary Points: GREEN Group [Pink Salmon]

Use of ecosystem models to inform management

- PFMC: Annual State of the California Current Ecosystem reports provide trends of forage species. Some groundfish assessments have used a Lorenzen M positing higher depredation of juveniles. Some salmon analyses factor depredation in salmon total mortality estimates and there is an intent to explicitly account for at least pinniped predation in the foreseeable future.
- WPFMC: EBFM model under development to better understand effects of avoiding protected species interactions and better inform fishery distribution. Ecosystem indicator trends, including trends in forage abundance, are captured in SAFE reports.
- NPFMC: Risk assessments indicating relative abundance of the forage base have been used in management decision-making.
- ASMFC: Single species predator assessments inform Atlantic menhaden assessments.

Non-target considerations in harvest control rules

- WPFMC: Protected species bycatch drives the management of the longline fishery.
- PFMC: Bycatch caps are used to manage the DGN fishery.

Management framework and system-level considerations

- NPFMC: 2M mt cap in the Bering Sea is specified for federally managed species.
- PFMC: 2 mt shortbelly rockfish cap is a threshold used to consider more stringent management measures for this EC species.

Appendix 2: Breakout Session 2 Recap

Summary Points: YELLOW Group [Eagle]

- Use of ecosystem models to inform management
  - Large scale: Menhaden on the Atlantic coast; herring in New England via a harvest control rule
  - Small scale: red tide in the Gulf of Mexico
- Non-target considerations in harvest control rules
  - Few across regions. EcoCast model: can allow for consideration of spatiotemporal interactions between target species and protected species
- Management framework and system-level considerations
  - Cooperative fishers practicing self-management
  - Discussion of struggles with stocks that do not seem to respond to rebuilding plans; also discussion of when reference points should be changed

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Overall Session Findings: Use of ecosystem models to inform management

- EBFM currently works through enhancing / informing single-species assessment models
- Intermediate models to account for predator needs when managing prey species (herring, menhaden)
- Multi-species models & ecosystem models for:
  - estimating predation mortality to inform SS models
  - cross-checking / validating SS models
  - strategic advice (climate context)
- Challenges
  - multi-species / system level reference points
  - data requirements
  - building complex models in a changing climate (non-stationarity, shifting stocks)

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Appendix 2: Breakout Session 2 Recap

Overall Session Findings: **Non-target considerations in harvest control rules**

- Some considerations for specific protected species issues (e.g. SSL in Aleutians, WPFMC in longline fishery)
- Bycatch caps
- Some considerations across regions on protection for forage fish (ban on directed fishing, caps etc)
- Spatial temporal management for protected species may be more common than HCR development

Overall Session Findings: Management framework and system-level considerations

- Limited use of system level caps across jurisdictions; BSAI 2 mmt OY cap one example; PFMC EC considerations for shortbelly rockfish species
- Multi species & ecosystem models may help inform system-wide considerations
- Importance of communication between SSCs across regions and stakeholder 'buy-in' particularly on system-level considerations and trade-offs

Appendix 3: Breakout Session 3 Recap

Session 3 Recap

How to assess and develop fishing level recommendations for species exhibiting distributional changes

Trigger Question Categories

- **Addressing changing fish distributions in stock assessments/survey implications**
- **Accounting for uncertainties in shifting distributions**
- **Adaptivity of management framework to address changing distributions**

Appendix 3: Breakout Session 3 Recap

Summary Points: RED Group [Auditorium]

- **Addressing changing fish distributions in stock assessments/survey implications**
  - The use of VAST and dynamic overlap approaches to determine survey catchability associated with different environmental parameters are becoming more routine.
  - Not just shifting fish that will impact surveys and assessment, but other spatial issues – offshore wind, area closures – need to be considered
  - There is a need for more finely resolved spatial distribution information and spatial assessment models for a greater understanding of stock implications in support of management decisions
- **Accounting for uncertainties in shifting distributions**
  - Current buffering approaches such as P* are likely more of a band-aid approach and not a long-term solution
  - Increased focus and development of short-term forecasting skills is needed to help inform how management can respond
  - Need to effectively communicate uncertainties and that predictions are becoming more uncertain (may get things wrong more often)
    - Use of ecosystem status reports to communicate these uncertainties and identify the relevant risks and challenges
- **Adaptivity of management framework to address changing distributions**
  - Management needs to be more adaptive and flexible in the future given these distribution changes and uncertainties. Greater role and more consideration for social and economic factors
  - This is particularly true for stocks under a rebuilding plan as drivers are changing
  - Lots of challenges given current national, regional, and geo-political climate, but there may be opportunities to collaborate and coordinate and potentially develop general guidance and evaluate what has worked or not

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Summary Points: BLUE Group [Raven]*

Addressing changing fish distributions in stock assessments/survey implications

- Shifts vary (north/south, east/west, depth); regions using various tools (VAST, survey resampling, research set asides)
- Fixed timing for long-term surveys may not continue to be appropriate given changes, e.g. in spawning time
  - Potential communication problem when fishery timing adapts to changing conditions and survey can't: fishermen have different perception of status of stock than scientists
- Concern with mismatch between the survey area and the assessment area, emphasizes need for adaptive monitoring

Jurisdictional boundaries affecting assessment and management needs

- Many examples of State/Fed tensions, as well as across international boundaries - process ranges from long-standing agreements with formalized processes to newly developing avenues of communication
- Historic agreements can be inflexible to changing envtl conditions - need for periodic review of these agreements
- Top priority - development of single cross-boundary assessment that aligns with the biological stock characteristics, so all managers have same starting point
  - If lacking, can result in asymmetrical impacts in terms of who gets penalized for ensuring conservation of resource

Adaptivity of management framework to address changing distributions

- Need to think about mechanisms in fishery systems to allow quota transfers or accommodate market responses to shifts
- MSA rebuilding timelines can be constraining, not adaptive to regime shifts or need for ongoing data collection from fishery
  - Highlight the importance of having fishery-independent data sources
  - Term 'overfished' misleading for stocks incapable of rebuilding
- EFH review process has the tools to provide advance warning of distributional shifts, but would need to more dynamic to be able to respond on management time-frames

Appendix 3: Breakout Session 3 Recap

Summary Points: GREY Group [Raven]

- **Addressing changing fish distributions in stock assessments/survey implications**
  - Need funding for additional/expanded surveys to capture when distributions may be shifting
    - Important to think about effects of timing, location, and gear types when adjusting/expanding surveys
    - Work with industry to respond to concerns and increase buy-in
  - Use LK/TK and create citizen science programs to capture observations over time and across regions
  - Need to develop statistical methods for using new survey data or make results from multiple surveys comparable
- **Accounting for uncertainties in shifting distributions**
  - Important to maintain genetic diversity. Some reproductive strategies may have been genetically beneficial under old climate but are not successful now.
  - If there are signs of changes in productivity then may be a regime shift
- **Adaptivity of management framework to address changing distributions**
  - Need new management vocabulary for species that may be "depleted" but not "overfished"
  - Pay attention to record landings or changes in fishing effort
  - Different management strategies needed for crustaceans and bony fish as they have different booms and busts and sensitivities to temperatures and oxygen
  - Potential for large economic impacts when stocks are assessed over large areas and allocated in smaller areas
  - Socio-cultural implications- access issues and differing abilities to adapt, fairness and equity
  - How to deal with rebuilding plan requirements for stocks that do not respond to fishing reductions

Summary Points: GREEN Group [Pink Salmon]

- **Addressing changing fish distributions in stock assessments/survey implications**
  - Research is occurring with modeling and tagging; however, there have been limited advances in accounting for distribution shifts in assessments.
  - Surveys are heterogeneous across the regions, as well as funding to support surveys, and research on distribution and regime shift investigations.
  - Movement models have explored changes in Bering Sea fish distribution.
  - Some surveys have been extended in the Bering Sea, Gulf of Mexico, the East Coast, and Caribbean to better understand changes in fish distributions, including using emerging technologies. These efforts are limited by funding.
- **Accounting for uncertainties in shifting distributions**
  - P-star approaches do not account for uncertainty due range shifts. Note the consequences of a range shift could result in misperceptions of stock size in either direction.
  - ESPs and ESRs can be a useful resource to provide information about regime shifts.
  - Projecting shifting distributions and regime shifts often relies on ocean model projections, which are lacking in many regions. Climate Ecosystem and Fisheries Initiative could begin to address this challenge.
  - MSEs are a useful tool to explore the consequences of shifting distributions in a simulation model (e.g., examples from NE and Pacific Hake).
  - Jurisdictional boundaries increase uncertainty due to challenges of coordination of management, assessments, and data collection.
- **Adaptivity of management framework to address changing distributions**
  - Management responses to shifting distributions and regime shifts are typically reactive in response to unexplained and severe stock declines.
  - **Recommend revisiting Klaer. et al. 2015 decision framework** to determine whether a shift in productivity has occurred for a stock.
  - Explore an F-based management framework to be more adaptive. Consider moving away from biomass-based reference points because they are hard to estimate and rely on assuming stationarity.
  - More collaboration and coordination is needed across jurisdictional boundaries. This is generally more challenging across international boundaries
  - Workshops across regions could come up with creative solutions and conduct simulation work needed to develop better guidance.

Appendix 3: Breakout Session 3 Recap

Summary Points: YELLOW Group [Eagle]

- **Addressing changing fish distributions in stock assessments/survey implications**
  - Communication between survey operators and data providers is critical for understanding distributional changes
  - Expansion of surveys would be ideal, but resources are often limiting
- **Accounting for uncertainties in shifting distributions**
  - P* approaches do not always adequately capture the uncertainty in a stock assessment
  - Consideration of social and economic factors can be difficult under P*
- **Adaptivity of management framework to address changing distributions**
  - Communication between regions is necessary to ensure proper consideration of biological, social, and economic effects
  - Some regions already have well-established collaborative relationships; all regions are expected to need to collaborate with their neighbors as distributions change

Overall Session Findings: **Addressing changing fish distributions in stock assessments/survey implications**

- Expansion of surveys is the best way to immediately begin to address problem but resources are often limited
- Increased collaboration with industry (surveys, communication of mis-matches between fishery timing and survey, other concerns, industry buy-in)
- Use of additional spatio-temporal modeling tools helpful; continued work on additional statistical tools recommended
- Priority should be to develop single cross-boundary assessment that aligns with the biological stock characteristics but requires issues of jurisdictional boundaries to be addressed

Appendix 3: Breakout Session 3 Recap

Overall Session Findings: **Accounting for uncertainties in shifting distributions**

- Current buffers (whether OFL distribution and P* or qualitative) may provide initial 'band-aid' to shifting distributions but longer-term solution to address uncertainty needed
  - P* does not necessarily account for uncertainty due to range shifts
- Need for increased social and economic considerations in addressing shifting distributions
- Need to more effectively communicate uncertainties and that predictions are becoming more uncertain
- Uncertainty compounded by issues in identification of regime shifts and when distributional changes and changes in productivity are more likely to be longer-term

Overall Session Findings: **Adaptivity of management framework to address changing distributions**

- Increased need for management systems that are robust to rapid and often unpredictable change
  - modifications in quota systems, increased ability to diversity operations, transferability provisions and other means to respond more rapidly to changing conditions in fisheries
- Modifications to rebuilding definitions
  - Term 'overfished' misleading for stocks when environmental conditions not fishing pressure is the cause of the decline > suggest term 'depleted'
  - How do we better address stocks that are incapable of rebuilding (regardless of cause of decline fishing or environmental)
- Increased communication and collaboration amongst all regions as well as internationally as distributions change and regions must address unforeseen situations
  - Workshops for conducting simulations and creative solutions
  - Collaboration/communication involves more than fisheries scientists and management; some require international diplomacy solutions

Appendix 4: Draft Overall Discussion Summary

Draft Summary Points

SCS7 August 2022

Some observations

- Effects of climate change on US Fisheries is being observed now with more profound implications expected in the next 20 years in several regions.
- Since 2018, several FMCs have started considering models that include ecosystem linkages and / or adopted climate informed risk assessments. However, challenges remain including: pros and cons of shifting biological reference points, carrying capacity, and management units.
- FMCs may (will) encounter new challenges due to competing use of marine systems, abrupt shifts in distribution or abundance, and changes in ecosystem structure and function with impacts on sectors and communities and data collection methodologies. Finding equitable management adaptation pathways will be challenging.

Recommendations

- Continue SCS on biennial basis?
- Reactions to meeting format?

Near term expectations

- Increased consideration of non-stationary spatial shifts in assessments. (Spatial temporal models)
- Monitoring/new technologies (early warning and trend analysis); are we measuring what we need to prepare for the future?
- Dynamic recruitment prediction scenarios (based on mechanistic models)
  - eg high res ocean modeling and > use of IBMs to inform spatial distribution of larvae, overlap with prey etc
- Adoption of MSM (perhaps informed by network models for key nodes of foodweb)
- Adoption of MICE models
- Communication/dialogue focus - Stakeholder workshops
- MSE scenarios based on ecosystem consideration are standard; testing robustness of mgt rules; data poor ones also useful
- identify climate ready management scenarios in regions that have high diversity and more complex monitoring challenges

Some Recommendations

- FMC's have shared goal for sustaining fisheries in a non-stationary future.
- Regional contexts differ and adaptation challenges needs to be tailored to regional context
- Insure the FMCs have the capacity to "adapt fisheries management to a changing environment". Continue and expand:
  - Monitoring & new technology (physical, biogeochemical, societal and biological)
  - Process and retrospective studies
  - Modeling (emerging research models & MSE & MICE)
  - Multiple ways of detecting change (LK/TK/S)
  - Evolving Standards
  - Peer review
  - Communication
- Interdisciplinary research teams are needed for success; training students to succeed in this setting is needed.

Some Recommendations

- SSCs need to prepare for transition from reliance on indicators derived from observations to informed dynamic simulations of marine ecosystem change tuned (or skill tested) to observations (CEFI)
- Start scenario planning now to avoid reactive responses
  - Triage options for extreme events
  - Testing tactical options
  - Evaluation of trade-offs in strategic change
  - testing ecological operating models by region [check wording here]
- Consider emergency funds for regional extreme events.
- Consider RFMOs and UNDOS for planning for international collaborations for transboundary management
- Consider next generation climate informed guidelines for climate ready management and adaptation option evaluation (In collaboration with CEFI FACSS Teams).
- Greater use of open source modeling environment to accelerate advancements (FIMS or other)

Appendix 4: Draft Overall Discussion Summary

Some Recommendations

- Streamline data management and more 'open source' type data flows and interoperability
  - cross jurisdictional data management
  - not behind a NOAA login; easily available outside of Agency staff
- exploration for flexibility to facilitate diversification in workload
- add flexibility to management process; create more opportunities for strategic thinking at regional and national level for increased creativity across regions/creating opportunities for that
- alternative ways of avoiding bifurcations in control rules
- Human element of EBFM- resilient fishing communities built into MICE models/other modeling efforts