Report of a National Scientific and Statistical Committee

Workshop on Ecosystem and Social Science Considerations in U.S. Federal Fishery Management

October 4-6, 2011 · Williamsburg, VA

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Fourth National Meeting of the Regional Fishery Management Council's Scientific and Statistical Committees

Hosted by the
Mid-Atlantic Fishery Management Council
in Williamsburg, Virginia
October 4-6, 2011

Report of a National SSC Workshop
on Ecosystem and Social Science Considerations in
U.S. Federal Fishery Management

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Executive Summary

The fourth National Scientific and Statistical Committee (SSC) Workshop was convened to provide an opportunity for the eight SSCs to discuss ecosystem considerations in fishery management and to discuss the role of social science in both traditional single species and ecosystem based fishery management (EBFM). The workshop opened in plenary session with a keynote address by Dr. Tony Smith who discussed the Australian experience in EBFM. Australia has adopted an integrated approach to decision making and EBFM and utilizes a broad range of qualitative and quantitative risk assessment tools to evaluate competing uses of the ocean and requires extensive stakeholder involvement. Following Dr. Smith's presentation, representatives from the eight SSCs provided progress reports which emphasized how each Council and SSC have incorporated ecosystem considerations into stock assessments and management with respect to sustainable harvest policy. In addition, each SSC described existing or planned methods of engagement of their social scientists in the SSC and Council processes. Finally, each SSC reported on progress on Acceptable Biological Catch (ABC) control rule implementation and other significant actions taken since the last national workshop. The SSC Report session was followed by a national overview of stock assessment activities by the National Marine Fisheries Service (NMFS) Office of Science and Technology (S&T).

The afternoon session on day one began with a keynote address by Dr. Lee Anderson on the role of social science in the SSC process. The presentation addressed underlying goals, philosophies, and operating procedures that will allow an SSC to successfully address its social science obligations. The second keynote address was given by Dr. Brian Wells on an integrated ecosystem approach (IEA) to management, currently being developed for the California Current ecosystem. An IEA approach was defined as one that considers the entire ecosystem, including humans, in order to maintain an ecosystem in a healthy, productive and resilient condition.

The second day of the workshop included two concurrent breakout sessions designed to provide more focus on issues specifically related to the two themes of the meeting. On day three, the two groups reconvened in plenary session and discussed their findings and recommendations.

The social sciences breakout session was organized around three sets of questions to address the following topics: 1) the role of the social science in the SSC and Council processes; 2) use of catch shares in achieving community objectives for management; and 3) procedural and data issues. The key conclusions of the social science group were:

1) The collection and analysis of additional social and economic fisheries data was identified as a high priority need.

2) There is a wide range of engagement of social scientists in SSC deliberations across the country ranging from full engagement in some regions to little or no engagement in some regions. Social scientists should be more fully engaged in the SSC process through review of

Council analyses included in annual specifications, Fishery Management Plans (FMPs), Amendments, and Framework actions.

3) The Councils should address community impacts in solicited comments and identify factors that can be used to determine those impacts (e.g., community diversity and capital investments). The SSCs should identify the information needed to appropriately assess community impacts.

4) Catch share programs should be viewed as one potential vehicle for attaining community objectives in fisheries management if carefully designed to achieve those objectives.

5) The development of EBFM goals and objectives should be viewed as a point of entry for social science into the SSC process, especially in the context of the development of national ocean policy.

6) A number of best practices which would facilitate incorporation of social science information into the Council decision making process include: SSC development of social science white papers; development of a social science section in the Council five-year research plans; peer review of social science models; social science training for new Council members; incorporation of social and economic sections in Stock Assessment and Fishery Evaluation (SAFE) documents; and inclusion of social and economic considerations in ABC specifications through use of fishing effort data in projections.

7) An SSC Social Science Working Group should be formed to build on discussions at National SSC IV.

The ecosystems breakout session was organized around three sets of questions to address the following topics: 1) system-level considerations in specification of optimum yield (OY); 2) forage issues; and 3) development of ecosystem-related goals and objectives. The key conclusions of the ecosystems group were:

1) With respect to system-level OY considerations: system level maximum sustainable yield (MSY) is generally less than the sum of single species MSYs, which implies more precautionary fishing mortality rate policies may be necessary. There is a need to define the "system" carefully and better information is needed that describes interactions among species and trophic levels.

2) There is a clear need to define forage species based on a regional approach with some degree of national consistency. There is also a need to review approaches to estimating biomass of forage species groups or guilds as well as forage demand by predators.

3) The SSCs should fully engage the Councils concerning the development of goals and objectives of EBFM within each region; stakeholder input in this regard is critical.

4) There is a need to evaluate EBFM versus current single species management.

5) A major national investment in ecosystem modeling and management strategy evaluation of potential EBFM approaches is warranted. Modeling can provide a cost-effective means of exploring the structure, function, and variability of ecosystems and the expected range of responses of those systems to natural and anthropogenic perturbation.

Preface

The 2006 revisions to the Magnuson-Stevens Act (MSA) placed renewed emphasis on the role of science in the management of our Nation's living marine fishery resources. Central to this approach was the strengthening of the role of SSCs in the Council decision-making process of the eight Regional Fishery Management Councils, particularly with respect to the mandate that the Councils specify annual catch limits (ACLs) to prevent overfishing. In recognition of the increased demands placed on their SSCs in this new role, the Councils convened national meetings of the eight regional SSCs annually, beginning in 2008, to discuss major challenges the SSCs face and to help develop solutions to implementing new MSA ACL requirements and related scientific issues.

The Western Pacific Council (WPFMC) hosted the first National SSC workshop, where SSC operating procedures and potential approaches to addressing the new ACL requirements of the revised MSA were discussed. In 2009, a second workshop was convened (hosted by the Caribbean Fishery Management Council (CFMC)) to discuss the technical aspects of establishing scientifically-based annual catch limits. In 2010, the South Atlantic Council (SAFMC) hosted the third national workshop of the SSCs, where representatives reported on progress toward implementing ABC control rules, which form the basis for providing fishing level recommendations to the Councils. At that meeting, there also was discussion of regional stock assessment peer review programs and the role the SSCs play in those processes.

Discussion at the end of the 2010 workshop highlighted the fact that the first three national workshops were focused almost exclusively on biological issues related to ABC control rule development and implementation, with only limited discussion about the role of the SSCs in providing social and economic advice to the Councils. In addition, the majority of attendees favored including discussion at future workshops about advice the SSCs need to provide the Councils with respect to ecosystem considerations.

The fourth National Scientific and Statistical Committee Workshop was convened to provide an opportunity for the eight SSCs to discuss ecosystem considerations in fishery management and to discuss the role of social science in both traditional single-species and EBFM. The meeting was hosted by the Mid-Atlantic Fishery Management Council (MAFMC) in Williamsburg, VA, with Dr. John Boreman (MAFMC SSC Chair) serving as workshop Chair. The workshop program was developed by the National SSC IV Steering Committee, a group composed of the eight SSC

Chairs and staff from the NMFS Office of S & T and the Mid-Atlantic Council (Appendix 4). In addition, two thematic Subcommittees (Ecosystems and Social Science) were formed to develop the workshop agenda. Special thanks to Dr. Jason Link (Ecosystems) and Dr. David Tomberlin (Social Sciences) for chairing their respective Subcommittees. This report is based on abstracts of presentations provided by workshop presenters. Subsequent workshop discussion was captured by rapporteurs from the regional Council staffs including Stephen Atran, Mike Burner, John Carmichael, Brian Chevuront, Mary Clark, Chris Kellogg, Jon McCracken, Marlowe Sabater, and David Witherell. Special thanks to these individuals for their efforts. Rich Seagraves and Kathy Collins edited and formatted the submissions for consistency and assembled the final report. The report benefited from review comments made by John Boreman, David Witherell, Craig Severance, Cindy Thomson, Ben Blount, Jason Link, David. Tomberlin, and Pat Livingston. Special thanks to Jan Saunders and Kathy Collins for providing outstanding logistical and administrative support and to Jason Didden for taking photographs during the workshop.

Plenary Session I

Keynote Address

The Australian Approach to EBFM

Presenter - Dr. Tony Smith, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia

Australia has the third largest maritime jurisdiction in the world, with an Exclusive Economic Zone (EEZ) of 8.2 million km^2. Income from Australia's marine industries has nearly doubled over the past decade. Revenue from seafood has remained stable (with a slight increase in aquaculture and decrease in wild capture) while offshore oil and gas has increased steeply.

With projected population increase along the coasts and booming marine resources and energy industries, there is now a degree of urgency around addressing marine use issues as the decisions made over the next few years will have profound implications for current and future Australians. To achieve enduring economic and social benefit from coastal environments, it is necessary to avoid both over-use and management failure from piecemeal decisions that arise when impacts and uses are treated in isolation. This requires an integrated approach to managing across the catchment-coast-ocean continuum – integrated coastal zone management – and a deeper understanding of how biophysical and human systems are coupled.

Legislative and policy drivers for EBFM in Australia extend back to the early 1990s with fishery legislation increasing the focus on ecologically sustainable development. New environmental legislation in the late 1990s increased the focus on the ecological effects of fishing. Oceans policy was also developed in the late 1990s, and in the following decade Australia adopted EBFM, although Fishery Ecosystem Plans (FEPs) are not formally required.

EBFM has four main components in Australia: *Harvest Strategies, Ecological Risk Assessment, Spatial Management,* and *"Whole of Fishery" Management.* Dr. Smith presented a framework for the scientific tools used to support EBFM in Australia (Figure 1). The tools, which are applied to monitoring, assessment and decision support, span from single species issues, through ecosystem concerns, to broader social and economic considerations. A key point is that the methods underlying them can be hierarchically organized, from qualitative, through empirical, to more quantitative approaches. Different tools are required depending on the problem and context being addressed.

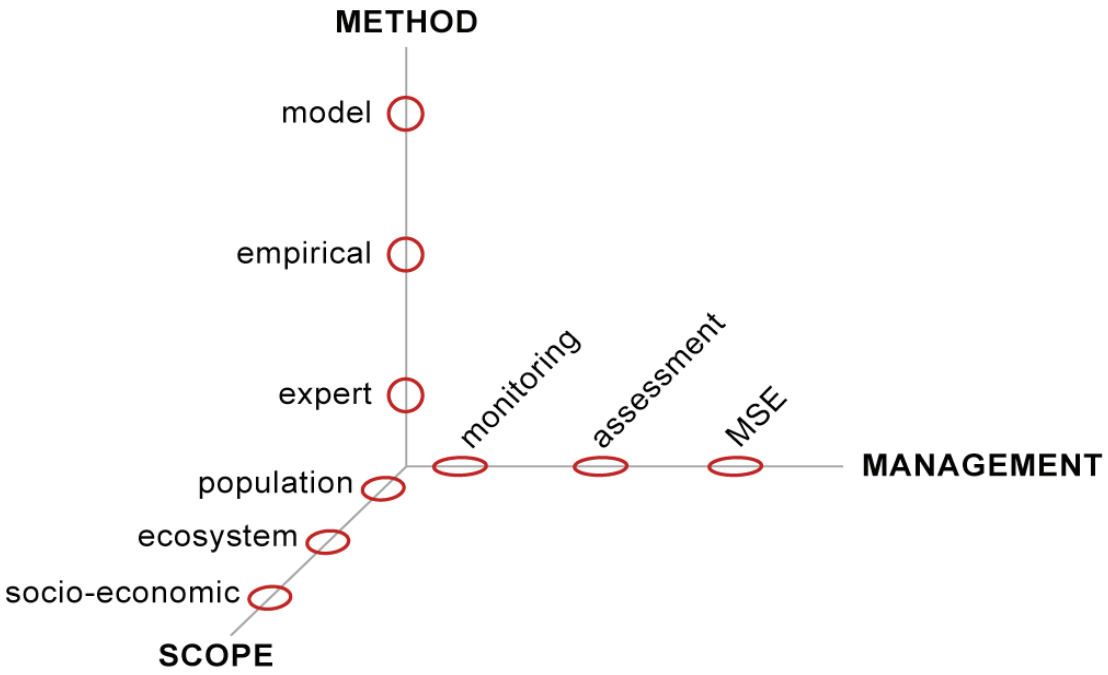


Figure 1. Framework for scientific tool development to support EBFM (Smith et al 2007).

One of the key tools used to support EBFM is ERAEF—Ecological Risk Assessment for the Effects of Fishing (Hobday et al. 2011). This methodology was developed through a partnership between CSIRO and the Australian Fisheries Management Authority (AFMA). ERAEF uses a hierarchical set of methods ranging from qualitative to quantitative and a tiered risk analysis approach. It considers a comprehensive range of hazards and requires extensive stakeholder engagement. The analyses have assessed the impacts of fishing on over 2000 species and 200 habitat types across over 20 fisheries. The results have been used by AFMA to develop environmental risk management plans for each managed fishery.

Another key tool in the EBFM armory is the Atlantis modeling framework (Fulton et al. 2011). This is a management strategy evaluation (MSE) tool built around a full ecosystem model, but also incorporating human use and a full adaptive management cycle. It was used in the Alternative Management Strategy (AMS) project to rethink management strategies for Australia's SE fisheries and resulted in profound changes in the overall management approach to this complex set of fisheries. Another example of use of the Atlantis model, along with the EwE and OSMOSE models, involved analysis of the trophic effects of fishing low trophic level "forage" species (Smith et al. 2011).

The focus of EBFM research in Australia has moved away from a primary concern with ecosystems to embrace human behavior and economic and social dynamics, thus bridging the two main themes of this workshop.

Discussion

Following the presentation, the group discussed potential risks of using expert judgment as a component of evaluation tools. Dr. Smith acknowledged the risks but also noted that Australia has done a poor job of investing in fishery independent data sets, so that formal modeling is not always possible. Many fisheries are data poor and the use of a triage approach takes a deliberately precautionary approach. In the absence of information, high risk is assumed. This results in a lot of false positives in terms of high risks, but it avoids false negatives. However the false positives can be progressively eliminated as more information comes to light, resulting in an incentive to collect better information. Dr. Smith was asked about the options for bringing other industries in to the EBFM analysis as "external drivers." He explained that tools such as ERAEF and Atlantis are well suited to deal with additional drivers. Within fishing communities there is general acceptance of ideas like management strategy evaluation.

When asked about management objectives, Dr. Smith noted that maximum economic yield (MEY) is the explicit target in the harvest strategy policy. The focus of the harvest strategy policy is fairly narrow but the EBFM focus is much broader and brings in all the other aspects of fishery management that fishery managers have to deal with in the real world. There is great variability across fisheries in terms of the economic and behavioral data that are available. At the federal level, there have been economic surveys in place since the 1990s for the major fisheries, with data collected on variable and fixed costs that are factored in to bio-economic models. Information is now being provided directly from fishing industries because they recognize that they need to provide and share data for economic modeling. Information on behavioral responses of fishers to changes in regulation is also starting to be collected. Some behavioral economic methods are being developed.

The group discussed methods of reviewing information that comes out of the more complex ecosystem models. Dr. Smith noted that applying the standards normally applied to stock assessments would result in most ecosystem models being rejected. However the use of such models for strategic evaluation (e.g. MSE) rather than to provide tactical advice means that greater uncertainty can be accommodated. .

A participant asked Dr. Smith whether there was a reason why Australia is not doing aggregate level yield analysis. He responded that Australia is resource limited in modeling expertise and that aggregate level yield analyses have been a lower priority than other applications such as whole of fishery MSE.

Dr. Smith was asked to elaborate on which methods of stakeholder engagement worked well and which ones were not effective as they related to ecosystem based management approaches. He explained that all management systems in Australia are built on extensive stakeholder

engagement and involvement, with resource assessment groups involving industry and environmental non-governmental organizations (ENGOs) as well as scientists and managers. This type of engagement is a feature at all levels in the advisory process. It is hard to say whether the participatory approach works better than a top down approach because it is now ubiquitous. There is good buy-in once the stakeholders get through the process, but it can take longer to get things done.

SSC Progress Reports and Updates

North Pacific Council

Presenter - Pat Livingston, SSC Chair

This report provides an overview of the North Pacific Fishery Management Council (NPFMC's) ecosystem perspective, and a short discussion of current practices and challenges with using social and economic information in a fishery management context.

Overview of NPFMC Ecosystem Perspective

The NPFMC has adopted many actions that comport with an ecosystem-based approach to fisheries management. The Council's policy is to apply judicious and responsible fisheries management practices based on sound scientific research and analysis, proactively rather than reactively, to ensure the sustainability of fishery resources and associated ecosystems for the benefit of future, as well as current generations. In addition to conservative ACLs for all managed species, Alaskan region fishery management incorporates a number of other conservation measures. Extensive area and seasonal closures exist throughout Federal waters in and off Alaska, protecting sensitive areas, such as deep sea coral gardens, areas where the risk of encountering bycatch and prohibited species is high, and marine mammal critical habitat. Gear restrictions are also used extensively, especially for bottom-contact trawling, as well as gear modification requirements to reduce adverse interactions. Examples include biodegradable panels on pots, salmon excluder devices in trawl nets, seabird deterrents on longlines, and elevation devices on trawl sweeps. All species or species groups are managed with individual ACLs and, in many cases, bycatch limits are also implemented for species outside of the FMP. For pollock and Pacific cod, retention requirements also exist to reduce discards and waste. Some additional elements of the Council's management approach are highlighted below.

Ecosystem-based Management Policy

The Council has developed a multi-objective ecosystem policy for its groundfish FMPs. The policy was developed during the course of a comprehensive, programmatic review of the

groundfish fisheries in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA). Each of the eight policy goals also has a set of specific objectives that further specify how the goal should be implemented. Additionally, the Council periodically develops a work-plan to prioritize actions to implement the policy goals and objectives, and the status of the work-plan is reviewed at each Council meeting. The eight policy goals are:

- Prevent Overfishing
- Promote Sustainable Fisheries and Communities
- Preserve Food Web
- Manage Incidental Catch and Reduce Bycatch and Waste
- Avoid Impacts to Seabirds and Marine Mammals
- Reduce and Avoid Impacts to Habitat
- Promote Equitable and Efficient Use of Fishery Resources
- Increase Alaska Native Consultation
- Improve Data Quality, Monitoring, and Enforcement

While the SSC is stalwart in its position that it does not recommend policy to the Council, the SSC is nonetheless essential in helping the Council to articulate how a given policy might be conceived, both with respect to ecosystem policy and the use of social and economic information in fishery management. During the development of the Council's groundfish management policy and programmatic groundfish fisheries review, the SSC provided comments to the Council at every iteration. The SSC did not recommend which of the various policy options the Council should finally endorse, but was nonetheless integral in helping to incorporate a multi-objective ecosystem approach into the alternatives that called for such an approach, one of which the Council eventually endorsed.

System-level OY

The NPFMC has an established OY range for BSAI and GOA groundfish FMPs. The OY range for the BSAI was determined when the FMP was first established, in the early 1980s, as 85% of the MSY range calculated for the groundfish complex. The groundfish complex includes target species (pollock, cod, flatfish, rockfish, sablefish, Atka mackerel, and squid), as well as four species groups then-categorized as 'other' (sharks, octopus, skates, and sculpins), and MSY was based on average catches of these species from 1968 through 1977. The 15% reduction from MSY was intended to assure the continued health of the target species, and to mitigate the impact of commercial groundfish operations on other elements of the natural environment. The BSAI OY range is 1.4 million metric tons (mt) to 2.0 million mt. In the last decade, the 2.0 million mt upper limit has been scientifically re-evaluated, and has also been codified in national law.

For the GOA, the OY range was established in 1986, as 116,000 mt to 800,000 mt. The lower end of the range is equal to the lowest historical groundfish catch during the 21-year period preceding the approval of the OY range. The upper end of the range was approximately equal to 95% of the mean MSY for the most recent five-year period, at the time of the amendment for all species of groundfish that supported their own fishery and for which sufficient data existed (pollock, cod, sablefish, rockfish, flatfish, and Atka mackerel).

The NPFMC also has a system-level OY of zero for the Arctic FMP. There are three target species identified for the Arctic FMP (snow crab, Arctic cod, and saffron cod), and an MSY was calculated for each stock. To calculate OY, the MSY values were reduced by the relevant socio-economic factors of uncertainty and costs, as well as relevant ecological factors. For each species, a decision theory calculation was made to reduce the MSY for each stock by a given percentage to account for uncertainty. Because no significant commercial fishery currently exists (nor has existed in recent history) for any of the three stocks to which the plan applies, the expected costs of fishing outweigh the expected revenues, which further reduced MSY to zero. Finally, as Arctic cod is a keystone species in the Arctic, the relevant ecological factors prescribe something close to a 100% reduction from MSY for Arctic cod and saffron cod (the latter of which cannot be targeted without harvesting Arctic cod).

Using Ecosystem Information in an ACL Context

One tactical mechanism to incorporate ecosystem information into stock assessments is to include a quantitative variable into a single species model. This variable might be a predation (M2) variable, or an environmental or habitat variable. For example, in the eastern Bering Sea yellowfin sole stock assessment, the survey catchability variable (q) fluctuates, based on water temperature (i.e., whether it is a cold or a warm year). In another instance, the GOA walleye pollock stock assessment incorporates a B_{20} threshold, limiting fishing at low biomass levels, as a protection measure for Steller sea lions, which prey on pollock.

Ecosystem information can also be incorporated into the annual ACL process in a qualitative way. Since 1995, the Council has had an Ecosystem Considerations Report presented as an appendix to the groundfish SAFE reports for groundfish management. Over the years, this section has evolved and expanded to include an ecosystem assessment for each region in addition to reporting of ecosystem indicators. Beginning this year, a targeted Ecosystem Considerations report is also being included with the crab management SAFE report. The groundfish stock

assessment authors include a section describing ecological interactions for their species, in each of their stock assessments. These are primarily qualitative in nature, and may be used in the annual assessment of whether ABC should be reduced below the maximum allowable. These are also used to identify stocks that are highest priority for multispecies modeling and assessment. Some stock assessments also incorporated ecosystem factors directly into the assessment model. Some species have temperature-dependent factors that shift the selectivity curves and some have age-varying natural mortality because of age-varying predation mortality. Also, commercially-important prey species of the endangered Steller sea lion have more conservative minimum stock size thresholds than other target groundfish species. Moreover, climate regime shifts factor into decisions about what years to select for estimating stock-recruit parameters and MSY.

The annual ecosystem assessment is presented during the groundfish harvest specifications discussions at the Plan Teams (PTs), and subsequently at the SSC and Council (Figure 2). Information from that assessment is also available to the stock assessment authors, for direct use in their assessments. A staff member from the ecosystem assessment group at the Alaska Fisheries Science Center sits on each of the groundfish PTs, to provide expertise in the harvest specification discussions. As noted above, the ABC deliberations by the PTs and SSC may include consideration of whether there is a trend in natural mortality due to predation, or whether there is sufficient forage for a target species that may be exhibiting reduced recruitment trends. This may play a role in deciding whether the ABC should be reduced below the maximum allowable.

An example of how qualitative evaluation of ecosystem information can affect the ACL process is the establishment of the ABC for Bering Sea walleye pollock for 2008. The PT and the SSC both reviewed the stock assessment, which resulted in a maximum permissible ABC of 1.17 million mt. However, new data indicated that various year classes appeared less strong than they had previously seemed, indicating that forage for pollock might have been reduced. Additionally, related information from the ecosystem assessment indicated a growth in the arrowtooth flounder population, which may be resulting in increased juvenile pollock mortality. Given the uncertainty of these various factors, the SSC recommended extra conservatism, and recommended that the ABC should be lowered to 1 million mt. As part of their deliberations, the SSC considered the economic implications of the ABC reduction, and provided the Council some additional analysis of how the Bering Sea pollock industry would be positioned to weather the projected pollock ABC reductions, and whether the change would be expected to result in wide-spread economic failure and dislocation.

Strategically, other tools can also be used to incorporate ecosystem information into the ACL process. Management strategy evaluations can be used to determine the robustness of management strategies. Additionally, the quantitative suites of ecosystem indicators and aggregate indices that are included in the annual Ecosystem Considerations report can be useful.

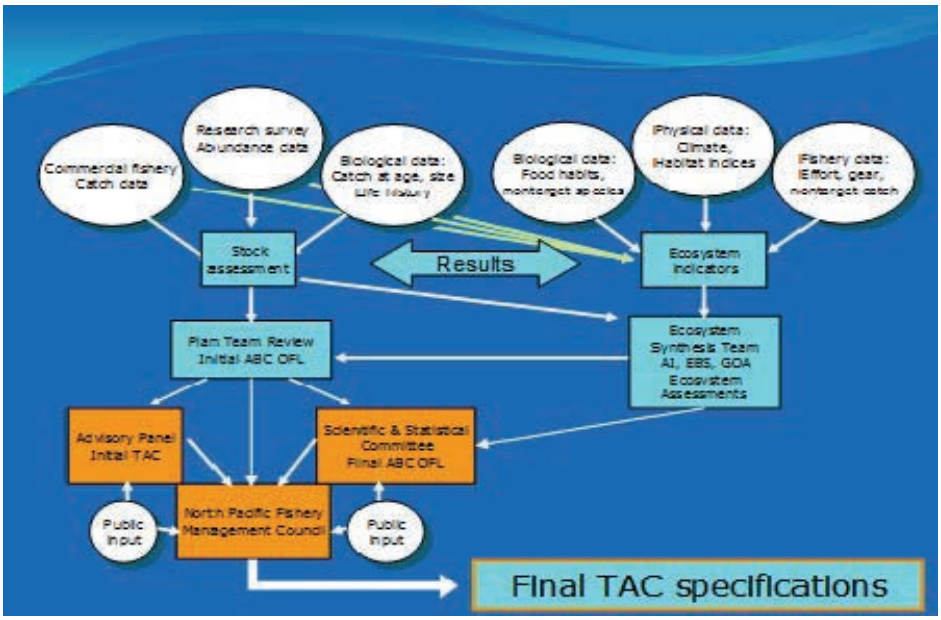


Figure 2. Schematic of the NPFMC process for specifying annual catch limits.

Considerations for Forage Fish

The NPFMC groundfish FMPs have a forage fish category, part of the ecosystem component of the fishery, which identifies species that are a critical food source for many marine mammal, seabird, and fish species. A directed Federal fishery for these species is prohibited, and a catch deterrent requires vessels to discard bycatch amounts that exceed 2% of the target catch they have onboard. Forage fish categories:

- Osmeridae family (eulachon, capelin, and other smelts)
- Myctophidae family (lanternfishes)
- Bathylagidae family (deep-sea smelts)
- Ammodytidae family (Pacific sand lance)
- Trichodontidae family (Pacific sand fish)
- Pholidae family (gunnels)
- Stichaeidae family (pricklebacks, warbonnets, eelblennys, cockscombs, and shannys)
- Gonostomatidae family (bristlemouths, lightfishes, and anglemouths)
- Order Euphausiacea (krill)

Some of the target groundfish species are also important as prey species. These include pollock, cod, Atka mackerel, squid, and others. Sometimes, detailed food habits data and trends are presented in assessments for such stocks to ascertain time trends in natural mortality that may be

a concern. Additionally, whereas herring and shrimp are not federally managed species, they are also important as forage species.

Council Activities Supporting Ecosystem-based Approaches to Fisheries Management

The NPFMC has also adopted several broader-scale efforts to consider an ecosystem-based approach to fisheries management. In 2004, the Council re-constituted its Ecosystem Committee to track national level ecosystem-related initiatives, and determine whether they are relevant for fishery management in and off Alaska. An idea that had its genesis in the Ecosystem Committee is the Alaska Marine Ecosystem Forum, with a membership of thirteen Federal and State agencies with jurisdiction over marine activities off Alaska. The group meets periodically to promote dialogue and information exchange about issues of shared responsibilities related to the marine ecosystems off Alaska's coast. The goal of the Forum is to improve agency coordination and allow agencies to understand the ecosystem impact of other marine activities.

The Council also has developed an Aleutian Islands FEP. The FEP identifies key interactions in the Aleutian Islands that should be monitored by fishery managers, and assesses the risk associated with those interactions, and how managers are currently addressing that risk. Both available and ideal indicators for these interactions are identified in the FEP, as an indication of priority data gaps and research needs for the ecosystem.

The recent development of the Arctic FMP by the Council was modeled on an ecosystem-based approach, both in its geographic scope and in its ecological basis. The development involved considerable outreach to stakeholders within the Arctic region, as well as fishing industry representatives.

Using Social and Economic Information in Fishery Management: current practices and challenges

Among the roles served by the NPFMC's SSC is that of reviewing the adequacy of all social and economic analyses, prior to the Council's final decision. The SSC utilizes its scientific expertise to provide technical advice to analysts concerning all FMP and regulatory amendment analyses prior to public review. In 2010, the SSC conducted 13 reviews of amendment analyses, of which the social and economic portions Regulatory Impact Review (RIR)/Initial Regulatory Flexibility Analysis (IRFA) ranged from 5 pages to 185 pages and averaged 20 to 30 pages. Although most analyses are reviewed a single time by the SSC, with recommendations to be addressed by analysts prior to the release of the document for public review, some analyses require more extensive revisions that require the SSC to review the revised document a second time prior to public release. In instances when the complexity of an issue may be anticipated or the SSC's expertise is deemed useful for development of alternatives for analysis, the SSC may review

discussion papers, analytical outlines, or preliminary analyses. In 2010, the SSC reviewed one analysis a second time and also reviewed four preliminary analyses. The SSC also reviewed four discussion papers, two of which addressed analytical methodologies and two of which addressed data collection. The SSC also reviews the economic portion of the SAFE report. Moreover, the SSC has conducted occasional workshops to hear and comment on ongoing and planned social and economic studies conducted by NMFS and university scientists related to Council issues and needs.

In reviewing a social and economic analysis, the SSC determines the "adequacy" of that analysis, based upon whether that analysis provides the Council with the best available information to evaluate: 1) the expected effects of each alternative on potentially affected groups; 2) the benefits and costs of each alternative (including a summary of the net benefits to the Nation; and 3) the action in relation to the MSA national standards (NS).

The SSC confronts several issues in assessing the adequacy of an analysis. Issues arise disproportionally from two particular limitations. First, analysts often are challenged by the Council to generate analyses in a relatively short period of time. It is not unusual for the Council to request that an analysis of a complex management decision be prepared in just a few months. This time constraint limits the ability of analysts to prepare more complex, sophisticated analyses. In particular, time is not available to develop complex models that quantify the effects of a management action. Second, analyses are often data constrained. In particular, few cost data for economic analyses and minimal social and cultural data are typically available.

In recent years, the Council has been challenged to resolve management issues that affect the distribution of resources among the commercial fishing sector and other interests (including, guide sport fishing interests, and subsistence users). Several issues arise in the development of analyses that contrast these, often, competing interests. For the commercial fishery sector, data are available to provide quantitative estimates of effects on landings, gross revenues, and prices. These estimates, however, are typically generated by using static models that analyze the effects of an action retrospectively. Behavioral changes may be discussed, but are not incorporated into the models. In the available time, it is unlikely that more complex models could be generated. Yet, the reliance on these limited analyses is questionable. A further challenge arises from the dearth of reliable cost data. Without cost data, analyses cannot quantitatively examine net effects on the commercial fishery sector, which are critical to understanding the true effect of the action.

Similarly, community effects are also typically analyzed through economic and social profiles that provide a historical 'snapshot' of the community. Limited quantitative information is available concerning interests other than commercial fisheries. Recreational and subsistence harvests are poorly documented. In addition, extensive modeling is needed to develop

quantitative estimates of effects and impacts that may be compared to commercial fishery effects and impacts. Biological uncertainties compound these challenges. For example, development of measures to compare the potential societal benefit derived from an uncertain recovery of an endangered species, with additional costs associated with commercial fisheries area closures, juxtaposes two substantial analytical challenges. Recently, a greater analytical challenge has arisen in connection with proposed management measures to establish a limit on Chinook salmon prohibited species catch in commercial trawl fisheries, in part, to protect subsistence fishing interests, which could arguably require analysts to value the subsistence lifestyle benefit derived from potential increases in Chinook salmon returns. In such a circumstance, the SSC must evaluate whether qualitative analyses adequately inform decision-making, concerning the effects of the action (including the net benefits to the Nation).

Two specific examples shed light on the challenges faced by the SSC's efforts to address these challenges. The first example is the crab economic data reports (EDR), a data collection program mandated by Congress, which were implemented simultaneously with the implementation of a catch share program in the BSAI crab fisheries. The program's objective is to collect comprehensive economic data (most importantly cost data) to allow more comprehensive analyses of the crab fisheries and the effects of the catch share program. Since its outset, there have been discussions about the utility of the program. These have included questions about the accuracy and consistency of the data, particularly cost elements that must be estimated or prorated across fisheries that may have different operational structures.

It has been acknowledged that some of the collection is redundant with other programs, which request similar (but not exactly the same) data. Costs of the program to both industry and the agency could also be reduced. The time for a submitter to complete a form is estimated to be approximately one week, annually. Agency costs are also substantial, as the cost of administration of the program has exceeded quota management costs in some years. These concerns have led the Council to consider revising the program, with alternatives that scale back the collection substantially. There is an ongoing discussion in the Council concerning the appropriate scale of economic data collection programs for fisheries analyses.

A second example arises from the development of a catch-sharing plan, to apportion the available halibut resource between the commercial fishery and the guided sport (charter) fishery. On its face, such a division requires analysts to examine the relative impacts of the two sectors on local and regional economies. The different industry structures affect local communities and economies very differently. In addition, analysts must develop estimates of demand for charter services under various proposed bag limits and size limits. A considerable challenge also arises from the need to assess the price effects of a provision allowing charter operators to supplement their operations by acquiring individual fishing quota from the commercial sector. Each of these considerations alone poses a substantial analytical challenge. The NPFMC's SSC will continue

to face this tension between the need for additional data and modeling, on one hand, and the need for timely management actions when providing scientific expertise and technical advice to analysts, on the other. While integrating more sophisticated models into analyses might improve social and economic information to decision makers, the development of such models for examining the effects of an action would often substantially delay the action. A further challenge arises in the development of quality sources of economic and social data needed to support analyses. The SSC will continue to endeavor to provide leadership and expert guidance to further the Council's understanding of the scientific basis for, and implications of, management actions under consideration.

Discussion

John Boreman asked about the status of the NPFMC ABC control rules. Pat Livingston responded that the overfishing limit (OFL)/ABC/ACL protocols for the Groundfish and Crab FMPS are in place and the Council is in the process of revising the Salmon FMP.

Mark Holliday asked who produces the SAFE Reports and if they are current for all the fisheries in the North Pacific region? Pat Livingston responded that the SAFE Reports are produced annually by the Alaskan Fisheries Science Center, although some of the SAFE chapters for the Crab FMP are authored by personnel from the Alaska Department of Fish and Game.

Pat Livingston was asked to give an example of how economic and social analyses reviewed by the SSC actually get incorporated into the ABC recommendations to the Council. She responded that the social and economic SAFE information does not affect the ABC and ACL analysis, although she thought it probably occurs mostly in FMP amendments that do not affect the ABC and ACL determinations directly, but social and economic factors are taken into account when the Council sets the total allowable catch TAC levels (annual catch targets (ACTs)) and prohibited species bycatch limits. Social and economic information is primarily used in analysis supporting FMP amendments and regulatory amendments.

Western Pacific Council

Incorporating Ecosystem Considerations in Developing Fishery Management Alternatives

Presenter - Craig Severance, SSC Representative

Institutional Framework for Ecosystem Consideration in Fishery Management

EBFM changes the biological emphasis from single species to ecosystems, it brings into the mix disciplines that have not traditionally been part of fisheries management. The WPFMC is utilizing a multi-step, multi-disciplinary approach to develop and implement FEPs for the Western Pacific Region. This will require increased understanding of a range of issues to be successful including trophic relationships, biological and ecosystem indicators, ecosystem models, and the ecological effects of fishing and non-fishing activities on the marine environment. In addition, the organizational structure for administering and monitoring FEPs is broader than for fishery management plans and explicitly incorporates community input and local knowledge that is essential to good resource management.

A series of workshops was convened by the WPFMC to facilitate understanding of an EBFM approach. These workshops brought together scientists and other experts from various disciplines from fisheries and ecosystem to sociology, economics, and policy development to formulate recommendations for implementation of an ecosystem approach on an archipelago scale. The workshop resulted in a transition from FMPs to FEPs in 2009. A concise summary of the approach is found in Glazier (2011). Although the FEPs are still primarily stock oriented, applying a place-based approach allows for a more localized focus on the issues surrounding the stocks as part of an ecosystem. This approach has facilitated the inclusion of institutions and individuals not included in a typical fishery management scenario and has broadened management considerations for the stocks.

In the Western Pacific Region, the management of ocean and coastal activities is conducted by a number of agencies and organizations at the federal, state, county, and even village levels. These groups administer programs and initiatives that address often overlapping and sometimes conflicting ocean and coastal issues. The Council expanded the mechanisms for participation in the Council process by establishing the Regional Ecosystem Advisory Committees (REAC) in order to increase collaboration with federal, state, and local management bodies, as well as other governmental and non-governmental organizations, communities, and the public. The committees for American Samoa, Hawaii, and the Mariana Archipelago are comprised of Council members and representatives from federal, state, and local government agencies; businesses; and non-governmental organizations that have responsibility or interest in land-based and non-fishing activities that potentially affect the area's marine environment.

Further, the Council's SSC is composed of nineteen members, with expertise and experience in ecosystem analysis, ecology, fisheries science, and local fisheries. SSC fishery biologists from American Samoa, Guam, Hawaii, and Commonwealth of Northern Mariana Islands provide in-depth knowledge of local fisheries.

Incorporating Ecosystem Consideration in Fishery Management: An Example from the ACL Process

The current Bottomfish Management Unit Species described in the FEPs are comprised of both shallow (mostly reef fish) and deep (deep water snappers and grouper) components. Ecosystem considerations were included in the 2011 Main Hawaiian Island (MHI) Bottomfish Stock Assessment. The stock assessment focused only on the primary stock complex of six snappers and one grouper (termed the Deep 7 complex) rather than mixing shallow and deep water species. The assessment incorporated new research information on the life span of *Pristipomoides filamentosus*, the primary Deep 7 catch, based on bomb radiocarbon and lead radium dating. The Deep 7 bottomfish complex was assessed as a single unit stock in the MHI.

Conducting the stock assessment on only the heavily targeted Deep 7 species provided a better assessment of the status and management advice for these key management species than if all bottomfish species had been included. Limiting the stock assessment only to the MHI made the assessment more ecologically consistent, since it has been shown that the larval connectivity is patchy for the Deep 7 species along the chain from the MHI and the Northwestern Hawaiian Islands. Environmental forcing was also considered in the assessment.

The MHI Deep 7 bottomfish stock is considered as a Tier 1 stock within the ACL specification process. Under this process, a probability of overfishing P* analysis, Social, Economic, Ecological, and Management Uncertainty (SEEM) analysis is to be applied to determine ABC and ACL. The P* Working Group was made up of one Council member and three SSC members. Council staff and a NMFS Pacific Islands Regional Office staff attended when the Working Group convened.

There were four scoring criterion employed to reduce P* from a 50% probability of overfishing the stock: 1) assessment information; 2) uncertainty characterization; 3) stock status; and 4) productivity and susceptibility.

Regarding assessment information, the working group reached consensus that the catch history and standardized catch history information was sufficiently reliable to conduct the stock assessment. Species-specific information and fishery independent sources of information, which included tagging and spatial analysis, were adequately addressed in the assessment. On uncertainty characterization, the working group unanimously agreed that the stock assessment model used adequately characterized model uncertainty. On stock status, since the stock is currently not overfished and not experiencing overfishing and is well below the overfishing benchmark, the percent reduction score (from P_{max}) was low but was adjusted higher since the assessment was done on a complex and not individual species making up the complex. On productivity and susceptibility, bottomfish life history experts were consulted on the species productivity and vulnerability to fishing that yielded a score of 4.9. The overall reduction from the P* maximum of 50% OFL was a P* value of 40.8, which corresponded to an ABC of 345,522 pounds. SEEM analysis was used to determine appropriate ACLs, which will be described in detail in the succeeding section.

Another example of application of ecosystem considerations in the ACL process was for reef fishes. Reef fishes are considered as Tier 5 stocks where only catch information is available. However, other sources of biological and ecological information were available that helped inform the ACL process, including:: 1) size-frequency distribution by species from catch and underwater visual census (UVC) data; 2) temporal trend in size for each species from catch and UVC data; 3) biomass information to the species level derived from UVC data; and 4) coral reef habitat area estimation, which was used as a biomass expansion factor.

The size-frequency distribution of species found in the catch and the UVC data were similar, indicating that the fishery in general does not select by size. However, spearfishing gear is highly selective and tends to harvest larger individuals. The temporal trend analysis showed no significant decline in sizes of species harvested in the fishery compared to the same species observed in the census surveys. Catch data plotted against biomass information showed small amounts being harvested relative to biomass on a family level. This result led to the decision by the SSC to set the ABC equal to 1 times the 75^{th} percentile of the long term catch history.

Integrating Social Sciences into the WPFMC SSC Decision Making Process

The SSC has five members with backgrounds in the social sciences, including cultural anthropology, archaeology, resource economics, and sociology. All have extensive experience with fisheries and fishing communities in one or more parts of the Western Pacific Region. Two are also experienced fishermen. The SSC works closely with Council staff. When action items such as plan amendments are put forth to the SSC in National Environmental Policy Act (NEPA)-like format with a range of alternatives, the SSC may choose to recommend one or more alternatives, modify the alternatives, or propose other alternatives. The social science members

do not usually see these items prior to the circulation of meeting documents, and rely heavily on staff for development of potential costs, benefits, and the impacts of proposed alternatives. This is an area, perhaps, where pre-meeting communication and interaction with Council staff could flesh out various scenarios for impacts of potential Council actions and lead to more effective SSC social science input. On a few issues such interaction does occur, especially if select members are placed on working groups, as happened with the SEEM analysis used to help develop the ACL for Hawaii Deep 7 Bottomfish. However, such interactions are not consistent or institutionalized.

SSC members are generally uncomfortable about recommending a specific "policy" action when it involves social and economic considerations, such as "allocation." SSC members generally believe that that social science should contribute by fleshing out the range of potential impacts, ramifications, and unintended consequences to fisheries and fishing communities of actions the Council chooses to take. This puts the emphasis on science, just as the SSC does with regard to biological issues. The MSA is clear that social and economic data on fisheries and fishing communities is to be taken into consideration by SSCs in their deliberations, especially in the ABC-ACL-annual catch target (ACT) process.

Social scientists on the WPFMC SSC have to be continually conscious and aware about their important role in developing or contributing to recommendations that may become the Council's policy choices. Some members are more assertive than others, and some have suggested that the social sciences members should be more assertive on matters of social and economic consequence. Some members are also able to put on different hats, disclose their affiliation and still provide their independent professional advice on matters affecting fishing communities during the scoping and/or Draft or Final Environmental Impact Statement public input process. In this regard the academic and private sector SSC members often have more flexibility than National Oceanic and Atmospheric Administration (NOAA) employees.

The WPFMC has not yet been forced to make major resource allocations among fisheries sectors, but it will most certainly be forced to do so in the future. The role of the SSC is not to direct the Council toward specific choices on issues that are clearly policy issues that fall within the Council's purview. The SSC's role is to apprise the Council of the potential range of ramifications, repercussions, unintended consequences, both social

and economic (quantitative and qualitative) that could impact fishermen, their families, and their communities. Here is an area where *post facto* or post impact assessments of actual versus projected scenarios and impacts could be useful to all the Council SSCs. The somewhat qualitative reviews of the impacts of past closures in the Hawaii Longline fisheries are a case in point.

The long-term tenure of many members of the WPFMC SSC is partly a result of the severe regional shortage of people with adequate training and background, as well as the need to have region-wide representation. An obvious recommendation is to nurture the development of fisheries social scientists based within the region, especially those from the indigenous population. Given the median age of current SSC members, this should be a priority. Another recommendation is to have the social science members of the SSC caucus and have more in-depth discussion of their proper appropriate role in the SSC process. A third recommendation is to encourage the social science SSC members to be more assertive in the SSC process, even if this requires expanding the education of non-social science members. A fourth recommendation might be for the chair to specifically query the SSC members as to their comments and concerns regarding the socio/economic ramifications of every consensus SSC recommendation made on day three.

Incorporating Socio-Economic Consideration in Fishery Management: An Example from the ACL Process

The SEEM Working Group reviewed and assessed four dimensions of the Deep7 Bottomfish fishery. The group included two SSC members, two state fishery managers, an economist and fishery biologist from Pacific Islands Fisheries Science Center, an economist and social scientist from NMFS Pacific Island Regional Office, and three active bottomfish fishermen.

The group met twice to develop a scoring system and flesh out the most significant factors to consider under each dimension. It was assumed that only negative scores could be used since positive scores on some socially and economically important dimension factors might place the ACL above ABC. Ultimately the group scored those factors, but it reached consensus that the positive scores were not used numerically in reducing the ACL from ABC, but that these social, economic, and ecological dimensions could be used to guide the Council on the social and economic importance of the fishery. The scoring provided a rationale for why the ACL should equal the ABC on these three dimensions. The score on the fourth dimension, management uncertainty, was utilized to reduce the ACT from the ACL. The four dimension factors were first presented as straw man factors, then evaluated by the group, and then refined and selected with the following rationale:

Social Dimension:

- Perpetuates cultural and traditional values.
- Provides symbolically-valued and culturally-important fish.
- Bottomfishing is a unique highly skilled occupation that is waning and should be maintained.
- Contributes to Hawaii's food security.

Economic Dimension:

- There is economic reliance of other industries on the fishery (multiplier effect).
- Financial security of the fishery and its participants is readily compromised by management decisions.
- Provides a unique product (never frozen, fresh low carbon footprint signature fish in regional cuisine).

Ecological Dimension:

- Uncertainty of ecosystem dynamics.
- Shift of fishing pressure onto species outside Deep 7 upon closure of the Deep 7 fishery.

Management Uncertainty Dimension:

- Unreported recreational landings.
- Commercial catch reporting, including misreporting.
- Weather influences ability to fish and productivity of fishing.
- Monitoring, including ability to forecast.
- Recreational discard mortality associated with high-grading.

Members of the team generated individual scores on each dimension. The positive average scores indicated the social cultural and economic importance of the fishery and supported the recommendation that the ACL be set equal to the ABC. However, due to management uncertainty, the SEEM Working Group recommended an ACT, which was 6% lower than the ABC/ACL. The SEEM working group recommendations were reviewed and supported by the SSC in their recommendation to Council in setting the Deep 7 ACT.

SSC–Council Interactions in Policy Development

The WPFMC is comprised of several advisory groups: 1) Advisory Panels (APs); 2) PTs; 3) REACs; 4) Council-established advisory bodies (Social Science Research Committee; Sea Turtle Advisory Committee; Non-Commercial Fisheries Advisory Committee; Marine Mammal Advisory Committee; Fisheries Data Coordinating Committee; Marine Spatial Planning Committee; and Hawaii Bottomfish Advisory Review Board). Specialized working groups may also be convened as needed.

Advisory Panel: The Council receives advice from a panel of recreational and commercial fishermen, charter boat operators, buyers, sellers, consumers, and others knowledgeable about the fisheries in the region, including indigenous fisheries. The panel includes subpanels for the American Samoa, Hawaii, and Mariana archipelagos; and for the Pacific Pelagic Ecosystem.

Council-established advisory bodies: The Council convenes these advisory bodies (composed of experts and stakeholders respective to each advisory bodies) to have focused recommendations on specific issues.

The PTs are the primary body responsible for reviewing the functioning of the FEP. The PTs put together the annual reports. The PTs are comprised of teams of scientists, managers, and industry representatives who make recommendations to the Council based on their annual review of the regions federally managed fisheries.

The Social Science Research Committee reviews socio-economic issues surrounding the different fisheries and national policies that affect the community. It also establishes social science research priorities. The Sea Turtle Advisory Committee reviews and makes recommendations on the status of the sea turtle population and on management measures that affect the turtle stocks and have impacts on the fishery. The Non-Commercial Fisheries Advisory Committee provides recommendations on non-commercial data reporting and management of the recreational, subsistence, and traditional fishing.

The Marine Mammal Advisory Committee focuses on issues surrounding marine mammal population, as well as their interactions with fisheries. It was formed primarily to address interactions between Hawaii longline vessels and false killer whales, which has been superseded by a False Killer Whale Take Reduction Team constituted under the Marine Mammal Protection Act (MMPA). The Council decided to maintain the team in case other fishery/marine mammal interactions require a Council response. The Marine Spatial Planning Committee was formed as in response the National Coastal Marine Spatial Planning initiative. This committee has a science sub-group that deals with the data compilation and analysis, and a management sub-group that deals with implementation.

Lastly, the Hawaii Bottomfish Advisory Review Board provides recommendations pertaining to issues specific administration of catch limits for the Hawaii bottomfish fishery, which were managed under a catch limit prior to the implementation of ACLs. Many of the recommendations from these advisory groups that have scientific implications are vetted through the SSC prior to consideration by the Council. Similarly, scientific aspects of recommendations arising during Council meeting discussions are also considered by the SSC at subsequent meetings

The SSC operates by consensus; no votes are taken but minority opinions may be recorded in the SSC minutes or recommendations. At the beginning a meeting SSC members are assigned by the Chair to rapporteur various agenda items. An attempt is made to insure cross-disciplinary expertise when making rapporteur assignments. Rapporteurs are responsible for capturing the draft wording and justification for an SSC consensus. As noted previously, the SSC also reviews many of the recommendations produced by the PTs, the APs, and the REACs. Some of these recommendations may be supported or modified. Others may receive no comment and be passed on to Council as policy items more appropriately considered within the Council's purview.

Pacific Council

Presenter - Martin Dorn, SSC Chair

ACL Implementation

The Pacific Fishery Management Council (PFMC) has adopted a P* approach for stocks managed under its Coastal Pelagic Species and Groundfish FMPs. ABCs are based on an evaluation of scientific uncertainty by the SSC in the form of a value for σ, the scale parameter for a log-normal distribution, and a P* selected by the Council to reflect its policy decision on risk. This approach has the advantage of having clearly delineated roles for the SSC and the Council, and avoids the back-and-forth negotiating that accompanies the use of arbitrary buffers to account for scientific uncertainty (e.g., ABC = 0.75*OFL). Three categories of stocks, data-rich, data-moderate, and data-poor, are assigned increasing values of σ to reflect the greater uncertainty of data-poor assessments.

The OFLs recommended by the SSC for the 2013-14 management cycle were adopted by the Council at the September 2011 meeting. For most stocks, the Council elected to use the same P* as in the previous management cycle to establish the ABC. The Council exercised its policy prerogative by selecting species-specific P*s for sablefish and spiny dogfish, reflecting its intent to manage these stocks with greater precaution.

In May 2011, a data-poor methods review panel reviewed and endorsed both Depletion Corrected Average Catch (DCAC) and Depletion Based-Stock Reduction Analysis (DB-SRA) as appropriate methods for obtaining OFLs for data-poor stocks. In June 2011, the Council adopted the ACL amendment to the Salmon FMP, and is currently awaiting secretarial approval. Nearly all salmon stocks are exempt from the ACL requirement because either they are managed under the Pacific Salmon Treaty, listed under the Endangered Species act (ESA), or are hatchery stocks. ACLs were required for only two salmon stocks. Alternative approaches needed to be developed due to unique aspects of salmon biology and management. For example, OFLs and

ABCs were defined in terms of projected spawning escapement, rather than as annual catch amounts.

Several workshops being planned for next year by PFMC as off-year groundfish science improvements. These include an assessment methods review panel to evaluate simple assessment techniques for data-moderate stocks, and a workshop to review B_0-based reference points used in harvest control rules and for status determination. The SSC is also considering ways to improve specification of scientific uncertainty, for example by setting stock-specific σs for data-rich stocks, and by using MSE modeling to evaluate the appropriate level of scientific uncertainty (σ) for data-poor groundfish stocks.

SSC Subcommittees

Much of the SSC's work is done by standing subcommittees that hold separate meetings for review of subject area analyses and to develop science recommendations. The SSC maintains subcommittees for each FMP (salmon, groundfish, coastal pelagic species, highly migratory species), and economics and ecosystem-based management (EBM) subcommittees. SSC members typically belong to two or more subcommittees. Reports developed by subcommittees go to the full SSC for review and endorsement. The EBM Subcommittee was initially established as the Marine Reserve Subcommittee to address scientific issues associated with the Channel Islands National Marine Sanctuary marine reserve initiative. The EBM subcommittee is the largest subcommittee of the SSC, and includes nine members out of the total SSC membership of seventeen. The subcommittee includes economists, marine ecologists, and stock assessment experts, which enables it to bring a broad range of expertise to bear on ecosystem-related issues. The Economics Subcommittee presently consists of two economists and two quantitative biologists with some expertise in economics.

EBFM Initiative

The PFMC launched a major EBFM initiative in 2009, and established an Ecosystem Plan Development Team (EPDT) and an Ecosystem Advisory Subpanel (EAS) to guide the plan development process. The EPDT consists of scientists and policy analysts from NMFS, and state and tribal agencies, while the EAS includes representatives from stakeholders groups and the general public, including both fishing industry representatives and conservation organizations. Based on Council direction, the initial focus of the EPDT was on developing a purpose and need statement and considering the regulatory scope of the plan. In addition, several presentations were scheduled to inform the Council on ecosystem-based management issues, including a presentation by the chair of NPFMC SSC on ecosystem-based management in the North Pacific, and a presentation by the developers of California Current Integrated Ecosystem Assessment.

The SSC has given advice on EBM to the Council in a number of areas, but has attempted to avoid making policy recommendations. The SSC has tried to clarify issues, and suggested the next steps and questions to be addressed by EPDT. The SSC has also recommended specific ways of incorporating ecosystem science into the Council process, and discussed review processes needed for ecosystem science tools and products.

The Council has generally taken a deliberative approach to adopting ecosystem-based management, and considers EBFM an evolutionary process rather than a revolutionary process. Potential changes in management under EBFM should provide tangible benefits in achieving Council responsibilities under MSA to sustainably manage fisheries resources while protecting marine ecosystems. The Council is already doing many things generally regarded as EBFM, such as closing areas to various types of bottom contact fishing gear under Essential Fish Habitat (EFH) provisions, using environmentally-based run size forecasts and harvest control rules, implementing bycatch restrictions to rebuild overfished groundfish stocks, and instituting a ban on krill fishing.

In June 2011 the Council approved the draft purpose and need statement as proposed by the EPDT, and moved to develop an ecosystem plan that is primarily advisory in nature with the potential for expanding the plan to include regulatory authority in the future. It also recommended continued management of stocks and fisheries through existing fishery management plans. The Council will consider additional management measures for forage fish species as is deemed appropriate. The Council's purpose statement is as follows: "The purpose of a FEP is to enhance the Council's species-specific management programs with more ecosystem science, broader ecosystem considerations, and management policies that coordinate Council management across its FMPs and the California Current Ecosystem (CCE). A FEP should provide a framework for considering policy choices and trade-offs as they affect FMP species and the broader CCE."

Socioeconomics Analysis and Review

Socioeconomic analyses are reviewed either by the full SSC or by the Economics Subcommittee. Review topics have included: a) socioeconomic data collection programs, b) economic models used for impact analysis, c) socioeconomic analyses in NEPA documents, and d) bycatch projection models with implicit fleet dynamics (joint with Groundfish Subcommittee). Recently, there has been an effort to identify and review the components of a regional impact model used to evaluate economic impacts of alternative groundfish management options (Figure 3).

Although the Council routinely uses the SSC for review of economic analyses, several long-standing problems with the review process have been identified. First, economic analyses often appear for review by the SSC as near final drafts, providing little opportunity for revision.

Reviews are often combined with, and are subordinate to, review of associated non-economic analyses. Finally, there is no formal review process with Terms of Reference (TOR), unlike the Stock Assessment Review (STAR) process for stock assessments, or the annual methodology review process for salmon management models. These shortcomings have been recognized, and potential improvements to the review process are under consideration.

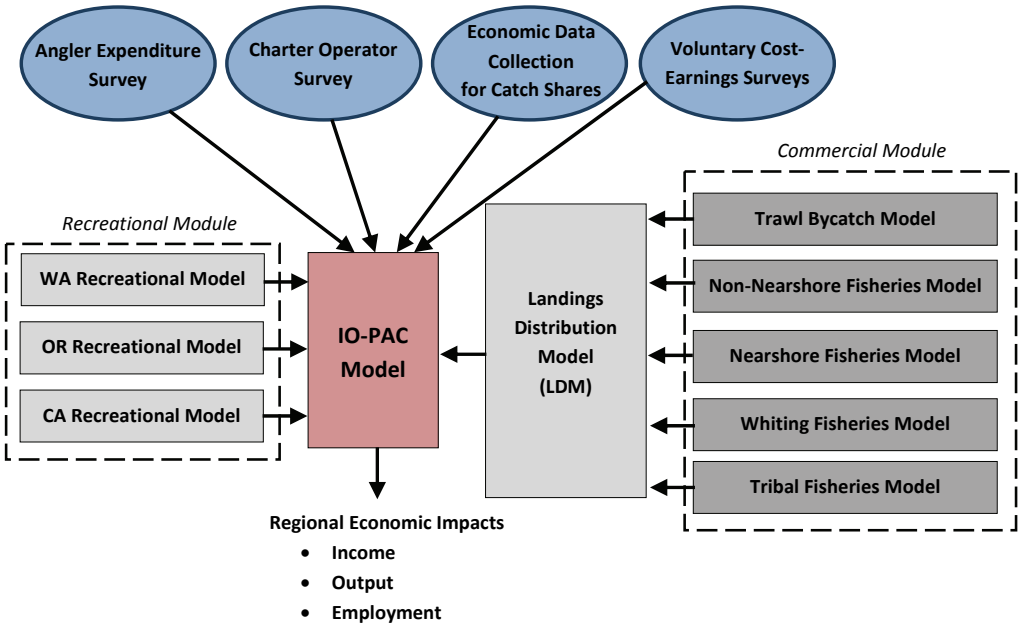


Figure 3. Schematic of the regional impact model used by the PFMC C to evaluate economic impacts of alternative groundfish management options.

Discussion

Rick Methot noted that Martin talked about the need for initial clarification in interacting with the Council on setting the P* level, and asked if the SSC had any technical analysis in the works to look at the trade-off analysis between forgone yield and preventing overfishing. Martin responded that they do not really have an analysis to point to. Some work has been done at the North Pacific on doing some modeling to look at the long term impacts of different choices of P*. They have not had the advantage of having that in front of them to give to the Council. He thinks it would be good, but it is a question of finding the people that are able and willing to do that kind of work.

Minling Pan asked what kind of improvements the PFMC is considering? Martin responded that they are trying to move toward a more informal process where the SSC proposes things that they want to review and try to pick those in the coming year. He also thought that there might be a little focus on TOR in terms of what they need to see provided in order to conduct a review.

Gulf Council

Presenters - Sean Powers, SSC Chair and Benjamin Blount SSC Vice-Chair

Synopsis of Major SSC Actions

Since the last national SSC meeting, the majority of the Gulf Fishery Management Council (GFMC) SSC's attention has been focused on completing ABC recommendations for all managed species, reviewing new stock assessments, revisiting ABC recommendation on several key stocks (e.g., red snapper and gag), as well as the recovery of the Gulf of Mexico's fisheries from the Deepwater Horizon Oil Spill. The Deepwater Horizon Oil Spill was the largest oil spill in US history, releasing almost five million barrels of crude oil into the Gulf of Mexico. Response activities from the oil spill included one of the largest fisheries closure in the nation's history. A third of the US EEZ in the Gulf of Mexico was closed to fishing, as was a significant portion of state waters in Louisiana, Mississippi, Alabama, and northwestern Florida. The duration of these closures varied, but many lasted close to 180 days. Many members of the SSC were and remain engaged in the assessment of the spill's impact on fisheries resources and the environment. The complexity of the incident, including the potential for wide spread toxicity of oil and dispersants on target and non-targeted species, reduced fishing pressure, and habitat degradation, will require a true ecosystem approach to understand the consequences of the spill.

Figure 4. The effects of the Deepwater Horizon explosion and oil spill have dominated much of the science in the Gulf of Mexico this past year (Picture courtesy NOAA).

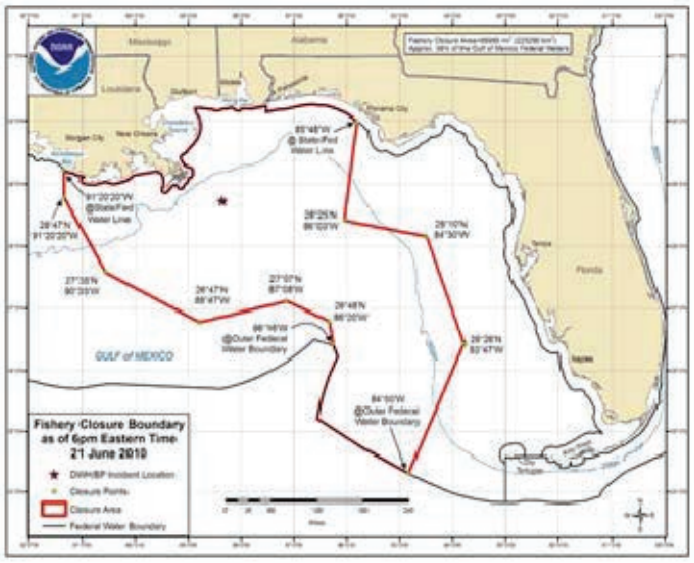


Figure 5. The Deepwater Horizon response included a large scale fishery closure for the Gulf of Mexico (see red lined areas).

To date, the SSC has been asked to formally comment on only one issue associated with the oil spill: whether any underage in the red snapper recreational

quota for 2010 could be added to the 2011 quota. The recreational red snapper fishery usually occurs in the summer (June-July). The oil spill delayed the opening until September. As a result of reduced fishing effort, the recreational harvest was under its allocation – a rare event over the last few years. At the request of Council, the SSC considered a "roll over" of the million pound underage into the remaining 2011 quota. To more objectively assess the impact of the quota underage, NMFS SEFSC re-ran projections from the 2009 update assessment, including both the underage in 2010 and an overage in 2009. The resulting yield stream from the projections allowed for a 300,000-pound increase (using the SSC previous decision on setting ABC = 75% of the OFL). In the end, the recreational fishery exceeded their quota in 2011 by more than 300,000 pounds, so hope of a fall opening season in 2011 was dashed.

A fair amount of the SSC's time has been spent responding to Council's request for clarification and or re-assessment of ABC recommendations. The GFMC asked its SSC to reconsider and provide more detailed rationale for several ABC recommendations over the last year. Gag and red grouper have been revisited multiple times. The SSC will revisit red snapper again in January 2012. Many of the SSC members have expressed concern when re-running only the projections of past assessments and not updating catch per unit effort (CPUE) indices, age composition, or fishery independent indices. About 25% of SSC meeting time is now consumed with this loop of reconsideration. In general, during the revisions in recommendations, the SSC has stayed consistent with their original rationale; however, if new projections change that value then the SSC has recommended a new ABC. In most cases, the re-runs have not significantly changed ABC recommendations.

Socioeconomic and Ecosystem Considerations of the SSC

The SSC has been largely consumed over the past two years in setting ABC and OFL levels and has not had time to discuss ecosystem or socioeconomic issues. SSC members are excited about new collaborations with the Ecosystem SSC (proposed) and reinvigoration of the Socioeconomic AP. It will be a tremendous improvement to have more socioeconomic information. The Council currently has a separate Ecosystem SSC (proposed) to identify and address long-term priorities for ecosystem based fisheries management. The planning for the Ecosystem SSC has occurred over the past five years, and the Standing SSC has had limited communication with the Ecosystem SSC; however, recent focus has been on increasing communication between the two committees. Plans are for the chair of Ecosystem SSC to attend the Standing SSC meetings and give a report on the Ecosystem SSC meetings. Currently, the Ecosystem SSC is conducting planning and scoping meetings to develop a work plan for the next couple of years. Our Standing SSC is in discussions with the provisional Ecosystem and Socioeconomic SSCs, as well as Council staff, to better define the roles and identify necessary collaboration. Currently, one of the items under discussion is the potential for membership overlap between the two committees.

From a socioeconomic point of view, one issue the SSC has felt strongly about is the lack of socioeconomic data in the Southeast Data Assessment and Review (SEDAR) assessments. As a first step, the SSC has added a specific term of reference to provide any demographics and socioeconomics data for the fishery, especially as it may relate to fishing effort. The shift to individual fishing quotas (IFQs) in the commercial fishery sector is one example of how changes in socioeconomic conditions could impact the SSC's interpretation of fishery-dependent data. The SSC has little information on how these major changes will affect the way the fishery is prosecuted.

South Atlantic Council

Presenter - John Carmichael, SAFMC Staff

Status of the ABC Control Rule

Since the last National SSC Workshop in Charleston, SC, the South Atlantic Fishery Management Council's (SAFMC) SSC has finalized the conceptual structure of its ABC Control Rule, choosing to go with a tiered approach. The upper two tiers use analyses that can produce a pdf of OFL and, therefore, the P* approach can be used to determine ABC. The lower two tiers are applied to more data-poor situations and provide a provisional ABC, as OFL is considered unknown. As a next step, the SSC will review the Only Reliable Catch Series (ORCS) workgroup report to evaluate the applicability of its recommend approach for providing ABCs for catch-only stocks (tier 4 in the current control rule structure). The structure and conceptual framework of the ABC Control Rule was reviewed by the SAFMC and has been included in its Comprehensive ACL Amendment.

Socioeconomic Issues

During this past year, the SAFMC SSC has established a dedicated Socio-Economic Panel (SEP). The Panel, composed of current SSC members as well as additional experts, is aimed at providing more focused socioeconomic input on Council decisions. Establishment of the SEP, as well as the addition of another social scientist to the SSC, reflects the fact that socioeconomics will be a bigger part of the SAFMC analytical and decision-making process. Until recently, nearly all the work done by the SAFMC SSC has been in response to biological issues that were brought to the forefront by the reauthorized MSA. Now that the MSA issues are almost resolved—mainly, ending overfishing and establishing rebuilding plans—what will the anticipated role of socioeconomics be? How does the SAFMC SSC plan to integrate socioeconomics more into the process? The SEP met once in February and will meet again in November.

Ecosystem Issues

The SAFMC's ecosystem-based approach to fisheries management builds on the biological, economic, and social information presented in the FEP, and provides the Council with the opportunity to evaluate needed actions across multiple fisheries and facilitate development of FMP amendments or measures that apply across FMPs. The Council's stakeholder-based process taps an extensive network of scientific, management, and fishery professionals within the region. Within this overarching structure, the Comprehensive Ecosystem-Based Amendment (CEBA) Plan provides the framework for addressing ecosystem-level issues in other FMPs. Although at this point the CEBA process has been dealing mainly with habitat issues (e.g., CEBA 1 is focused on corals, sargassum, and Habitat Areas of Particular Concern), it is progressively being expanded to address more directed fisheries issues (e.g., CEBA 2 is focused on snapper-grouper, shrimp, and coastal migratory pelagic stocks). As for now, the SAFMC SSC has minimally commented on CEBAs in regards to data poor stocks (octocorals) and how to provide recommendations on an ABC. However, the plan is to expand SSC participation and input on ecosystem-level issues. Near-future discussions are likely to focus on marine protected area (MPA) effectiveness and other spatial/area management considerations.

Caribbean Council

Presenter - Barbara Kojis, SSC Chair

The SSC of the CFMC met twice in 2011 (each meeting lasting two days) to make recommendations regarding OFLs and ABCs to the CFMC for species/species groups (Fisheries Management Unit (FMU)) not designated as undergoing overfishing or overfished.

March 2011 SSC Meeting

The SSC initially recommended that the OFL be equal to the mean of the recreational and commercial (calculated separately) average landings for each FMU. They recommended using different year sequences for each jurisdiction (three jurisdictions: Puerto Rico, St. Thomas/St. John District, and St. Croix District). The year sequences selected were the longest sequence available with reliable data in order to incorporate the variability inherent in natural systems.

The year sequence varied among jurisdictions, based on when data collection at the FMU level commenced, and extended through the most recent year for which reliable data were available. Recreational data were only available from Puerto Rico. The Marine Recreational Fisheries Statistics Survey (MRFSS) started operating in Puerto Rico in 2000 and has not successfully operated in the U.S. Virgin Islands. The SSC recommended that ABC=OFL for most FMUs. The only exception was the Acanthuridae (surgeonfishes-reef herbivores) and Pomacanthidae (angelfishes-reef spongivores). The Acanthuridae and Pomacanthidae play a significant ecological role in regulating algal and sponge populations on coral reefs. There was insufficient time to discuss an appropriate scalar for ABC for these two FMUs, so the SSC recommended that a new option be inserted in the draft amendment that would reduce the ABC by 0.50 of the OFL.

The SSC did not present their advice in pounds of landings for specific species or species groups, but rather determined the method, time sequence, and scalars for calculating OFL and ABC. During the subsequent 137th CFMC meeting, the CFMC requested that the SSC revisit the OFL and ABC levels that the SSC approved in their March meeting. The CFMC requested that the SSC provide justification for using a different time series of total landings for all FMUs not addressed in the 2010 amendment, and asked the SSC to address the application of a single rule for all FMUs. The CFMC also requested that the SSC present their recommendations in pounds of landings. Additionally, the CFMC asked the SSC to consider an OFL higher than average landings for healthy stocks.

May 2011 SSC Meeting

The SSC considered the concerns raised by Regional Administrator (RA) Crabtree about the use of average catch to set OFLs. RA Crabtree's concern was communicated as follows:

If one believes a stock is healthy with no signs of overfishing, but you then set the OFL at average catch, aren't you then saying that overfishing has been occurring on average about half the time? Isn't that inconsistent with the starting premise that the stock is healthy? So if a stock healthy, shouldn't the OFL be a level above average catch?

The SSC responded by noting that setting OFL equal to average catch over a period of time does not mean that overfishing occurred about half the time. The concepts of MSY and overfishing need to be interpreted in a stochastic context. MSY is commonly interpreted as the long-term average catch (also referred to as MAY - Maximum Average Yield) that results from fishing at a rate (F_{msy}) that corresponds to the maximum long-term average productivity. When fishing at this rate, the stock is expected to fluctuate resulting in a catch different from MSY (either higher or lower) each year. Catches greater than MSY are not overfishing so long as F equals F_{msy}.

It is well known that MAY, resulting from a constant fishing mortality strategy of F_{msy}, is higher than the maximum constant catch (MCY, constant catch strategy) that can be taken from a stock (e.g., Sissenwine 1978). However, managing by a constant fishing mortality strategy requires information on stock size and fishing mortality so that catch can be adjusted annually. When average catch is used to estimate OFL, this information is usually lacking, thus requiring a constant catch strategy. Therefore, OFL should be lower than average catch during a period when F equaled F_{msy}. When an SSC estimates OFL equal to average catch, it is implicitly assuming F during the catch averaging period is enough lower than Fmsy that average catch is less than or equal MCY. Another implication is that the catch under a constant total allowable catch (TAC) strategy is likely to be lower than the average catch during a period when F equaled F_{msy} when overfishing was not occurring.

This is an inherent consequence of TAC management when the TAC cannot be adjusted to achieve a desired fishing mortality rate. RA Crabtree also pointed out that the Gulf of Mexico Council's SSC has been working on the following:

Based on expert evaluation of the best scientific information available, recent historical landings are without trend, landings are small relative to stock biomass, or the stock is unlikely to undergo overfishing if future landings are equal to or moderately higher than the mean of recent landings. Set the overfishing limit equal to the mean of recent landings plus two standard deviations.

The CFMC SSC noted that the conditions for applying this approach (i.e., landings without trend, landings small relative to stock size, stock unlikely to undergo overfishing) were not generally applicable to Caribbean stocks because of insufficient information. Furthermore, the CFMC SSC was not aware of a scientific basis for assuming that OFL occurs at a "catch equal the average plus two standard deviations." This corresponds to assuming that a catch that occurred rarely (about 2.5% of the time) during the averaging period could have been taken as a constant catch without overfishing. Why should this be true in general?

Given that only two days were scheduled for the May meeting, the SSC was only able to revisit the OFL and ABC for Puerto Rico. Puerto Rico was addressed first because there was concern that the early years of landings may be inflated because part of the Puerto Rican fleet fished throughout the Caribbean until 1988. Also, the expansion factors prior to 1988 were unknown.

The SSC based the OFL for recreational landings on the median of the 2000-2009 recreational time series (all the available data) for all the FMUs, with the exception of surgeonfish, tilefish, and angelfish. These three FMUs are comprised of species not targeted in Puerto Rico and as a result the median of the recreational landings was zero.

The OFL for the three excepted FMUs was based on the maximum landings recorded over the time period. The SSC selected the median of the annual commercial landings for the time sequence 1988 to 2009 for all FMUs except for the three FMUs referenced above. For these FMUS, the SSC based the commercial OFL values on maximum recreational landings recorded times two. These values were compared with the landings in St. Thomas/St. John where these taxa are targeted to ensure that they were reasonable.

The median was chosen for both the recreational and commercial datasets because it is more robust to errors in measurement. It is also less sensitive to outliers, such as the 2005 peak in the commercial landings data and the outliers in the recreational data, due to the high annual variability in the landings estimates.

To calculate the OFL, the SSC used the ORCS Working Group approach (Berkson et al. 2011). The first step employs an evidence-based scoring system to determine if a stock is lightly moderately or heavily exploited. Of the nine attributes in the ORCS report, the SSC scored six. Information for the other three was either not available or duplicative of other attributes. All stocks scored between 1.5 and 2.5 and, therefore, were classified as moderately exploited. For stocks classified as moderately exploited, the OFL is defined as the product of a scalar (1.0) and a catch statistic (see above).

The next step, according to the ORCS method, is for the Council to decide on a scalar to multiply by the OFL to get ABC. The scalar multiplier is to reflect the Council's risk tolerance for overfishing (the lower the value, the more risk averse). The ORCS Working Group method gives three unique scalars to illustrate low-, moderate-, and high-risk tolerances. However, the CFMC decided to use scalars to calculate the ACL for the FMUs based on OFL=ABC. The scalar chosen was 0.90, with the exception of surgeonfish and angelfish, which were given a scalar of 0.75 because of their ecological importance.

The CFMC had issues with the fact that different SSCs used different procedures for determining ABC. The CFMC was especially concerned because the resulting OFL of the Caribbean SSC was the median or average of the annual landings/catch when the SSCs of other Councils' had calculated an OFL higher than some central tendency of landings or did not determine an OFL at all and based ABC on average landings/catch. The CFMC was concerned because the FMUs under consideration had not been determined to be overfished or undergoing overfishing. If the SSC's OFL is exceeded for any of these FMUs then the FMU will be considered to be overfished and action must be taken. If there is no determination of OFL, then these FMUs cannot be designated as overfished. The CFMC also felt that the spiny lobster fishery was healthy, primarily because of the management measures in place, and wanted the SSC to review their determination of OFL and ABC for that fishery.

Comments

The two day meetings have been too short to adequately address the issues before the SSC. The chair and other SSC members requested at least three days for the second meeting. However, apparently there was insufficient funding available at the time that the meeting was scheduled to allow an extension of the meeting.

Mid-Atlantic Council

Presenter - John Boreman, SSC Chair

Since the last National SSC Workshop in Charleston, several significant events occurred in the Mid-Atlantic. First, the ABC control rules, part of an omnibus amendment to all the FMPs under the aegis of the MAFMC, were approved by the Secretary of Commerce and are now being used to guide the SSC. The final ABC rules and risk policy are essentially the same ones presented at last year's workshop.

The MAFMC also supported a simulation study to evaluate the effectiveness of approaches to setting ABCs for both data-rich and data-poor stocks (Wilberg, et al. 2011). These studies evaluated the adopted MAFMC control rules and approaches recommended by Berkson, et al. (2011). In data-rich situations, these studies indicate a conservative P* rule that assumed a coefficient of variation (CV) in the OFL of approximately 100% were most reliable. For the data-poor control rules, there was not a single rule that performed best in all situations explored. Simulation studies indicated that, if managers choose to err on the side of caution, particularly in highly uncertain situations for species with risky life histories, the Restrepo control rule was most reliable.

As mentioned last year, the SSC has formed a Social Sciences Subcommittee with the primary mission of working with the fishing industry to develop performance reports for each fishery. The pilot set of fisheries was the pelagic fisheries for longfin squid, shortfin squid, Atlantic mackerel, and butterfish. The performance reports for these fisheries were used as background documents by the SSC during the formulation of ABC recommendations. Based on the utility of these reports to the SSC decision-making process, performance reports will be prepared in the

coming year for all MAFMC managed fisheries and submitted to the SSC for use in the ABC setting process.

Finally, the Ecosystems Subcommittee began their work on assisting the MAFMC as it moves towards EBFM. The subcommittee defined forage species, proposed a stepwise methodology by which forage species can be handled in the ABC setting process, and provided the MAFMC with some thoughts on how to set goals, objectives, and standards for EBFM.

Discussion

Rick Robins noted as a follow up, a first cut at the Fishery Performance Report concept that was introduced by the MAFMC at the Charleston meeting has been quite a success. The Council had the Social Science Subcommittee of the SSC interact with an AP and it put them in a great setting for a two-day, face-to-face meeting where they discussed all of the operational details of the fishery. Several of the Council members attending the meeting learned a lot and the SSC members benefitted significantly from that dialog. It also gave the industry and the AP an opportunity to provide their perspective on the performance of the fishery over the last year. The Council would like to build on that first effort and hopes to expand that to include all its fisheries over the course of the next year.

John Boreman noted that this year our Ecosystem Subcommittee launched their efforts in working with the Council on moving towards EBFM in the Mid-Atlantic. One of their first tasks was to define what a forage species is and they came up with a proposed definition. They also developed a decision tree method for considering forage species when setting ABCs, like what special considerations should we have in setting the ABC and what criterion go into those considerations? They also provided advice to the Council on setting goals, objectives, and standards for EBFM. Ed Houde is a member of the Ecosystem Subcommittee on the SSC, and has been involved for many years with EBFM in the Chesapeake Bay and, prior to that, down in the Caribbean and South Florida. He reviewed the literature and basically offered up some initial guidance that the Council may want to consider when they go into EBFM in terms of what type of goals they try to achieve and standards for achieving those goals.

Martin Dorn asked if the MSE analysis was available and if there was some way to get a copy? John Boreman responded that the report has not been finalized. It is still in draft form and will not be released until it goes through peer review. The MAFMC SSC is looking for people to serve on the peer review panel.

New England Council

Presenter - Eric Thunberg, SSC Member

Since the last National SSC meeting, the New England Fishery Management Council (NEFMC) appointed a number of new members to their SSC, increasing the size of the committee to eighteen. The appointments were made in three groups of initial terms lasting from one to three years, with the intention of future appointments all lasting three years. This will facilitate an orderly transition and turnover on the SSC, while maintaining institutional knowledge within the group.

Given the focus of this National SSC meeting on ecosystem and socioeconomic issues, these topics will be highlighted in this update. Additional information is provided regarding recent activities related to ABC uncertainty, a new process being implemented this winter to address update assessments, and the forming of a risk policy team.

At the request of the Council, the SSC developed a white paper on possible pathways toward EBFM in the Northeast. This white paper was presented to the full Council three times during development: November 2010, February 2011, and April 2011. The final white paper describes ecological production units as possible management units to replace the current stock-centric FMPs, and a transition strategy to move from the current management system to full EBFM. The paper describes an eight-step process to implement full EBFM and the principal elements of the scientific approach to be used in the region.

At the September 2011 Council meeting, a strategy was outlined to develop EBFM in three phases. The first phase consists of establishing goals and objectives. Included in this phase is the definition of the specific ecosystem production units (EPUs), which will serve as the basis for management units. The second phase identifies management and scientific requirements to implement EBFM in the region. For example, the Northeast Multispecies, Skate, and Monkfish FMPs could be combined into a joint plan to account for biological interactions. This would require definition of new reference points based on new modeling efforts for the species complex. The third and final phase implements EBFM using quota-based management in all ecosystem production units. This requires allocating all fishery resources to each EPU. The many details of accumulation limits, transferability requirements, permitting, and monitoring requirements would all need to be defined. An environmental impact statement would be

developed for the new plan during this phase as well. These phases would last one, two, and three years, respectively, for a total implementation time of six years.

There were no specific social science terms of reference this past year. However, with the addition of three new social scientists to the committee, there is expected to be increased attention given to a number of issues in the coming year. Specifically, risk and ABC buffers, MSE, the mixed stock exemption, and socioeconomic aspects of ecosystem-based fishery management are all expected to be considered.

Currently, the NEFMC does not have a general control rule to deal with risk. The risk policy team, described below, will be working to develop such a rule or process for addressing risk concerns. The Council decided that rules would be established for each FMP to allow for specific factors within each FMP to be addressed directly. For example, in the Northeast Multispecies FMP, which covers 20 groundfish stocks, the default control rule is to use 75% of F_{msy} when calculating ABCs to account for uncertainty. This is a simple and easy to apply control rule, but ignores the different amounts and types of uncertainties in the 20 stock assessments.

Risk considerations were explicitly raised by a report of the Massachusetts Fisheries Institute (MFI), which states that "Scientifically valid alternative references points have been identified which can trigger increases in ACLs without sacrificing conservation." The SSC was tasked with reviewing this report and concluded "the information in the MFI report does not justify revision of the ABCs recommended by the SSC and adopted by the Council." However, the SSC acknowledged that the MFI report raised some issues that deserve consideration in the future, as seen in the following quotes from the SSC review report regarding MSE and the mixed stock exemption.

"The implicit management strategy described by NS1 Guidelines should be subjected to a MSE designed to accommodate the range of assessment and management situations confronted. The MSE should consider performance in terms of biological, economic and social impacts. Further, the SSC recommends that the Council consider additional social and economic information in the development of ABC control rules

and in setting ABCs (rather than relegated to secondary impact analyses). Such an evaluation would also identify potential problems of misspecification or inconsistencies in the Guidelines. While this is a significant research undertaking, it is both critically important and achievable."

"The mixed stock nature of NE groundfish and many other fisheries is a reality. Preventing overfishing of each individual stock in a mixed stock fishery is likely to result in forgone yield and potentially loss of net benefits to the Nation. In order to mitigate potential losses while maintaining safeguards to prevent irreversible damage to any individual stock, scientific analysis of the biological, economic, and social dimensions of the mixed stock exemption should be explored. The SSC recommends that the reasons for the unharvested commercial ACLs be explored."

As noted above, there is a large role for social scientists in ecosystem-based fishery management. Virtually all definitions of marine EBM share at least three common elements: (1) a commitment to establishing spatial management units based on ecological rather than political boundaries; (2) consideration of the relationships among ecosystem components, the physical environment, and human communities; and (3) the recognition that humans are an integral part of the ecosystem (NMFS EBFM brochure). The NEFMC SSC is well positioned to fulfill this role with the new social scientists on the committee. During this past year, the NEFMC SSC has been tasked with addressing uncertainty when recommending acceptable biological catches for a number of stocks. The SSC has met with the plan development teams (PDTs) to provide methodological guidance on how to best address uncertainty in each situation. These interactions have been productive and informative to both groups. For the skate complex, a new discard mortality rate was used in both the stock assessment and the calculation of ABC. The need to apply the same rate consistently throughout all the calculations was clearly demonstrated in this case.

For the whiting stocks (red hake, silver hake, and offshore hake), the review panel rejected all analytical assessments, so no risk analysis was possible. This is because the trade-offs between future catches and changes in stock abundance could not be estimated. Instead, the uncertainty in the overfishing limit was characterized by the uncertainty in both the survey abundance and relative F_{msy}. The ABC was then calculated for a range of risk tolerances relative to the probability of overfishing. These calculations led to ABCs, which were much larger (5-9 fold) than recent catches. The SSC advised that a gradual increase in catch would be preferred to a large sudden increase in catch.

For the groundfish stocks in the Northeast Multispecies FMP, the PDT was augmented with additional members to address concerns about medium-term (5-7 years) projections. The augmented PDT conducted a number of simulation studies examining the performance of projections starting at earlier points in the recent assessments (retrospective peels). The results indicated that uncertainty in the initial population abundance at age estimates, combined with

incorrect future recruitment assumptions and changes in mean weights and selectivity-at-age, caused poor performance of these medium-term projections. This led to the need for updated assessments because the medium-term projections were not deemed sufficiently reliable to set ABCs.

The new update process for stock assessments will be applied this winter to twelve groundfish stocks, which were last assessed in Groundfish Assessment Review Meeting (GARM) III, held in 2008. The process has an assessment oversight panel consisting of the chairs of the NEFMC and MAFMC SSCs (or their delegate if the chair is a NMFS employee) and a senior stock assessment scientist from the Center. These three individuals will review plans provided by the NMFS lead scientists on how they will update the assessments. The key feature of these plans is the sequence of fallback positions if the standard "turn-the-crank" update fails for any reason. These fallback positions will only be examined as necessary. The updated assessments will have reduced terms of reference and documentation requirements compared to the standard review process. It remains to be seen how the opposing needs of speed, openness, transparency, and inclusiveness are balanced.

Finally, the need for a risk policy team to address overarching questions regarding management under the new MSA has become apparent. This team is still being formed but will include representatives from the Council, SSC, Council staff, Science Center, and Regional Office. The team will examine trade-offs between different types of risk to both the stock and the fishery, which will require a holistic approach to address issues ranging from data collection to estimation of uncertainty to implementation of management actions. However, as noted above, the team is not expected to create a single rule to be applied to all FMPs, but rather a set of guiding principles that will be interpreted for each specific FMP.

Discussion

Pat Livingston's question was related to social science considerations in making ABC recommendations - what is the thinking behind that? Does it have to do with reliability of the fishery data going into an ABC calculation or something different? Eric Thunberg answered that ABCs can be set in a variety of different ways, each of which essentially involves accepting different levels of risk. Right now the NEFMC has the ABC control rule specified at 75% of F_{MSY} or $F_{rebuild}$, whichever is lower. Why 75%? Is there an opportunity cost that is associated with an ABC control rule that might be 78% or 80% or 85%? So the SSC is asking what are the trade-offs between ABC buffers and essentially the kinds of things one must give up in order to achieve lower levels of risk. The SSC is dealing with the relationship between social and economic opportunity costs versus levels of risk, asking what those trade-offs are.

Rick Methot asked if the NEFMC is looking at a actually transitioning to that large of a buffer in any of your plans by stepping it down from 95% to 75% in a phased in approach? Eric Thunberg stated that it must be recognized that this is the first go round for many New England species, while it is the second go round for a number of stocks. So the issues related to a step down or a phased approach or something along those lines has not come up in that context. One could probably do these things in an analytical setting and could essentially use modeling, so it will not be necessary to experiment with real people and fish. The SSC has not done that yet, so this is a process of identifying what those trade-offs might be to inform a future decision.

An attendee asked Eric Thunberg to comment briefly on the risk policy team since it is made up of SSC, Council, and staff members. Where is this going? Eric noted that the MAFMC adopted an explicit risk policy that was implemented in their ACL/AM Omnibus Amendment. This is not the case with the NEFMC, which has not yet articulated its risk policy. The idea of a risk policy team is to help inform the Council about what kinds of risks are appropriate to think about and how to construct a more formal risk policy. It may be patterned after what the MAFMC has done or it may be somewhat different. He thought that having a risk policy would substantially help guide the SSC because they are basically shooting in the dark on this issue.

Gordon Kruse noted that the NEFMC does not appear to have a routine schedule for updating stock assessments and asked that that point be clarified. Eric Thunberg responded that the stock assessment schedule is set by the Northeast Regional Coordinating Council (NRCC). This group consists of the leadership from the New England and Mid-Atlantic Councils, the NE Science Center, and Regional Office. This group essentially agrees on benchmark assessments and what schedule they are going to be put on. There might be a five-year hiatus between benchmark stock assessments. The SSC has been finding that they are not performing very well in terms of their use in setting ABCs. A new process is being developed through the NRCC to attempt to deal with this issue.

John Boreman noted that it was basically a combination of both. The Science Center raised the issue because they were overworked and understaffed. They went to the NRCC, and all parties agreed to re-examine the whole SAW/SARC process, which is currently underway.

National Overview of Stock Assessment Activities

Presenter - Dr. Richard D. Methot, Jr., NMFS Office of Science & Technology

Stock assessment activity is reported nationally through the Species Information System (SIS https://www.st.nmfs.noaa.gov/sisPortal/sisPortalMain.jsp) maintained by the Office of Science & Technology. In 2010, there were 55 assessments reported among the 230 stocks of the Fish Stock Sustainability Index (FSSI) plus 40 assessments for non-FSSI stocks. This is a somewhat slower pace than in recent years, but an increase is expected in 2011 as Pacific Coast groundfish rotates to an assessment year in its biennial cycle. Of the 55 FSSI assessments in 2010, 49 were fully accepted by review panels/SSCs. Of these 49 assessments, 10 were trend analyses (level 1), 4 used biomass dynamics models (level 3), 33 used size and/or age-structured modeling approaches (level 4), and 2 included some form of linkage to ecosystem or environmental factors (level 5). Forecasting the number of assessments to be finished each year has been a challenge due to inconsistent expectations on assessment completion dates. In order to provide more accurate forecasting of expected assessments, expected and actual completion dates for assessments should be based on the date of SSC acceptance of the reviewed assessment, not the date on which the draft assessment is submitted to the regional peer review process, nor the date on which the assessment finishes the peer review process.

For the purpose of reporting a national performance measure, assessments of FSSI stocks are considered adequate if they done at assessment level 3 or higher and have passed a regional review process. Further, they are considered to remain adequate for five years. On this basis, the number of FSSI stocks with adequate assessments declined to 132 at the end of fiscal year 2011 due to several assessments from 2006 not getting updated within the five-year period. The NMFS is currently considering a revised performance metric that would provide finer gradation of an assessment's contribution to the metric. This will probably include a contribution that is proportionally related to the assessment's level, rather than being zero for levels 1 and 2, and 1 for levels 3 and higher. It also will probably include a gradual decay over time, rather than a sharp sunset after five years.

A faster pace of assessment throughput would support more timely revisions to ACLs. Also, as NMFS attempts full age-structured assessments for stocks with marginal data, some are not being accepted by the peer review process. Some suggestions on how to improve the throughput of assessments include: (1) when conducting a benchmark assessment of a previously assessed stock, keep the TOR for the assessment restricted to issues that need re-investigation rather than defaulting to a re-investigation and documentation of every factor in the assessment; (2) include a range of simpler models in the assessment package rather than risking complete review rejection of the entire package because the highest attempted level of model is not supported; and (3) provide specific TOR relevant to the expected level of the assessment and to guide reviewers to the particular new assessment issues that need reviewing.

Several projects and working groups are underway to improve our assessment and management processes nationally. A total catch and ACL module has been added to the SIS to track the success in keeping catch below the ACL. A linkage has been established between the SIS assessments and a separate database containing surveys so that each assessment will be able to reference the surveys that support that assessment. The assessment prioritization working group is collating and organizing information to facilitate the process of selecting stocks for assessment in each region. A report is being developed by the Office of Sustainable Fisheries (OSF) to describe the history of OY approaches and definitions in each FMP. Another OSF project is developing a report to describe the degree of management uncertainty across a range of fisheries. Work on the NS 2 guidelines resumed in late 2011 and the completed guidelines are expected in 2012. Work by the ABC control rule working group is on hold due to workload issues pending completion of the report from the February 2011 ACL science meeting and the assessment prioritization project.

Discussion

Jason Link noted that under the last bullet "More Assessments More Frequently" one of the challenges is that it seems like extra credit is given if it is above, as Rick said, a "Chevy" type of assessment. More credit is given for those in FSSI versus a production model or even a biomass dynamics model. As we get more into a management procedures and the frequency of these assessments ramps up, is there any thought being given to reconsidering that weighting or crediting?

Rick Methot responded yes, that dovetails very well with the prioritization working group, realizing that prioritization cannot happen until a goal is set. Do we need a Cadillac or a Chevy or just baseline monitoring for a particular stock? That is one prioritization. The other is to set a target frequency. That pretty much depends upon the inertia of the stock which depends on its natural mortality and degree of recruitment variability. Those things play against each other to help determine the appropriate level of assessment update frequency. The agency is thinking about those things, and the analysis that comes out of that exercise will help us revise things like the way performance statistics are calculated. It also could potentially lead to a revision of what stocks are on the index list, because questions are being asked about why certain stocks are even on the list.

Social and Economic Keynote Address

The Role of Social Science in SSC Activities

Presenter - Dr. Lee G. Anderson, University of Delaware; College of Earth, Ocean and Environment

The purpose of the presentation was to suggest underlying goals, philosophies, and operating procedures that will allow an SSC to successfully address its social science obligations. To set the stage, it is clear that social science and social scientists have an important role in SSC activities. The necessity and use of social science is mandated in the law:

"Each Council shall establish a scientific and statistical committee to assist it in the development, collection, evaluation, and peer review of such statistical, biological, economic, social, and other scientific information as is relevant to such Council's development and amendment of any fishery management plan."

Two important tasks are specifically assigned to the SSC. First, the Council is mandated to develop ACLs for each of its managed fisheries that may not exceed the fishing level recommendations of the SSC. Second, the Council is directed to develop, with the help of the SSC, multi-year research priorities for fisheries, fisheries interactions, habitats, and other areas of research that are necessary for management purposes. These five-year plans are to be used by the Secretary and the regional science centers in developing research priorities and budgets for the region of the Council.

The specific need for social science is also contained in the mandate to the Secretary to "initiate and maintain, in cooperation with the Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of this Act. Such program shall be designed to acquire knowledge and information, including statistics, on fishery conservation and management and *on the economics and social characteristics of the fisheries."*

But how do these legal mandates translate into marching orders for SSCs especially with regard to social science? In Dr. Anderson's view, the role of the SSC is to assist the Councils as it fulfills its obligations under the MSA. Arguably, its most important role is to set ABCs, but there are other important roles as well. Admittedly, thus far the ABC work has been primarily a biological task, but there are indications that socio-economics can play a larger role in the future. This point was made many times during the National Annual Catch Limit Science Workshop held in February of 2011. The Fishery Performance Reports designed to provide background information on the economic aspects of the industries associated with the relevant stocks that are

being developed by the MAFMC are another indication of the increased role of social science in ABC activities.

The history of the SSCs of the different Councils, including their level and quality of output and the role played in Council activities, is definitely a mixed bag. For some Councils, they have been a critical part of Council proceedings, but in others literally years would go by with no SSC meetings. However, all SSCs have become active parts of Council activities since the recent revision of the MSA and the mandate to set ABCs. More importantly, the increased role of the SSCs has demanded a degree of independence, at least when setting ABCs. This required independence has improved the SSC's perceived stature in the pecking order of some of the Councils. The provision of the Act that allowed for compensation of SSC members and its ultimate implementation with funds provided by NMFS with the agreement of the NRCC was also an important change, because it was another step in putting the stature of SSC members closer to that of Council members. The work completed with respect to ABCs has also done a lot to improve the image of the SSCs and this is leading to more requests for assistance in other non-mandated areas.

Possible Social Science Roles and Activities

As the SSCs continue to transition to take on a larger role, it is important to think about what the social scientists members of SSCs can and should do to help the Councils carry out their fishery management mandates. To begin, take a fairly wide perspective. It is important view the role of social science in the SSCs in relation to the totality of the socioeconomic work done in NOAA. In this regard, it is also important to realize that Councils receive advice on a range of socioeconomic matters from its own staff and from staff in the Centers, the Regions, and the National S&T Office in Silver Spring and, in some instances, from contracted outside consultants.

The SSCs can play a productive role in that process but, except for their role in setting the ABCs, perhaps they should view themselves as helpful participants and advisors but not research centers. That is, except for small projects directed at specific management questions raised by the Council, the SSC social scientists will likely be more helpful to the system if they focus on developing suggestions for what types and amounts of work should be done, what methodologies or procedures should be used, or to perform evaluations of and develop policy recommendations from existing work as opposed to doing actual social science research.

This is especially relevant given that the SSC is fundamentally a volunteer organization. There is a limited amount of time and effort that members can contribute, and it needs to be allocated to its highest-valued use given the entire system's capability to provide social science. But more specifically, how can Social Science be used to help Councils meet their fisheries management

obligations? The following is a list of social science topics that, depending on the specific management issues facing the various Councils, may be useful in this regard.

Efficiency: Economic efficiency, in the pure sense that we learned it in graduate school, is the study of organizing production so as to maximize the net value of output taking into account both non-market and markets outputs and costs. While this is not as important in the fisheries management world as was taught in economics classes, some of the basic principles are very relevant to the concerns of Councils, industry, and consumers. For example, information on how fishery regulation directly, or indirectly through changes in incentives, can affect the cost of fishing or otherwise change fishery profitability is important for Council decision-making.

Distribution: Information on which groups or sectors gain the benefits of regulatory changes, and which ones bear the costs, is also important. From the approach of sociology and anthropology there are interesting research questions about what participants think is a "fair" distribution. This is important because it can influence how people will react to certain regulations. On the other hand, while traditional economics cannot formally address distribution issues in a normative way, it can be used to determine the likely distributional effects of proposed actions.

Identification and evaluation of trade-offs: The concept of opportunity cost is central to economic analysis, and there are many cases where framing typical fisheries management questions in this context could be very illuminating. For example, we often talk about the ability to reduce the risk of overfishing by increasing the buffer between OFL and ABC. But what is the opportunity cost of increasing the buffer? At minimum, it is the foregone net value of the fish not harvested. Discussions of setting buffers can become more robust and rational if we start thinking about how we can measure what we are gaining and what we a losing in comparable metrics.

The same principles apply to various aspects of ecosystem approaches to fisheries management. The question of the proper amount of "forage" fish is a hot topic at the moment. In order to understand this it will be necessary to understand a good deal about ecological relationships between predator and prey species. But posing the questions in terms of what is being gained and what is being lost as more fish are allocated to "forage" can also help to provide sound and rational framework for considering different policy approaches. The goal of such work should not necessarily be to provide yes or no answers, but instead to provide comparable information on what is being given up and/or what is being gained by various options.

Incentives: It is commonly said that fisheries management is about managing people and not fish. To the extent that this is true, it is important to understand what motivates people and how they will respond to different incentives. It is important that the Councils understand how and

why participants will react the way they do in response to management actions, in response to various market trends, and in response to other related motivating forces.

These are few examples of the types of issues that can be addressed using socioeconomic analysis in SSC activities. But the potential list is practically endless. Some have asked if there are any questions that should be considered off limits for SSC consideration. There are different views on this but Lee's own view is that there should be no limits on possible areas of inquiry. It does make sense to give mandated work and work requested by the Council higher priority. But, the SSC should not shy away from raising social science research issues that it believes are related to general Council activities or specific management issues. The main thing is that it is not the role of the SSC to set Council policy. But it is perfectly appropriate, and in fact necessary, to do policy analysis on the effects of different management options both in general and specific cases.

As a final thought, one might ask how the SSC can be more proactive in providing socioeconomic information and advice. It may be useful to consider setting up a social science subcommittee with its first task to develop, with the help of various Council committees, specific annual activities designed to address the current decision making needs. Thought should be given to developing detailed terms of references for these activities to ensure that the work is both well thought-out and will be consistent over time as members of the SSC change.

Summary

The role of the SSC is to assist Councils as they fulfill their obligations under the MSA and good social science is necessary to do that properly. The SSC should find ways to be a productive part of the existing social science research institutional structure in the Silver Spring/Centers/ Regions/Council staff continuum that performs, evaluates, and applies social science work. Given the nature of that structure and the volunteer nature of SSCs, they should maintain a major emphasis in planning, review, and evaluation tasks rather than actually performing social science research. SSCs will be most successful and useful in addressing social science goals if they have an established set of annual tasks with clearly defined TOR and lines of responsibility. This of course does not rule out the possibility of performing other self-generated tasks or ad-hoc assignments from the Councils.

Discussion

A participant noted that one difficulty with social science analyses is that some SSCs use a consensus model, but it is much easier to reach consensus with biological research than with social science issues. He suggested that the SSCs should rethink the consensus model if they are going to make real efforts to incorporate social and economic data. Another participant

responded that there is some area between voting and consensus where the SSC can relay to the Council the range of opinions held by SSC members regarding an issue.

It was pointed out that the SSCs serve the Councils and that there are distinct differences among the Councils in how they develop FMPs. The MAFMC has a monitoring committee that has the unique role of looking at management uncertainty. A standard one-size-fits-all set of recommendations is going to be something that is difficult to achieve. Dr. Anderson's talk highlighted the point that Councils do not know what they do not know. They don't take a step back to think about what they can do differently from what they are doing now. This is why TOR could be useful.

Another participant responded that the Councils need to be more specific. SSCs are committees of the Council and their purpose is to serve the Councils. A problem with not getting the right information means that the Councils are not asking the right questions. It was also noted that it is important to separate short-term and long-term research needs and goals.

Another participant offered a different perspective, saying that he does not feel that he works at the pleasure of the Council; rather, he feels that the SSC should be an advisory to the Secretary and should represent the public interest in the protection of the natural resource. Someone else agreed and urged the other participants to take another look at the original mandates for the Council and SSC.

A participant mentioned the frustration social scientists feel when they spend a week at an SSC meeting and only make a couple of comments. The SAFMC has the SEDAR process, but there is no comparable social science process that can justify the time of the social scientists on the SSC.

A member of the PFMC SSC responded that they still think it is helpful to meet as a body and have social scientists participate in the discussion of stock assessments and ACLs. Another participant agreed that social scientists can evaluate landings data and can say something about odd data points.

An attending social scientist noted that she felt she had more impact than she may have realized. She noted that she had never made a comment that was not picked up on and approved, and that she had been encouraged by other members of the SSC to speak up more. She suggested that social science could play a more prominent role in the SSC if social scientists make an effort to speak up more.

It was pointed out that the SSCs need to think realistically about which parts of the process social scientists can participate in. For example, they do not have much to say about MSY, but they *do* have a lot to say about OY, although this is often forgotten.

Ecosystem Keynote Address

Integrated Ecosystem Assessment: The Science Needed for a Healthy California Current

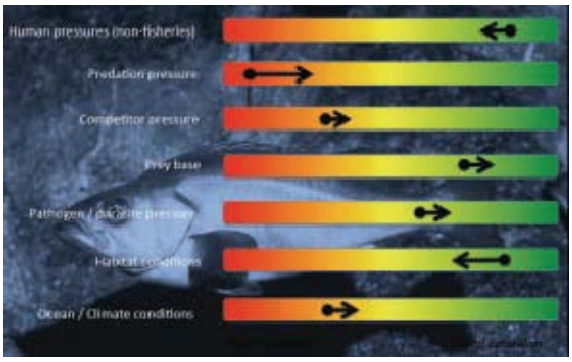
Presenter - Dr. Brian Wells, NMFS Southwest Fisheries Science Center

An IEA is defined as one that considers the entire ecosystem, including humans in order to maintain an ecosystem in a healthy, productive and resilient condition.

Policy Question	IEA Step
What does a healthy ecosystem look like?	*Objectives, indicators / targets*
What is the health of the ecosystem?	Current status, risk assessment
What action should be considered?	Generate alternative management options
Where should we start	Management strategy evaluation

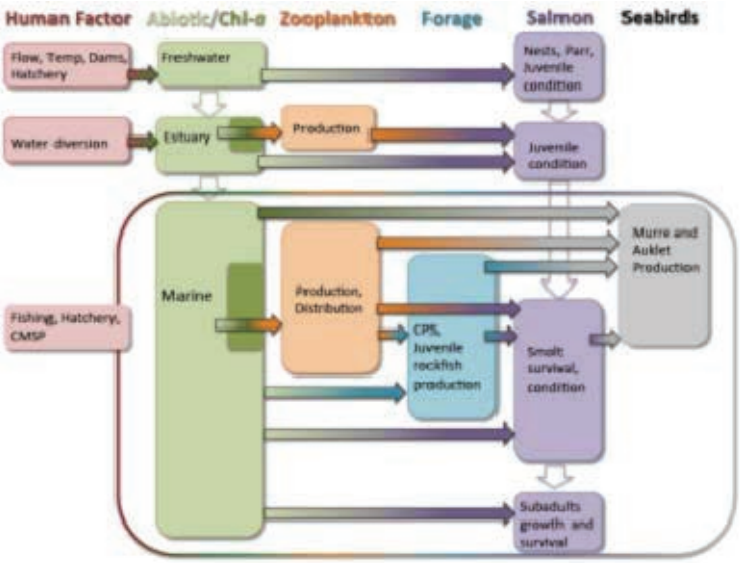
IEA is a process tool by which ecosystem management can be accomplished. The process starts with scoping to identify goals of EBM and threats to achieving these goals. This is the most important step in the whole process. Ecosystem indicators and targets are developed. Analysis starts with a risk assessment, followed by an assessment of ecosystem status relative to EBM goals and a MSE. Monitoring of ecosystem indicators and management effectiveness allows for an adaptive process.

IEA relates to policy questions and can be used to improve fishery management. For example, what does a healthy ecosystem look like? What is the current health of the ecosystem? What actions should be considered?

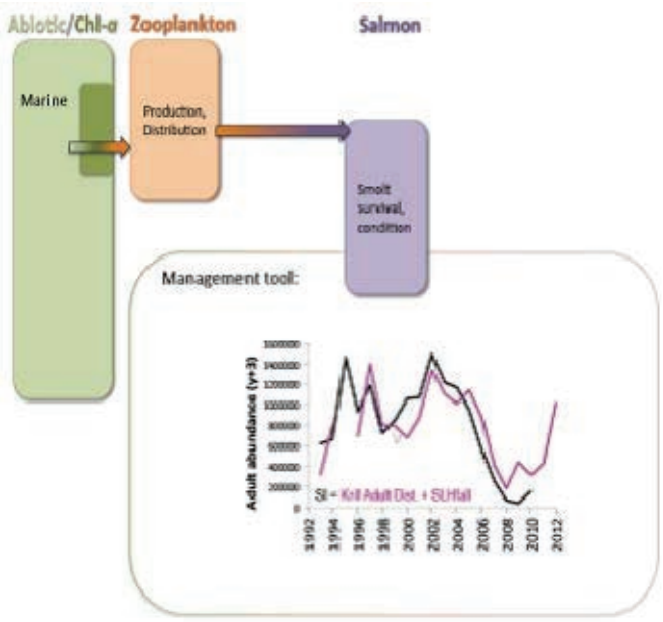


Strategic/advisory models consider numerous use sectors and resources. These models consider more than fish. It is a useful model to determine what the system looks like. A report card can be developed for each species. A Radar plot is a product of what can be expected by management actions.

Tactical models are designed to accommodate ecosystem-informed fisheries management. California salmon was used as a case study. For an IEA of the California current, some information is readily available, whereas other types of information are not available. Oceanographic modeling was used to forecast future conditions, and functional relationships are known. Models can predict warming from sea height, and thus central California coastal temperature can be forecasted about 4 months in advance. The model can then add in how these changes in temperature affect the ecosystem including salmon. Connections were made between ocean conditions (wind) and krill distribution and abundance, which have been observed from acoustic surveys. The authors found that salmon abundance is related to krill adult distribution and sea level height three years prior.



The tactical life-cycle ecosystem model can predict run size years in advance and thus can be used for strategic planning purposes. The model could accurately forecast the collapse of salmon three years in advance, rather than only a few weeks in advance using existing observational methods. Another benefit of this model is that it can be adapted to incorporate and examine sensitivities such as location of harvest.



Dr. Wells has provided a presentation to the PFMC SSC, but the SSC has not reviewed this extensively, other than to provide some comments. This model has not been used in ACL-setting to date, and it will take time for management to trust model. Past attempts at predictive models for salmon run size have been way off and managers are cautious about predictive modeling.

An SSC member noted that the IEA, as presented, appears to be a bottom-up approach, rather than a broad scale tradeoff analysis. While an IEA should not be dependent on a detailed model, the author provided a more useful tactical model for forage fish and salmon. For coastal pelagics and other groups, an Atlantis model works better. Another SSC member noted that we need to report to the Council how this type of information might be used, including its applications, and how the models might be peer reviewed. Concern was raised that this might cause information overload for decision makers.

Discussion

Following the presentation, the plenary group discussed how to evaluate tradeoffs across fisheries, stocks, fleets, and other ocean use sectors. The question was raised, "*What are we not measuring or reporting that we should to capture human dynamics*?" Responses to this question differed across regions. In the Western Pacific, more information is need to understand the benefits of post-harvest catch distribution through social network in communities (i.e., gifted, shared, exchanged). Other regions were concerned about employment data, cost data, seasonal changes in price and demand, passive-use values (including existence value), cultural values, non-consumptive use (e.g., observing species by tourist and others), tourism information, community data, passive use values of people just knowing that a species or population exists in a particular area.

A workshop participant provided an anecdote of how community and employment information is important to fishery management. He noted that many west coast fishermen fish in different fisheries over the year. They fish for dungeness crab during the open season, and salmon in the summer, with the fishery for groundfish providing a foundation for income throughout the rest of the year. In this case, trip limits for groundfish were used to provide optimal yield from the fishery, even though this likely reduces harvesting efficiency.

It was noted that reductions in ACLs have impacts within communities. When fishermen are not being fully employed, they tend to go into construction jobs, which may cause changes in the existing construction labor force, and have other implications including social services effects. Unfortunately, without employment information, changes in employment due to fishery regulatory changes cannot be adequately predicted. Some social information is available to evaluate these impacts. A NMFS socioeconomic workgroup identified a list of variables and existing data from the census bureau and elsewhere.

Employment information could be useful to ameliorate potential impacts. Management is currently based on biological analysis to determine quotas; the challenge is finding a way to build in transitions that are kinder and gentler to users. No transitory steps are built into the management system. It may be possible to build control rules that do not have to change

instantly with biological information. For example, changes could be addressed by using a pre-agreed set of management options if thresholds are exceeded to avoid major changes. ACLs need not be annual.

The group discussed reasons why cost data has been so difficult to obtain. It was noted that most data collection is voluntary, and OMB clearance is required to survey more than 10 people. In addition, there are institutional problems, industry resistance to data collection, and a limited allocation of scarce funding within NMFS (<5% for economic data and modeling). The reality is that Congress is not up in arms that data are not available. Further, Councils have taken action in absence of economic data, and these actions have been approved. So one could argue that the *status quo* has been acceptable to date and meets legal requirements.

It was noted that the Council system is a political process, and to the extent that the science can inform the public and Council, economic information is critically important. Many Council members representing fisheries owner/operators may internally calculate their own impression of effects, and vote on their own calculations and experience. Economic data collection was prohibited for many years. Now that data collection is allowed, and in some cases mandated, there is reluctance of Councils to push data collections.

Councils have accepted biological advice based on limited biological data to set ACLs and other fishery regulations, but this may not the case with economic advice. It was suggested that socioeconomists should develop a plan to use proxies like the ORCS group did for ACLs on data limited stocks. Some proxies for data exist, including gross revenues, but may be poor proxies to use.

The lack of economic data makes it difficult to quantitatively predict impacts on fisherman or communities. Changes in behavior cannot be predicted with current information. The SSCs can help define the most valuable information to gather, whether economic or ecosystem level data.

Socioeconomic analysis of potential impacts tend to be crude and qualitative as data are not available. An analysis can be based on the best data available, but can still be a very poor analysis from an economist's standpoint. So, is the analysis ready for public release? Yes, because it meets some low arbitrary level, or no, because it fails to provide information needed for effective decision making? Additional effort should be made to collect needed information.

The group discussed requirements for social and economic analysis. It was noted that analyses would improve if decisions were affected by the analytical results. It does not appear to be the case in some instances. It was noted that routine economic analysis are required in SAFE documents, but not every region does them. Objectives tend to be lacking, so it is difficult to evaluate progress towards a goal and how the decisions are affected by economic analyses. For

example, there are no specific objectives established for communities in FMPs. It was noted that the MAFMC is conducting a visioning program to define goals for what fisheries in its region should look like in five or ten years, and this is expected to be a valuable tool for evaluating progress.

Members noted that Coastal and Marine Spatial Planning (CMSP) will require additional information on the location and importance of fisheries. It was suggested that spatial plans should use ecological delineations first before breaking into smaller areas for other uses. Maps to show critically important areas relative to proposed wind farms or other proposed activities are urgently needed. The current approach to spatial planning is based on conflict resolution among users, but a spatial management plan based on ecologically important areas and fishery areas would provide a better starting point.

Spatial management plans also require additional spatial information relative to fisheries. Spatial dynamics are important for economics and communities. Data can be collected from logbooks, observer data, and vessel monitoring systems (VMS), if available. As a first cut, we should be mapping fishing distribution by communities or ports. Fishing behavior can also differ among individuals who tend to return to fish in their favorite locations. However, confidentiality requirements may limit the scale in the presentation of results.

Workshop Breakout Sessions

The second day of the workshop consisted of two concurrent breakout sessions designed to provide more focus on issues specifically related to the two themes of the meeting.

Social and Economic Breakout Session I

Presenter - Craig Severance
Discussion Leader - Eric Thunberg

The social and economic breakout session was organized around three sets of trigger questions (TQ) developed by the Social Science Subcommittee. The session began with a presentation of TQ Set 1 by Eric Thunberg.

TQ 1: Role of Social Science in the SSC and Council Process

- What is the role of social sciences in the Councils' management process other than the SSCs? (Plan teams, Council staff, other).
- What is the role of the SSC in your region in these processes?
- Are SSCs asked to review social science work resulting from these processes? How are TOR set by the Councils for the SSC?
- How often do these TOR include issues requiring social science expertise?
- What are the key issues (top five) where social sciences input would be informative?

The discussion around TQ 1 was framed based on the following presentation by Craig Severance. This strawman resulted partly from conversations with social science types on four SSCs about their process. It is not representative but is intended to be provocative and to stimulate reflection and discussion.

Strawman SSC Social Science Integration: Member Qualities, Process, Outcomes

- Fishery management is people management.
- Better integration of social sciences and economics into the SSC process would help guide the Councils toward more effective, balanced, and more acceptable decisions.
- Deeper understanding of fishermen, their families, and their communities, as well as their economic and cultural motivations, would help guide the Councils toward deeper understanding of potential impacts of regulatory alternatives on the fishery and fishery sectors. This includes potential impacts of taking no action -- better data and analysis guide councils.
- Reflexive thought about each of our own SSCs may give us a better sense of what is working well and what may not be working so well.
- Observing or hearing about other SSCs in action may give us constructive ideas.

Imagine or recall a recent 2-3 day SSC meeting with a heavy agenda of action items. Was there full consideration of social and economic information? Did the stock assessment folks or biologists dominate the conversation? Was there a place for possible consideration of socioeconomic data on the issue at hand? Was there a mutual understanding and respect among the different SSC members regardless of their backgrounds? Were some comments more effective than others? Were the final recommendations sensitive to the economic and cultural needs of people in the fishery? Did the fish always come first? Did anyone engage in the "tactical uses of passion"? Was there a semblance of objectivity?

Member Qualities

Having reflected on the process from your regional perspective, what qualities make a more effective social and economic scientist on your SSC?

Possible Strawman member qualities:

- Disciplinary background is less important than having adequate training and practice in basic statistics and social research methodologies.
- Multidisciplinary training and background can be useful if there is adequate training in qualitative and quantitative methodologies.
- Recognition of how qualitative preliminary work and basic understanding of fishing communities and language can make quantitative survey work and analysis of documents and data sets more grounded and effective.
- Past and perhaps continuing social and/or economic research on fisheries and fishing communities in the region makes one a more effective SSC member.
- Basic understanding of ecology and ecosystems makes a more effective SSC member
- An interest in policy, "studying up," and grasping the political side of the Council process makes one a more effective SSC member.
- Attending and observing Council and Council-related meetings and understanding the public process makes one a more effective SSC member.
- Reading and re-reading the MSA makes one a more effective SSC member.
- Understanding related statutes especially NEPA, ESA, MMPA, etc, makes one a more effective SSC member.
- Basic understanding of international organizations, especially regional fishery management organizations (if relevant in your region) makes one a more effective SSC member.
- Basic understanding of environmental non-governmental organizations (NGOs) makes a more effective SSC member.
- Respecting the need for empirical data and not being too POMO (postmodernist) makes one a more effective SSC member.
- Participant observation in the fishery or fisheries makes one a more effective SSC member.

- Personality factors may also influence how effective one is as an SSC member. Straw factors: humility, openness, willingness to listen, willingness to ask potentially naïve questions, and patience.
- Understanding of social theory from a broad perspective encompassing many of the social sciences makes one a more effective SSC member.
- Reading and thinking about briefing materials in advance of the meeting makes one a more effective SSC member.

SSC Process: How well are the social sciences integrated into your SSC process?

- Do the non-social science types ever comment on impacts of regulations on fishing families and communities? Do they suggest things that the social science types haven't considered?
- Are there descriptive baseline data sets on the fishing communities and fishery dependent communities in your region?
- Are your SSC members fully aware of these data sets? Do they refer to them in SSC meetings?
- Are there social science research plans, Council committees, etc., that identify data gaps and prioritize research?
- Is there funding through the Agency, Regional Science Center, or other sources?
- Are there funds or procedures by which quick and responsive research can be conducted on pressing issues?
- Is there an adequate cadre of fisheries social scientists in your region? Are many of them retirement age?
- Is there adequate respect between the social science types and the natural science types? Between the economists and the "non-economic" social scientists?
- Does Council Staff include an adequate number of social science and economics types, and do they communicate outside the SSC process on sharing research questions and ideas?

Idealized SSC Process

- Issues are fully explored in terms of the need for regulations, the regulatory alternatives, and the projected range of scenarios of possible impacts on sectors and communities of the recommended regulations.
- Social science input puts a human face on the fishery.
- Social science input is broad, scientifically sound, and up-to-date enough to guide Council actions.
- Staff input in terms of background documents and draft alternatives is vetted by Social Science and Economics SSC members before the meeting, so presentations are improved.
- Presentations on high quality and relevant social research are given to the SSC.

- Adequate time is given to discussion of contentious issues such as design of catch share programs or other allocation schemes.
- All SSC members have opportunity for input on social science research priorities.
- Background data such as fishing community profiles are made available to all SSC members.
- All SSC members review this data.
- Social Science SSC members review the biological data, make some attempts to understand the basics of stock assessments, and understand the uncertainties involved.
- There is respect for each other's perspectives and each other's differing contributions among all SSC members.
- Where appropriate, respect and understanding are shown toward indigenous and tribal perspectives.
- Public testimony is welcomed after SSC discussion and before final recommendations are developed.
- People are clear about their respective roles inside and outside the SSC.
- NOAA employees serving on SSCs feel comfortable taking positions as independent scientists.
- Social gatherings, soirees etc. bring conviviality to the members, staffers and others in the process.

Outcomes: How satisfied are you with your SSC outcomes, and reports?

- Is there time for members to reflect on and give editing input to SSC reports?
- Is there an institutionalized mechanism to share internal disagreements and minority views with the Council?
- Is the agenda too full? Does it include extraneous reports?
- Is social science fully considered and displayed in reports on issues that have a human dimension?
- Are the social science and economic analyses credible?
- Was there adequate baseline information on fishing communities to project a range of potential impacts?
- Was the information current and up to date?
- Did your SSC stick to the agenda in a timely fashion?
- Did you leave the SSC meeting feeling empowered or frustrated?

Discussion Group Strawman on SSC Outcomes:

- SSC reports and recommendations fully integrate social science and economic information that is clear, understandable, and relevant.
- SSC reports include clear, understandable writing on social science and economic issues.

- SSC reports give the Council a range of alternatives with adequately-characterized costs and benefits of possible Council actions on fishing sectors and communities.
- SSC reports put a human face on the fishery and fishing communities.
- SSC reports are suggestive rather than directive.
- SSC reports are scientifically sound and credible.
- SSC reports are acceptable to most members.
- SSC reports adequately consider the NSs.
- SSC reports display a degree of objectivity
- SSC reports adequately display scientific uncertainty.
- SSC reports adequately display data gaps.
- SSC reports clearly express concerns of the SSC on contentious issues like allocation.

Discussion

Consensus or Voting on Your SSC?

The NEFMC SSC operates by consensus, but there is a feeling among the social scientists on the SSC of being battered because they are overwhelmed by the biologists. The GMFMC utilizes a voting procedure, but votes are mostly unanimous. However, the GMFMC SSC process is something between voting and consensus because they ask if there is opposition to the position being taken. If there is, it is discussed and they feel that it works pretty well. Differences of opinion are usually related to stock assessment/status issues and not so much about social and/or economic impacts on fishermen.

Lee Anderson wanted to know how much of the voting on SSCs is about non-mandatory issues (not ABCs), such as much of the social and economic issues? Mark Holliday noted that during MAFMC SSC deliberations the majority of time was spent on ABC-setting and making research recommendations to NMFS (the MAFMC SSC does not deal with management alternatives/uncertainty). They do not have presentations on social science, but occasionally they do for biological issues. The social and economic members of the MAFMC SSC have played a fairly limited role to date.

The SAFMC SSC has tried to get its social scientists on the SSC to attend stock assessment meetings. The social scientists have played a role in helping to understand the nature of historic data. The SAFMC SSC operates by consensus. If someone does not agree with the consensus, they can stop the process to deal with their issues.

The WPFMC SSC operates by consensus following Pacific Islands style. Craig Severance advocated crossing over among disciplines and rotating rapporteur assignments.

What SSCs Should be Doing as Best Practices

The group agreed that the SSCs should be providing technical review of RIR and IRFAs. They do not usually get involved until these documents/analyses are complete, so the documents normally do not get reviewed by SSC social scientists before they are finalized.

Mark Holliday reminded participants that they work at the pleasure of their Council (the Council are the clients). Whatever the SSC does, they need to make sure they give the Council what they ask for. Because each Council is different, it might be difficult to have a standardized set of tasks that SSCs need to be doing. He agreed with Lee Anderson's suggestion of the SSCs having an annual set of social science TOR from the Council which would outline what is expected from their SSC.

Social Scientists know how to evaluate data including landings data, but the information usually does not include price data. The biologists need to understand that landings are not always determined strictly by stock size. Fishery performance can be influenced by a number of social and economic factors, which can sometimes help to explain changes in time series of catch data. Input from industry representatives at SSC meetings can also be very useful in understanding fishery performance. Many of the Councils want SSC input on social and economic issues but do not know what to ask for. The social scientists on the SSCs need to help educate the Council members as to what to ask for.

The limited time available at SSC meetings makes it difficult for social scientists to get enough time on the agenda for social and economic issues to be fully discussed. The Councils need to establish separate SEPs to allow for this to happen and these panels need to be given adequate time to fully discuss all the issues. The work of the SEPs should be vetted through the full SSC before being forwarded to the Council. In addition, it is important that the social scientists on the full SSC help interpret the work of the SEP for the full SSC (and the Council as well).

Social scientists have more impact on the process than they realize. Ben Blount indicated that the issues he raises are not ignored. He feels his positions, if anything, usually get supported and/or adopted too readily without being fully vetted. He is encouraged to contribute even more than he does, even if the issues he brings up are not specifically on the agenda.

Is there a role for social scientists in setting ABCs or should the social scientists just wait for this to pass and then later get back to issues they can contribute to more clearly? Whose role is it to even ask this question, that is, what is the role of the SSC? The social and economic scientists can contribute by providing the social and economic implications of inaccurate biological stock projections.

Supply can create its own demand – the social scientists should let the Councils know what they can do. The Councils may be at fault for not taking advantage of what social and economic expertise they have available to them. The Councils need to come up with their demands, i.e., what do they want? In addition, the Councils should tell the SSCs what is the desired final outcome and let the SSC tell them how it can be done. However, the SSC probably will not be able to do the work. Perhaps it could be done by Council staff.

Social scientist cannot always determine what some biological values ought to be such as MSY, but they can have some impact on things like setting OY.

Social science has a lot to say about setting buffers and opportunity costs/trade-offs that can be beneficial to Councils. SSCs should help the Councils to understand the importance of these things.

Is there enough supply? Are there enough training programs for social scientists to help stir up interest in younger folks to join the field?

The social scientists are in a position to help the Councils by insuring that fishery issues are considered in deliberations about larger ocean policy issues by providing information about economic and social dependence, community sustainability, etc., relative to fisheries. It is not really happening now, but needs to happen in order for the Councils to represent their interests in the broader CMSP process.

Social and Economic Breakout Session II

Discussion Leaders - Mark Holliday and Sherry Larkin

This session focused on how to encourage greater engagement and recognition of communities and community objectives in the fishery management policy process, as well as linking them to the application of catch share design tools for long-term sustainability of the community. The unique perspective of social scientists on the SSCs provides an opportunity to advise their respective Councils in this endeavor.

To frame this session's discussion, a summary of findings from a January 2011 NOAA Fisheries-convened workshop on fishing communities and the use of catch shares was provided to the session participants. The purpose of the January 2011 workshop was to add clarity to the potential role and function of fishing communities in current and future catch share programs. Framing the discussion around the workshop findings was an efficient means to compare information generated from the workshop on sustainable fishing communities needs around the country with policy guidance gaps and impediments, and to provide recommendations to the

Council and NMFS leadership regarding steps to reduce these gaps and impediments. A summary of the workshop findings is provided below.

- The MSA includes a legal definition of "fishing community" (FC) and "regional fishing association" (RFA) However, Councils need to delimit regionally-specific eligibility criterion that account for the social, political, economic, geographic, and temporal distinctness/diversity of FCs in their region, and define how these criterion relate to overarching management objectives so that group may design FCs and/or RFAs that align with Council goals.
- The function, advantage, and appropriate/intended use of FCs and RFAs need to be expressed more clearly to stakeholders and potential members.
- Existing entities (e.g., commercial fishermen's cooperatives) could provide the basis for future FCs and RFAs; however, it is unclear how/if these entities are better than non-Section 303A entities that currently exist given that fact that FCs and RFAs require more accountability.
- Sustainability plans should be comprehensive (e.g., objective statements, performance standards, strategic goals, justification for collective quota holdings, confidentiality requirements, administrative responsibilities, and accounting/accountability clauses), but they should also strive to reduce reporting of superfluous information.
- To successfully develop FCs and RFAs, communities need financial and technical assistance from NOAA and the Councils and, in some cases, third-party expertise.
- NOAA should develop an online clearinghouse of information to house and disseminate data, knowledge, and case study building blocks about catch share programs to support decision-makers, community leaders, and the industry.
- There are a suite of regulatory "levers" that can be integrated into catch share programs to achieve economic, social, and ecological outcomes (e.g., limited consolidation, community quota, etc.). Recognizing the flexibility of the model, it is important that explicit community goals and objectives be set by a Council to inform the design of the catch share program.
- To facilitate effective and efficient community organization efforts, an interagency and/or public-private cross-sector approach that includes governmental, non-governmental, and non-profit collaboration should be considered. NOAA and the Councils can be proactive in this process by providing understandable information about catch share programs, financial and technical assistance to off-set start-up costs, and a commitment to long-term communication, monitoring and follow-up with communities.
- To develop FMP goals that address community needs, community-related issues need to be brought to and sought out by the Councils more directly by way of formal advisory committees or expanded consultation mechanisms in communities.
- Information about the benefits and impacts of catch share programs need to be made more accessible to the public. The information needs to be synthesized and

disseminated by a consortium of governmental, non-governmental, and non-profit entities that have experience and long-term relationships working with local communities.

Prominent within the group discussion was the need to encourage greater engagement and recognition of communities and community objectives in the fishery management process. It was noted that SSC social scientists could include community impacts and the magnitude of these impacts in solicited comments regarding proposed regulatory changes, as well as include the underlying management objective that these proposed regulatory changes support. Participants noted that presenting these impacts in ways that Council members can use and interpret in the decision making process will also help communicate community impacts.

Another important topic in the discussion was addressing information needed to appropriately assess the proposed change. Relying on methodologies and data that are easily available or are routinely applied may not be appropriate in addressing community impacts. Instead, a well thought-out process of what should be done to address the impacts can be useful in communicating accurate community impacts. For example, one group member noted that methodologies used to capture community-level impacts were unable to provide an accurate community assessment. Community impacts often focus on fishery dependence through resident catch and revenue data or community vulnerability using Census statistics, but are insufficient at incorporating, for example, impacts to aging infrastructure or harvest-generated revenues.

It was also noted that identifying factors that determine the impacts (e.g., community diversity, capital investments) is also important in conveying community impacts. It was noted by some group members that communities impacted by fishery regulations are often composed of diverse populations and it is crucial to engage these groups to properly assess Council impacts. One example cited during the discussion was the creation of a rural outreach program. By engaging these rural communities early on in the Council process, the Council is able to consider the diversity of viewpoints of proposed fishery actions.

Session participants also spent time discussing different approaches on how to capitalize on the institutional knowledge of SSC social scientists to better address the Council's fishery-related actions. One approach noted was to generate terms of reference for the Council, thereby informing them of what the social scientist can provide in the fishery management process. Another approach noted was the potential to leverage social scientists expertise among the different SSCs to capitalize on institutional knowledge of previous social science work on catch share programs and community impacts.

Finally, participants briefly discussed Council-defined objectives in the context of catch share programs so social scientists are better able to provide impacts of catch share elements to the Council. It was noted that most Council-generated FMP amendments have general objectives,

but many FMPs and/or amendments lack explicit community objectives. Having Councils include community-specific objectives in developing a catch share program can help prevent unintended consequences downstream by designing a better program that meets the Council's community-specific objectives.

Social and Economic Breakout Session III

Procedural and Data Issues

Discussion Leaders - Dan Georgianna and Cindy Thomson

The discussion during this breakout session was informed by five trigger questions. Suggestions made during the discussion are described below following each question.

1. What is the role of social scientists and social science in the context of SSC structure and process?

Presenter Dan Georgiana briefly described how the NEFMC uses its SSC in the process for setting ABCs. He explained that the social scientists on the NEFMC SSC have not had a role in setting ABCs, but there is an effort to consider the opportunity cost of setting different buffers between ABC and the OFL. In the past several years, the SSC has been almost completely tied up in setting ABCs and has not addressed any social science issues. The NEFMC process for setting ABC calls for the SSC to review preliminary proposals from the plan development teams and to provide guidance or alternatives for further development. After the second meeting and review of the work by the plan development teams, the SSC usually provides an ABC recommendation to the Council. In some instances, the SSC has recommended a range of possible ABCs with a description of their biological consequences for the Council to consider. In these cases, the Council has chosen from the range of alternatives according to its risk tolerance. In general, the SSC has considered social science information only for data poor stocks or for Atlantic sea scallops, for which there are some useful economic performance data. In the case of data-poor stocks, the non-biological considerations in making ABC recommendations have been limited to determining if historical catch might have been constrained by the lack of markets instead of biological factors. Although the NEFMC uses a simple process for setting ABCs, it can take a long time for data-poor stocks or if assessment projections are unreliable.

Following Dan Georgiana's presentation, suggestions about the role of social scientists and social science in the context of SSC structure and process were:

- The group should not recommend a specific approach or process for incorporating social science concerns in Council actions because different Councils have different processes, including stock assessment and peer review processes, for including scientific information in management actions. In at least one region, the North Pacific, the SSC

reviews all social and economic analyses, including regulatory impact analyses such as the Regulatory Flexibility Analysis, for routine FMP adjustments. Participants from other SSCs stated that their SSCs were either too busy setting ABCs in recent years to review all of the social and economic analyses, or did not think it was a good use of SSC's time to review these analyses for all routine actions.

- Social scientists recommend the Councils optimize, not maximize catch.
- Social scientists should be involved in setting ABCs as well as other issues.
- Social science needs to be connected with the move to EBFM. For example, as part of a University of Maryland effort to look at ecosystems management, a social science team concluded that there was an increase in the scale of human dimensions in EBM.
- If the Councils are going to be on ecosystems regional planning bodies, SSC social scientists could help the Councils get onboard by helping them to identify and request the appropriate data. Social scientists should also look at the direct and indirect impacts of management policies on ecosystems services. The challenges of providing Councils guidance on social science with respect to EBM issues will be harder if there are new information needs, but not insurmountable.
- Non-economists often think economists care about only efficiency and prices. Economists need to suggest other ways they can be relevant. Economists analyze or describe impacts on things other than economic efficiency.
- SSCs should be pro-active in considering how they might improve their interactions with the Councils.

2. What practices exist or could be developed to improve social science inputs to the Council?

- SSCs should review all social science analyses related to important or controversial fisheries management decisions and actions.
- Some participants suggested that it might be helpful for Councils and their SSCs to develop annual terms of reference for considering social science concerns with respect to Council actions. Another suggestion was that SSCs might find ways to better help Councils deal with their annual cycles of setting ACLs or other management measures.
- Social science should be involved in the appropriate places in the stock assessment process; some stock assessments have been modified based on social scientists' participation on stock assessment committees.
- Involve potential partners to the greatest extent possible. These include Sea Grant programs, other academics and academic programs including teachers, researchers and graduate students. Other important potential partners are state as well as federal scientists because state personnel are usually closer to the data collection programs and fishing communities. The North Pacific management system has many participants who work for the state of Alaska and the Council greatly depends on data-sharing data between federal managers and the state of Alaska. However, it was noted that state fisheries

management agencies usually lack social scientists. For example, in New England not a single state fisheries agency employs a social scientist and, although the states participate quite actively in fisheries management, recent budget cuts have severely reduced the availability of state personnel to work on regional fisheries management issues.

3. How can the SSC develop and improve social science data and methods that are useful to the Council?

- There are many different data collection programs within NMFS. Social scientists could identify new pieces of data that would not cost much but provide valuable management information. For example, in some regions fishing permits cannot be tracked to boats over time. A couple of boxes on a data form that would solve this problem would have enormous payoffs. Also, permit ownership data could have been archived at very little expense. If social scientists do not identify social science uses for information, the information might not get collected or archived.
- Develop criterion for when certain types of analyses should be used to evaluate Council actions.
- SSC social scientists need to communicate to academic institutions that there is a need for social science research programs related to fisheries management. Research programs should balance the needs between biological and social science.
- The statutory requirements for economic and social impact analysis are not being effectively met. When social scientists draft recommendations, they should make the case that the MSA states that social science should be considered.
- Social scientists should be clearer about what they need to do and what data they need.
- For data-poor fisheries, social scientists should work with biologists on fisheries data needed for social science.
- Catch data are generally good, but there is a need for expanded effort data because the SSCs and Councils need a better understanding of how Council actions affect fishing effort. Also, SSCs could assist the Councils by making contributions to characterizing trends in fishing effort. For example, in the western Pacific, because of the long distances to the fishing grounds, the speed of vessels is very important in determining changes in fishing effort.

4. What can be done more generally to develop and improve social science data and methods that are useful to the Council?

- In some regions the greater problem is not the lack of social science data, but the lack of human capital to analyze the data. Social scientists need to advocate for more human resources to work with existing data and methods.
- Find ways for SSCs to interact with each other.

- Usually there is only funding for projects that address very specific problems about which the Councils need information. SSC social scientists should advocate for the need for social scientists to do social science research that is important in the long term.
- Involve people with a variety of social science disciplines to get different perspectives on social issues. These include, but are not limited to, different specialties within economics, sociology, anthropology, and geography. Often, accepted methods might not meet Council needs or answer their questions. Graduate students also bring new and different perspectives to social science issues.
- Explore game theory approaches to research fishermen's decisions about dealing with tradeoffs.
- Explore the utility of getting recommendations from fishermen using the Delphi method by having them reach consensus on what decisions should be made. Neither has been pursued in terms of research or research funding.
- One thing that could be explored in human ecology or similar fields is to look at the human dimensions of developing management reference points. All reference points were human-induced or human-involved. Reference points for human dimensions could be established, although they would not relate well to what other scientists are doing. In terms of ecosystems modeling, there should not be biomass reference points without a human component.

5. What are best practices for data collection and research that address Council social science needs?

Although the group agreed that Councils usually do not collect data, participants made the following suggestions:

- More work is needed to standardize data among the states in order to improve data quality and eliminate inconsistencies. SSC social scientists should participate on interagency data management committees that provide fishery data to the Council (e.g., PacFIN, RecFIN).
- Social and economic indicators need to be developed. Even coarse indicators would improve the understanding of community impacts.
- Social scientists need to collaborate to the greatest extent possible.

Recommendations—Social Science Breakout

Following the three sets of presentations and trigger questions, the social science breakout group discussed recommendations. The group decided not to rank the recommendations because the Councils vary significantly, so something at the bottom of one Council's priority list may actually be a relatively high priority for another Council.

Social Science Priorities

The group discussed the need for SSCs to have annual terms of references that the Councils develop to guide SSC priorities. Social scientists on SSCs feel underutilized, and several participants noted that the SSCs (and specifically social scientists) should be given directions from the Councils about what they need from them so that their expertise can be better utilized. SSCs should have a set of data needs, and this should include a social science section. These needs should be prioritized.

Social Science in the SSC Process

The group discussed options for outside peer review. One participant suggested that other SSCs could peer review the models used to determine the potential impacts of management decisions. Someone responded that Congress envisioned the SSCs as providing a peer review role, not just for assessment work, but for all science that comes before the Council. A formalized peer review process for SSCs would help social scientists to be appreciated more as scientists.

It was suggested that fishery performance reports should be institutionalized across the board so that there is some kind of peer review process for social science analysis. Several other suggestions for improving the SSC process included: (1) formation of an SSC Social Science group among Councils; (2) development of a library of available analyses and resources, and (3) a wiki for all eight SSCs to exchange information. These ideas would all promote ongoing dialogue so that momentum for social science research can be maintained.

The timing of Council and SSC meetings was discussed by the group after a participant asked why the South Atlantic decided to separate their meetings. A South Atlantic representative responded that it was putting a lot of pressure on the SSC to get reports done in time to be delivered to the Council. There was mutual agreement to have the SSC meeting ahead of the Council so they have plenty of time to write the report. The group agreed that concurrent SSC and Council meetings put great pressure on the SSC to complete its reports before they appear on the Council agenda but also provide greater opportunity for interaction between the SSC and other Council entities.

One participant pointed out that the needs and recommendations vary for the different SSCs, depending on their individual circumstances. For example, many of the recommendations that have been made in the North Pacific are already being done. Someone added that it is also important to explain why these recommendations are important. They are not just to promote uniformity, but they also serve to improve the value and contribution of the SSC in the decision-making process. It was suggested that the recommendations be termed “best practices,” but that they do not all necessarily need to be adopted by each SSC.

Several participants agreed that social and economic science should be leveraged by reminding the Council of their mandates, including those that require them to consider social and economic impacts of management decisions. Councils are required to do cost-benefit and community analysis. The Councils are not doing their jobs if they are not doing these analyses.

Social Science Research and Data Needs

In addition to highlighting the need to prioritize research requests, several participants also pointed out that SSCs need to develop indicators of economic and social well-being for fisheries. Councils need both baseline data and metrics of success so their efforts can be directed towards some purpose.

Participants voiced both support for and caution with mandatory data reporting requirements. While they generally support the notion of mandatory data reporting (because fishing is a privilege), they recognize that this can raise data quality issues. There are also issues with data getting collected and then being used as political ammunition. Another participant added that data collection is a completely reasonable cost of access to a public resource, but the burden needs to be proportional to the benefit.

Ecosystem Breakout Session I

OFL-ACL Continuum

Presenters - Pat Livingston and Martin Dorn
Discussion Leader - David Witherell

Breakout Session Overview Presentation

Pat Livingston provided a brief presentation on the different levels of utilization of ecosystem-level productivity throughout the US to determine limits along the OFL-ACL management continuum. The NPFMC utilizes an ecosystem cap (a form of optimum yield) on groundfish harvest for the GOA and BSAI. This is the only region to date that has implemented a system-level OY cap in U.S. fishery management. A BSAI groundfish OY cap was set equal to 85% of the MSY range (estimated to be 1.7 to 2.4 million metric ton based on average catches 1968-1977), and based on a range (1.4 to 2.0 million metric ton) to allow for flexibility with changes in the ecosystem. This cap has constrained the TAC limits for many species (especially pollock and flatfish) nearly every year since implementation in 1984. After the OY limit was first established, there were several proposals to increase the upper limit, but these proposals were rejected due to uncertainties in biological information, market concerns, and concerns about potential impacts on marine mammals and seabirds. Since then, the upper limit for BSAI groundfish OY has been codified in Federal legislation (Public Law 108-199) and, therefore, is

difficult to change. In contrast, the GOA OY cap is not constraining because the upper limit has been higher than the combined ABC for all groundfish stocks (to date).

The NEFMC and, its predecessor, the International Convention of the Northwest Atlantic Fisheries (ICNAF), had several estimates of system-level OY and associated caps. The values are wide ranging, for the entire Northeast U.S. Shelf Large Marine Ecosystem or various sub-regions (e.g. Georges Bank, Gulf of Maine). These system-level OY estimates tend to be consistent in magnitude over time and tend to be lower than summing the individual MSYs/OYs of species comprising the complex. The historical estimates have not been used directly in management, at least until recently. In 2008, a GARM III (groundfish assessment) meeting was held to aggregate groups and estimate system-level MSYs. These were used as context for the groundfish assessment and ultimately the groundfish FMP. More recently, those estimates were updated for various regions. These were presented to the NEFMC and the decision to utilize this approach for management has not yet been made although future plans for implementation are under consideration.

The MAFMC has not addressed the concept of system-level OY, but systemic OY caps are currently under consideration at various levels of the OFL specification process. The MAFMC is only in nascent stages of considering these estimates.

The WPFMC utilizes a single MSY value for an aggregated species complex (six species of deep water snappers and one species of grouper) for the MHI bottomfish fishery. A P* approach was used to determine the risk of overfishing the Council is willing to take to determine ABC and a SEEM Uncertainty Analysis was used to determine ACL and ACT. A system-level OFL definition was initially proposed for the coral reef fish management unit species using the Restrepo guideline for data poor stocks, but since they were using proxy information, such as biomass data from transect surveys, an available catch data, this alternative was dropped.

To date, the South Atlantic, Pacific, and Gulf of Mexico Fishery Management Councils have not considered system-level OY in their decision making processes.

Discussion

The main goal of this session was to identify the utility of a system-level OY based on existing management regimes from different regions of the US as a means of implementing EBFM. A critical part of the issue is the inherent dependence of the system-level OY prescription on the identification of the species that comprise the ecosystem. In most cases, the ecosystem-level OY will be less than the sum of individual species level OYs that comprise the system. One way to attain an ecosystem-based OY is to take information from individual species stock assessments that will generate MSY, and, subsequently OFL and ABC estimates. The sum of all these

species ABCs can be compared to the ecosystem-level OY. If the sum is greater than the system-level OY, one can negotiate at the Council level on how to get below it by reducing the allowable harvest for some species (or reducing harvest evenly across all species). In any management allocation approach, the goal would be to insure that the sum of the individual harvest allocations does not exceed the system level OY.

Harvesting across all trophic or taxonomic levels has been shown to assist in maintaining ecosystem stability. However, proportional harvesting across the different levels is difficult to estimate. One can probably extract harvest at a certain effort level across the ecosystem (i.e., representatives from each trophic groups) while maintaining the balance as long as ecosystem structures are kept intact. Determining the level of extraction at each level can be very challenging. In addition, extraction from a particular level in an array of different trophic assemblages or guilds has an impact on the whole system. Australia tried to explore this idea using across-ecosystem level extraction models. The most important result was that low rates of extraction across trophic levels had a significant effect on maintaining and even enhancing the productivity of the system. Removal of large-sized fish was found to have more impact than removal of smaller fish in terms of reproduction and population productivity, but exploitation of smaller fish may also have an impact on the larger fish in terms of food limitation and increased competition among higher-level predators.

Another potential approach to maintaining ecosystem balance in response to fishing is through the establishment of closed/reserve areas. This approach has been explored for both reef and ground fish ecosystems. In the Gulf of Mexico, where their current fishery is at various levels of exploitation and stock status, time-area closures are being used to conserve the gag grouper that is more vulnerable than the other species of groupers being caught on the same fishing trip.

Ecosystem models can assist in determining the appropriate system-level harvest cap, but this has to be done at an agency level (i.e., it transcends the capacity of individual researchers) and should be made a priority. At this point, the SSC and the Council can only conduct meta-analyses using existing information, as there are very few practical examples that have dealt with this issue. A review of multispecies systems with multispecies harvest would be helpful and could be compared with a single-species system to determine efficacy of multispecies OY limits. A study of 15 ecosystems in the northern hemisphere done under the auspices of Comparative Analysis of Marine Ecosystem Organizations (CAMEO) showed that the sum total of all single species catch limits is always higher than a system level. This can be summarized and should be forwarded as a recommendation.

Shifting baselines in terms of defining virgin biomass has always been a problem. Most of the fisheries have been exploited throughout human history and defining a level of virgin biomass is prone to subjective interpretation and assumptions. Nonetheless, in a multispecies fishery

scenario, the assessment generally results in a more conservative cap than other approaches. No matter what the system-level cap would be, one should put in special precautionary caps for really vulnerable stocks. Based on 45 years of survey data collected in the northeastern US, the species making up the ecosystem complex were never known to exist in a state where all key species were at a high level simultaneously, suggesting that the system had already achieved maximum productivity. Not only did the status of the stocks that comprise the system change, but the properties, linkages, and processes within the ecosystem itself had also changed, therefore altering the maximum productivity of the entire ecosystem.

A 50-year data series in the Mid-Atlantic exhibited fluctuations in environmental variables and the guilds that make up the ecosystem responded to those fluctuations. When the primary species declines it is often compensated for by an increase in other guild members or other guilds. This will not be apparent if you look only at general ecosystem-level trends. There are dynamics occurring at finer scales that are often overlooked. With increased dynamics, the complexity of the model system also increases.

If a system-level OY is to be used, the question is – where in the OFL-ACL continuum should the uncertainties about species interactions be accounted for? It may well be in the specification of ABCs. This can be done by using a multispecies model that treats all the parts as a whole. Summing up OYs from single-species assessments may not be optimal. In some cases, some stocks have been rebuilt and have achieved recovered levels at three to four times lower than the virgin biomass. A less popular approach would be to use a single species OY as a proxy for a multispecies OY. This approach is flawed because it does not account for species interactions.

OY has often been treated as a static number but, in reality, it shifts due to the dynamic nature of the stocks. The cascading effect of fishing has impacts at every level of the system. In the Gulf of Mexico, the microbial abundance and lower trophic level biomass may have increased, thus affecting the energy flow of the system. Thus, OY should be related to lower trophic level production, or at least ultimately constrained by it. OY is expected to be as dynamic as the system it describes and therefore may be a moving target, but less so than individual species. When the OY cap is considered as a dynamic quantity, one could use a simple production model and incorporate any number of variables that treat it as a shifting, dynamic system. For example, in tracking the energy flow through the multispecies ecosystem from the microbial to the consumer level, most of the energy may be dissipated at the lower trophic levels. If most of the energy is lost at lower trophic levels, there should be some mode of compensation at other levels in order to achieve net conservation of population production. The changes in each level due to compensation also shift the individual OYs and therefore the total OY will also change.

Habitat improvements may also have a significant impact on stock dynamics and system level productivity. Habitat has a direct influence on shrimp production in the Gulf of Mexico. In

addition, increased red snapper populations may have occurred as a result of increases in artificial habitat and carrying capacity through oil rig pipeline development.

Three things need to be carefully considered when working on a system level OY. The first is species composition, which will determine the internal dynamics of the system characterized by fluctuations in abundance over time as influenced by environmental factors. Next, species interactions need to be considered as they define the biological balance exhibited within the system as driven by predator-prey relationships. For example, a decrease in predation pressure on a particular species may result in an increase in its abundance. The third consideration relates to trophic cascades which drive energy flow within the system.

Recommendations

- Review and compare approaches to estimate any fundamental features resulting from system-level OY estimates.
- Compare system-level production stability: system-level biomass is more stable than guild-level biomass, which is more stable than stable-stock biomass. The stability has a lot of utility in fishery management (from a regulatory, business, etc. planning perspective).
- More information/data is necessary nationally, particularly with respect to species interactions (trophic, bycatch, etc.).

Ecosystem Breakout Session II

Presenters - Jason Link and Richard Methot
Discussion Leader - Churchill Grimes

The session began with a presentation by Jason Link and Richard Methot relative to forage species issues. The attributes of forage species mostly include:

- Highly migratory, locally dominant, spatially overlapping with many species
- Predation by protected species, commercially valuable species – odontocetes, seals, birds, fish, invertebrates
- Competition with protected or commercial species – planktivores, ichthyoplanktivores
- Predation on larvae/juveniles of commercial species
- Large fishery potential
- Lower-intermediate trophic levels
- Very high trophic efficiency
- Horizontal flux, high biomass
- High linkage density, strong interactions for some stocks

- High exploitation rate, high historical fishery
- Temperature-mediated changes in distribution, migration, or production
- Demonstrably susceptible to climate change

For forage species, natural mortality can be noteworthy. Natural mortality rate estimates are continually improving and have a substantial impact on reference point estimation. Particularly, the estimation of predation and food habits is improving with recent publications specific to natural mortality. The ratio of consumption to catch is often greater than one. If catch to consumption begins to approach one then this situation should raise a "flag" meriting examination. In some cases consumption can be four to five times catches.

Revised estimates of predation mortality imply a history of underestimation of this component of natural mortality. Estimates of MSY with predation included can be 1.5 to 4 times higher than estimates without this predation explicitly estimated. Total removals are higher, but upon allocating across sources of removals, the harvestable portion decreases. The assessment process often focuses on precision, but accuracy is often more important.

A survey of current Council practice around the US revealed that most of the Councils have forage species under some form of management. These usually include small pelagic species such as krill, squids, clupeids, etc. In the Gulf of Mexico, corals and decapods are listed. Many of the Councils are beginning to incorporate ecological factors into stock assessments, albeit in a qualitative fashion, although there are a few examples of quantified uses. Council application of forage issues to harvest policy ranges from threshold or cutoff values to predation considerations in natural mortality estimates.

Dr. Link then presented an example under consideration in the Mid-Atlantic of a proposed protocol for forage and a generic ecosystem consideration TOR for the purpose of exploring major ecological implications (Figure 6). It is built on a hierarchy of qualitative questions: Is the stock forage? Is it retained or is it incidental bycatch which is discarded? Is there a stock assessment with an acceptable OFL estimate? Does the stock assessment consider predation? OFL buffers are increased depending on the quality of the assessment and the trends in landings. If the species is not landed, it can be binned as an ecosystem component species.

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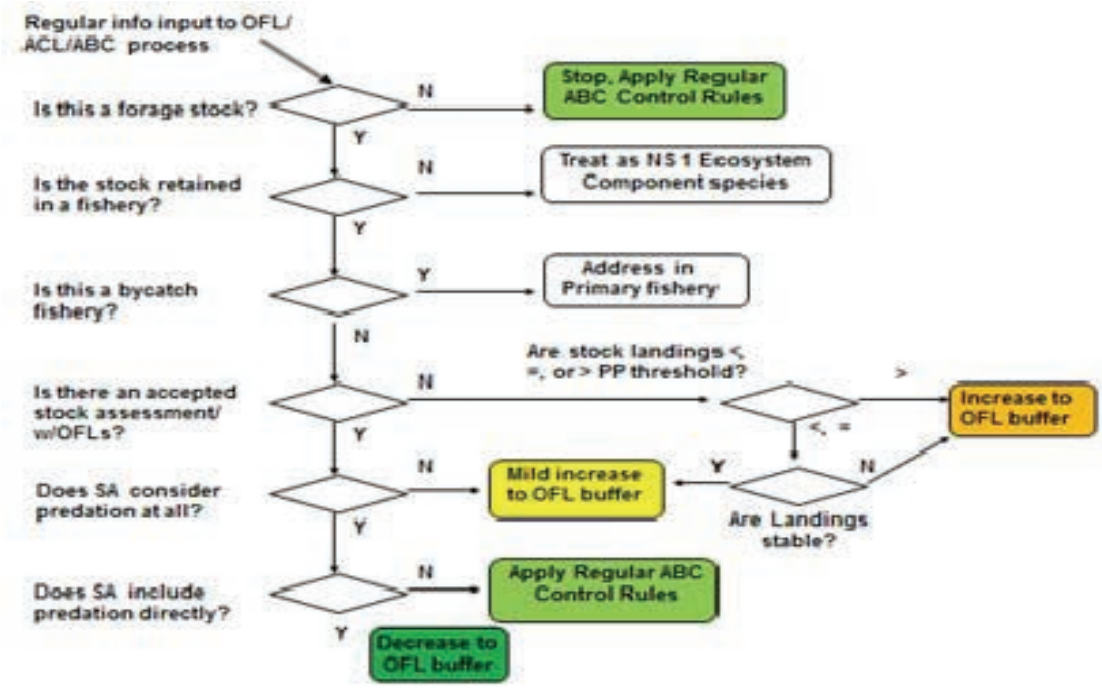

Figure 6. Proposed protocol for forage and generic ecosystem TOR.

This protocol/TOR has been approved by the MAFMC SSC and is moving forward for Council approval.

In the MAFMC context, the question of whether a species is forage is a bit gray, but criterion are being developed as follows:

- Is small to moderate in size (average length of ~5-25 cm) throughout its lifespan, especially including adult stages;
- Is subject to extensive predation by other fishes, marine mammals, and birds throughout its lifespan;
- Comprises a considerable portion of the diet of other predators in the ecosystem in which it resides throughout its lifespan (usually >5% diet composition for >5 years);
- Has or is strongly suspected to have mortality with a major element due to consumptive removals;
- Is typically a lower- to mid-trophic level (TL) species; itself consumes food usually no higher than TL 2-2.5;
- Has a high number of trophic linkages as predator and prey; serves as an important, major (as measurable by several methods) conduit of energy/biomass flow from lower TL to upper TL;
- Often exhibits notable (pelagic) schooling behavior;

- Often exhibits high variation in inter-annual recruitments; and
- Relative to primary production and primary producers, has a ratio of production and biomass, respectively, to those producers no smaller than on the order of 10^{-3} to 10^{-4}.

The Marine Stewardship Council and Lenfest Forage Task Force efforts have identified similar forage criterion. It is also unclear how many of these criterion need to be met. It could be argued that some of these could stand alone if the science suggested it has a high priority. It is not clear whether these national forage criterion are generally applicable, but there was some consensus that this forage issue warrants continued attention. The above list was agreed as generally germane for further consideration.

Discussion

In general, predation data is lacking, particularly at the egg and larvae stages. In the North Atlantic there are some larval indices for cod and herring being developed. There are some Councils that have listed juvenile stages as forage. It seems to be a given that juveniles are forage. But it was unclear whether we want to make a recommendation on the practice of listing juveniles or simply move forward with a general expectation that juveniles are often important prey items?

On the list of attributes, the schooling criterion is an important one. Schooling behavior can increase, but also mitigate, predation and can confound stock assessment work. The role of a forage species in diets is important (opportunistic versus obligate). This is a key difference to consider in predator-prey relationships. This is one important step in the complex process of understanding or modeling species interactions. Presently, we are simply at the level of whether the species is a consistent component of diets.

What are the rationales for treating forage species differently? Where does one enter the buffer? Is the OFL calculated differently, should a buffer be added for scientific uncertainty, or is it an OY consideration as described in the NS1 guidelines and MSA? Predation removals are not always included in the stock assessments, so it seems one could build that into the assessment and reduce the buffer or calculate a point estimate of OFL with a greater buffer given the forage role. If an inappropriate natural mortality rate is used in the assessment, the calculated F will more than likely be inaccurate.

An age-structured assessment will not miss a source of mortality. If predation is underestimated, that extra mortality will likely be attributable to fishing mortality. Forage species can easily disappear from the system only to return many years later. Diets shift in response to abundance of forage, and therefore, predation mortality is also likely to be variable. Estimates of mortality need to be updated frequently to account for changes in abundance and to corresponding harvest

and predation rates. The group concluded that natural mortality estimates in stock assessments need to adequately address predation mortality.

It is hard to quantify the predatory demands on a single forage species because natural fluctuations in prey species populations force dietary changes that are dynamic. Diet studies are fairly conclusive that prey targets change, in response to changing availability. The Lenfest Task Force is recommending cutoff values in response to the natural population fluctuations. These cutoffs are based on B_0, which can be problematic. There is also a consideration of the relative importance of a prey species to a given predatory field (obligatory versus opportunistic, or place-based versus migratory predators). Spatial management would be another addition to the cutoff mechanism for stationary predator needs (nesting sea birds).

The group concluded that it may be more important to identify an overall forage cutoff or biomass target rather than a species-specific goal. Oceanographic or ecological conditions that result in poor survival across species can have broader and greater impacts at the ecosystem level than fluctuations in a single-species population level.

The group then discussed whether or not existing ecosystem models are adequate in terms of assessing forage issues, forage OY, predator needs, food web interactions, optimal stock sizes, etc. Assigned values and model functions are often assumptions or educated guesses, which can minimize the validity or appropriate use of results. Many models are designed for developing strategic objectives rather than tactical management decisions. When coupled with an MSE, they can shed light on major areas of focus. However, we need to be conscious of the risks of over application and where vulnerabilities lie.

The Marine Stewardship Council forage effort has taken the approach of applying a variety of model platforms to a single management question. The level of model agreement can be used to assess the accuracy of projections. One still needs to be mindful of the assumptions made and model independence but using a variety of model approaches strengthens the analysis. This point raised the question of the burden of proof and where it lies. The burden of proof should be applied more heavily to modeling efforts that do not take into account ecosystem considerations rather than the converse.

The group then returned to the forage discussion. Gear or fishery types could also be used for organizing and include criterion. Forage fisheries tend to target planktivorous pelagic species that are generally mid-water and low in bycatch. Like many of the criterion discussed, this would not likely stand alone. There is a need for a forage species definition but with careful application that should have a regional component with some degree of national consistency. The key question is how does one consider if there is adequate food and adequate food for what? We need to change the burden of proof. Some thought that using an uncertainty buffer just

because a species is forage may be outside the intended use of the buffer process. Buffers are less effective for highly variable populations, particularly when assessments are not conducted regularly. Criterion need to be reviewed regularly for consistency and continued relevance.

Public comment

Judd Crawford noted there is a lot of focus in the NE region on the forage issue with lots of Council participation. It is important to provide guidance on what is forage. It should not be binding, but it should be advisory. There is no perfect definition. In the Council setting, if there is not some guidance, management based on ecosystem principles will be hampered by ongoing debates about what is forage rather than meaningful management decisions.

Ken Stump stated that forage issues have been at the forefront of his work for 15 years. He cautioned the group to be careful in how forage is defined. It is easy to exclude legitimate forage species, particularly obscure, non-target species. Species like salmon, atka mackerel, pollock, and herring were excluded for reasons of fishery importance rather than ecosystem science. When determining how to identify adequate forage, it is important to consider an ecosystem set-aside, which is not a simple matter because we needs to account for space and time as well, not just a biomass level. A set-aside may account for basic metabolic needs if there was 100% efficiency, but there needs to be more than just the bare metabolic need to ensure adequate forage. He recommended that a subcommittee be formed to consider the topic.

Ken Hinman stated that system-level OY may be misguided. Rather a system-level optimum productivity, particularly for overall forage species, is more important.

Greg DiDomenico provided a Mid-Atlantic perspective. There is a clear directive from the agency with regard to the ocean policy. But what is the regulatory imperative that the Councils need to comply with? Ecosystem management is not required under current US fisheries law and was specifically left out of MSA reauthorization. There is no clear reason why EBM has to be done. There has been lots of talk of making adjustments to ensure adequate forage. First, the adequacy of the existing forage should be assessed. Productivity works both ways. Will ecosystem modeling efforts ever result in increased fishing opportunities? It must go both ways. Take advantage of higher yields when they are evident.

Ecosystem Breakout Trigger Questions

Forage Discussion Summary

Here is a summary of responses to key trigger questions on forage. These were filled in prior to the meeting from each Council SSC representative and then formed the basis for discussion at the meeting. The responses and resultant commentary represent a survey of what each Council's SSC is attempting with respect to each topic noted.

i. Is there a generic basis for defining forage species?

The definition of forage species is not specific. The following criterion were agreed upon as characteristic of forage in general, but how they would be used nationally was less clear.

- Is small to moderate in size (average length of ~5-25 cm) throughout its lifespan, especially including adult stages;
- Is subject to extensive predation by other fishes, marine mammals, and birds throughout its lifespan;
- Comprises a considerable portion of the diet of other predators in the ecosystem in which it resides throughout its lifespan (usually >5% diet composition for >5 years);
- Has or is strongly suspected to have mortality with a major element due to consumptive removals;
- Is typically a lower to mid trophic level (TL) species; itself consumes food usually no higher than TL 2-2.5;
- Has a high number of trophic linkages as predator and prey; serves as an important, major (as measurable by several methods) conduit of energy/biomass flow from lower TL to upper TL;
- Often exhibits notable (pelagic) schooling behavior;
- Often exhibits high variation in inter-annual recruitments; and
- Relative to primary production and primary producers, has a ratio of production and biomass, respectively, to those producers no smaller than on the order of 10^{-3} to 10^{-4}.
- The level of natural mortality or higher predation mortality could serve as indicators. Other forums have identified similar forage criterion. Gear or fishery types could also be criterion. Fisheries tend to target planktivorous pelagic species that are generally mid-water and low in bycatch. Like many of the criterion discussed this could not likely stand alone.

Another proposed a criterion discussed was "is the species a key prey item of a predator of concern?" Criterion could be useful for the identification of key species by region, but may never be specific enough to be applied across many species and across many regions/ecosystems. There was agreement that continued exploration of delineating forage was warranted.

There was general agreement that the exercise of defining forage should be approached with caution and probably at a regional level; doing so could be limiting or without strong functionality for a practical management application if generic delineations were applied without consideration of local or regional features. It was observed that nearly everything plays a role in the food web to some degree and is prey during at least juvenile life stages, thus adopting such a definition could be fruitless if it was all-inclusive. Conversely, there are species that clearly play a critical role in the food web that could be easily identified (i.e., krill) and there might be value in treating them as forage directly Certainly further exploration of the topic seemed warranted to the group.

ii. How does each SSC evaluate forage stocks in incoming stock assessment (SA) information?

- GFMC – Shrimp, spiny lobster, and stone crab assessments take into account all environmental interactions.
- CFMC – N/A
- SAFMC – N/A
- MAFMC – Considered as context for forage stock assessments, particularly with regard to predation mortality (M2), directed removals in some SAs.
- NEFMC – Considered as context for forage stock assessments, particularly with regard to M2, directed removals in some SAs.
- PFMC - Considered as context for forage stock assessments, particularly with regard to M2, directed removals by age included in stock assessments.

The group agreed that natural mortality estimates in stock assessments need to adequately address predation mortality.

iii. How does each SSC evaluate forage stocks in the context of OFL-ACLs?

- NPFMC - the ABC deliberations by the PTs and SSC may include consideration of whether there is a trend in natural mortality due to predation or whether there is sufficient forage for a target species that may be exhibiting reduced recruitment trends. This may play a role in deciding whether the ABC should be reduced below the maximum allowable.
- WPFMC - A one-year life span exception was used for Hawaii squids and the MSY values from the stock assessment were used for the two Hawaii scads. ACLs for the scads were set equal to ABC and OFL due to short lifespan and the observation that catch for the past decade is below MSY.
- PFMC – Ecological factors are reviewed in the management of all species in the CPS FMP and are an explicit part of the MSY and OFL decisions relative to Pacific sardine.
- GFMC – No, See stock assessments
- CFMC – N/A

- SAFMC – N/A
- MAFMC – Considered as ecosystem considerations TOR in ACL process; also, specific forage protocol proposed.
- NEFMC – No

There was no nationally consistent treatment of forage fishes.

iv. How does each SSC account for "adequate" food for commercial, protected, other species?

- PFMC – Cutoff or threshold levels are identified as biomass levels below which harvest does not occur.
- NPFMC – No directed harvest and bycatch limits for other fisheries.
- GFMC – Nothing in place for menhaden or shrimp.
- Other Councils do not explicitly account for this consideration.

Again, there was general agreement that it may be more important to identify an overall forage base cutoff or biomass threshold rather than a species-specific goal. Oceanographic or ecological conditions that result in poor survival across species can have broader and greater impacts on the system than fluctuations in a single species' population level and this aggregated treatment of forage would better mitigate such fluctuations.

v. What models, data or information is needed to begin to consider forage more directly?

An alternate question would be "Are existing ecosystem models adequate for assessing forage issues, forage OY, predator needs, food web interactions, optimal stock sizes?" Many such models are designed for developing strategic objectives rather than tactical management decisions, but there are some that can provide tactical outputs. When coupled with an MSE, this range of models can shed light on major areas of focus. Such ecosystem models results will likely be more robust at the functional group level rather than at the species level. Complexity tends to go up with increased interactions between functional groups, so an aggregated grouped perspective would be beneficial to consider. A healthy level of mistrust is wise and a high level of validation should be applied to any such models. Further evaluation of such ecosystem models, generally, is needed.

These model projections are being explored as a means of developing harvest reference points for data poor forage species that are not targeted and not sampled well in traditional surveys.
The MSC approach has taken the tact of applying a variety of model platforms to a single management question. The level of model agreement can be used to assess the accuracy of projections.

Ecosystem Breakout Session III

Presenters - Bob Skillman and Selina Heppell
Discussion Leader - Sean Powers

Bob Skillman and Selina Heppell provided an overview of each SSC's role so far in progressing toward EBFM.

There was discussion of the "IEA" experience at different SSCs. Few SSCs noted actual experience with this approach. It will be difficult to proceed effectively toward EBFM and EBM without such clear guidance on goals and objectives, as noted in the IEA approach. The lack of Council jurisdiction over many components of the ecosystem was also noted as a significant challenge to EBM. The National Ocean Policy and Regional Ocean Councils may provide means of addressing such issues by enabling multiple agencies to work together toward common goals.

It was suggested that goals and objectives could be established by first considering important ecological entities at operational levels, such as particular habitats, protected species, production regions, or trophic groups. One way to accomplish this would be to consider ecosystem components affected by fishing, as fishing is the primary ecosystem effect addressed by the Councils and this provides a tangible starting point that could lead to broader goals. Many Councils work best from such a 'bottom up' approach. Although this may work well initially and procedurally, consideration must also be given to broad concerns and goals, to avoid being led into an undesirable end point. It would also help to consider broadly how ecosystem management can improve overall Council management, and what Councils could accomplish through ecosystem management that they are not able to accomplish through current approaches. In other words, ecosystem management should address some currently unmet need. Such needs may include:

- Addressing components of NS 1 and 2.
- Addressing biodiversity issues.
- Addressing the inter-relationships among ecosystem components.
- Improving overall efficiency and performance by establishing appropriate ecological boundaries to management, as opposed to political boundaries.
- Fostering identification and possible prevention of problems with developing fisheries.
- Improving risk evaluation and identification.

There was general consensus on the following points regarding EBFM goals for Councils:

- There is a clear need to establish clear goals and objectives
- Bottom-up approaches may be effective for developing goals and objectives.
- There is a need to identify how EBFM can improve Council performance.

Plenary II

Recommendations and Wrap up

On day three of the workshop the two groups reconvened in a final plenary session to summarize breakout discussions and attempt to reach consensus on findings and recommendations to the CCC. David Tomberlin summarized the discussions and recommendations of the social science breakout sessions on day two (see Breakout Session above). The Social science group noted that there is a wide range of engagement of social scientists in SSC deliberations across the country, ranging from near full engagement in some regions to little or no engagement in some regions. There was general recognition of the need for collection and analysis of additional social and economic fisheries data, and to more fully engage social scientists in the SSC process through review of Council analyses included in FMPs, Amendments, and Frameworks.

The social science group also noted that catch share programs should be viewed as one potential vehicle for attaining community objectives in fisheries management (if carefully designed to achieve those objectives). Catch shares encompass a broader range of issues that extend well beyond ITQs. The Councils should address community impacts in solicited comments and identify factors that can be used to determine those impacts (e.g., community diversity, capital investments). The SSCs should help to identify the information needed to appropriately assess community impacts.

Many of the SSC members who participated in the social science breakout viewed the development of EBFM goals and objectives as a point of entry for social science into the SSC process, especially in the context of the development of national ocean policy. The social science group identified a number of practices which would facilitate incorporation of social science information into the Council decision-making process, including: the development of white papers; including a social science section in the Council five-year research plans; providing peer review of social science models; providing social science training for new Council members; including social and economic sections in SAFE documents; and inclusion of social and economic considerations in ABC specifications through use of fishing effort data in projections. In general, social scientists need to be more fully engaged in the review of Council documents and analyses related to Council actions and in the development of novel social science data sets and analyses, including those related to community impact analysis. Finally, there was general support to form a cross-SSC Social Science Working Group to build on discussions at National SSC IV.

Jason Link presented a summary of the discussions and recommendations of the ecosystems breakout sessions on day two (see Breakout Session above). With respect to system-level OY considerations, the Ecosystem group agreed on the following points: system level MSY is

generally less than the sum of single species MSYs, which implies more precautionary F policies may be necessary; there is a need to define the "system" carefully; and better information is needed to describe interactions among species and trophic levels. The Ecosystems group also agreed that there is a clear need to define forage species based on a regional approach with some degree of national consistency. There is also a need to review approaches to estimating biomass of forage species groups or guilds and forage demand by predators. In terms of developing ecosystem goals and objectives, the ecosystem breakout group agreed that it is important that the SSCs engage the Councils concerning goals and objectives, and that stakeholder input is critical. There is also a need to evaluate EBFM versus single species management.

Final Wrap-up Discussion

Participants discussed the need to communicate with the CCC about the commissioning and authority of any working group established at National SSC Workshops. For example, the data-poor working group (ORCS) was assembled at the second National SSC Workshop held in Charleston, SC rather than through NMFS. Consequently, the working group's report is not considered technical guidance even though it provided valuable and useable results to help fill in the gaps in the NS1 guidelines. The National SSC Workshop Reports are valuable, and build a bridge to improve outcomes of all Councils by sharing best practices. The question is, should the SSCs establish working groups to flesh out issues, or should the group simply inform the CCC and NMFS that a topic needs more attention? This issue will be presented to the CCC at their upcoming meeting in January 2012.

The group further discussed how to address management of forage fish, which is a critical issue for some Councils (particularly on the East Coast). Discussion centered around whether or not to establish a committee or working group to better frame the issue and develop some ideas to address it. It was noted that this is a subset of ecosystem issues in general, and that perhaps we are not ready for a national statement about forage fish. More scoping is needed on this issue at both the national and regional level. It was clear that more evaluation is needed, but the question remained if the National SSC was the appropriate group to form a committee to explore best practices for forage fish management. It might be a more appropriate task for NMFS.

Several possible topics were suggested for the next National SSC Workshop including: Council and SSC communications; forage fish; stock-rebuilding analysis and results; evaluation of risk and uncertainty; spatial management; and transition to EBFM.

One participant suggested that a transition strategy to full EBFM is needed, and management of forage fish might be a good first step. The agency has invested a substantial amount of money and effort to collect ecological data on more than just harvested species; and more effort should be made to take advantage of this research and fully integrate the information into assessment

and management. It was noted that the NEFMC SSC is looking into transition to EBFM; they are considering managing by ecological units that cut across regions, rather than by individual species FMPs that do not consider interrelationships among them. First steps might include specifying spatial management units and consolidating FMPs by ecoregion. Councils across the nation are at different stages of implementing ecosystem-based fishery management, and participants agreed that transitional approaches will be a critical issue for Councils in the near term.

Participants noted that the topic of transition could include progress towards fishery ecosystem plans, implementing ecosystem considerations, integrated ecosystem assessments, and the next generation of fishery management challenges, such as spatial analysis relative to the National Ocean Policy. ACLs are now required for all managed fish stocks and, under full implementation of ecosystem-based management, total catch (all species) would be reduced in most instances. Allocation of allowable catch will be required to allow more even distributions of catch among trophic levels and prevent the most valuable species from being relatively overharvested. It was noted that this is a very broad scope, and may be a better topic for the next Managing Our Nations Fisheries conference.

EBFM is the stated U.S. national policy for ocean management. The Councils need to determine how to implement ecosystem-based management in a way that best serves their interests. Non-fishing ocean use sectors will be competing for use of the ocean, so there is some urgency to completing this task. NS 1 states that NMFS and the Councils must protect ecosystems and we need to quickly be in the best position to represent interests in the living marine resource management sector. The SSCs are in a position to advise the Councils on how to meet NSs and ocean policy objectives.

The role of the SSCs was also discussed as a topic for a future meeting. The SSCs are advisors to the Councils and provide decision support. While SSCs should not be in a position to advocate, there is a need for an operational framework to educate the Councils and, conversely, get direction from Council. It was generally agreed that SSCs should focus on the role of advising the Councils, rather than pursuing interesting research topics or preparing analyses. It was suggested that a topic for a future meeting could be to compare how different SSCs communicate with their Councils and work to determine best practices in this regard.

Participants generally felt that the next SSC Workshop should not be held until after the forthcoming Managing Our Nations Fisheries III conference scheduled for May of 2013. Based on the outcomes of that conference, the SSCs will be in a better position to address critical topics and share best practices. It was suggested that a report of the four SSC Workshops be given at the national conference, which will generate interest and ideas for the next SSC workshop.

Chairman Boreman made several closing remarks, thanking all participants, rapporteurs, and organizers for their efforts in completing another successful meeting.

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Appendix I. Fourth National SSC Workshop Agenda

October 4-6, 2011, Kingsmill Conference Center, Williamsburg, VA

Day 1 Oct 4	**Time:**		**Speaker/Leader**
	830	Welcome and Introductions	Dr. John Boreman
Plenary	845	Keynote Speaker	Dr. Tony Smith
		Round Robin	
	945	NPFMC	
	1000	WPFMC	
	1015	PFMC	
	1030	Break	
	1100	GMFMC	
	1115	CFMC	
	1130	SAFMC	
	1145	MAFMC	
	1200	NEFMC	
	1215	NMFS	
	1230	Lunch	
	1330	Keynote Speaker	Dr. Lee Anderson
	1415	Broader Context & Tradeoffs	
		Plenary Discussion, Trigger Questions (TQ)-Set 1	
	1515	Break	
	1530	IEA & Frameworks Speaker	Dr. Brian Wells
	1615	Plenary Discussion, TQ -Set 2	
	1730	Adjourn	

Day 2 Oct 5 **BREAKOUT GROUPS**

(Each topic in breakouts to have an overview talk, followed by structured discussions, trigger questions and Q&A leading to specific recommendations)

	830	**Ecosystem Breakout Group**	
	850	OFL-ACL continuum: System MSY Talk by Pat Livingston/Martin Dorn	
		Breakout Discussion, Eco TQ Set 1	Leader: Dave Witherell
	1030	Break	
	1100	Forage Discussion Talk by Jason Link/Rick Methot	
	1120	Breakout Discussion, Eco TQ Set 2	Leader: Churchill Grimes
	1200	Lunch	
	1300	Breakout Discussion, Eco TQ Set 2	Leader: Churchill Grimes
	1430	Break	
	1500	Goals and Objectives Talk by Bob Skillman/Selina Heppell	
	1520	Breakout Discussion, Eco TQ Set 3	Leader: Sean Powers
Plenary	1630	Reconvene in Plenary, Discuss Breakouts	
	1700	Adjourn	
	1800	Group Dinner	

	830	**Social Sciences Breakout Group**	
	850	Role of social science in SSC	Leader: Craig Severance
		Breakout Discussion, SS TQ Set 1	Eric Thunberg
	1030	Break	
	1100	Catch shares	Leader: Mark Holliday
	1120	Breakout Discussion, SS TQ Set 2	Sherry Larkin
	1200	Lunch	
	1300	Procedural / Data Issues	Leader: Dan Georgianna
	1320	Breakout Discussion, SS TQ Set 3	Cindy Thomson
	1430	Break	
	1500	Recommendations	Leader: Bonnie McCay
Plenary	1630	Reconvene in Plenary, Discuss Breakouts	
	1700	Adjourn	
	1800	Group Dinner	

<u>Day 3 Oct 6</u>	**830**	**Continued Reporting on Breakouts**
Plenary	930	Revisit Day 1 Discussions
		Frameworks, Broader Context, Tradeoffs
		Plenary Discussion, TQ set 3
	1030	Break
	1100	Plenary Discussion, TQ set 3
	1200	Lunch
	1300	Specific Recommendations for the CCC
		Plenary Discussion, TQ set 4
		Consolidate summaries, consensus, notes
		Assign reporting/follow up action items
	1530	Adjourn
		Steering Committee Meets to Wrap Up

Appendix II. Terms of Reference and Trigger Questions

TERMS OF REFERENCE (TOR)

Ecosystem TOR

1. Review each Council's SSC EBFM approaches, with general overviews loosely touching on the following topics (as appropriate for each region; i.e. the "round robin", 1st day, joint with socio-economics session).

a. An ecosystem perspective from each SSC to provide a general overview.
b. A socioeconomic perspective from each SSC on current practice and challenges.
c. How each SSC interacts with their Councils in policy development.

2. Evaluate how each SSC is incorporating ecosystem considerations into the full OFL-OY-ACL continuum, particularly relative to quantifying scientific uncertainty?

a. Evaluate how system-level OYs could be used by each SSC in this process.

3. Evaluate how to account for forage species in setting ABCs/ACLs, including technical definition of "forage species"?

4. Evaluate how each SSC is helping their Councils to establish EBFM goals and objectives, cognizant of and constrained by the best available science, as looking to the future?

5. Describe what are the frameworks (procedures, standing advisory bodies, TOR, etc.) for incorporating ecosystem considerations into management.

a. Evaluate how broader, contextual efforts inform and get utilized in the Council SSC advisory process, including items such as IEAs, CMSPs, annual state of the ecosystem reports, ecosystem status reports, and similar information? (joint with socio-economics session).

6. Evaluate how to evaluate tradeoffs across fisheries, stocks, fleets and even other ocean-use sectors (joint with socio-economics session)?

a. Evaluate how system-level OYs could be used by each SSC to facilitate EBFM (joint with socio-economics session).

Social Science TOR

1. Review each Council's SSC fishery management approaches, with general overviews loosely touching on the following topics (as appropriate for each region; i.e. the "round robin", 1st day, joint with ecosystem session).

a. An ecosystem perspective from each SSC to provide a general overview.
b. A socioeconomic perspective from each SSC on current practice and challenges.
c. How each SSC interacts with their Councils in policy development.

2. Evaluate role of social science analysis in SSCs generally, as well as the contributions social scientists can make as SSC members.

3. Evaluate role of SSC social scientists in supporting Council deliberations on catch shares.

4. Explore issues regarding data and procedures for socioeconomic analysis in SSC work, e.g. peer review, terms of reference for subcommittees, etc.

5. Describe what are the frameworks (procedures, standing advisory bodies, TOR, etc.) for incorporating socioeconomic considerations into management.

6. Evaluate how to evaluate tradeoffs across fisheries, stocks, fleets and even other ocean-use sectors (joint with ecosystems session).

7. Develop recommendations for the integration of social science in SSC procedures.

TRIGGER QUESTIONS

Plenary Set 1

i. How could system-level OYs be used by each SSC to facilitate EBFM?
ii. What facets of an ecosystem perspective regarding what would be needed, what's desired, and what's feasible to establish a framework for evaluating trade-offs?
iii. How do socioeconomic factors play into OY, in principle or in practice?
iv. How are trade-offs of all kinds (ecological, economic, social) captured in OY?
v. How can risk analysis be used to help Council decision-making (link to ABCs)?
vi. How do/could ecosystem assessments capture human behavior within the ecosystem?

Plenary Set 2

i. How do broader, contextual efforts inform and get utilized in the Council SSC advisory process, including items such as IEAs, CMSPs, annual state of the ecosystem reports, ecosystem status reports, and similar information?
ii. How to identify and use the best institutional structures, protocols and procedures for doing so?
iii. What are the best practices in broader, resource management frameworks?

Plenary Set 3

i. What are the best practices for frameworks to evaluate trade-offs?
ii. What is the most important thing we need to nail down for the OFL-ACL continuum?
iii. What is the biggest challenge facing SSCs nationwide?
iv. Are there any lessons learned from data-rich situations that could inform data-poor situations?
v. Are there any lessons and simpler methodologies from data-poor situations that could inform data-rich situations?

Plenary Set 4

i. What are the main recommendations from this workshop worth passing onto the CCC?
ii. What topics should be covered at the next National SSC Workshop?
iii. What other planning do we need to do for the next National SSC Workshop?

Ecosystem Considerations

Ecosystem TQ Set 1

i. How are system-level OYs calculated?
ii. How have system-level OYs been used by SSCs?
iii. What ecosystem considerations are being considered in the OFL-ACL continuum? Apart from predation (covered specifically later), what about the following? Protected and Endangered Species; Fisheries Sustainability; Biodiversity; Habitat; Coastal Zone Management & Nutrients; HABs; Trophic balance; Systemic Considerations; Climate Effects; Invasive Species; Toxic Deposition; Offshore Energy Systems; Navigation Routes; Relativity & Interactions Among Drivers; Cumulative Impacts; and, Systemic Resilience.
iv. How are ecosystem considerations being considered in the OFL-ACL continuum?
v. How is uncertainty associated with such ecosystem considerations being considered?
vi. What models, data or information is needed to begin to consider these issues more directly?

Ecosystem TQ Set 2

i. Is there a generic basis for defining forage species?
ii. How does each SSC evaluate forage stocks in incoming SA information?
iii. How does each SSC evaluate forage stocks in the context of OFL-ACLs?
iv. How does each SSC account for "adequate" food for commercial, protected, other species?
v. What models, data or information is needed to begin to consider forage more directly?

Ecosystem TQ Set 3

i. How are SSCs helping their Councils to establish EBFM goals and objectives?
ii. Are there overarching principles that can be agreed upon to guide the process?
iii. What is the best way to provide technically feasible advice statements without prescribing policy to the Council?
iv. Are there best practices of goals and objectives that could form a standardized listing?
v. Are there best practices of goals and objectives that have been known to work elsewhere?

Social Science Considerations

SS Set 1: General discussion of social science in SSCs

i. What is the role of Social Science in an SSC context?
ii. How does social science information directly inform OFL/ACL/ACT discussions?
iii. How does social science information directly inform goals and objective setting discussions?

SS Set 2: Catch shares focus session

SS Set 3: practical and procedural issues in social science and SSCs

i. What industry information could be useful to SSCs?
ii. What community information could be useful to SSCs?
iii. How best to measure such information and distill into advice for SSCs?
iv. What data or models are needed or lacking?
v. TORs and review of socioeconomic data/analysis
vi. Resources to do analyses: data, models, and people

Appendix III. Workshop Participants and Observers

NMFS
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