# Use of Scientific Review by the Regional Fisheries Management Councils: The Existing Process and Recommendations for Improvement

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Abstract: Scientific review is essential for successful fisheries management because it ensures that the best available scientific information and advice is provided to fishery managers. However, the process for scientific review differs among the fishery management councils. An overview of these processes used by each of the regional fishery management councils is provided in this paper. Based on these reviews, I conclude that the scientific review process currently used by the regional fishery management councils is rigorous overall, but a few modifications would further strengthen this process. I recommend that:

- Councils retain appointment authority for SSC, but existing membership should have a role in nominating/recruiting new members.
- SSC members should receive honoraria (compensation) for their service.
- SSC members should not be subject to term limits.
- SSCs should meet concurrently with Council meetings, and at the same locale.
- Councils should adopt acceptable biological catch (ABC) limits determined by their SSCs, and set total catch limits (or control effort) such that catch would be at or below ABC. However, Councils must be allowed flexibility to exceed these levels on a short term basis.
- Councils should provide written rationale for their decisions, including how scientific information was weighed.
- Each Councils SSC should provide peer review of all analyses (NEPA, RIR, RFA) and stock assessments, and make the determination that best available scientific information is provided prior to Council decision making.
- SSCs should develop research priorities and identify data needs for effective management.
- Independent scientific reviews, in addition to SSCs reviews, should be considered only in cases of extreme controversy among scientists in interpretation of scientific information.
- Opportunity should be provided for regional or national SSC meetings, where members from different regions could discuss best practices and seek to identify analytical and research needs.

## Introduction

Scientific information is essential for successful management of fisheries. This is especially true for marine fisheries, where policy decisions can have substantial social, economic, and environmental consequences. Scientifically informed decisions are the foundation of laws governing fishery management laws in the United States.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), which is the governing law for managing fisheries in the United States, established eight regional fishery management councils to develop regional fishery management plans (FMPs) and management measures to regulate fisheries in the Exclusive Economic Zone (3-200 nm). The MSA requires that conservation and management measures be based upon the best available scientific information; this is National Standard 2 of the MSA. Each regional fishery management council is required to establish a Scientific and Statistical Committee (SSC) to ensure that the best scientific information available is used. Specifically, Section 302 of the MSA

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states that “Each Council shall establish and maintain, and appoint the members of a scientific and statistical committee to assist it in the development, collection, and evaluation of such statistical, biological, social, and other scientific information as relevant to such Council’s development and amendment of any fishery management plan.” In addition to the SSC, many of the Councils also rely on other scientific advisory bodies to review and synthesize scientific information, such as technical monitoring groups or stock assessment review panels.

Improving the process of incorporating science into decision-making for fisheries has been the topic of several recent laws and studies. The U.S. Commission on Ocean Policy noted that the regional fishery management councils currently incorporate science-based , peer-reviewed information in the development of FMPs, but offered a number of recommendations to strengthen the council SSCs and the use of scientific information in management of our nation’s fisheries. Specifically, the Commission recommended that SSC members should meet more stringent scientific and conflict of interest requirements and receive compensation, SSCs should have the final authority to set allowable catch limits, there be an additional independent review process for scientific information relied on by SSCs, and default measures should be used to ensure timely action by the SSCs, the fishery management councils, and NOAA Fisheries. Based on the findings and recommendations of the U.S. Commission on Ocean Policy, the President’s U.S. Ocean Action Plan of 2004 directed NOAA to establish guidelines and procedures for the development and application of scientific advice for fishery management decisions, in consultation with the Regional Fishery Management Councils, Interstate Fishery Commissions, stakeholders, and other agencies as appropriate.

The National Research Council recently completed a study on improving the use of the ‘best scientific information available’ standard in fisheries management (NRC 2004). The National Research Council recommended that NOAA Fisheries should implement guidelines on the production and use of scientific information in the preparation of FMPs and supporting documents. To ensure the best scientific information is used, they recommended that the guidelines be based on criteria of relevance, inclusiveness, objectivity, transparency and openness, timeliness, and peer review. Further, the National Research Council recommended that NOAA Fisheries establish an explicit and standardized peer review process, require the fishery management councils to justify their use of scientific information and determine whether a plan adheres to National Standard 2, improve communication of scientific findings and uncertainty, and implement a plan to systematically improve the quality of scientific information used for fishery management decisions.

In this paper, I review the structure and utilization of SSCs by the different regional fishery management councils. Further, I provide additional details and discussion of the scientific review process in the North Pacific. Additionally, I offer suggestions on how to amend the MSA, or establish guidelines, to improve scientific advice for fisheries management.

**Methods**

To gain an understanding of the existing process, I surveyed each regional fishery management council as to the composition and utilization of its scientific and statistical committee and the use of other independent scientific reviews. In addition, I provided each Council with an opportunity to explain other mechanisms to ensure that the best available scientific information is used. In some cases, I augmented these surveys with personal inquiries. Further, I researched readily available summary literature and regional Council internet sites describing other scientific bodies and procedures used by each regional council to review scientific information. I reviewed the procedures used by the North Pacific Fishery Management Council, based on written reports and meeting records, as well as my personal experience and informal discussions with several SSC members.

**Results**

Each regional fishery management council has developed its own scientific review process to suit its individual needs. In most cases, there are multi-level reviews of scientific information before it reaches the Council for a policy decision. Each of the Councils appoint and maintain a SSC. Some Councils utilize their SSC intermittently when a special need arises, whereas SSCs of other Councils meet regularly to review all scientific information used by the Council. A comparison of SSC structure and process among the regional councils is provided in Table 1. Current SSC membership is listed in Table 2. In addition, most Councils also maintain other scientific advisory bodies to review stock assessments or other technical information, as detailed in Table 3. A more detailed review of the scientific review process used by each region is provided below.

North Pacific

The North Pacific Council's SSC currently has 15 members, consisting of population dynamics biologists, ecologists, economists, and social scientists from academia and federal and state agencies, appointed on an annual basis. There are no SSC members from private businesses or other organizations. While most members are drawn from the Pacific northwest, the SSC includes members from California, Utah, and Rhode Island. In practice, the SSC is a self-appointing body that recruits new members as they see fit, although in practice there are members who serve in "agency" seats for Oregon, Washington, Alaska, and NOAA Fisheries. Although the Council has final approval authority regarding SSC membership, recommendations of the SSC regarding its membership have always been approved by the Council. Each year, SSC members elect a chair and vice-chair from among their membership. While most chairs serve for several years, few serve for more than 3-4 years. The current SSC includes two former chairs, who serve with the current chair as an informal chairman's council regarding the structure and operation of the SSC.

The SSC meets for 2 to 3 days, 5 times per year (or more frequently if the Council schedules additional public meetings). The SSC chair or vice-chair remain available to the Council for 2-3 days following the completion of the SSC meeting, to be able to present the minutes to the Council as each agenda item is reviewed by the Council and to respond to questions that Council members may have about the meaning and intent of those minutes. The SSC meetings occur at the same locale and begin just prior to each Council meeting to facilitate public participation and input. In addition, the SSC holds occasional workshops with agency analysts and researchers to explore analytic innovations or to encourage the development of new research programs.

The SSC reviews the scientific information for most actions that come before the Council[1]. The process for changing regulations begins with a proposal that may originate from the fishing industry, environmental groups, NOAA Fisheries, the Council, or other advisory groups including the SSC itself. The proposal is evaluated in subsequent meetings through discussion papers, environmental assessments, and socio-economic analyses. At each stage, the SSC provides scientific input to improve the analysis, and also makes a recommendation as to whether the analytical document is ready for public review, meaning that it meets their standard of best scientific information available.

The process for SSC review is similar in most instances. First, the SSC receives the first draft of an

[1] Before each meeting, the Executive Director (or Deputy Director) and the SSC chair discuss Council agenda items and identify those items that are most likely to require scientific review. The SSC generally does not review housekeeping items or items that are in final review. If however, the SSC requested that draft analytic documents be released after revision, the SSC is often asked to review the final draft document for compliance with SSC requests. The SSC may also be asked to review final review documents if there have been substantive changes in the documents or information included in the documents.

environmental assessment or impact statement, regulatory impact review, or other analytical document, by mail about 1-4 weeks prior to a meeting. At the SSC meeting, the lead analytical staff for a particular agenda item presents a summary of the analysis, and answers questions from SSC members. The public is given an opportunity to testify, and frequently several fishery participants or environmental representatives may testify on the scientific and technical details of a given analysis.

Following the staff reports and public testimony, SSC members deliberate the scientific content of a given analysis. Generally, the SSC focuses their deliberations to determine best available scientific information by examining the appropriateness of input data, the methodology applied, and the conclusions drawn from the analysis. To ease the workload for individual SSC members, the SSC chair generally assigns 2-3 members to be discussion leaders for each agenda item topic. These individuals also summarize the SSC discussion and deliberation, and then prepare the first draft minutes for that particular analysis or issue. All SSC members have an opportunity to review the draft minutes before they are presented to the Council by the SSC chair. The turn around time for preparing written minutes is short; in some cases the issue may have been discussed by the SSC less than one day prior to reporting to the Council. SSC members, particularly the chair and vice-chair, often work long hours to complete their minutes for distribution at the Council meeting. The minutes of the NPFMC SSC are not a formal record of deliberation, but represent a consensus opinion regarding the scientific merit of the documents under consideration. These minutes are not adopted by formal vote. The minutes also provide recommendations to improve the scientific analysis to meet SSC approval. Should analysis be deficient and major revisions be required, the SSC will recommend to the Council that it not be released for public review.

With the exception of a few very technical scientific issues (e.g., establishing overfishing definitions and setting acceptable biological catch limits), the SSC does not generally provide the Council with an explicit recommendation on which alternative should be chosen, but rather provides guidance on relative strength of the scientific information available (i.e., uncertainty). For example, in February 2005, the SSC reviewed the revised analysis and evaluation of fishing effects on essential fish habitat, and commented that "The analysis found no evidence that Council-managed fishing activities have more than minimal and temporary effects on essential fish habitat for any FMP species. Yet, a significant proportion of the ratings for fishing effects were classified as unknown. Given this result, application of the precautionary approach is warranted." Citing the SSCs recommendation in their deliberations, the Council voted unanimously to prohibit bottom trawling over vast areas, and establish 'marine reserves' in the areas shown to have dense deep water coral aggregations.

There are several levels of scientific review for stock assessments of North Pacific groundfish stocks (Figure 1). Nearly all of the stock assessments are conducted by highly competent and respected NOAA Fisheries scientists from the Alaska Fisheries Science Center. These assessments are subject to internal review process at the Science Center. As a further quality control measure, one or two assessments are sent each year to the Center for Independent Experts for further peer review. Following these review processes, the stock assessments are further vetted by the Council's Plan Teams established for each FMP. The plan teams consist of state and federal scientists and managers that meet twice annually to review the assessments, prepare stock assessment and fishery evaluation reports, and, for groundfish stocks, recommend acceptable biological catch limits. The SSC makes a final review of the stock assessments and acceptable biological catch limits (ABCs). The Council has had a long standing practice of adopting all of the SSC's ABC recommendations, and this process was formally incorporated into the groundfish FMPs by amendments 83/75.

On occasion, an independent review by scientists outside of the SSC has been requested to get additional insights into scientific information on particularly controversial scientific issues. Recent examples of independent review include an evaluation of the harvest rate strategies used for North Pacific groundfish (Goodman et al. 2002), reviews on potential competition of fisheries with Steller sea lions (Bowen et al., 2001, NRC 2003), and a review of the evaluation of fishing activities that affect essential fish habitat

(Drinkwater et al. 2004). These reviews came at a cost of time and money (approximately $110,000 for the harvest rate review, $140,000 for the Steller sea lion Biological Opinion review, $500,000 for the NRC review of Steller sea lions and fisheries, and $130,000 for the review of fishing effects on benthic habitat). Although none of the conclusions of these peer reviews were contrary to earlier findings by the SSC on these same issues, they did provide other perspectives regarding scientific content and analytical procedures. From this standpoint, the reviews were beneficial in that they provided additional scientific guidance for analysts and the Council, and increased confidence that the best scientific information was made available.

Western Pacific

The Western Pacific Council has a 16 member SSC, consisting of scientists from NOAA Fisheries, State/territorial agencies, University faculty, Regional Organizations, and the private sector. Of the total, there are three social scientists (one anthropologist, one sociologist, one economist), and the remainder are biologists or population dynamics modelers.

SSC members are generally nominated by the SSC, Council, and agencies. Generally the agencies (NOAA Fisheries, State & Territories) nominate their SSC representatives. The Council has final appointment authority. There are no term limits.

The Western Pacific Council's SSC meets three times a year. The meetings generally occur at least a week prior to each Council meeting. SSC meeting are generally attended by the public, and public testimony is allowed. The SSC presents both a written and oral report to the Council. Currently, SSC meeting minutes are not posted to web.

The SSC may comment and make recommendations on any issue, although they focus on reviewing scientific issues. They do review catch limits when applicable. Scientific review of stock assessments is limited, in part, by the limited number of stock assessments conducted on species in the Western Pacific region. The NMFS Pacific Islands Science Center has generated stock assessments for swordfish, blue marlin, blue shark, Northwestern Hawaiian Islands lobsters, and Precious Corals in Hawaii. Stock assessments for tuna species are prepared by either IATTC for the Eastern Pacific, or the Oceanic Fisheries Program of the Secretariat of the Pacific Community for the Western Pacific.

The Council generally incorporates the SSC recommendations in their entirety. The Council either concurs with an SSC recommendation or adopts the SSC recommendation as a Council action. The Council tends to look to the SSC for guidance so its recommendations generally dictate how the Council will act (but not always).

In addition to the SSC, the Council also has Plan Teams for its pelagics, bottomfish, crustaceans, precious corals, and ecosystems/coral reef FMPs. The Plan Teams generally provide management advice, but may also review stock assessments when available. Outside independent reviews have been used occasionally to provide additional reviews of stock assessments and harvest rates (e.g., lobster harvest guideline model).

Pacific

The Pacific Council has a single SSC, with a 16 member composition set by a representation formula established in the Council's operational procedures. There are four state representatives (ID, WA, OR, CA), five federal representatives (2 Southwest Fishery Science Center, 2 Northwest Fishery Science Center, 1 Alaska Fishery Science Center), and 1 representative from the Treaty Indian Tribes. These members have indefinite terms and are nominated by their home agencies. In addition, there are six "at-large" members that serve 3-year terms. Current composition of the "at-large" seats is: 2 Southwest

Fishery Science Center, Fisheries Research Biologists, 1 University of Washington faculty, 1 University of California, Santa Cruz faculty, 1 California State Monterey faculty, and 1 private sector (an economist not associated with an agency or academia). The SSC operating procedures further requires that the committee consist of three social scientists, of which at least two shall have economic expertise. Currently, there are 3 economists; other expertise includes fishery biology, population dynamics, biostatistics. In addition to the standing SSC, there are six SSC subcommittees, one for each or the four FMPs (salmon, groundfish, highly migratory species, coastal pelagic species), one for MPAs, and one for economics.

Nominations for at-large seats are sought through an open nomination process. Vacancies are announced and candidates are solicited via the Pacific Council's website and via mailings to the public, agencies, and universities. The nomination period opens at least one month ( and often longer) before consideration at a Council meeting and nominations are due along with Council meeting briefing materials, approximately two weeks before the meeting. Anyone can nominate an individual and individuals can self-nominate. Nominations must include a cover letter and CV. The SSC reviews nominations and evaluates qualifications of candidates in closed session and presents review results to the Council. The SSC review results are provided during Council closed session before the Council makes the appointments. The SSC chair and vice-chair serve two-year terms. Officers are elected by the SSC and approved by the Council chairman.

The SSC meets at each of the five Council meetings in a year, usually for the first two days of the meeting, but sometimes longer. The subcommittees meet as needed at the direction of the Council chair or the Executive Director. In recent years, the SSC subcommittees have met frequently, on the order of a half-dozen meetings in addition to the five Council meetings. Meetings of the SSC and SSC subcommittees are open to the public, and public comment is taken during SSC agenda topics (at the discretion of the SSC chair). There is also a public comment period for items not on the SSC agenda on the Monday of each SSC meeting. The SSC produces written reports at the Council meeting, and the SSC chair (or other SSC member) provides an oral report of their findings and responds to Council questions. Public testimony on SSC recommendations to the Council are taken after each SSC statement. SSC minutes are made available in the subsequent Council meeting briefing materials and are available on the Pacific Council's website.

The Pacific Council's SSC provides scientific review of all science and technical matters that are a component of Council decision making including harvest levels, fishery and economic models used by Technical Teams, population prediction models, harvest guidelines, Terms of Reference for stock assessment processes, and technical portions of Fishery Management Plan amendments and National Environmental Protection Act documents. Examples of special projects by category include: the SSC's marine reserves subcommittee has completed a white paper, *Marine Reserves: Objectives, Rationale, Fishery Management Implications, and Regulatory Requirements*, the groundfish subcommittee is working on terms of reference for reviewing rebuilding plans, the groundfish subcommittee and economics subcommittee jointly reviewed Groundfish Essential Fish Habitat analyses, completed an economic capacity report for the *Groundfish Strategic Plan*, and reviewed commercial fishery bycatch modeling methods, and the highly migratory species subcommittee reviewed methods for assessing sea turtle impacts in the high seas longline fishery. Additionally, each year, the salmon subcommittee reviews salmon fishery modeling, run size prediction, and harvest policy methodologies

For specific recommendations, like harvest levels, if a single value is provided by the SSC the Council generally adopts the recommended harvest level. The SSC may provided a range of possible harvest levels derived from the stock assessment process to advise to the Council on inherent uncertainties and risk. The SSC reports to the Council the range of values, the uncertainty, and level of risk (e.g., risk-prone, risk-neutral, risk-averse).

Outside review of scientific and technical matters for the Pacific Council occurs during the Council-sponsored stock assessment review process (which has been used for coastal pelagic species and groundfish) included participation by Center for Independent Expert reviewers from outside the Pacific Council family. The SSC then reviews the results of the stock assessment process and reports to the Council. SSC statements to the Council are not subject to outside review.

In addition to the SSC, each FMP has both a technical (or management) team. Technical teams are composed of fishery managers, biologists, and statisticians from the federal, tribal, and state agencies. Technical teams monitor catch rates, recommend harvest levels, and analyze the impacts of various management measures. Models and methods used by Technical Teams are reviewed by the SSC.

Gulf of Mexico

The Gulf of Mexico Fishery Management Council has a standing SSC of 14 members, as well as a special SSC for each fishery that largely consist of biologists knowledgeable about that particular fishery. The standing SSC consists of members with expertise in population dynamics, biological anthropology, economics, marine law, and state regulatory processes. When the SSC meets to review any material, the standing SSC is convened along with one or more special SSCs, depending on fishery issues being reviewed. The Gulf Council also has a Socioeconomic Panel that consists of eight fishery economists and six anthropologists/sociologists. The panel develops management scenarios for achieving TAC and advise the Council of the socioeconomic impacts of the alternatives.

In addition to the SSC and Socioeconomic Panel, the Gulf Council also has stock assessment panels (SAPs) for finfish (16 members) and for shrimp (6 members). These SAPs, historically, had reviewed and made recommendations on stock assessments drafted by scientists at the Southeast Fishery Science Center. The SAP members are now involved in new Southeast Data, Assessment, and Review (SEDAR) panels, that develop peer-reviewed stock assessments. By changing to the SEDAR process over the past 2 years, the Council gets independent peer-reviews of all its stock assessments.

The SSC typically meets three to six times per year, often for multi-day sessions. The SSC typically meets independently, and almost never meets with Council, although the chair of the SSC does attend Council sessions on occasion.

The SSC reviews a wide variety of analytical documents. It reviews each FMP amendment at least once, as well as any other action submitted by the Council. The SSC also reviews all the stock assessments as the final peer reviewer, following the SEDAR process.

The SSC meeting reports are usually drafted by technical staff and, occasionally, supplemented by verbal reports by the SSC chair. The written SSC minutes are subsequently prepared and available upon request. Minutes are not currently available on the Council webpage, but the Council anticipates posting this information in the coming year.

As it is considering final action on amendments (or other issues) the Council considers the SEDAR workshop reports, the Socioeconomic Panel report, the Advisory Panel recommendations and the SSC recommendations and bases its decision on all of this input. Rarely does the Council not accept an SSC recommendation. When this occurs, it most likely is related to opposing view-points between the SSC and another advisory group (SAP, for example).

There is always a record when the Council deviates from the recommendations of any advisory group. Almost all catch limits are currently part of long-term rebuilding plans and the Council aims to implement management measures (e.g., bag, size, trip limits) that will constrain the fishing within the total allowable catch (TAC) limits. The TAC limits are currently set to have at least a 50% chance to achieve that level.

Caribbean

The Caribbean Council maintains an SSC comprised of biologists, oceanographers, economists, socioanthropologists, and stock assessment experts. Most SSC members are from academia, but there are also members from the local fishery agencies and NGOs.

SSC members are nominated by council members or other interested parties. Members serve two-year terms, and if they are willing, they are usually re-elected. In the Caribbean, the community of scientists is rather small, so the SSC generally consists of the same group of 12 members. The Caribbean Council also maintains a habitat panel, composed of scientists from academia and local agencies with expertise on habitat, including coral reefs.

The SSC usually meets twice per year. They meet independently from Council meetings, however, the chairs of the SSC, Habitat Panel, and Advisory Panel attend all council meetings and sit at the table with the council members. The Council receives both verbal and written reports from the SSC. The SSC meets at the request of the Council chair. SSC meetings are open to the public, but public rarely attends.

The SSC reviews every aspect of the FMPs, monitoring projects, and programs. The Council generally incorporates the SSC recommendations by following the scientists advice whenever possible and feasible. The Council always adopts the SSC recommendations for catch limits relative to MSY when available. However, data are generally not available for most stocks in the Caribbean region. To date, the Council has not had a need to seek independent reviews, in addition to getting advice from the SSC and other advisory bodies.

South Atlantic

The South Atlantic Council's SSC is comprised of 10 university, 1 NMFS/university, 1 university/Marine Extension, 1 Sea Grant agent, 6 state, and 2 private sector representatives. The 21 member SSC has two subcommittees, a 7 member Biological Subcommittee and a 10 member Socio-Economic Subcommittee. The Biological Subcommittee is comprised of individuals with a population dynamics/fishery biology background and the Socio-Economic Subcommittee is comprised of individuals with a social, economic or anthropology background. The States of NC, SC, GA and FL each have one dedicated seat on the SSC. This ensures that each State Director has a staff member involved with the SSC review and their input helps the State Directors carry out their duties during council meetings.

SSC members are nominated by Council members and staff, and by SSC members themselves. The Council has a SSC Selection Committee whose duty is to review the credentials of nominated members and make recommendations to the Council on SSC appointments. SSC Selection Committee meetings are closed to the public because personnel issues are being discussed. The Council discussion and final appointment process is open to the public and the Council votes on each SSC appointment. SSC members serve indefinite terms.

The SSC generally meets twice each year, once jointly with the Council and once separate from a Council meeting. The subcommittees may be convened independently during the year to address specific issues. SSC meetings by the Executive Director depending on which documents, fishery management plans/amendments, or stock assessments need to be reviewed.

The South Atlantic Council does not limit the scope of the SSC review. The SSC is responsible for ensuring the Council's decisions are based on the best available science. At the request of the SSC, Council staff prepares a "road-map" that lays out the issues and identifies specific questions and issues

that need to be resolved. The SSC reaches consensus and/or votes on each issue. The SSC generally provides input on a safe range for ABC rather than recommending a specific TAC. They do provide input on the relative level of impacts (biological, social and economic) at various levels within an ABC range.

All SSC meetings are open to the public and are advertised in the Federal Register, web site and press releases/newsletters. Members of the public do attend, with numbers attending depending on the issue. Allocation issues (e.g., setting annual king mackerel TAC, trip limits and bag limits) generally result in more members of the public attending. The Council's SSC does not have a formal agenda item for public testimony, however, members of the public have been allowed to comment.

SSC reports have been verbal and given by Council staff. Minutes are provided to Council members and to anyone requesting a copy through the Council office. The Council is in the process of placing all minutes on their web site. More recently, the Council is working to have the written SSC reports given orally by the SSC Chair or Vice-Chair.

The Council addresses the SSC recommendations as they discuss and vote on specific measures. For instance, the SSC (and Advisory Panel) recommendations on TAC would be presented and then the Council discussion would begin. The SSC has requested that the Council provide them (the SSC) with some documentation of how the Council responded to the SSC recommendations. Minutes of all committee and Council meetings are available to the SSC and members of the public.

The Council always follows the SSC's advice when they establish ABC ranges. Only once has the South Atlantic Council set a catch limit that exceeded the SSC recommendation. This was in the 1980s for an Atlantic king mackerel TAC, and the Council's rationale for doing so was included in the minutes and the framework document that resulted from the TAC setting process.

The Council has used an independent panel in the past to address swordfish stock status. The Council used a Mackerel Stock Assessment Panel to make determinations about stock status; this was an attempt to get some "outside" and "independent" review of mackerel stock assessments. The Council has used a Shrimp Review Team to evaluate the need for closures due to winter kills of white shrimp. In the past, a Snapper Grouper Assessment Group was used to provide advice on stock status. More recently, the Council has implemented the Southeast Data Assessment and Review (SEDAR) process for independent peer reviews of its stock assessments. The review component of the SEDAR process uses scientists from the Center for Independent Experts (CIE) to review all of the stock assessments conducted in the Southeast Region.

Mid-Atlantic

The Mid-Atlantic Council uses several sources of scientific review in its decision-making. For the majority of its stock assessment advice, the Mid Atlantic Council relies on the Northeast Fishery Science Center Stock Assessment Review Committee (SARC) process. The SARC meets twice a year to review stock assessments for the New England Council, the Mid-Atlantic Council, and the Atlantic States Marine Fisheries Commission, and is comprised of independent experts from inside and outside the United States.

In addition to the SARC, the Council has Monitoring Committees for most of its FMPs, which meet once or twice a year for each FMP to provide management advice to the Council. The Monitoring Committees review the SARC advice, as well as additional information provided by the state scientist/managers on the committee, to develop management recommendations for Council consideration. Because the Council has both a SARC and Monitoring Committees, it generally does not use the SSC for general scientific or management advice. In effect, these Monitoring Committees serve a role that is similar to the SSCs of most regional councils. As such, most issues related to SSC nominations and processes have no direct application to the Mid-Atlantic Council and its scientific review process.

Nevertheless, the Mid-Atlantic Council does have an SSC, which has met a few times over the last several years to address specific concerns related to stock assessments. The SSC has reviewed a bluefish assessment (April 1998), a tilefish assessment (March 1999), and several Atlantic States Marine Fisheries Commission analyses related to the biological reference points for summer flounder (April 2001). These meetings occur only when requested by the Council, and the SSC meetings occur independently of Council meetings. The SSC meetings are open to the public and the public can ask questions/offer comments. The SSC reports are presented by the SSC chair to the Council with a verbal and written summary report.

New England

The New England Council has two primary scientific review bodies; an SSC to provide additional review of biological issues, and a Social Sciences Advisory Committee (SSAC) to review social and economic analyses. The SSC has 9 members, all with professional backgrounds in biological sciences. The SSAC has 10 active members consisting of four anthropologists, one environmental geographer, and five economists. Members of both committees are from academia, state agencies, environmental NGOs, or may be former employees of NMFS. In an effort to get independent review, the Council has not allowed current NMFS employees to be members of these committees. NMFS scientists and social scientists provide advice to the Council through other channels in the FMP development process.

Anyone may nominate candidates to serve on the SSC or SSAC, or individuals may simply apply. Members serve for renewable three-year terms. Although members do not select their own replacements, they may recommend new candidates.

Both the SSC and SSAC meet on an ad-hoc basis. The SSC typically meets once or twice per year and the SSAC typically meets at least twice per year. The SSAC meets to review social science analyses of major Council actions. The number of SSAC meetings is determined by the number of major actions under Council consideration. Both committees meet independently of the Council and designate a member or members to report their findings to the Council during the Council meeting. The Council usually receives both a verbal and written report from the SSC and SSAC. Tapes of the meeting are kept for the administrative record. The public may attend SSC and SSAC meetings. Public comment is usually allowed but it is taken at the discretion of the committee chair.

Similar to the Mid-Atlantic Council, the New England Council relies on the Northeast Fishery Science Center Stock Assessment Review Committee (SARC) process for a majority of its stock assessment advice. The SARC meets twice a year to review stock assessments and is comprised of independent experts from inside and outside the United States.

The SSC typically meets when there is conflicting or unclear stock assessment advice or when the Council plan development teams request its assistance in resolving an issue over biological reference points. The SSC does not review management changes. Management strategies are developed by the Council and analyzed by the plan development teams (PDTs). TACs associated with management reference points are determined by the PDTs; however, they directly flow from the stock assessments that are conducted independently of the Council. The PDTs, not the SSC, set catch targets in reference to the advice of the Stock Assessment Workshop. In terms of catch targets, the Council does not deviate from scientific advice.

PDTs are always chaired by a Council staff member. Their primary function is to assist the Council and its committees to develop management actions (FMPs, amendments, framework adjustments, etc.). The PDTs consist of scientists from the Council staff, NMFS, states and occasionally academic institutions. Typically, each PDT has one to three biologists, one or two economists, the NMFS regional office plan coordinator, and usually (but not always) a social scientist capable of providing social impact analyses. In

some cases the chair of a species advisory panel attends PDT meeting to ensure some industry input/communications. PDTs work directly for Council committees and produce decision documents and regulatory analysis including NEPA documents.

Since SSC and SSAC recommendations are diverse, there is no general way that they are incorporated into management plans. For example, when the SSC was asked to evaluate two conflicting stock assessments for herring and to provide management reference points, it only provided very general advice to the Council by ruling out some of the proposed reference points and recommending that the plan development team perform a "risk analysis" to determine appropriate management targets. In this case the Council followed the SSC advice.

The Council sometimes seeks independent reviews in addition to getting advice from the SSC and other advisory bodies. Most recently, the Council requested an independent review of new management reference points for groundfish stocks that were substantially different from earlier reference points. This independent review was requested because the SSC simply did not have the time and resources necessary to undertake a comprehensive review of reference points for 19 stocks. Also, user groups has requested a review by experts that were entirely independent of any association with NMFS.

**Discussion**

My evaluation of the scientific review process currently used by the regional fishery management councils indicates that the need for a more robust process is, for the most part, one of perception and not of reality. In most cases, scientific information, and particularly stock assessment information, is rigorously reviewed prior to policy decisions being made by the regional fishery management councils. All of the Councils have a scientific review process that includes committees to review stock assessments and/or other analyses (i.e., Plan Teams, Stock Assessment Review Committees, SEDAR Panels, Stock Assessment Panels, Monitoring Committees, Social Science Advisory Committees, etc.), along with an SSC. Nevertheless, additional changes should be considered to strengthen this process. The U.S. Commission on Ocean Policy had a number of specific recommendations regarding scientific advice to management, and based on my review of the regional fishery management council's existing scientific review process, I offer the following comments for each recommendation:

SSC Membership and Compensation: *The Commission recommended that SSC members be nominated by each Council, candidate qualifications be reviewed by an independent review process (by a credible, scientific organization), and SSC members ultimately be approved by the NOAA Administrator. Further, the Commission recommended that SSC members serve fixed terms, and that members (or their home institutions) be compensated for time spent on Council business.*

Highly qualified and respected scientists are currently members of the SSCs. It is not clear that any independent scientific organization will be better able to evaluate the qualifications of potential SSC members than the existing process. Moreover, it is not clear that transferring appointment authority to the NOAA Administrator will improve SSC composition and ultimately scientific advice. Once could certainly argue that the NOAA Administrator would be in a conflicted position in approving SSC members that review stock assessments and analyses, of which a majority is prepared by NOAA personnel.

Presumably, the Commissions recommendation is to address a perception that SSC members may not be qualified or may have some conflict of interest. Yet the Commission provided no guidance on what qualifications would be acceptable. For example, would SSC membership require a Ph.D., minimum number of scientific publications, a non-NOAA agency scientist, or some other criteria? Over 90% of the members on standing SSCs across the country have a Ph.D., and the number of publications prepared by all members is likely numerous. As far as I know, conflict of interest has never been a serious issue with

SSC members; only a handful of SSC members across the country have worked outside of their role as SSC members, either directly or indirectly, for fishery interests, environmental organizations, or other groups with a stake in the outcome. There may be a few SSC members with family or friends that derive income from fisheries or advocacy groups, but this number is probably small. Both SSC qualifications and conflict of interest appear to be non-issues, and there is no explanation provided for this recommendation by the U.S. Commission on Ocean Policy. **I recommend that SSC appointment authority should remain with the Councils. However, SSC members should have a role in nominating new members, as they are in the best position to evaluate strengths and weaknesses of their committee, and recruit the most knowledgeable and qualified candidates.**

Compensation of SSC members for their time (preparation time and meeting attendance days) is currently not authorized by the Magnuson Stevens Act. SSC members are reimbursed for travel, lodging, and meals during meetings, but are not compensated for their time. In the absence of pay for services, one may question why a scientist would volunteer his or her time to serve on the SSC. The incentives for members vary, however in regions where scientific advice greatly influences management, SSC members realize the impact of their recommendations and this provides incentive to actively participate on the SSC. I believe that is the primary motivation for members of the North Pacific Council's SSC. There is also a desire by many scientists to keep up to date with applied research and changes affecting fisheries. SSC membership may also be within the job duties for federal and state agency positions. Nevertheless, it is a very large commitment to become an SSC member, involving days of preparation before the meeting, as well as time away from work and family. While it is not practicable to pay for preparation time, **I recommend that all SSC members, including federal scientists, receive at least an honoraria (or some other type of compensation) for their time spent at SSC meetings**. A small amount of compensation may be enough incentive to attract additional qualified scientists that would otherwise be disinclined to make the commitment necessary for active SSC membership. It is unlikely that some nominal honorarium would create a perception of 'conflict'.

Currently, none of the regional fishery management council SSCs have term limits. While the concept of term limits may offer the potential benefit of new membership and consequently new perspectives, the long-term experience of some SSC members contributes to the overall knowledge, understanding, and collective memory of the committee. It is also very difficult to recruit and maintain SSC members with research backgrounds that are tangential to fisheries (e.g., those with backgrounds in marine mammals, seabirds, anthropology, and particularly economics). Additionally, the pool of knowledgeable and qualified scientists may be small in some regions (e.g., the Caribbean). Thus, adoption of term limits may actually result in a less qualified scientists serving on the SSC – the exact opposite effect envisioned by the U.S. Commission on Ocean Policy. Our experience in the North Pacific is that there is enough turn over of SSC membership (about 1 member per year) to gain fresh perspectives, while simultaneously benefiting from experience of long term membership. For this reason, **I recommend against adoption of term limits for SSC members**. The Council would retain authority to appoint members and replace members if there is not enough turnover to gain new perspectives, or if additional expertise is needed.

SSC Role in Setting ABC Limits: *The Commission recommended that the SSC should determine the allowable biological catch based on the best scientific information available. Further, they recommended that the MSA be amended to require that Councils set harvest limits at or below the SSC's allowable biological catch. In the event that the SSCs cannot determine acceptable biological catch within a set time, it should be done by the NMFS regional science director. Lastly, once an ABC is determined, the Councils should propose a management plan, and if it is not implemented in a timely fashion, NMFS should prohibit all fishing on that stock until NMFS is able to review the adequacy of the management plan.*

On its surface, this recommendation seems to be a reasonable way to address the perception that "the fox

is guarding the hen house" (i.e., that conservation may take the back seat to socioeconomic considerations). However, fisheries cannot be managed by science alone; there will always be policy choices, tradeoffs, and scientific uncertainty to consider. This is true even in the case of establishing maximum acceptable biological catch limits. For example, even when catch limits are established based on robust data and models, uncertainty associated with biomass estimate parameters (e.g., survey catchability) or harvest rate parameters (e.g., natural mortality rate) make it impossible to scientifically determine an absolutely 'correct' amount of fish removals. The experience with groundfish management on the west coast illustrates this point (Ralston 2002). There are biological risks associated with any level of ABC (above zero), and these risks are balanced with social and economic factors of the fishery.

By granting the SSC final authority to determine the allowable biological catch, public pressure to increase or decrease catch limits may be transferred from the Council to the SSC. However, scientists may be less susceptible to pressure than Council appointees in particular (Ginter 2004). In the North Pacific, where the SSC does determine maximum allowable catch levels, both the fishing industry and conservation groups testify at SSC meetings, but all arguments need to be scientifically based to affect the SSC decisions. Most of the Councils already appear to follow the SSC's recommendations on scientifically based catch limits (e.g., ABC, MSY, OY). **I recommend that all Councils make it a policy to adopt maximum ABCs determined by their SSC, and set catch limits at or below the ABCs. However, there may be unforeseen situations in which a catch limit may need to be set higher than ABC on a short-term basis (say one year), so flexibility must be built into any guidelines developed for the Councils.** For example, based on new scientific information, the SSC could recommend that ABCs be established for each regulatory area within the species' distribution, yet the management system may be unable to accommodate such a change in a timely fashion. One could envision other scenarios that would require some flexibility in this rule.

Proposals to further separate science from management (i.e., separating conservation from allocation decisions), such as suggested by the Pew Ocean Commission (2003) should be viewed with caution. With the possible exception of annual catch limits, virtually all other management actions involve aspects of both conservation and allocation, aspects which are impossible to separate. Even catch limits themselves have a strong allocation component because it involves dictating when and where fish can be caught. Other actions that appear at first to be strictly conservation measures (e.g., habitat area closures, bycatch reduction, size limits, bag limits, etc.), clearly have a strong allocation component, as the regulations basically make fish more difficult to catch by one group or sector and make the fish more available to other sectors. It would be impossible for an SSC to make scientific data-based decisions on issues other than catch limits because the issues involve more than just biological science. Council decisions involve weighing all the analytical scientific information, public testimony, advisory panel advice, personal experience, and other information, and then each Council member makes an informed decision (i.e. a vote) as to what alternative best achieves the goals and objectives of the FMP and the Magnuson Stevens Act national standards, as well as meets legal requirements. Although decisions cannot be made on science alone, scientific advice is a critical and integral part of the decision-making process. **Rather than separating conservation from allocation decisions -- which would be impossible -- I recommend that Councils further integrate science into decision making and provide rationale for their decisions, including how scientific information was weighed**. The National Research Council (NRC 2002, 2004) also recommended that the fishery management councils explain their treatment of scientific information to improve outside perceptions of how the agency conducts its scientific work.

Independent Reviews and Research Priorities. *The Commission recommended that a process should be developed for independent review of the scientific information relied on by the SSCs. Additionally, the Councils and SSCs should develop an annual, prioritized list of management information needs (research priorities) and provide it to NMFS for incorporation into designing research, analysis, and data collection programs.*

Independent peer review is a fundamental procedure to ensure quality control of scientific information, but it is unclear why the existing SSC peer review process was deemed inadequate by the Commission. The Commission offered no explanation as to the need for additional review beyond SSCs (or Monitoring Committee in the case of the Mid Atlantic Council). Most of the SSCs across the country appear to meet the OMB guidelines for peer review, as well as the guidelines set forth by the National Research Council (NRC 2004). The NRC noted that key elements of peer reviews should include:

- The review should be conducted by experts who were not involved in the preparation of the documents or the analysis contained in them;
- The reviewers should not have conflicts of interest that would constrain their ability to provide honest, objective advice;
- All relevant information and supporting materials should be made available for review; and
- A peer review should not be used to delay implementation or measures when a fishery has been determined to be overfished.

With only minor exceptions, peer reviews done by regional fishery management council SSCs incorporate all of these elements. The process is open, and all analytical documents and supporting materials provided to SSCs are available to any interested publics. Regarding conflict of interest elements, there may be a few instances when a contributor to a stock assessment or other analyses is also an SSC member. In the case of the North Pacific Council, SSC members from NOAA Fisheries may have been part of an internal stock assessment review or assisted in some other way with the annual stock assessment report or fishery evaluation. Additionally, other SSC members have contributed material from research projects that has been incorporated into amendment analyses. While these members have not found it necessary to recuse themselves from the SSCs discussion and deliberations, these members do disclose if they have participated in the analysis in some way. As such, conflict of interest has not been raised as an issue with SSC members.

The Information Quality Act, also known as the Data Quality Act, was enacted in 2000 to ensure standards of information used in national policy-making. Based on the OMB guidelines for implementing this Act, further independent scientific peer review, in addition to SSC review, may be required. The guidelines apply when scientific information is influential, include precedent-setting methods or models, result in conclusions that are likely to change prevailing practices, or is likely to affect policy decisions that have significant impact.

OMB Guidelines require that agencies conduct a peer review of all influential scientific information that the agency intends to disseminate. Influential scientific information is defined as that which will have a clear and substantial impact on important public policies or private sector decisions Given that many changes to fisheries regulations would result in substantial impacts, peer review may be required. Fortunately, the guidelines allow agency discretion on the form of peer review for most actions, and regional council SSCs should be deemed satisfactory because they appear to meet the guidelines for most scientific reviews. The guidelines require a more rigorous form of peer review for highly influential scientific assessments (defined as having an impact of more than $500 million or if the assessment is novel, controversial, precedent-setting, or has significant interagency interest). For highly influential assessments, the guidelines specify that scientists employed by the sponsoring agency (e.g., NOAA Fisheries) are not permitted to serve as reviewers. Additionally, the guidelines specify that agencies shall avoid repeated use of the same reviewer on multiple assessments, unless their participation is essential and other reviewers cannot be obtained. In summary, it appears that Council SSC can and should be used as an ‘alternate procedure’ (as opposed to a National Academy of Sciences review) for peer review of most fishery related actions. For the highly influential scientific assessments, peer reviews by the National Academy of Sciences, Center for Independent Experts, or other scientific peer review body may be required.

Although additional peer review has occasionally been requested by a few of the Councils prior to taking action, and as a consequence causing a delay of potential regulatory measures, this is a rare occurrence. The Councils all understand that strong science is the basis of good management practices, but each region has approached the scientific review process differently. Given the new OMB guidelines, peer review of most analyses prepared for fisheries management will be required. **I recommend that all Councils make it a policy to utilize their SSCs for peer review of all analytical documents (stock assessments, analysis for NEPA, RIR, RFA, etc.), and not to make final decisions until the scientific information passes muster (i.e., is deemed the best available scientific information) by their SSC. In most cases, there is no need for additional outside independent review.** Outside peer reviews are very expensive ($100,000+ per review), and may result in lengthy delays (it may be difficult to find qualified independent reviewers with adequate time available). There will be some instances, involving controversial science issues, where additional peer review may be warranted, but these should be considered on a case-by-case basis relative to OMB guidelines and other considerations.

Some SSCs and other scientific advisory bodies assist their Councils in developing research priorities. In the case of the North Pacific, research needs are identified on an annual basis by the Plan Teams and further developed and prioritized by the SSC. The Council then forwards the list of research priorities to the various scientific research institutions in the region (NMFS, Sea Grant, Universities, North Pacific Research Board, etc.). The usefulness of this exercise has never been evaluated, but the list of research is used by the NMFS Science Center for budgeting and planning purposes, and may also be useful for university researchers seeking grant monies. **I recommend that Councils, through their SSCs, take responsibility for identifying research priorities and information they need for effective decision-making**.

Other recommendations

My experience with the North Pacific Fishery Management Council is that the scientific review process provided by the Plan Teams and SSC is strongly supported by all stakeholders. Once the SSC approves an analysis or recommends an ABC, everyone understands that this represents the best scientific information available. The only exception is those rare cases when there are extreme differences of opinion within the scientific community (e.g., effects of fishing on essential fish habitat or Steller sea lions), in which case it may be desirable to request an additional independent review. In my opinion, a major part of the North Pacific Council's success is due to the fact that SSC meetings are held concurrently (starting a day or two earlier) with Advisory Panel and Council meetings. Fishery participants, Council members, Advisory Panel members, and interested members of the public will generally attend a portion of each SSC meeting. The public enhances its understanding of the science involved in each analysis, and gains an appreciation for the scientific review process. Additionally, SSC members can learn more about the fisheries by attending portions of the other meetings, as well as having open dialog with fishery participants and representatives of environmental organizations. **I would recommend that all Councils consider scheduling SSC meetings to be held at the same time and locale as Council meetings**. An added benefit of scheduling these meetings together is that the SSC Chair (or designee) can report to the Council while the deliberations are still a fresh memory, and the Council members have an opportunity for questions and to seek clarifications of the SSC's report.

Scientific reviews are handled differently by each regional council, and each SSC has developed its own process for reviewing analyses and providing advice to the Council. There may be much to gain by sharing information among all SSCs across the country. SSC members can learn from each others experience, and thus better standardize what constitutes an adequate peer review, best available scientific information, and research and data needs for improving scientific analyses. **I recommend that opportunity should be provided for regional or national SSC meetings,**

**where members from different regions could discuss best practices and seek to identify analytical and research needs.** A national workshop with all members of standing SSCs (there are about 110 members) could provide substantial improvements to the process for about the price of one independent peer review.

**Conclusion**

The structure, process, and use of SSCs by the regional fishery management councils differs somewhat among the regions. The flexibility provided under the Magnuson Stevens Act has allowed the councils to adapt to their regional needs and conditions. However, based on my review of the scientific review process used by the Councils, I suggest that some standardization among the regions could potentially improve efficiencies, improve quality control, make the process more robust, increase transparency in the decision process, and increase awareness that the Councils base decisions on the best available scientific information.

The U.S. Commission on Ocean Policy recommendations point out some useful ways to improve the scientific process. I agree with many, but not all of these recommendations. The changes I propose would standardize the scientific review process across regional fishery management councils, while still providing flexibility necessary to address regional specific issues. Criticism of the Council's use of science should be taken very seriously, and steps must be taken to increase the public's confidence in Council stewardship.

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**Figure 1**. Flow chart depicting the scientific review process for stock assessments and establishment of catch specifications in the North Pacific region. Catch specifications include the overfishing level (OFL), the acceptable biological catch level (ABC), and total allowable catch limits (TAC), where TAC≤ABC≤OFL.

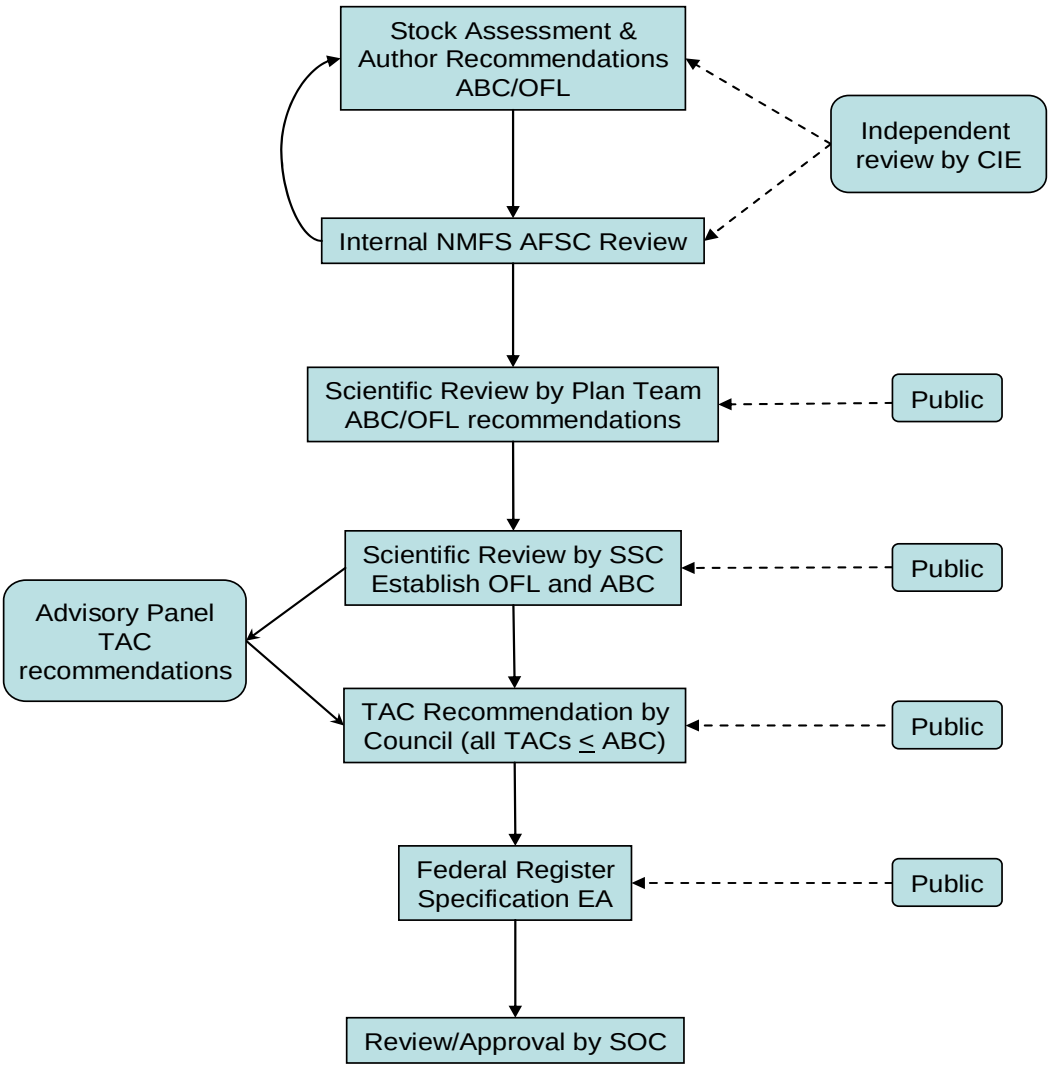

**Table 1. Current structure and practices of regional fishery management council Scientific and Statistical Committees.**

| | North Pacific | Western Pacific | Pacific | Gulf of Mexico | Caribbean | South Atlantic | Mid Atlantic | New England |
|---|---|---|---|---|---|---|---|---|
| **Composition** | N= 15: no specific apportionment of representation, but consists of state and NMFS staff and academics. Includes fishery biologists, economists, social scientists, seabird and marine mammal ecologists, population dynamics experts. | N=16: representatives currently include 3 state/territorial, 3 NMFS, 2 regional organizations, 2 others (consultant, retired academic). Includes fishery biologists, population dynamics experts, social scientists, economists. | N=16: SOPPs specifies representatives to include 4 state, 5 NMFS, 1 Treaty Indian Tribe, 6 'at-large' (allows private consultants). Includes fishery biologists, population dynamics experts, social scientists, economists. | N=55. Standing SSC of 14 includes fishery biologists, economists, social scientists, and experts in population dynamics, marine law, and state regulations. Special SSCs for each fishery meet along with the standing SSC, depending on the issue. | N=12: membership includes local fishery agencies, NMFS, academia, and environmental groups. Includes fishery biologists, population dynamics experts, oceanographers, social scientists, economists. | N= 21: membership consists of academic faculty, state and NMFS staff, and private sector individuals. SSC has Biolgocial Subcommittee and Socio-Economic Subcommittee. Includes economists, social scientists, and population dynamics experts. | N=13: membership includes state fishery agencies, NMFS, academia, and environmental groups. Includes fishery biologists, population dynamics experts, oceanographers, social scientists, economists. | N=9: membership includes state fishery agencies, academia, environmental groups, and retired NMFS employees (current NMFS employees not allowed on SSC). Includes fishery biologists and population dynamics experts. |
| **Appointment** | Members nominated by the SSC and approved by the Council. All serve 1 year terms, but no term limit. | Agency reps nominated by agencies; SSC nominates other members. Council has final appointment authority | Agency reps nominated by agencies with indefinite terms. At-large reps appointed for 3 year terms through open nomination process. SSC recommends and Council appoints members. | SSC members nominated by Council and others. 2 year terms with unlimited reappointment. | SSC members nominated by Council and others. 2 year terms with unlimited reappointment. | SSC members nominated by Council, staff, and SSC members. There are no fixed terms. | SSC members nominated by Council and others. 2 year terms with unlimited reappointment. | SSC members nominated by Council and others. 3 year terms with unlimited reappointment. |
| **Meeting Frequency** | Meets 5 times per year, concurrent with Council meetings, for 3 days. | Meets for 3 days, 3 times per year, a week prior to each Council meeting. | Meets 5 times per year, concurrent with Council meetings for 2-3 days. Subcommittees meet when requested, about 6 times per year. | Meets 3-6 times per year, for multi-day sessions; meetings are independent from Council meetings. | Meets twice per year at request of Council chair; meetings are independent from Council meetings. | Meets twice per year, once jointly with the Council and once seperately. | Meets only rarely (once or less per year) at the request of the Council or staff. | Meets once or twice per year at the request of the Council, staff, or Plan Development Team. |
| **Scope of Recommendation** | Reviews all scientific and technical aspects of amendment analyses, stock assessments; provides research recommendations | Reviews all scientific and technical aspects of all issues, including stock assessments and allocation issues. | Reviews all scientific and technical aspects of amendment analyses, stock assessments; provides research recommendations | Reviews all scientific and technical aspects of every FMP amendment and stock assessments | Reviews all scientific and technical aspects of FMP amendments, monitoring projects, and other programs | | Reviews stock assessments on occasion | Reviews stock assessments if there is conflicting or unclear assessment advice from Northeast Stock Assessment Workshop |
| **Public Testimony** | Open meetings with high public attendence; oral testimony common | Open meetings with public attendence; oral testimony common | Open meetings with public attendence; oral testimony common | Open meetings with public attendence; oral testimony common | SSC meetings are open, but public rarely attends. | Open meetings with public attendence; oral testimony allowed | Open meetings with public attendence; oral testimony allowed | Open meetings with public attendence; oral testimony allowed |
| **Reports and Minutes** | Both verbal and written reports are presented to Council. Also available on Web. | Both verbal and written reports are presented to Council. Also available on Web. | Both verbal and written reports are presented to Council. Also available on Web. | Written reports are presented to Council. Not currently available on Web. | Both verbal and written reports are presented to Council. | Both verbal and written reports are presented to Council. | Both verbal and written reports are presented to Council. | Both verbal and written reports are presented to Council. Also available on Web. |
| **Council Use of SSC Recommendations** | Council follows SSC advice whenever possible or feasible. Council always follows SSC catch limit recommendations (always a single number for each stock or complex) | Council follows SSC advice whenever possible or feasible. Council always follows NMFS/SSC catch limits where applicable (lobster, precious corals) | Council follows SSC advice whenever possible or feasible. Council always follows SSC catch limit recommendations for single catch limit value, and within the SSCs range of values for ABC and OY (Council generally selects mid-point). | Council follows SSC advice whenever possible or feasible. | Council follows SSC advice whenever possible or feasible | Council follows SSC advice whenever possible or feasible | SSC input is incorporated directly into the management plan. However, the Council relies on SARC process and FMP Monitoring Committees for most advice | SSC input is incorporated into Council considerations. However, the Council relys on SARC process and Plan Development Teams for most advice |

**Table 2. Current composition of regional fishery management council Scientific and Statistical Committees.**

| Expertise | North Pacific | Western Pacific | Pacific | Gulf of Mexico |
|---|---|---|---|---|
| **Fishery Biology & Population Dynamics** | Steve Hare, Ph.D., Pacific Halibut Commission<br>Anne Hollowed, Ph.D., NOAA Fisheries, AFSC<br>Gordon Kruse, Ph.D., University of Alaska<br>Terry Quinn, Ph.D., University of Alaska<br>Dave Sampson, Ph.D. Oregon State University<br>Doug Woodby, Ph.D., Alaska Dept.Fish and Game<br>Farron Wallace, WA Dept. Fish and Wildlife<br>Franz Mueter, Ph.D., University of Alaska | Milani Chaloupka, Ph.D., University of Queensland<br>Douglas Fenner, Ph.D., Am. Samoa Dept. Resources<br>Charles Daxboeck, Ph.D., BioDax Consulting Tahiti<br>Richard Deriso, Ph.D., Inter-Am.Tropical Tuna Comm.<br>John Hampton, Ph.D., South Pacific Commission<br>Jeff Walters, Ph.D., HI Division of Aquatic Resources<br>Michael Trianni, CNMI Division of Fish & Wildlife<br>Pierre Kleiber, Ph.D., NOAA Fisheries PIFSC<br>John Sibert, Ph.D., PFRP University of Hawaii<br>Robert Skillman, Ph.D., NOAA Fisheries PIFSC | Thomas Barnes, CA Dept. Fish and Game<br>Steve Berkeley, University of California<br>Alan Byrne, ID Dept. of Fish and Game<br>Robert Conrad, Northwest Indian Fisheries Comm.<br>Ramon Conser, Ph.D., NOAA Fisheries SWFSC<br>Martin Dorn, Ph.D., NOAA Fisheries, AFSC<br>Kevin Hill, Ph.D., NOAA Fisheries, SWFSC<br>Tom Jagielo, WA Dept. Fish and Wildlife<br>Han-Lin Lai., Ph.D., NOAA Fisheries NWFSC<br>Andre Punt, Ph.D., University of Washington<br>Stephen Ralston, NOAA Fisheries<br>Dave Sampson, Ph.D. Oregon State University | Luiz Barbieri, Ph.D., FL Fish&Wildlife Res. Institute<br>Robert Colura<br>James Cowan, Ph.D., Louisiana State University<br>Sandra Diamond, Ph.D., Texas Tech Univeristy<br>Bully Fuls<br>Douglas Gregory, University of Florida<br>Albert Jones, Ph.D.<br>Andrew Kemmerer, Ph.D.<br>Charles Wilson, Ph.D., Louisiana State University<br><br>(numerous special SSCs)<br><br>Marine Law<br>James Wilkins, Louisiana State University |
| **Economics** | Keith Criddle, Ph.D, Utah State University<br>Mark Herrmann, Ph.D., Univeristy of Alaska | Paul Callaghan, Ph.D., University of Guam | Hans Radke, Ph.D.<br>Cindy Thomson, NOAA Fisheries SWFSC<br>Micheal Dalton, Ph.D., CA State University | Charles Adams, Ph.D., University of Florida<br>Walter Keithly, Ph.D., Louisiana State University |
| **Socioeconomics & Anthropology** | Seth Macinko, Ph.D., University of Rhode Island | Stewart Allen, Ph.D., NOAA Fisheries PIFSC<br>Craig Severance, Ph.D., University of Hawaii | | (14 member Socioecomonic Panel) |
| **Ecologists** | Sue Hills, Ph.D., University of Alaska<br>Ken Pitcher, Alaska Department of Fish and Game<br>George Hunt., Ph.D., University of California<br>Pat Livingston, NOAA Fisheries, AFSC | Mary Donohue, Ph.D., University of Hawaii<br>James Parrish, Ph.D., Hawaii Coop. Fish. Res. Unit | | (12 member Ecosystem SSC) |

| Expertise | Caribbean | South Atlantic | Mid Atlantic | New England |
|---|---|---|---|---|
| **Fishery Biology & Population Dynamics** | Barbara Kojis, Ph.D., USVI Div. Fish and Wildlife<br>William Tobias, Ph.D, USVI Div. Fish and Wildlife<br>Jose Rivera<br>Richard Nemeth, Ph.D., University of the Virgin Is.<br>Roger Uwate, Ph.D., USVI Div. Fish and Wildlife<br>Ralph Boulon, USVI National Park Service<br>Richard Appeldorn, Ph.D., Univeristy of Puerto Rico<br>James Bohnsack, Ph.D., NOAA Fisheries, SEFSC<br>Walter Keithly, Ph.D., Louisiana State University<br>Craig Dalgren, Ph.D., Perry Institute for Marine Sci.<br>Jorge Capella, Ph.D., URB Marbella<br>Vance Vincente, Ph.D. | James Berkson, Ph.D., Virginia Polytechic Institute<br>Carolyn Belcher, University of Georgia<br>Andrew Cooper, Ph.D., University of New Hampshire<br>Doug Gregory, University of Florida<br>Dave Griffith, Ph.D., East Carolin University<br>Joe Grist, NC Div. Marine Fisheries<br>Pat Harris, Ph.D., SC Dept. Natural Resources<br>Jeff Johnson, Ph.D., East Carolina University<br>Jim Kirkley, Ph.D., VA Institute of Marine Science<br>Thomas Long, Ph.D.<br>Robert Muller, Ph.D., FL Marine Research Insitute<br>Debra Murie, University of Florida<br>Bob Trumble, Ph.D., MRAG Americas<br>Dave Whitaker, SC Dept. Natural Resources<br>Ron Micheals, Ph.D., Georgia Dept Natural Res<br>(7 member Biological Subcommittee) | Jim Gilford, Ph.D., retired<br>David Conover, Ph.D., SUNY<br>Wendy Gabriel, Ph.D., NOAA Fisheries<br>Joe Hightower, Ph.D., NC Coop F&W Research Unit<br>John Hoenig, Ph.D., VA Institute of Marine Science<br>Cynthia Jones, Ph.D., Old Dominion University<br>Mike Prager, Ph.D., NOAA Fisheries | Vaughn Anthony, Ph.D. (retired, NMFS)<br>Victor Crecco, Ph.D., CT Dept. Env. Protection<br>John Hoenig, Ph.D., VA Institute of Marine Science<br>Desmond Kahn, Ph.D., DE Dept. Natural Resources<br>Jean-Jaques Maguire, Wildlife Conservation Society<br>Andrew Rosenberg, Ph.D., Univ. of New Hampshire<br>Brian Rothchild, Ph.D., Univ. of Massachusetts<br>Alexei Sharov, Ph.D., MD Dept. Natural Resources<br>Pat Sullivan, Ph.D., Cornell University |
| **Economics** | | Chris Dumas, Ph.D., University of North Carolina<br>Sherry Larkin, Ph.D., University of Florida<br>John Whitehead, Ph.D., Appalachain State U | Lee Anderson, Ph.D., University of Deleware<br>Jim Kirkley, Ph.D., VA Institute of Marine Science<br>Mark Holliday, Ph.D., NOAA Fisheries | |
| **Socioeconomics & Anthropology** | | Benjamin Blount, Ph.D., University of Texas<br>Brian Chevront, Ph.D., NC Div. Marine Fisheries<br>Paul Durrenberger, Ph.D., Penn State<br>(10 member Socioeconomic Subcommittee) | Bonny McCay, Ph.D., Rutgers University | (10 member Social Science Advisory Committee) |
| **Ecologists** | | | Ed Houde, Ph.D., University of Maryland<br>Tom Miller, Ph.D., Chesapeake Biological Lab | |

Note: For the Gulf of Mexico Council, only the standing SSC members are listed; there are also many special issue SSCs with membership too numerous to list.

**Table 3. Other scientific review committees, in addition to the SSCs, used by regional fishery management councils.**

| | North Pacific | Western Pacific | Pacific | Gulf of Mexico |
|---|---|---|---|---|
| **Stock Assessment** | Plan Teams | Plan Teams | Technical Teams, Stock Assessemt Review Panels | Stock Assessment Advisory Panels; SEDAR Panels |
| **Ecosystem** | Ecosystem Committee (policy and science); Plan Teams | Plan Teams | | Ecosystem Management Committee; Ecosystem SSC |
| **Management** | Plan Teams | Plan Teams | Technical Teams; Habitat Committee | |
| **Socioeconomics** | | | Economic Subcommittee | Socio-Economic Panel |
| **Independent Reviews** | Independent reviews have been conducted for controversial scientific issues | Occasionally for controversial scientific issues (e.g., lobster harvest model) | None to date | Independent stock assessment reviews with SEDAR Process. |

| | Caribbean | South Atlantic | Mid Atlantic | New England |
|---|---|---|---|---|
| **Stock Assessment** | | Stock Assessment Advisory Panels; SEDAR Panels | Stock Assessment Workshop/ Stock Assessment Review Committee | Stock Assessment Workshop/ Stock Assessment Review Committee |
| **Ecosystem** | Habitat Advisory Panel | Habitat and Coral Advisory Panels (policy and science) | Ecosystem Committee (policy) | |
| **Management** | | | Monitoring Committee; ASMFC Technical Committees | Plan Development Teams |
| **Socioeconomics** | | Socio-Economic Subcommittee | | Social Sciences Advisory Committee |
| **Independent Reviews** | None to date | SEDAR process CIE review of stock assessments | Rarely (once in last 10 years) | Sometimes. Most recently, an independent review of new management reference points for groundfish stocks |