E. Organization and Priorities

NMFS Science Centers' Organization and Roles

Currently, the Northwest and Southwest Fisheries Science Centers conduct nearly all of the assessments, and contribute much of the research, for the 90+ species of west coast groundfish regulated under the Pacific Fishery Management Council's Groundfish Fishery Management Plan. The NWFSC has lead NMFS responsibility for groundfish research and the Fishery Resource Analysis and Monitoring (FRAM) Division, at the NWFSC, is the Center's only Division focused primarily on groundfish. FRAM's Population Ecology Program currently includes 9 fishery stock assessment FTEs, a Ph.D candidate who is a part-time employee, 3 supporting staff, and a spatial analyst. The SWFSC is also actively involved in groundfish science and assessments, within its Fisheries Ecology Division, located in Santa Cruz, California. The SWFSC's Groundfish Analysis Team currently has 3 assessment FTEs and one supporting analyst, and has begun the process of hiring another assessment FTE. The members of both groups are committed to forging productive research collaborations, within and outside of NOAA, advancing the state of assessment science, and working closely with staff of the PFMC to ensure that fishery managers are provided with relevant, timely, high-quality, and understandable science upon which to base their decisions.

Groundfish Stock Assessment and Review Process

The development of stock assessments and other research is organized under the umbrella of the PFMC's biennial management cycle. Assessments for species other than Pacific hake are reviewed in odd-numbered years. Accordingly, assessment authors are generally most engaged in the development, review, and communication of their assessments for an 8-12-month period beginning around November in even-numbered years. This cooperative NMFS-Council assessment and review process is characterized by a high degree of collaboration, transparency and openness. This begins with discussions of the species to be assessed, in the public Council forums, and continues through reviews by STAR Panels and the SSC, which are all open to the public. In addition to reviewers, STAR Panels also include representatives from the Council's groundfish advisory bodies (e.g. management team and the industry advisory panel), to help ensure that model development as well as the interpretation of data and results, are informed by those who have been actively involved in the fishery and its management.

These formal STAR representatives, as well as others from the fishing and management communities, frequently have considerable interaction with authors throughout the development of benchmark assessments. As part of the assessment development process, both Science Centers have historically engaged the public via pre-assessment workshops. These have been designed to provide opportunities for both the public and assessment authors to better understand the data that will be used in upcoming assessments. In recent years, however, opportunities for this valuable form of interaction have been reduced by recent budget and travel restrictions. A webinar format that was tried in 2013 attracted few members of the public. On the other hand, the Treaty science process for Pacific hake includes not only public meetings for the review of hake assessments, but also two formally announced, public assessment-development meetings of

the Joint Technical Committee each year. In both processes, assessment authors are encouraged to solicit perspective from those with extensive fishery and management experience.

Stock Assessment Prioritization Process

Because of the large number of groundfish species and limitations on assessment throughput, including staffing and review demands, a subset of species is selected each cycle for assessment. Discussions begin early in even-numbered years with the Council, its staff, and advisory bodies regarding the selection of stocks for assessment and review in the following year. A wide range of factors is considered, including the length of time since the last assessment, trends and depletion status in the last assessment, the species Productivity-Susceptibility (Vulnerability) rating, its importance to commercial and recreational fisheries, and the magnitude of catch, relative to estimates of sustainable removals. Stocks that are being managed under rebuilding plans have special consideration, particularly if they are approaching their target biomass levels. The evolution of data assembly to support the process of selecting species for assessment has been highly influenced by the work of NMFS' national working group on stock assessment prioritization.

Until 2011, the PFMC, in consultation with NMFS, interpreted the SFA's requirements for rebuilding species to mean that a stock assessment had to be conducted every two years. Due to the number of rebuilding species, more than half of the benchmark and update assessments for species other than Pacific hake conducted since 2006 were for one of 8 such species. This interpretation inhibited timely re-assessments for some species and reduced opportunities to develop new assessments for previously unassessed stocks. Beginning in 2011, the PFMC and NMFS began the selective use of 'Catch Reports', in which estimates of total fishing mortality are compared with rebuilding ACLs, over the period since the last assessment. This alternative to conducting a full or update assessment has been limited to rebuilding stocks with protracted rebuilding schedules and marginal indices of abundance.

The Council's Scientific and Statistical Committee (SSC) provides comments on the assessment level that would be most appropriate when a stock is next assessed. These recommendations are relied upon in identifying whether an update of a previous assessment should be considered during subsequent assessment cycles. Relatedly, since updates are highly constrained in the Council TORs, in terms of revising prior models and adding new data series, the availability of new types of data or avenues for resolving previous modeling challenges are important in determining the appropriateness of conducting an update. The availability of new data sources, such as the NWFSC shelf-slope trawl survey and the Southern California Hook-and-Line Survey, both of which were started in 2003, meant that many assessments since 2009 were conducted as benchmarks, rather than updates, in order for these new sources of information to be incorporated into assessment models. Additionally, Stock Synthesis underwent a major revision between the 2007 and 2009 assessment cycles.

Despite these limitations, the 31 groundfish species with adequate assessments conducted in the last 5 years account for 85% of recent average commercial ex-vessel revenues and 56% of recreational landed catch. Through research and testing of new approaches to conducting data-limited assessments, both Science Centers are advancing the ability to identify safe harvest levels for most species, and evaluate stock status for many, in less resource-demanding ways. In 2013, two alternative data-moderate modeling approaches were used to develop adequate assessments for six previously unassessed species, as well as two others with prior, but dated, update assessments. By comparison, the same development effort for these, and the 1-week STAR-

panel review, would have yielded only two benchmark assessments. These data-limited methods have their limitations and should not be viewed as a wholesale replacement for benchmark assessments. However, they have enhanced the suite of tools that is available for striking an appropriate balance in the tradeoffs between species priority and allocation of assessment/review resources.

Workload and Research Opportunities

In addition to producing world-class stock assessments, assessment scientists at both Centers have published more than 80 peer-reviewed articles in the last five years, having had lead authorship on 48. Of the total, 17 articles have focused on developing or improving stock assessment methods, with eight others addressing the preparation of data for use in assessments. The group has another 29 papers in various stages of review, with eight of those addressing assessment methods and five the preparation of data. Much of this research has responded directly to prior assessment review comments and/or issues highlighted in the PFMC's 2008 Research and Data Needs document (E.4 PFMC_Research_and_Data_Needs_2008). Other published research topics closely related to assessment have included reconstruction of historical catch data, ageing error, and aspects of fish life history--such as maturity, fecundity, and meta-analytic approaches for dealing with natural mortality and productivity

Scientists at the NWFSC also play an important, ongoing role in testing new versions of the Stock Synthesis (SS) assessment platform, and improving the R4SS package, which provides assessors with an off-the-shelf means of producing scores of diagnostic and presentation graphics and tables. Additionally, in support of improving global assessment practices, members of the Population Ecology Program have conducted five week-long training sessions on the use of SS and its application to local species, on four continents, since 2012.

In addition to conducting assessments and research, assessment personnel are actively engaged in helping fishery managers better understand and apply scientific findings through their decisions. In the past year, two assessment scientists have served on the Council's Scientific and Statistical Committee—one as overall chair and one as chair of the Groundfish Sub-Committee—and one has served on the Groundfish Management Team, a multi-agency advisory body which helps the Council develop, analyze, and implement management alternatives. Within the last 5 years, up to five assessment scientists from the two groups have served, concurrently, on these two bodies. With five Council meetings a year to attend, and numerous outside commitments, these obligations can easily account for up to 25% of an individual's available work time. Additionally, over this same period, assessment staff have served on at least 14 committees and working groups organized by the NMFS Office of Science and Technology. These groups play an important role in the development of agency policies and standards, in reviewing applications for agency research funding, and in identifying ways of improving assessment performance.

Constraints and Bottlenecks

Many factors have acted as constraints on either the overall throughput of assessments or the time available for assessment development. Some of these, such as staff size, the PFMC's biennial cycle, and narrowly-defined criteria for update assessments, in conjunction with a changing data landscape, have already been mentioned. Additional constraints on the assessment process include a general decline in the participation of State agency staff and graduate students in assessment development. Even though Pacific coast NMFS assessment staffing has generally increased since 2001 (from 8 to 12 FTEs, perhaps 13 by 2015), these gains have been offset by

reductions in non-federal participation in, and particularly leadership of, assessments. During 2003-05, one third of the assessments conducted were led by state agency staff or students. Since 2008, none have been. The availability of data-moderate assessment approaches, which can be developed and reviewed more rapidly, is beginning to address this issue, as will an increasing future ability to utilize updates in place of some benchmark assessments. Regional adaptation/refinement of nationally-developed algorithms for identifying target assessment frequency (and assessment priority), and their application to those groundfish species with sufficient data to support adequate assessments, will also aid in the development of a more strategic, decadal plan for addressing regional groundfish assessment needs.

Other constraints include limited number of weeks available to hold STAR panel reviews, limitations on other resources for conducting reviews (particularly reviewers), and delays in the availability of final data. This last factor often means that assessment authors presenting early in the cycle (e.g. some benchmarks, all data-moderate and updates) have very limited time to thoroughly evaluate and document final model runs (including a full suite of sensitivity analyses) using the prior year's survey and fishery data before their documents must be distributed to reviewers. For example, landings and associated fish-length data from the prior year are often not finalized until March or April, while the first STAR panels are typically held in late-April and early-May. Efforts are underway to redesign the NWFSC bottom trawl survey database and processes, in order to expedite the availability of these data (which are typically not available until February-April of the following year). The acoustic survey for Pacific hake has developed new methods for processing data, however the combination of post-survey processing time and the Treaty's review schedule has continued to leave assessors with less than one month between receipt of final survey data and the deadline for distributing a draft assessment to reviewers. An important, related constraint to the production of reliable assessments for many species remains the lack of a comprehensive abundance survey in untrawlable habitats.

Because of the long-lived nature of many west coast groundfish species and their growth characteristics, age-reading provides vital information for many assessments. While the SWFSC and some state fishery agencies engage in limited ageing of fish samples, most ageing of west coast groundfish is conducted by the Cooperative Ageing Project (CAP), which is a collaborative undertaking of the NWFSC and Pacific States Marine Fisheries Commission. Although the number of CAP age readers has increased over the past decade, to a current total of 7, this number is inadequate to resolve historical backlogs of un-aged or poorly-aged samples and keep up with ongoing additions to the sample inventory. As a result, they are often in the position of playing 'catch-up', once species have been scheduled for assessment. Despite ageing-priority discussions between FRAM and CAP, which begin even before the Council has finalized assessment selections, the existing backlog has meant that several recent assessments have been conducted with age data from a limited sample of years for which age structures are available. Ongoing NWFSC-CAP research is focused on evaluating relationships between otolith size and fish age, in an effort to identify circumstances under which a more rapid but still robust method of determining fish ages may be available.

A final area of constraint involves institutional resource limits and policies, particularly as they affect computing and travel. NMFS assessment scientists on the Pacific coast, as in other regions, rely on desktop computing resources that are generally about 60-80% as powerful as computers used by avid gamers. As a result, most assessors utilize a collection of computers of various ages to meet peak assessment demands. However, security protocols generally do not

allow active control of any machine without a CAC card login, and each person has only one card. Reliance on multiple computing platforms is challenging enough, but not being able to monitor and control what is happening on each of them without logging in and logging out continuously is highly unproductive. Elaborate laptop back-up, wiping, and re-installation procedures must be accommodated whenever assessment staff leave the country, even to work in Canada. Agency travel caps, and associated budget reductions, have cut the non-reimbursable travel of assessment staff to near the bare minimum needed to meet essential responsibilities. Even when NMFS headquarters is able to support travel to strategic meetings, the common practice of transferring the money to field offices leaves their Divisions liable for the travel-cap impact. These factors have increased considerably the challenges of integrating NWFSC staff in Seattle and Newport, much less between the two Centers. They have also dramatically reduced opportunities for engaging with the public, during assessment development/review, and for promoting staff development and networking, through attendance at professional meetings.

Conclusion

The west coast groundfish assessment enterprise faces numerous constraints in meeting management demands for timely, well-reviewed assessments within each biennial management cycle. Where possible, actions have been initiated to reduce several of these constraints, however many remain systemic. Nevertheless, scientists at the NW and SW Science Centers are producing world-class assessments, while continuing to lead the development of innovative assessment analytical methods. They are actively engaged with the management process, maintaining an ongoing, open dialogue with policy-makers, industry, and the public. Their interest in transparency and communication, along with their technical expertise, has produced assessment teams that are highly effective and widely respected by both the scientific community and fishery management participants.