An Evaluation of Scientific and Assessment Needs

to Support the Development of

Acceptable Biological Catches (ABCs) and Annual Catch Limits (ACLs)

for Managed Fishery Resources in the Northeast Region

A White Paper to the NRCC

prepared by

NEFSC ACL Working Group

with review and consultation

with the

NEFMC/MAFMC/NERO/NEFSC ACL Working Group

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EXECUTIVE SUMMARY

In spring 2009, the Northeast Region Coordinating Council (NRCC) called for the formation of two NRCC Working Groups to evaluate scientific needs to support the new requirements for annual catch limits (ACLs) as specified in the reauthorized Magnuson-Stevens Fishery Conservation and Management Act (MSRA). These Working Groups were formed because the NRCC recognized that the Northeast Fisheries Science Center (NEFSC), in conjunction with the NEFMC and the MAFMC, will be required to carry out significant additional analytical tasks on federally managed stocks to support the new MSRA requirements related to ACLs. One NRCC Working Group comprised eight staff of the NEFSC and was deemed the Internal Working Group. This Group was tasked to provide an assessment of the science information that could be provided to support ACLs and to examine the availability of this information for the New England and Mid-Atlantic Fishery Management Council's ACL processes. These findings and any accompanying recommendations were to be summarized in a White Paper to be presented for discussion to the NRCC at its October 2009 meeting. The second Working Group (called the External Working Group) comprised 11 individuals, with members from the Council staffs, the Northeast Regional Office, the New England and Mid-Atlantic Science and Statistical Committees (SSCs), and the NEFSC. ASMFC representatives were included on this Working Group's correspondence and invited to attend its meetings. The External Working Group was tasked to discuss the assessment information necessary to support the development of Acceptable Biological Catch (ABC) and ACL limits, and was expected to be kept abreast of the activities of the Internal Working Group, provide feedback to this Group as appropriate, and to review, discuss and comment on the draft of the White Paper.

Both Working Groups met several times between May and September 2009. This White Paper represents the collaborative input, discussions and guidance from both Groups with respect to identifying the short-term and long-term scientific requirements—and challenges—for ABC and ACL development. Due to the significant additional scientific requirements imposed by the MSRA and the limited capacity for any short-term increases in current NEFSC staffing and resources, there is very little capacity to accommodate any workload increases. As such, both Working Groups strived to identify ways to accomplish the new required tasks and still provide the existing information and support to the management process. From the deliberations of both Working Groups, the following short-term and longer-term recommendations were developed:

Short-Term Recommendations:

- The SAW/SARC should continue to be the process for peer reviewing benchmark stock assessments prepared by SAW WGs. Typically, a benchmark assessment of any stock should not be scheduled more than every three to five years.

- After a short transition period (~1 year), discontinue Assessment Updates that have been performed annually, particularly those that require age data.

- Instead of annual Assessment Updates that are done on a subset of stocks, NEFSC staff and technical committees of the Councils will jointly conduct annual 'Assessment Evaluations' for each federally managed stock, based on evaluations of 'signposts' (see Appendix I: Glossary).

- A "Transition Team" should be established to develop a recommended process and timeline for approval by the NRCC in transitioning from Updated Assessments to Assessment Evaluations for each federally-managed stock.

- Age data available on specific stocks should be provided and analyzed approximately every three years, in coordination with the SAW/SARC schedule of benchmark assessments developed by the NRCC.

- Provide appropriate support to SSCs to make ABC recommendations for each managed stock. Specifically:

    a. Modify the SAW/SARC TORS for benchmark assessments to include descriptions and quantitative estimates of uncertainty related to data inputs (e.g., both fishery-independent and fishery-dependent data) and assessment model outputs (F, B, R, BRPs and projections). A review of any retrospective patterns, including those associated with changing to a different assessment model, should also be included in a benchmark assessment.

    b. Have designated SSC members attend SAW WG meetings as well as the SARC. Have a member of the SSC chair the SARC.

    c. Provide consultation to the SSC on technical details of the assessments and provide a liaison from the NEFSC to the SSC.

Longer-Term Recommendations:

- As the new MSRA requirements for science information become clearer, identify resources to meet these requirements.

- Examine whether simpler assessment models could replace more complex models, and support and investigate new assessment approaches.

INTRODUCTION

The Reauthorized Magnuson-Stevens Fishery Conservation Act (MSRA) includes new requirements for annual catch limits (ACLs) on federally managed stocks and other provisions to prevent and end overfishing and rebuild fisheries. Although the Northeast Fisheries Science Center (NEFSC) assessment workload is already substantial, demands for additional technical support to the NEFMC and MAFMC and their committees will increase with implementation of the new MSRA requirements. Guidance on how to develop and comply with these ACLs was provided in the 16 January 2009 Final Rule. Notwithstanding this guidance, it is unclear how the new requirements will impact the timetables of assessment analyses needed for the FMP annual specifications process in the Northeast Region, other than that ACLs will be required for all FMP managed fisheries beginning in 2011.

At the spring 2009 meeting (31 March - 1 April) of the Northeast Region Coordinating Council (NRCC), a discussion ensued on the annual scientific information needed to support ACLs during the years between assessment updates or benchmarks. Dr. Nancy Thompson, Science and Research Director of the Northeast Fisheries Science Center (Center) indicated that the Center would take the lead in developing and completing a 'white paper' as to what scientific information could be provided on an annual basis to support ACLs. This 'white paper' would be presented to the NRCC for review and comment at the October 2009 NRCC meeting.

To this end, the NRCC assigned the following Action Item to the Center:

8. <u>ABC and ACL Development and Ongoing Scientific Information Needs</u>:

Develop evaluation of what science information can be provided to support ACLs.

Examine timing of information availability for Council's ACL processes. Specific tasks to be completed:

a) Center to complete white paper for discussion
b) Discuss white paper, information availability, information needs with Council SSCs
c) Report findings/recommendations/discussion results to NRCC at fall meeting (October)

Responsible Party: NEFSC

Timeframe: Entire process as outlined completed by October NRCC meeting

The NRCC also crafted a supplemental Action Item (as a subcomponent to the one above) to create a formal Working Group (WG) to discuss assessment information to support Acceptable Biological Catch (ABC) and ACL development. This AI states:

8a. <u>ABC and ACL Development and Ongoing Scientific Information Needs</u>:
N*ote: This Action Item is a subcomponent Action Item 8.*

Convene a working group designed to discuss assessment and assessment update information necessary to support ABC and ACL development.

Responsible Party: NEFSC (lead), NERO, membership from MAFMC, NEFMC and both MA and NE SSCs

Timeframe: Complete membership roster of working group by April 30.
Schedule 1st working group meeting for soon there after (May-June).

In effect, two NRCC Working Groups were created: an Internal NEFSC Working Group to develop the 'white paper' in AI 8, and an External Working Group to address scientific information needs to support ABCs and ACLs. It was understood that close interactions between the two Groups would occur, and that the efforts of the two Groups would be synergistic.

The Internal WG was established in early April 2009 with eight members: Fred Serchuk (Internal WG Chair), Jim Weinberg, Richard Merrick, Paul Rago, Eric Thunberg, Wendy Gabriel, Steve Cadrin, and Mike Fogarty. The External WG was established in late April 2009 with a membership (finalized in early May) of 11 individuals: Jim Weinberg (External WG Chair and NEFSC staff), Brian Rothschild (MA SSC Chair), Steve Cadrin (NE SSC Chair), Bob O'Boyle (NE SSC member), Chris Kellogg and Tom Nies (NEFMC staff), Rich Seagraves (MAFMC staff, with Jessica Coakley as backup), Mike Ruccio (NERO staff, with Tom Warren as backup), and Fred Serchuk, Paul Rago, and Eric Thunberg (NEFSC staff). In late July 2009, John Boreman replaced Brian Rothschild on the External WG because John replaced Brian as the Chair of the MA SSC. As the five NEFSC staff on the External WG were also members of the 'internal' WG, this provided continuity between the two Groups.

To date, both Groups have met several times. The initial meetings of the two WGs clarified that the principal scientific and information needs which first had to be addressed to support ABC and ACL development were those involving short-term data and analytical requirements and assessment scheduling. With more than 50 stocks managed in the Northeast Region (see Table 1), it was clear that guidance was needed on (a) how often assessments could be conducted in the future to meet ABC/ACL requirements, and (b) the types of new information and assessment analyses that would be needed to support ABC/ACL specifications.

An evaluation was therefore undertaken of the current SAW/SARC (and TRAC) stock assessment process to better understand the resource requirements (data, analyses, personnel, and scheduling) and constraints of the present system, and to identify some of the major challenges ahead in addressing ABC/ACL needs and in supporting the new responsibilities of the SSCs in establishing ABCs for all managed stocks.

The NEFSC workload has increased in recent years and is substantial. There are increased NEFSC responsibilities in Cooperative Research Projects, development of new methods for systematic treatment of discard monitoring and estimation, evaluation of LAPPs, and reviews of proposals, grants, progress reports, Council Amendments, Framework Adjustments, etc. The overall stock assessment load has increased as have the Terms of Reference for each stock assessment. The change in research vessels has increased assessment requirements because of major changes in catchabilty and the need for novel methods for inter-vessel calibration.

Three key factors have increased the stock assessment workload:

1. Reauthorization of the Magnuson-Stevens Act (MSRA)
2. SSC involvement and requests for science information to help set ABCs, and
3. "Updates" are no longer "simple".

With passage of MSRA in 2007, fishery management councils are required to avoid overfishing by setting Annual Catch Limits for all managed stocks. Councils will require more frequent and additional scientific information from the NEFSC. MSRA also requires that councils use their SSCs as science advisors whose job is to recommend annual Acceptable Biological Catches (ABC) for each stock. The SSCs need additional scientific information from the NEFSC upon which to base ABC recommendations. SSCs are requesting that new SAW/SARC Terms of Reference (TORs) be added to provide the scientific information required to support the ABC-ACL system. In addition, SSCs require time to meet and deliberate which puts additional stress on schedules for delivery of assessment information. Finally, assessment updates, which do not require CIE peer review, are no longer a "simple exercise". Many of the assessments that were index-based are now based on analytical models, which require more data and more time for analysis and preparation of reports. This White Paper includes a list of short and longer-term recommendations for coping with the added workload.

Table 1. Summary of stock status in the Northeast Region.

FMP	Species	Stock	Assessment Type	Projection Method	Overfishing?	Overfished?	Rebuild Date	Fishing Year
Northeast Multispecies	Cod	GB	VPA	AGEPRO	Yes	Yes	2026	1-May
	Cod	GOM	VPA	AGEPRO	Yes	No	2014	1-May
	Haddock	GB	VPA	AGEPRO	No	No	Rebuilt	1-May
	Haddock	GOM	VPA	AGEPRO	No	No	Rebuilt	1-May
	Yellowtail Flounder	GB	VPA	AGEPRO	Yes	Yes	2014	1-May
	Yellowtail Flounder	SNE/MA	VPA	AGEPRO	Yes	Yes	2014	1-May
	Yellowtail Flounder	CC/GOM	VPA	AGEPRO	Yes	Yes	2023	1-May
	American Plaice	GB/GOM	VPA	AGEPRO	No	No	2014	1-May
	Witch Flounder		VPA	AGEPRO	Yes	Yes	2017	1-May
	Winter Flounder	GB	VPA	AGEPRO	Yes	Yes	2017	1-May
	Winter Flounder	GOM	None	None	Unknown	Unknown		1-May
	Winter Flounder	SNE/MA	VPA	AGEPRO	Yes	Yes	2014	1-May
	Redfish		ASAP	AGEPRO	No	No	2051	1-May
	White Hake	GB/GOM	SCAA	AGEPRO	Yes	Yes	2014	1-May
	Pollock	GB/GOM	AIM	AIM	Yes	Yes	2017	1-May
	Windowpane Flounder	GB/GOM	AIM	None	Yes	Yes	2017	1-May
	Windowpane Flounder	SNE/MA	AIM	None	Yes	No	2014	1-May
	Ocean Pout		Index	None	No	Yes	2014	1-May
	Atlantic Halibut		Repl. Yield	None	No	Yes	2055	1-May
	Atlantic Wolffish		SCALE	None	Unknown	Yes		1-May
	Silver Hake	North	Survey Index	None	No	No		1-May?
	Silver Hake	South	Survey Index	None	No	No	Rebuilt	1-May?
	Red Hake	North	Survey Index	None	Unknown	No		1-May?
	Red Hake	South	Survey Index	None	Undefined	No		1-May?
	Offshore Hake		Survey Index	None	Undefined	No		1-May?
	Cusk		SCALE	None				N/A
Northeast Skate Complex	Little Skate		Survey Index	None	No	No		1-May
	Winter Skate		Survey Index	None	No	No		1-May
	Barndoor Skate		Survey Index	None	No	No		1-May
	Thorny Skate		Survey Index	None	No	Yes	Not defined	1-May
	Clearnose Skate		Survey Index	None	No	No		1-May
	Rosette Skate		Survey Index	None	No	No		1-May
	Smooth Skate		Survey Index	None	No	Yes		1-May
Atlantic Herring	Atlantic Herring		ASAP	AGEPRO	No	No		1-Jan
Deep-Sea Red Crab	Deep-Sea Red Crab		Survey	None	Unknown	Unknown		1-Jan
Atlantic Sea Scallop	Atlantic Sea Scallop		CASA	SAMS	No	No	Rebuilt	1-Mar
Monkfish	Monkfish	North	SCALE	None	No	No	Rebuilt	1-May
	Monkfish	South	SCALE	None	No	No	Rebuilt	1-May
Spiny Dogfish	Spiny Dogfish		Catch at Length	Length-based	No	No	Rebuilt	1-May
Summer Flounder, Scup & Black Sea Bass	Summer Flounder		ASAP	AGEPRO	No	No	2013	1-Jan
	Scup		ASAP	AGEPRO	No	No	Rebuilt	1-Jan
	Black Sea Bass		SCALE	None	Yes	No	Rebuilt	1-Jan
Atlantic Mackerel, Squid & Butterfish	Atlantic Mackerel		ASAP	AGEPRO	No	No	Rebuilt	1-Jan
	Loligo Squid		Production	N/A	No	No		1-Jan
	Illex Squid		Survey Index	N/A	No	Unknown		1-Jan
	Atlantic Butterfish		KLAMZ	KLAMZ	No	Yes		1-Jan
Atlantic Surfclam & Ocean Quahog	Atlantic Surfclam		KLAMZ	KLAMZ	No	No	Rebuilt	
	Ocean Quahog		KLAMZ/VPA	KLAMZ	No	No	Rebuilt	
Bluefish	Bluefish		ASAP	AGEPRO	No	No	Rebuilt	1-Jan
Tilefish	Golden Tilefish		ASPIC	ASPIC	No	No		1-Nov
American Lobster	American Lobster	GB	CKWM	N/A	No	No	Rebuilt	
	American Lobster	GOM	CKWM	N/A	No	No	Rebuilt	
	American Lobster	SNE	CKWM	N/A	No	Yes		
Northern Shrimp	Northern Shrimp		CSA/ASPIC	N/A	No	No	Rebuilt	1-Dec
Striped Bass	Striped Bass		SCA/MARK	N/A	No	No	Rebuilt	1-Jan

[1]Rebuilt = Current biomass is ≥ Bmsy or Bmsy proxy OR biomass exceeded these levels in one or more years of the rebuilding period

Current SAW/SARC (and TRAC) Stock Assessment Process

Scheduling of Assessments

The NRCC oversees scheduling of stock assessments as well as the assessment and peer review process. Venues for presenting and peer reviewing assessments include the SAW/SARC, GARM, TRAC, and NE Data-Poor Stocks Working Group. The NRCC meets twice a year to schedule benchmark stock assessments and assessment updates. The planning horizon is 2-3 years, and except for special circumstances, the schedule is locked in 1-2 years ahead. The NRCC works from a draft schedule that was prepared before the NRCC meeting by the NEFSC and reviewed by the NERO. During their meeting, the NRCC makes changes to the draft schedule based on consensus. Many factors are considered by the NRCC during their deliberations. Some of the main factors include:

- needs for science information to support upcoming fishery management actions (including SSC, Council, and NERO actions and schedules)
- stock status
- uncertainty about conclusions from a previous peer reviewed assessment
- time since the previous assessment
- level of public and political interest
- availability of assessment scientists
- availability of staff to process age samples
- identifying the right number and mix of stocks to schedule for peer review in one meeting.

SAW/SARC Stock Assessment Process

Assessment Terms of Reference (TORs)

TORs are prepared in a series of steps starting with the 'generic' SAW/SARC TORs (Appendix IX Terms of Reference). The SAW Chair meets with the primary assessment scientists to edit the 'generic' TORs for each stock. This is then submitted to the NRCC for feedback, revision, and eventual approval. NRCC members are responsible for distributing the draft TORs to their staffs and committees, and returning comments to the NEFSC SAW chair in a timely manner. Final TORs need to be set 3-4 months before the SARC review meeting, so the assessment scientists have time to do their work.

Conducting Stock Assessments

Data Issues

Tremendous effort, planning and resources go into collecting the appropriate data to support stock assessments. Many of the stock assessments are based on age-structured models, and it takes months-years for trained experts to make those measurements on the fish and invertebrate species. Although many samples (scales, otoliths, shells) are collected annually during resource surveys, it is not possible or efficient to age every species every year. Therefore, activities in Age and Growth must be coordinated with the Assessment Schedule, well in advance of stock assessments.

Data from state and federal resource surveys are often used as indices of stock abundance. The primary survey is typically the NEFSC bottom trawl survey of federal waters. This survey, now done with the *FSV Bigelow*, lasts two weeks longer than the *RV Albatross IV* survey and samples more stations in deeper water to provide more precise estimates. The two week extension will impact how quickly survey data are available in both the spring and fall to be used in fish stock assessments. The change was made in the survey sampling to provide improved data from regions that were singled out by advisors as needing better coverage and higher statistical precision.

Analysis Issues

Stock assessments are performed by NEFSC Working Groups (e.g., Invertebrate, Southern Demersal, etc.). There is typically one lead scientist per stock. WGs can vary in size from about 5-15 members. WGs typically comprise federal and state fishery scientists, as well as appropriate representatives from universities, private companies and the fishing industry. Most WGs have 2 or 3 meetings, each lasting for several days, to prepare assessments. Thus, the WG gets active 4-6 months before the peer review.

Peer Review of Stock Assessments

Benchmark stock assessments are peer reviewed by the SARC (Stock Assessment Review Committee). The SARC has been functioning in the Northeast Region since about 1985. Over time the composition of review panels has changed. For the last 5-10 years, panels have been smaller and comprised primarily of fishery scientists provided by the CIE (Center of Independent Experts). The CIE reviewers are independent of the work they are reviewing, and they are not chosen by the NRCC or the NEFSC. Under the current model, the SARC Chair is typically an expert from either the MAFMC SSC or the NEFMC SSC.

Reports from Stock Assessment Meetings

Each CIE panelist writes a detailed report about whether each TOR of the assessment was satisfied and can be used as a basis for fishery management. In addition, the SARC chair and SARC committee together write a panel summary report with their findings about the acceptability of the assessments. These reviewer reports are received 4-7 weeks after the SARC peer review meeting.

Detailed science reports (Assessment Summary Report and Assessment Report) undergo final editing, with the SAW chair coordinating this step. Final assessment reports are published as NEFSC Center Reference Documents, typically 2-4 months after the peer reviewed meeting. As soon as the Assessment Summary Report is published, it is made public along with the Review Panel reports. After publishing the Assessment Summary Report, it typically takes an additional month or two to publish the large Assessment Report.

The SAW Chair gives public presentations of the SAW/SARC results to the MAFMC and NEFMC, typically at the Council meeting that follows the publication of the Assessment Summary Report and release of the Review Panel Reports.

TRAC Stock Assessment Process

The NRCC also participates in setting the TORs for the TRAC. These assessments are done jointly by US and Canadian scientists. Unlike the SARC, the TRAC review meeting has the "Interactive" peer review format. The results are published as Canadian fishery documents and typically as NEFSC Center Reference Documents. The assessment results for groundfish are used to negotiate quotas between the two countries by the Transboundary Management Guidance Committee (TMGC). In 2009, the following stocks are scheduled in the TRAC process: Eastern Georges Bank cod, Eastern Georges Bank haddock, Georges Bank yellowtail flounder, Georges Bank-Gulf of Maine Atlantic herring stock complex, spiny dogfish, and Atlantic mackerel. The addition of new stocks and the frequency with which they will be assessed is related to scientific and management considerations.

"Other" Peer Reviewed Assessments at the NEFSC

The NEFSC carried out GARM-III in 2007-2008. This involved benchmark assessments of 19 groundfish stocks managed by the NEFMC. In addition, the NEFSC convened two "Northeast Region Data-Poor Stocks" meetings: one for monkfish in summer 2007, and another in December 2008 involving five resources: the Northeast skate complex, deep-sea red crab, scup, black sea bass, and Atlantic wolffish.

Assessment Updates

Assessment updates have been carried out annually by NEFSC staff for many Mid-Atlantic stocks. In the past, several of these updates were relatively simple to carry out because they were index-based assessments (typically the NEFSC survey index). Recently however, a number of index-based stocks had analytical assessment models applied and accepted by peer reviewers. It is no longer possible to do quick annual updates for scup, bluefish, summer flounder, and black sea bass because these assessments require data sets beyond a simple survey biomass index. The more detailed data that are necessary to support these assessment models include age and size of fish in fishery independent surveys and in the commercial catch of fish. Such data are time consuming to collect and analyze. Trained experts are required to make age determinations from samples of fish.

Number of Benchmark Assessments and Annual Assessment Updates

The NEFSC has responsibility for carrying out stock assessments of approximately 55 stocks in the NE region. The total number of assessments and peer reviews that have been carried out annually has increased since 2004.

Since 2004 there have been 8 SAW/SARC meetings. During this period, an average of three benchmark stock assessments were completed and reviewed per meeting. In addition significant stock assessment work was completed and peer reviewed annually in other venues. Examples include the 19 benchmark assessments of New England groundfish in GARM-III in 2008, and the Northeast Region "Data Poor" Stocks Working Group review of one assessment in 2007, and 12 in 2008. The NEFSC also participates annually in the TRAC process carrying out three Georges Bank groundfish assessments. Other stocks assessed within the TRAC process include Atlantic herring, spiny dogfish, Atlantic mackerel, and pollock.

Annual assessment updates have also been done on a regular basis for 5-7 stocks and stock complexes. Most of these stocks occur in the Mid-Atlantic region.

Relation of Current Process to New ACL Requirements

Although the assessment workload for the NEFSC has been substantial, and with current staffing and resources there is no capacity for workload to increase, three aspects of routine stock assessments recently changed that effectively increase that workload:

1. Reauthorization of the Magnuson-Stevens Act (MSRA)
2. SSC involvement and requests for science information to help set ABCs, and
3. "Updates" are no longer "simple".

With passage of MSRA in 2007, fishery management councils are required to avoid overfishing by setting Annual Catch Limits for all managed stocks. The councils are in the process of amending their FMPs to accommodate ACL requirements. Councils will require more frequent and additional scientific information from the NEFSC. MSRA also requires that councils use their SSCs as science advisors whose job is to recommend annual Acceptable Biological Catches (ABC) for each stock. Council must set ACLs less than or equal to ABCs, and Council recommendations are then submitted to the NERO for approval. The SSCs need additional scientific information from the NEFSC upon which to base ABC recommendations.

The ABC-ACL system of fishery management is based on defining the catch associated with the overfishing limit (OFL) and 'scientific uncertainty' associated with OFL. ABC is then determined to account for uncertainty in OFL, such that a fishery that removes ABC has low risk of overfishing the resource. The ABC-ACL system also involves accountability measures for when the ACL is exceeded. Annual Catch Targets (ACTs) are an optional approach to avoiding overfishing by accounting for 'management uncertainty.' A more technical description of how ABCs are derived and how routine stock assessments can provide the necessary information is provided in Appendices VI and VII.

SSCs are requesting that new SAW/SARC Terms of Reference (TORs) be added to provide the scientific information required to support the ABC-ACL system. These additional tasks will increase the workload for assessment scientists and take longer for peer review panels to review. In addition, SSCs require time to meet and deliberate, and they would like stock assessment information to be provided to them sooner than it has typically been available in the past. Given existing constraints (related to when data for assessments become available, time required for preparing assessments, peer review by the CIE [Center of Independent Experts], and publication of assessment reports), it has not been possible to find an additional block of time for the SSC.

Finally, assessment updates, which do not require CIE peer review, are no longer a "simple exercise". Many of the assessments that were index-based are now based on analytical models, which require more data and more time for analysis and preparation of reports. Unlike an annual survey index, some information sources needed to support analytical models (*e.g.,* catch at age estimates) are not routinely produced on an annual basis for every stock. Short- and long-term recommendations for coping with the added workload are provided in the next section. Because NEFSC does not work in isolation, recommendations have to consider the needs of the organizations and committees involved with fisheries in the Northeast region, including the NRCC, NERO, NEFMC, MAFMC, SSCs, ASMFC, and TMGC.

Recommendations

The NEFSC needs to provide enough science information on each stock so that the Councils and NERO can set ACLs (Annual Catch Limits). For many stocks, the Councils have the option to set multi-year specifications, and those actions will impact how frequently new science information is required for each stock.

Short-term Recommendations

1. *Recommendation:* The SAW/SARC should continue to be the process for peer reviewing benchmark stock assessments prepared by SAW WGs. Typically, a benchmark assessment of any stock should not be scheduled more than every three to five years.

   Explanation: SAW/SARC is the primary process used in the NE region for conducting and peer reviewing stock assessments. Benchmark assessments are needed periodically because they offer the chance to make real progress in improving assessment methodology and obtaining a more detailed and current understanding of stock status. Waiting three to five years between assessments will allow enough time to pass for current and new management regulations to take effect, for new data to be collected and provided, and it will facilitate scheduling of benchmark assessments by the NRCC.

2. *Recommendation:* After a short transition period (~1 year), discontinue Assessment Updates that have been performed annually, particularly those that require age data.

   Explanation: Under the reauthorized MSA, the NEFSC will now have to provide annual science information on all federally managed stocks in the NE region to support ACL and ABC determinations. Annual Assessment Updates that have been done routinely on certain stocks have become more complex and require substantial staff resources to complete. Given current Center staffing and resources, it is not possible to carry out the new work in addition to the annual Assessment Updates.

3. *Recommendation:* Instead of annual Assessment Updates that are done on a subset of stocks, NEFSC staff and technical committees of the Councils will jointly conduct annual 'Assessment Evaluations' for each federally managed stock, based on evaluations of 'signposts' (see Appendix I: Glossary). A "Transition Team" should be established to monitor the transition process to signposts.

   Explanation: The NEFSC needs to support the Council's PDTs, Technical Committees, Monitoring Committees, FMATs, and SSCs in the annual ACL process. The 'signpost' approach does not provide as much information as a stock assessment (benchmark or update), but should be sufficient to indicate substantive changes in fishery resource conditions. This will allow fishery managers to take action, if required. Although signposts will be chosen as indicators of stock conditions, the

performance of signposts for management in the NE region will need to be monitored and evaluated over time (see Appendix VII)

Spring and fall NEFSC bottom trawl surveys now take two weeks longer to complete than surveys done with the Albatross through 2008. As a result, there will be a two week delay in availability of audited survey data. The change was made in the survey sampling to provide improved data from regions that were singled out by advisors as needing better coverage and higher statistical precision. Assuming that the most recent survey data need to be used in benchmark assessments, then the timing of major assessment peer review meetings (SAW/SARC, TRAC) will have to be shifted back approximately two weeks. Because they require fewer data sets and analyses, the timing of Assessment Evaluations based on 'signposts', could be earlier and would support current management requirements and schedules. Councils and the NERO *may* need to modify their schedules to adapt to the new timing for delivery of survey data for benchmark assessments and Assessment Updates during the transition period, although it is recognized that modifying any such schedules may be very difficult due to administrative and legal constraints.

The increased duration of surveys is only one of several logistical concerns. Major changes in the underlying databases for assessments will impose additional complications for assessment timing. These factors include:

- Major changes in groundfish fishing patterns under Sectors
- Potential processing delays with respect to stock area allocation for landings and discards.
- Implementation of length-specific calibration factors and interactions with estimation of age-specific abundance indices from the FSV Bigelow
- Implications of increased uncertainty in abundance indices may require model revisions and reduce ability to detect trends in resource abundance.
- Processing of landings data from sectors and other special programs.
- Estimation of discards when discard rates may be biased by compliance and observer presence.

4. <u>*Recommendation:*</u> Age data available on specific stocks should be provided and analyzed approximately every three years, in coordination with the SAW/SARC schedule of benchmark assessments developed by the NRCC.

   <u>*Explanation:*</u> Under existing funding and staff size, samples of fish hard parts for aging can not be analyzed every year for every species. Annual aging of samples for all species would be a very inefficient use of staff. Aging must be done carefully by experienced experts, and this is more difficult to accomplish with consistent quality control if staff have to switch frequently from aging one species to another.

5. *Recommendation:* Provide appropriate support to SSCs to make ABC recommendations for each managed stock. Specifically:

   a. Modify the TORs for benchmark assessments to include descriptions and quantitative estimates of uncertainty related to data inputs (*e.g.,* both fishery-independent and fishery-dependent data) and assessment model outputs (F, B, R, BRPs and projections). A review of any retrospective patterns, including those associated with changing to a different assessment model, should also be performed in a benchmark assessment.

      Explanation: This is key information needed to make an ABC recommendation. The SAW/SARC TORs have already been modified, but additional edits may be necessary (See Appendix IX).

   b. Have designated SSC members attend SAW WG meetings as well as the SARC. Have a member of the SSC chair the SARC.

      Explanation: Both of these steps will bring the SSC up to speed on the details of the assessments and about decisions made by the SARC reviewers.

   c. Provide consultation to the SSC on technical details of the assessments, and provide an NEFSC liaison to the SSC.

      Explanation: This will help the SSC during their meeting and prevent delays in their decision making. The intent is for the assessment scientist and/or the Center's SSC liaison to explain what was done in the assessment, but not to interpret the reports of the Independent Peer Reviewers (which should be read by the entire SSC).

Longer-term Recommendations

1. *Recommendation:* As the new MSRA requirements for science information become clearer, identify resources to meet them.

   Explanation: This is an evolving process and the Councils and SSCs are going through the process of setting ABCs and ACLs for the first time. New requests for science information (*e.g.,* modifying the SAW/SARC TORs) are likely to be made in the coming year or two.

   The current approach for scheduling SAW/SARC assessments used by the NRCC is described earlier in this White Paper. There may be more systematic ways to prioritize stocks for assessments based on ranking of multiple factors (*e.g.,* stock status, uncertainty, public interest, time since last assessment, etc.).

Relative sources of uncertainty in the data and the cost effectiveness of acquiring data for assessments and Assessment Evaluations need to be evaluated. This could include such activities as statistical analyses of optimal sample sizes (N) of otoliths and scales required to support assessments, although developing such an optimization over the range of species/stocks currently assessed and types of data collected will be a complex undertaking. Consider number of trained staff needed to achieve various tasks, and make appropriate adjustments.

2. *Recommendation:* Examine whether simpler assessment models could replace more complex models and investigate new assessment approaches.

   Explanation: Simpler models could potentially reduce the current requirements in terms of number of data sets and time and resources in conducting some stock assessments. New areas to explore include ecosystem-based approaches and Management Strategy Evaluations (MSEs).

APPENDIX I

Glossary

Signpost. A signpost is a variable that can be monitored about the fish stock and/or fishery. One class of signposts should reflect changes in stock size (e.g., survey catch per tow) and perhaps population structure (e.g., recruitment index). Other signposts could be estimates of annual catch and/or landings which can be compared to current fishing quotas. A signpost should be easy to compute, and is less complex than carrying out an assessment update or benchmark assessment.

Assessment Evaluation (AE). An Assessment Evaluation considers the total set of information provided from the latest set of signposts. The AE should indicate to managers whether the landings and catch are close to what was assumed when projections were carried out, and whether there are any 'red flags' that alert scientists and managers that the stock is changing in ways that were not foreseen. If such changes are detected, managers can take appropriate action. Assessment Evaluations may be used to set or adjust ABCs or ACLs; to evaluate the stock or fishery in support of FMP requirements such as SAFE reports or monitoring programs; and in support of other management actions. At this time it is not anticipated that signposts or Assessment Evaluations will be used to determine formal stock status, in accordance with defined stock status determination criteria. The specific uses of signposts and Assessment Evaluations will depend on a variety of factors, including the pertinent FMP requirements, stock status (as determined by assessments), and the characteristics of a particular signpost. As experience is gained with the use of signposts and Assessment Evaluations, it is likely that uses of these tools will evolve over time.

Benchmark Assessment. A complete review and potential revision of the critical elements of a stock assessment that includes a review of the underlying fishery dependent and independent data and methods for estimation, candidate models for describing the resource dynamics, biological reference points, measures of uncertainty, forecasting methodology and evaluation of scenarios, consideration of ecosystem implications, and identification of future research. In other words, a benchmark assessment addresses all generic terms of reference of the SAW/SARC. Benchmark assessments are scheduled by the NRCC well in advance of the peer review meeting to allow technical groups to prepare data and develop new methodologies.

Update Assessment. A subset of a Benchmark Assessment that typically focuses on updating of the most recent fishery independent and dependent data, has modest or no revisions to the underlying assessment model, has limited or no revisions to Biological Reference Points, and generally does not expand its scope beyond that of the previous Benchmark Assessment. In other words, an update assessment does not address all generic terms of reference of the SAW/SARC. Most assessments however, are sufficiently complex that even updates may require exploration of alternative model formulations. Some model properties, e.g., retrospective patterns, are progressively revealed as new data are acquired. Addressing these types of problems often leads to workloads comparable to Benchmark Assessments.

List of Acronyms

Acronym	Meaning
ABC	Acceptable Biological Catch
ACL	Annual Catch Limit
ACT	Annual Catch Target
AI	Action Item
AIM	An Index Method
ALK	Age Length Key
ASMFC	Atlantic States Marine Fisheries Commission
ASPIC	A Stock Production Model Incorporating Covariates
B	Biomass
B_{MSY}	Stock size at which yield can be maximized
BRP	Biological Reference Point
CASA	Catch at Size Analysis
CIE	Center for Independent Experts
CKWM	Chen-Kanawai-Wilson-Model or U Maine lobster model
CPUE	Catch per Unit Effort
CSA	Collie-Sissenwine Analysis
DMF	Division of Marine Fisheries
F	Fishing mortality rate
FMAT	Fishery Management Assessment Team
FMP	Fishery Management Plan
$F_{rebuild}$	Fishing mortality rate that will rebuild the stock by time t
FSV	Fishery Survey Vessel
GARM	Groundfish Assessment Review Meeting
KLAMZ	A Delay difference model first developed for clam assessments.
MA	Mid-Atlantic
MAFMC	Mid-Atlantic Fishery Management Council
MP	Management Procedure
MSE	Management Stategy Evaluation
MSRA	Reauthorized Magnuson Stevens Act
MSY	Maximum Sustainable Yield
NE	New England
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Ceneter
NERO	Northeast Regional Office
NRCC	Northeast Regional Coordinating Council
NWFSC	Northwest Fisheries Science Center
OFL	Overfishing Level
PDT	Plan Development Team
R	Recruitment
RV	Research Vessel
SAFE	Stock Assessment Fishery Evaluation
SAMS	Scallop Area Management Simulator
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
SCA/MARK	Statistical Catch at Age and MARK--Mark and Recapture Model
SCALE	Statistical Catch at Length
SMAST	School of Marine Science and Technology
SSC	Science and Statistics Committee
TAC	Total Acceptable Catch
TMGC	Transboundary Management Guidance Committee
TOR	Terms of Reference
TRAC	Transboundary Resource Assessment Committee
VPA	Virtual Population Analysis
VTR	Vessel Trip Report
WG	Working Group

APPENDIX II

Utility of Signposts for Assessment and Management

As previously noted (and also see Appendix VII) a need exists for more timely information in assessments, particularly in view of the requirements for ACLs. The process for updating assessments and providing timely information on resource status is an important aspect of future fisheries management.

A signpost is a variable that can be monitored and is related to status of the fish stock and/or fishery. One class of signposts should reflect changes in stock size (*e.g.,* survey catch per tow) and perhaps population structure (*e.g.,* recruitment index). Other signposts could be estimates of annual catch and/or landings which can be compared to current fishing quotas. A signpost should be easy to compute, and is less complex than carrying out an assessment update or benchmark assessment.

A very basic operating principle is that the signposts should be directly linked to the more complicated model that they hope to inform. Under this premise, any index used in the development of a complex model is a candidate signpost. Data streams that are not included in more complex models are unlikely to be useful as stand alone indices. Modern models are generally so inclusive that the excluded data streams typically have major flaws that render them useless or misleading. This does not mean that every index in an integrated model is a worthy signpost.

Signposts Based on the Assessment Model

The predictions of existing forecast tools for biomass and abundance can be inverted to quantify predicted size composition and survey indices under various catch limits, perception of year class strength and so forth. Let $X^*(t+m)$ represent some predicted quantity of interest at time t+m. If X(t) is proportional to some index, say I(t) then I(t)=qB(t). Hence one can directly translate the sampling distribution of X(t+m) into a sampling distribution of I(t+m). Comparison of the observed value of I(t+m) with the sampling distribution of the predicted index can be used to approximate the probability of obtaining the observation due to chance alone. This directly links the interpretation of observable properties to the unobserved population state and the model originally used to construct the population. The observed index can be treated as a test statistic(with error). This process could be used to estimate the percentiles of observations and possibly to develop a composite probability statement about population trends relative to forecasts.

Age disaggregated indices are costly to compute as they require processing of samples. In view of these additional costs a candidate signpost would not be age-based unless the index could be obtained by "borrowing" an age-length key (ALK) from an earlier year. The general principle is that the ALK for some future year, t+m, could be written as

$$ALK(t+m)=g(ALK(t), ALK(t-1), \ldots.\theta)$$

Where m=some number of years in the future, $g(.)$ is a function, and $g(ALK(t)$, and θ is a set of parameters.

The efficacy of previous, rather than contemporary, ALKs is a necessary area of research. Existing assessment models could be used to test the effects of averaged or borrowed ALKs on critical measures of stock status. The utility of borrowing ALKs is likely to vary by species. If borrowed ALKs could be used, one of the primary limitations of annual assessment updates would be relaxed. Full-scale updates to assessments however would still incur major costs for analyses, scheduling reviewers, and report preparation.

Signposts Based on Derived Quantities Apart from the Assessment Model

This class of signposts consists of measures that are related to, but not necessarily part of the stock assessment model. For example, a measure of recruitment in the assessment model based on age might be approximated by a survey index truncated to a specific length range. Adults might be defined as the average relative density of individuals above some threshold length. A possible surrogate for SSB might sum product of fraction mature at length, numbers by length interval and average weight at age. Changes in average length might also serve as an index of fishing mortality (*e.g.,* Gedamke and Hoenig 2006). Other candidate signposts include changes in average weight at age, condition factor, maturity, and survey-based total mortality rates.

One method that has generated some interest is the method of Froese (2004) which assesses the relative fractions of the stock that is mature, above some cutoff for very large spawners, and within a range of average sizes that approximate the maximum yield per recruit. The NWFSC (Cope, pers. Comm.) is investigating the utility of this approach for long-lived west coast groundfish. An initial application of the method to Georges Bank yellowtail flounder was not informative. This divergence in utility brings up an important point. Signposts which are nominally related to the assessment may work only under a restricted set of circumstances related to the species biology and history of the fishery.

All models can be envisioned as a parametric smooth of the underlying data that transforms the data to some set of quantities of interest (*e.g.,* total biomass). The degree of smoothing depends upon the underlying structure of the model and manner in which it treats deviations from the predicted values. Nonparametric smooths of data can accomplish the same objective but the underlying causality is ignored for the more pragmatic purpose of separating the signal from the noise. One method that is widely used in engineering is the Kalman filter. Applications in fisheries are more limited (*e.g.*, see Pella 1993, Sullivan 1992.). Kalman filters and other state space model offer a way of including the underlying variability of the sampling design with the temporal variation in means. Unlike Box and Jenkins (1976) time series methods, the Kalman filter explicitly incorporates the sampling error of the observation into the smoothing process. Such capabilities are particularly important in fisheries where estimates of quantities like survey indices and discards are subject to considerable error. A Kalman-like model might also be a good way of incorporating the effects of the Albatross to Bigelow conversion into measures of

trend. These approaches have not been fully explored but should be included as part of a 5 to 10 person-year project.

This class of signposts has a more tenuous relationship to the assessment model and attendant concerns about their utility as measures of stock status. Signposts are unlikely to be useful if the inferred measures of trend are confounded by external events. For example, reductions in average length can be the result of increased fishing mortality or increase recruitment. Without some assumption or evidence of recruitment magnitude, changes in average length can be biased signposts of fishing mortality.

Performance of Signposts in other Fishery Management Systems

Signposts as indicators are used in other fishery systems as a basis for harvest control rules (Caddy 2002 and 2004, Koeller *et al.* 2000, Halliday *et al.* 2001). Indicators can also be used in the stock assessment and peer review systems that are similar to the Northeast U.S. system. For example, the International Council for the Exploration of the Seas provides multiannual catch advice based on the most recent stock assessment, and indicators from the fishery are used to determine if the assessment needs to be updated during the multiannual advice period (ICES 2008). A more formal application of signposts is in the management procedures developed for the International Whaling Commission *(e.g.,* Punt and Donovan 2007) and for New Zealand fisheries (*e.g.,* Bentley et al. 2003, Breen and Kendrick 2007). The advantages in these management procedures over traditional stock assessment approaches is more stable catch advice, adherence to pre-defined indicators and responses, and appropriate application of risk and precautions (Butterworth 2007)

Candidate Signposts for Northeast Species

The foregoing suggests a number of principles that will rapidly reduce the number of candidate signposts. The first basic cut is that any fishery independent measure of stock abundance that is not confounded by availability issues is a primary candidate for a signpost. For most stocks that would mean the NEFSC surveys but not the state surveys. The complex models MAY be sufficient to sort out and dampen true trends from random availability. Stand-alone signposts do not get that support. The second cut would be measures that are included in the models. Using the "inversion" process described previously, one can compare observed values to the predicted sampling distribution of inverted biomass or abundance measures.

Candidate Fishery-Independent Based Indicators (and a few Fishery-Dependent Indicators)

Appendix II, Table 1. Summary of Candidate Signposts for Northeast Stocks. Total commercial landings and discards would be monitored as signposts for all of these stocks. Recreational landings, effort and discards would be monitored as appropriate.

Fishery Management Plan	*Species*	*Stock*	*Candidate Signpost*
Northeast Multispecies *(large mesh species)*	Cod	Georges Bank	NEFSC Fall Survey NEFSC Spring Survey DFO Spring Survey
		Gulf of Maine	NEFSC Fall Survey NEFSC Spring Survey Mass DMF Spring Survey (recruits) Mass DMF Fall Survey (recruits)

	Haddock	Georges Bank	NEFSC Fall Survey NEFSC Spring Survey DFO Spring Survey
		Gulf of Maine	NEFSC Fall Survey NEFSC Spring Survey
	Yellowtail flounder	Georges Bank	NEFSC Fall Survey NEFSC Spring Survey DFO Spring Survey
		Cape Cod/Gulf of Maine	NEFSC Fall Survey NEFSC Spring Survey Mass DMF Spring Survey Mass DMF Fall Survey
		Southern New England	NEFSC Fall Survey NEFSC Spring Survey
	American Plaice		NEFSC Fall Survey NEFSC Spring Survey DFO Spring Survey
	Witch Flounder		NEFSC Fall Survey NEFSC Spring Survey
	Winter Flounder	Gulf of Maine	NEFSC Fall Survey NEFSC Spring Survey Mass DMF Spring Survey Mass DMF Fall Survey
		Georges Bank	NEFSC Fall Survey NEFSC Spring Survey DFO Spring Survey
		South. New England	NEFSC Fall Survey NEFSC Spring Survey Mass DMF Spring Survey CT DEP Spring
	Redfish		NEFSC Fall Survey NEFSC Spring Survey
	White Hake		NEFSC Fall Survey NEFSC Spring Survey
	Pollock		NEFSC Fall Survey
	Windowpane Flounder	GOM/GB	NEFSC Fall Survey
		SNE/MA	NEFSC Fall Survey Mass DMF Fall Survey Mass DMF Spring Survey NEFSC Spring Survey
	Ocean Pout		NEFSC Spring Survey
	Atlantic Halibut		NEFSC Spring Survey
Northeast Multispecies	Silver Hake	North	NEFSC Fall Survey NEFSC Spring Survey
(small mesh species)		South	NEFSC Fall Survey NEFSC Spring Survey
	Red Hake	North	NEFSC Fall Survey NEFSC Spring Survey
		South	NEFSC Fall Survey NEFSC Spring Survey
	Offshore Hake		NEFSC Fall Survey NEFSC Spring Survey
Other	Atlantic Wolffish		NEFSC Spring Survey Mass DMF Spring Survey NEFSC Fall Survey Recreational CPUE (Party boats)
	Cusk		NEFSC Fall Survey
Northeast Skate Complex	Little Skate		NEFSC Spring Survey
	Winter Skate		NEFSC Fall Survey
	Barndoor Skate		NEFSC Fall Survey
	Thorny Skate		NEFSC Fall Survey
	Clearnose Skate		NEFSC Fall Survey
	Rosette Skate		NEFSC Fall Survey
	Smooth Skate		NEFSC Fall Survey

Atlantic Herring	Atlantic Herring		NEFSC Fall Survey NEFSC Acoustic
Deep Sea Red Crab	Deep Sea Red Crab		Commercial CPUE
Atlantic Sea Scallop	Atlantic Sea Scallop		NEFSC Dredge SMAST Photo WHOI Image
Monkfish	Monkfish	North	NEFSC Fall Survey NEFSC Spring Survey ASMFC/NEFSC Shrimp Survey
		South	NEFSC Fall Survey NEFSC Spring Survey NEFSC Scallop Dredge Survey
Spiny Dogfish	Spiny Dogfish		NEFSC Spring Survey
Summer flounder, scup and black sea bass	Summer flounder		NEFSC Fall Survey NEFSC Spring Survey Mass DMF Spring Survey Mass DMF Fall Survey RI Fall Survey CT Fall Survey CT Spring Survey
	Scup		NEFSC Fall Survey NEFSC Spring Survey Mass DMF Fall Survey NJ BMF Survey URI GSO Trawl Survey RI DFW Fall Survey CT DEP Fall Survey
	Black Sea Bass		NEFSC Spring Survey MRFSS number per angler trip
Atlantic Mackerel, Squid, and Butterfish	Atlantic Mackerel		NEFSC Spring Survey
	Loligo Squid		Commercial in-season catch rates
	Illex Squid		Commercial in-season catch rates
	Butterfish		NEFSC Fall Survey NEFSC Spring Survey RI Fall Survey (1+ wt) MA DMF Fall Survey (1+ wt) CT DEP Fall Survey (1+ wt)
Atlantic Surfclam and Ocean Quahog	Atlantic Surfclam		Coop Industry Dredge Survey
	Ocean Quahog		Coop Industry Dredge Survey
Bluefish	Bluefish		Recreational CPUE Numerous State and NEFSC Juvenile indices
Tilefish	Golden Tilefish		Commercial CPUE
American Lobster	American Lobster	Gulf of Maine	NEFSC Fall Survey
	American Lobster	Georges Bank	NEFSC Fall Survey
	American Lobster	South. New England	NEFSC Fall Survey
Northern Shrimp	Northern Shrimp		ASMFC/NEFSC Shrimp Survey
Striped Bass	Striped Bass		ASMFC Tagging Program Numerous State Juvenile Indices MRFSS CPUE Index CT recreational CPUE MA Commercial CPUE

Total catch and easily derived functions of catch are candidate signposts for all species. Thus, changes in fleet contributions, evidence of high discarding, unexplained changes in size composition, perhaps gender ratios and so forth would be important to monitor as signposts. The following list provides an initial set that could be applied to all species.

Candidate Fishery-Based Indicators

a. Commercial Catch rates
    i. CPUE for representative study fleet
    ii. Time to achieve quota
    iii. Spatial Distribution of catch
    iv. Market categories
    v. Year over year comparisons
    vi. Spatial distribution of landings
    vii. Discard rates
    viii. Expert opinions—Fishermen's Forums (focus groups)
b. Recreation Catch rates
    i. Landings, Discards
    ii. Temporal and Spatial patterns
    iii. Size composition
    iv. Effectiveness of bag and size limits (e.g., frequency distribution of catches)
    v. CPUE measures from Charter/Party fleet.

c. Discard Rates
    i. Major changes in discard pattern likely under Sector management
    ii. Historical patterns of discarding will be less informative for sample size information
    iii. Evidence of high discarding of small fish is often an important indicator of true year class strength. It can also be indicative of slower than average growth rates

Recommendations on Transitioning to Signposts

Use of signpost measures of stock status and simpler models offers several benefits including more focused effort on the most important stock assessments, a more rational allocation of resources, and safeguards for reducing the chances of overfishing. Nevertheless, the approach will require extensive evaluation to validate its utility in an operational mode. To accomplish this, a transition team with sufficient technical skills and of adequate size and duration will need to be established. The danger of diverging greatly from the models used to craft management advice by relying on a single signpost can be attributed to both trend and scale. Scale differences are particularly important because ACLs are, by definition, measures of scale. At the Northeast Fisheries Science Center, the differences in scale between a VPA and a surplus production model have caused numerous problems of comprehension for scientists, managers and fishermen. A switch between assessment methodologies is likely to generate confusion regarding the absolute biomass of the resource and therefore the fishing mortality rates as well.

Candidate Signposts

- Must be rigorously confirmed by simulation and MSE. Need to test utility of any proposed measures against known assessments AND simulated populations

- Should have correspondence with more complex models.

- Measures of fishing mortality depend on the complexity of the model. SPR is probably the only consistent measure of effective fishing mortality on a population but its interpretability depends on the assumptions of underlying constancy in parameters.

- Signpost measures ultimately rely on a suite of often-correlated measures of change. Making decisions based on these measures is difficult because of ambiguities of interpretation. Defining an appropriate multi-dimensional vector is tough, but it is critically important the multi-attribute methods account for the correlated nature of the underlying information. Standard data reduction methods, such as PCA could work but communicating this type of information contravenes the desired simplicity of signpost measures.

Methodology

- Existing forecast approaches (*e.g.,* AGEPRO) serve as a sound basis for selection and interpretation of signpost indices

- Graphical methods for communication of signposts are also well developed and existing methods can be modified as necessary, *e.g.,* Traffic light, Consumers Report.

- Control chart methods are well described in the statistical and manufacturing literature. Implementation for use in fisheries may best be done through R, which would have the requisite statistical charting features. Cusum methods from Statistical Process Control theory may prove useful for updating information. Consider as deviations whose cumulative effect triggers either a management action or re-evaluation of existing data.

- Interleaving of complex and simple models [*e.g.,* SS2 (benchmark) to ASPIC (interim) to SS2 (benchmark)] is likely to cause major problems of reconciliation of abundance and status measures. One of the most difficult challenges in current stock assessment occurs when models change. Reconciling scale differences between models is hard to explain.

- Time series methods, state space models, and the application of a Kalman filter (*i.e.,* an efficient numerical method that estimates the value of parameters from a series of noisy measurements and time delays) may be useful smoothers of information (see Appendix II, Figures 1and 2 for an example of the application of a Kalman filter to George Bank haddock data).

Control Rules

Failure to correct overfishing has more lasting consequences for stock status than underfishing. Therefore policies of the form "Slow Up, Quick Down" may have some merit as these will respond quickly to downturns.

- Signpost Measures should be resistant to rapid change. Rapid changes in allowable landings are undesirable, and credibility damage is acute when catch recommendations are reduced.

- Lags in detection and implementation have important consequences for policy choice and emphasize the need to respond to downturns.

- Rules should be determined in advance (*e.g.*, striped bass recovery was based 3-yr moving average of Maryland Juvenile Index exceeding a threshold).

- Effects of transient conditions are important in many fish stocks, particularly those in overfished state.

- Signposts should probably only be used as triggers to indicate major concerns regarding the efficacy of multiyear ACLs. Such concerns might arise in stocks with severe retrospective patterns.

Assessment Process

- Changes due to vessel have major implications for precision of estimates. In particular, it will be necessary to explicitly account for the increased variability in the estimates, particularly when measuring trend.

- The scientific status of reports that analyze signposts has not been determined. These will need to meet the same measure of data quality act criteria as data used in assessments.

- The logistics of how and who will conduct these analyses remains to be determined. Irrespective of these concerns, the process must be closely linked with the species' primary assessment scientist.

- Groundwork for acceptance by partners must be assiduously cultivated.

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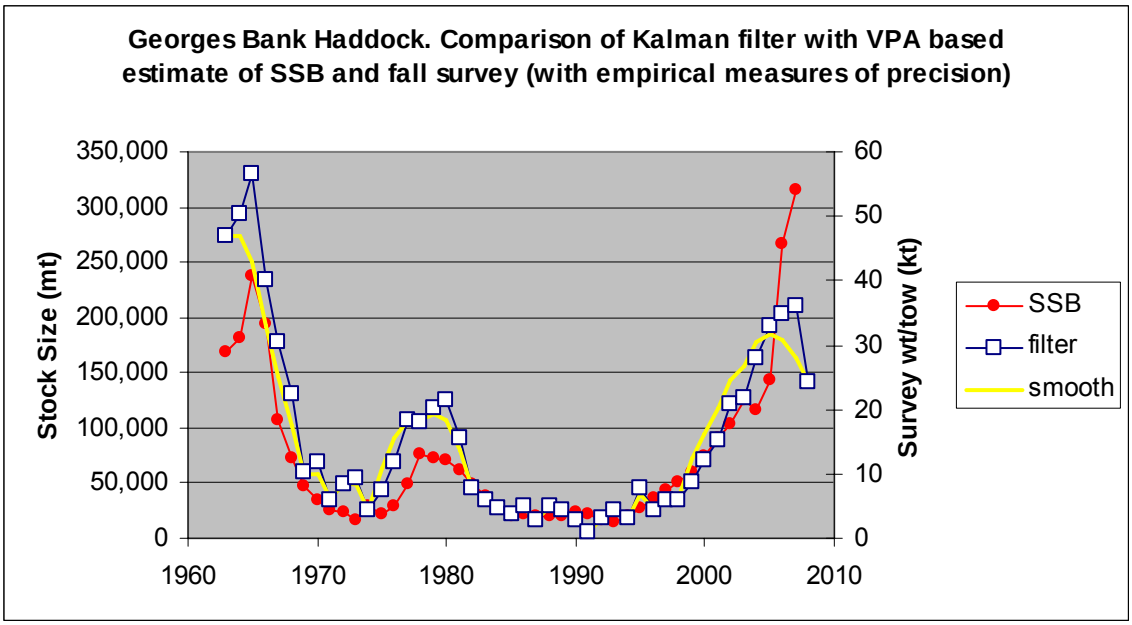
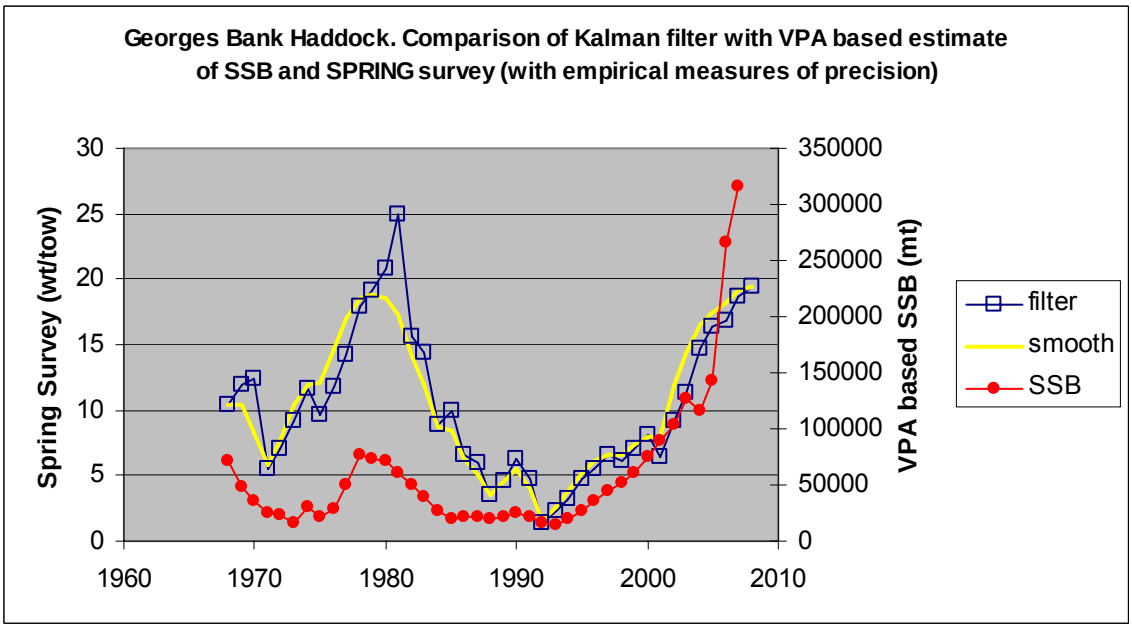
Appendix II, Figure 1. Application of a Kalman Filter to Georges Bank Haddock.



Appendix II, Figure 2. Comparison of VPA-based estimate of Georges Bank haddock SSB (mt) with Kalman filter of NEFSC fall (top) and spring (bottom) trawl survey estimates of average weight per tow



APPENDIX III

Monitoring Committee and Plan Development Team Roles in Setting ACLs

The MAFMC and the NEFMC have different processes in receiving scientific information for purposes of providing management advice to their respective Council's. The NEFMC relies on PDTs to evaluate scientific advice whereas the MAFMC uses a combination of Council staff, Monitoring Committees (MC), and the SSC in setting annual quota specifications. The specification process used by the MAFMC relies on Council staff to draft a recommendation for ABC and TAL to be considered by both the SSC and the MC. The SSC bases its ABC and TAL recommendations on options provided by Council staff combined with stock assessment information. The MC may recommend adjusting this catch level downward, if necessary, to reflect implementation uncertainty in the recommendation of an ACL. This ABC/ACL setting process is currently under review by the MAFMC where the roles and responsibilities for the SSC and MC will be more clearly defined.

The MCs used by the MAFMC and PDTs have similar responsibilities and composition in terms of expertise including members from the NEFSC, state fishery management agencies, and Council staff. For convenience the term technical team will be used hereafter to refer to both PDTs and MCs.

Technical teams of the MAFMC and NEFMC are the primary interface between the NEFSC and the Councils. In very general terms the NEFSC is the principal producer of scientific information while technical teams are the users and interpreters of this information in their responsibility to provide biological advice to the Councils. To facilitate this information flow, technical team membership includes both Council and NEFSC staff as well as individuals from State fishery management agencies.

The 2006 reauthorization created a new set of requirements as well as a more formal role for SSCs in the setting of biological objectives. As a practical matter, compliance with these new requirements falls to the Councils and, by extension, to their SSCs and technical teams. Adopting a market analogy the 2006 reauthorization increased the demand for scientific information needed by the Councils without assuring that a corresponding increase in the supply of scientific information would be available to meet the new demand. Much of this white paper is about reconciling the disequilibrium between the amount, timing, and type of scientific information needed by the Councils' technical teams and the ability of the NEFSC to provide it[1]. The remaining discussion focuses on the role of technical teams in the setting of ABCs and ACLs.

[1] In groundfish the disconnect between demand and supply of scientific information has been an ongoing problem since the Framework 33 lawsuit was decided in December, 2001 leading to the scientific treadmill that resulted in GARM I, II, and III.

Councils are required to set OFL, ABC and an ACL. Councils also have the latitude to set ACT where the ACT is set below the ACL. The difference between the OFL and ABC is an adjustment to account for scientific uncertainty. The difference between ABC and ACL is an adjustment to account for management uncertainty. This means that Councils and technical teams need to account for both scientific and management uncertainty whereas the production of information by the NEFSC addresses scientific uncertainty[2].

The MAFMC and NEFMC are currently taking different approaches to the setting of ABCs and ACLs[3]. At this time the MAFMC is preparing an omnibus amendment to deal with the setting of ABCs and ACLs as well as the process by which control rules for these requirements will be set. Draft alternatives (May 2009) developed thus far specify that ABC controls rules and the setting of ABCs will be done by the SSC using options recommended by the MAFMC staff as a starting point for SSC discussion. Technical guidance on sources of scientific uncertainty is under development by a sub-committee of the SSC.

The NEFMC has addressed the need to set ABC and ACLs on an FMP basis as plan amendments have been developed. Although there are differences across FMPs they all include a process whereby PDTs are responsible for developing ABC recommendations to the SSC and recommended ACLs to the Council. By design ABCs would be set for two or more years (see Appendix III, Table 1), but PDTs would still meet annually to evaluate fishery management program performance. Additionally, depending on the FMP PDTs will be responsible for preparing periodic SAFE reports.

Appendix III, Table 1. Proposed New England Fishery Management Council FMP Adjustment Schedule

FMP	Cycle	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Groundfish	2	Specs										
Skates	2	Amendment 3										
Scallops	2	FW21	Amendment 15									
Herring	3	Specs	Amendment 4									
Whiting, hakes	3	None	Amendment 18									
Red crab	3	Specs	Amendment 3									
Monkfish	3	Amendment 5										

[2] Note that this is not strictly true since Center staff also contribute to assessments of management uncertainty, but the primary focus of this white paper is on issues related to the provision of stock assessment information.

[3] Note that both Councils also must set an OFL and may set ACTs for some stocks.

To date the administrative process for setting ABCs and ACLs has not been developed for the Monkfish, Red Crab, Scallop, or Small Mesh Multispecies plans so the schedule of SAFE reports or requirements for annual reviews has yet to be determined for these FMPs. For herring, the proposed administrative process would require an annual review and production of a SAFE report every three years (Appendix III, Table 2). For groundfish a SAFE report would be required in every year while the skate plan would require PDTs to produce a SAFE report every other year and a plan review in the intervening years.

Appendix III, Table 2. NEFMC Proposed Specifications Including SAFE Reports and Annual Reviews

FMP	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Herring											
Specs	Spec	Amendment 4									
SAFE		SAFE			SAFE			SAFE			SAFE
Review			Review	Review		Review	Review		Review	Review	
Groundfish											
Specs	Specs										
SAFE		SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE
Skates											
Specs	Amendment 3										
SAFE	SAFE		SAFE		SAFE		SAFE		SAFE		SAFE
Review		Review		Review		Review		Review		Review	

APPENDIX IV

Simple Population Models and the Management Procedure Approach

As noted in previous sections, the demands for information and analysis associated with setting Annual Catch Limits (ACLs) are substantial. The requirements for developing and vetting full age-structured stock assessments in particular are formidable, especially in the context of annual or even biennial reporting cycles. Accordingly, it is worth exploring the strengths and weaknesses of employing simpler analytical approaches and developing simpler management rules to inform the establishment of ACLs. It has long been recognized that simpler models may have greater predictive power than more complex and presumably more realistic models (*e.g.,* Ludwig and Walters 1985, Peters 1991). Brooks (2006) demonstrated in a simulation environment that simple surplus production models can outperform full age-structured models when data limitations affect parameterization of the more complex models. Error propagation and uncertainty associated with highly parameterized models often degrades the effectiveness of complex models (Fulton *et al.* 2003). The potential constraints on parameterization of full age structured stock assessment models associated with the increased demands of establishing ACLs suggest that an examination of the potential of simpler models is warranted. Here, we describe the potential utility of simpler assessment models and the adoption of a Management Procedure (MP) Approach (see Butterworth *et al.* 1997 for a review) with respect to the need to set ACLs.

Management Procedures have been successfully implemented under the International Whaling Commission (e.g. Kirkwood 1997) and a number of national management authorities (*e.g.,* Germont *et al.* 1999). In essence, a Management Procedure entails the development of a (potentially simple) set of rules for translating information from an operating model drawing on fishery independent and/or fishery dependent monitoring into a pre-agreed management action (e.g. specification of a TAC). The performance of alternative MPs is evaluated by simulation with respect to factors such as yield and/or profitability and uncertainty and risk. These characteristics make the MP approach a useful candidate for consideration in the context of setting ACLs.

In part, the original motivation for development of the MP approach arose in an attempt to develop cost-effective approaches to setting and implementing management strategies. Here the motivation arises from the need to meet substantially increased assessment responsibilities in a timely and effective way. Embedded in these considerations is the issue of tradeoffs in operating model complexity and performance in the face of potentially reduced information availability such as updated age information for a broad spectrum of managed species to meet the needs of ACL management. We note that the adoption of an MP framework (and the related concept of Management Strategy Evaluation – see Evaluating Uncertainty for Deriving Acceptable Biological Catch) fits naturally into the requirements for development of Integrated Ecosystem Assessments which are now under consideration for nationwide implementation.

Simulation and Performance Testing

The general approach involves examining the potential utility of management procedures based on simple operating models for setting ACLs by first:

- Testing the performance of simple models in simulations based on full age-structured population models (taken as 'reality' in a virtual world). The simple models to be considered include (a) non-age-structured biomass dynamics models; (b) delay- difference models incorporating a simple age structure; and (3) empirical time series models of biomass change over time

- Examining the performance of the simple operating models in an empirical setting by comparing the estimated population trajectories with results of full age structured assessments for selected species, and

- Developing candidate management procedures that utilize one or more simple population models as operating models and testing the performance of alternative MPs by simulation if the initial evaluation of performance of one or more of the simple models proves promising.

All of the simple models under considerations embody an underlying autoregressive structure and can, in principle, be used to provide short-term forecasts of population biomass. The approach involves sampling 'data' from the simulation model to mimic fisheries and research surveys, and these data are then passed to the operating model. The performance of the models is then compared with the known virtual population trajectories under different conditions including stochasticity in underlying population dynamics and measurement error in monitoring programs feeding into the modeling framework. This ultimately permits testing the utility of modifying assessments, monitoring plans, management strategies, or decision rules.

Operating Models

All the models types to be examined have relatively modest data requirements (principally catch, survey biomass data, and survey catchability estimates) although for delay-difference model, external specification of growth, and for some applications, stock-recruitment parameters). The model types are described below.

Biomass Dynamics Models

We begin with the non-equilibrium biomass dynamics model:

$$B_{t+1} = (1+\alpha)B_t - \beta B_t^{\,m} - C_t$$

where B_t is the biomass at time t, α and β density-independent and density-dependent population parameters respectively, and m is a 'shape' parameter (m=2 gives the Schaefer-type logistic model), and C_t is the catch at time t. The requirements for estimating model parameters are time

series of catches and biomass indices. For our case, biomass indices are derived from bottom trawl surveys and a survey catchability coefficient is required to properly scale the estimates (see above). The basic model structure is a first-order autoregressive process.

Delay-Difference Model

The fundamental form of the delay difference model is:

$$B_{t+1} = S_t(1+\rho)B_t - S_t\, S_{t-1}\,\rho\, B_{t-1} + w_k\, N_{k,t}$$

where S_t is the survivorship at time t:

$$S_t = s'(1-h_t)$$

comprising the 'natural' survival rate (s′) and an annual harvest rate (h_t). The parameter ρ is the Brody growth coefficient from the simple monomolecular growth model:

$$w_a = W_\infty(1-\rho) + \rho\, w_{a-1}$$

where w_a is the weight at age a and W_∞ is the asymptotic weight . The product $w_k\, N_k$ is the biomass of incoming recruitment at time t.

The delay difference model therefore requires specification of growth and natural survival parameters external to the model and incoming recruitment (which can be specified directly from biomass indices or from a stock recruitment model). Data requirements again include a time series of catches in addition to biomass indices and a survey catchability coefficient. The basic model form here is a second-order autoregressive model.

Empirical Time Series Models

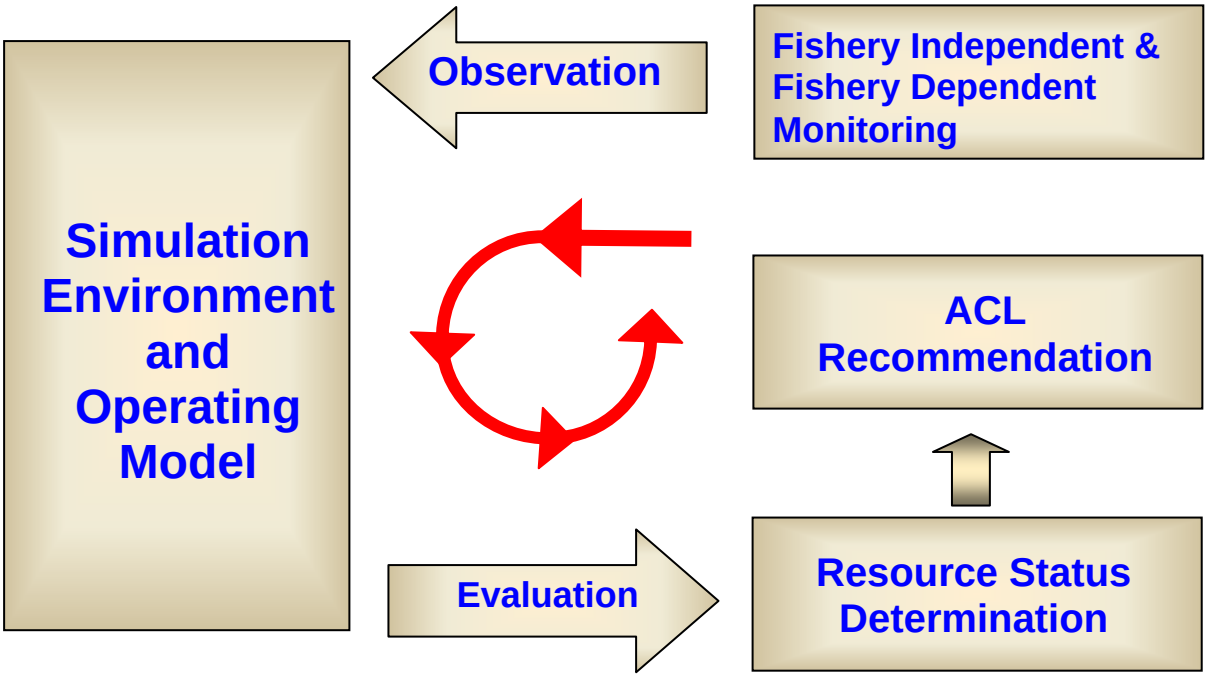
We can specify a general time series model compactly as:

$$\varphi(B)\, z_t = \alpha(B)\, a_t$$

where z_t is the time series of interest (in our case population biomass), φ(B) represents the generalized autoregressive operator, α(B) represents the moving average operator, B represents the backward shift operator and the a_t are *iid* normally-distributed random variables (Box and Jenkins 1976). This formulation allows for the specification of higher order autoregressive processes than the two structural models identified above. Models of this general form have been applied to NEFSC survey data to isolate random effects (e.g. interannual variability in survey catchability) to identify the underlying population signal (Stockhausen and Fogarty 2007). The noise reduction method employed has elements in common with the Kalman Filter approach described earlier.

Management Procedure

Assuming acceptable simple operating models can be identified, the basic approach to be followed once the simulation phase is completed is to test the performance of candidate management procedures and then implement the procedure with real data. The approach in practice depends on the specification of the target exploitation rate and estimated biomass from the operating models, accounting for uncertainty as specified in *Evaluating Uncertainty for Deriving Acceptable Biological Catch.* The sequence is depicted in Appendix IV, Figure 1.



Appendix IV, Figure 1. Implementation of Management Procedure Approach for Setting Annual Catch Limits.

It is possible to directly incorporate considerations of how much change would be allowed from year to year in the ACL . For example a potential Management Procedure might take the form:

$$ACL_t = \Delta ACL_{t-1} + (1-\Delta) ACL_t^*$$

where the ACL in year t is a function of the ACL in the previous year, Δ is a control parameter that determines the magnitude of allowable change from one time step to the next that is specified *a priori* and ACL_t^* is the ACL for year t developed using the selected operating model and the target exploitation rate adjusted for uncertainty. The performance of this and other candidate management procedures can be compared by simulation and application to actual fishery data.

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APPENDIX V

Example of Current Data and Analysis Needs from NEFMC to support GARM stocks)

Currently, the information needed is expected to be:

a. Annual catches (landings and discards); by July 1. Needed to set ABCs every two years and possibly for completion of a SAFE report in non-ABC years.

b. Trawl survey indices; by June. For stocks with an index assessment, needed to set ABCs every two years. It is likely that these will be needed for all stocks when setting ABCs, and possibly for completion of a SAFE report in non-ABC years.

c. Information from most recent assessment needed to run projections; by June; only in ABC setting years. (Need: terminal year numbers at age, selectivity, weights-at-age, etc. for the AGEPRO input file).

d. Information to annually support TRAC assessments of Georges Bank yellowtail flounder, Eastern Georges Bank cod, and Eastern Georges Bank haddock.

Example of Current Data and Analysis Needs from MAFMC to support Summer Flounder, Scup, and Black Sea Bass)

Currently the information needed is expected to be:

a. Annual catch at age (landings and discards) and updated NEFSC and state survey indices by May 1.

b. Update of catch projections based on operational F (stochastic model output from ASAP or SCALE to run AGEPRO) by June 1.

c. Staff quota paper with ABC/TAL recommendations to SSC and Monitoring Committee by mid-July.

d. Council considers SSC and MC recommendations and adopts ABC/TAL recommendations in mid-August for upcoming fishing year (Jan 1).

APPENDIX VI

Evaluating Uncertainty for Deriving Acceptable Biological Catch

The 2007 reauthorization of the Fishery Conservation and Management Act specifies that management plans shall establish a mechanism for specifying annual catch limits, such that overfishing does not occur. Considering that the catch associated with overfishing (*OFL*) is estimated with uncertainty, Acceptable Biological Catch (*ABC*) should be less than *OFL* to ensure that catch limits prevent overfishing. Accordingly, National Standard 1 guidelines suggest that "*the determination of ABC should be based, when possible, on the probability that an actual catch equal to the stock's ABC would result in overfishing*" (NOAA 2009).

Routine stock assessment is the most appropriate process for providing information for the derivation of *ABC*. In order to meet the new requirements of the reauthorized Act and associated guidelines, stock assessments should continue to identify sources of uncertainty. Stock assessments should also quantify uncertainty whenever possible. The information required for *ABC* evaluations are identified below, with examples of how the information might be used to determine an appropriate *ABC*.

Probabilistic Approach

A statistical approach to deriving *ABC* is to consider *OFL* to be a composite estimate which is a function of projected biomass and F_{MSY}, both of which are estimated with uncertainty:

1) $$O\hat{F}L_{t+k} = \hat{B}_{\exp,t+k}\left[\hat{F}_{MSY} \Big/ \left(\hat{F}_{MSY} + M\right)\right]\left[1 - e^{-\left(\hat{F}_{MSY} + M\right)}\right]$$

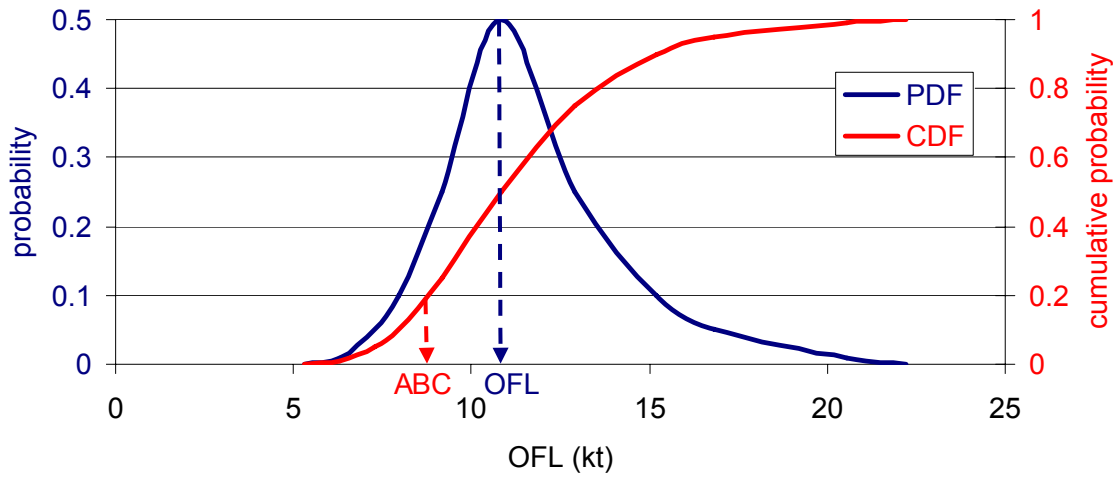
… where $B_{\exp,t+k}$ is the projected biomass k years from the last year of the assessment (t). The most direct approach to deriving *ABC* is as a function of the projected *OFL* estimate and its distribution (Shertzer et al. 2008; either parametrically or nonparametrically):

2) $$ABC = O\hat{F}L - \sigma_{OFL} z_{p*}$$

or

$$ABC = P_{p*}\left(O\hat{F}L\right)$$

… where σ_{OFL} is the standard error of the *OFL* estimate, z is a function of the desired probability ($p*$; Prager et al. 2003) of exceeding *OFL* (e.g., for p=0.1, z_p=1.96; Appendix Figure 2.1), and P_{p*} is the $p*$ percentile of the distribution of *OFL*. Ideally, $p*$ should be identified in the management plan, but in lieu of guidance on $p*$, stock assessments will have to provide the information needed to derive ABC at a range of reasonable $p*$ values (e.g., $p*$=0.1 to 0.4, z_{p*}= 1.96 to 1.28). Note that fully integrated models that include catch projections as well as MSY reference point estimates are most suited for stochastic projections that account for both components of uncertainty in *OFL* (projected biomass and F_{MSY}) for the derivation of *ABC*.



Appendix VI, Figure 1. Distribution of projected catch associated with overfishing (*OFL*) and an example of Acceptable Biological Catch (*ABC*) based on a 10% risk of overfishing (p^*=0.1).

One complicating factor in projecting uncertainty in *OFL* is that a fixed $F=F_{MSY}$ projection scenario may underestimate uncertainty in *OFL*, because *F*-based projections are typically more sensitive to uncertainty in B_{exp}. For example, stock size and F_{MSY} from integrated models that estimate both have joint distributions, such that low-B_{exp}/high-F_{MSY} realizations would produce similar *OFL* projections as high-B_{exp}/low-F_{MSY} realizations. Sequential, catch-based projections would incorporate uncertainties more comprehensively. A sequential, catch-based projection would have iterative steps: first, a one-year projection assuming $F=F_{MSY}$ is used to estimate *OFL* in the first year of the projection; next, a two-year projection assumes catch=median *OFL* in the first year and $F=F_{MSY}$ in the second year; and so on.

Accounting for Model Specification Error

The probabilistic approach to deriving *ABC* assumes that uncertainty in *OFL* can be accurately measured (i.e., the stock assessment model is correctly specified). If so, stochastic projection of catch associated with F_{MSY} should provide all the information that is needed to derive *ABC*. Unfortunately, many sources of uncertainty are not typically included in stochastic catch projections, and those unaccounted sources should be considered for the objective of avoiding overfishing. Therefore, in addition to stochastic catch projections, unaccounted sources of uncertainty should be identified and measured when possible. Estimates of precision used for stochastic projection assume that the stock assessment and projection model is correct (*i.e.,* the model accurately represents the population and fishery dynamics), but they do not include uncertainty resulting from the model being incorrect.

Two approaches to quantifying model error are retrospective analysis and sensitivity analysis. Retrospective analysis can determine if a pattern of inconsistency exists; and if so, the retrospective inconsistency can be measured. If the magnitude of recent retrospective inconsistency in exploitable biomass is greater than its confidence interval, inconsistency should be considered for the derivation of *ABC*:

3) $$ABC = OFL\left(1 - \rho_{B\exp}\right)$$

… where $\rho_{B\exp}$ is the retrospective inconsistency in recent estimates of exploitable biomass, expressed as a percentage of the estimate (Mohn 1999).

Another method of quantifying model error is sensitivity analysis, in which differences in biomass estimates among viable model types or specifications can be measured. Similar to the approach described for retrospective error, if the magnitude of model sensitivity for estimating exploitable biomass is greater than its confidence interval, model sensitivity should be considered for the derivation of *ABC*:

4) $$ABC = OFL\left(1 - \Delta_{B\exp}/2\right)$$

… where Δ_{Bexp} is the relative magnitude of model sensitivity for estimating exploitable biomass, expressed as a percentage of the estimate. Note that unlike retrospective patterns, which are by definition unidirectional, differences among models from sensitivity analysis are bidirectional, so half the relative magnitude would be appropriate for determination of *ABC*. Sensitivity analysis can be used to evaluate different perspectives among alternative stock assessment models, and the approach can be used to evaluate sensitivity to model or projection assumptions for which there is a range of valid assumptions or equally valid decisions. For example:

- What is the sensitivity of the estimate of $B_{\exp}$ to a viable range of natural mortality (*M*)? to alternative selections of survey indices? to the time series of data in the assessment? to the age-range in the assessment? to the selectivity assumptions? … etc.

- What are the sensitivities of rebuilding expectations to assumed recruitment?

The two examples of deriving *ABC* from measures of model uncertainty described above assume that all or most uncertainty is represented by retrospective inconsistency (equation 3) or model sensitivity (equation 4). If these measure do not account for the major sources of uncertainty, the buffer between *OFL* and *ABC* may need to be derived from both model precision (equation 2) as well as model bias (equations 3 or 4). However, measures of precision and bias are probably not additive.

Evaluations of *Ad hoc ABC* Methods

All of the above approaches to determining *ABC* attempt to derive a buffer between *OFL* and ABC that is based on a measure of uncertainty. *Ad hoc* approaches to determining *ABC* can also conform to the guideline to determine *ABC* based on the probability that it would result in overfishing – if that probability is evaluated. For example, *ABC* can be based on any percent buffer (*x*%) between *OFL* and *ABC*:

$$ABC = x\%OFL$$

5) *or*

$$ABC = \hat{B}_{\exp,t+k}\left[x\%\hat{F}_{MSY} \Big/ \left(x\%\hat{F}_{MSY} + M\right)\right]\left[1 - e^{-\left(x\%\hat{F}_{MSY} + M\right)}\right]$$

… provided that the probability of overfishing is evaluated. The conventional approach to determining the probability of overfishing is a Management Strategy Evaluation (MSE, Butterworth & Punt 1999) that involves a series of simulations:

1. A complex operating model is simulated that captures all important dynamics of the population and fishery system; such that the operating model is structurally more complex than the stock assessment model.

2. The operating model is used to generate multiple sets of routine stock assessment information (e.g., fishery catch, fishery samples, surveys) measured with error.

3. The stock assessment method is used to analyze the simulated assessment data and calculate the *ad hoc ABC* in equation 5.

4. The *ABC* is removed from the simulated population in the next year of the simulation.

5. The process is repeated to develop a time series of assessment and management realizations, and replicated many times to generate multiple simulation series.

For the purposes of *ABC* determination, MSE can evaluate the probability of overfishing as the relative frequency of $F>F_{MSY}$. Other performance criteria (e.g., frequency of depleting the stock to less than ½ B_{MSY}, average long-term yield, variability in yield, economic yield) can also be evaluated to inform the management system on performance with respect to other management objectives.

Although MSE may be beyond the scope of routine stock assessments, it requires all of the expertise and data used in stock assessments. Evaluations of *ad hoc ABC*s proposed by the management system should be considered in the scheduling of stock assessments, because they will require a substantial investment of the same resources needed for stock assessments.

Rebuilding *ABC*s

According to national standard guidelines, "*For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan*." Therefore, if the *ABC*s described above are not expected to meet rebuilding goals (*i.e.,* biomass at or above B_{MSY} by the end of the rebuilding period with the desired probability), ABC should be based on $F_{rebuild}$:

6) $$ABC = \hat{B}_{\exp,t+k}\left[\hat{F}_{rebuild} \Big/ \left(\hat{F}_{rebuild} + M\right)\right]\left[1 - e^{-\left(\hat{F}_{rebuild} + M\right)}\right]$$

… where $F_{rebuild}$ allows rebuilding to B_{MSY} by the end of the rebuilding period with the desired probability.

Data-Poor Approaches to Interim ABCs

Many stock assessments do not support the estimation of quantities needed to derive *ABC* as specified in national standard guidelines. However, catch advice is mandated for all fisheries, with few exceptions. Therefore, interim *ABC* methods are needed until more analytical approaches to *ABC* can be developed. Accordingly, data-poor stock assessments should provide information on sources and magnitudes of uncertainty in the assessment, particularly with respect to catch advice. In data-poor situations, interim *ABC* can be based on the magnitude of catch or exploitation index during periods of stability (or periods of stock increase for rebuilding plans).

In summary, the information required from stock assessments to derive *ABC* includes:

- Stochastic projection of catch associated with overfishing
    - If the desired probability of overfishing has not been provided by the management system, stochastic projections should include the entire distribution of projected catch or a range of confidence intervals of *OFL*.
    - If the stock is in a rebuilding plan, and the *OFL* projection does not meet rebuilding objectives, $F_{rebuild}$ should be estimated, and stochastic projection of catch from the $F_{rebuild}$ scenario should be provided.
    - If the accepted *ABC* method involves an Ad hoc calculation of $x\%F_{MSY}$, stochastic projection of catch should be from a $x\%F_{MSY}$ scenario.
- A comprehensive list of the sources of uncertainty, and when possible quantification of uncertainty for each in the context of catch advice
    - Inspection for retrospective patterns and measurement of inconsistencies should be examined for all analytical assessments.
    - If alternative models or model configurations are equally justifiable, sensitivity of stock biomass estimates should be evaluated.
- In lieu of an analytical assessment, data-poor alternatives for interim ABCs

This information should be provided for all assessments of federally managed stocks for determination of *OFL* and *ABC* by the management system. Of the 55 management units assessed by NEFSC, 48 require *ABC*s (5 are managed by ASMFC, and the squids are exempt because of their short lifespans: see Table 1). Of the 48 management units for which *ABC*s are required, 29 (60%) have analytical assessments, 26 (54%) have accepted projection methods, and 25 (52%) can support stochastic projections. Therefore, about half of the assessments include analytical methods and stochastic projections to support probabilistic approaches to determining *ABC* and can be used for evaluating model error. Ad hoc or data-poor *ABC* methods are needed for the 19 index-based assessments and analytical assessment that do not have stochastic projection methods that are considered to be reliable for catch projections.

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APPENDIX VII

Analysis of Information Flow for Stock Assessments

Stock assessments are complicated. Stock assessments integrate multiple data sources to distill estimates of historical and current stock sizes and fishing mortality rates. These estimates, when compared to biological reference points, provide a measure of the departures from target population size and harvest rates. Moreover, stock assessment scientists are charged with devising optimal fishing mortality rates that attain MSY and appropriate fishing mortality rates for recovery of populations to desired levels within fixed time periods.

Data Acquisition and Processing

The complexity of the assessment models is complemented by an equally complex process of acquiring, auditing and preparing data for use in such models. Similarly, the results of stock assessment models must ultimately be translated into catch limits and rebuilding strategies through the management process. Finally, to be effective, management advice must be accepted as legitimate by the fishing industry.

In this section we provide an overall description of the stock assessment process and the factors that influence the timing of assessments and limitations on number of assessments possible.

The translation of landings, observer and survey data into estimates of relative abundance at age and total catch at age is shown schematically in Appendix VII, Figure 1. Landings from commercial fisheries are monitored through a census of dealer records and mandatory vessel trip reports (VTR) from fishermen. State landings also contribute to the total observed removals. The biological attributes of landings are monitored by port agents who collect length and age samples. Federal and industry-funded observers collect data on species composition, and the amount/size/age composition of landings and discards at sea on commercial fishing vessels. In the recreational fishery, both landings and discards must be estimated from samples. Scientific trawl surveys or species-specific surveys provide estimates of relative abundance and age composition. Special studies, such as cooperative surveys constitute another group of data that act to inform assessments in various ways.

All of these primary data streams must be audited. Research survey data are collected under controlled conditions with a comprehensively designed database. Data collected by fishery observers are reviewed by editors, input, and then subjected to further automated error checks. Dealer landings records have improved greatly but lack of critical information requires that such data must be merged with less complete VTR data. Owing to the incomplete matching of dealer and VTR records, a highly specialized allocation process must be performed before the landings data can be assigned to stock areas. Landings by stock area also serve as the basis for discard estimation as discard rates, obtained from at-sea observers, are multiplied by total landings to obtain total discards.

The resulting estimates of landings plus discards must then be disaggregated further to obtain catch at age. To accomplish this, samples of scales, otoliths, vertebrae, spines or shells must be processed, read, computerized and audited. This process is manually intensive and requires skilled biologists to read samples. Quality control methods typically require a second reader to validate estimates and comparisons with known age samples. Additionally, readers will use reference collections of known age samples to validate readings. The formation of a growth ring in fish represents the integration of environmental conditions, ration, maturity and other physiological attributes. These conditions can vary over time so ageing of fish also requires collaboration with other laboratories to ensure that consistent approaches are being used.

The required skill, necessary volume of samples, and need for continuous QA/QC measures makes ageing of samples a major potential bottleneck in the stock assessment process. Sampling strategies and the number of samples required for construction of age-length keys (ALK) are species dependent. The ALK estimates the probability of being age A given the animal is of length L. Thus the range of possible ages and lengths gives a maximum estimate of the number of probabilities to be estimated. The nature and variability of the growth curve has implications for the number of samples necessary for each length class. Owing to annual and seasonal variations in growth rates and varying size selectivities of gears, ALKs must often be constructed seasonally and by gear type. These considerations may require additional sampling or when not possible, informed coalescing of appropriate ALKs.

Other processing tasks for biological samples include estimation of sex, maturity status, fecundity, and, increasingly, measures of egg size (or fitness). These tasks are motivated by increasing concerns that differences in life history attributes between males and females (*e.g.,* dimorphic growth, natural mortality) and effects of age (improved viability, increased spawning duration) on egg quality are important to include in stock assessment models. Such concerns have been addressed in the recent summer flounder, and black sea bass assessments and will likely enter into future assessments of yellowtail flounder and cod.

Assessment, Peer Review and Provision of Advice

The current assessment process is schematically outlined in Appendix VII, Figure 2. The primary data ingredients include fishery-independent indices of abundance, and fishery-dependent landings, discards, and relevant ecosystem considerations. These data are integrated and interpreted via one or more candidate stock assessment models based on various objectives of realism and generality and consideration of the quantity and quality of the available data. Measures of uncertainty typically include the degree of fit about the model, assuming it is the true state of nature. Uncertainty can also include the aggregate effect of variation about multiple alternative models but this type of analysis, while having significant epistemological advantages, is not often used in practice in routine stock assessment models. (In contrast, tagging models do include general approaches for model averaging, but these are often part of a hierarchical model framework). Methods for model averaging or Bayesian approaches for complex stock assessment models—specifically for the provision of scientific advice, are an important area of research. As with most good ideas, gaining acceptance of the approach requires extensive communication to peer-reviewers, managers and industry.

Draft results of the assessments are generally reviewed by a committee of external experts. This process generally takes about 8 weeks given the necessary time to read the reports, participate in the review meeting, and prepare a summary report. For some assessments, the duration can be reduced by reducing the scope of the review or restricting the terms of reference. The stock assessments identify OFLs and a suite of factors relevant to the determination of ABCs to be considered by the Science and Statistical Committee. Products from the assessment process also provide relevant information to federal and state regulators, the Fishery Management Councils, and the Atlantics States Marine Fisheries Commission. Ultimately these groups prepare the various products of development of regulations.

The schematics in Appendix VII Figures 1 and 2 identify the linkages among groups and processes, but do not give insight into the time tables. Appendix VII Table 1 provides a measure of the time dependencies associated with an assessment cycle. In this white paper, we focus on the products prepared via the assessment process rather than the regulatory process. Our objective is to identify the major issues associated with the sequential processing of information. Simultaneous processing is possible for some tasks but the actual stock assessment report must have a fixed cutoff date for information. This cutoff date is critical because it ultimately defines the "age" of data used to make decisions. Managers and industry are often critical of regulations based on assessments whose most recent data may be two years old. Appendix VII Table 1 provides some insight into the sequencing of information that often leads to this undesirable situation.

Appendix VII Table 1 identifies different classes of events that must occur for each stock assessment. These events are based on the components identified in Appendix VII Figures 1 and 2 but are more expansive since they provide additional details on tasks and add the necessary time dimension to the links among boxes in the flow diagrams. Appendix VII Table 1 is based on a calendar year with 52 weeks.

The fishery-independent events (primarily surveys) are fixed in time but modest changes have been made over the years (*e.g.,* scallop and clam surveys). Changes in the timing of finfish surveys are more problematic because of the long-standing history of the surveys. Timing is an important element of consistency in a multispecies survey of animals with seasonal migration and availability patterns. With the new Bigelow-based surveys and the need to increase sampling efforts especially in deeper strata, the fall and spring surveys will be 10 weeks in duration (2 more weeks than for Albatross-based surveys). The ripple effects for assessments are important and have already influenced the time of TRAC assessments. Similar effects may occur for the timing of information for the Mid-Atlantic annual specification process.

Despite major increases in sampling efficiency and onboard quality control measures, the resulting data must be audited on land. Often this requires intensive review of subsampling procedures and more importantly, the review of sensor data on gear performance. Historically the survey focused on standardization of input measures (tow duration, scope, etc.). That focus has now shifted to include measures of actual gear performance such as net spread, headrope height and time on bottom. These measures require post processing of sensor information and consideration of missing data, electronic monitoring failures and so forth.

Hence, the desired post processing audit process is about 8 weeks after completion of the final leg of the survey. This time period can be compressed by adding additional personnel but that incurs costs elsewhere.

Cooperative surveys with industry are less standardized so typically additional work is necessary to process cruise information. In particular, many of the studies require side-by-side towing or depletion experiments that must be interpreted using advanced statistical models. Such approaches can often delay the release of information that ironically was motivated by a perceived lack of timeliness in the standard fishery independent surveys.

Fishery dependent data acquisition is continuous. To illustrate the dependencies for stock assessments, an arbitrary cutoff date for the first calendar year quarter is used in Appendix VII Table 1. It assumes that the most recent landings and discard data will be collected through March 31. Realistic time lags for reporting are included for each data component. Lags in VTR data are especially problematic because these data serve as the basis for allocation of landings to stock areas. Appendix VII Table 1 uses a 10 week delay that includes about 90% of the reports. The remaining 10% of the reports can come in up to a year later, often just prior to the start of the next fishing year. The cumulative effects of delays in reporting, auditing of data, ageing of samples and inclusion of observer data generally means that the fishery-dependent stock assessment ingredients are not available until the end of the second quarter. Note that this determination is based on a finely-tuned mobilization of resources to ensure preparation of the data. In general, this accelerated schedule has been oriented toward preparation of TRAC assessments and updates of Mid-Atlantic species, particularly summer flounder. Even for these stocks, the most recent data for a stock assessment in June of year t are the catches though December of year t-1.

The actual stock assessment process, assuming an experienced analyst, can be accomplished over 16 week period. This includes preparation of the age based indices and catches, model selection, uncertainty estimates, projections, peer review and preparation of the final report (Appendix VII Table 1). The flow of information to the Councils officially begins after the assessment report has passed Center review. Unofficially, it often begins before then, usually in order to meet regulatory deadlines. This can be risky if the final products deviate from expectations. Nonetheless, the post processing of information, including reporting to the Council, and post processing by the various technical and deliberative committees often extends over a full year after the assessment. This is true for assessments that serve as the basis for major plan amendments but less relevant for assessments that serve as the basis for ACLs.

The NEFSC SAW process has two major events in June and December. Since most assessment models typically work with a calendar year landings timeframe, the December SARC in year t will be based on information acquired through December of year t-1. Given the typical timeframes associated with post assessment tasks, Council actions, regulatory review process, and the offset of fishing years (often spanning two calendar years), the regulations imposed for fishing year beginning in mid-year t+2 will be based on data collected through year t-1. In other words, the assessment conducted in December 2008 would include landings data collected through Dec 2007. Regulations would be developed in 2009 for implementation at the start of the fishing year beginning in say May of 2010. Hence the data used in the assessment would be

28 months "old". To compensate for these lags, the various technical committees of the Councils and Commission rely heavily on Center staff to provide "checks" on the most recent data. However, these checks do not typically have formal status. In the following section, the concept of signposts is elaborated. Essentially, the signpost process is a natural extension of the methods now used less formally to inform current management.

Summary Points and Recommendations

- Sufficient lead time for benchmark assessments is critical for allocation of NEFSC staff, particularly in the Population Biology Branch which ages the samples.

- Under current staffing constraints some combinations of species cannot be assessed in the current year because age readers often have multiple species responsibilities. The maximum number of aged species that can be handled in a given year is about 10-15.

- Similar constraints apply to assessment scientists (*e.g.,* cannot do surfclams and ocean quahogs at same time).

- New demands for Population Biology Branch include sampling for sex ratio and fecundity. Many aspects of underlying biology that were obscured by intense fishing are now being revealed.

- Review sampling strategies for ALKs should be undertaken with an eye toward estimating sample sizes necessary to achieve desired precision targets. A comprehensive review of sampling intensity and strategies has not been conducted. In particular, the volume of fish per tow on the Bigelow mandates that sound methodology for subsampling is employed.

- Quality of landings data may change significantly if sector implementation becomes widespread. Uncertainty in estimates of landings and discards may increase as new management measures are implemented.

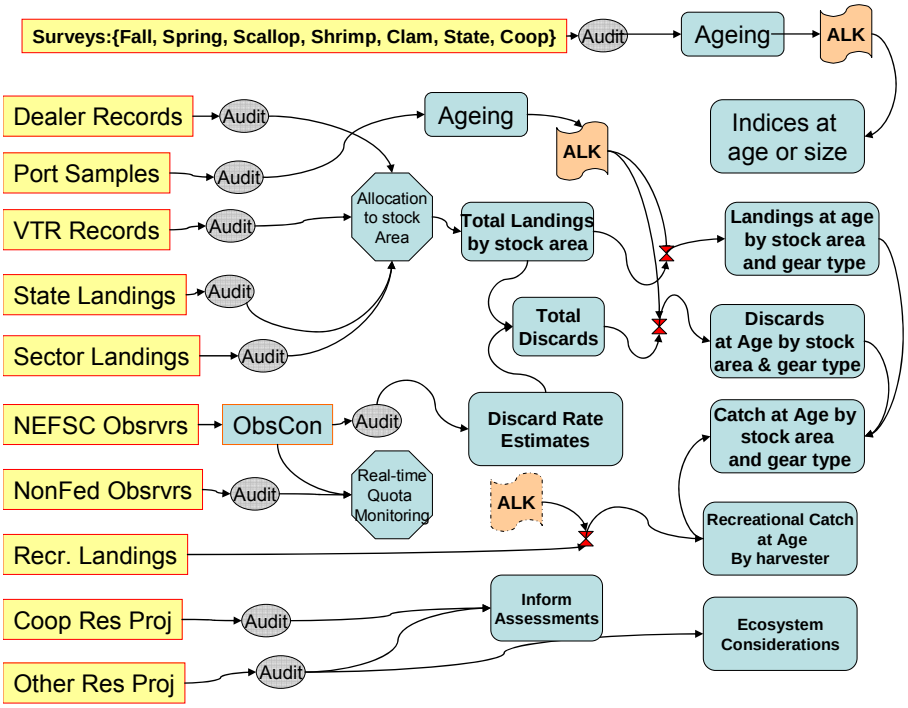
- Mixing of compliance issues with at-sea monitoring AND the implementation of ACLs may compromise utility of existing bycatch monitoring program. Incentives to discard on non monitored trips will be high.

- The timelines in Appendix VII Table 1 are gross simplifications of reality. All processing times are optimistic and do not account for unanticipated irregularities in particular data base behaviors, or stock-specific model refinements. Additional work on various technical teams, reviews of technical documents, preparations for impromptu and emergency assessment meetings, etc. often consume as much time as the assessment process

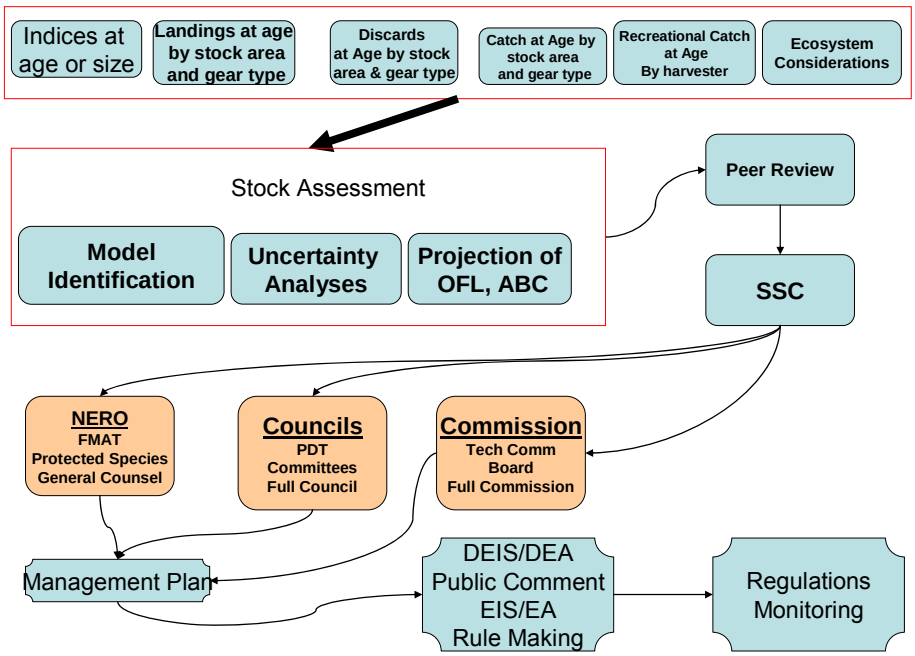
Appendix VII, Table 1. Draft time line for preparation of scientific advice for management. Annual cycle assumes data though March of year t.

Class	Event	Subevent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
			Week of Year t																																																				
			January				February				March					April				May					June				July					August				September				October				November				December				
Fishery Independent Data	Spring Survey	Survey									X	X	X	X	X	X	X	X	X	X																																		
		Audit																			X	X	X	X	X	X	X	X																										
		Ageing																			X	X	X	X																														
	Fall Survey	Survey																																				X	X	X	X	X	X	X	X	X	X							
		Audit																																														X	X	X	X	X	X	X
		Ageing																																														X	X	X	X			
	Scallop Survey	Survey																					X	X	X	X	X	X	X																									
		Audit																												X	X	X	X	X	X	X	X																	
	Shrimp Survey	Survey																														X	X	X	X																			
		Audit																																		X	X	X	X																
	Clam Survey	Survey																															X	X	X	X	X																	
		Audit																																				X	X	X	X	X	X	X	X									
		Analyses																																												X	X	X	X	X	X	X	X	X	X
	Coop Surveys	Survey (eg monkfish)					X	X	X	X	X	X	X	X	X																																							
		Audit														X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		Analyses																											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			Week of Year t																																																				
			January				February				March					April				May					June				July					August				September				October				November				December				
Class	Event	Subevent	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
	Dealer Landings	Landing Event	X	X	X	X	X	X	X	X	X	X	X	X	X																																								
Fishery Dependent Data		Electronic Reports Rc'd	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																					
		Audit		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																			
	Port Sampling	Collection	X	X	X	X	X	X	X	X	X	X	X	X	X																																								
		Length and Ageing														X	X	X	X	X	X	X	X	X	X	X	X	X																											
	State Landings	Landing Event	X	X	X	X	X	X	X	X	X	X	X	X	X																																								
		Reports			X	X	X	X	X	X	X	X	X	X	X	X	X	X																																					
		Audit					X	X	X	X	X	X	X	X	X	X	X	X	X	X																																			
(ASSUME	Sectors	Landing Event	X	X	X	X	X	X	X	X	X	X	X	X	X																																								
QTRLY		Sector Reporting		X	X	X	X	X	X	X	X	X	X	X	X	X																																							
TIME STEP)		Sector Discard Rates		X	X	X	X	X	X	X	X	X	X	X	X	X																																							
		Reconsile with VTR/ Dealer																		X	X	X																																	
	VTR data	Landing Event	X	X	X	X	X	X	X	X	X	X	X	X	X																																								
		VTR Received		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																					
		Data Entry		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																															
		Audit																				X	X	X	X																															
	Area Allocation	Data Prep/Accommodations																								X	X	X																												
	(depends on	Run programs																											X	X																										
	Observer	Collection	X	X	X	X	X	X	X	X	X	X	X	X	X																																									
		Obscon		X	X	X	X	X	X	X	X	X	X	X	X	X																																								
		Data Entry + Final Audit														X	X	X	X	X	X	X	X	X	X	X	X	X																												
	Recreational	by Wave	X	X	X	X	X	X	X	X																																														
		Data Entry + Final Audit									X	X	X	X	X	X	X	X																																						
Analyses and Assess-ment	NEFSC	Assess Subcom Tasks																																																						
		LAA, DAA, CAA																											X	X	X	X	X																							
		State Data																											X	X	X	X	X																							
		Coop Res Data																											X	X	X	X	X																							
		Special Studies																											X	X	X	X	X																							
		Survey Indices																											X																											
		Model Selection																														X	X	X	X	X																			
		Uncertainty/Risk																																		X	X																		
		Assess Subcomm. Mtg																																		O	O																		
		Report Review Period																																				X	X																	
		SARC--Benchmark																																						X															
		SARC Update																																						X															
		SARC Signpost																																X																					
		CIE report Review																																						X	X	X													
		Final Report																																									X	X											
	TRAC (C, H, Y)	Analyses																							X	X																													
		Meeting																									X																												
		Reports																										X																											
	MAFMC updates	Analyses																							X	X	X																												
		Meeting																										X																											
	SBRM	Analyses (year t-1)																																																X	X	X	X	X	X
		Initial Report	X	X	X	X	X	X	X	X																																													
		Feedback										X	X	X	X																																								
Manage-ment and Review	Councils	PDT (~5/yr)			X								X									X																						X				X						
	and	Committee (~5/yr)				X								X									X																										X					
	Commission	Council (~6/yr)						X									X										X													X						X				X				
	NERO	DEIS/ DEA																																																					
		Public Comment																																																					
		EIS/ EA																																																					
		Public Comment																																																					
	SSC	Review Reports																																											X	X									
		Meeting																																														X							
		Advice to Councils																																															X						

Appendix VII, Figure 1. Northeast Stock Assessment Process: Derivation of Estimates of Relative Abundance at Age and Total Catch At Age



Appendix VII Figure 2. Northeast Stock Assessment Process: Linkages Between Information, Stock Assessments, and Management Groups.



APPENDIX VIII

Summary of Discussions by External Working Group on Signposts

During discussion on long term recommendations, the group moved back to discussion on who will develop interim evaluations or 'signposts', when such things will be in use, and how will acceptance be secured. It was evident from the discussion that interim evaluations or 'signposts' may be in use within the next two years and that there are many questions that remain unresolved. Examples and working definitions were discussed as were potential issues that may arise out of the vessel calibration exercise to be completed later this summer.

A number of critical questions were raised by the working group during the meeting. Some answers were partially developed or suggestions made, as follows:

1. What are interim evaluations or 'signposts'?

Interim evaluations or 'signposts' are metrics used to evaluate stock status or develop ABCs in the years in between benchmark assessment or stock assessment updates. Examples of interim evaluations or 'signposts' suggested to date: Index of stock status and exploitation--expected versus observed, recruitment--expected vs. observed, exploitation rates, catch per unit of effort, survey indices, and catch.

2. Who will develop interim evaluations or 'signposts'?

General consensus was that stock assessment biologists or scientists were best suited to develop interim evaluations or 'signposts'. It remains unclear if such metrics will be developed and evaluated in benchmark assessments as part assessment TORs, developed separately by PDTs, FMATs, the working groups, or other as of yet unidentified processes. It is unclear how interim evaluation metrics will relate to stock status determination criteria or if FMPs will have both analytical and 'signpost' status determination criteria.

3. When will 'signposts' by utilized and by whom?

The majority of discussion seems to indicate that 'signpost' evaluation would occur in the intervening years between benchmark assessments or stock assessment updates. However, some discussion occurred wherein 'signposts' were used as biennial or triennial ABC setting mechanisms, suggestive that benchmark or stock assessment updates would occur at a frequency greater than every third year. Discussions indicated that PDTs and FMATs are appropriate to derive ABCs using benchmark or assessment update methodology. Using that logic, it would seem appropriate for PDTs and FMATs, or other appropriate bodies, to compute 'signposts' for SSC evaluation and subsequent ABC modification, as needed.

4. How will 'signposts' be utilized?

The discussions held to date indicated that 'signposts' would be used to evaluate the continued adequacy of previously established multi-year ABCs and potentially to develop ABCs for specification cycles when either a benchmark or assessment update is not performed. Presumably, when 'signposts' move outside pre-defined tolerances some pre-determined action then occurs. This could be control-rule type modification of ABCs by the SSC, independent modification of the ABCs by SSC (*e.g.,* non control rule adjustment), initiation of a more thorough assessment update, scheduling of a benchmark, or some combination thereof. It has been discussed that there are technical approaches yet to be addressed for when the level of change in a signpost has been determined to be significant and ABC must be modified. It has not been resolved if signposts will serve only as a threshold used to decrease ABC if stock metrics indicate unfavorable conditions or if signposts will apply in a two tailed format for both ABC increases and decreases.

5. When will 'signposts' be developed?

General discussions indicated that the need of interim evaluation metrics or 'signposts' are necessary at a minimum within the next two years. However, it was clear from the discussions that the sooner the process can be developed, the better.

6. How will the SAW/SARC and TRAC, etc., (i.e., benchmark assessment processes) be revised in moving forward?

Both the internal and external working group have endorsed that changes to the benchmark assessment processes may require revision in timing, planning, TORs, and frequency. The volume of assessment-related work provided by the Northeast Fisheries Science Center in recent years is unsustainable and will only increase as MSRA requirements come on line for regional FMPs. Attempts to map the critical timing of data acquisition, synthesis, and analysis in the process have clearly indicated the complexity of the process and have been informative about timing bottlenecks. There has not been clear resolution on how the processes may be modified moving forward. Suggestions have been made that the schedule for assessments could be made well in advance based on objective criteria rather than the historic practice of scheduling assessments to respond to management.

7. *How will buy in for the potential changes in assessment process and stock monitoring through 'signposts' be achieved?*

While the details have not yet been established, the external working group acknowledged that getting acceptance from industry, Councils, the NRCC, while meeting mandated requirements (*e.g.,* National Standard 2, Data Quality Act, etc.) are of paramount importance. It is unclear what the way forward will be if approval of a 'signpost' approach is not supported by the NRCC or other groups; much of the existing assessment update structure remains codified in Mid-Atlantic plans while the process is just being developed for most New England plans. It was suggested that Atlantic States Marine Fisheries Commission staff be added to the external working group for future meetings.

At the close of the meeting, it was suggested that ICES quality control type-plots be constructed and that examples of 'signposts' be developed before the next external working group meeting.

APPENDIX IX

Terms of Reference for SAW/SARC Assessments

(A) pre-2009; (B) revised in 2009 to respond to MSRA and SSC requirements; and (C) Appendix to the SAW TORs

(A) Example for a stock assessment in 2007:

1. Characterize the commercial catch, effort and CPUE, including descriptions of landings and discards of that species.

2. Estimate fishing mortality, spawning stock biomass, and total stock biomass for the current year and characterize the uncertainty of those estimates. If possible, also include estimates for earlier years.

3. Either update or redefine biological reference points (BRPs; proxies for B_{MSY} and F_{MSY}), as appropriate. Comment on the scientific adequacy of existing and redefined BRPs.

4. Evaluate current stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 3).

5. Recommend what modeling approaches and data should be used for conducting single and multi-year stock projections, and for computing TACs or TALs.

6. If possible,

    a. provide numerical examples of short term projections (2-3 years) of biomass and fishing mortality rate, and characterize their uncertainty, under various TAC/F strategies, and

    b. compare projected stock status to existing rebuilding or recovery schedules, as appropriate.

7. Review, evaluate and report on the status of the SARC/Working Group Research Recommendations offered in recent SARC reviewed assessments, and offer new research recommendations.

(B) Example for a stock assessment in Fall 2009:

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.

2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.

4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

5. Evaluate stock status with respect to the existing BRPs, as well as with respect to updated or redefined BRPs (from TOR 4).

6. Identify potential environmental, ecological, and fishing-related factors that could be responsible for low recruitment.

7. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).

    a. Provide numerical short-term projections (1-5 years; through 2015). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment.

    b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.

    c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

8. Review, evaluate and report on the status of the SARC and Working Group research recommendations listed in recent SARC reviewed assessments and review panel reports. Identify new research recommendations.

(C) Appendix to the SAW TORs:

Clarification of Terms used in the SAW/SARC Terms of Reference

(The text below is from DOC National Standard Guidelines,
Federal Register, vol. 74, no. 11, January 16, 2009)

On "Acceptable Biological Catch":

Acceptable biological catch (ABC) is a level of a stock or stock complex's annual catch that accounts for the scientific uncertainty in the estimate of [overfishing limit] OFL and any other scientific uncertainty…" *(p. 3208) [In other words, OFL ≥ ABC.]*

ABC for overfished stocks. For overfished stocks and stock complexes, a rebuilding ABC must be set to reflect the annual catch that is consistent with the schedule of fishing mortality rates in the rebuilding plan. *(p. 3209)*

NMFS expects that in most cases ABC will be reduced from OFL to reduce the probability that overfishing might occur in a year. (p. 3180)

ABC refers to a level of ''catch'' that is ''acceptable'' given the ''biological'' characteristics of the stock or stock complex. As such, [optimal yield] OY does not equate with ABC. The specification of OY is required to consider a variety of factors, including social and economic factors, and the protection of marine ecosystems, which are not part of the ABC concept. (p. 3189)

On "Vulnerability":

Vulnerability. A stock's vulnerability is a combination of its productivity, which depends upon its life history characteristics, and its susceptibility to the fishery. Productivity refers to the capacity of the stock to produce MSY and to recover if the population is depleted, and susceptibility is the potential for the stock to be impacted by the fishery, which includes direct captures, as well as indirect impacts to the fishery (e.g., loss of habitat quality)." (p. 3205)

APPENDIX X

Meeting Summaries of the 'Internal' ACL Working Group

NEFSC 'Internal' ACL WORKING GROUP, MAY 8, 2009, MEETING SUMMARY

MEETING AGENDA ITEMS:

1. Review NRRC Discussions and AIs 8 and 8a
2. Review Scheduling Worksheet for Stock Assessments
3. Review Summary of Stock Status in the Northeast Region
4. Review SSC ABC/ACL Activities
5. Discuss Assessment Data Collection/Data Preparation/Data Analyses Time Lines
6. Discuss Monitoring Metrics ('Signposts' or 'Barometers' of Stock Status in the interim between Assessments)
7. White Paper Components and Assignments
8. Other Issues

SUMMARY:

Fred Serchuk will serve as the Chair of the internal NEFSC ACL WG.

Item 1. We reviewed the background for why the NRCC wanted this WG to be formed. The NEFSC and NRCC are both concerned about the Center's ability to provide staff support necessary to meet the increased demand for assessment updates and benchmarks to support the SSCs and Councils re: MSA requirements.

Item 2. The demand for age and growth data and for stock assessments has increased significantly. The MAFMC needs annual assessment updates, the NEFMC needs biennial updates for GARM stocks, and there are TRAC and SARC reviews of benchmark assessments. Most of these analyses would typically involve age data and age-based assessment models. Neither PopBio nor PopDy has the capability to do all of this on a continuing basis, given current staffs and available resources. There is a need to determine whether multi-year specs will be set, and for which species, and to respond by adjusting the assessment schedule accordingly.

> Action: Make a stock assessment flow diagram showing the typical steps and the data required for assessment updates and benchmark assessments. (Rago, Gabriel, others)
>
> Action: Determine whether multi-year specs will be set, for which species, and respond by adjusting stock assessment schedule. (Discuss this with 'external' WG)

Item 3. Some of the stocks are especially difficult to assess/track, either because the stock assessments are highly uncertain, or because data are lacking (e.g., red crab – no NEFSC survey is planned for this stock).

Some recent assessments have become more complex (monkfish, scup) and this is considered by reviewers to represent a substantial improvement. Furthermore, the annual report to Congress on FSSI stocks considers the more complex (i.e., age- and size-based) assessment models to be "adequate". In contrast, simpler approaches based on relative indices are generally considered to be "inadequate", and receive a lower FSSI score. If the NEFSC adopts simpler approaches, peer reviewers may not accept this as the best science available. For a number of reasons, there may be resistance to using simpler (and perhaps more parsimonious and less uncertain) modeling approaches, even if that is necessary to get required work done on every stock.

Action: In Fred's table "Summary of Stock Status…", add a column about whether stocks are rebuilt or not. (Weinberg).

Action: Carry out analyses to determine whether simpler assessment models could be used in place of age- or size-structured models. Compare performance of different models which have different complexity. (Fogarty, others).

Action: Carry out analyses to determine whether age-length keys from previous surveys could be used, which might reduce the number of fish that need to be aged per year. (Fogarty, others).

Item 4. The NEFMC and MAFMC appear to be addressing the implementation of ACLs/ABCs differently. The NEFMC is modifying each FMP separately in new frameworks and amendments. The MAFMC is taking an "omnibus" approach. It is unclear what will need to be done annually to meet the two Council's needs.

Both the NEFMC and MAFMC SSCs have indicated that SAW/SARC stock assessments need to better characterize uncertainty to support the development of ABC control rules and the establishment/implementation of ACLs and AMs. More collaboration is needed (NEFSC and SSCs) in setting TORs for stock assessments so that scientific uncertainty in more synoptically addressed.

It is unclear whether the SSCs will conduct uncertainty and related analyses (as suggested by Cadrin), or whether the SSCs will request that this work be carried out by the PDTs and Tech Committees. These types of activities by different groups need to be monitored carefully, and coordinated between groups. There are also potential concerns re: Data Quality Act and additional tasking of the Center staff from the SSC.

Action: Discuss this matter with the 'external' WG.

Item 5. A flow chart of the stock assessment process needs to be prepared (see Item 2). The spring and autumn *Bigelow* trawl surveys will be two weeks longer in duration than the *Albatross IV* surveys. This has implications for causing delays in stock assessments, which will potentially impact the Councils and NERO. If the surveys always last this long, what can be done to mitigate the impacts on the stock assessment schedule and subsequent delivery of science information to fishery managers? Is there any flexibility at the user end (in the past, the answer has been no)?

Item 6. There are two possible main approaches to providing interim evaluations of stock status between scheduled benchmark assessments.

(1) One approach is to continue to do benchmark assessments (as described in the "Scheduling Worksheet for Stock Assessments") and to evaluate stock status in the intervals between assessments using monitoring metrics as "signposts" or "barometers" of stock and fishery conditions. This approach could be applied to the biennial updates of GARM stocks and to the annual updates of Mid-Atlantic stocks.

(2) The second approach would be to require full assessment updates each year between the benchmark assessment, using the analytical models accepted at the SAW/SARC and TRAC peer reviews. This approach requires much more work than the current staff can presently accomplish. As well, it is inefficient to age all of the fish or to assess all of the fish on an annual basis. Furthermore, this would require additional staff, more space, etc. The frequency of assessments and assessment updates could impact SSC and Council decisions about the size of the scientific and management uncertainty buffers incorporated into the ABC and ACL determinations.

Action: This issue needs to be thoroughly discussed with the 'external' WG (NRCC AI8a), which includes staff from both Councils, their SSCs, and the NERO.

P. Rago raised the idea of having sectors collect their own data and provide written/electronic reports to the Agency. This could potentially take some of the work load off of the Agency. However, there may be complications with implementing this plan regarding who will review the quality of the data and the reports, and the logistics of establishing new file and database management systems.

Item 7. This WG agreed to produce a White Paper. It will describe the components of stock assessments, the current and future assessment work load to support fishery management in the NE, and recommendations about the approaches needed in the future to provide the scientific information needed for the ACL/ABC work. The White Paper will be shared with and discussed with the 'external' WG (NRCC AI8a) and then revised before it is submitted to the NRCC in fall 2009.

The WG agreed to that someone from the NEFSC, probably Jim Weinberg, would be an appropriate chair for the 'external' WG. Jim will contact that WG and try to schedule a first meeting in May or June.

NEFSC 'INTERNAL' ACL WORKING GROUP, June 19, 2009,
FINAL MEETING SUMMARY

MEETING AGENDA ITEMS:

1. Review of Minutes/Summary of Previous Meeting
2. Review of Summary of External ACL WG Meeting
3. Review of recent Council ACL/AM Activities
4. Review of SSC ABC/ACL Activities
5. MAFMC Workshop (14 July 2009) on ACLs and AM
6. Updates on Assessment Data Collection/Data Preparation/Data Analyses Time Lines
7. Update of Developing Monitoring Metrics ('Signposts' or 'Barometers' of Stock Status Between Assessments)
8. Status of White Paper Components and Assignments
9. Other Issues

LIST OF DOCUMENTS:

a. Summary of NEFSC ACL WG Meeting of 8 May 2009
b. Summary of External ACL WG Meeting of 29 May 2009
c. Draft NEFMC SSC Recommendations for Groundfish Rebuilding & ABC Specs (23 June 2009 memo from Steve Cadrin to Paul Howard)
d. NERO Guidance on ABC Control Rules and Fishery Management Plans (sent by Mike Pentony to Jessica Coakley/Chris Kellogg on 4 June 2009)
e. MAFMC ACL/AM Committee Materials (sent out by Jessica Coakley on 26 May 2009)
f. MAFMC Actions Related to ACLs and AMs
g. Summary of MAFMC SSC Meeting of 19 May 2009

ATTENDEES:

Fred Serchuk (Chair), Richard Merrick, Eric Thunberg, Paul Rago, Steve Cadrin, Jim Weinberg, Wendy Gabriel (called in).

MEETING SUMMARY:

Focus of the WG:
The 'Internal' WG reviewed meeting summaries from the first meetings of the 'Internal' (NEFSC) ACL WG (8 May 2009) and the 'External' ACL WG (29 May 2009). Previous meetings clarified principal needs that the WGs should address: **Principal short-term needs are to provide advice on what assessment updates will be done in the years between benchmark assessments, recommend what should be included in assessment updates (i.e., what data and analyses would comprise an assessment update), and advise on scheduling benchmark stock assessments for the next 2-3 years.** Principal long-term needs involve how to use new programmatic approaches for scheduling stock assessments and

examining the utility of Management Strategy Evaluation (MSE) in the NE region. Because the current fishery management system and regulations are in a state of flux, and are likely to remain in flux, the WG feels that it will be difficult to address the long-term needs at this time.

Coordination between the NEFSC, the Councils and NERO:

The previous 'External' WG meeting discussed the Council's schedule for specification setting (1-yr vs. multi-year).

> **ACTION:** The WGs need to get additional and more specific descriptions of this from both Councils so that the WG can figure out when specific assessment updates and benchmark assessments will be needed.

Scheduling Worksheet for Stock Assessments:

Based on the discussions at the first meetings of the 2 WGs ('Internal' and 'External'), the recommended approach for future assessment updates will be to monitor 'signposts and barometers' about each stock. For example, this could involve checking to see whether catches (landings plus discards) match those that were used in stock projections, and examining relevant annual abundance indices. This is likely to be made more difficult and more uncertain by the change in survey research vessels now taking place.

With the adoption of the 'signpost' approach for assessment updates, the 'Scheduling Worksheet for Stock Assessments' that is used by the NRCC will have to be re-evaluated. Several Mid-Atlantic stocks currently receive full assessment updates annually (using ageing data from the latest year). This would no longer occur. There was also discussion about some problems with the TRAC process, which might signal a change in when and where certain transboundary stocks are assessed. The WG felt that assessment updates based on the 'signpost' approach should be handed off to PDTs and Tech Committees for management purposes.

The Council's SSC are recommending additional Terms of Reference for the SAW benchmark assessments. Most of these call for estimates and descriptions of uncertainty in data inputs to models and uncertainty in BRPs. Adding TORs to benchmark assessments will probably reduce the number of stocks that can be assessed per year in the SARC process.

> **ACTION:** The 'Internal' WG is unsure whether switching to 'signposts' will require modifying FMPs. Ask the Council staff at the next meeting of the 'External' WG.
>
> **ACTION:** If the 'signpost' approach is adopted, who is going to do the analysis and what level of peer review (PDT, NEFSC, SSC)? Discuss this at next meeting of the 'External' WG.
>
> **ACTION**: For every federally managed stock, list and describe the signposts and barometers that would be examined whenever that stock has an annual update. (The WG felt that to do this properly will require significant thought, analysis and staff time. No date was set for doing this and it isn't clear who should do it.)

ACTION: Consider the tradeoff between additional TORs per assessment and fewer stock assessments.

The White Paper:

The Internal WG planned the contents of the White Paper. Fred would like to put together a draft by late July.

ACTION: Fred will send out a report outline soon.

ACTION: Fred requested that 'internal' WG members submit a 1st draft of specific sections of the White Paper by July 17:

Fred: Introduction.
Wendy: Describe surveys, dates when key data become available, fish ageing and limitations on this, and generally cover 'inputs to assessments'.
Paul: Describe the synthesis and analysis of the 'inputs to assessments', QA/QC, and production of assessment reports, dates, general timelines.
Steve C.: Describe how uncertainty needs to be parameterized in assessments, how this is used by SSCs, and the ABC setting process.
Jim: Describe the SAW/SARC process and its relationship to schedules for setting required ACLs.
Eric: Extent of peer review needed for those analyses (e.g., biennial updates of GARM multispecies stocks) conducted between benchmark assessments.
(others??).

Coordination between the 2 WGs ('Internal' and 'External'):

The NRCC charged the 'Internal' WG with producing the White Paper. The 'Internal' WG discussed the best way to integrate and get input from the 'External' WG. We also questioned how the White Paper will be received by the NRCC and the impact it will have. Some WG members felt that the NRCC should accept and adopt the recommendations that will be in the White Paper, while others questioned whether they will simply take this as advice, and seek feedback from the Councils, etc. to determine what parts to approve/adopt. We agreed that the White Paper stood a better chance of being approved/adopted if the two WGs work together on it, with the 'Internal' WG still taking the lead.

ACTION: These issues should be discussed further at the next meeting of the 'External' WG on July 2, 2009.

Meeting in Oregon:
Paul Rago is going to a meeting in July which may address some of the same assessment issues mentioned here. He can report to us on what he learned at that meeting.

Next meeting of the 'Internal' WG: July 17, 2-4 pm. (probable)

NEFSC 'INTERNAL' ACL WORKING GROUP, July 24, 2009,
MEETING #3 SUMMARY

MEETING AGENDA ITEMS:

1. Review of Meeting Summary of Last Internal WG Meeting (June 19)
2. Review of Meeting Summary of last External ACL WG Meeting (2 July)
3. Review recent SSC ABC/ACL Activities (Gabriel, Cadrin, Serchuk, Weinberg)
4. Review draft sections of NEFSC ACL White Paper
5. White Paper recommendations: Next steps?
6. Timetable for completion of Draft White Paper
7. Other concerns and issues
8. Next meeting

LIST OF DOCUMENTS:

a. Summary of NEFSC ACL WG Meeting of June 19 2009
b. Summary of External ACL WG Meeting of July 2 2009

ATTENDEES:

Fred Serchuk (Chair), Richard Merrick, Eric Thunberg, Paul Rago, Steve Cadrin, Jim Weinberg, Wendy Gabriel.

MEETING SUMMARY:

It was announced that John Boreman, the new MAFMC SSC chair, will replace Brian Rothschild on the External ACL WG.

Previous meetings were summarized. Progress was made on most of the writing assignments although there is more to do.

Most of the new discussion focused on two topics: 1.'sign posts' and 2. definitions of and distinctions between annual evaluations, assessment updates, and benchmark assessments.

1. Signposts.

   Assessment scientists will define them eventually, but in the short term, it would be a good idea for the White Paper to put forward suggestions to be used in the interim. If we are going to include this in the White Paper, when are we going to make the list of signposts by stock, and who will do it?

   We will probably do annual updates for no more than 1 year, after which we are witching to signposts.

The actual implementation of the signpost process will depend on the specification periods set by the Councils (1-yr or multi-year specs). If the Council keeps setting 1-yr specs, then there will be more pressure to continue doing/providing assessment updates.

2. Annual evaluations

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There was discussion about whether "annual evaluations" would be the same as a SAFE report (which is not really used in the NE Region compared to other regions). The WG debated, but did not draw a conclusion about whether every stock (40+) needs to have some kind of 'evaluation' every year. Not sure if this is a legal requirement. Regardless, if we go that route, then for many of the stocks only a cursory evaluation will be possible. Other tocks that are more important (for any number of reasons) would get more attention and analysis.

We discussed what the drivers would be for determining which stocks should receive more attention. The simplest approach would be to only consider stock status criteria (i.e., does it need to be rebuilt, is it overfishing or overfished?). Some did not agree with this and felt that other criteria needed to be considered. Also, if it were only based on stock status, the MAFMC would get less attention than the NEFMC.

We need to ask the External WG for clarification on who does what and when with respect to the process for setting annual specs. Would be good to get the MAFMC flow chart showing how assessment info feeds into the process.

Discussion about the White Paper and writing:

We need to add text on "time constraints" in the overall process (i.e., When data are available, Council needs, RO needs.).

Paul's tables - These are good but we have to extract and clearly write about: What do they imply with respect to ACL setting? (Related to this is that the survey timing now takes longer. We have to tell the NRCC that we are considering moving the SARC and TRAC dates.)

Draft text was submitted by Serchuk, Weinberg, Cadrin, Fogarty and Rago.

Fred would like Weinberg's Section 3 expanded because that is so important. Cadrin volunteered to tackle that.

Weinberg agreed to draft WG recommendations (focus on: What the Center can provide to support ACLs).

It was mentioned that the Fogarty text should be modified to be less like a research proposal.

Fred reminded us that we have to focus the White Paper on the main topic: **what science information can be provided to support ACLs.** This is closely tied to the TOR for the External WG: what **"assessment update information is necessary to support ABC and ACL development."** Some issues we are thinking about are related to these, but not our main focus.

July Meeting in Oregon:

Paul Rago reported that he did not learn much at this meeting of use to our WG.

Next meeting of the 'Internal' WG:

August 7. The main purpose of the next 'Internal' WG meeting will be to pull together and edit the White Paper, including revised drafts and any additional text.

Next meeting of the 'External' WG:

Sept. 10, 2009. The External ACL WG will review the draft White Paper that is being prepared by the 'Internal' ACL WG.

APPENDIX XI

Meeting Summaries of the 'External' ACL Working Group

ACL 'External' Working Group (WG); May 29, 2009 Meeting, Hotel Providence

Attendees

Steve Cadrin, Chris Kellogg, Tom Nies, Paul Rago, Brian Rothschild, Rich Seagraves, Fred Serchuk, Eric Thunberg, Tom Warren, and Jim Weinberg.

Designation of Working Group Chair and Rapporteur

Jim Weinberg volunteered to be chair and Tom Warren volunteered to be rapporteur.

List of Documents

The following documents were circulated: (1) NRCC spring 2009 action items 8 and 8a; (2) WG membership list; (3) external ACL WG agenda for May 29, 2009; (4) NEFSC ACL WG (internal WG) summary of May 8, 2009 meeting; (5) summary of stock status in Northeast region; (6) NEFMC FMP adjustment schedule; (7) NEFSC scheduling worksheet for stock assessments; (8) constraints on production by NEFSC fishery biology program, (9) excerpt from NE Multispecies Amendment 16; and (10) generic assessment terms of reference.

Working Group Goal – Scientific Support of ABCs and ACLs

The WG was formed as a result of action items developed by the NRCC, at its spring 2009 meeting. Eight people are on the NEFSC's internal working group, and eleven are on this working group (and three back-ups). The principal concern for the WG to address is how scientific information will support the new requirements of the Magnuson-Stevens Act to develop ABCs and ACLs. There are severe constraints upon the NEFSC ability to expand the scope of stock assessment and data update activities due to large number of current stock assessments and updates, groups working at full capacity (*e.g.,* age and growth), the complexity of the stock assessment process, little flexibility and static resources. There are motivations to make stock assessments age structured, and because analytical assessments require more information, workloads and resource use has increased.

The current process of stock assessments was described, as well as suggestions made regarding how to support the implementation of ABCs and ACLs. It was noted that in addition to the need to respond to new MSA requirements, other changes that may influence the stock assessment process included the calibration of the new research vessel, the longer survey period (2 weeks longer), the trend toward assessing transboundary stocks using the TRAC process instead of the SAW/SARC process, and changes in the fishing industry. Currently, stocks assessments are scheduled on a periodic basis by the NRCC in consideration of Council priorities, with managers playing a significant role in the scheduling of stock assessments. It was agreed that in the future, the stock assessment process needs to accommodate a new way of doing business.

A multi-dimensional method of determining what stock to assess, and when, may be necessary. Further, the schedule of stock assessments needs to align with Council schedules for FMP modifications.

Changes to Process and Prioritization of Stock Assessment Activities

There was consensus that changes to the current stock assessment and update process would need to be considered as short term changes and long term changes. Short term changes are needed to immediately meet the MSA 2010 and 2011 deadlines, using current resources. Increasing resources and funding is a long term strategy that would help achieve change. Other suggestions for long term changes included restructuring roles in the NEFSC (practitioners versus researchers). It would be instructive to get information from other Councils and NMFS regions to see how they are responding to new requirements.

With respect to how to prioritize stock assessment activities with limited resources, it was noted that NE multispecies stocks will be important due to the number of stocks that need rebuilding. Criteria need to be developed in order to prioritize effectively. In determining the frequency of assessment, consider factors such as stock status, rate of stock change, rebuilding date, risk to stock in the absence of information, level of uncertainty, economic importance, costs and benefits, amount of action required by the fishery to rebuild, and balancing the needs of both Councils. The process of developing a new process and effectively prioritizing will likely be an iterative process. Allocation of resources is a key question. There are a large number of inputs to stock assessments, involving different people and timelines, and bottlenecks occur. Cooperative research data is another input.

The issue of prioritization was discussed at several levels: Prioritization of stocks assessments; the prioritization of the collection and compilation of inputs for stocks assessments and updates; and prioritization of ABCs relative to the entire budget. With respect to the prioritization of information it is important to differentiate between scientific uncertainty and management uncertainty. The costs and benefits of reducing uncertainty may be different. It was noted that complex modeling of the value of information and tradeoffs may be a large source of uncertainty in itself. There is an economic model that may be of use in evaluating tradeoffs and a simple example could be used to look at the opportunity costs. A systems analysis approach was also suggested.

ABC/ACL Methods and Data Requirements

The focus of this discussion was specific data elements and the developing ABC/ACL methods.

<u>Mid Atlantic Council Activities:</u> The Council is using a two track approach: (1) An omnibus amendment and control rule for all species; and (2) a longer term approach will look at the issue from a broader perspective. Fluke will be used as a test case because it is a data rich stock, and a management strategy evaluation (MSE) will be completed. The principal responsibility for the SSC is scientific uncertainty, and there will be a line drawn between scientific and management uncertainty.

New England Council Activities: The SSC will only be addressing scientific uncertainty for the most FMPs. The New England Council will be using a more piecemeal approach than the Mid-Atlantic. The ACL will be set at less than the ABC for groundfish. For groundfish, due to the difficulty in measuring uncertainty, a single control rule will be used for many stocks, which will not be responsive to cost/benefit analyses. The monkfish FMP is discussing setting the ABC equal to the ACL, but setting an ACT below that level. The frequency of stock assessments for monkfish is important, because there is no accepted projection method.

The terms of reference for SSCs and the determination of scientific uncertainty are important. Terms of reference should be specific, provide useful information that supports the SSC work, and when possible, simple. The terms of reference of the ABC could be for current and alternate ABCs, similar to other reference points. There was agreement that the generic terms of reference distributed for SAW/SARCs were appropriate and that the PDTs or FMATs are the appropriate groups to derive the ABC values after the peer reviewed assessments. In addition to specifically addressing ABCs, the SSC could play a role in allocation of observers, which is closely related to the calculation of discards. The role of the SSC as a reviewer versus an analytical body needs to be clear in any terms of reference in order to avoid potential conflicts. One idea to accommodate the need for more time in the process of ABC development was to shorten the public comment period (on the proposed rule).

Estimation of Scientific Uncertainty: Although complex approaches such as probability density functions could be used, they can get more complex than the stock assessment itself, and as difficult to interpret. The uncertainty of stock assessment models has generally been underestimated. One element of uncertainty to present to the SSC would be how well an assessment has performed in the past at matching fishing mortalities and catches. If scientific uncertainty is correlated with management uncertainty, it will be difficult to assess the two elements separately.

Biological Metrics; Barometers and Red-Flags of Stock Status

There was agreement that the NEFSC cannot do benchmark assessments on all stocks every year, therefore the principal question of this discussion is how to monitor stock status (and develop ABCs if necessary) between stock assessments. There are some papers on the specific topic of using simpler metrics and performing a reconstruction of assessment advice, as well as scientific literature in the broad sense that supports this approach. It was noted that simple models also have major issues (e.g., missing catch data and differences in availability will impact results). The pertinent metric may be different for each species. In the past the multispecies monitoring committee used metrics such as catch and trawl survey indices. Many metrics are used without projections, but some could be used to forecast and look at deviations from the expected. Other metrics are average size, and portion mature. New methods can be tested, and simple methods may or may not be informative. The stock assessment people would be most qualified to do these analyses. Red flags should be included in the specification process or developed in benchmark assessments. There was discussion of making FMPs flexible in order to be able to respond to red-flag indicators.

Future Activities: NEFSC WG will meet on June 19, discuss this WG meeting and work on the draft white paper, for completion in July, with subsequent iterations by the fall.

External ACL Working Group; July 2, 2009 Meeting, Hotel Providence

Attendees

Steve Cadrin, Chris Kellog, Tom Nies, Paul Rago, Brian Rothschild, Mike Ruccio (Rappateur), Rich Seagraves, Fred Serchuk, Eric Thunberg, Tom Warren, and Jim Weinberg (Chair).

List of Documents

The following documents were circulated: (1) Working Group Information Packet: Agenda, NRCC spring 2009 action items 8 and 8a, Summary of 1st External Working Group Meeting, Summary of 2nd Internal Working Group Meeting, Summary of 1st Internal Working Group Meeting, Generic SAW TORs, Comments on Generic SAW TORs; (2) TRAC TORs; (3) Scheduling Worksheet for Stock Assessments; (4) Draft Timeline for Preparation of Scientific Advice for Management

Review of Past Meeting Progress (Internal & External)

Jim Weinberg began the meeting by relating several previously agreed summary statements from the 1st external working group meeting:

- That stock assessment process needs to accommodate a new way of doing business;
- That new Magnuson-Stevens Reauthorization Act (MSRA) requirements (i.*e.,* Annual Catch Limits (ACLs) and Accountability Measures (AMs), changes to NMFS survey timing, Stock Assessment Review Committee(SARC)/Stock Assessment Workshops (SAW), and the Transboundary Resources Assessment Committee (TRAC) process need to better synchronize with Council priorities and timing;
- Regarding prioritization of stock assessments: There will be short-term and long-term fixes and the new process will be iterative;
- Generic Terms of Reference (TORs) for stock assessments to meet the new ABC requirements were thought to be a good approach and appropriate;
- Plan Development Teams (PDTs) and Fishery Management Action Teams (FMATs) are appropriate groups to perform the calculations to derive Acceptable Biological Catch (ABC) based on established ABC control rules after peer-reviewed assessments (*Note: SSCs must still make the actual ABC recommendation to Councils)*;
- Benchmark assessments and stock assessment updates cannot be supported or performed with existing resources on an annual basis;
- "Signpost approaches" or interim evaluations using different metrics should be used to update and monitor stock status.

Fred Serchuk provided an update on the white paper under development and the internal working group progress. The white paper will outline how the current assessment process is performed from data acquisition, synthesis, and evaluation. The paper will highlight constraints within the process. The internal working group's current focus is on short term needs as too many things are in flux to formulate constructive approaches to long term needs. These short term needs are to identify a new process/system that is responsive to the MSRA requirements. It was stated that the existing SAW/SARC model is no longer appropriate and that the process of planning specification processes, benchmark assessments, and interim evaluations needs to be well developed for presentation to the Northeast Region Coordination Council (NRCC) during their October 2009 meeting.

A brief discussion was held on the roles of the internal and external working groups. There is some uncertainty about the actual roles and if the working groups are advisory, how input from the external group is to be handled by the internal group, and how the final product(s) will be received by the NRCC. It was stated that both working groups should endeavor to coordinate discussions, and where possible, produce recommendations on as many issues relating to a new assessment operating paradigm so that there are fewer outstanding or unresolved issues for the fall NRCC discussion.

Discussions

The scheduled agenda items were discussed in a free-form manner; hence, the summary follows the agenda loosely.

Benchmark Assessment Related Discussion:

Discussion occurred to better define what constitutes a benchmark assessment, an assessment update, and 'signpost' or interim evaluation. Many working group members sought clarification on how an interim evaluation would be utilized in the intervening years between a benchmark assessment *(i.e.,* full assessment in the current SAW/SARC paradigm) or between assessment updates (*i.e.,* current "turn of the crank" stock assessments). The concept of defining interim evaluations resurfaced multiple times during the working group discussion. In general, it appears that benchmark assessments or assessment updates would occur at some designated frequency. This may be every 3 to 5 years. These more data and labor intensive assessments would be utilized to develop multiple year ABC recommendations that, in turn, would be used to develop ACLs. In the years in between assessments, interim evaluations or 'signpost' metrics would be utilized to potentially develop ABC or inform decisions about actual stock status compared to expected performance from benchmark or assessment update projections. These interim evaluations or 'signposts' would be utilized to develop ABCs or deviate from the established ABC if the magnitude of change in the designated metric exceeded preconceived tolerances.

The working group discussed, without resolution, the periodicity of benchmark assessments. Some working group members stated that the period of time between benchmark assessments would have direct bearing on the acceptability of interim evaluation methods. Some discussion was held on the maximum number of benchmarks that could be held per year, per SAW/SARC,

TRAC, etc. It was stated that as TORs become more complex with each successive benchmark or benchmark-like assessment, that fewer can be performed. Additional analyses on scientific uncertainty and the narrow focus of TORs require participation of more individuals with broader skills both within the assessment and in peer review panels. It was stated that TOR complexity and the considerations necessary for assembling, conducting, and peer reviewing benchmark assessments, from a quality control vetting perspective, may set the maximum number range in the mid to high teens for a 3-year cycle.

The working group discussed peer review as it occurs in the current operating paradigm. It was discussed, without resolution, that adaptive peer review or some other systematic approach could be employed to mitigate the need for extensive peer review. It was suggested that external peer review could be utilized under specific criteria.

The working group discussed stock status determination criteria as provided by analytical assessments and what proxies would be established for interim evaluations or 'signposts'. The merits of producing converging products from benchmark assessment to provide a set of analytical and 'signpost' metrics for evaluation of overfishing and overfished status was discussed. Concerns were debated about risks of using interim evaluation or 'signpost' metrics to determine stock status versus calculating appropriate ABCs. The working group did not resolve the issue of stock status during the meeting discussion; however, Paul Rago offered that an upcoming meeting on simpler assessment approaches in Portland, Oregon is designed to potentially address some of these issues.

Terms of Reference Related Discussions:

The working group discussed the draft generic TORs for stock assessments previously distributed. To date, some individual SSC members had commented on the TORs. The Scientific and Statistical Committee (SSC) chairs in attendance agreed to provide a single set of comments on the draft generic TORs. The working group discussed if interim evaluations or 'signposts' should be included in the TORs. The group discussed inclusion of 'signposts' within TORs without resolution. The group discussed how TORs might direct evaluation of what metrics could be used for interim evaluations or 'signposts'. It was also suggested that TORs could direct benchmarks to establish how informative a particular signpost might be and could provide direction on when responses to 'signpost' information should be undertaken. During this portion of the discussion, the working group contemplated what actions could be undertaken following an interim evaluation or 'signpost'. Responses ranged from ABC modification to immediately revisiting the assessment or modification to the future assessment schedule.

A discussion was held on when interim evaluations or 'signpost' examination would occur. Working group members offered that the frequency of interim evaluations or 'signposts' might require annual review given the potential data lag, the need to evaluate annual catch, annual rulemaking, or other FMP requirements. Some discussion occurred on using interim evaluations or 'signposts' as biennial or triennial evaluations. There was general recognition by the working group that the frequency and magnitude of annual updates is not likely to continue, but resolution on frequency, content, responsible groups, evaluation, and resultant action from interim evaluations or 'signposts' remained incomplete.

Paul Rago provided the working group an overview of an upcoming meeting in Oregon that will examine simpler assessment approaches. The objective of the meeting is to explore simpler approaches that help alleviate workload and bottleneck issues while providing sufficiently robust stock information. Dr. Rago expects to report any applicable findings to the working group during the next schedule meeting.

The working group discussed scheduling and timing issues. Some concerns were expressed that trying to list all bottlenecks and timing constraints could lead to many matrices that would ultimately be uninformative. The working group did agree that the process is highly complex, interdependent on each successive step, and that some constraints (*e.g.,* survey timing) are universal while others may have some degree of variability (*e.g.*, regulatory process). The group found listing the universal constraints informative about data availability. The timing discussion included, without resolution, potentially conducting analysis on the optimal number of aging samples to be handled or methods for borrowing age length keys. The working group discussed the timing of the existing SAW/SARC schedule. The discussion focused on inclusion or exclusion of the most recent survey data as a means to maintain the existing schedule. It was suggested that the spring SARC might be moved from June to July and the winter SARC from December to January to accommodate the increased survey length (spring and fall surveys +2 weeks).

A brief discussion was held on modifying the rulemaking process by shortening public comment periods, decreasing internal review periods, or waiving the Administrative Procedures Act (APA) 30-day delay in effectiveness period. It was relayed that some of the legally required constraints in rulemaking cannot easily or predictably be modified.

The upcoming SAW/SARC assessment schedule was discussed. The current scheduling paradigm wherein the NRCC establishes the 2-3 year assessment schedule was relayed and discussed. The group then discussed, without resolution, objective criteria and methods for scheduling assessments. Some concerns were raised that modifying the SAW/SARC schedule might be beyond the scope of what was intended by the NRCC, however, it is clear that ad hoc changes to the assessment schedule create modifications to available resources that in turn carry potential far-reaching impacts.

During discussion on long term recommendations, the group moved back to discussion on who will develop interim evaluations or 'signposts', when such things will be in use, and how will acceptance be secured. It was evident from the discussion that interim evaluations or 'signposts' may be in use within the next two years and that there are many questions that remain unresolved. Examples and working definitions were discussed as were potential issues that may arise out of the vessel calibration exercise to be completed later this summer.

A number of critical questions were raised by the working group during the meeting. Some answers were partially developed or suggestions made, as follows:

1. *What are interim evaluations or 'signposts'?*

Interim evaluations or 'signposts' are metrics used to evaluate stock status or develop ABCs in the years in between benchmark assessment or stock assessment updates. Examples of interim evaluations or 'signposts' suggested to date: Index of stock size and exploitation--expected versus observed, recruitment--expected v. observed, exploitation rates, catch per unit of effort, survey indices, and catch.

2. *Who will develop interim evaluations or 'signposts'?*

General consensus was that stock assessment biologists or scientists were best suited to develop interim evaluations or 'signposts'. It remains unclear if such metrics will be developed and evaluated in benchmark assessments as part assessment TORs, developed separately by PDTs, FMATs, the working groups, or other as of yet unidentified processes. It is unclear how interim evaluation metrics will relate to stock status determination criteria or if FMPs will have both analytical and 'signpost' status determination criteria.

3. *When will 'signposts' by utilized and by whom?*

The majority of discussion seems to indicate that 'signpost' evaluation would occur in the intervening years between benchmark assessments or stock assessment updates. However, some discussion occurred wherein 'signposts' were used as biennial or triennial ABC setting mechanisms, suggestive that benchmark or stock assessment updates would occur at a frequency greater than every 3rd year. Discussions indicated that PDTs and FMATs are appropriate to derive ABCs using benchmark or assessment update methodology. Using that logic, it would seem appropriate for PDTs and FMATs to generate 'signposts' for SSC evaluation and subsequent ABC modification, as needed.

4. *How will 'signposts' be utilized?*

The discussions held to date indicated that 'signposts' would be used to evaluate the continued adequacy of previously established multi-year ABCs and potentially to develop ABCs for specification cycles when either a benchmark or assessment update is not performed. Presumably, when 'signposts' move outside pre-defined tolerances some pre-determined action then occurs. This could be control-rule type modification of ABCs by the SSC, independent modification of the ABCs by SSC (*i.e.*, non control rule adjustment), initiation of a more thorough assessment update, scheduling of a benchmark, or some combination thereof. It has been discussed that there are technical approaches yet to be addressed for when the level of change in a signpost has been determined to be significant and ABC must be modified. It has not been resolved if signposts will serve only as a threshold used to decrease ABC if stock metrics indicate

unfavorable conditions or if signposts will apply in a two tailed format for both ABC increases and decreases.

5. *When will 'signposts' be developed?*

General discussions indicated that the need of interim evaluation metrics or 'signposts' are necessary at a minimum within the next two years. However, it was clear from the discussions that the sooner the process can be developed, the better.

6. *How will the SAW/SARC and TRAC, etc., (i.e., benchmark assessment processes) be revised moving forward?*

Both the internal and external working group have endorsed that changes to the benchmark assessment processes may require revision in timing, planning, TORs, and frequency. The volume of assessment-related work provided by the Northeast Fisheries Science Center in recent years is unsustainable and will only increase as MSRA requirements come on line for regional FMPs. Attempts to map the critical timing of data acquisition, synthesis, and analysis in the process have clearly indicated the complexity of the process and have been informative about timing bottlenecks. There has not been clear resolution on how the processes may be modified moving forward. Suggestions have been made that the schedule for assessments could be made well in advance based on objective criteria rather than the historic practice of scheduling assessments to respond to management.

7. *How will buy in for the potential changes in assessment process and stock monitoring through 'signposts' be achieved?*

While the details have not yet been established, the external working group acknowledged that getting acceptance from industry, Councils, the NRCC, while meeting mandated requirements (*i.e.,* National Standard 2, Data Quality Act, etc.) are of paramount importance. It is unclear what the way forward will be if approval of a 'signpost' approach is not supported by the NRCC or other groups; much of the existing assessment update structure remains codified in Mid-Atlantic plans while the process is just being developed for most New England plans. It was suggested that Atlantic States Marine Fisheries Commission staff be added to the external working group for future meetings.

At the close of the meeting, it was suggested that ICES quality control type-plots be constructed and that examples of 'signposts' be developed before the next external working group meeting. The next internal working group meeting is tentatively scheduled for mid-July with the next external working group meeting date TBD.

External ACL Working Group; September 10, 2009, Hotel Providence

Attendees

John Boreman, Steve Cadrin, Chris Kellogg, Tom Nies, Paul Rago, Rich Seagraves, Fred Serchuk, Tom Warren, and Jim Weinberg.

List of Documents

The September 8, 2009 draft of the white paper to the NRCC was discussed (*"An Evaluation of Scientific and Assessment Needs to Support the Development of Acceptable Biological Catches (ABCs) and Annual Catch Limits (ACLs) for Managed Fishery Resources in the Northeast Region*").

Introduction and Goal

The agenda was discussed briefly, and the meeting goal characterized as a review of the draft report and if possible, a consensus on the recommendations of the report. It was acknowledged that this report will be just the first step in a process requiring time and transitions, and the importance of transparency was noted. The NRCC will make subsequent decisions whether and how to pursue the white paper recommendations.

Summary of Discussion

The structure of the white paper was discussed first. Summary points, and the Question and Answer format were developed after the second external working group meeting. Most of the discussion related to details of the text and recommendations, and organization of the white paper. The suggested revisions and edits will be reflected in the revised white paper and are therefore not captured in this meeting summary. Some of the important points discussed follow:

The signposts and assessment evaluations will not be used for formal stock status determinations. Staffing for technical committees of the Councils was a concern due to the anticipated increase in work load that may accompany the monitoring of ACLs, as well as implementation of new management concepts. The Northeast Fishery Science Center (NEFSC) is committed to support the technical committees. The minutes of the working group meetings will be included in the white paper appendices for transparency. The appendices will also include technical details, background and elaborations.

One concern expressed was that the underlying premise and justifications for the short term recommendations needed to be spelled out more clearly. Some of the pertinent facts are that the scheduled assessments have expanded terms of reference and are more complex (*e.g.,* evaluate and quantify uncertainty, numbers of analytic assessments; annual ABCs), and interim monitoring will need to be expanded in-between assessments. These changes involved increase workload and manpower demands. The new requirements are no optional and occur in the context of relatively fixed resources. A systematic evaluation of assessment capabilities is also important, however and optimized and/or increased resources to support assessments should not

be forgotten. The current progress of many FMPs in reducing fishing mortality has created the context that will enable us to implement signposts.

Other suggestions included that the white paper needs to provide examples of sign-posts that work, and a SARC could be convened to develop signposts. As a practical matter, the use of signposts may be limited to one or two per stock. There needs to be solid justification for changing the timing of current processes, because timing of the many elements in the process is tight.

Transition should be swift, but will be difficult and may need a transition team. After the transition period, the updates that have been done annually will be discontinued, particularly those that rely on age data. The distinction between a particular indicator, and the response to an indicator should be kept distinct in future discussions.

Future Activities

The NRCC will discuss this topic for 1 to 2 hours at its October 2009 meeting. The target timeframe for white paper finalization is the last week of September.

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