Center for Independent Experts
University of Miami

Independent Experts Report of

Peer Review of the Stock Assessment and Population Dynamics Science Meeting Durham, New Hampshire February 3-5, 2003

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Executive Summary

The Terms of Reference had three major themes: 1) survey gear and its affect of the estimates of abundance; 2) biological reference points; and 3) stock rebuilding and projections. In each case the themes led to larger issues. The gear topic focused on the power and selectivity of the gear, especially when the warps were unaligned. This topic led to the comparability of survey estimates from year to year and their use in estimating abundance. The biological reference point issue focused on selection of among stock-recruit models. Once selected, these models led to biological reference points. In several cases the biomass (usually SSB based) led to BRPs that were beyond any levelof biomass or biomass index seen to date. Model selection received a great deal of attention while model validation did not. More work on model validation would have addressed how well the BRPs, especially biomass-based references, were determined by the data rather than model extrapolation. The role of resource projections in the determination of management objectives and strategies was again well analyzed. However, the related issue of adaptive and time-dependent strategies needed more consideration. In summary, in all three cases specific questions were well addressed and investigated, but the larger issues seem to have been received less emphasis, been ignored, or left unreported. Although not a major term of reference, an alternate assessment model was presented for two cod stocks. The first issue arising from the alternate analysis was that it used different data, which led to a different view of the resource status, and in turn different BRPs. The second, larger issue was how the system that generates scientific advice can accommodate multiple models, and how to use the information afforded by these models, particularly in terms of uncertainty and risk.

Too much emphasis was given to the power of the survey gear instead of the 'comparability.' The main issue addressed was: 'was the gear stable through time so that a catch rate in the 2002 was comparable to one in the 1960s?' No gear will sample all species, so compromises must be made in their selection (general groundfish trawl or flat fish trawl or shrimp or scallops…). Once the choice is made, it should be used as long as possible, with routine mensuration to assure consistency. The work to assess the probable magnitude of the warp offset surveys, and in turn the sensitivity of the assessed stock, was thorough and convincing, but did not get to the larger comparability issue. Moreover, the need to communicate what constitutes an accurate and precise survey to stakeholders, and the difficulty in doing so, requires more attention.

The stock-recruit relationship (or some analogous model of production) is pivotal in estimating MSY, which in turn gives definitions of overfishing and overfished status. In those stocks for which sufficient data were available, a thorough and credible analysis was presented as to which model to select, which in this context is usually constrained to either Ricker or Beverton-Holt. The bigger issue of model validation, supported by the data and offering a reasonable description of recruitment dynamics, was not addressed. The need to select a stock-recruit model was driven by the need for an MSY estimate, instead of approaching the question from the perspective of what the data can support. The data requirements to support F targets are less demanding than those for biomass targets. Furthermore, the F_{MSY} estimates are usually within the range of observations, and are not extrapolations like B_{MSY}, which in many cases extend to unseen levels of biomass.

The need to define a rebuilding strategy once the resource falls beneath the biomass limits places three requirements on the advisory science: determination of current status, biomass target and rate of recovery (as a function of fishing mortality). These three requirements have been listed in order of difficulty of estimation and hence distance from an empirical foundation. The current biomass (at least to the standards of a virtual population) can be estimated without an understanding of the underlying dynamics. The biomass target needs a general relationship between stocks and recruitment. The trajectory needs a causal relationship between effort and stock and in turn stock and recruitment.

A new model for stock assessment and BRP determination was presented. It gave a view of the resource that was divergent to the accepted analysis. The scientific review system is not amenable to multiple models. It appears that if a new model is proposed an evaluation takes place (at a SARC or GARM), and the selected model becomes the one upon which the assessment, BRPs and projections are made. This winner take all scenario selection process may produce significant year to year changes in the perception of stock status with regard to the BRPs, and hence disruption to the industry. Another approach would be to maintain the non-selected model, using it as an estimate of model uncertainty to more fully capture uncertainty in risk in projections. This method would result in less specificity in advice to managers, but would provide a more realistic description of uncertainty and risk. In the present context, VPA models are used, and the criteria for replacement or joint resource description need to be investigated and codified.

Report

This report is structured to follow as closely as possible the questions asked in the Terms of Reference. Without repeating the terms here, each point will be labeled to match them with numbers and subpoints explicitly referenced. The same reference numbers will be used to link them to questions posed during the meeting (Appendix 5). General comments will follow each of the three questions.

Question 1. Trawl Survey Issues and Influence on Management Advice

For a trawl survey to be a useful index of abundance, it must be comparable over a long period of time. Its power is of less importance as long as the species of interest are adequately sampled. The project to assess the impact of the change in RV Albatross's trawl doors in 1985 is an example of the requirement to assure comparability of survey gear performance. The relative unimportance of power is a concept that has proven difficult to communicate to stakeholders, and more effort should be made to do so.

Question 1A. Are conclusions regarding use of 2000-2002 trawl survey data adequately supported…

The principle conclusions from the GARM were the identification of the affected surveys (8 since the winter of 2000), and the finding that there was "… no indication of a systematic reduction in trawl survey catch efficiency due to trawl warp offsets." The meeting further concluded that the size frequencies were not affected. Once the potential magnitude of the affect was evaluated, a model-based sensitivity analysis was performed to evaluate the size of an effect needed to change the status of a resource. GARM Figure 5.1.1 is a useful summary of the status of the stocks under consideration regarding their nearness to either the overfishing or overfished boundaries. Most sensitive were the two stocks, which were just beneath the overfished biomass boundary, and which would have had their status changed if the trawl effects were 10%. These conclusions seem well founded up to the limitations of the data.

Were analyses sufficient to detect differences in survey catches arising from unequal warps and other survey problems?
The analyses were sufficient, but the data were more problematic. Gear trials are notoriously noisy and it is not surprising that a three-day experiment was not conclusive.

Did the sensitivity analyses presented in the GARM report adequately bound the range of potential effects inferred from analyses of historical and comparative data?
Yes, the 10, 25 and 100% were reasonable magnitudes. Although, the magnitudes were all in the same direction, I acted under the assumption that the mis-configured gear had lower efficiency. In light of the number of instances where this assumption was not true, -10% and -25% perturbations would have been of interest.

Did the GARM adequately characterize the uncertainties in estimated stock sizes and rebuilding mortality rates potentially arising from unequal warp offsets?
The uncertainties are the product of the size of the warp effect, and the sensitivity of the attribute in question (e.g. stock status and BRPs) to that effect. Both of these factors were adequately considered.

Question 1B. Was the design and analysis of data from experimental trawl comparisons adequate…?

Design must be evaluated in reference to the objectives of the experiment. The control versus test gear experiment was meant to be a bounding experiment in order to investigate the maximum potential impact. If all the perturbations to the control caused responses in the same direction for all species of interest, were additive, the design was appropriate, given sufficient tows to detect a difference. The design was not adequate to ascertain causality among the perturbations, especially warp offset, given the high data variation. Gear comparisons are notoriously data hungry. Further, the design was incomplete in that it did not vary the warp offset at depth, which is not surprising given the limitations of time. As an example of the difficulty with this type of investigation, it was observed that the differences seen by the R/V Sea Breeze using the same gear were greater than the R/V Albatross using control and test gear in the same locations. Furthermore, haddock, which were well sampled, were more abundant in the test gear (although not at a statistically significant level) than in the control.

Question 1C. Advise on the significance of differences in species composition…

The R/V Sea Breeze trawl comparisons emphasize the greater power of the modern, commercial gear. The advantages of greater power must be compared to the cost of breaking a long-term and hopefully consistent survey series. Gear power is species and size specific, and many factors must be balanced to choose a single gear that is best for a multi-species survey.

The ‘other species’ may be of use for selecting years of data for which the gear was on the bottom. For example, if a selection criterion were made to select those years during which the survey was on the bottom, as evidenced by say the presence of scallops and skates in areas where they are know to be present, then the abundance of the selected years could be compared across the entire series.

Question 1D. Comment on the precision of model-based calculations of stock size…

The more important issue is that of comparability and use in estimating abundance. Although not a factor in precision, changes in comparability could lead to biased estimates of abundance. Unfortunately, it appears to be impossible to know how the gear was configured in the past or when changes drifted into rigging or practice. At least, dates

of the acquisition of new warps and gears could be checked and compared to residuals in the smoothed time series. Also, cohort strengths in species that are aged could be used to investigate the reliability of RV results by following unusually large or small cohorts. A simple bubble plot could be used to make a visual examination of the data. Further model approaches to changes in trawl performance would be to examine residuals from a VPA. One example of such an approach is in Mohn (1999).The power of the gear will be most influential in those species or size of species that are rarely caught in the traditional gear but are well sampled by a different (perhaps commercial) net.

Question 2. Biological Reference Points

Biological reference points are defined for fishing mortality (F) so as to define overfishing and biomass (B) to define overfished stocks. Once a stock has been determined to be overfished, a rebuilding strategy is required; those proposed were constant F strategies to get the resource back to B_{MSY} in a specified period. Most of the concern related to biological reference points was focused on B_{MSY} and the rebuilding. The following table is a summary of B_{MSY}'s and their relationship to present and historical biomass levels. In many cases, B_{MSY} has not been seen in the period of data, usually back to the 1960s. This data gap calls into question whether rebuilding $F_{Rebuild}$ and related time horizons are well founded. An adaptive strategy which intermittently reassesses F targets without reference to B_{MSY} would be more estimable (for example a variation on the F strategies proposed in Shepherd 1981), and a definition of rebuilt that is not dependent on theoretical levels of biomass.

Stock	B2001	Bmsy	Bmax (yr)	Survey max yr	Overfished	Bmsy Seen In
Stock	B2001	B_{MSY}	Bmax (yr)	Year of in Survey	Overfished	B_{MSY} Seen In
Stock	B2001	Bmsy	Bmax (yr)	Survey max yr	Overfished	Bmsy Seen In
GM Cod	22	82.8	24 (1990)	# 1964	Yes	Never
GB Cod	29.2	216.8	92.6 (1980)	# 1972	Yes	Never
GM Haddock	10.31	22.17	50.7 (1963)	kg 1963	Yes	VPA
GB Haddock	74.4	250.3	168 (1963)	# 1964	Yes	Never
CC Yellowtail	1.9	8.4	2.1 (1990)	kg 1979	Yes	Never
GB Yellowtail	38.9	58.8	39 (2001)	kg 1964	No	Never
SNE Yellowtail	1.9	45.2	21.9 (1982)	kg 1972	Yes	Never
MA Yellowtail	0.21	12.91	~15 (1972)	kg 1972	Yes	Never
Witch	11.3	19.9	18.1 (1982)	kg 1966	No	Survey?
Am. Plaice	13.8	28.6	46.6 (1980)	kg 1963	Yes	VPA
GM Winter Fl.	5.37	5.4	?	kg 1980	No	
GB Winter Fl.	9.8	9.4	10.5 (1970)	kg 1970	No	Survey
SNE-MA Winter Fl.	7.6	30.1	14.8 (1983)	kg 1970	Yes	Never?
White Hake	2.35	7.70	9.0 (1980)	kg 1980	Yes	Survey
Pollock	1.6	3.0	5.38 (1978)	kg 1976	No	Survey
Redfish	119.6	236.7	**	kg 1964	No	Never
Ocean Pout	2.46	4.90	~6 (1982)	kg 1981	No	Survey
N. Windowpane	0.79	0.94	~2. (1984)	kg 1984	No	Survey
S. Windowpane	0.21	0.92	~1.2 (1965)	kg 1963	Yes	Survey
Halibut	0.20	5.4	**	kg 1969	Yes	Never

** could not directly convert but MSY appears outside of observed range of observations

Table 1. Summary of biomass and biomass reference points for the stocks considered by GARM. The estimated maximum observed biomass and year of maximum in the fall survey are given. Finally, a column that summarizes if B_{MSY} was observed in either the estimated biomass or survey is compiled. These values were compiled by hand and errors could inadvertently have been introduced.

Question 2A. Comment on the technical basis for the estimation…

Question 2A1. Are the Working Group assumptions (growth, maturity ogive, natural mortality, partial recruitment) appropriate…?

There are two principal assumptions regarding these underlying biological attributes, that they are well estimated and that they are stationary. This issue was not investigated in detail either in terms of the uncertainty in the underlying attribute nor in terms of its impact on BRPs. For example, the uncertainty in natural mortality was neither estimated nor carried forward to its impact on B_{MSY}. Although MSY is relatively insensitive to natural mortality, B_{MSY} is not. Such an exercise would require considerable resources. The adaptive F based attributes are easier to evaluate and some data should be available to test their uncertainty, stationary and impact. This suggestion is based on the ability to provide defensible scientific advice, and is also contradictory to current practice and policy.

Question 2A2. Comment with reference to specific species on whether the use of Beverton-Holt type…

The model selection analysis comparing these two types of models was complete and well done. The larger question of model validation needed more consideration. Perhaps neither Ricker nor Beverton-Holt models were adequately supported by the data. This is especially important as B_{MSY} is based on extrapolations beyond the range of observations. More divergent models should also be investigated, such as non-parametric deterministic (Loess or kernel) or probabilistic (Getz and Swartzmann (1981) types. The non-parametric model without extrapolation emphasizes the relative contribution of data to model. The following sample analysis, using Gulf of Maine cod, shows the data (although not the hindcast data), and compares Beverton-Holt, Ricker and non-parametric fits.

Sample analysis

An age-structured production model similar to that used in the GARM was developed to test the relative effects of model versus data driven impacts in the setting of BRPs. While the results are similar to those in the BRP report, this model was developed only for illustrative purposes. The data for this example were copied by hand during the meeting, and errors may easily have been introduced. Also, the partial recruitment was arbitrarily increased (from 0.0134 to 0.134) on age 2 fish to force solutions nearer to the origin for the Beverton-Holt model. The upper most panel shows the three fits to the data, Ricker, Beverton-Hold and a non-parametric model. The non-parametric solution has been constrained to the range of the SSB data. In the range of the observations, all three models behave similarly, and the residuals among them are much less than the residuals to the data. It makes little difference which one is chosen. The second panel (Y-B) is the equilibrium yield as a function of the SSB. Again, the non-parametric solution is constrained to the range of SSB observations, and again all three perform similarly over this range. In this case, the dynamics of the resource outside the range of observations are entirely dependent upon the assumed model, and the two need not be bounding or even representative. Furthermore, BRPs are generally based on the extrapolated performance (see Table 1).

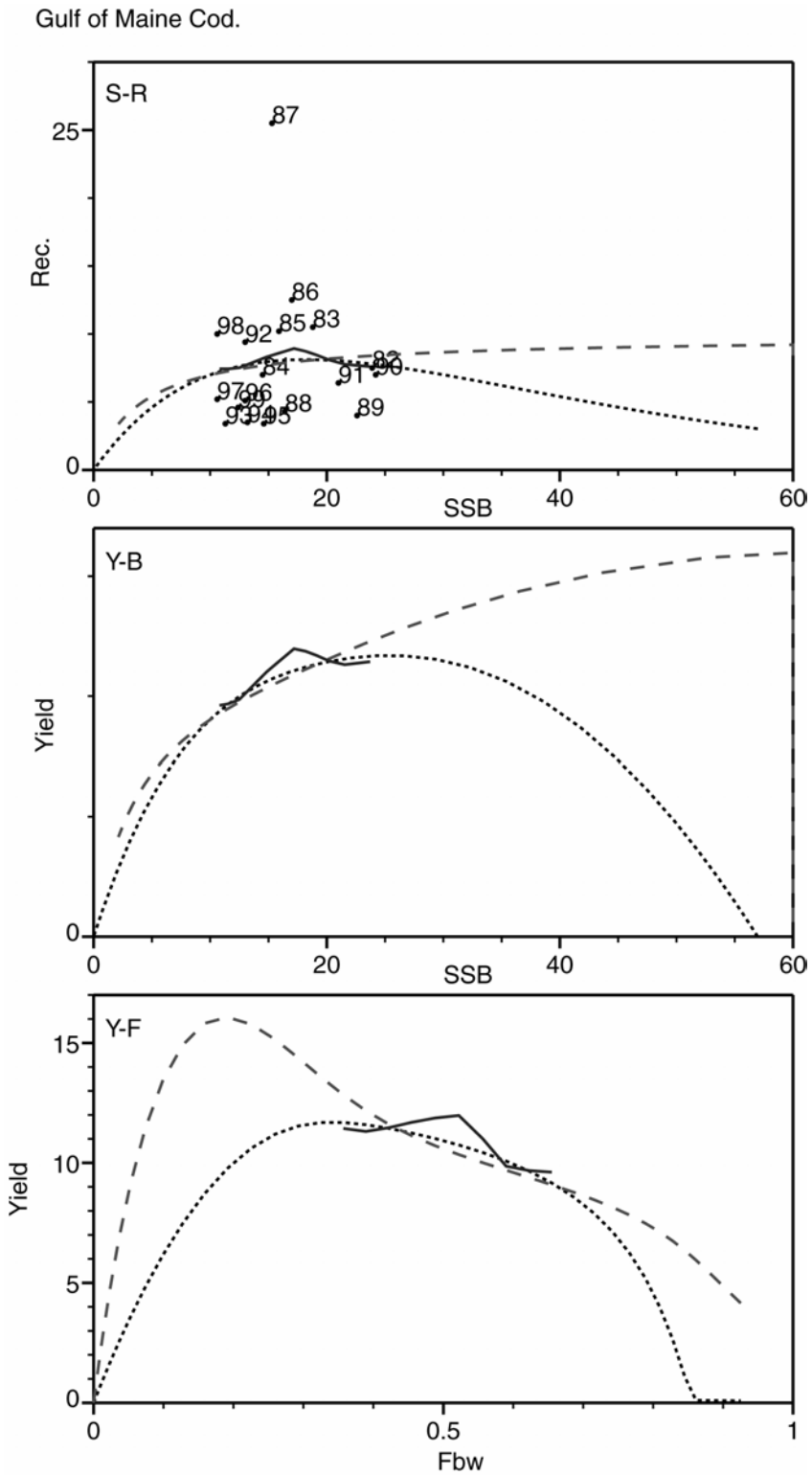

Figure 1.Equilibrium production model using Gulf of Maine cod as an example. The upper most panel (S-R) is the stock recruit data that has been fitted non-parametrically using a kernel smoother (solid line), by a Ricker curve (dotted line) and a Beverton-Holt model (dashed line). The non-parametric fit is constrained to the range of SSB data. The middle panel is the equilibrium yield as a function of SSB and the respective lines for each model shown. The lowest panel is the yield as a function of biomass weighted F.

The dynamics to the left and right of the observed data range pose separate problems. To the left is the importance (leverage) of the origin. It is very influential in the steepness of fit model. The path by which the system approaches the origin is important, especially if depensation were suspected, a characteristic of the fit model, but which is sometimes difficult to estimate unless the stock is driven to the origin. Refugia, larval drift, and migration all affect the position of the 'true' origin instead the apparent one. To the right is the realm that determines B_{MSY}. When this is an extrapolation, it could be well outside the range of biomass ever observed.

Once a VPA was fit, the survey power at age (q's) can be applied to survey estimates before the period of the VPA to get scaled estimates of abundance. These estimates were called hindcasts and used to provide priors for the stock-recruit relationships. They also may have been used to investigate the stationary nature of recruitment processes.

Question 2A3. Could alternative non-equilibrium production models…

Alternative non-equilibrium production models should be investigated, and other types of models as well. Alternative models are required to provide insight into 'model uncertainty' and a better estimation of overall uncertainty and risk. How to evaluate the divergent views from such models, and determine a best estimate of stock status and BRPs, is probably beyond the resources available for routine assessments and will require dedicated workshops.

Question 2B. Proxy reference points.

Comment on the justification for changing the overfishing threshold to $F_{40\%}$ (the proposed proxy for most groundfish stocks) from $F_{20\%}$ …

Material was not presented to evaluate this question in any detail. Reviewing earlier work, Clark (1993) and Mace, (1994, shows that extensive simulations were done with Beverton-Holt and Ricker models, and that the $F_{40\%}$ is well founded for these models. The decision to go from $F_{20\%}$ to $F_{40\%}$ was a policy-driven decision rather than a scientific evaluation of which was a better proxy for F_{MSY}. From an estimation point of view, $F_{40\%}$ is no more difficult to estimate than $F_{20\%}$. The related SSB reference points require a bit further extrapolation for $F_{40\%}$.

Question 2C. Evaluate evidence for density-dependent regulation…

Data from the survey series were presented to address biological interactions. The data did not show any such interactions, but it is not known how sensitive this analysis is. It might be informative to extend the analysis to known prey species, shrimp or sandlance, to see if an effect is seen for any species. The analysis to assess if the B_{MSY}'s could be simultaneously achieved was not presented. Extensive modeling is required to assess the ability to achieve the B_{MSY}'s simultaneously. Although no biological interactions among

species were presented, they may exist in the extremes of the B_{MSY}'s that are being sought. As well as biological interactions, models are needed to assess technical interactions in multispecies fisheries. These models would need to be spatially heterogeneous as well. These models could also estimate lost yield under different harvesting strategies. An example of such modeling is the BORMICON program developed in Iceland.

A multi-species VPA approach, or related modeling, might be useful in estimating more realistic values of natural mortality. The M's used in assessment and setting BRPs were constant over ages and years. Investigations when these assumptions are relaxed generally find age dependency and, in some cases, changes over time.

Q3. Stock rebuilding and related projections.

Although not asked for explicitly in the Terms of Reference, the issues of variable F rebuilding strategies and adaptive strategies were discussed at some length. The time varying rebuilding Fs are no less well estimated than constant F rebuilds. The problems they present are not scientific, but /rather the management framework constrains them to be beneath F_{MSY} (or F_{MSY} proxy), and some of the trajectories presented had vary low Fs as the stock rebuilt which could exacerbate discarding. Adaptive strategies in rebuilding require assessing, and responding to, deviations between the actual response of the stock to the predicted response. If the stock were rebuilding faster than expected, for example due to unexpectedly good recruitment, the F rebuild could be relaxed. On the other hand, if rebuilding were below expected levels, F would have to be reduced. Both these observations are subject to institutional and legal framework constraints. A number of non-scientific considerations would have to be kept in mind. If the updates were too frequent, it might be disruptive, but if they were too infrequent the stock could get in trouble or yield loss.

Question 3A. Evaluate the adequacy of projection methods used to guide the attainment of B_{MSY}, specifically focusing on estimates of uncertainty in starting stock sizes, recruitment, and implementation uncertainty in the attainment of target fishing mortality rates. Comment on potential biases and precision of stock projection methodologies.

Four types of uncertainty may be considered: measurement, process, model and implementation. The measurement error is well considered in the projections that have a full VPA treatment, both parametric S-R and empirical non-parametric stocks. It was not obvious in those using catch -survey data, although something might be possible with bootstrapping. Although measurement error is estimated in the production model based projections, it is probably insignificant compared to model assumptions regarding process. Process error was an explicit parameter in the projection software, but details were not given as to how it was estimated and used. The parameter was a variance term, which did not include either time or density dependent effects. These could be included if they were identified. As mentioned above, model error has not been addressed, nor has implementation error.

Question 3B. Are stock projection methodologies sufficient…?

The stock projection methodologies are sufficient to distinguish among management scenarios, up to the limits imposed by the uncertainties included.

Question 3C. The Magnuson-Stevens Act requires that overfished stocks be rebuilt to a biomass level consistent with producing the maximum sustainable yield from the fishery. Is there a scientific basis for arguing that an intermediate biomass target meets that requirement?

From a scientific point of view, an intermediate biomass target could be defended. For example, once rebuilding F and trajectories were found, the biomass target could be used as a signpost to see if the stock were on track. If a stock were not on track, an assessment would be required to determine why the stock was off track. Questions to be asked include: 'Were the projections in error?', 'Were they right, but did atypical recruitment occur?', and 'Were they right, and did predicted recruitment occurred but F was not achieved?'

Conduct of Meeting

The public portion of the meeting (February 3-5, 2003) was well conducted. The schedule was very tight in light of the number and complexity of the issues. Moreover, a good deal of time was allotted to soliciting the observations and questions of the stakeholders. There was an unusual degree of cooperation and professionalism shown by all the participants.

Three days following the public portion were given to the five CIE personnel to prepare their individual reports and a summary document. Although it was a bit contradictory to draft independent reports and require a summary document, this schedule was useful and efficient. As we were effectively cloistered, we could work uninterrupted. Secondly, it was valuable to be able to check details with one another as to what was presented and how to find supporting documentation. Information was exchanged without the constraint of consensus building.

Finally, the Terms of Reference were too optimistic both in terms of what could be covered in the public meeting and what could be assessed and condensed into the Reviewers' reports. Priorities had to be set and some items were given little or no consideration.

New Citations:

Getz, W.M. and Swartzmann, G.L. 1981.a probability transition model for yield estimation in fisheries with highly variable recruitment. Can. J. Fish. Aquat. Sci. 38:647-855

Mohn, R., 1990. The retrospective problem in sequential population analysis: An investigation using cod fishery and simulated data. ICES J. Mar. Sci., 56, 473-488.

Shepherd, J.G., 1981. Cautious management of marine resources. Math. Biosci. 55: 179-187.

APPENDIX 1

STATEMENT OF WORK

Consulting Agreement between the University of Miami and Dr R. Mohn

January 7, 2003

Introduction

This document presents terms of reference for peer review of the stock assessment and population dynamics science supporting the New England Fishery Management Council's (NEFMC's) Northeast Multispecies Fishery Management Plan (FMP). Specifically, the review will focus on three major terms of reference:

- Effects on the accuracy and present usefulness of trawl survey data due to uneven trawl warps and other recently-discovered gear-related trawl survey problems. These evaluations will be based on gear testing cruises and related workshops conducted during autumn 2002 as well as any other information available to the reviewers.

- Estimates of stock biomass and fishing mortality targets and thresholds for the complex of stocks comprising the groundfish resource, and,

- The adequacy of projections of stock rebuilding to achieve the biomass targets, consistent with time frames as mandated under the Sustainable Fisheries Act.

These three focus areas were originally proposed by the staff of the NEFMC. Specific comments appropriate to three terms of reference provide guidance to the review committee recognizing that reviewers are likely to be unfamiliar with the specifics of the Northeast Multispecies FMP and, the provisions of the Sustainable Fisheries Act. Overall, the terms of reference generally concentrate on the adequacy of the science currently available to support fishery management plan development.

For each subject area, a brief objective statement is provided to give an overall context for the terms of reference to the reviewers. Within these subject areas, specific questions are provided with the intent of providing a minimum set of questions to consider in formulating the group's responses. It is envisioned that the reviewers' responses will take the form of detailed reviews of the information and conclusions reached in the various supporting documents and verbal presentations made to the group, along with their own summaries and opinions regarding the adequacy of existing science in supporting fishery management decisions. The reviewers are encouraged to pay particular attention to alternative methods presented by independent experts, if any, in concluding whether the conclusions of the Report, or other approaches, represent the best science available.

1. **Trawl survey issues and influence on management advice**

Considering the results of the Groundfish Assessment Review Meeting (GARM), subsequent results from experimental trawl comparisons, and other appropriate information, provide an evaluation of the significance of potential differences in trawl survey catchability resulting from recently-discovered survey gear problems on management advice for groundfish stocks managed under the Northeast Multispecies Fishery Management Plan.

In responding, reviewers should consider the following:

A. Are conclusions regarding use of 2000-2002 trawl survey data adequately supported by analyses reported by the GARM? Were analyses sufficient to detect differences in survey catches arising from unequal warps and other survey problems? Did the sensitivity analyses presented in the GARM report adequately bound the range of potential effects inferred from analyses of historical and comparative data? Did the GARM adequately characterize the uncertainties in estimated stock sizes and rebuilding mortality rates potentially arising from unequal warp offsets?

B. Was the design and analysis of data from experimental trawl comparisons adequate to estimate the magnitude of differences resulting from the use of unequal trawl warps and other experimental treatments? Were estimates of the power of these experiments to detect statistical differences in fish catches between treatment and control survey configurations adequately described?

C. Advise on the significance of differences in species composition and relative catch rates resulting from side-by-side tows performed by commercial and government vessels in the recent trawl experiment with respect to model- and index-based estimates of stock size and fishing mortality rates.

D. Comment on the precision of model-based calculations of stock size and fishing mortality rates in relation to variability in trawl survey catches and other sources of information included in assessments. Are the methods used for incorporating uncertainty into management advice sufficient? How should other sources of uncertainty (e.g., model selection, estimates of total removals) be incorporated?

2. **Biological reference points**

Review the fishing mortality and biomass targets and thresholds established for the 20 groundfish stocks included in the Northeast Multispecies FMP. Consider the adequacy of technical analyses supporting estimates of F_{MSY}, B_{MSY} or their proxies, as provided in the *Report of the Working Group on Re-Estimation of Biological Reference Points for New England Groundfish Stocks* (the "Report"). Comment on issues related to the simultaneous achievement of B_{MSY} values for the groundfish complex.

In responding, reviewers should consider the following. Of particular note, the NEFMC's Science and Statistical Committee recommended that additional work was needed "…specifically to explore the implications of the uncertainty in the stock recruitment relationship." For this reason, more specific questions are included in order to add clarity to the issues to be addressed by the reviewers.

A. Comment on the technical basis for the estimation of F_{MSY} and B_{MSY}, and choices regarding the use of parametric (Beverton-Holt, Ricker, other candidate models, etc.) and non-parametric stock-recruitment relationships applied to yield per recruit estimates, surplus production models, or proxies for biomass and fishing mortality rate targets and thresholds.

- Are the Working Group assumptions (growth, maturity ogive, natural mortality, partial recruitment) appropriate for estimating a B_{MSY} proxy, which establishes a minimum biomass threshold and a rebuilding target?

- Comment with reference to specific species on whether the use of Beverton-Holt type stock-recruitment curves, as opposed to the use of dome-shaped (Ricker type) curves, represent reasonable scientific judgment employing sound methodology and appropriate data sources. Is there a theoretical or practical basis to detect overcompensation (Ricker curve) from the stock-recruitment curve for each groundfish species based on the magnitude of the intrinsic rate of population increase (r) and the carrying capacity (K) parameter estimates from ASPIC production models?

- Could alternative non-equilibrium production models for groundfish species be examined for estimating F_{MSY} and B_{MSY} thresholds?

B. Comment on the justification for changing the overfishing threshold to $F_{40\%}$ (the proposed proxy for most groundfish stocks) from $F_{20\%}$ that generally defined overfishing before Amendment 9, or from the F_{MSY} estimates in Amendment 9? Are the proposed proxies for F_{MSY} (e.g., $F_{40\%\ MSP}$ for Georges Bank haddock, $F_{50\%\ MSP}$ for Acadian redfish, etc.) more appropriate to achieve MSY, given the groundfish stock dynamics? Are the proposed proxy reference points overly conservative or too liberal for a fishing mortality threshold that complies with the Magnuson-Stevens Act?

- Reconstruction of the theoretical S-R curve can be done indirectly for each groundfish species by merging results (YPR, SSB/R) from the Thompson-Bell yield-per-recruit model and expected equilibrium yield (mt) from various stock production models. Are the resulting F_{MSY} values similar to the $F_{40\%}$ values (e.g. for haddock) from the Y/R curve? Is $F_{40\%}$ a suitable proxy for F_{MSY} under these conditions?

C. Evaluate evidence for density-dependent regulation of population size (e.g., simultaneous occurrence of various stocks at higher population sizes, predator-prey, and growth rate information) for the groundfish complex. Are potential non-stationary stock dynamic processes (i.e. environmental variations in recruitment survival) and/or trophic limitations adequately accounted for in estimates of B_{MSY}? Is there evidence that B_{MSY} values estimated for the 20 groundfish stocks cannot be simultaneously achieved?

3. Stock rebuilding and related projections

The Sustainable Fisheries Act requires that various resources be rebuilt to B_{MSY} in no more that 10 years, unless life history attributes of individual stocks dictate a longer rebuilding period (e.g. Georges Bank cod, Acadian redfish). Considering the uncertainty in stock dynamics and the ability to achieve target rebuilding fishing mortality rates for all stocks in the complex simultaneously, comment on stock projection methodology used to advise on management strategies intended to achieve stock rebuilding goals.

In responding, reviewers should consider the following:

A. Evaluate the adequacy of projection methods used to guide the attainment of B_{MSY}, specifically focusing on estimates of uncertainty in starting stock sizes, recruitment, and implementation uncertainty in the attainment of target fishing mortality rates. Comment on potential biases and precision of stock projection methodologies.

B. Are stock projection methodologies sufficient to distinguish the relative merits of various management scenarios?

C. The Magnuson-Stevens Act requires that overfished stocks be rebuilt to a biomass level consistent with producing the maximum sustainable yield from the fishery. Is there a scientific basis for arguing that an intermediate biomass target meets that requirement?

Schedule

The independent peer review is to be completed by March 1, 2003. In order to meet that deadline, the following review format and timeline is proposed.

3-5 February: Public workshop **(including participation of independent reviewers**) on the GARM Report and report of biological reference points during this week.
6-8 February: Independent reviewers meet in executive session to discuss results from the two workshops and supporting documentation.
10-14 February: Independent reviewers prepare their individual reports and submit them to the summarizer.
17-21 February: Summarizer prepares his/her report summarizing findings of individual reports prepared by panel members, which will be made available to the public.

The February 3–5, 2003 public workshop will begin with an introduction followed by a series of presentations summarizing the various documents presented to the panel. Open comment periods will allow for additional scientific input from various members of the public regarding additional analyses and comments. Peer reviewers will interact with agency and independent scientists and members of the public to ask appropriate questions and discuss results.

Specific

The consultant shall be provided with all background material required to prepare for the review, and the consultant shall attend the February 3 – 5, 2003 workshop, the February 6 – 8, 2003 executive session, and to develop an individual, non-consensus report that shall be submitted for final summarization. The report shall also be submitted to the Center for Independent Experts as a review report.

The consultant's duties shall not exceed a maximum total of 14 days: Several days prior to the workshop for document review; the three-day workshop; the three-day executive session; and several days following the meeting to complete the workshop and executive session report. The reports are to be based on the consultant's findings, and no consensus reports shall be accepted.

The consultant's duties include:

1. Reading all background material provided;

2. Participating in the February 3 – 5, 2003 workshop on the Groundfish Assessment and Review Meeting (GARM) Report and report of biological reference points;

3. Participating in the February 6 – 8, 2003 executive session to discuss results from the two workshops and supporting documentation;

4. No later than February 14, 2003, submitting a written, nonconsensus report that is based on the results of the workshops and supporting documentation, the closed door session discussions, and on the terms of reference described in the statement of work. The report should be submitted to the workshop summarizer and to the CIE[1]; the CIE report should be addressed to the "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson via email at David.Sampson@oregonstate.edu, and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu

[1] The written report will undergo an internal CIE review before it is considered final. After completion, the CIE will create a PDF version of the written report that will be submitted to NMFS and the consultant.

APPENDIX 2

TERMS OF REFERENCE FOR THE GROUNDFISH SCIENCE REVIEW, FEBRUARY 3-8, 2003

Introduction

This document presents terms of reference for peer review of the stock assessment and population dynamics science supporting the New England Fishery Management Council's (NEFMC's) Northeast Multispecies Fishery Management Plan (FMP). Specifically, the review will focus on three major terms of reference:

- Effects on the accuracy and present usefulness of trawl survey data due to uneven trawl warps and other recently discovered gear-related trawl survey problems. These evaluations will be based on gear-testing cruises and related workshops conducted during autumn 2002 as well as any other information available to the reviewers.
- Estimates of stock biomass and fishing mortality targets and thresholds for the complex of stocks constituting the groundfish resource, and,
- The adequacy of projections of stock rebuilding to achieve the biomass targets, consistent with time frames mandated under the Sustainable Fisheries Act.

These three focus areas were originally proposed by the staff of the NEFMC. Specific comments appropriate to the three terms of reference provide guidance to the review committee, recognizing that the independent reviewers are likely to be unfamiliar with the specifics of the Northeast Multispecies FMP and the provisions of the Sustainable Fisheries Act. Overall, the terms of reference generally concentrate on the adequacy of the science currently available to support FMP development.

For each subject area, a brief objective statement is provided to give an overall context for the terms of reference to the reviewers. Within these subject areas, specific questions are provided with the intent of providing a minimum set of questions to consider in formulating the group's responses. It is envisioned that the reviewers' responses will take the form of detailed reviews of the information and conclusions reached in the various supporting documents and verbal presentations made to the group, along with their own summaries and opinions regarding the adequacy of existing science in supporting fishery management decisions. The reviewers are encouraged to pay particular attention to alternative methods presented by the independent experts, if any, in concluding whether the conclusions of the Report, or other approaches, represent the best science available.

TERMS OF REFERENCE

1. TRAWL SURVEY ISSUES AND INFLUENCE ON MANAGEMENT ADVICE

Considering the results of the Groundfish Assessment Review Meeting (GARM), subsequent results from experimental trawl comparisons, and other appropriate information, provide an evaluation of the significance of potential differences in trawl survey catchability resulting from recently discovered survey gear problems on management advice for groundfish stocks managed under the Northeast Multispecies Fishery Management Plan.

In responding, reviewers should consider the following:

A. Are conclusions regarding the use of 2000-2002 trawl survey data adequately supported by analyses reported by the GARM? Were those analyses sufficient to detect differences in survey catches arising from unequal warps and other survey problems? Did the sensitivity analyses presented in the GARM report adequately bound the range of potential effects inferred from analyses of historical and comparative data? Did the GARM adequately characterize the uncertainties in estimated stock sizes and rebuilding mortality rates potentially arising from unequal warp offsets?

B. Was the design and analysis of data from experimental trawl comparisons adequate to estimate the magnitude of differences resulting from the use of unequal trawl warps and other experimental treatments? Were estimates of the power of these experiments to detect statistical differences in fish catches between treatment and control survey configurations adequately described?

C. Advise on the significance of differences in species composition and relative catch rates resulting from side-by-side tows performed by commercial and government vessels in the recent trawl experiment with respect to model- and index-based estimates of stock size and fishing mortality rates.

D. Comment on the precision of model-based calculations of stock size and fishing mortality rates in relation to variability in trawl survey catches and other sources of information included in assessments. Are the methods used for incorporating uncertainty into management advice sufficient? How should other sources of uncertainty (e.g. model selection, estimates of total removals) be incorporated?

2. BIOLOGICAL REFERENCE POINTS

Review the fishing mortality and biomass targets and thresholds established for the 20 groundfish stocks included in the Northeast Multispecies FMP. Consider the adequacy of technical analyses supporting estimates of F_{MSY}, B_{MSY} or their proxies, as provided in the *Report of the Working Group on Re-Estimation of Biological Reference Points for New England Groundfish Stocks* (the "Report"). Comment on issues related to the simultaneous achievement of B_{MSY} values for the groundfish complex.

In responding, reviewers should consider the following. Of particular note, the NEFMC's Science and Statistical Committee recommended that additional work was needed "…specifically to explore the implications of the uncertainty in the stock recruitment relationship." For this reason, more specific questions are included in order to add clarity to the issues to be addressed by the reviewers.

A. Comment on the technical basis for the estimation of F_{MSY} and B_{MSY}, and choices regarding the use of parametric (Beverton-Holt, Ricker, other candidate models, etc.) and non-parametric stock-recruitment relationships applied to yield per recruit estimates, surplus production models, or proxies for biomass and fishing mortality rate targets and thresholds.

- Are the Working Group assumptions (growth, maturity ogive, natural mortality, partial recruitment) appropriate for estimating a B_{MSY} proxy that establishes a minimum biomass threshold and a rebuilding target?

- Comment with reference to specific species on whether the use of Beverton-Holt type stock-recruitment curves, as opposed to the use of dome-shaped (Ricker type) curves, represent reasonable scientific judgment employing sound methodology and appropriate data sources. Is there a theoretical or practical basis to detect overcompensation (Ricker curve) from the stock-recruitment curve for each groundfish species based on the magnitude of the intrinsic rate of population increase (r) and the carrying capacity (K) parameter estimates from ASPIC production models?

- Could alternative non-equilibrium production models for groundfish species be examined for estimating F_{MSY} and B_{MSY} thresholds?

B. Comment on the justification for changing the overfishing threshold to $F_{40\%}$ (the proposed proxy for most groundfish stocks) from the $F_{20\%}$ that generally defined overfishing before Amendment 9, or from the F_{MSY} estimates in Amendment 9? Are the proposed proxies for F_{MSY} (e.g. $F_{40\%\ MSP}$ for Georges Bank haddock, $F_{50\%\ MSP}$ for Acadian redfish) more appropriate to achieve MSY, given the groundfish stock dynamics? Are the proposed proxy reference points overly conservative or too liberal for a fishing mortality threshold that complies with the Magnuson-Stevens Act?

- Reconstruction of the theoretical S-R curve can be done indirectly for each groundfish species by merging results (YPR, SSB/R) from the Thompson-Bell yield-per-recruit model and expected equilibrium yield (mt) from various stock production models. Are the resulting F_{MSY} values similar to the $F_{40\%}$ values (e.g. for haddock) from the Y/R curve? Is $F_{40\%}$ a suitable proxy for F_{MSY} under these conditions?

C. Evaluate evidence for density-dependent regulation of population size (e.g. simultaneous occurrence of various stocks at higher population sizes, predator-prey, and growth rate information) for the groundfish complex. Are potential non-stationary stock dynamic processes (i.e. environmental variations in recruitment survival) and/or trophic limitations adequately accounted for in estimates of B_{MSY}? Is there evidence that B_{MSY} values estimated for the 20 groundfish stocks cannot be simultaneously achieved?

3. STOCK REBUILDING AND RELATED PROJECTIONS

The Sustainable Fisheries Act requires that various resources be rebuilt to B_{MSY} in no more than 10 years, unless life history attributes of individual stocks dictate a longer rebuilding period (e.g. Georges Bank cod, Acadian redfish). Considering the uncertainty in stock dynamics and the ability to achieve target rebuilding fishing mortality rates for all stocks in the complex simultaneously, comment on the stock projection methodology used to advise on management strategies intended to achieve stock rebuilding goals.

In responding, reviewers should consider the following:

A. Evaluate the adequacy of projection methods used to guide the attainment of B_{MSY}, specifically focusing on estimates of uncertainty in starting stock sizes, recruitment, and implementation uncertainty in the attainment of target fishing mortality rates. Comment on potential biases and precision of stock projection methodologies.

B. Are stock projection methodologies sufficient to distinguish the relative merits of various management scenarios?

C. The Magnuson-Stevens Act requires that overfished stocks be rebuilt to a biomass level consistent with producing the maximum sustainable yield from the fishery. Is there a scientific basis for arguing that an intermediate biomass target meets that requirement?

APPENDIX 3

REVIEWERS AND AGENDA
GROUNDFISH PEER REVIEW (GPR)

Public Meeting – 3-5 February 2003, New England Center, University of New Hampshire, Durham, New Hampshire
http://www.necc.unh.edu/

Independent Peer Reviewers (contracted through the Center for Independent Experts (CIE: University of Miami)

Dr Ewen Bell, Centre for Environment, Fisheries and Aquaculture Science, Lowest, England

Dr Robin Cook, FRS Marine Laboratory, Aberdeen, Scotland

Dr Murdoch McAllister, Imperial College, London, England

Dr Robert Mohn, Department of Fisheries and Oceans, Halifax, NS, Canada

Dr Andrew Payne (Chair/summarizer), Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, England

Public Session Moderator

Mr Don Perkins, Gulf of Maine Aquarium

AGENDA - modified during meeting to accommodate participants' availability

Monday, 3 February

0900-1700 Public Session – Topic: **Trawl Survey Issues**

Background Documents:

-Report of the Workshop on Trawl Warp Effects on Gear Performance
http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0215/

- Report of the Groundfish Assessment Review Meeting
http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0216/

- Report of the Trawl Survey Experiment Workshop
available online

- Other contributed documents

Order of the Day:

Introduction of peer reviewers, presentation of terms of reference, and discussion of ground rules (Moderator)

Formal Presentations:

- *An overview of trawl survey issues* – **Russell Brown** (30 minutes)
- *Intervention analyses to detect trawl warp offset problems, sensitivity analyses, scale of potential offset factors*- **Paul Rago** (1 hour)
- *Trawl warp and related experiments*- **Michael Fogarty** (1 hour)
- *An evaluation of Paul Starr's analysis of the fishing gear experiment*- **Doug Butterworth** (20 minutes)
- *Comparison of length composition data from trawl experiments*- **Tom Nies** (30 minutes)

Facilitated discussion regarding presented materials in relation to terms of reference (all)

Tuesday, 4 February

0800-1700 Public Session – Topic: **Biological Reference Points**

Background Documents:

- Report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish

http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0204/

- Report of the Overfishing Definition Review Panel:
http://www.nefmc.org/documents/overfishing/

- Report of SAW 36

- Report of the Groundfish Assessment Review Meeting:
http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0216/

- NEFMC Council Meeting Report for July 2002, summarizing Scientific and Statistical Committee review of re-estimated reference points
http://www.nefmc.org
(Go to "News and Motions," then click on "Council Reports")

- Other contributed documents

Order of the Day:

Formal Presentations:

- *Re-Evaluation of biological reference points: goals and objectives*- **Steven Murawski** (1 hour)
- *A Strategy to evaluate alternative stock-recruitment models*- **Christopher Legault** (30 minutes)
- *Evidence for density-dependence in species and ecosystem responses*- **Ralph Mayo** (30 minutes**)**
- *An age-structured production model based assessment and reference point evaluation for the Gulf of Maine cod stock*- **Doug Butterworth** (1 hour)
- *Decision analyses using biological reference points in evaluating groundfish stock status*- **Yong Chen** (30 minutes)
- *Overfishing thresholds (F_{MSY}, B_{MSY}) for New England groundfish from empirically based stock recruitment models*- **Victor Crecco** (30 minutes)
- *A general biological reference point working group model*- **Andy Applegate** (20 minutes)

Facilitated discussion regarding presented materials in relation to terms of reference (all)

Wednesday, 5 February

0800-1700 Public Session – Topic: **Projections of Stock Rebuilding**

Background Documents:

-National Standard Guidelines for Overfishing Definitions: Final Rule
http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=1998_register&docid=fr01my98-23.pdf

- AgePro Users manual:

- GARM Report Revised Projections
http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0216/

- Other Contributed Documents

Order of the Day:

Formal Presentations:

- *NMFS National Standard Guidelines and Stock Rebuilding*- **Pamela Mace** (40 minutes)
- *Projection Methodologies used to evaluate medium-term impacts*- **Jon Brodziak** (40 minutes)
- *A phased rebuidling strategy, using the cod stocks from Gulf of Maine and Georges Bank as examples*- **Doug Butterworth** (30 minutes)
- *Rebuilding strategies for three key stocks*- **Dave Lincoln** (30 minutes)

Facilitated discussion regarding presented materials in relation to terms of reference (all)

Thursday, 5 February – Saturday, 8 February

Executive Session – Invited Peer Reviewers and support staff person (Karena Jolles, New Hampshire Fish and Game Department)

Discuss issues raised at public workshop and in supporting documents. Develop strategy for completing individual reports and how summarizer will convert them to a final document.

Commence the report drafting process individually and through debate.

Consult other participants for clarity purposes.

APPENDIX 4

BIBLIOGRAPHY CONSULTED/MADE AVAILABLE

1. Formal Documentation (received before or at the meeting)

Almeida, F. and L. Jacobson. Working Paper: Species Compositions from the NMFS/Industry Survey Trawl Study Conducted by the R/V *Albatross IV* and F/V *Sea Breeze* 28 October-6 November, 2002. 24 pp.

Almeida, F., and L. Jacobson. Species Size Compositions from the NMFS/Industry Survey Trawl Study Conducted by the R/V *Albatross IV* and F/V *Sea Breeze*, 28 October - 6 November 2002.

Almeida, Frank. Working Paper: Comparison of R/V *Albatross IV* and F/V *Sea Breeze* Catch during the NMFS/Industry Survey Trawl Study. Presence vs. Absence by Species. 9 pp.

Almeida, Frank. Working Paper: Composition of the R/V *Albatross IV* 'Other Catch' Component during the NMFS/Industry Survey Trawl Study Conducted 28 October-6 November, 2002. 5 pp.

Almeida, Frank. Working Paper: Cruise Report of the NMFS/Industry Survey Trawl Study Conducted by the R/V *Albatross IV* and F/V *Sea Breeze*, 28 October-6 November, 2002. 6 pp.

Brodziak, J. K. T. and P. J. Rago. AGEPRO Version 2.02 User's Guide. July 23, 2002. 107 pp.

Brodziak, Jon. Comparison of Average Catch Rates of 20 Species for Optimal and Worst-Case Scenario Net Configurations by Area. January 14-15, 2003.

Butterworth, D S, R A Rademeyer and E´ E Planganyi. An Age-Structured Production Model Based Assessment and Reference Point Evaluation for the Gulf of Maine Cod Stock. 41 pp. (3 pp. Addendum added)

Butterworth, D S, R A Rademeyer, É E Plaganyi. Results for Georges Bank Cod of Age-Structured Production Model Based Assessments Similar to those Conducted for the Gulf of Maine Cod Stock. 22 pp.

Crecco, Victor. Overfishing Thresholds (F_{MSY}, B_{MSY}) for New England Groundfish from Empirically-Based Stock-Recruitment Models. January 26, 2003. 21 pp.

Fogarty, Michael J. Analysis of R/V Albatross IV - F/V *Sea Breeze* Trawl Configuration Experiment. 9 pp.

Lovgren, Jim. Observations from the *Albatross IV* correctional cruise. February 5 2003. 4 pp.

National Oceanic and Atmospheric Administration. 50 CFR Part 600 Magnuson Stevens Act Provisions; National Standard Guidelines; Final Rule. May 1, 1998. Federal Register 63(84): 24212-24237.

New England Fishery Management Council. Council Report. July 2002. 6 pp.

New England Fishery Management Council. Correspondence received by Council regarding the trawl gear survey information.

New England Fishery Management Council. Report of the Groundfish Overfishing Definition Committee. November 27, 2000. 12 pp.

Nies, Tom. Working Paper: Analysis of Catch-at-Length Data from the NMFS Industry Survey trawl Study Conducted by the R/V *Albatross IV* and F/V *Sea Breeze*. October 28 - November 6, 2002. 18 pp.

Northeast Fisheries Science Center Reference (NEFSC) Document 02-15. Report of the Workshop on Trawl Warp Effects on Fishing Gear Performance. October 2-3, 2002. 80 pp.

Northeast Fisheries Science Center (NEFSC) Document 02-16. Assessment of 20 Northeast Groundfish Stocks through 2001. A Report of the Groundfish Assessment Review Meeting (GARM) October 8-11, 2002. 511 pp.

Northeast Fisheries Science Center (NEFSC)/Industry Cooperative Survey Gear Study 28 October-6 November, 2002. Source Document: Specifications for Construction of NEFSC Standard #36 Bottom Trawl.

Northeast Fisheries Science Center (NEFSC), National Marine Fisheries Service. Final report of the Working Group on Re-Evaluation of Biological Reference Points for New England Groundfish. March 19, 2002. 232 pp. + 163 pp. of Appendix 7.0.

Northeast Regional Stock Assessment Review Committee (36th SARC). Draft Advisory Report on Stock Status. January 2003. 50 pp.

Overfishing Definition Review Panel. Final report: Evaluation of Existing Overfishing Definitions and Recommendations for New Overfishing Definitions to Comply with the Sustainable Fisheries Act. June 17, 1998. 179 pp.

Restrepo, V.R. et al. Technical guidance on the Use of Precautionary Approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. 1998. NOAA Technical Memorandum NMFS-F/SPO-31.

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2. Presentation or illustrative material (received at the meeting)

Applegate, Andy. Handout: General Biological Reference Point Working Group Model.

Brodziak, Jon. Presentation: (Age-Structured) Projection Methodologies Used to Evaluate Medium-Term Impacts. February 5, 2003.

Brown, Russell W. Presentation: Issues with NOAA Fisheries Bottom Trawl Surveys Conducted.

Butterworth, Doug. Summary of Paul Starr's Analysis Presented to the trawl Experiment Workshop, January 14, 2003.

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Correspondence Received by Council Regarding the Trawl Gear Survey Information

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Goudey, Clifford A. Letter to Paul Howard (NEFMC). Comments on the significance of the warp offset issue and on the utility of the recent R/V *Albatross IV* and F/V *Sea Breeze* comparison cruise in determining the possible sampling errors in recent trawl surveys. January 28, 2003.

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Legault, Christopher M. Presentation: A Strategy to Evaluate Alternative Stock-Recruitment Models.

Lincoln, Dave. Presentation: Rebuilding Strategies vs. Catch.

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2. Cited material in this report not mentioned above.

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APPENDIX 5

CLOSING QUESTIONS POSED AND COMMENTS MADE TO THE PANEL BY PARTICIPANTS

Where appropriate I have added a reference back to the ToR in which I addressed the specific issues below. Although not answered specifically, the questions were considered when responding to each ToR. The numbering is the same as the main body of the report and the references are in Italics.

Doug Butterworth

1. Have ADAPT assessments explored a sufficient set of sensitivities, for example in respect of alternative values of M, and what are the implications for reference point estimates?
   See ToR 2C

2. Comment on the appropriateness of MSY-based management targets given the imprecision of the estimates and difficulties associated in particular with changes over time resulting from new data and changed methodologies.
   See ToR 2, 2A2 but emphasis was on Bmsy

3. Given the ASPM-based reference points for two cod stocks, albeit based on initial analysis, are appreciably different from those based on ADAPT methodology, how important is it that further ASPM-based results be developed to be taken into account in the next set of management decisions for these stocks?
   See Executive Summary

4. Given that assessment method, with current data, appear unable to estimate parameters such as stock-recruitment steepness (and hence B_{MSY}) with great precision, what is the potential role of adaptive management towards improving such precision? (Note the relevance of this question in respect of scientific aspects of the TOR 3C.)
   See ToR 2C, 2A, 3

5. Is it important for the Albatross to survey efficiently (as well as comparably over time) to be able to use associated swept-area estimates of absolute abundance to "ground-truth" estimates provided by population model assessment methods?

Geoffrey Smith

1. Given the fact that B_{MSY} values are generally set at one half of the carrying capacity of the stock, is it unreasonable to assume that all 19 stocks of groundfish can be rebuilt to B_{MSY} simultaneously?
   See ToR 2C

2. Do rebuilding strategies that allow continued over fishing in the near term pose a greater biological risk than those that reduce fishing mortality rates to levels at or below F_{MSY}?

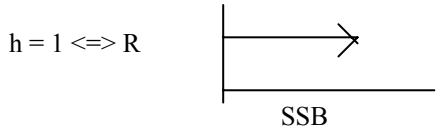
3. Is the question of the National Standard Guidelines requirement to rebuild overfished stocks to B_{MSY} in 10 years or less a scientific question or a legal and/or public policy question?

Priscilla Brooks

1. Fisheries management in the United States is governed by the Sustainable Fisheries Act and National Standards that dictate narrowly the parameters with in which management plans are developed. Pamela Mace's presentation gave you a fairly thorough overview of the law and guidelines. I believe that you must keep in mind the legal reality in which we work and in which your report will be incorporated B_{MSY} and F_{MSY} must be estimated and stocks must be rebuilt within 10 years, except in circumstances in which the natural history of the stock dictates more time. Given these realities, is the NMFS science related to the biological reference points, that is the GARM report, sound?

Jon Brodziak

1. Are the steepness parameters (h) values implied/estimated in the Butterworth production models for GOM cod credible, in the context of Myers et al. (1999. Maximum reproductive rate...CJFAS)?



Ron Smolowitz

1. What is the sensitivity of the trawl survey to towing speed changes over time?

Eric Smith

1. Perhaps a useful follow-on question is to ask "Is there justification, given scientific uncertainty in biological reference points and projection methodology, for setting a lower intermediate 10-year rebuilding target that can be adjusted upwards as the stock builds and our estimate of that value becomes more certain?" This better captures the essence of the Council's question/concern from a management standpoint. TOR 3C
   See ToR 2, 2A, 3

2. Is a Ricker-type S-R curve more (or equally) justified relative to a B-H type curve for cod and haddock? TOR 2A, bullet #2
   See ToR 2A2

Phil Ruhle

Please look over NMFS protocol for groundfish surveys, recently developed.

1. The speed issue is of great concern but the gear used is also a problem. In all other surveys gear is well addressed but NEFSC survey net design and age is 40 years. The design has not been used by industry in 20 years.

2. Bottom contact on this gear is very lax as is all aspects of handling of this gear; this is shown in NEFSC protocol as compared to other science centers.

Pamela Mace

Note about the Precautionary Approach:

1. See page 11 of Technical Guidance for a statement about how the precautionary approach is appropriate to management decisions, but not to scientific estimation of assessment-related parameters and variables.

Andy Applegate

1. Which other analytical methods can be used to validate the reference point estimates and rebuilding projections given the heavy reliance on less robust and variable recruitment estimates? How do managers use the scientific advice while this effort is made?
   See ToR 2A2

2. Are there better methods within the context of the current National Standards to evaluate the performance of the plan and monitor rebuilding of a set of multispecies fisheries?
   See ToR 2C

Tom Nies

Question on Trawl Experiment

1. Was the design of the experiment adequate to determine if errors in the trawl warp cable affected resent survey results?

   Points to consider:
   -The control net differed from the design of the survey net used for the past two years (ignoring the issue of warp length). Some differences: different doors, use of swivels on doors, different backstraps, different ground cable rigging.
   -Experimental tows were all conducted either into or with the current. Survey tows are towed in the direction of the next station, without regard to current. The experiment never towed cross-current, and a poorly rigged net may tow differently in a cross-current.
   -If, as suggested by Paul Rago based on Pennington's work, the effective sample size for frequency distributions is closely related to number of tows (as opposed to fish caught), were there enough tows to draw conclusions on catch at length/age?
   -Is the assumption of a covariate relationship between the commercial vessel and Albatross catches justified by the analysis? (I have not seen the final paper by Dr. Fogarty).
   -For the covariate analysis, how does the insertion of values for missing Sea Breeze catches affect the results?

Jim O'Malley

1. Is there evidence of any application of the precautionary principle in the assessments or rebuilding targets?

2. Is such an application legitimate in science?

David Frulla

1. If one manages towards B_{MSY} for every species in a mixed stock fishery at the same time, can this result in under utilisation of certain species? TOR 3
   See ToR 2C

2. Can differing F reduction strategies accommodate considerations relating to a mixed stock fishery, economic consideration, and uncertainties related to significantly higher new reference points, while achieving the appropriate biomass target over the relevant rebuilding period? TOR 3
   See ToR 2C