GARM III: Biological Reference Points Meeting

April 28 – May 2, 2008
Woods Hole, Massachusetts

Prepared for:
Center for Independent Experts

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1 BACKGROUND

This document reports on an independent peer review of Biological Reference Points (BRPs) for 19 northeast groundfish stocks, conducted for the Center for Independent Experts (CIE). The primary review activity was participation in the April 28- May 2, 2008 Groundfish Assessment Review BRP Meeting (GARM-III) in Woods Hole, Massachusetts.

The CIE *Statement of Work* (Appendix A) defines the scope of this review. In addition to participation in the GARM-III BRP meeting and contribution to the peer review summary report, the *Statement of Work* requests an independent peer review report of the soundness of the science, methods and results with regard to each of the meeting Terms of Reference (TOR, Appendix A). The meeting agenda was extensive, including papers and discussion of ecosystem considerations, influence of trends in stock productivity and retrospective patterns, and methods for determining BRPs for each of the 19 GARM stocks (Appendix B).

The BRP meeting builds on previous GARM-III meetings that reviewed data and appropriate methods for analyzing the data (Data Methods) and methods and modelling approaches (Modelling) for each of the 19 groundfish stocks. A final GARM-III meeting will be held in August 2008 to finalize assessment models, BRPs, and initial conditions for stock forecasts.

A GARM-III BRP Panel Summary Report was drafted by the chair and reviewers during the review meeting and finalized in the two weeks following the review. Panel members agreed to all major issues and recommendations with respect to the TORs, and the Panel Summary Report represents the consensus view. This report, prepared for the CIE, focuses on the findings that I found most pertinent to the conclusions resulting from the BRP meeting. Detailed discussion of the rationale for the BRPs developed for each stock are provided in the Panel Summary Report and are not reiterated here.

2 SUMMARY OF FINDINGS RELATIVE TO TORS

2.1 TOR 1 (RETROSPECTIVE PATTERNS)

For relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting.

Retrospective patterns that persist in one direction imply bias in the estimates of abundance (and hence fishing mortality rates) for the terminal years of the assessment. This bias will directly affect the initial conditions for stock projections, primarily through misspecification of the numbers at age but also potentially through misspecification of the partial recruitment vector (PR). The effect on BRP calculations should be relatively minor; only a small proportion of the recruitment estimates used in the BRP calculations will be biased. For BRPs based on F%MSP, bias in the PR would result in a biased F_{msy} proxy, however the same PR would be used in stock projections so there would be internal consistency.

A number of GARM stocks show persistent retrospective patterns whereby terminal year spawning stock biomass (SSB) is overestimated and fishing mortality rates underestimated. For stocks exhibiting this pattern, the GARM III "Models" review suggested using a "SPLIT" model parameterization (assuming a change in survey catchabilities in the mid 1990s). In many cases this resolved or minimized the retrospective pattern, which should result in unbiased stock projections.

The "SPLIT" approach for resolving the retrospective pattern is somewhat unsatisfactory because the underlying mechanism is not identified. Factors other than changes in survey catchability, such as increased natural mortality (possibly the result of low abundance) or unreported or unidentified fishing mortality (e.g., mortality of fish that escape the larger mesh cod ends), may underlie the retrospective pattern. Because the reason for the retrospective pattern is unknown, it may be difficult to identify if or when conditions revert to those associated with the pre-SPLIT period. This could be aggravated with a new survey vessel in 2009, if conversion factors for the vessel are uncertain.

Not all retrospective patterns were fully resolved using the SPLIT model approach. A paper evaluating alternative methods to account for retrospective bias in stock projections was presented. Although results from the analyses were not definitive, they did provide a preferred method for adjusting initial conditions for forecasting when retrospective patterns are present. The method is appropriate to use for projections and stock rebuilding scenarios that arise from the GARM III "Final" meeting stock assessments and it should minimize bias in the projections. It would be useful to have an objective basis for assessing whether retrospective patterns are "significant", and hence require adjustments for stock projections. A statistical measure, combining the persistence and magnitude of the retrospective pattern, could be developed to assess the significance of retrospective patterns.

While the accepted method for adjusting initial stock conditions when retrospective patterns exist is a considerable step towards minimizing projection bias, additional simulation work is required. The method assumes the stock reconstructions using the full data series are correct. A management strategy evaluation approach (e.g., Stokes et al. 1999, and papers therein), with an operating model where "true" conditions are known, would facilitate further investigations to determine how best to deal with retrospective patterns in stock projections.

The consistency in retrospective patterns for a number of GARM stocks suggests some common underlying mechanism. Comparison of species/regions where the SPLIT parameterization resolves the retrospective and comparison of patterns in the relative changes in the age-specific catchability estimates may provide some insight to the underlying mechanism that manifests as a change in catchability.

2.2 TOR 2 (TRENDS IN STOCK PRODUCTIVITY)

a.) For relevant stocks, identify trends in biological parameters (i.e., life history and/or recruitment) and assess their importance for the computation of BRPs and for specification of rebuilding scenarios;

b.) If possible, summarize trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to BRPs.

A majority of the GARM stocks show significant trends in recent growth (length- and weight-at-age) and maturation, with a general trend towards reduced growth and delayed maturation. The relative influence of density-dependent and environmental factors on these life history characteristics has not been assessed;

compilation of a number of environmental variables for GARM-III will facilitate further work in this area, possibly with a meta-analysis approach to increase statistical power.

For all GARM stocks, BRPs were calculated using the mean of the most recent five years for weights-at-age, partial recruitment (fishery selectivity), and the maturity ogive (except where there was no trend or minimal sampling). These should provide the best estimates of short to medium term stock productivity, and are therefore appropriate for BRP calculations. For stocks that exhibit strong recent trends (e.g., GB haddock weight-at-age) the five year averages may not be appropriate for stock projections or rebuilding scenarios. For those cases, the most recent estimates or forward projection of the trends may provide more accurate estimates of future (short-term) life history parameters.

For the GARM stocks, the recruitment series used to calculate BRPs were selected to reflect the long-term stock productivity. A number of the stocks exhibit poor recruitment and low spawning stock abundance in recent years, and it is unclear if the reduced recruitment is caused by environmental or stock conditions. If lower recruitment is the result of a shift in environmental conditions which persists, BRPs calculated based on higher average recruitment levels may be unattainable. However, the burden of proof must lie on demonstrating that recent lower average recruitment is related to environmental changes rather than low spawning stock abundance, before adjustments are made to BRPs.

Stock projections and rebuilding scenarios should use the same recruitment assumptions as used in calculating BRPs. However, environmental or depensatory stock-recruitment effects may imply that short-term rebuilding targets are unattainable even with little or no fishing pressure.

2.3 TOR 3 (ECOSYSTEM APPROACHES TO GULF OF MAINE/GEORGES BANK FISHERIES)

a.) Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem;

b.) Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches.

A series of five papers presented a range of analyses to address questions related to the production potential of the Northeast Continental Shelf and whether the ecosystem is capable of simultaneously supporting all GARM species at their individual B_{msy} levels. The body of work undertaken was significant and the results constitute a major step forward in understanding the dynamics of the ecosystem. Results, however, were not definitive and it would be premature to adjust stock-specific BRPs on the basis of these analyses.

The first paper expressed B_{msy} targets for GARM, pelagic, and elasmobranch species in terms of fish density $\left(t/km^2\right)$, and found that results were in general agreement with values found for other temperate marine ecosystems.

The second paper presented analyses based on an *Ecopath* simulation of the Northeast Continental Shelf. *Ecopath* energetics were “balanced” based on current biomass estimates for the major fish components, and then the system was perturbed by changing the abundance of one component. While results suggested the GARM species could not rebuild to all their B_{msy} levels, these are somewhat suspect

because all perturbations resulted in conditions reverting towards the initial conditions. That is, results may be highly dependent on the initial "balancing" of the ecosystem. A test of this would be to perturb the system to some previous known configuration, for example that of the early 1980s when the majority of GARM species were at high abundance relative to current levels. If the *Ecopath* dynamics are not constrained by the current "balancing", biomass conditions for the early 1980s should be supported by the system.

The third paper presented results for an aggregate production analysis of the GARM stocks and concluded that the aggregate yield (*MSY*) and the biomass that supported the maximum yield (B_{msy}) is lower for the aggregate than the sums for the individual GARM species. This approach to addressing the question of the production potential of the fishery has considerable merit and further work with the aggregate production model is warranted. Results of the analysis suggested the aggregate GARM species abundance was at virgin or carrying capacity $(B_0$ or $K)$ in 1960. This seems highly implausible, given a long exploitation history for the GARM species prior to 1960. Development of a prior for the initial status (B_{1960}/B_0), even if the prior is somewhat *ad hoc*, together with a Bayesian analysis would allow exploration of the uncertainty in the parameters of interest (*MSY* and B_{msy}).

The fourth paper presented results from an aggregate and multi-species production dynamics simulation model. The primary objective of the work was to emphasize the importance of species interactions; often harvest was a low source of "loss" relative to species interactions.

The final paper investigated fishery yield based on primary production and energy transfer through successive trophic levels. The paper concludes that harvesting of GARM species, pelagic species, small elasmobranchs, and bivalve species at *MSY* levels accounts for 70 – 83% of the estimated production potential. This represents an undercounting because it does not include all species and discards. Additionally, consumptive demands of marine mammals, large sharks, sea birds and sea turtles are not included. Overall, the amount of primary production available may limit the production potential of the GARM species. This approach of studying primary production and energy flow through higher trophic levels has excellent potential for understanding the dynamics and limitations of the ecosystem. Concepts presented in the paper related to ecosystem overfishing merit further investigation.

Overall the analyses related to the production potential of the Northeast Continental Shelf ecosystem represent a significant body of work that contribute to the understanding of the dynamics of this ecosystem, and further work along these lines should be encouraged. In particular, studies to investigate if there have been shifts in the system energetics, as suggested by a shift from finfish to bivalve dominated catch, could provide insight to the current production potential of GARM stocks relative to the historical potential.

2.4 TOR 4 (BIOLOGICAL REFERENCE POINTS)

a.) For each stock, list what the <u>current</u> BRPs and/or BRP Proxies are (e.g., B_{MSY}, B_{MAX}, F_{MSY}, $F_{40\%MSP}$, historical survey catch per tow, etc.), and give their values (i.e., typically from GARM II);

b.) For each stock, update or redefine BRPs or BRP proxies that will be used for stock status determination, and compute their expected values and precision. Note: These BRPs and their proxies must be comparable and consistent with outputs from the recommended assessment models from the GARM III "Modeling" Meeting.

The analyses undertaken to develop BRPs for the 19 GARM stocks builds on considerable work conducted previously and evaluated at the GARM-III "Data Methods" and "Modelling" reviews. In general, the new or updated BRPs were based on methods or models recommended at the "Modelling" meeting. The rationale for the approach used to calculate the BRPs for each of the 19 GARM stocks is presented in the Panel Summary Report, and is not repeated here. For all the GARM stocks, the data, models, and methods employed for the BRP calculations were appropriate and used correctly. As such, the BRPs provide a scientifically credible basis for developing fishery management advice.

Where adequate data were available analytical assessment models were used to develop BRPs for the GARM stocks. These were primarily catch-age models (VPA and ASAP), though Atlantic Halibut were assessed using a production model. For the remainder of the stocks (two windowpane flounder stocks, pollock, and ocean pout) an index-based method (AIM) was used. In all cases the best use was made of the available data.

For stocks where catch-age models are used, there is the potential to derive analytical estimates of BRPs $\left(B_{msy} \text{ and } F_{msy}\right)$ based on stock-recruitment (SR) analyses. However, the spawning stock biomass (SSB) and recruitment data should be informative with respect to the SR relationship (i.e. R_0 and steepness) for this approach to be adopted. For the GARM stocks, the SSB and recruitment data are generally uninformative about SR parameters because the SSB observations are at low levels relative to B_{msy} and B_0. For some of the SR analyses tight priors were placed on the R_0 parameter, however the priors were *ad hoc* and the resultant BRPs highly dependent on the prior. An alternative approach, developing priors for steepness, may show greater utility in the future. There is a growing literature where meta-analytical approaches have been used to derive steepness priors for fisheries resources that can direct the development of these priors (Myers et al. 2002; Myers et al. 1999).

BRP proxies in the form of Y/R analysis and % Maximum Spawning Potential (MSP) were adopted for a majority of the GARM stocks because the S-R analyses were considered unreliable to inform analytical estimates. The proxies were generally based on 40%MSP, except for the long-lived redfish where a 50%MSP proxy was selected. These proxy values are appropriate and consistent with generally accepted fisheries practise. The %MSP proxies should be conservative relative to analytical BRPs unless the S-R steepness is extremely low (i.e. <0.4).

The %MSP approach requires an average recruitment (or distribution of recruitment) to derive BRP proxies. A number of the GARM stocks exhibit low SSB and low recruitment in recent years. It is unclear if the low SSBs are a function of poor recruitment or poor recruitment is a function of low SSBs. However, without a demonstrated environmental cause for recent poor recruitments the conservative assumption, that the historically higher recruitment levels reflect the long-term productive potential of the stocks, should be the default. For stocks which exhibit the pattern of low recruitment at low SSB a "razor" approach (minimizing the total variance from two mean recruitment levels) was adopted to determine the SSB level (SSB *threshold*) below which there was a reduction in average recruitment. The recruitments observed at SSBs above the *threshold* were then used to estimate the BRPs. This pragmatic approach to distinguishing the SSB level below which recruitment may be reduced ensures a consistent approach among stocks for determining the recruitment series to use in calculating BRPs.

For the GARM stocks where BRP calculations were based on outputs from catch-age analysis, a forward simulation method (AGEPRO) was used to estimate B_{msy}. That is, F_{msy} proxy values were based on the yield per recruit %MSP, and B_{msy} was the median long-term average SSB resulting from a constant

F_{msy} fishing rate. The rationale for selecting the median SSB was to have the reference point consistent with the rebuilding target (i.e. to satisfy the requirement that rebuilding plans ensure a 50% probability of achieving B_{msy} within a specified time period). The use of the median SSB differs from the standard definition of B_{msy}, which is the average biomass that results from fishing at F_{msy}. There is no inherent reason that long-term fishing at F_{msy} need achieve rebuilding targets, and the standard definition of B_{msy} is use broadly and consistently in the fisheries community. The re-definition of B_{msy} for GARM-III should be reconsidered.

The majority of catch-age analyses (VPA and ASAP) for the GARM stocks were based on short time series, restricted to the period where age composition data for the catch are available. For most stocks the time series of trawl surveys is considerable longer (generally beginning in 1963) and the catch time series even longer. Development of statistical age-structured model(s) to incorporate all the data should be supported as the longer catch time series would provide information about the average historical level of recruitment (R_0) that is consistent with removals, and hence facilitate calculation of analytical BRPs. A paper addressing the question of the relative accuracy and precision of VPA and a statistical catch-age model (ASAP) for estimating SR parameters concluded that statistical catch-age models performed poorly. However, results of this analysis appeared suspect (e.g., high accuracy and precision in steepness estimates in conjunction with consistent relative bias in R_0 estimates) and the equations used for the simulation/analysis experiment should be verified for internal consistency.

2.5 TOR 5 (FORECASTING AND REBUILDING)

For each stock, identify appropriate models for forecasting and for evaluating rebuilding scenarios.

There were no papers presented that dealt specifically with models to use in forecasting and evaluation of rebuilding scenarios. Implicit in the selection of models for calculating BRPs is the assumption that the same models will be used for conducting assessments and hence specifying the initial conditions for stock projections. The PR vectors, weights-at-age and maturity-at-age used for calculating BRPs are also appropriate for stock projections, except as noted in section 2.2 (i.e. if there are strong trends in weights-at-age, then the most recent or projected values may be more appropriate than the 5-year average).

The question of the appropriate recruitment series to use in stock projections is more problematic. Methods used for forecasts and rebuilding scenarios should be consistent with those used for BRP calculations. For stocks that are above the SSB *threshold*, or for which no *threshold* level was determined, the recruitment series (cumulative density function, CDF) that were used to calculate the BRPs are appropriate for stock projections. For stocks that are below the SSB *threshold*, the consistent approach would be to sample from the CDF of recruitments observed where SSB was below the *threshold* until the SSB exceeds the *threshold.* This approach, however, may lead to other inconsistencies. For example, if the recruitment CDF for the below *threshold* SSB does not rebuild the stock above the SSB *threshold* level. These issues will require resolution at the GARM-III "final" meeting.

3 CONCLUSIONS AND RECOMMENDATIONS

The GARM-III process is thorough, rigorous, and well-designed to ensure management is based on scientifically sound analyses. The review structure includes four separate meetings directed to reviewing data and data-methods, reviewing assessment models and methods, defining BRPs, and finalizing assessments and results. Well-defined terms of reference for each meeting ensure that objectives are met and that end products are useful to the overall process.

The GARM-III process is highly ambitious, developing and reviewing assessments for 19 stocks. This creates a large work load for the reviewers, and more importantly for the NEFSC stock assessment staff. While the objectives for the GARM-III "BRP" meeting were fully met and the basis for defining and calculating biological reference points for all 19 GARM stocks achieved, time for greater in-depth evaluation of some issues would have been useful. Future GARM processes should consider covering only a sub-set of the 19 stocks so each receives greater in-depth attention.

Many of the GARM stocks are currently at historical low levels and are under rebuilding deadlines. The potential for these stocks to rebuild will be highly dependent on future recruitment. The methods used to determine BRPs for the GARM stocks were based on recent weights and maturation at age but assumed recruitment levels intended to approximate long-term average productivity. Recent poor levels of recruitment for some of the GARM stocks may be related to low spawning stock biomass or to prevailing environmental conditions. If the poor recruitments continue it may be difficult or impossible to attain rebuilding objectives.

The BRPs developed for the 19 GARM stocks are based on theoretically sound analyses and as such they provide a reasonable basis to inform management decisions. The data used were appropriate, and models and methods used to calculate BRPs made full use of the available data.

4 REFERENCES

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Stokes, T.K, D. S. Butterworth, R. L. Stephenson, and A. I. L. Payne. 1999. Confronting uncertainty in the evaluation and implementation of fisheries-management systems: Introduction. ICES J. Mar. Sci. 56: 795–796.

APPENDIX A. STATEMENT OF WORK

Statement of Work for Vivian Haist

External Independent Peer Review by the Center for Independent Experts

GARM-III "Biological Reference Point" Meeting:

Meeting Date: April 28 – May 2, 2008

Statement of Work (SOW) for CIE Panelists

(including description of GARM-III Chairman's duties)

GENERAL

The Groundfish Assessment Review Meeting (GARM) brings together stock assessment experts to peer review work on the status of 19 important fish stocks that are managed by the New England Fishery Management Council. GARM-III takes place in 2007-2008, and it will consist of four meetings that are cumulative in nature (i.e., successive meetings incorporate methods and results that were accepted at previous GARM-III meetings). Each meeting will have a chair as well as external panelists. A brief description and dates of the four GARM-III meetings are given below:

1. "Data Methods" Meeting (October 29 – November 2, 2007)
Review the commercial and survey data that will be used in the stock assessments. Identify appropriate statistical methods for analyzing those data (including bycatch and discard issues, changes in growth rates and other life history traits, issues related to merging databases, etc.). Other sources of data to be considered are tagging programs for cod and yellowtail flounder, and Industry-Based Surveys. Candidate sources of data relevant to ecological and ecosystem considerations will also be described.

2. "Modeling" Meeting (February 25 – 29, 2008)
Determine the most appropriate stock assessment methods and models for each of the 19 stocks. Perform runs of those models to obtain results (historical and current estimates of F and B) based on commercial and survey data, probably through calendar year (CY) 2006. The runs of the models will be used to evaluate diagnostics of model fit and appropriateness, including retrospective analyses.

3. "Biological Reference Point (BRP)" Meeting (April 28 – May 2, 2008)
Update or redefine BRPs for each of the 19 stocks. Use data available through CY2006. Consider whether the BRPs are reasonable in light of results from the "Modeling" Meeting. Define the appropriate initial conditions for forecasting and rebuilding strategies, particularly with respect to trends in biological attributes, recruitment and survival rates. Comment on relevant ecosystem considerations as they relate to rebuilding strategies.

4. GARM-III "Final" Meeting (August 4 - 8, 2008)

Use all of the methods proposed from the previous three meetings, along with survey and catch information through CY2007, to estimate historical and current fishing mortality rates and biomass for each stock. Based on procedures from the BRP Meeting, finalize the BRPs, appropriate initial conditions, and biological assumptions related to forecasts. Determine the status of each stock.

This SOW applies specifically to the GARM-III "Biological Reference Point (BRP)" Meeting, which will take place at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts, from April 28 – May 2, 2008. The meeting will have a chairman (non-CIE) as well as external panelists, three of whom will be provided by the Center of Independent Experts (CIE).

Overview of CIE Peer Review Process:

The Office of Science and Technology implements measures to strengthen the National Marine Fisheries Service's (NMFS) Science Quality Assurance Program (SQAP) to ensure the best available high quality science for fisheries management. For this reason, the NMFS Office of Science and Technology coordinates and manages a contract for obtaining external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of stock assessments and various scientific research projects. The primary objective of the CIE peer review is to provide an impartial review, evaluation, and recommendations in accordance to the Statement of Work (SoW), including the Terms of Reference (ToR) herein, to ensure the best available science is utilized for the National Marine Fisheries Service management decisions.

The NMFS Office of Science and Technology serves as the liaison with the NMFS Project Contact to establish the SoW which includes the expertise requirements, ToR, statement of tasks for the CIE reviewers, and description of deliverable milestones with dates. The CIE, comprised of a Coordination Team and Steering Committee, reviews the SoW to ensure it meets the CIE standards and selects the most qualified CIE reviewers according to the expertise requirements in the SoW. The CIE selection process also requires that CIE reviewers can conduct an impartial and unbiased peer review without the influence from government managers, the fishing industry, or any other interest group resulting in conflict of interest concerns. Each CIE reviewer is required by the CIE selection process to complete a Lack of Conflict of Interest Statement ensuring no advocacy or funding concerns exist that may adversely affect the perception of impartiality of the CIE peer review. The CIE reviewers conduct the peer review, often participating as a member in a panel review or as a desk review, in accordance with the ToR producing a CIE independent peer review report as a deliverable. The Office of Science and Technology serves as the COTR for the CIE contract with the responsibilities to review and approve the deliverables for compliance with the SoW and ToR. When the deliverables are approved by the COTR, the Office of Science and Technology has the responsibility for the distribution of the CIE reports to the Project Contact.

Requirements for CIE Reviewers:

Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the Terms of Reference (ToR) herein. Each CIE reviewer's duties shall not exceed a maximum

of 14 days conducting pre-review preparations with document review, participation on the GARM panel review meeting, editorial assistance to the GARM Chair, and completion of the CIE independent peer review report in accordance with the ToR and Schedule of Milestones and Deliverables. CIE reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Reviewers should have experience in development of biological reference points that includes knowledge for the varying quality and quantity of data available to support estimation for individual fish species living within the ecosystem. Expertise should include statistical catch-at-age, traditional VPA approaches, and index-based methods. Desirable background includes life-history theory, risk analyses, stock-forecasting methodology, and ecosystem fisheries ecology. Some experience with groundfish (such as cod, haddock, flounder) population dynamics would be useful.

Specific Activities and Responsibilities

The CIE's deliverables shall be provided according to the schedule of milestones listed on page 6. The GARM Chair will use contributions from the CIE panelists, as well as from other external panelists, to produce the GARM Panel Summary Report. In addition, each CIE panelist will write an individual independent report. These reports will provide peer-review information for a presentation to be made by NOAA Fisheries at meetings of the New England and Mid-Atlantic Fishery Management Councils in 2008. The GARM Panel Summary Report shall be an accurate representation of the GARM panel viewpoint on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1). The report shall also contain recommendations for improvement that might be implemented in a future GARM meeting.

Charge to GARM panel

The panel is to determine and write down its viewpoint on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1). Criteria to consider include whether: (1) the data are adequate and were used properly; (2) the analyses and models were appropriate and correctly accomplished; and (3) the conclusions are correct/reasonable. Where possible, the chair shall identify or facilitate agreement among the panelists regarding each Term of Reference.

During the course of the review, the panel is allowed limited flexibility to deviate from the results and recommendations of earlier GARM-III meetings. This flexibility may include only minor alterations in procedures previously established at the peer review of the "Data Methods" Meeting in October 2007 and the "Modeling" Meeting in February 2008. Large scale changes, such as changing a stock definition would not be possible in view of the difficulties of implementing these changes in time available before the final GARM meeting in August 2008.

Furthermore, if the panel rejects certain assessment models or Biological Reference Points (BRP), the panel should explain why they are not suitable, and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing (status quo) models and/or BRPs are the best available at this time.

Roles and responsibilities

(1) Prior to the meeting

(GARM Chair and CIE panelists)

Background reports will be provided to the CIE reviewers in advance of the GARM review meeting.

(2) During the Open meeting

(GARM Chair)

Act as chairperson, where duties include control of the meeting, coordination, facilitation of the presentations and discussions, and ensuring that all Terms of Reference of the GARM are reviewed and completely addressed.

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses and when possible, suggest improved approaches. It is permissible to discuss the working papers, and to request additional information to clarify or revise existing analyses, if that information can be produced rather quickly.

(CIE panelists)

Participate in panel discussions on the quality and soundness of the science, methods and results with regard to each Term of Reference (see Annex 1).

During the question and answer periods, provide appropriate feedback to the assessment scientists on the sufficiency of the analyses. It is permissible to request additional information if it is needed to clarify or revise existing analyses, if that information can be produced rather quickly.

(3) After the Open meeting

(GARM Chair, CIE and non-CIE panelists)

The GARM Chair will lead preparing, editing, and completing the GARM Panel Summary Report, based on contributions from the panelists (CIE and non-CIE). This report (see Annex 3 for information on contents) is to comment on the quality and soundness of the science, methods, and results with regard to each Term of Reference. If any modeling approaches and/or BRPs are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

The panelists and the chair will discuss whether their views on each Term of Reference can be summarized into a consensus conclusion. In cases where multiple, differing views exist on a given Term of Reference, the GARM Panel Summary Report will note that

there was no consensus and will summarize the various opinions and the reason(s) for these.

(GARM Chair)
The Chair's role during GARM Panel Summary Report development will be to facilitate rather than to force consensus from the panel.

The GARM Chair shall prepare the introduction to the GARM Panel Summary Report, summarizing the background of the work to be conducted as part of the review process, and whether the process was adequate to successfully address the Terms of Reference. As appropriate, the chair will include suggestions (in an Appendix) on how to improve the process.

The GARM chair will finalize all editorial and formatting changes of the draft GARM Panel Summary Report prior to its final approval by all panelists. The GARM chair will then submit the approved GARM Panel Summary Report to the NEFSC contact (i.e., SAW Chair).

(GARM CIE panelists)
Each CIE panelist shall prepare a CIE independent peer review report (see Annex 2). This report should comment on the quality and soundness of the science, methods, and results with regard to each Term of Reference.

If any modeling approaches and/or BRPs are considered inappropriate, the CIE independent peer review report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

During the meeting, questions which are not in the Terms of Reference but are directly related to the meeting may have been raised. Questions not explicitly referenced in the TOR but relevant to its intent can be documented and addressed.

Schedule of Milestones and Deliverables

The milestones and schedule are summarized in the table below. No later than May 16, 2008, the CIE panelists should submit their CIE independent peer review reports to the CIE for review[1]. The CIE reports shall be sent to "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson, via e-mail to David.Sampson@oregonstate.edu and to Mr. Manoj Shivlani via e-mail to mshivlani@ntvifederal.com

Milestone	**Date**
CIE reviewers attend GARM workshop to conduct peer review at Northeast Fisheries Science Center (NEFSC) in Woods Hole, MA, USA	April 28 – May 2
GARM Chair and CIE panelists work at the NEFSC drafting reports. Report writing starts during the meeting. Panelists leave meeting with at least the summary bullets.	May 1 - 2
Draft of GARM Panel Summary Report, reviewed by all panelists, due to the GARM Chair **	May 16
CIE panelists submit CIE independent peer review reports to CIE for approval	May 16
GARM Chair sends Final GARM Panel Summary Report, approved by CIE panelists, to NEFSC contact (i.e., SAW Chairman)	May 23
CIE provides reviewed CIE independent peer review reports to NMFS COTR for approval	May 30
COTR notifies CIE of approval of CIE independent peer review reports	June 6 *
COTR provides final CIE independent peer review reports to NEFSC contact	June 6

* Assuming no revisions are required of the reports.
** The GARM Panel Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the GARM chairman prior to, during, and after the meeting in ensuring that documents are distributed in a timely fashion. NEFSC staff and the SAW Chairman will make the final GARM Panel Summary Report and CIE independent peer review reports available to the public. Staff and the SAW Chairman will also be responsible for production and dissemination of the collective Working Group papers.

Acceptance of Deliverables:

Upon review and acceptance of the CIE reports by the CIE Coordination and Steering Committees, CIE shall send via e-mail the CIE reports to the COTRs (William Michaels William.Michaels@noaa.gov and Stephen K. Brown Stephen.K.Brown@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE report in *.PDF format to the COTRs. The

[1] All reports will undergo an internal CIE review before they are considered final.

COTRs at the Office of Science and Technology have the responsibility for the distribution of the final CIE reports to the Project Contacts.

Key Personnel:

Contracting Officer's Technical Representative (COTR):

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Request for Changes:

Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect any approved changes. The Terms of Reference (ToR) and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

ANNEX 1:

Draft Terms of Reference for the GARM-III "Biological Reference Point (BRP)" Meeting

(Last Revised: 1/11/08; A final draft will be distributed to the Panel prior to the meeting.)

1. For relevant stocks, determine the influence of retrospective patterns in parameter estimates (e.g., fishing mortality, biomass, and/or recruitment) from assessment models on the computation of BRPs and on specification of initial conditions for forecasting.

2. Trends in Stock Productivity:

   a.) For relevant stocks, identify trends in biological parameters (i.e., life history and/or recruitment) and assess their importance for the computation of BRPs and for specification of rebuilding scenarios;

   b.) If possible, summarize trends in pertinent environmental variables that might be related to the trends in those biological parameters relevant to BRPs.

3. Ecosystem approaches to Gulf of Maine/Georges Bank fisheries:

   a.) Determine the production potential of the fishery based on food chain processes and estimate the aggregate yield from the ecosystem;

   b.) Comment on aggregate single stock yield projections in relation to overall ecosystem production, identifying potential inconsistencies between the two approaches.

4. Biological Reference Points (B_{target}, $B_{threshold}$, F_{target}, $F_{threshold}$):

   a.) For each stock, list what the <u>current</u> BRPs and/or BRP Proxies are (e.g., B_{MSY}, B_{MAX}, F_{MSY}, $F_{40\%MSP}$, historical survey catch per tow, etc.), and give their values (i.e., typically from GARM II);

   b.) For each stock, update or redefine BRPs or BRP proxies that will be used for stock status determination, and compute their expected values and precision. Note: These BRPs and their proxies must be comparable and consistent with outputs from the recommended assessment models from the GARM III "Modeling" Meeting.

5. For each stock, identify appropriate models for forecasting and for evaluating rebuilding scenarios.

ANNEX 2:

Contents of GARM-III CIE independent peer review report

1. The Independent CIE Report should comment on the quality and soundness of the science, methods and results with regard to each Term of Reference. CIE panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

2. If any modeling approaches and/or BRPs are considered inappropriate, the Independent CIE Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

3. Any independent analyses conducted by the CIE panelists as part of their responsibilities under this agreement should be incorporated into their Independent CIE Reports. It would also be helpful if the details of those analyses (e.g., computer programs, spreadsheets etc.) were made available to the respective assessment scientists.

4. Additional questions that were not in the Terms of Reference but that are directly related to the meeting can be addressed. This section need only be included if additional questions were raised during the GARM meeting.

5. The report shall include a copy of the Statement of Work with Terms of Reference and meeting agenda attached as appendices.

ANNEX 3:

Contents of GARM-III Panel Summary Report

1. The first section the report shall consist of an introduction prepared by the GARM chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the GARM. The next section will contain comments on the quality and soundness of the science, methods and results with regard to each Term of Reference. The GARM Panel should consider whether the work provides a scientifically credible basis for developing fishery management advice. Scientific criteria to consider include: whether the data were adequate and used properly, the analyses and models were carried out correctly, and the conclusions are correct/reasonable.

If the CIE panelists, the non-CIE panelists and GARM chair do not reach an agreement on a Term of Reference, the report should explain why. It is permissible to express majority as well as minority opinions.

2. If any modeling approaches and/or BRPs are considered inappropriate, the GARM Panel Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing modeling approaches and/or BRPs are the best available at this time.

3. The report shall also include: a.) the bibliography of all materials provided during the meeting and any papers cited in the GARM Panel Summary Report; and separate appendices with b.) a copy of the CIE Statement of Work; c.) the assessment with the Terms of Reference used for the GARM BRP Meeting, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice; d.) a list of participants; e.) the meeting agenda, f.) a list of working papers; and g.) Presentation Highlights and Meeting Discussion Summary for each working paper. The Highlights and Discussion Summary are to be written by the assessment scientists and rapporteurs, respectively, with editing and oversight by the GARM Chairman.

APPENDIX B. MEETING AGENDA

Draft Meeting Agenda (last revised April. 22, 2008)

GARM III Biological Reference Points Meeting
April 28-May2008

Date /Day	*Start*	*End*	*Duration (min)*	*Topic*	*Presenter*
28-Apr	9:00	9:10	10	Introduction	
1	9:10	9:30	20	Overview of GARM and objectives of this meeting	Chair
				TOR #4 Biological Reference Points: a.Current values and proxies	
1	9:30	9:45	15	*Working Paper 4.1* Overview of current BRPs methods and estimates	Rago
1	9:45	10:00	15	Discussion	
1	10:00	10:30	30	*Working Paper 4.2* Setting SSBmsy via Stochastic Simulation Ensures Consistency with Rebuilding Projections. Chris Legault	Legault
1	10:30	10:45	15	Break	
1	10:45	11:00	15	Discussion	
				TOR #2: Trends in Stock Productivity	
1	11:00	11:45	45	WP 2.1 Trends in Average length, weight and maturity at age for relevant stocks and trends in environmental variables.	*O'Brien*
1	11:45	12:00	15	Discussion	
1	12:00	12:15	15	WP 2.2 Implications of biological trends for estimation of biological reference points and rebuilding schedules.	*Rago et al*
1	12:15	12:30	15	Discussion	
1	12:30	13:30	60	Lunch	
				TOR #3 Ecosystem Approaches to Gulf of Maine/Georges Bank Fisheries	
1	13:30	13:50	20	*WP 3.1* US Northeast Shelf LME Biomass, target biological reference points for fish and worldwide cross-system comparisons. Overholtz, Link, Fogarty, Col, Legault.	Overholtz
1	13:50	14:00	10	Discussion	
1	14:00	14:20	20	WP 3.2 Energy Budget contextualization of fish biomasses at B_MSY	Link
1	14:20	14:30	10	Discussion	
1	14:30	14:50	20	WP 3.3 Estimates of aggregate surplus production for the GARM and other stock groups for the US Northeast Shelf LME. Overholtz, Fogarty, Link, Legault, Col.	Overholtz

1	14:50	15:00	10	Discussion	
1	15:00	15:15	15	Break	
1	15:15	15:35	20	WP 3.4 An Aggregate and MS Production Model: A Simulator Tool	Link
1	15:35	15:45	10	Discussion	
1	15:45	16:10	25	WP 3.5 Fishery Production Potential	Fogarty
1	16:10	17:00	50	Discussion—WP 3.6 Synthesis: Implications for single species reference points	Link/Fogarty
				TOR #4 Biological Reference Points:	
1	17:00	17:15	15	WP 4.3. Sensitivity of the Long-term Observation-error Survey Series (LOSS) model to variable stock-recruit steepness and stock depletion inputs: A test case using Gulf of Maine haddock (Palmer and Legault).	Palmer/Legault
1	17:15	17:25	10	Discussion	
1	17:25	17:40	15	Supplementary Paper WP 4.7 Size-specific tag recovery rates of cod and implications for estimation of fishing mortality in analytical models. Miller and Hart	Miller/Hart
1	17:40	17:50	10	Discussion	
1	17:50	18:00	10	Summary/Followup (Chair)	
Date /Day	***Start***	***End***	***Duration (min)***	***Topic***	***Presenter***
29-Apr	***9:00***	9:15	15	Progress review and Order of the Day (Chair)	Chair
				TOR #1 Influence of retrospective patterns on parameter estimates and specification of initial conditions for forecasting.	
2	9:15	9:35	20	*WP 1.1* Specifying Initial Conditions for Forecasting When Retrospective Pattern is Present.	Legault/ Terceiro
2	9:35	9:50	15	Discussion	
2	9:50	10:10	20	*WP 1.2.* A simulation study to evaluate estimation of biological reference points from VPA and ASAP.	Brooks/ Legault/ Seaver
2	10:10	10:25	15	Discussion	
2	10:25	10:40	15	Break	
				TOR #4 Biological Reference Points: b. Update by stock	
2	10:40	11:25	45	WP 4.A Georges Bank Cod	O'Brien
2	11:25	11:55	30	Discussion	
2	11:55	12:55	60	Lunch	
2	12:55	13:40	45	WP 4.F Gulf of Maine Cod	Mayo
2	13:40	14:05	25	Discussion	
2	14:05	14:30	25	WP 4.F.1 Gulf of Maine Cod	Butterworth
	14:30	14:40	10	Discussion	
2	14:40	15:30	50	WP4.B. Georges Bank Haddock	Brooks

2	15:30	15:55	25	Discussion	
2	15:55	16:10	15	Break	
2	16:10	17:05	55	WPs 4.C. Georges Bank + 4.D. Southern New England + 4.E Cape Cod-Gulf of Maine Yellowtail Flounder	Legault
2	17:05	17:50	45	Discussion	
2	17:50	18:00	10	Summary/Followup	Chair
Date /Day	***Start***	***End***	***Duration (min)***	***Topic***	***Presenter***
30-Apr	***9:00***	9:15	15	Progress review and Order of the Day (Chair)	Chair
3	9:15	10:00	45	*WP* 4.G. Witch Flounder	Wigley
3	10:00	10:15	15	Discussion	
3	10:15	11:00	45	4.H. Gulf of Maine/Georges Bank American Plaice	O'Brien
	11:00	11:15	15	Break	
3	11:15	12:15	60	*WP* 4.I. Gulf of Maine Winter Flounder	Nitschke
3	12:15	12:30	15	Discussion	
3	12:30	13:30	60	Lunch	
3	13:30	14:15	45	WP 4.J. Southern New England Winter flounder	Terceiro
3	14:15	14:30	15	Discussion	
3	14:30	15:15	45	4.K. Georges Bank Winter Flounder	Hendrickson
3	15:15	15:30	15	Discussion	
3	15:30	15:45	15	Break	
3	15:45	16:45	60	WP 4.N. Gulf of Maine/ Georges Bank Acadian Redfish	Miller
3	16:45	17:00	15	Discussion	
3	17:00	17:30	30	*WP* 4.M. Georges Bank/Gulf of Maine Pollock	Mayo
3	17:30	17:45	15	Discussion	
3	17:45	18:00	15	Summary/Followup	Chair
	19:30	22:30		Social/Dinner --British Beer Company, Falmouth Heights	
Date /Day	***Start***	***End***	***Duration (min)***	***Topic***	***Presenter***
1-May	***9:00***	9:15	15	Progress review and Order of the Day	Chair
4	9:15	10:05	50	*WP* 4.L. White Hake	Sosebee
4	10:05	10:20	15	Discussion	
4	10:20	10:35	15	Break	
	10:35	10:55	20	WP.4.L.1 White Hake alt	Butterworth
	10:55	11:05	10	Discussion	
4	11:05	12:00	55	*WP* 4.R. Gulf of Maine Haddock	Palmer
4	12:00	12:15	15	Discussion	
4	12:15	13:15	60	Lunch	
4	13:15	13:35	20	*WP* 4.O. Ocean Pout	Wigley
4	13:35	13:45	10	Discussion	

4	13:45	14:05	20	WP 4.P. Gulf of Maine/Georges Bank Windowpane Flounder	Hendrickson
4	14:05	14:15	10	Discussion	
4	14:15	14:35	20	*WP* 4.Q. Southern New England – Mid-Atlantic Windowpane	Hendrickson
4	14:35	14:45	10	Discussion	
4	14:45	15:05	20	*WP* 4.S. Atlantic Halibut	Col
4	15:05	15:15	10	Discussion	
4	15:15	15:30	15	Break	
4	15:30	17:50	140	Review/Revisions/Follow-up	TBD
4	17:50	18:00	10	Summary/Followup (Chair)	Chair
2-May	***9:00***	9:30	30	Progress review and Order of the Day	Chair
5	9:30	10:30	60	Review of Outstanding Issues as necessary	TBD
5	10:30	10:45	15	Break	
5	10:45	12:00	75	Report Development [CLOSED]	
5	12:00	13:00	60	Lunch	
5	13:00	16:00	180	Report Development, Summary and Assignments [CLOSED]	
5	16:00	16:00	0	Adjourn	