Report on the 40th Northeast Regional Stock Assessment Review Committee (SARC) meeting in 2004 to review the assessments for Goosefish and Weakfish in the northeast United States

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Prepared for

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Contents

Executive summary

Stock assessments of goosefish (monkfish), weakfish, and scup in waters off the north-eastern coast of the United States were scheduled to be reviewed in 2004 by SARC 40 (Stock Assessment Review Committee No. 40). The Assessment Review Panel met at Woods Hole, Massachusetts, from November 29 to December 2, 2004. However, as the stock assessment for scup was not yet ready for review, it had been withdrawn from consideration by SARC 40. Although the weakfish assessment was also incomplete, the Atlantic States Marine Fisheries Commission (ASMFC) had asked that the current work be reviewed and guidance offered by the SARC on several issues that were impeding progress of the assessment. The goosefish assessment, led by a SAW Working Group from the Northeast Fishery Science Center (NEFSC), was complete and available for review .

The assessment of the biomass of goosefish presented by the SAW Working Group at SARC 40 is considered sound and of acceptable quality to guide fishery management. For the Northern Region, the biomass proxy, B, *i.e.*, the three-year moving average of the weight per tow recorded for the NEFSC autumn survey, lies above $B_{threshold}$ and is currently at 81% of B_{target}. For the Southern Region, the value of the biomass proxy has increased to a value equal to $B_{threshold}$ and equivalent to 50% of B_{target}. Assessment of the level of fishing mortality for goosefish and comparison of this with the threshold level of fishing mortality was considered by the Working Group to be not yet of sufficient reliability for use in guiding fishery management.

The implications of a discontinuity in the time series of survey indices for goosefish, which will result from the imminent replacement of the existing survey vessel and its fishing gear by a new vessel with more efficient gear, need to be considered, especially as the current threshold and target reference points of the proxy for biomass are framed in terms of the survey indices produced by the current research vessel.

Considerable reliance is placed on the NEFSC survey indices for goosefish, however, because of small sample sizes and variable catches, age-disaggregated data from these surveys were considered by the 2004 SAW Working Group not to be of sufficient reliability for use in estimation of fishing mortality. As data on age compositions of catches and surveys are of considerable value in stock assessment, strategies to produce reliable estimates of age composition for goosefish need to be developed. Advice was presented to SARC 40 that methods used for ageing goosefish had not yet been validated.

The absence of older males in the goosefish cooperative survey data raises interesting questions regarding the adequacy of the assumption of a common instantaneous rate of natural mortality for males and females and/or the accuracy and adequacy of survey estimates of abundance and biomass. Information on the distribution and patterns of movement of goosefish is needed to resolve this apparent inconsistency in data. The spatial distributions of the catches and of the different age and length classes of each sex need to be examined.

The SARC expressed concern that the results from the Bayesian surplus production model for goosefish appeared to be highly dependent on the assumption concerning the prior probability distribution for the intrinsic rate of natural increase and thus were likely to be unreliable.

The SARC advised that the retrospective problem that the ASMFC had encountered when assessing the status of the weakfish stock arose from an inconsistency between the survey indices and fishery-dependent indices of abundance and catch-at-age data. The former indices indicated that the stock was recovering, while the fishery data suggested that the stock had continued to decline in recent years. This inconsistency would not be resolved by application of more complex models, but needed to be addressed by more detailed analyses of the survey and fishery data to determine either the biological basis for the differences between the signals or the aspects of the sampling regime and statistical analyses that had produced the different trends. Such reconciliation of the inconsistency was required before appropriate methods of analysis could be applied to the different data sets to assess the state of the weakfish stock.

1. BACKGROUND

SARC 40 met at Woods Hole from November 29 to December 2, 2004. The intent of the meeting was to review the assessments for goosefish, weakfish and scup (see Appendix 1 for the terms of reference for these assessments). However, the scup assessment, which was being undertaken under a private contract, was not ready for review, and, accordingly, had been withdrawn from the agenda. Although the weakfish assessment, which was being undertaken by the Atlantic States Marine Fisheries Commission (ASMFC), was also incomplete, the ASMFC had asked that the current work be reviewed and guidance offered by the SARC on several issues that were impeding progress of the assessment. The goosefish assessment, led by a SAW Working Group from the Northeast Fishery Science Center (NEFSC), was complete and available for review.

2. REVIEW OF ACTIVITIES

Panelists for the SARC 40 meeting, which was held in the Aquarium Conference Room at the Northeast Fisheries Science Center, Woods Hole, Massachusetts, are listed in Appendix 2. The agenda for this meeting, which was chaired by Dr Robin Cook, Marine Laboratory, Aberdeen, Scotland, is presented in Appendix 3.

Although the meeting was open to observers, very few people, other than those directly involved in the assessments, attended the meeting. The draft assessment of the goosefish stock was presented and the input data, methods of assessment, and findings were discussed in open forum. Draft conclusions of the Working Group regarding the biomass of the stock and of the level of fishing mortality relative to the threshold and target reference points for these variables were considered by the Panel.

3. FINDINGS

3.1 Goosefish

3.1.1 Summary of findings

3.1.1.1 The current status of the stock assessment units relative to existing reference points.

The assessment presented at SARC 40 is considered sound and of acceptable quality to guide fishery management.

For the Northern Region, the biomass proxy, B, *i.e.*, the three-year moving average of the weight per tow recorded for the NEFSC autumn survey, lies above $B_{threshold}$ and is currently at 81% of B_{target}. For the Southern Region, the value of the biomass proxy has increased to a value equal to $B_{threshold}$ and equivalent to 50% of B_{target}.

Reliable estimates of fishing mortality for goosefish were not available for consideration by SARC 40, as thorough assessment of the data from the 2004 Cooperative Survey had not yet been completed. Thus, there was no value of F that might be compared with $F_{threshold}$ to advise fishery managers.

3.1.1.2 The status of SARC/Working Group recommendations from the previous SARC-reviewed assessment

The Working Group Report summarized the status of actions taken in response to the various recommendations arising from the previous SARC-reviewed assessment of goosefish. While action had been initiated to address all the recommendations, in most cases data are not yet available for use in stock assessment.

It is pertinent to note that the recommendation to maintain improved sampling rates for commercial landings had the intent of eventually producing data required for an age-based assessment. While sampling intensity was improved, no advice was presented in the Working Group Report as to whether the resulting age-composition data are of sufficient quality for this application.

The recommendation that the spatial distribution of mature and immature fish should be evaluated to resolve a question relating to the impact of minimum size limits on discards and fishing behavior was resolved by modification to the minimum size regulations[1]. However, increased understanding of the movement and distribution of fish is also essential and, as recommended elsewhere in this report, examination of the distribution of the different size and age classes would provide valuable information on the biology of goosefish.

The number of tagged fish appears low, and the appropriateness of the distribution of released tagged fish as part of the Rutgers/SMART/ MADMF gillnets fishery project for use in evaluating adult movements has not been reported. There is the potential that an ad hoc addition to an existing study may produce data that cannot adequately address the specific question raised by the previous SARC.

3.1.2 Input data

3.1.2.1 Characterization of commercial catch including landings and discards.

The time series of commercial catch, landings and discards had been updated by the Southern Demersal Working Group. The data from

[1] Clarification of this statement was requested by the CIE following their review of an initial draft of this report. In preparing a response to this request, it was recognized that, although discards would be reduced by permitting the landing of previously-discarded fish, egg production would also be reduced. A detailed response to the question raised by the CIE is presented in Appendix 6.

1964 to 1992 were considered by the Working Group to be less reliable than those of subsequent years (see the code for the Bayesian surplus production model in the Working Group Report), with considerable catch being under-reported, particularly during 1964 to 1979 (SARC 34). However, more recent data derived from the combination of vessel-trip reports (VTR) and dealer weigh-out records were considered to provide accurate estimates of the landings, disaggregated by statistical area and gear type, with trip-level resolution. Foreign landings since 1993 had been small, *i.e.*, less than 545 mt.

Estimates of discards since 1996 had been derived from the fishery-observer database at a management region, gear type and half-year resolution. It is noted that, at this level of resolution, some cells contained data derived from a relatively small number of observed tows, and that, in some cases, data for cells were missing. Discards were considered by the Working Group to be a reflection of both market acceptance and minimum size regulations. No information was provided in the Working Group Report regarding the estimation of discard rates for years prior to 1996, however, earlier, when developing the Bayesian surplus production model, it was reported that discard fractions of 10% of total catch weight [presumably landed weight] were assumed for 1964 to 1994 (SARC 34). The basis for this assumption needs to be reported. The Working Group had noted that a potential bias in the estimation of discard rates may have been introduced through increased observer coverage of the multi-species groundfish fishery. This bias needs to be investigated further, and, if it exists, an appropriate adjustment needs to be made to the estimates of discarded catches. The percentage of the catch discarded ranged from 6 to 50%.

The total catch of 32.3 thousand mt in 2003 exceeded the mean catch of 30.1 thousand mt for 1970 to 2003.

3.1.2.2 Update of other goosefish survey indices *(i.e.*, NEFSC and MADMF indices) and analyses based on those indices.

The Working Group reported that, following the receipt of advice from MADMF staff that "their indices were of little utility", no further use had been made of these indices in the assessment.

The NEFSC spring and autumn bottom trawl indices for the goosefish in each management region, which extend from 1963, were updated by the Working Group to 2003. The autumn survey index currently plays a crucial role in calculating the proxy for biomass that is used to determine whether or not the goosefish within each region are considered to be overfished, and to determine days at sea (DAS) and trip limits for each region. The spring and autumn indices have been disaggregated by age since 1995 and 1993, respectively, to produce estimates of the mean number of goosefish per tow and mean length at age in both the northern and southern regions.

The impending disruption to the NEFSC indices, which will arise when a new research vessel and fishing gear are introduced and the current survey vessel is retired, requires consideration. From advice presented to SARC 40, it appears likely that the new vessel will use fishing gear that produces more reliable estimates of goosefish density in the area swept by the net and will employ mensuration technology and inclinometers to ensure reliable estimation of area swept and biomass. Calibration will be needed, however, to ensure that the indices of goosefish abundance produced by the new vessel may be related to the indices of abundance produced by the current vessel.

Indices of goosefish abundance and biomass derived for the southern management region from the NEFSC winter flatfish survey had been updated by the Working Group to produce a time series extending from 1992 to 2004. Similarly, indices of goosefish abundance for the southern region had been derived from the NEFSC summer sea scallop survey, giving a time series from 1984 to 2004

The time series of data from the inshore trawl survey for groundfish, conducted by the Maine Department of Marine Resources in conjunction with the State of New Hampshire, had also been updated to 2003 by the Working Group. This index, which appears to represent predominantly age 2 goosefish, is considered by the Working Group to be likely to become of increasing value as additional years of data are added.

The NEFSC spring and autumn bottom trawl surveys provide good coverage of the region for waters up to depths of 200 m. However, these surveys are characterized by relatively low catches per tow and, thus, the indices are likely to be less precise than would be desired. The potentially low ratio of signal to noise raises concern. However, plots of the time series of abundance and biomass indices for each region derived from the NEFSC surveys suggest a relatively high auto-correlation, implying inter-annual consistency in the measures. There also appear to be no major inconsistencies among the indices of abundance calculated for the southern region from the various NEFSC surveys. Furthermore, peaks in the indices of abundance of goosefish of lengths corresponding to ages 1 and 2 years calculated from the autumn NEFSC surveys appear to be matched by peaks derived from the spring surveys. In the southern region, the peaks in the autumn recruitment indices appear to match well the peaks derived for the abundance of similar-sized goosefish derived from the NEFSC summer sea scallop survey.

The subjective comparisons above suggest that the indices of abundance calculated from the NEFSC spring and autumn bottom trawl surveys are likely to provide an adequate, albeit imprecise, measure of abundance of goosefish. It is interesting to note, however, that the Working Group Report contains virtually no information on life history, on spawning regions, nursery areas, or any changes in distribution of fish with age and season. Thus, the extent to which such changes in

distribution might affect the indices of abundance cannot be assessed. The paucity of biological data presented in the Report is somewhat surprising. Indeed, even such fundamental studies as validation that growth zones in otoliths are formed annually appear to be lacking.

The feature that characterizes the recent length compositions derived from the NEFSC surveys in both regions is the shift towards smaller fish that occurred during the 1990s and a subsequent slight shift towards larger fish in more recent years.

3.1.2.3 Review of results of the 2004 Cooperative Goosefish Survey and comparison to the results of the 2001 survey.

Results of the 2004 Cooperative Goosefish Survey became available for assessment approximately two weeks prior to the working group meeting due to the duration of the survey and the time required for data input and auditing. As a consequence, results from the 2004 survey have not yet been subjected to the peer review that is considered essential by the NEFSC prior to acceptance of their reliability. Thus, the results of this survey are of a very preliminary nature. Furthermore, the results are not directly comparable with those of the 2001 Cooperative survey as only one of the two vessels employed in the earlier survey operated, different nets than those used in the earlier survey were employed, the sampling sites were restricted to those at which goosefish had been successfully caught in 2001, and severe weather conditions reduced the number of sampling sites at which fishing was successful. Despite these differences, some results of the two surveys may be compared and some findings of the 2004 survey noted.

- Whereas, at a given length, the females were found to have a greater weight than the males of the same length in the 2001 survey, no such difference was found in the females and males from the 2004 survey. It is hypothesized by the Working Group that this may have resulted from the slightly later timing of the latter survey and the capture in the earlier survey of females with developing egg veils.
- It is stated in the Working Group Report for Goosefish that the lengths at age of fish caught in the 2004 survey were similar to those of the 2001 survey, and that the length at age of males is nearly identical to that of females until age 7, after which the length at age of the males becomes less than that of the females. However, the lengths at age have not yet been tested to determine whether there are statistically significant differences nor compared statistically with the lengths at age of the fish caught in the NEFSC surveys of the same year.
- There was a similar lack of males of older age classes in the 2001 and 2004 studies, *i.e.* none after age 8 and after age 7 in the 2001 and 2004 surveys, respectively. If the survey covered the area occupied by the entire goosefish stock, then the data suggest greater mortality of older males than females. However, if the mortality of the two sexes is

similar, then the data imply that fewer older males were available for capture, possibly because of differing spatial distributions between the sexes. Further investigation is warranted and the implications for stock assessment need to be considered.

- The trends of the sex ratio with respect to length were found by the Working Group to be similar in both regions and in the samples from both the 2001 and 2004 surveys. A similar trend was also seen in the sex ratios in the winter NEFSC survey in the northern zone. The trend is characterized in the northern region by an approximately 50:50 ratio females to males for lengths up to about 60 cm then a progressive decline in the numbers of males present until, by about 70 cm, there are no males. In the south, there is parity until 40 cm, then an increase in the number of males in the range from 40-60 cm, followed by a decrease in the number of males until, by 70 cm, the fish are predominantly females. A plot in the Working Group Report of the spatial distribution of the sex ratio between 50 and 65 cm revealed an area in the south at which the sex ratio was mainly males. No similar areas were found for females of this same length range, however no investigation of the spatial distribution of the sex ratio of other length classes appears to have been undertaken. Examination of the Working Group Report revealed no plots of the spatial distributions of the catch per unit of effort from NESFC survey tows of fish of different ages or length classes that might have revealed further patterns of spatial structure.
- Although the gear mensuration system used in the 2004 Cooperative Survey provided reliable data on only ~15% of tows, the results proved useful in improving the estimate of area swept through adjusting for the effect on wingspread of depth. More reliable estimates were obtained for the flat net rather than the rockhopper net, as only 6 measurements of wingspread were obtained for the latter gear type and the intercept had to be constrained to the value obtained for the flat net with a theoretical adjustment for net geometry.
- Assuming 100% efficiency of nets, the 2004 survey produced minimum biomass estimates in the north and south of 28.5 and 65.9 thousand mt, respectively, compared with corresponding values of ~35.9 thousand metric tones in each region calculated using data collected in the 2001 survey. Minimum population numbers in the north and south were estimated from the 2004 survey to be 14.4 and 36.6 million, respectively, compared with 25 and 22.6 million, respectively, in 2001.
- The length compositions of the fish caught in both the 2001 and 2004 surveys were very similar to those of the corresponding winter surveys. A considerable fraction of the length composition in the south was found by the Working Group to be smaller than 53 cm total length.

3.1.3 Methods of assessment

3.1.3.1 Assessment of biomass using NEFSC autumn survey indices

Currently, the biological reference points for goosefish are defined in terms of a proxy for biomass, B, calculated as the three-year moving average of the weight per tow recorded for the NEFSC autumn survey, and the estimate of fishing mortality, F. The target value for biomass is specified as the median of the values of these three-year moving averages for 1965-1981, while the threshold value is set at $0.5B_{target}$. Thus, $B_{threshold} = 1.25$ for the northern region and 0.93 for the southern region. The threshold level of fishing mortality is specified as equal to F_{max}, which had been calculated by the NEFSC in 2002 as 0.2 $year^{-1}$.

The assessment of the fishery thus requires that the NEFSC conducts a standard autumn research survey and that the data obtained are analyzed by the Working Group to produce an estimate of the mean weight per tow in both the northern and southern management regions. A three-year moving average of this statistic is then calculated to provide an estimate of the biomass proxy, B, which may be compared with the target and threshold values for this variable.

3.1.3.2 Assessment of fishing mortality using results from Cooperative Survey data

Estimates of the instantaneous rate of fishing mortality, F, derived from NEFSC research survey length frequency distributions were assessed by the SAW 31 and SAW 34 reviews as of insufficient reliability to be used in determining whether or not overfishing was occurring. The 2004 Working Group also considered that estimates of F calculated from NEFSC survey age frequency data were not sufficiently reliable for use in assessment.

Estimates of fishing mortality were also obtained by calculating the annual exploitation rate in each management region by dividing the estimated catch by the estimate of biomass derived by applying the swept area technique to the data collected in the 2001 and 2004 Cooperative Surveys. Estimates of fishing mortality were then calculated from the annual exploitation rate using the estimate of natural mortality, M=0.2 $year^{-1}$. However, because of lack of adequate time for thorough analysis of the data from the Cooperative Survey before the Working Group met, the preliminary estimates of F reported in the Working Group Report were considered not to be of sufficient reliability for use in the assessment.

3.1.3.3 Bayesian surplus production modeling

The Bayesian surplus production model presented at SAW 31 had been extended by the 2004 Working Group. Catches from 1964-1979 had been introduced, biomass estimates from the 2001 and 2004 Cooperative Surveys had been input, and the uniform prior that had previously been used for the intrinsic rate of natural increase, r, had been replaced by a beta distribution with a mean set to twice the estimate of the instantaneous rate of natural mortality for goosefish. Estimates of F_{msy}, B_{msy}, F_{2003} and B_{2003} could be derived from the model.

3.1.3.4 Other approaches

Egg production indices, which may be used as a proxy for spawning stock biomass, were calculated from estimates of catch per tow at length derived from NEFSC surveys by multiplying by the fraction mature and expected egg production at each length.

While not explicitly stated in the Working Group Report, it may be inferred from the conclusion by the 2004 Working Group, that estimates of F calculated from NEFSC survey age frequency data were not sufficiently reliable for use in assessment, that age-disaggregated estimates of abundance and biomass derived from the NEFSC surveys were also considered not to be of sufficient reliability for use in catch at age analyses. However, it may have been informative to have presented in the Working Group Report a table showing goosefish catch at age in each region.

3.1.4 Results of the assessment

3.1.4.1 Assessment of biomass using NEFSC autumn survey indices

The Working Group reported that, for the Northern Region, the biomass proxy, B (*i.e.*, the three-year moving average of the weight per tow recorded for the NEFSC autumn survey) "has remained above $B_{threshold}$ since 2000 and that [in 2003] it is currently at 81% of B_{target}". For the Southern Region, the value of the biomass proxy increased from values that were approximately 50% of $B_{threshold}$ in the late 1990s to a value equal to $B_{threshold}$ and to 50% of B_{target} in 2003. The results of this assessment were accepted by the SARC.

3.1.4.2 Assessment of fishing mortality using results from Cooperative Survey data

The SARC endorsed the view that the results from the 2004 Cooperative Research Survey had not yet been subjected to sufficiently thorough analysis and that preliminary results were not sufficiently reliable to be

used in assessing whether the current fishing mortality exceeded $F_{threshold}$. However, preliminary results from the survey, using 2001 intermediate net efficiencies and 2001/2004 nominal tow distances, suggest that F=0.38 $year^{-1}$ in the northern region and F=0.17 $year^{-1}$ in the southern region, compared with $F_{threshold}$=0.2 $year^{-1}$.

3.1.3.3 Bayesian surplus production modeling

Replacement of a uniform prior probability distribution for the intrinsic rate of increase with a beta distribution with a mean set equal to twice the instantaneous rate of natural mortality and use of additional, rather imprecise catch estimates for 1964-1979 appeared to resolve a problem that had been identified in earlier results from the Bayesian surplus production model. Without these enhancements, the posterior probability distribution for the rate of increase output by the model indicated that the expected value of this parameter was much higher than considered feasible. Thus, the changes appear to have been very informative, suggesting that the data possessed little information to allow precise determination of the intrinsic rate of increase or pristine biomass. Thus, estimates of B_{msy} and F_{msy} produced by the analysis are very likely to reflect the assumption made concerning the prior probability of the rate of increase rather than information in the data.

From the above, it appears likely that information on current levels of biomass and fishing mortality derived from the Bayesian model is drawn principally from the biomass estimates from the Cooperative Surveys and current levels of catch rather than from the trends shown by the biomass indices in response to catches. However, these estimates are unlikely to be affected by the assumption made concerning the prior probability distribution for the intrinsic rate of increase.

The SARC expressed concern that the results from the Bayesian model were likely to be highly dependent on the assumption concerning the prior probability distribution for the intrinsic rate of natural increase and thus likely to be unreliable.

3.1.4.3 Other approaches

Egg production indices were found to be at 44% of their 1970-1979 average level in the northern management region and at 31% of this level in the southern region. Thus, although the proxy for biomass, as measured by the three-year moving average of the weight per tow recorded for the NEFSC autumn survey, has recovered to 81 and 50% of the target values in the northern and southern regions, respectively, *i.e.*, the median values of this variable from 1965-1981, it appears likely that, as a consequence of the truncated length composition, recovery of the spawning biomass will lag the recovery of biomass.

3.1.5 Conclusions and recommendations for future assessments

The Cooperative Surveys were considered to produce more precise estimates of total biomass and population sizes than could be obtained from the NEFSC survey results. Such information provided valuable information to the Bayesian model, supplementing the information on trends in relative indices of abundance obtained from the NEFSC survey indices. Because of lack of contrast over the period of historical catch and abundance indices, little information on the absolute abundance is provided by these time series. Thus, the estimate produced from the Cooperative Surveys has proven valuable. It may assist in providing information that can also be used when calibrating the new survey indices that will accompany the introduction of a new research vessel to replace the R/V Albatross.

3.2 Weakfish

3.2.1 Summary of discussions

Discussion of the weakfish fishery was focused on the questions posed to the SARC by Dr Desmond Kahn in B13 Report to the 40th Stock Assessment Review Committee on preliminary assessment results for weakfish, *Cynoscion regalis* (Sciaenidae), i.e.,

(1) Currently, catch-at-age modeling has been done with ADAPT. Given the results to date, would the committee suggest other catch-at-age modeling approaches?
(2) Currently, biomass dynamic modeling has used the logistic form presented in a separate report (B11). Length frequency analysis (B12) and growth modeling (B3) indicate significant growth decline, suggesting a decline in productivity. Possibly, parameters such as r and K have changed over the period in question. Does the committee have suggestion for alternative approaches?
(3) Both fishery independent and fishery dependent indices have been employed in both ADAPT and biomass dynamic models. These have different trends and affect model results differently. The latter often produce negative residuals for recent years. Would the committee have any recommendations on selection among these indices?
(4) Currently, an active hypothesis is that species interactions have influenced stock dynamics, including striped bass competition or predation and possibly decline in important prey species. Modeling approaches in progress are exploring these possibilities, but this work is not completed. Does the committee have suggestions for exploring this hypothesis?

The fundamental problem identified by the ASMFC Working Group was that retrospective analysis indicated that final year estimates of biomass produced by ADAPT were very highly overestimated and fishing mortality estimates very highly underestimated. A further problem was that the results of ADAPT indicated that, in recent years, there had been a very rapid and marked increase in biomass to very high levels and that fishing mortality had fallen markedly to very low levels. However, catches recorded by fishers had fallen markedly to very low levels and the fishery-dependent indices of catch per unit of effort failed to reflect the increase in biomass predicted by ADAPT or implied by NEFSC and other bottom trawl indices.

3.2.2 Suggestions and recommendations for future assessments

Responses to the questions posed by Dr Kahn are discussed below:

(1) The SARC advised that the fundamental problem confronting the ASMFC Working Group was that there was inconsistency in the input data. This problem would not be resolved by applying additional models, but required that the input data be carefully analyzed to identify the reason for the inconsistency. Essentially, the trends shown by the catch-at-age data appeared inconsistent with the trends shown by the fishery-independent trawl survey indices. Thus, the very recent estimates of biomass produced by ADAPT relied strongly on the trends shown by the survey data. However, as additional years of catch-at-age data became available, the influence of the survey data diminished and the biomass estimates of earlier years of data reflected the catch at age data and were influenced less by the survey indices. In contrast, the fishery-dependent data were more consistent with the catch-at-age data but inconsistent with the survey indices. That is, the catch-at-age data showed a declining trend in abundance over recent years and reflected continued levels of relatively high fishing mortality, while the survey indices, which were more influenced by younger age classes, suggested an increase in biomass over more recent years, implying that reduced catches were a result of considerably reduced fishing mortality.

The SARC advised that the inconsistency should not be resolved by arbitrarily selecting sets of indices that matched a chosen hypothesis. It was essential that the cause of the inconsistency should first be identified in order that an appropriate assessment of stock status might be undertaken. It was suggested that the survey data should be comprehensively and exhaustively examined to determine whether the cause of the inconsistency might lie in the data or in the way in which they were processed, that spatial and temporal trends be examined in both the survey indices and in the catch at age data, that a GLM analysis of survey and catch-at-age data might tease out indices that revealed consistent cohort effects suggestive of informative indices, and that ADAPT might be applied using small subsets of indices to tease out where the

inconsistencies might lie. Consideration should also be given to validating that the growth zones present in the otoliths are formed annually and that counts of these zones can be used to produce reliable measures of age.

(2) While biomass dynamics models may provide insight, considerable information resides in the age structure of both the catches and abundance indices. The issue of inconsistency among the indices of abundance and catch will continue to affect the results obtained when fitting biomass dynamics models. Thus, the primary objective must be to resolve the cause of the inconsistency. Changes in growth and weight at age are more easily and directly incorporated in a model that uses an age-structured representation than one that employs data aggregated over all age classes.

(3) The response to this question is essentially that presented in response to question 1.

(4) The solution to the problem concerning the inconsistency among indices of abundance and catch at age would not necessarily be resolved by a more complex model, such as an ecosystem or multispecies model, unless that model addressed the fundamental cause of the inconsistency. Without a valid *a priori* hypothesis to indicate that such a model would predict the inconsistency between the indices of abundance and catch at age, it is unlikely that such modeling would resolve the immediate problem for stock assessment that lies in the inconsistent input data. The SARC advised that it would be more appropriate to concentrate research effort on detailed analysis of the input data.

APPENDIX 1: Terms of reference for SAW 40

Terms of Reference - 40th Northeast Stock Assessment Workshop

SARC, November 29 - December 2, 2004
NEFSC, Woods Hole

Goosefish/Monkfish - SAW Southern Demersal Working Group

1. Review results of the 2004 Cooperative Monkfish Survey; make comparison to the results of the 2001 survey.
2. Characterize the commercial catch including landings and discards.
3. Update other monkfish survey indices *(i.e.,* NEFSC and MADMF indices) and analyses based on those indices.
4. Evaluate the current status of the stock assessment units relative to existing reference points.
5. *Review, evaluate, and report on the status of the SARC/Working Group Research Recommendations offered in the previous SARC-reviewed assessment (i.e., SAW 34 in November 2001).*

Weakfish - ASMFC Technical Committee/Assessment Subcommittee

1. Characterize commercial and recreational catch including landings and discards.
2. Evaluate adequacy and uncertainty of fishery-independent and dependent indices of relative abundance.
3. Estimate fishing mortality, spawning stock biomass, and total stock biomass for 1981-2003, and characterize the uncertainty of these estimates.
4. Evaluate and update or re-estimate biological reference points, as appropriate.
5. Perform stock projections if possible.
6. Make research recommendations for improving data collection and the assessment.
7. *Review, evaluate, and report on the status of the SARC/Working Group Research Recommendations offered in the previous SARC-reviewed assessment (i.e., SAW 30 in December 1999).*

Scup - DeAlteris and Associates Inc. – Assessment withdrawn

1. Characterize the commercial and recreational catch for scup including landings and discards.
2. Estimate fishing mortality, spawning stock biomass, and total stock biomass for the current year, and characterize the uncertainty of these estimates.
3. Evaluate and update or re-estimate biological reference points, as appropriate.
4. Evaluate rebuilding schedules, *i.e.*, provide projections of stock status under various Total Allowable Catch (TAC) and fishing mortality (F) strategies.

APPENDIX 2: Panelists

The 40th NORTHEAST REGIONAL STOCK ASSESSMENT REVIEW COMMITTEE (40th SARC)

November 29 – December 2, 2004

Northeast Fisheries Science Center
Woods Hole, Massachusetts

SARC Chairman

Robin Cook
Marine Laboratory, Aberdeen, Scotland (CIE)

SARC Panelists

John Casey
Centre for Environment, Fisheries and Aquaculture Science, Lowestoft, England (CIE)

Norm Hall
Centre for Fish and Fisheries Research, Murdoch University, Western Australia (CIE)

Peter Shelton
Department of Fisheries and Oceans, St. Johns, Newfoundland (CIE)

APPENDIX 3: Agenda

40th Northeast Regional Stock Assessment Workshop (SAW 40)
Stock Assessment Review Committee (SARC) Meeting

Aquarium Conference Room - Northeast Fisheries Science Center
Woods Hole, Massachusetts

November 29 – December 2, 2004

AGENDA

TOPIC	PRESENTER	RAPPORTEUR
MONDAY, 29 November (1:00 - 5:00 PM)		
Opening	**John Boreman**, Science Director	
Welcome	**Terry Smith**, SAW Chairman	
Introduction	**Robin Cook,** SARC Chairman	
Agenda		
Conduct of meeting		
Goosefish/Monkfish (A)	**Anne Richards**	**Kathy Sosebee**
SARC Discussion	**Robin Cook**	
TUESDAY, 30 November (8:30 - 5:00 PM)		
Weakfish (B)	**Des Kahn / Jim Uphoff**	**Des Kahn / Jim Uphoff**
SARC Discussion	**Robin Cook**	
WEDNESDAY, 1 December (8:30 - 5:00 PM)		
Weakfish (B) (if necessary)	**Des Kahn Jim Uphoff**	**Des Kahn / Jim Uphoff**
SARC Discussion	**Robin Cook**	
THURSDAY, 2 December (8:30 - 5:00 PM)		
SARC Report writing (closed)		

APPENDIX 4: Bibliography

SARC 40 documents

Terms of Reference - 40th Northeast Stock Assessment Workshop

Goosefish (Monkfish) documents and materials

Documents provided before the meeting:

Monkfish – SAW 40 Entire Working Group Report

SARC 40: Goosefish (Monkfish) Assessment Summary

The 34th Northeast Regional Stock Assessment Workshop (34th SAW): Public Review Workshop. Northeast Fisheries Science Center reference Document 02-07. March, 2002.

SAW 34 Consensus Summary of Assessments (including text, tables, and figures)

Weakfish documents and materials

Documents provided before the meeting:

B1: Weakfish stock assessment summary. Memo from Jim Uphoff

B2: Assessment of Atlantic Coast Weakfish (Cynoscion regalis), 1999
Report to the Stock Assessment Review Committee (SARC)
February 2000. ASMFC Weakfish Stock Assessment Subcommittee

B3: Weakfish growth analysis, based on 2000 samples from pound net and long haul seine in the Chesapeake Bay and Pamlico Sound. A Report to the ASMFC Weakfish Technical Committee. Desmond Kahn

B4: Fishing mortality based reference points for weakfish in 2000 based on two growth models.

B5: Advisory Report. 2002 Weakfish Stock Assessment

B6: Stock Assessment Of Weakfish Through 2000, Including Estimates Of Stock Size On January 1, 2001. Desmond M. Kahn,

B7: Risk Assessment of Virtual Population Analysis Estimates of Atlantic Coast Weakfish Fishing Mortality and Spawner Biomass during 1982-2000. Jim Uphoff

B8: An evaluation of Separable Virtual Population Analysis as a tool for assessing the stock status of weakfish on the Atlantic Coast of the United States. Janaka A. de Silva

B9: Trends in Weakfish Fishing Mortality and Stock Biomass based on Relative Exploitation from Recreational CPUE and Abundance Indices from Fisheries Independent Trawl Surveys. Victor Crecco.

B10: Powerpoint presentation: Board presentation

B11: Powerpoint presentation: Biomass

B12: Powerpoint presentation: Weakfish proportional densities

B13: Report to the 40th Stock Assessment Review Committee on preliminary assessment results for weakfish, *Cynoscion regalis* (Sciaenidae). Desmond M. Kahn

B14: Weakfish ADAPT output data file

B15: Weakfish ADAPT output plots

B16: Weakfish ADAPT diagnostics

B17: Weakfish ADAPT run 8 output

B18: Weakfish ADAPT run 10 output

30th Northeast Regional Stock Assessment Workshop (30th SAW): Public Review Workshop. Northeast Fisheries Science Center reference Document 00-04. April, 2000.

Additional documents provided:

Weakfish catch-at-age data

ADAPT run descriptions

Powerpoint presentations:

1. Data and ADAPT runs
2. Biomass dynamic modeling
3. Weakfish proportional densities
4. Trophic interactions

APPENDIX 5: Statement of work

STATEMENT OF WORK

Consulting Agreement between the University of Miami and Dr. Norm Hall

September 24, 2004

General

The Northeast Regional Stock Assessment Review Committee meeting (SARC) is a formal, multiple-day meeting of stock assessment experts who serve as a peer-review panel for several tabled stock assessments. The SARC is the cornerstone of the Northeast Stock Assessment Workshop (SAW) process, which includes peer assessment development (SAW Working Groups or ASMFC technical committees), assessment peer review, public presentations, and document publication.

The Center for Independent Experts (CIE) shall provide a panel chair and three panelists for the 40th Stock Assessment Review Committee panel. The panel will convene at the Woods Hole Laboratory of the Northeast Fisheries Science Center in Woods Hole, Massachusetts, the week of 29 November 2004 (November 29 – December 2) to review assessments for monkfish (*Lophius americanus*), scup (*Stenotomus chrysops*), and weakfish (*Cynoscion regalis*).

Specific Activities and Responsibilities

Each panelist's duties shall occupy a maximum of 14 workdays; a few days prior to the meeting for document review; the SARC meeting; and a few days following the meeting to prepare a Review Report. The SARC Review Report will be provided to the SARC Chair, who will produce the Summary Report based on the individual Review Reports.

Roles and responsibilities:

(1) Prior to the meeting: review the reports produced by the Working Groups.

(2) During the meeting: participate, as a peer, in panel discussions on assessment validity, results, recommendations, and conclusions especially with respect to the adequacy of the assessments reviewed in serving as a basis for providing scientific advice to management.

(3) After the meeting: prepare individual Review Reports, each of which provides an executive summary, a review of activities and, for each stock assessment reviewed, a summary of findings and recommendations that emerge from the findings, all in the context of responsiveness to the Terms of Reference for each

assessment. See Annex 1 for further details on report contents and milestone table below for details on schedule. No later than December 16, 2004, these reports shall be submitted to the CIE for review[2] and to the Chair for summarization. The CIE reports shall be addressed 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@rsmas.miami.edu.

No consensus opinion among the CIE reviewers is sought, and all SARC reports will be the product of the individual CIE reviewer or chairperson.

NEFSC staff and the SAW Chairman will be responsible for the production of the final SARC report, which will include the Chair's Summary Report and the individual panelist's Review Reports. Staff and the SAW Chairman will also be responsible for production and publication of the collective Working Group papers, which will serve as a SAW Assessment Report.

Contact person:
Dr. Terrence P. Smith, NEFSC, Woods Hole, SAW Chairman, 508-495-2230, Terry.Smith@noaa.gov.

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

ANNEX 1: Contents of Panelist Report

1. The report shall be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the report shall consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.

3. The report shall also include as separate appendices the bibliography of all materials provided and a copy of the statement of work.

APPENDIX 6: Response to CIE request for clarification of a statement relating to recommendations from the previous SARC.

Details of the CIE query

On page 4, under section 3.1.1.2, the statement is made that

"*The recommendation that the spatial distribution of mature and immature fish should be evaluated to resolve a question relating to the impact of minimum size limits on discards and fishing behavior was resolved by modification to the minimum size regulations*".

The CIE requested clarification as to what was resolved by the modification.

Background

Comment is made in the Working Group report to SARC 40, in the section headed Working Group Comments, that the minimum size limit, which went into effect on the implementation of the FMP in 1999, was more constraining in the Southern Management Area (*i.e.*, ~53 cm total length) than that in the Northern Management Area (*i.e.*, ~43 cm). It should be noted that, in the Southern Management Area, this minimum landing size exceeded the length at which 50% of females become mature, *i.e.*, 40-41 cm, as reported in the Saw 34 Consensus Summary of Assessments, whereas, in the Northern Management Area, the minimum landing size was approximately equivalent to this length.

In the section of the Working Group Report for SARC 40 headed "Discard Estimates", the Working Group noted that the most frequent reason for discard was that goosefish were too small for regulations or market. Comparison of Figures A9 and A10 of the Working Group report reveals that, although similar ratios of discards were recorded in the two Management Areas for both the gillnet and the dredge fisheries, the ratio of discards in trawl catches increased markedly in the Southern Management Area in 2000 and subsequent years, on introduction of the FMP, and to a far greater extent than those in trawl catches in the Northern Management Area. The majority of the goosefish catch is taken by trawl (Fig. A3 of the Working Group Report), and thus, although trawl landings in the Southern Management Area have declined since 2000, the extent of trawl discards in this area are of concern. The Working Group noted that the large number of discards in the Southern Area might also have been influenced by market acceptance or the presence of a relatively strong 1999 year class. It was interesting to note also, however, that the 2004 Cooperative Survey reported preliminary results that indicated that the majority of the population in the Southern Management Region were smaller than the minimum landing size required under the FMP, *i.e.*, approximately 53 cm total length.

Recommendation of SARC 34

The recommendation of SARC 34, listed on page 19 of the Working Group report for SARC 40, was that

"Spatial distribution of mature and immature fish and the potential effects of size limits on fishing behavior should be evaluated as a basis for advising on strategies to minimize catch and discard of immature fish".

Working Group response

The Working Group response to the recommendation of SARC 34 was that:

"Elimination of minimum size regulations were [sic] considered, but not adopted, in the development of Amendment 2 to the FMP as a means to reduce discards. Instead, the minimum size regulation was reduced in the southern area to be consistent with the northern area".

Assessment of the Working Group response

In Section 3.1.1.2 of this report, on page 4, it is stated that:

"The recommendation that the spatial distribution of mature and immature fish should be evaluated to resolve a question relating to the impact of minimum size limits on discards and fishing behavior was resolved by modification to the minimum size regulations. However, increased understanding of the movement and distribution of fish is also essential and, as recommended elsewhere in this report, examination of the distribution of the different size and age classes would provide valuable information on the biology of goosefish."

The Working Group's comment that "the minimum size regulation was reduced in the southern area to be consistent with the northern area" was interpreted to mean that the minimum size regulation in the Southern Region had been or would be changed from ~53 cm to ~43 cm, thereby directly reducing the number of goosefish in the Southern Area that would need to be discarded. Thus, it appeared that, rather than waiting on an evaluation of the "spatial distribution of mature and immature fish and the potential effects of size limits on fishing behavior" to determine "strategies to minimize catch and discard of immature fish", fishery managers had responded directly by acting to eliminate the requirement in the Southern Management Area to discard a large fraction of these fish. That is, the SARC's stated intention of minimizing "catch and discard" had been addressed, to some extent, by reducing the "discard" component of fish in the "catch and discard" category of catches in the Southern Management Area. On this basis, the statement was made in this report that "the recommendation that the spatial distribution of mature and immature fish should be evaluated to resolve a question relating to the impact of minimum size limits on discards and fishing behavior was resolved by modification to the minimum size regulations".

On re-examining this issue in response to the CIE's question, however, it was concluded that it appears unlikely that the intent of the SARC 34 recommendation was to reduce the quantity of immature fish that were discarded (and died as a consequence of their capture and discard) by simply retaining and landing such fish. Certainly, the Advisory Report from the 34th SAW included the management advice that "efforts should be made to reduce discards" and advised that the goosefish stocks in both Management Areas were overfished and that overfishing was occurring in both areas. The advice also indicated a need to rebuild biomass and the assessment of the 34th SAW was that indices of egg production had declined by around 80% since the 1970s. Thus, it would appear likely that the intent of the SARC 34 recommendation was to identify alternative approaches to minimum landing size that might be effective in allowing a greater proportion of the immature fish to attain maturity and contribute to egg production. In direct contrast to the outcome that was probably intended by SARC 34, the decision to reduce the minimum size in the Southern Area is likely to increase the mortality of both immature and mature fish in this area following implementation of Amendment 2 of the FMP. As recommended by SARC 34, there would be value in undertaking the evaluation of the "spatial distribution of mature and immature fish and the potential effects of size limits on fishing behavior" to determine "strategies to minimize catch and discard of immature fish", as this need has not been met by the action taken to reduce the minimum landing size in the Southern Area such that it is now consistent with that in the Northern Area.