UM Independent System for Peer Reviews
Consultant Report on:

37th Stock Assessment Review Committee for Witch Flounder, Spiny Dogfish, Atlantic Surfclam, Shortfin Squid and Hagfish Assessments

17th-21st June 2003, New Bedford, MA

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Executive Summary

- The management system works well. The assessments were well supported with scientific evidence. The SARC meetings are focused on the advice, which is appropriate for the management council and appears to have influence over management decisions.
- The main problems were with the mathematical modelling in the assessments. Working groups should work towards acceptable, simple stock assessment models as benchmark assessments as soon as possible.
- The witch flounder stock has a standard VPA model, which provides an adequate assessment. A statistical catch-at-age model is being developed, and should replace the VPA if it can be shown to reduce the retrospective bias.
- The spiny dogfish stock is clearly overfished. However, better stock modelling may be required as the stock recovers and its status as overfished becomes less certain.
- The hagfish fishery is a small scale, new fishery. If a large investment is to be avoided in the scientific research for this fishery, innovative approaches to monitoring and management would be required.
- The Atlantic surfclam stock appears not to be overfished. Recent recruitment has been poor, so the biomass is expected to continue to decline. An age-structured model is possible and recommended for this stock, as it will include all evidence into a single assessment.
- The northern shortfin squid stock is probably not overfished, although there is considerable uncertainty with this assessment. The stock size depends on the recruitment each year, which will be difficult to predict. A new in-season assessment model is under development, and some suggestions were made to improve it (Appendix 1).

Overview

The following are personal observations on future improvements in the assessments and are not necessarily shared by the other panel members. This report does not repeat issues raised in the main SARC report, which needs to be consulted for the committee's consensus views on these assessments.

The committee meeting was carried out in a cordial and constructive atmosphere and consensus was reached on all issues. The assessments were well supported with scientific evidence and the responsible scientists demonstrated a good understanding of the main issues in the fisheries and of the available data. All fisheries assessments demonstrated progress towards improved stock assessment modelling.

Activities

Copies of all working reports were obtained from a secure website and reviewed prior to the meeting. I attended the SARC panel meeting held June 16-20, 2003 in New Bedford, MA. Authors presented working group reports at the meeting and management advisories were proposed and then edited during the meeting by consensus. This report was based on notes made from discussions and the review of the working documents.

General Comments

Working groups need to develop acceptable standard models for each stock as quickly as possible. Standard models can be used as benchmarks with which improved models might be compared. Having an accepted model that incorporates all relevant information and uncertainty should provide a focus for research and management advice.

With the exception of witch flounder, no assessment had applied standard population models to the entire stock. Although such models always have problems, they are useful in summarising results and uncertainties. For example, the surfclam and spiny dogfish could have had an age-structured model fitted to the available data. This would not have resolved issues such as differing trends in indices of abundance, but might have made the implications of such uncertainties clearer in the assessment.

I support use of decision rules by the management council. This is both transparent and effective. They provide focus in the assessment advice and allowed consensus in the meeting to be reached rapidly.

Updating reference points continues to be a problem. Concern was expressed at the meeting that once reference points have been estimated in one stock assessment, they might remain unchanged even when better information is obtained. Complex qualifications were added to the spiny dogfish biomass target estimate to allow for changes in estimated survey q in future assessments.

It is recommended to avoid absolute reference points if possible. Problems might be reduced by making all reference points dimensionless (e.g. target biomass defined as the proportion of the estimated unexploited biomass). Such reference points can often be estimated with greater accuracy, but may be unpopular with managers as they are more difficult to interpret. Managers also probably lack the ability to appreciate uncertainty in fishery assessments. It is difficult to see how to address these issues without training managers in interpreting the advisories.

It would make more sense to run stock projections with quotas rather than fishing mortality to account for the greater uncertainty. Standard stock projections appear to be carried out under an assumption of constant fishing mortality. This is partly because yield-per-recruit reference points are used. However, the control applied to most fisheries is a constant quota, which usually assumes some absolute level of recruitment. Projections of different levels of quota may help managers, even if such information does not address the legal requirements. If the scientists feel projections based on quota controls would be too unreliable, it would suggest alternative management controls to quotas should be considered.

Parametric bootstraps can be used to simulate autocorrelations in residuals and need not assume independence. In most assessments, residuals are not independent, but some time series patterns remain. ARIMA models can be used to simulate these rather than assuming independent identically distributed errors. This does not deal with the model problems that such patterns in residuals imply, but does attempt to account for this additional source of uncertainty in the bootstraps.

Specific Comments on Stock Assessments

Witch Flounder

Concern was expressed in the meeting over the retrospective bias evident in the VPA fit. Retrospective bias is used to indicate how good the parameter estimates are for the current year by checking the performance in previous years. It is recognised that VPAs are better at assessing past cohorts than predicting future ones.

The most important test for any model is its ability to predict future values. Retrospective analyses effectively do this by estimating year class strength before the cohort has run through the model. The witch flounder assessment illustrated problems in this regard. The test of the statistical catch-at-age model being developed should be whether it provides more accurate predictions of stock size than the current model.

Spiny dogfish

In estimating recruitment, the indices were smoothed to remove what are thought to be unrealistic fluctuations. For exploratory analyses, it is quite reasonable to smooth data, but applying models to these data makes diagnostics difficult to interpret. In principle, data should be manipulated as little as possible, but all explanations as to its properties should be included in the model. The aim of assessments is usually to use population models to explain autocorrelation and trends in observed indices. A successful model will explain these, so that the residuals appear to be independent and identically distributed random variables. Most methods, such as smoothing, can be incorporated in the models being fitted.

It is accepted practice to use processed information for fitting models (e.g. GLMs are used to standardise CPUE indices). So, although I do not think this is universally a good practice, I cannot condemn the manipulation of indices that was applied in the spiny dogfish assessment. It should, however, be carefully justified as moving averages introduces autocorrelations that may subsequently have a significant affect on fitted time series models.

I support the development of GLM, GAM or an economic model to estimate discards. GLMs would allow estimates to vary with the species being targeted. For example, spiny dogfish may be more likely to have been discarded if there was a high catch of a species with a price greater than spiny dogfish than of a species with price less than spiny dogfish. An economic model should be able to go further by modelling the decisions of the fishermen, based on hold size, freezer sizes, catch by species value and so on. GAMs might be particularly useful where the function form of relationships were suspected to be non-linear but unknown. They require large amounts of data, but could produce the most robust estimates of discards. I am not convinced that an effort based estimator would do better than the catch based one, however, as effort is often difficult to measure. Overall, the ratio estimator presented is a reasonable approach for the estimates produced and should provide a good indication of the degree of discarding.

Rather than obtaining F as a linear function of landings, it would be better to use the classical catch equation to get the instantaneous rate, as used in the yield-per-recruit. Maximum F estimates of around 0.4 suggest differences will be small, but nevertheless it is simple to calculate and this small error can be avoided.

Growth models are notoriously difficult to use in converting length to ages. Errors in age become significant as animals approach their length asymptote. Where a growth model is used, it is worth checking how sensitive the assessment is to this error. Alternatively the growth model can be used to estimate a length-at-age key, which incorporates the probability distribution of the age based on length from an estimate of the variation in growth.

It would be worth exploring further the cross correlations between the spring, fall and Canadian surveys. These together may provide better indices for fitting population models.

The reference point used was a demographic replacement, which was reasonable for shark species. However, the reference point used, pups-per-recruit = 1.0, would only imply replacement if pups were recruited to the fishery at birth. If there were a delay, the population would decline as $\exp(-Mt)$ where M is natural mortality rate and t is the delay between birth and recruitment.

Hagfish

Ghost fishing from lost traps is a significant problem in many fisheries. This may turn out to be a significant cause of mortality in the hagfish fishery, as hagfish are already attracted to dead fish in the traps. The problem can be easily addressed by use of biodegradable escapement doors. This should be implemented prior to research testing whether this is a significant source of mortality. It is a low cost intervention, easy for the fishers to understand, and any source of mortality that is removed, however small, benefits the fishery.

Exploitation of the hagfish stock has only started relatively recently. There is only a short time series of data and very little biological research. The current system set up to provide scientific advice presumes considerably more knowledge about the stock than will be available for many years. This is not only an expensive approach to managing small-scale fisheries, but also may be unable to provide timely advice to developing fisheries.

If management and scientific research is to be appropriate to small-scale fisheries, the focus of management and scientific advice needs to be different. There is no prescriptive approach, but the following may be considered.

- Statistics should have a more central role than biology. Biological research clearly reduces uncertainty particularly in the longer term, but it is expensive and slow. Simple models, such as the biomass dynamics or recruitment index models, with a few biological assumptions and parameters are more appropriate. However, even these may be difficult to apply with any degree of confidence.
- When risks form a significant part of the assessment, they should be quantified and dealt with explicitly. This means more focus on what the costs might be if the assessment is wrong, rather than assuming it is correct. The main formal way of dealing with risk is Bayesian decision analysis.
- Innovative sources of data, indicators and reference points should be considered. For example, it may be possible to use subjective information in the form of parameter priors generated by interviews (Press 1989) or catch rates may be used as an indicator of the state of the fishery, rather than attempting to estimate either biomass or fishing mortality.
- Fishers may need to be involved more directly in decision-making. If there is very little information, risks of overfishing will be very high. The degree to which the decision-maker is risk averse will have a great influence on setting the amount of fishing. The people who are affected by the decision may have a quite different attitude to risk, and should at the very least be consulted.

Atlantic Surfclams

As well as standardising tows using calculations of tow distance and depletion models, direct statistical relationships between sensor data and efficiency might be estimated using a generalised linear model approach. This will standardise survey indices and potentially allow survey gear efficiency to be increased rather than kept constant.

There are three relevant variables from the sensor data: dredge angle, hydraulic pump power, and pump water pressure. The time units need to be standardised using either the average or one covariate observation from each time unit. The observations can also be transformed using any suitable non-linear transformation. The information (covariance) matrix from these covariates can be calculated in the normal way for each tow. Covariate observations designated as “not fishing” should be excluded. Unfortunately the catch rate is not recorded during the tow, so only the average catch rate can be used. This is the total catch for the tow divided by the number of time units (X covariate observations) and should be used as the Y variate. This Y variate multiplied by the sum of the sensor data gives the Y covariate vector. The vector and information matrix can be summed over tows to carry out the regression. The regression can easily be generalized to other link and error models (McCullagh and Nelder 1980).

If the regression can be shown to work, not only can some of the variables (water pressure, speed of tow etc.) be experimentally changed to improve parameter estimates, but also it may be possible to standardise LPUE data. The regression approach could be incorporated within the depletion model used to calibrate the survey.

Northern Shortfin Squid Stock

I recommend that the fishery move away from quota management as it is not appropriate for an annual species. Effective quota management will require accurate predictions of recruitment to take advantage of the stock size. Otherwise, to be sustainable, quotas would have to be set relatively low and would not be able to take advantage of good recruitments. Pressure to raise the quota will probably eventually lead to overfishing.

If it can be implemented, effort (fishing mortality) based controls are most appropriate. Limited entry and variable season closure dates could be implemented to enforce a constant escapement policy. This is equivalent to applying SSB reference points.

I support the in-season modelling approach. This is a necessary step to obtain a good assessment for this fishery.

The conceptual model is good, but the analyses were not well presented in the document. It was not clear whether the mistakes in the document were due to document errors or errors in the model that was fitted. Maybe some of the problems are related to the nomenclature used in the equations.

The population model equations describing the number of immature and mature animals after a time step (Working Document Page 15) should probably be written as:

$$N_{t+1} = N_t e^{-M_{NS}} \left(1 - p_t\right)$$

$$S_{t+1} = S_t e^{-M_{sp}} + N_t e^{-M_{NS}} p_t$$

assuming all animals mature at the end of the time step. Although this model would work, it mixes a discrete state change model and continuous mortality rate model, which is not recommended.

More seriously, the parameter p_t appearing in most of the equations appears to be a probability describing the transition from immature to mature individuals. However, in the likelihood equation it appears to be fitted as the proportion of mature animals in the sample ($S_t/(N_t+S_t)$), which is different. If this is what was done, using the fitted parameter in the yield-per-recruit calculations would be incorrect. Appendix 1 develops a consistent continuous time model along the lines of that presented in the assessment.

The logistic model presented did not fit the observed proportion mature data. The logistic model starts from close to zero for the inflexion to be in the centre of the series. The initial proportion mature was clearly greater than zero, suggesting some minimum proportion mature in the data. This suggests an alternative model with an additional parameter:

$$p_t = p_0 + \frac{1 - p_0}{1 + e^{-a(t-h)}}$$

where p_0 is the initial proportion mature at 13 weeks. While this model could fit the proportions better (Fig. 1), it is not clear how to interpret p_0, and so the model should not be extrapolated below 13 weeks old.

The inclusion of aging errors in fitting the model should continue. This is often a problem in assessments and it is good that it has been addressed here. If the model continues to fit the data poorly, a more robust error distribution could also be used, such as the beta-binomial, which has the likelihood:

$$L = \frac{\Gamma(n+1)}{\Gamma(n-s+1)\Gamma(s+1)} \frac{\Gamma(d\,p_t+s)\Gamma(n+d(1-p_t)-s)}{\Gamma(n+d)} \frac{\Gamma(d)}{\Gamma(d\,p_t)\Gamma(d(1-p_t))}$$

where n = sample size, s = the number mature in the sample, d = an additional dispersion parameter and p_t = the binomial parameter being estimated. The log-likelihood is very easy to calculate, as there is an accurate and fast numerical approximation to the log-gamma function (Press *et al* 1989). The additional dispersion parameter (d) allows the variance to exceed that of the binomial model by a factor of $(d+n)\,(d+1)^{-1}$.

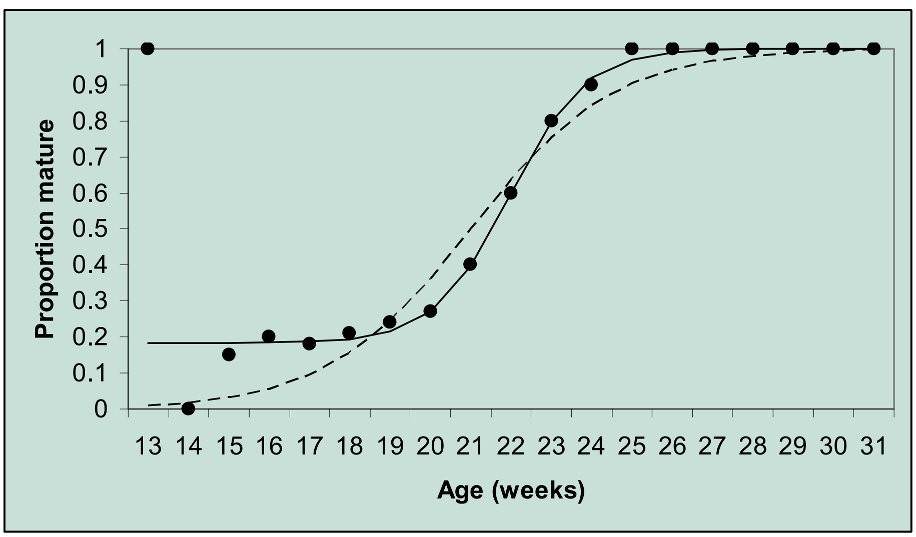

Figure 1 Logistic with an additional parameter to allow for precocious maturity (solid line) compared to the logistic model used (dotted line). The additional parameter significantly improves the fit to the observed proportion mature. The model is illustrative only, as models were only fit as to the proportions excluding 13 and 14 weeks, not to the original data, which were unavailable.

I did not consider these issues critical as the model is still under development and results were not used directly in the assessment. However, I suggest the scientists review the model carefully, and in particular consider what they realistically might fit. Simulations might help in this regard. In addition, I suggest a model (Appendix 1) that I think the scientists might find useful based upon the conceptual description. Although they may wish to simplify the equations for fitting purposes, the underlying model should be considered in designing simulations and data collection.

References

McCullagh P, Nelder JA (1983) Generalized linear models. Chapman and Hall, New York.

Press, S.J. 1989. Bayesian Statistics: Principles, Models and Applications. John Wiley and Sons, New York.

Press, W.H., Flannery, B.P., Teukolsky, S.A., Vetterling, W.T. 1989. Numerical Recipes in Pascal. The Art of Scientific Computing. Cambridge University Press, UK.

Appendix 1: Suggested *Illex* Population Model

The scientists responsible for the *Illex* assessment asked for any suggestions on improving the models described in the working document for the 37th Northeast SAW. Below I work out a model based upon the description in the working document and the following two differential equations that describe a deterministic continuous time process. While I believe the equations are correct, they should be carefully checked if they are to be used in any stock assessment.

The numbers of immature animals will follow the normal negative exponential model, with constant mortality and maturing rates.

$$N_t = N_0 e^{-(M+F+P)t} \tag{1.}$$

where M is the natural mortality rate, F is the fishing mortality rate and P is the rate of change from immature to mature animals. The numbers of mature animals is more complicated, as it will depend on the numbers of immature animals and the rate they are maturing. The differential equation would be:

$$\frac{dS_t}{dt} = -(M+F+R)S_t + PN_t \tag{2.}$$

where S_t is the number of mature animals at time t and R is the spawning rate. By substitution:

$$\frac{dS_t}{dt} = -(M+F+R)S_t + P N_0 e^{-(M+F+P)t} \tag{3.}$$

This linear differential equation has the solutions (Fig 2):

$$\begin{aligned} S_t &= \frac{PN_0 e^{-(M+F)t}}{P-R}\left(e^{-Rt} - e^{-Pt}\right) + S_0\, e^{-(M+F+R)t} \qquad && P \neq R \\ S_t &= PN_0\, t\, e^{-(M+F+P)t} + S_0\, e^{-(M+F+R)t} && P = R \end{aligned} \tag{4.}$$

Where P and F vary over time, the appropriate value can be replaced in each time step, with N_0 and S_0 being the numbers of the mature and immature animals at the beginning of the time step and t is the time in each step. If P and F are constant from recruitment onwards, the model may be simplified by setting $S_0 = 0$.

The difference between this model and that presented in the working document is that the working document yield-per-recruit model does not allow for spawning or mortality of animals that mature within the time step. If the time step is small, there should only be a small difference.

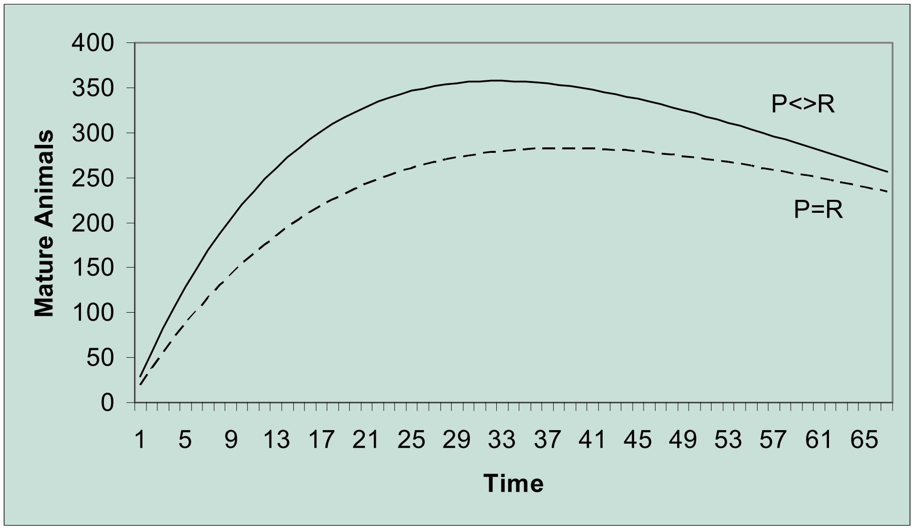

Figure 2 Numbers of mature Illex over time for two sets of parameters. In this model, time is the same as age. (R=0.3, P=0.2, Z=0.06, N_0=1000, S_0=0)

The number of animals that spawn is found by integration over the time step:

$$
\begin{aligned}
E_t &= V\int_0^1 R\ S_t\,dt \\
&= \frac{VRPN_0}{P-R}\left(\frac{1-e^{-(M+F+R)t}}{(M+F+R)}-\frac{1-e^{-(M+F+P)t}}{(M+F+P)}\right) \\
&\quad +\frac{VRS_0\left(1-e^{-(M+F+R)t}\right)}{(M+F+R)} \qquad P\neq R \\
&= \frac{VRPN_0}{(M+F+P)}\left(te^{-(M+F+P)t}+\frac{1-e^{-(M+F+P)t}}{(M+F+P)}\right)+\frac{VRS_0\left(1-e^{-(M+F+R)t}\right)}{(M+F+R)} \qquad P=R
\end{aligned}
\tag{5.}
$$

These equations can be used in the yield-per-recruit model in the usual way, but are now independent of the size of the time step used.

I suggest that the same model used in the yield-per-recruit should be fitted to the available data if possible. This has the advantage that the fitted parameters are exactly the same as those used in the yield per recruit model, which would be useful when looking at the parameter uncertainty.

The model could be fitted to the survey data using the same general approach set out in the assessment document.

$$
\begin{aligned}
L(s|n) &= \binom{n}{s}\alpha_t^s\left(1-\alpha_t\right)^{n-s} \\
\alpha_t &= \frac{S_t}{N_t+S_t}
\end{aligned}
\tag{6.}
$$

where n is the sample size of age t animals and s is the number of mature animals in the sample. Note that α_t is independent of M and F as long as these rates act equally on mature and immature animals, even if selectivity by age operates. If P is constant (i.e. does not vary with age) and no animals are mature at recruitment ($S_0=0$), α_t can be further simplified as it becomes independent of N_0 as well, so α_t will be a function of P and R only.

$$\begin{aligned}\alpha_t &= \frac{S_t}{N_t + S_t} \\ &= \frac{P\left(e^{-Rt} - e^{-Pt}\right)}{Pe^{-Rt} - R\,e^{-Pt}} \qquad P \neq R \\ &= \frac{P\,t}{P\,t + 1} \qquad P = R\end{aligned} \tag{7.}$$

This model does not fit the observed proportions mature at each age (Working Document Figure D25). Both the observations and biological considerations support the idea that P increases with age. Introducing P_t as a function of time makes the model much more complex, so that equation (1.) becomes insoluble, but could still be used as a difference equation. Another approach is to model P_t so that it is constant within each time step, but increases between time steps based on some time function. In this case, S_0 cannot be assumed to be 0.

$$\begin{aligned}\alpha_t &= \frac{S_t}{N_t + S_t} \\ &= \frac{\left(P_t - \alpha_0 R\right)e^{-Rt} - \left(1-\alpha_0\right)P_t\,e^{-P_t t}}{\left(P_t - \alpha_0 R\right)e^{-Rt} - \left(1-\alpha_0\right)R\,e^{-P_t t}} \qquad P \neq R \\ &= \frac{P_t\,t\left(1-\alpha_0\right) + \alpha_0}{\left(P_t\,t + 1\right)\left(1-\alpha_0\right) + \alpha_0} \qquad P = R\end{aligned} \tag{8.}$$

where α_0 = the proportion already mature at the start of the time step. The asymptotic maximum proportion will be P/R if $P<R$, because they are spawning (dying) at a faster rate than being replenished from the immature stock. It is apparent from the data that the asymptote approaches 1.0 implying that $P>R$ for older animals.

The choice of function for P_t is arbitrary, but must be non-linear to provide the observed change in proportion. The model, equation (8.), with P_t as the logistic function would be reasonably consistent with the data (Fig. 3), although simpler, more parsimonious functions might fit the data equally well.

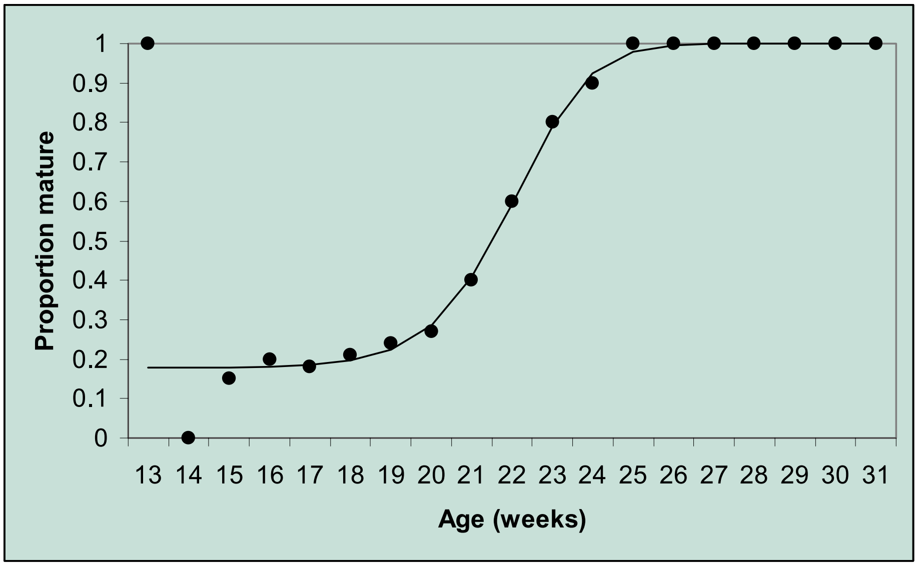

Figure 3 Population model with $P_t = P_0 + (1-P_0)/(1+\exp(a^*(t-h)))$ in equation (8.), after fitting the curve using least squares to the observed proportions excluding weeks 13 and 14 (R=0.93, a=0.92, b=21.2, P_0=0.16).

The initial proportion would actually be P_0/R and any value for $P_t > R$ would derive a final proportion mature of 1.0. This makes these data alone difficult to determine both P_t parameters and R accurately. It is likely there would be strong correlations between the fitted parameters (a, P_0 and R). Sensitivity of the yield-per-recruit to these correlations would have to be determined.

If biological data are collected from the landings, a cohort-based model could be fitted based on equation (4.). This would reveal more information about the parameters and test whether the model fits the data or not. However, rather than try to estimate each week's recruitment, recruitment could be smoothed over weeks and represented as two seasons, for example, as two normal distributions with means at the recruitment mode.

Appendix 2: Bibliography of Materials Provided

SARC 37 working papers, including the working group reports and other analyses.

	Title	Authors
A1	Witch Flounder Assessment	Witch Flounder Northern Demersal Working Group
B1	Assessment Of Spiny Dogfish (Squalus Acanthias) For 2002	Southern Demersal Working Group/Asmfc Spiny Dogfish Technical Committee
B2	Summary Of Research On Spiny Dogfish In North Carolina By East Carolina University, 1997 - 2003	R. A. Rulifson
B3	Biological Characterization Of The North Carolina Spiny Dogfish (Squalus Acanthias) Fishery	Rulifson Et Al., 2002
B4	Characterization Of The Spiny Dogfish Population South Of Cape Hatteras For Potential Commercial Harvest And Management Plan Development	Newman Et al., 2000
B5	Biological Information of the Northern District Spiny Dogfish Fishery Needed for the Fishery Management Plan	C. S. Hickman, T. Moore, R. Rulifson
C1	Assessment Of Atlantic Surfclam	Invertebrate Subcommittee
D1	Assessment Of The Northern Shortfin Squid Stock In The Northwest Atlantic For 2002	Invertebrate Subcommittee
E1	Review Of Atlantic Hagfish Biological And Fishery Information With Assessment And Research Considerations	Ad Hoc Atlantic Hagfish Working Group

Appendix 3: Statement of Work

Consulting Agreement between the University of Miami and Dr. Paul Medley

May 23, 2003

General

The Stock Assessment Review Committee meeting (SARC) is a formal, one-week long meeting of stock assessment experts who serve as a peer review panel for several tabled stock assessments. It is part of the overall Northeast Stock Assessment Workshop (SAW) process which also includes peer assessment development (SAW Working Groups), public presentations, and document publication within a cycle that lasts six months. The panel is made up of some 12-15 assessment scientists: 4 scientists from the NEFSC; a scientist from the Northeast Regional office, scientists from the staff of the New England and Mid-Atlantic Fishery Management Councils, and Atlantic States Marine Fisheries Commission and additional panelists from state fisheries agencies, academia (US and Canada), and other federal research institutions (US and Canada).

Designee will serve as a panelist on the 37th Stock Assessment Review Committee panel. The panel will convene at the School for Marine Science and Technology, University of Massachusetts, Dartmouth the week of 16 June 2003 (16-20 June) to review assessments for Atlantic surfclam (*Spisula solidissima*), northern short-finned squid (*Illex illecebrosus*), witch flounder or grey sole (*Glyptocephalus cynoglossus*), and spiny dogfish (*Squalus acanthias*). The panel will also be asked to comment on a working paper discussing approaches to assessing Atlantic hagfish (*Myxine glutinosa*), a developing fishery with little or no fishery-independent and fishery-dependent information.

Specific

The reviewer's duties will occupy a maximum of 14 workdays; a few days prior to the meeting for document review; the week long meeting; and a few days following the meeting to ensure that the final documents are consistent with the SARC'S recommendations and advice, and a few days to prepare the review report. No consensus opinion between two CIE reviewers will be accepted.

(1) Prior to the meeting: become familiar with the working papers produced by the SAW Working Groups (total number not final; there will be at least one per stock);
(2) During the meeting: participate, as a peer, in panel discussions on assessment validity, results, recommendations, and conclusions. Participate in the formulation of the draft SARC Advisory Report;
(3) Review the final Draft Advisory Report and Consensus Summary Report.

(4) No later than July 7, 2003, submit a written report[1] consisting of the findings, analysis, and conclusions, addressed to the "University of Miami Independent System for Peer Review," and sent to Dr. David Sampson, via email to David.Sampson@oregonstate.edu, and to Mr. Manoj Shivlani, via email to mshivlani@rsmas.miami.edu.

Contact persons: Dr. Terrence P. Smith, NEFSC, Woods Hole, SAW Chairman, 508-495-2230
Mary Jane Smith, NEFSC, Woods Hole, SAW Coordinator, 508-495-2370

Signed______________________________ Date_______________

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

ANNEX I: REPORT GENERATION AND PROCEDURAL ITEMS

1. The report should be prefaced with an executive summary of findings and/or recommendations.
2. The main body of the report should consist of a background, description of review activities, summary of findings, conclusions/recommendations, and references.
3. The report should also include as separate appendices the bibliography of all materials provided and a copy of the statement of work.