CIE Review of Stock Assessments for

1. Atlantic Surfclams in the US EEZ

2. Butterfish

Woods Hole, 30 Nov – 3 Dec 2009

External, independent peer review report by

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30 December 2009

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0. Executive summary

The goal for this review was to determine whether the 2009 benchmark stock assessments for surfclam and butterfish were adequate to serve as a basis for developing fishery management advice. My role was to provide an independent viewpoint on whether or not each of the terms of reference (ToR) for the SAW addressing each species had been met, to explain my views, and to add any other constructive suggestions based on my background in fisheries and statistical science. This report should be read with the reports of the other two reviewers (M. Smith, H. Sparholt) and the agreed joint report prepared by the SARC chair (R. Latour). A short summary of my duties in the SARC is given in section 2 of this report.

Atlantic surfclams

This species provides a rich dredge fishery off the U.S. east coast. Assessments of the entire stock in the U.S. EEZ are carried out every 3 years use landings and survey data. The 2009 assessment met all eight terms of reference (ToR). The bulk of landings has shifted from the south to the north in recent years with total landings being slightly below quota. Landings data are thought to be accurate and discarding negligible because of good governance associated with the ITQ system. Fishing effort has increased while LPUE has declined gradually. The fishery is spatially diverse. Survey results indicate that recruitments have been relatively low in southern regions over the last four years but the spatial and annual detail about this decline are poor because of the 3-year intervals between surveys and low selectivity of the survey dredge for surfclams < 70 mm SL. Efficiency, selectivity, and other technical aspects of the survey dredge were newly estimated in 2009 thereby allowing improvements to estimates of swept area biomass.

The assessment utilised KLAMZ, a two life-stage, biomass-based model. This allowed characterization of the uncertainties of efficiency-corrected stock biomass and fishing mortality. Biomass estimates were slightly lower than in 1999 primarily because of new scaling parameters flowing from improved survey techniques; biomass reference points were revised downwards accordingly. Estimated stock biomass in 2008 exceeded the new reference point by around 60%. Estimated F=0.027 which was well below the F reference point set at 0.15 yr^{-1}, unchanged from previously. The reference points represent a pragmatic approach to regulating the fishery as a single stock and, on this basis, the stock is not overfished. Recruitment estimates produced by KLAMZ were highly smoothed and not very informative. This is partly due to use of an unstructured, simple random walk model for recruitment, and partly because modelling of the EEZ surfclam stock as a single homogeneous population has composited and obscured regional and latitudinal diversity of recruitment. Projections of future stock states under different fishing intensities were made as required but I would not pin much weight to them, mostly because of the uncertainties over future recruitments. Consequently, if fishing effort were to be increased it would be prudent to increase surveillance of the stock.

Possible causes for poor recruitment in recent years were investigated. Spatfall seems to occur successfully but young clams are being lost in their first years of life. There remain several avenues for further investigations, e.g. by taking a closer look at invertebrate predators using existing benthic surveys, by better characterizing the hydrographics of the stock region as they affect food supply and larval dispersal, and by tapping into existing environmental studies made in relation to waste disposals or run-off from developed land.

My advice on surfclams includes:

- Give high priority to a desk study of existing benthic, hydrographic, and environmental studies to underpin quantitative assessments.
- Shell length to meat weight factors could be better estimated for landings and surveys by modelling effects of latitude, depth, age, season, and perhaps other factors.
- Dredge efficiency trials could be improved by considering sediment cohesiveness and burial depth of clams, possibly in aquarium trials.
- Annual recruitments and total mortality rates, Z, should be assessed regionally using year-class curves applied to survey CPUE-at-age. Z would serve as a check on $F+M$ as used in the modelling. The capability to age surfclams up to 30 years is hardly being exploited at present.
- Survey strata might be worth re-assessing in light of stock movements in order to maintain or improve survey efficiency.
- Growth parameters might be estimated more precisely by including additional factors in the growth model, such as latitude, depth, year, etc. but also including random factors to allow for clustered sampling.
- Reconsider the design of the proposed new survey using commercial dredging vessels in one of three regions annually. I am concerned that year and region will be confounded.
- Develop a spatial approach to assessment and management of the surfclam stocks in recognition of their regional diversity. This should be supported by socio-economic findings showing where the benefits of the surfclam industry are falling.
- Supplement the dredge used on the existing survey with a simple benthic sampling device designed to catch young surfclams so as to allow better knowledge of recruitment to the fishery. I have included details of an epibenthic beam trawl (2 m) that might form a basis for the new technique.

Butterfish
Butterfish are a short-lived, seasonally migrating, schooling, pelagic fish mainly caught as a bycatch of the Loligo fishery, and without a directed fishery. They are plankton feeders implying that they undertake diurnal vertical migrations to pursue their prey at night and hide from their many predators during the day. These facts make them elusive to catch with a demersal survey trawl, and very difficult to quantify in assessments. They also suggest that the significance of the species is more ecological than economic since they could be performing an important stabilising role in the trophic 'pyramid' along the U.S. eastern shelf. Nevertheless, the species has a negative economic importance to the Loligo fishery because controls on butterfish bycatch have the effect of restricting catches of Loligo.

The main inputs to the butterfish assessment are the NEFSC trawl surveys in spring, fall, and winter, and catch data consisting, nowadays, mostly of observer estimates of discarding in the Loligo fishery. For the reasons given above, precision of all but one of these data series is so low as to make them almost devoid of information about the stock or the fisheries. The exception is the fall survey which offers CVs (standard error/mean) for biomass/tow consistently falling around 25%. This survey is good because it coincides with the widespread distribution of young (mostly < 2 years) butterfish over the shelf. It indicates that biomass has had an underlying trend downwards for the last 25 years. I accepted that the decline was probably not caused by over-fishing. In these circumstances, managing to achieve an MSY equilibrium through control of fishing mortality is inappropriate.

Butterfish ToR were mainly met. ToR 1 required fishing effort to be characterized but, unfortunately, effort data for the Loligo fishery were not available; however, expert views were that effort had not increased significantly over the period of the butterfish decline. ToR 1 also refers to temporal management objectives that relate to bycatch in the Loligo fishery. This matter was deferred while discussions about that fishery continue. ToR 2, concerning surveys, was met. An important component of the work was development of a scaling or catchability factor dependent on swept area, intercalibration studies of survey vessels, and a skewed prior distribution judged to represent catchability by one of the survey vessels. This represents a reasonable attempt to estimate MSY and allowable catches in absolute units but, necessarily, the result rests heavily on the truth of assumptions made.

Stock parameters were estimated using the KLAMZ biomass model (ToR 3). The two life stages needed for this model were separated at the age of 12 months from the presumed summer birth time. The fall survey occurs shortly after this time and, since it has been carried out at dates which have been drifting gradually earlier in the year, I am slightly concerned that this, together with some of the assumptions made for the modelling, might have influenced the perceptions of declining biomass and recruitment in the butterfish stock. The envelope method was helpful in providing limits to stock biomass given credible constraints on *F* and *Q* though it cannot limit the influence of all the assumptions made for the KLAMZ model. Year-class curves fitted to survey log numbers-at-age found high total mortality rates inconsistent with assumed *M* and estimated *F*. Whether this is due to under-estimated natural mortality or low catchability of old individuals cannot definitely be determined at present.

ToR 4 was met for *F*. Current fishing mortality is well below all candidate reference points. A biological reference point for biomass was thought inappropriate given the uncertainties of the assessment and the difficulties of applying an equilibrium state when the population is falling. Possibly, a B_{lim} could be devised based on SSBs that produced successful recruitments; however, this could not be an absolute reference point without confidence in the scaling factor for the assessment. There is little chance that the butterfish is overfished, i.e. ToR 5 was met. ToR 6, concerning predatory consumption of butterfish was met for fish predators. It indicated a gap between predatory *M* and *M* = 0.8 assumed for the assessment. There may be other predators, or butterfish may get less catchable as they get older. ToR 7 was met by making stock projections. However, their reliability is low because of reservations about the assessment modelling. Responses were provided to all eight research recommendations under ToR 8.

My advice on butterfish includes:

1. Revisit statistical theory of ratio estimators as they are being used to estimate butterfish discards in conjunction with total landings. Current estimates have high instability arising from use of the total landings figure for all fisheries or just the Loligo fisheries. Possibly, simpler estimators would give lower CVs.

2. Revisit survey stratifications used to estimate butterfish average catch/tow. Given the patchiness of catches, amalgamation of neighbouring strata might give lower CVs. A day-time index, as suggested by NESFC, may be more stable than a 24-hour index because of likely vertical migrations.

3. Given the problems of quantifying butterfish, attention should be turned more to characterizing biological properties of the stock. Age and length compositions, already collected, can inform about reproductive capacity. Condition could also be informative, e.g. about predation or disease.

4. Knowledge of whether old (> 2 years) butterfish, not usually found in trawls, do nevertheless exist in large quantities is needed to assess and manage the stock well. It is particularly relevant to the assumed rate of natural mortality, *M*. The knowledge might be gained through enquiries amongst fishers and scientists, or by special deployment of mid-water trawls.

5. Re-visit estimation of butterfish growth parameters. Additional fixed (e.g. *season*, *latitude*) and random (e.g. *year*, *catch*) effects might greatly improve precision without much risk of over-determination, judging from the number and variance of growth data available.

6. Recruitment should be estimated independently of KLAMZ, either directly from ALKs applied directly to survey length frequency distributions, or using year-class curves. This would corroborate the KLAMZ estimates of trends in recruitment.

7. I support research recommendations (ToR 8) (1) concerning growth and distribution, and (2), (3), and (5) concerning estimation of discards. Recommendation (6) concerning ecological relationships of the butterfish could be most profitably linked to evaluating its trophic importance to the Atlantic coastal ecosystem. Better knowledge of vertical migrations would also be helpful for targeted fishing and ecology. I do not support development of an age-based model for butterfish. Improvement of the quality of catch and survey data by whatever means are available should have higher priority.

8. My own preferences for future research are for: (1) developments of the gear and fishing practices of the Loligo fishery so as to reduce discarding of butterfish; (2) development of an indicator-based method of management of the butterfish to supplement or replace the present biomass-based approach; and (3) assemble effort data for the Loligo fishery together with a record of mesh sizes or other technical changes that might affect the bycatch of butterfish.

Other comments

I had difficulties using working papers A1 and B1, and referring to them subsequently. I recommend that a more systematic structure for future working papers would make less work for everyone.

1. Introduction

The objectives of this external peer review were to determine whether the benchmark stock assessments for two commercially fished species are adequate to serve as a basis for developing fishery management advice. The present report is supplementary to the SARC 49 agreed summary report prepared jointly by the three CIE reviewers. It presents my own understanding of the assessments together with my detailed views on various aspects. I believe that there are no significant points where I disagree with the joint summary report for either species.

In accordance with Annex 1 of the Statement of Work for CIE panellists, this report presents a short description of my role in the activities of SARC 49 in section 2. Sections 3 and 4 form the main body of the report. They consider the two species assessed, namely Atlantic surfclams and butterfish, respectively. Each of these sections consists of:

1. A background on the biology, fishery, and assessment.
2. A list of each of the terms of reference (ToR) together with my statement on whether or not it was met, an explanation of my decision, and any other comments I can offer based on my personal experience as a scientist.
3. My Conclusions and Recommendations for the species.

Following the two assessment sections, section 5 offers what are intended as constructive comments on SAW documentation, the only point of difficulty I had in relation to the SARC process which, generally, I found to be admirably scientific and thorough. Appendix 1 of the complete report lists materials provided for review. Section 6 provides the few references I have mentioned. I apologize that a lot of these have me as an author as a result of what I have been doing in recent years. Readers will find many other authors cited in the papers. Appendix 2 is a copy of the CIE statement of work, and Appendix 3 lists members of the SARC panel, all as required by the Statement of Work.

Acknowledgements: I would like to thank Jim Weinberg, Rob Latour, and Andrea Toran for a well-run meeting, Paul Rago for making so many of the Population Dynamics team available to advise the meeting, Larry Jacobson, Tim Miller, Toni Chute, and Jason Link for helpful presentations, and members of the fishing industry for additional advice. The rapporteurs' notes were succinct and timely.

2. My role in SARC 49

My activities for the review included study of all documents submitted to me beforehand (as listed in Appendix 1), and participation in the SARC 49 review panel from 30 November to 3 December 2009 where we discussed presentations of the working papers and supplementary materials requested. I also participated in short closed sessions attended only by the SARC chair and the three reviewers in order to decide the content of the agreed summary review report. Following my departure from Woods Hole, I prepared this report with the help of electronic versions of NEFSC's presentations and rapporteur's notes.

3. Atlantic surfclams

3.1 Background

The northern surfclam, *Spisula solidissima solidissima*, is distributed along the US east coast in sandy sediments from the intertidal zone down to 130 m between Georges Bank (42 deg N) in the north and Cape Hatteras (36 deg N) in the south. Surfclams have a planktonic larval stage lasting between 19 and 35 days, depending on temperature, before settlement on a suitable sandy substrate. The surfclam grows quickly and may mature in less than a year in the south, or over 4 years in the north. It lives buried in the sand by filter feeding on plankton (e.g. diatoms, ciliates) using its siphon. The maximum size attained is more than 22 cm, and some individuals live more than 30 years, as found by counting annual marks in the shell. The distribution of surfclams southward is thought to be limited by high temperatures. Surfclams have many predators and are susceptible to several metazoan parasites (WP A6).

The EEZ fishery occurs outside coastal state waters. It is managed by an ITQ system. Clams are caught with a special dredger fitted with a hydraulic pump to loosen the sand, a blade to lift the clams, and a cage dragged behind to receive them. Individuals less than 120 mm shell length (SL) can escape through the bars of the cage or are discarded on deck. A similar dredging technique is used for ocean quahogs but since that species lives in different habitats there is seldom a bycatch of quahogs in the clam fishery or vice versa; furthermore, landings of mixed species are not permitted. Fisheries on Georges Bank (GBK), where stock levels are high, have been closed to harvesting since 1989 due to occurrences of contamination with algal PSP toxins. The next richest fishing grounds occur off Southern New England SNE), Long Island (LI) and New Jersey (NJ). Stocks in the southern regions, Delmarva (DMV) and Southern Virginia & South Carolina (SVA) are currently weaker. Landings of surfclams are strictly controlled using sealed, standard cages of known volume. Quantities are mostly just below the allowed quota because of limited markets. Logbooks giving effort and the spatial movements of each fishing trip to within 10' squares of latitude and longitude (TMS) are mandatory. Discarding of surfclams is nowadays minor though it was not prior to 1993 when minimum landing sizes were enforced.

Stock assessments for surfclams are carried out every 3 years or so. Data inputs include landed weights converted to meat weights using a standard conversion factor. Landed quantities are increased by 12% for the assessment to allow for unrecorded mortalities incidental to the fishery. Also available are numbers-at-length and numbers-at-age derived from sampling landings. Another important input to the assessment is the regional biomass estimated by NMFS triennially using a special dredge similar to, but about half the size of a commercial dredge. Survey biomass estimates depend on the area swept by the dredge, on dredge efficiency, and on size-selectivity as determined by special field trials involving comparisons with commercial dredges. The survey dredge has been operated consistently since 1982, except in 1994 when technical inconsistencies occurred that suggested unusually high stock levels. The rate of natural mortality assumed for the assessment is 0.15 y^{-1}.

3.2. Findings

Below, I state my views on whether or not each ToR was met, explain my decision, and add personal observations and comments in case they are of any assistance, now or for future work.

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

This ToR was met. Landings from the EEZ and from state waters are tabulated separately as metric tonnes (mt) of clam flesh from 1965 to 2008 in table A2, those from the EEZ being based on vessel log books. The time series are illustrated in figure A3 and, broken down by region, in table A3 and figure A4. A notable shift in landings from Delmarva (DMV) in the south to New Jersey (NJ) in the north is evident and is also visible in the spatial charts shown in figure A8. Total quantities landed from the EEZ have been slightly below quota in recent years. I was reassured about the accuracy of landings data when told that clams may only be landed in standard, sealed cages and that they are carefully monitored under the ITQ system.

Fishing effort for each EEZ region are shown in table A4 and figure A5. It has increased substantially since 1999 particularly in the New Jersey (NJ) region (figure A9) where landings are also highest (figure A8). Effort is not regulated in this fishery and I know of no reason to doubt that these figures are reasonably accurate.

Landings per unit effort (LPUEs) are shown in figure A7 and table A6. The gradual decline in LPUE since 1990 shown for most regions (but not Southern New England (SNE)) in figure A7 is likely to be accurate because landings and effort are thought to be accurate. The size distributions of landed clams since 1990 (figures A14-16) are not sufficiently detailed to decide whether the decline was mainly caused by declining shell sizes (more clams per cage) or smaller numbers of clams on the grounds, though clearly declining lengths-at-age in two regions (figure A2) suggests that fishers are bringing home more clams per cage there. The spatial plots of LPUE, figure A10, again underline the importance of the New Jersey (NJ) region in recent years. High LPUEs marked in some of the deepest TMS in figure A10 suggest that there may be resources of surfclams in waters deeper than those usually fished.

Discards for 1982 to 1994, as estimated, are shown in table A1. Rates per bushel landed clearly reduced to zero following removal of size limits in 1990 when ITQ management began. Discards prior to 1982 are best estimates by comparisons with other times.

Comments on ToR 1

Landings, effort, and discard data are collected in standard ways so, presumably, formal written protocols exist to protect against drifting methods over time (Cotter and Pilling, 2007). If so, the SAW reports should routinely give the web site or reference for the reassurance of readers.

Landed quantities are multiplied by a standard shell length – meat weight (SLMW) factor, i.e. 1 bushel of clams = 17 lbs of meat. In effect, this merely scales the landings (and the assessment based on them). I would expect this factor to vary considerably by season, depth, latitude, shell size, year, and possibly other factors. If there is a good reason to be interested in the flesh content of surfclams in preference to shell volumes (cages), a large sample could be taken across the EEZ and all of the covariates measured on each clam so as to permit estimation of a formula that would allow flesh weight to be estimated more accurately.

Surfclam samples for meat weight (or any other variable) should be drawn from the landings (or survey catches) as randomly as can be contrived within necessary strata. Clustering of the sample around individual localities, or dates, should be avoided if possible, or allowance made for it in the estimation methods (Cotter, 2009).

The length compositions of landings shown in figures A14-17 look somewhat lumpy despite the large numbers of clams reported measured in WP A1, p11. Possibly, smaller length bins would help. I would also prefer that the precision of length measurements be indicated by the number of trips sampled rather than by the numbers of clams measured since one can expect intra-sample correlation of lengths within each trip. This is the point about cluster sampling again. Ideally, I suggest that there would be quota of trips selected randomly from those made by the fleet, region by region. Since this species lives until it is 30 years old, there is potentially much information on growth and year classes available from good sampling for length and age.

The finding from figure A13 that there are few important TMS in which LPUE has not trended downwards in recent years is interesting to compare with the overall stock trends downwards shown in figure A7. From a quick scan, most of the TMS trends downwards for DMV are consistent in timing with the general trend in figure A7. Those for NJ often show double or recent peaks and seem less consistent with the trend in figure A7. The results imply that the fishery is spatially diverse in performance even in the most important TMS.

A point that could not be answered during the SARC, though of minor significance for the current assessment because of the 15 intervening years, concerns whether the discards for the early period were alive or dead.

The price data, figure A6, are additional to the requirements of ToR 1. Interestingly, the declining value of clams in real terms suggests that, if fewer clams were landed, the price might increase, leading to a more profitable, more sustainable fishery.

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

ToR 2 was met. Table A9 shows results in numbers and weight for three size groups (> 50 mm SL) from 1982 to 2008 by region, and grouped. Figures A19-24 plot overall trends in number by size and region, uncorrected for size selectivity of the survey dredge. Relatively low recruitments in the southern regions are evident for the last four surveys.

Results for small (< 120 mm SL) and large clams in 2008 are mapped in figure A18 from which it is evident that the survey is extensive with many stations particularly in the most populated regions, e.g. New Jersey (NJ). The achieved allocations of fishing stations to strata are shown in table A8.

Almost all surfclams caught in the survey are measured. The length compositions, uncorrected for the selectivity of the survey dredge, are shown in figures A25 to A30. These data quantify the fishable stock (> 120 mm SL). Age compositions, based on ALKs applied to the length compositions, are shown in figures A31 to A34. "Recognizable" and "Strong" year classes can be seen.

The efficiency of the survey dredge is important for estimating clam biomass from clams per tow. The depletion experiments (figures A35 to A38) represent a good method to estimate efficiency though I appreciate that high accuracy is hard to achieve and that replication of trials is limited by resources. Using the running mean of efficiency estimates made over the years is sensible for the present purpose.

Results of repeat-tow analyses to estimate cable and pump effects on survey catch rates are given in table A12 and figures A42 and A43. I accept that the effects of pump and cable were not having significant effects on survey results relative to the usual range of sampling errors.

The dome-shaped selectivity curve (figures A47, A48) resulting from the selectivity trials seems reasonable and the explanation that larger clams are less catchable because they live deeper in the sediments seems plausible. A question of nomenclature arises. Does this effect reflect changing dredge efficiency with clam size (as referred to above) or is it selectivity with size?

Shell length vs. age results are given in figures A51 to A54. They are important because they estimate the age of recruitment to the fishery used in the KLAMZ model. Sampling rates as numbers of shells measured per region are given in table A20.

Comments on ToR 2

I understand that formal written protocols for the techniques of the survey exist and are followed. WP A1 does not refer to these, and I therefore recommend that they routinely be cited when survey data are used so as to reassure readers that they were consistently collected over time.

The achieved allocations of fishing stations to strata are important because they relate to efficiency and the precision of variance estimates for the survey. It is not possible to assess the situation without a detailed analysis of the survey results, something I did not pursue during SARC 49 though it is a task that may be worth undertaking in future, particularly if the distribution of surfclams among strata has been changing (as implied by the drift of populations northwards). Spatial indicators (Woillez et al., 2009) might also be helpful for studying movements of the clam populations.

The technique for filling missing values in the survey involves borrowing data from adjacent strata or from the surveys just before or afterwards. This technique introduces a dependence among stations and surveys although probably not seriously except possibly at the extremes of the surveyed regions (Southern Virginia & South Carolina (SVA) and Georges Bank (GBK) in table A8). Spatial modelling in conjunction with the expectation-maximization (EM) algorithm might be a better method for filling missing values (as mentioned in WP A1, p. 12) though it too would give poor estimates at the extremities. Use of the EM algorithm would mean that the whole survey, not just the locally surrounding values, contributes to the estimates with the benefit that localised spatial and temporal correlations among results would be reduced, as is desirable to prevent people mistakenly thinking that there is more information in graphs and tables than actually exists.

I note that confidence limits in the plots of trends in number size and region (figures A19-A24) are based on the log normal distribution, whereas I would have expected the normal distribution to be used given that the stratified mean is a linear estimator based on a large sample size (such that the Central Limit Theorem should apply). I would expect that normal CI would be slightly narrower on the upper side than those illustrated.

The survey length distributions disappoint if recruitment successes or year class strengths are of interest because partial selectivity up to about 70 mm SL, when clams may be 2 or 3 years old, obscures annual peaks among smaller clams. A different survey technique that effectively catches newly settled surfclams would be beneficial if recruitment is important scientifically. A suggestion is given in my comments on ToR 8, concerning research recommendations.

Assessing declines in recruitment over time, and the coherence of year classes across regions is awkward from figures A31 to A34 because of the 3-year intervals between surveys, and the different scalings needed across the regions. The poor selectivity of the survey dredge for small clams does not help. Arbitrarily taking 1 clam per tow as a threshold of high recruitment, I notice, for example, that for Delmarva (DMV): the 2005 class > 1 at age 3, the 1999 class > 1 at age 3, and the 1993 class > 1 at age 4. For New Jersey (NJ): the 2005 class > 1 at age 3, the 1999 class > 1 at age 3, and the 1993 class > 1 at ages 1 and 4. These year classes match well implying coherence of recruitments between Delmarva (DMV) and New Jersey (NJ) and, therefore, that there is biological justification for treating these two regions as one stock. Data for the other regions are patchier and harder to assess. Fitting year class curves (Cotter et al., 2007), allowing different recruitments in each region, would probably be an easier way of assessing recruitments over time and its coherence across regions. The method could serve to test the validity of grouping regions as one stock, and might also cast light on the importance of latitude/temperature on recruitment success, especially as recruitment successes seem to show serial correlation over years in figures A31 to A34. If this is not due to spillage from year to year during age reading, there may be recognizable multi-year oceanographic events that correlate in time with good recruitment periods. Year class curves would also estimate total mortality rates which would serve as a check on estimated F + M.

Possibly, the efficiency trials could be improved and accuracy increased, by examining the effects of sediment particle size distributions and cohesiveness, since presumably both have a large influence on the security of a buried clam. Only mean sediment size is reported in table A11 and in figures A40 and A41. The depth of clam burial could also be relevant. Is there a relationship with size such that efficiency varies with size? This would be relevant also to selectivity studies. Possibly some tank experiments with different sized clams observed in different types of sediment would be informative. Figure A41 indicates that there may be relationships between survey efficiency and other variables. This appears to be an area deserving further study when resources permit.

Estimation of SLMW for clams in different regions is important for estimating clam biomass (as meat) from the survey. The curves in figure A50 are useful in this regard. There is, however, more information that could be gained from the broad-scale sampling of SLMW relationships since one would expect that flesh weight would vary with depth, latitude, age, year, and season (though the latter is hardly determinable from one survey per year). This could provide useful clues about feeding and condition spatially and give more precise estimates of SLMW in a future modelling study. A study of survey SLMW would inform about the stock but may not be needed if a similar study is made for landings, see comments under ToR 1.

The precision of the estimated growth parameters (tables A21, A22) will depend on the independence among the measured clams, i.e. how many localities they were collected from in each region. A mixed model (Pinheiro and Bates, 2000) allowing for variation of parameters among localities within a region might give more estimation precision, as it would for any other relationships estimated from clustered samples. Nevertheless, the estimated ages at recruitment (table A22) are plausible.

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

ToR 3 was met. Estimates of efficiency-corrected stock biomass and fishing mortality (catch/biomass, WP A1, p24) are illustrated in figures A57 and A58 respectively. The probability densities shown characterize the uncertainties clearly. The percentage change by region compared to the 2005 survey due to modified survey procedures and dredge efficiency estimates are shown in table A26. A retrospective analysis of estimates back to 1997 is given in tables A27 and A28. The distinction between stock biomass and spawning stock biomass referred to by ToR 3 is not clear for this species since most of the biomass caught by the survey dredge will consist of mature individuals. Instead, two size groups are distinguished for the KLAMZ model: individuals recruited at the beginning of the current year (120 – 128 mm SL), and the entire stock (120+). The review team accepted that inclusion of recruits in the entire stock component had little practical effect because of the relatively lighter weight of them (around 0.4 Kg per tow as shown for 120-128mm in figure A59, mostly between about 1 and 5 Kg per tow for 120+ mm in table A9).

Recruitments (small group) were estimated with the KLAMZ model using a random walk, the effect of which was to provide a smooth series (figures A59 and A60, both top left panels). Data points and standard deviations are also shown in figure A59, so characterizing the uncertainty.

Comments on ToR 3

One model of recruitment must be used for the entire EEZ stock because of its official definition as one stock. Consequently, the recruitment estimates made by KLAMZ are not highly informative. Much information about regional diversity of recruitment and year-to-year variability is being lost in this composite approach. I agree with WP A1 (p27) that "Recruitment estimates . . . are complicated to interpret because of the constraints on variability".

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

ToR 4 was met.

Comment on ToR 4

The reference points chosen for this stock represent a pragmatic approach to regulating the fishery. I doubt whether they can be made more rational and scientific whilst single values for F and B must be set for the whole Atlantic EEZ despite the geographic variation in biological conditions.

WP A1 (p31) correctly points out that Georges Bank (GBK) by itself almost complies with the biomass reference point, implying that regional management of this stock is needed.

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

ToR 5 was met. I agree that the stock as a whole has a very low probability of being overfished, despite scaling and estimation difficulties reported in WP A1.

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

This ToR was met in the sense that some obvious potential factors were identified and investigated. The assessment team examined evidence for the most likely causes of poor growth or survival of young surfclams, namely high water temperatures, predation by fish, and fishing. Summer bottom temperature anomalies (figure A74) were high in 1999, 2000, and 2002, low in 2001, and unexceptional since, so I agree with WP A1 that "there is no evidence that (warm water) effects are ongoing". The study of predators only included fish.

Comments on ToR 6

Figure A20 shows recruitment of small surfclams (50-119 mm SL) by region from which it can be seen that recruitment has been low compared to past levels in the same region since 1999 in New Jersey (NJ) and Delmarva (DMV), and since 2005 in Georges Bank (GBK). However, the scaling of the vertical axes of these graphs is higher than the other regions (Southern New England (SNE) and Long Island (LI)) suggesting that the problem is not so serious relative to the whole stock. Figure A73 displays maps of the incidences of clams < 60 mm; low recruitments generally can be seen since 1999 compared with 1994 and, to a lesser extent, 1997. The caption to figure A75 states that most of the Delmarva (DMV) region south of Hudson Canyon was not sampled during 2008. This probably did not help us to get a clear picture of whether recruitment has been low in the south recently. However, other evidence was heard during the SARC, when surfclam fishers told of seeing poor recruitments recently in southern regions. We also learned that spatfalls seem to be happening but that young surfclams are failing to develop, as also reported in WP A1.

Concerning predators of surfclams, WP A6 reports:

PREDATION

Atlantic surfclams have many predators, including the naticid snails *Euspira heros* and *Neverita duplicata* (Franz 1977; Dietl and Alexander 1997), the sea star *Asterias forbesi* (Meyer *et al.* 1981), lady crabs (*Ovalipes ocellatus*), Jonah crabs (*Cancer borealis*) (Stehlik 1993), and horseshoe crabs (*Limulus polyphemus*) (Botton and Haskin 1984). Fish predators include haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) (Ropes 1980). The sevenspine bay shrimp, (*Crangon septemspinosa*) preys on recently settled clams (Viscido 1994). In the New York Bight, crabs accounted for 48.3-100% of Atlantic surfclam mortality while naticid moon snails accounted for 2.1% of mortality (MacKenzie *et al.* 1985).

Also in WP A6, there is mention of parasites of surf clams:

Atlantic surfclams are susceptible to several parasites, including the thigmotrich *Sphenophyra dosinae*, the cyclopoid copepod *Myocheres major*, a cestode of the genus *Echeneribothrium*, a nematode tentatively identified as *Paranisakiopsis pectinis*, and the hyperparasite haplosporidian *Urosporidium spisuli* (Ropes 1980; see also Perkins *et al.* 1975 and Payne *et al.* 1980). Payne *et al.* (1980) found an anisakine nematode of the genus *Sulcascaris* in clams from New Jersey to Virginia. Yancey and Welch (1968) noted the presence of trematodes in Atlantic surfclams, but their effects are unclear.

To these possible explanations of poor survival of young surfclams can be added pollution events, e.g. from dumping of contaminated dredgings offshore or discharges and run-off of waste or contaminants. I learned from the internet that dumping of major quantities of sewage sludge at the New York 106 mile site, a topic I mentioned in the SARC meeting, apparently stopped in 1992. Hydrographic changes are another possibility, perhaps affecting the planktonic food as well as dispersal of the surfclam. If recruitment is definitely agreed to be poor, there are several avenues for further enquiry, given suitable resources. A broad scope review of existing environmental information for the Atlantic habitat of the surf clam (though collected for other purposes) would almost certainly be helpful for management of the stock even if it did not provide firm answers on the recruitment issue.

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

a. *Provide numerical short-term projections (1-5 years; through 2015). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment.*
b. *Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.*
c. *Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.*

ToR 7 was met.

Comment on ToR 7

It would seem unwise for managers to allow F to increase to Fmsy proxy=$0.15yr^{-1}$ without increasing the frequency of surveys and assessments to annually since the projections are necessarily based on the assumptions made with the KLAMZ model and these become more uncertain as time goes forward.

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

ToR 8 was met. Comments are provided on all of the 18 research recommendations.

Comments on ToR 8

Concerning recommendation (vi): Conduct surveys . . . *The NEFSC clam survey is expected to transition in 2011 to a co-operative survey carried out by a commercial vessel that would cover one third of the stock each year.*

The problem with the proposed survey design is that any comparison among the three survey-regions will be confounded with years, possibly also survey methods, e.g. cable or pump problems. Similarly, any comparison over time will be confounded with survey-regions, at least for the first decade or two. I recommend that surveys be repeated at regular intervals, preferably annually to allow a check on year classes. Spatial coverage would have to be reduced to allow this with the available resources. Less detail will be available but at least the confounding problems would be avoided.

Regarding research more generally, my priorities would be as follows:

1. Develop a spatial approach to assessment of the surfclam stock. These animals stay still and either enjoy or endure the environment they find themselves in. The spatial information is already available. It is a question of looking at it in the right way. I think that much is being lost by compositing all information into a few summarising statistics and a 'black box' model. In the case of fish stocks, compositing is more justifiable because fish move and their whereabouts are not so well known. For surfclams, there is evidence, or reasonable expectations for variations with

location and latitude of larval dispersal, survival of spat, growth, SLMW ratios, sediment and, of course, commercial fishing. GIS contouring, e.g. using Kriging, of survey data (figure A18), and possibly landings and effort data (figures A8-10) as well, might provide better estimates of biomass and exploitation rate because, instead of treating all strata as independent (design-based inference), the spatial correlations among neighbouring strata are utilised to get a better (model-based) estimate of the functional form of biomass and catch over the region. Better spatial knowledge might provide a better understanding of stock dynamics, might reveal localised heavy fishing that possibly threatens broodstock, might help understanding of recruitment patterns, and might expose a need for different management of different regions so as to get the best out of stocks.

2. Review environmental, benthic, and hydrographic reports on Atlantic coastal waters with the objective of assembling all available information relevant to the growth, recruitment, survival, and management of surfclams. This could be added to the excellent existing information in WP A6 on biology and life history. Of particular interest would be better information on hydrography as it affects larval dispersal, sediment qualities influencing larval settlement, production of planktonic or suspended food, and occurrences of predators of the surf clams, notably crabs, brittle stars, etc.. Parasites and diseases could also be important, e.g. where water is warming gradually.

3. Develop a simple method for sampling young clams from spatfall to 100 mm SL or so. At present the survey dredge is giving very low selectivities in this size range, leaving the assessment team poorly informed on recruitments and their variation annually and spatially. We have had success sampling epifauna, including various infaunal small clams, in the seas around UK using a 2-metre beam trawl from a large research vessel. Specifications are published in Jennings et al., 1999. The beam trawl described might benefit from being heavier and being fitted with a toothed bar designed to cut into the surface sediment (though I've no experience of trying this). The trawl is operated from a light winch and "cast like a fly" from the drifting ship according to one skipper. It is towed for a standard 5 minutes on the bottom and GPS is used to estimate distance towed. Sensors confirming when the trawl is on the bottom and, preferably, a measure of the distance travelled would give better (more quantifiable) results. The sample collected from a tow can usually be processed quite easily by washing through graduated sieves, depending on how many species (e.g. predators) must be identified, e.g. 0.5 to 3 hours per tow.

4. I support the project on socio-economics reported at the SARC as being under way. Management of the fishery needs to know which human communities are affected by its decisions, and to what extent.

3.3. Conclusions and recommendations

1. The SAW met all ToR.

2. WP A1 should make reference to standard sampling protocols to guard against drifting methods for collecting landings and survey data.

3. If it is important to perform the assessment in terms of flesh weight rather than shell volume (or numbers), the SLMW factor applied to landings or survey LPUE

should be made more accurate by assessing the effects of depth, season, year, latitude, shell size and any other readily measurable factors.

4. The difference between random samples and cluster samples should be clarified, rather than just stating, e.g. "500 surfclams were measured", as in tables A20, A21. Taking many individuals from one landing, period, or locality provides a cluster sample whose means and variances differ from those of the overall population. This can be allowed for with cluster sampling formulae or mixed models. Cluster samples give much less information than expected from all the hard work (Pennington et al., 2002, Pennington and Vølstad, 1994). Random samples, on the other hand, tend to be harder to collect in a fisheries context but are unbiased and have a mean whose variance declines with increasing sample size. I expect that mixed models with a random factor for sampling locality would give better estimates of vBL parameters than those in tables A21, 22.

5. Reported results imply that the surfclam fishery is geographically diverse with respect to LPUE (figure A13), possibly recruitment (figures A31 to A34), SLMW (figure A50), and growth (tables A21, 22).

6. Efficiency of the survey might benefit from a re-analysis of stratum design and station allocations to strata, given that the stock is moving northward. There could also be implications for strata if a spatial model is used to estimate biomass (and missing values) from the survey, and if the move to commercial vessels for the survey goes ahead.

7. The survey is not good for estimating spatfalls and young clams < 100 mm SL. A quickly deployable sampling device to complement the half-sized commercial clam dredge in use should be considered. This could help to understand recruitment problems, e.g. in the south, and to manage the stock better through having knowledge of likely future clam populations.

8. Fitting year class curves to LPUE-at-age by region (where age data are available) would be worthwhile to obtain clearer pictures of recruitment by year, and to estimate Z as a check on estimated F + M.

9. Efficiency and selectivity trials appear to be related. Sediment particle size distributions and sediment cohesiveness could be influencing results more than has been allowed for so far. Further study seems worthwhile, given the importance of biomass estimates.

10. The value of combining all surfclam results from 6 degrees of latitude into one stock assessment model seems questionable. Results are produced with standard errors but they cannot allow for geographic variability of the species and the fishery (see conclusion 5 above). Besides, since clams are sedentary, the need for a single, combining model when spatial modelling methods are available is arguable. Recruitments produced by KLAMZ offer little insight into the stock.

11. The current reference points seem to be the best available if the whole stock must be assessed as one unit. The stock is not overfished with respect to them. Regional

management, possibly with protection of spawning stock and rotation of cropped areas (Johannes, 1998), could lead to a more secure and profitable fishery in future.

12. Environmental knowledge about surfclams could be enhanced relative to what is presented in WP A6 and in response to ToR 6 (low recruitment). I recommend a review of benthic, hydrographic, pollution, and disease factors using published information.

13. ToR 7 (projections), though complied with, does not seem particularly helpful for realistic management of the stock, given the uncertainties of the model and the lack of spatial output.

14. I am concerned that the proposed new survey design using 3-year rotation of sampling around regions will confound region and year effects, greatly reducing the interpretability of the results. My recommendation is for a low intensity, complete survey every year.

15. My research recommendations are for developing a spatial approach to the stock, a review of environmental factors (conclusion 12 above), develop a simple survey method for surfclams from 10 to 100 mm SL, and a socio-economic study of surfclam fisheries (which I understand is already under way).

4. Butterfish

4.1 Background

The biology of the butterfish, *Peprilus triacanthus*, is well summarized in Appendix 8 of vol. 2 of Amendment 9 to the Atlantic mackerel, squid, and butterfish fishery management plan. Butterfish are a fast-growing species ranging from Newfoundland to Florida but are most abundant from the Gulf of Maine to Cape Hatteras. The species is described as pelagic, forming loose schools, often near the surface. They can also be found near the bottom over sand, mud, and rock to about 360m. They migrate seasonally from over-wintering grounds near the shelf edge to inshore waters in spring. During summer, they occur all over the mid-Atlantic shelf out to about 200m, moving southward and offshore in late fall as the water cools. Butterfish mature at 1-2 years. Few live beyond age 3. They are eurythermal and euryhaline. Butterfish are broadcast spawners, reportedly in the upper part of the water column, beginning as early as May at the south, and as late as October at the north of their range. Butterfish feed mainly on zooplanktonic groups including coelenterates and ctenophores. Butterfish themselves form the prey of many larger fish and squid.

A fishery for butterfish began in the late 1800s. In the 1960s, the fishery was greatly expanded by foreign fleets until these were restricted and landings were only made by U.S. vessels. Landings are currently low because of poor market prices. Most of these fish are caught as bycatch in the squid fishery, and many are discarded.

The stock of butterfish was last assessed in 2003. The main inputs to the assessment are LPUE from NEFSC trawl surveys in spring, fall, and winter, observer, and landings data. Of the three surveys, only the fall survey consistently takes butterfish in catches. The assessment uses the KLAMZ implementation of the delay-difference model (WP B5). The stock mainly consists of 0 and 1 group fish where, biologically, the two age groups are separated at mid summer. The main influences on stock size appear to be recruitment and natural mortality.

4.2. Findings

ToR 1: *Characterize the commercial catch including landings, effort and discards by fishery (i.e., Loligo fishery vs. other fisheries). Characterize recreational landings. Describe the uncertainty in these sources of data. Evaluate the precision of the bycatch data with respect to achieving temporal management objectives throughout the year.*

ToR 1 was met except that effort was not specifically characterized, nor were temporal management objectives discussed. The various fisheries and their estimated historic landings are described in WP B1, p6. U.S. observer coverage started from 1977. Directed fisheries stopped in 2001 but butterfish continue to be taken as bycatch, mainly in the Loligo bottom trawl fishery. WP B1 describes the different methods of estimating catch for the different multi-year periods when different types of data were available. Total catch estimated from landings and discards are shown in figure B1 and table B1. Time series of proportions of U.S. and foreign landings, and discards are shown in figure B2. The precision of discard estimates are mostly low, with CVs between 21 and 168% in the last 20 years. This is because observers pick trips to observe mainly according to vessel characteristics/location, giving lower priority to the target species, in this case *Loligo*. Since discards often make up the larger part of the catch in that period, the precision of catch is also low.

Since most butterfish are now being caught in the Loligo fishery, it is the effort in that fishery which is most relevant to fishing mortality on butterfish, particularly as the observer data have low precision. Effort data were not presented but the total catch of the mid Atlantic and New England Loligo fisheries can be found in table B10. An illustration of total US and foreign Loligo landings was also provided. To some extent, these data serve as a proxy for fishing effort on butterfish. They imply – but do not guarantee – that effort has been quite steady in recent years.

Catches of butterfish were looked for in the Marine Recreational Fishery Statistics Survey but no records were found. Recreational landings are thus characterized.

Sampling rates for length compositions, including numbers of samples collected per quarter, are given in table B11. Length compositions of butterfish catches by year are shown in figures B3-4. They are unimodal, reflecting the fact that most butterfish are 0- or 1-group fish. Length compositions in observer data (figure B5-6) are more informative because they sometimes reveal a second mode in the discarded fraction, implying a discernible new year class. Sampling rates for observer data are indicated as numbers of fish; the effects of cluster sampling by haul or trip are presumably not taken into account.

Temporal management objectives were discussed briefly during SARC 49. They refer to a bycatch cap to be implemented on the Loligo fishery starting in 2011. The method of calculating this cap is not finalized but it is likely that expanded observer coverage specifically on the Loligo fishery would be needed. The present assessment did not consider this part of the ToR.

Comments on ToR 1

Discards estimated in table B10 relating to the Loligo bottom trawl fishery are mostly substantially in excess of the estimates for discards for all fisheries in table B1. For example, in mt, for 2008: B1 total = 1178, B10 Loligo = 1842; for 2007: B1 total = 241, B10 Loligo = 868. I understand that this is because the "total landed weight of all species" used in the denominator of the ratio estimator recommended by Wigley et al. 2006/07 changes because total landings of *all* fisheries is not the same number as total landings of the Loligo fishery in the same year. If my understanding is correct, I am concerned that the ratio estimator may be being wrongly used. In the textbooks, x and y are measured on the same sampling units to give the estimated ratio, y/x which thus has a probability distribution related to the sampling frame. Here, y is measured on the Loligo fishery, as is x in table B10, but x is from *all* fisheries in table B1. In other words, the ratio in table B1 is not a statistical estimate; it is a model without clear statistical properties. This might explain the large differences between the discard estimates in the two tables. There may be other explanations, e.g. variable and near-zero total landings whose effects are magnified by being in the denominator of the ratio. I think this needs further investigation since discard estimates may not be as bad as they are portrayed in these tables.

ToR 2: *Characterize the survey data that are being used in the assessment (e.g., indices of abundance including RV Bigelow data, NEAMAP and state surveys, age-length data, etc.). Describe the uncertainty in these sources of data.*

ToR 2 was met. The strata used in the spring, fall, and winter NESFC surveys are shown in figures B8 to B9. The dates of execution of the spring and fall surveys over the years are shown in figure B23. Abundance and biomass indices together with CVs are shown in tables B13-15 and illustrated in figures B10-11. CVs of biomass indices are illustrated in figure B12. It is evident from the last figure that the steadiest results are obtained from the fall survey with CVs varying around 25%. This survey showed highly variable numbers and weights per tow in the 1980s and 1990s, then a lowering of trend level in the 2000s (figure B10-11). The spring and winter surveys were more erratic judging from their CVs so their more level trend lines appear not to be good indices of the state of the butterfish stock. The timing of surveys is shown in figure B23. A drift to earlier dates arose for the NESFC fall survey.

Distribution maps shown during the SARC meeting showed that the larger catches of butterfish are mainly taken along the shelf edge in spring, and generally across the shelf and into coastal waters in the fall. Winter survey data were not shown as maps; presumably they would show distribution along the shelf edge as in spring since that is where they are thought to over-winter (Amendment 9, FMP, appendix 8).

Age compositions for the spring and fall surveys are shown in figures B13-17 and tables B16-17. The scarcity of butterfish 2 years and older in the survey catches is evident.

Numbers per tow are also shown for the inshore, State surveys in tables B19 and figures B18-22. These surveys were not used for the assessment because of large CVs (probably due to limited areal coverage relative to the stock domain) or because they do not produce biomass indices by age. The NEAMAP survey began only since fall 2007 which is too short a series to use in the assessment.

The scaling factor (catchability, *Q*) for the NEFSC surveys is estimated in WP B1 pages 15-17. *Q* is broken down into an efficiency, the swept area with certain assumptions about where trawl width is measured, the survey area, and the ratio of stock area to survey area. The efficiency is further broken down into a calibration factor between two survey vessels, and a prior distribution for the efficiency of the first vessel. Different bounds for these variables were investigated.

Comments on ToR 2

Survey protocols should be cited to prevent survey creep or procedural inconsistencies over the years (Anonymous, 2006, Anonymous, 2004, Anonymous, 2005), as noted under surfclam, ToR 2. I understand that the survey is highly stratified (figures B7-9) but was not able to investigate this in the time available at the SARC. Given that butterfish are quite patchy in their occurrences on surveys, there may be a benefit to survey precision if some neighbouring strata are amalgamated for estimation of this species. Then fewer degrees of freedom are used up on un-needed stratum means, and much better variance estimates would be obtained.

Nevertheless, it is not surprising that the various surveys give poor precision for the butterfish. It is often described as a pelagic species, whereas the trawls in use are demersal with only 2 to 3 m headline heights. NEFSC trawling takes place around the clock so it is likely that about half of the tows are unlikely to catch butterfish if, as you would expect for a plankton-feeding species, it follows a diurnal vertical migration. The states' surveys would give poor precision for the additional reason that they do not encompass the stock and therefore could be strongly affected by the biological timing of the survey relative to the annual inshore-offshore migrations of butterfish. It may also be true that the NESFC surveys do not encompass the stock completely because (1) fish within shallow coastal and estuarine waters would not be found, and (2) nor would fish in the Atlantic over deeper water than the furthest offshore survey strata. The proportions not surveyed might be changing from year to year. Added to these handicaps, the butterfish is a schooling species with the schools sometimes related by size. A large trawl catch might be taken by passing through the center of a small shoal, or a small catch might be taken by clipping the edge of a large one. Either way, the sample for statistical purposes is poor. Furthermore, estimating length or age from a large sample from size-related schools, i.e. cluster samples, tells relatively little about the stock (Pennington and Vølstad, 1994).

Despite these difficulties, the CVs for the fall survey weight/tow (figure B12) are not too bad, presumably because of the wide distribution and good catchability of butterfish at that time of year. Judging from CVs, the fall survey in fact appears to be the most reliable data set going into the assessment, although this does not take into account variance in the scaling factor, Q.

Estimation of Q is a best attempt to provide the required scaling factor for this hard-to-estimate species. The sequence of multiplied estimates used in the formula implies multiplied errors which may therefore be quite large. The bounds to the efficiency and area factors reflect thinking on an arithmetic scale when, in fact, logarithmic might be more appropriate particularly given the multiplicative components. The lack of a 'probability of encounter' in the formula is noticeable too unless it is included in the 'efficiency' factors and the prior. It might sensibly be modelled as proportional to depth and time of day. Another missing term is size selectivity. In my view therefore, Q has been estimated because it is required to support the MSY concept but it has low scientific credibility.

Age and length compositions are estimated from surveys. It is possible that other biological indicators of the health of the stock, e.g., condition factor, length and age at maturity, gonado-somatic index, could be derived from surveys at the appropriate season to provide an indicator of stock health to supplement the assessment models based on biomass (Petitgas et al., 2009) though the lack of large fish in the survey catches could cause problems for some indicators, as for age-based models.

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

ToR 3 was met. The estimates did not have good precision because of high variance of the input data and uncertainty about *M*. The preferred run of the KLAMZ model made the following assumptions (from SARC presentation):

- *M* = 0.8
- Age 0 (< 12 months) not mature, Age 1+ fully mature
- All ages fully selected to commercial fishing
- CV of catch 0.1
- Equal weighting of all data likelihood components
- No spawner-recruit model; recruitments are iid lognormal
- Weights of annual survey and catch reflect uncertainty estimates from survey design or discard estimation methodology
- Prior on fall age 1+ catchability

M was taken from best information in the literature. The high value reflects fast growth and maturation. Growth was estimated outside the KLAMZ model by fitting vBL curves (figure B24).

Estimates of spawning (figure B39, table B24) and recruitment biomasses (figure B40, table B24) produced by the final run of KLAMZ are substantially higher than were estimated in 2004 mainly due to re-scaling with *Q*, and they show more pronounced trends downwards. These too may owe something to the multiplier effect of re-scaling. The new estimates match the decline in biomass found by the fall survey (figure B11). Correspondingly, *F* was estimated lower than in the previous survey, also with a gradual trend downwards (table B24, figure B41). Estimated stock and recruitment points are well scattered (figure B42) as they are for most species. Marking the years on the points, as was done in a SARC presentation, indicates that recruitment has been declining quite consistently and matches the decline in stock biomass. Annual standard errors for the estimated biomass and *F* are given in tables B25 and B26. Uncertainties are high with CVs often > 50%.

Comments on ToR 3

Bold assumptions were necessary to get the KLAMZ model to fit, notably that the CV of the catch was 0.1. Bearing in mind that the observer CVs were mostly in excess of this (table B1), while the fall survey CVs varied around 0.25, the catch may have been over-weighted. The 'envelope' scheme for finding the range of likely values for stock biomass given credible constraints on *F* and catchability, *Q*, was a valuable adjunct to the modelling.

High survey *Z* 🕒 2 calls for high *M*, but not so high if *Z* is inflated as a result of older butterfish occupying higher levels in the water column and thus escaping demersal trawls. Trying to discover more sources of *M* to explain high *Z* through study of more predators than has already been accomplished under ToR 6 seems unlikely to provide a satisfactory result.

Growth parameters were estimated from all NEFSC survey results for weight-at-age from 1992 to 2009 using a simple function fit, even though substantial residual variability is evident in figure B24. I suspect that ρ and J were estimated with high correlation (e.g. >0.95) because the residuals in figure B24 could be re-arranged in many ways around a differently shaped curve and still give the same sum of squares. If they are correlated they are probably not well estimated. I expect that a model with random *year* and fixed *season* effects would produce a much tighter fit. A fixed *latitude* and a random *catch* effect might also be beneficial without much risk of over-fitting. I do not know whether the more detailed results could be incorporated into the KLAMZ model. Nevertheless, better information on how the butterfish has been putting on weight in recent years could cast light on the causes for the falling stock biomass indicated by the fall survey. Under-weight fish could indicate a disease or food shortage; consistently fat fish suggests predation if not fishing effects.

Given surveys in three seasons, data on maturity-at-age or gonado-somatic index could be obtained at the best time of year as a small practical project without additional sea time. The data could assist understanding of the nutritional state of the stock, its potential for breeding, and the declining success of recruitments annually. It might also assist estimation of growth parameters for modelling, since southern butterfish breed earlier than northern butterfish (see Background, above) so that the current practice of adding the average survey date to the nominal age (WP B1, p12) could be refined, a relevant consideration for a short-lived species.

I am concerned that there is a small risk that the striking downward spiral of recruitment of butterfish over the years could be an artefact of the way the data are being processed for the KLAMZ model. The reasons for my concerns are:

- recruited adults are defined as > 12 months which could often be a small proportion of the measurable biomass, given high M
- the fall survey has been trending later each year (figure B23) which could be significant, given that it occurs just after the cut-off point for recruits (k=12 months) and M is high
- estimates of ρ and J in the growth model are probably highly correlated and, perhaps, not well estimated as a consequence
- the catch data, and the spring and winter surveys may be over-weighted.

None of these points is conclusive. I suggest that declining recruitment should be investigated further outside the KLAMZ model, e.g. by examining trends in annual numbers of 0-groups estimated using ALKs (figures B14-16), or by fitting year class curves (as was done to estimate Z during the SARC meeting).

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

ToR 4 was met for F but not B. Overfishing is defined when $F > F_{msy}$. The equilibrium performance of different F values is shown in figures B46-48. $F_{0.1} = 1.04$ is proposed as the best proxy for F_{msy} given uncertainty about M. No reference point can be usefully defined for B because the stock biomass has been declining gradually over many years, giving no information about an MSY equilibrium.

Comment

I agree that the approach taken to these reference points was appropriate in the circumstances for butterfish in 2009, though $F_{0.1} = 1.04$ should be recognized as well above current values of *F* (table B26).

A possible different approach to setting a reference point for *B* might be found in the stock-recruitment curve. Inspection of figure B42 indicates that biomasses between 50 and 70,000 tonnes have successfully led to average levels of recruitment. The stock is currently estimated to be within this bracket (figure B39) but use as a reference point would depend on consistent scaling.

Reference points could be designed without reference to MSY if that were permissible at some time in the future. For example, condition and maturity indicators measured on NEFSC surveys might be estimable with greater precision than abundance or weight indices, thereby making the testing of compliance easier. Reference points for such indicators could be defined based on previous 'good' conditions, though not without some arbitrariness, admittedly. An alternative approach suitable for low stock abundance and not initially needing reference points is merely to look for improving trends (Jennings and Dulvy, 2005).

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

ToR 5 was met. Recent estimates of *F* are < 0.1 (table B26) and there is therefore very little chance that butterfish are overfished though it may continue to decline for other reasons.

Comment

The low value estimated for *F* allowed a high margin of error for the statement that overfishing did not occur. However, the method of regulating overfishing using *F* and *B* is difficult to apply to a species such as the butterfish for which existing data collection methods are poorly suited because of its pelagic and schooling behaviour. Better precision is needed on catch, i.e. landings and discard data. This may mean more observer effort specifically in the Loligo fishery, or it may mean generally re-visiting sampling and estimation methods for this species, so far as practicalities permit (see ToR 1 comments). Modifications to spring and winter surveys to help them catch butterfish more consistently would also be desirable. An additional problem for modelling the stock is the short life span and the uncertainty surrounding *M*. I am not suggesting that any of these difficulties can be dealt with easily in practice.

ToR 6: *Evaluate the magnitude, trends and uncertainty of predator consumptive removals on butterfish and associated predation mortality estimates and, if feasible, incorporate said mortality predation estimates into models of population dynamics.*

ToR 6 was completed for fish predators. Those that consistently eat butterfish were identified as smooth dogfish, spiny dogfish, silver hake, summer flounder, bluefish, goosefish and, possibly, pollock, buckler dory, and winter skate. The main data used for the analysis were predator abundance, stomach contents and % butterfish in the diet, and ambient temperature. Major findings were that consumption of butterfish by predators was in the same order as quantities landed, >80% of consumptive removal by predators is on adults. Predation by marine mammals and birds has not been estimated.

Comment
It seems unlikely that predation by groups other than fish would be as great. If this hunch is right, the gap between M+F and survey Z must be real. Low catchability of older butterfish then must be considered as a serious possibility.

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

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

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

c.For a range of candidate ABC scenarios, compute the probabilities of rebuilding the stock by January 1, 2015.

d.Describe this stock's vulnerability to having overfished status (consider mean generation time), and how this could affect the choice of ABC.

ToR 7 was met with projections estimated using recruitment at long-term average levels and at recent levels which are lower. The level set for proxy for F_{msy} did not much affect the probabilities of B being below B_{msy} which were 0.5 or higher (figures B50-51). The precision of predictions should be treated as low because of reservations about the KLAMZ model.

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

ToR 8 was met. Responses were provided to all 8 research recommendations.

Comments on ToR 8
I support research recommendation (1) in WP B1 concerning studies of growth, morphometrics, and distribution. These could offer useful information on feeding, growth, and reproduction to support the quantitative stock assessment. Better

knowledge of distribution of this species at different ages in the water column might cast light on high survey *Z*s. This may call for special fishing techniques.

I support recommendations (2), (3? not so clear in WP B1), and (5) concerning estimation of discards. Discard data are typically highly variable because of variation in catches and, due to limited resources, low numbers of sampled trips. Nevertheless, the fairly large discrepancies in estimates in tables B1 and B10 suggest that there could be a hitherto un-examined statistical problem in the estimation of discards of butterfish.

Recommendation (6) concerning ecological relationships is broad in scope and difficult to achieve with sufficient confidence to enable improved stock assessments. Since butterfish are planktivorous and will often take jelly-plankton, a concern I have is that they may be performing an important role in preventing over-abundance of that group with disastrous consequences to other zooplankton, leading in turn to over-growth of phytoplankton and, possibly, blooms. This has been well analyzed for the Black Sea (Daskalov, 2008, Daskalov et al., 2007). Butterfish ecology could be better understood with more knowledge of dietary habits and vertical migrations. A search for large butterfish using appropriate pelagic fishing gear might also be fruitful unless it is already very well known that they definitely do not occur anywhere, e.g. they die after spawning as suggested at the SARC meeting by Henrik Sparholt.

Recommendation (7) concerns an age-based model despite the fact that most butterfish live for only a few months. It therefore seems doubtful that an age-based model could achieve much. I am also concerned that almost any new modelling developments will still need to use observer data, surveys, and natural mortality, yet the reliability of these results (except for the fall survey) remains low. Getting better results from a new model is not therefore guaranteed, and additional assumptions may have to be made.

My suggestions for future research are as follows:

Since conservation of the stock of butterfish depends heavily on discarding of butterfish by the Loligo fishery, research on improvements to gear and fishing practices used by that fishery deserves high priority. We don't have to wait for perfect measurements of discarding if there is a good idea for preventing it without excessive cost to the Loligo industry. The rapporteur's notes report a butterfish exclusion device being tested at Rhode Island.

I would also like to see development of an indicator-based approach (Petitgas et al., 2009, Cury and Christensen, 2005, Jennings, 2005) to managing the butterfish. The traditional MSY approach is clearly not doing well because of difficulties of sampling a pelagic species with short life span, and of scaling survey results. BRP could be set for CPUE of 'large' fish, condition, or perhaps other variables. They would be arbitrary but then, without an accurate scaling factor and *M*, catch controls are too. Another potential advantage of an indicator-based approach is that it may shed light on why the stock has been declining in the absence of heavy fishing pressures.

Finally, the butterfish assessment needs effort data for the Loligo fishery. This was not produced for the SARC and may not be readily available. If not, I would like to see the omission corrected. Effort data would provide another source of information to assess the current widely varying discard estimates from the Loligo fishery, and to compare with estimates of *F*.

4.3. Conclusions and recommendations

1. ToR 1 was met except that fishing effort was not characterized, nor were temporal management objectives addressed. I understand that effort data were not readily available, and that temporal management objectives are not yet implemented. Ratio estimators applied to observer data gave highly variable results, possibly for reasons other than variability of the observed quantities caught and discarded. A check should be made on whether the estimators are being used in accordance with statistical theory.
2. ToR 2 was met. The fall survey by NEFSC showed consistent CVs between 20-30% and appears to be the most reliable input to the butterfish assessment. The spring and fall NEFSC surveys performed less well because of lower seasonal catchabilities. Estimation of a scaling factor, *Q*, required strong assumptions. The state surveys gave poor precision, probably because survey domains were small subsets of the stock domain.
3. Better survey precision might be available if a trawl gear better suited to catching pelagic species were used, and by calculating a day-time index only. Also, reduction of the number of survey strata used to estimate biomass indices for butterfish might assist precision. However, diurnal migrations and schooling behaviour probably limit the precision available from any trawl survey for butterfish.
4. ToR 3 was met but modelling estimates had low precision and required strong assumptions, e.g. catch CV=0.1. They are not comparable with those produced in 2004 because of different scaling. The envelope method usefully constrained model results for a range of feasible *F* and *q* values. Declining biomass appears to be driven mainly by the fall survey results. It was accompanied by declining recruitment suggesting a stock in trouble for reasons other than fishing. Year-class curves indicated survey *Z*🕔2 which is substantially greater than estimated *F* and assumed *M*. This inconsistency needs further investigation. Occupation of higher levels in the water column by older butterfish, i.e. above the trawl headline, could provide a simple explanation for high *Z*.
5. Estimation of growth parameters from the surveys used only a basic model even though more fixed and random explanatory factors could be justifiable and would give better precision. Better estimates might improve KLAMZ estimates and help explain changes in the stock.
6. Downward trends in recruitment may not be as marked as estimated. This possibility should be investigated by looking at survey CPUE-at-age data with techniques independent of the KLAMZ model, in case the modelling procedures have in some way created a colinearity between recruits and biomass.
7. ToR 4 was met for *F* but not *B*. The concept of a biomass equilibrium is inappropriate for a long-term declining stock. A biomass reference point based on levels historically known to have given successful recruitments might be more appropriate, provided that it could be worded to avoid scaling inconsistencies from year to year.

8. ToR 5 was met. There is little chance that butterfish are overfished though they may continue to decline for other reasons. Assessing whether or not overfishing is occurring is especially difficult for this species because its pelagic and schooling habits hinder data collection.
9. ToR 6 was completed for fish predators. Other predators exist but more extensive investigations of their significance to butterfish seem unlikely to bridge the current gap between *F* and *Z*.
10. ToR 7 was met but, because of reservations about the KLAMZ model, predictions should be treated as having low precision.
11. ToR 8 was met. I support existing recommendations (1 – growth, distribution), (2, 3, 5 – estimation of discards). Recommendation (6) concerning ecological relationships could usefully examine the relevance of the trophic role played by butterfish. I do not support development of an age-based model, recommendation (7), while so few age classes are catchable and most input data has high CVs. Research to diminish the butterfish bycatch should be given priority. The surveys might be used to estimate useful additional biological indicators for the stock, e.g. condition, age at maturity. They might help explain declining recruitment or form the basis of an indicator approach to management.

5. Other comments

Documentation

The one aspect of the SARC procedure that I found less than excellent was the text of the WP A1 and B1 reports for both the surfclam and the butterfish. Beneath each ToR is given a variously ordered mix of:

- responses to the ToR;
- technical descriptions of methods and models;
- assumptions;
- descriptions of data and surveys;
- other comments, and;
- conclusions.

Also, the status of sub-headings seemed irregular in some places. I was not able to develop a good understanding of the assessments from reading these documents before the meeting, nor have they been easy to refer to subsequently. Points of detail have to be searched for in the reports.

A particular difficulty when modelling is being reported is knowing what data form inputs to the model, what is being assumed, what settings and likelihood function are being used, and what are outputs. A difficulty with the various surveys used is understanding how and why they were stratified, and the sample allocation schemes and estimators used.

I appreciate that these reports are written to tight time pressures but I think a more standardised and structured format would actually be easier for readers, writers, and editors. So, I suggest that future SAW reports should be structured as follows:

1) Main report: Introduction with standardized summaries of the biology, fishery, and assessment. This is followed by the ToRs listed, as currently, but with the text under each only including brief, direct responses and cross-references to data and methods presented in appendices. Only special tables and figures would be included here. This is much like the Summary report but with ToR systematically presented.

2) Technical appendices: Most would be structured in the time-honoured scientists' style even if highly compacted, i.e. Introduction, Materials and Methods, Results, Discussion. Standard protocols and web sites, where they exist, would be referenced. Sampling schemes, sample allocations to strata, and estimators would be summarised. Bibliographies would be given. There should be one such appendix, even if only one a page, for:

- Landings data and associated biological sampling/measurements.
- Discards data, ditto.
- Survey data, ditto.
- Special trials, e.g. efficiency.
- Each model used, with tables showing data-in, assumptions, settings, results-out, comparisons with previous runs. The specific likelihood functions used should be shown. I don't see that a description of the model is needed if it is in the literature, only the new modifications.
- Glossary of terms, paying particular attention to NEFSC special terms.

Except for updating the data, these technical appendices could often stand from one SAW to the next. The text of some could even be transferable from one species to another. Reviewers would find logically ordered presentations of the foundations of the assessment and would know where to look up details. Stock managers would find succinct presentations against ToR without having to sift them from technicalities of little interest. Possibly, the SARC meetings could take the papers as read, and launch straight into discussions of issues arising. This would give more time for discussions and review of output texts.

6. References

Anonymous. 2004. Report of the workshop on survey design and data analysis (WKSAD). 261 pp.

Anonymous. 2005. Report of the workshop on survey design and data analysis (WKSAD).

Anonymous. 2006. Report of the study group on survey trawl standardisation (SGSTS). 67 pp.

Cotter, A. J. R. 2009. Statistical estimation of mean values of indicators form trawl surveys. Aquatic Living Resources, 22: 127-133.

Cotter, A. J. R., Mesnil, B. and Piet, G. 2007. Estimating stock parameters from trawl cpue-at-age series using year-class curves. ICES Journal of Marine Science, 64: 234-247.

Cotter, A. J. R. and Pilling, G. M. 2007. Landings, logbooks and observer surveys: improving the protocols for sampling commercial fisheries. Fish and Fisheries, 8: 123-152.

Cury, P. M. and Christensen, V. 2005. Quantitative ecosystem indicators for fisheries management. ICES Journal of Marine Science, 62: 307-310.

Daskalov, G. M. 2008. Overfishing affects more than fish populations: a case of trophic cascades and regime shifts in the Black Sea. *In* Advances in fisheries science 50 years on from Beverton and Holt., pp. 418-433. Ed. by A. I. L. Payne, A. J. R. Cotter and T. Potter. Blackwell Publishing, Oxford, UK.

Daskalov, G. M., Grishin, A., Rodionov, S. and Mihneva, V. 2007. Trophic cascades triggered by overfishing reveal possible mechanisms of ecosystem regime shifts. Proceedings of the National Academy of Sciences, 104: 10518-10523.

Jennings, S. 2005. Indicators to support an ecosystem approach to fisheries. Fish and Fisheries, 6: 212-232.

Jennings, S. and Dulvy, N. K. 2005. Reference points and reference directions for size-based indicators of community structure. ICES Journal of Marine Science, 62: 397-404.

Jennings, S., Lancaster, J., Woolmer, A. and Cotter, J. 1999. Distribution, diversity and abundance of epibenthic fauna in the North Sea. Journal of the Marine Biological Association of the United Kingdom, 79: 385-399.

Johannes, R. E. 1998. The case for data-less marine resource management: examples from tropical nearshore finfisheries. TREE, 13: 243-246.

Pennington, M., Burmeister, L.-M. and Hjellvik, V. 2002. Assessing the precision of frequency distributions estimated from trawl-survey samples. Fishery Bulletin, 100: 74-80.

Pennington, M. and Vølstad, J. H. 1994. Assessing the effect of intra-haul correlation and variable density on estimates of population characteristics from marine surveys. Biometrics, 50: 725-732.

Petitgas, P., Cotter, J., Trenkel, V. M. and Mesnil, B. 2009. Fish stock assessments using surveys and indicators. Aquatic Living Resources, 22: 1-254.

Pinheiro, J. C. and Bates, D. M. 2000. Mixed-effects models in S and S-plus., Springer, New York.

Woillez, M., Rivoirard, J. and Petigas, P. 2009. Notes on survey-based spatial indicators for monitoring fish populations. Aquatic Living Resources, 22.

Appendix 1: Bibliography of materials provided for review

Surfclam assessment

- WP A1: Assessment Report, 13 Nov 2009
- WP A1a: Appendixes 1-5
- WP A1b: Tables
- WP A1c: Figures
- WP A2: Assessment Summary Report, 13 Nov 2009
- Appendix
- WP A3: Atlantic surfclam assessment summary for 2006
- WP A4: Assessment of Atlantic surfclam (SAW 44)
- WP A5: ICES J mar Sci 62: 1444-1453 by Weinberg
- WP A6: EFH document on surfclam

Other documents seen:
Rago et al. (2006) A spatial model to estimate gear efficiency and animal density from depletion experiments. CJFAS 63: 2377-2388

Butterfish assessment

- WP B1: Assessment Report, tables and figures, 18 Nov 2009
- WP B1a: Appendixes A re. ToR 6 (predation)
- WP B2: Assessment Summary Report, 18 Nov 2009, revised 11 Dec 2009
- WP B3:Butterfish assessment report for 1994
- WP B4:Butterfish assessment report for 2003
- WP B5:Appendix A: KLAMZ assessment model

Other documents seen:

- Amendment 9 to the Atlantic mackerel, squid, and butterfish FMP vol 1 & 2
- Wigley et al. 2007, 2nd edition "The analytic component to the standardized bycatch reporting strategy . . ."

Appendix 2: CIE statement of work

Attachment A: Statement of Work for Dr. John Cotter (FishWorld Science, LTD)

External Independent Peer Review by the Center for Independent Experts

49th Stock Assessment Workshop/ Stock Assessment Review Committee (SAW/SARC)
Atlantic Surfclam and Butterfish

Statement of Work (SOW) for CIE Panelists
(including a description of SARC Chairman's duties)

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in **Annex 1**. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.com.

Project Description: The purpose of this SARC49 meeting will be to provide an external peer review of benchmark stock assessments for Atlantic surfclam (*Spisula solidissima)* and butterfish *(Peprilus triacanthus)*. Surfclams are sedentary infaunal bivalves. Butterfish are a schooling pelagic fish. This review determines whether the scientific assessments are adequate to serve as a basis for developing fishery management advice. Results form the scientific basis for fishery management in the northeast region. This meeting satisfies Prioritization criteria 1-3. The Terms of Reference (ToRs) of the peer review are attached in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**. The SARC Summary Report format is attached as **Annex 4.**

The SARC49 review panel will be composed of three appointed reviewers from the Center of Independent Experts (CIE), and an independent chair from the Science and Statistics Committee (SSC) of the New England or Mid-Atlantic Fishery Management Council. The SARC panel will write the SARC Summary Report and each CIE reviewer will write an individual independent review report.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have working knowledge and recent experience in the application of modern fishery stock assessment models. Familiarity with statistical models for estimating gear efficiency is desirable, as the surfclam assessment will apply methods for experimentally estimating survey dredge capture efficiency. For butterfish, reviewers should be familiar with schooling pelagic species whose catchability in research trawl surveys is highly variable and influenced by environmental conditions; expertise in discard estimation for pelagic species and in the analysis and interpretation of trawl surveys is desirable.

Reviewer expertise should include statistical catch-at-age, catch-at-length, delay-difference, and traditional VPA approaches. Reviewers should also have experience in evaluating measures of model fit, identification, uncertainty, and forecasting. Reviewers should have experience in development of Biological Reference Points that includes an appreciation for the varying quality and quantity of data available to support their estimation. Reviewers should have familiarity with the development and interpretation of rebuilding strategies. Experience with the biology and population dynamics of species on the agenda would be useful.

Each CIE reviewer's duties shall not exceed a maximum of 14 days to complete all work tasks of the peer review described herein.

Not covered by the CIE, the SARC chair's duties should not exceed a maximum of 14 days (i.e., several days prior to the meeting for document review; the SARC meeting in Woods Hole; several days following the open meeting for SARC Summary Report preparation).

Location and Date of Peer Review: Each CIE reviewer shall conduct an independent peer review during the panel review meeting scheduled at the Woods Hole Laboratory of the Northeast Fisheries Science Center (NEFSC) in Woods Hole, Massachusetts during 30 November through 3 December 2009.

Charge to SARC panel: The panel is to determine and write down whether each Term of Reference of the SAW (see Annex 2) was or was not completed successfully during the SARC meeting. To make this determination, panelists should consider whether the work provides a scientifically credible basis for developing fishery management advice. 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. Where possible, the chair shall identify or facilitate agreement among the reviewers for each Term of Reference of the SAW.

If the panel rejects any of the current Biological Reference Point (BRP) proxies for B_{MSY} and F_{MSY}, the panel should explain why those particular proxies are not suitable and the panel should recommend suitable alternatives. If such alternatives cannot be identified, then the panel should indicate that the existing BRPs are the best available at this time.

Statement of Tasks:

1. Prior to the meeting

(SARC chair and CIE reviewers)

Review the reports produced by the Working Groups and read background reports.

Each CIE reviewer shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein:

Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, foreign national security clearance, and other information concerning pertinent meeting arrangements. The NMFS Project Contact is also responsible for providing the Chair a copy of the SoW in advance of the panel review meeting. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

<u>Foreign National Security Clearance</u>: When CIE reviewers participate during a panel review meeting at a government facility, the NMFS Project Contact is responsible for obtaining the Foreign National Security Clearance approval for CIE reviewers who are non-US citizens. For this reason, the CIE reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the NMFS Project Contact for the purpose of their security clearance, and this information shall be submitted at least 30 days before the peer review in accordance with the NOAA Deemed Export Technology Control Program NAO 207-12 regulations available at the Deemed Exports NAO website: http://deemedexports.noaa.gov/sponsor.html).

<u>Pre-review Background Documents</u>: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

2. During the Open meeting

Panel Review Meeting: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. **Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator.** Each CIE reviewer shall actively participate in a professional and respectful manner as a member of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NMFS Project Contact is responsible for any facility arrangements (e.g., conference room for panel review meetings or teleconference arrangements). The NMFS Project Contact is responsible for ensuring that the Chair understands the contractual role of the CIE reviewers as specified herein. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements, including the meeting facility arrangements.

(SARC chair)
Act as chairperson, where duties include control of the meeting, coordination of presentations and discussion, making sure all Terms of Reference of the SAW are reviewed, control of document flow, and facilitation of discussion. For the assessment, review both the Assessment Report and the draft Assessment Summary Report.

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

(SARC CIE reviewers)
For each stock assessment, participate as a peer reviewer in panel discussions on assessment validity, results, recommendations, and conclusions. From a reviewer's point of view, determine whether each Term of Reference of the SAW was completed successfully. Terms of Reference that are completed successfully are likely to serve as a basis for providing scientific advice to management. If a reviewer considers any existing Biological Reference Point proxy to be inappropriate, the reviewer should try to recommend an alternative, should one exist.

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

3. After the Open meeting

(SARC CIE reviewers)
Each CIE reviewer shall prepare an Independent CIE Report (see Annex 1). This report should explain whether each Term of Reference of the SAW was or was not completed successfully during the SARC meeting, using the criteria specified above in the "Charge to SARC panel" statement.

If any existing Biological Reference Point (BRP) proxies 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 BRPs are the best available at this time.

During the meeting, additional questions that were not in the Terms of Reference but that are directly related to the assessments may be raised. Comments on these questions should be included in a separate section at the end of the Independent CIE Report produced by each reviewer.

The Independent CIE Report can also be used to provide greater detail than the SARC Summary Report on specific Terms of Reference or on additional questions raised during the meeting.

(SARC chair)
The SARC chair shall prepare a document summarizing the background of the work to be conducted as part of the SARC process and summarizing whether the process was adequate to complete the Terms of Reference of the SAW. If appropriate, the chair will include suggestions on how to improve the process. This document will constitute the introduction to the SARC Summary Report.

(SARC chair and CIE reviewers)
The SARC Chair and CIE reviewers will prepare the SARC Summary Report. Each CIE reviewer and the chair will discuss whether they hold similar views on each Term of Reference and whether their opinions can be summarized into a single conclusion for all or only for some of the Terms of Reference of the SAW. For terms where a similar or a consensual view can be reached, the SARC Summary Report will contain a summary of such opinions. In cases where multiple and/or differing views exist on a given Term of Reference, the SARC Summary Report will note that there is no agreement and will specify - in a summary manner – what the different opinions are and the reason(s) for the difference in opinions.

The chair's objective during this Summary Report development process will be to identify or facilitate the finding of an agreement rather than forcing the panel to reach an agreement. The chair will take the lead in editing and completing this report. The chair may express the chair's opinion on each Term of Reference of the SAW, either as part of the group opinion, or as a separate minority opinion.

The SARC Summary Report (please see Annex 4 for information on contents) should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, this report should state why that Term of Reference was or was not completed successfully. The Report should also include recommendations that might improve future assessments.

If any existing Biological Reference Point (BRP) proxies are considered inappropriate, the SARC Summary Report should include recommendations and justification for suitable alternatives. If such alternatives cannot be identified, then the report should indicate that the existing BRP proxies are the best available at this time.

The contents of the draft SARC Summary Report will be approved by the CIE reviewers by the end of the SARC Summary Report development process. The SARC chair will complete all final editorial and formatting changes prior to approval of the contents of the draft SARC Summary Report by the CIE reviewers. The SARC chair will then submit the approved SARC Summary Report to the NEFSC contact (i.e., SAW Chairman).

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Other Tasks – Contribution to SARC Summary Report: Each CIE reviewer will assist the Chair of the panel review meeting with contributions to the Summary Report, based on the terms of reference of the review. CIE reviewers are not required to reach a consensus, and should provide a brief summary of the reviewer's views on the summary of findings and conclusions reached by the review panel in accordance with the ToRs.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables**.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Participate during the panel review meeting in Woods Hole, Massachusetts during 30 November through 3 December 2009, and conduct an independent peer review in accordance with the ToRs (**Annex 2**).
3) No later than 17 December 2009, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and Dr. David Sampson, CIE Regional Coordinator, via email to david.sampson@oregonstate.edu. Each CIE report shall be written using the format and content requirements specified in **Annex 1**, and address each ToR in **Annex 2**.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

26 Oct 2009	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
16 Nov 2009	NMFS Project Contact will attempt to provides CIE Reviewers the pre-review documents by this date
30 Nov – 3 Dec 2009	Each reviewer participates and conducts an independent peer review during the panel review meeting in Woods Hole, MA
2-3 Dec 2009	SARC Chair and CIE reviewers work at drafting reports during meeting at Woods Hole, MA, USA
17 Dec 2009	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
21 Dec 2009	Draft of SARC Summary Report, reviewed by all CIE reviewers, due to the SARC Chair *
29 Dec 2009	SARC Chair sends Final SARC Summary Report, approved by CIE reviewers, to NEFSC contact (i.e., SAW Chairman)
31 Dec 2009	CIE submits CIE independent peer review reports to the COTR
7 Jan 2010	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

* The SARC Summary Report will not be submitted, reviewed, or approved by the CIE.

The SAW Chairman will assist the SARC chair 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 SARC Summary Report available to the public. 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.

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with **Annex 1**,
(2) each CIE report shall address each ToR as specified in **Annex 2**,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

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Key Personnel:

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Annex 1: Format and Contents of CIE Independent Peer Review Report

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of whether they accept or reject the work that they reviewed, with an explanation of their decision (strengths, weaknesses of the analyses, etc.).

2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Findings of whether they accept or reject the work that they reviewed, and an explanation of their decisions (strengths, weaknesses of the analyses, etc.) for each ToR, and Conclusions and Recommendations in accordance with the ToRs. For each assessment reviewed, the report should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, the Independent Review Report should state why that Term of Reference was or was not completed successfully. To make this determination, the SARC chair and CIE reviewers should consider whether the work provides a scientifically credible basis for developing fishery management advice.

   a. Reviewers should describe in their own words the review activities completed during the panel review meeting, including a concise summary of whether they accept or reject the work that they reviewed, and explain their decisions (strengths, weaknesses of the analyses, etc.), conclusions, and recommendations.

   b. Reviewers should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the SARC Summary Report that they feel might require further clarification.

   d. Reviewers shall provide a critique of the NMFS review process, including suggestions for improvements of both process and products.

   e. The CIE independent report shall be a stand-alone document for others to understand the proceedings and findings of the meeting, regardless of whether or not others read the SARC Summary Report. The CIE independent report shall be an independent peer review of each ToRs, and shall not simply repeat the contents of the summary report.

3. The reviewer report shall include as separate appendices as follows:

   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work
   Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

ANNEX 2:

Assessment Terms of Reference for SAW/SARC49 (Nov-Dec 2009)
(file vers.: 8/12/09)

A. Atlantic surfclam

1. Characterize the commercial catch including landings, effort, LPUE and discards. Describe the uncertainty in these sources of data.
2. Characterize the survey data that are being used in the assessment (e.g., regional indices of abundance, recruitment, state surveys, age-length data, etc.). Describe the uncertainty in these sources of data.
3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.
4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

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

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

7. Develop and apply analytical approaches and data that can be used for conducting single and multi-year stock projections and for computing candidate ABCs (Acceptable Biological Catch; see Appendix to the TORs).
    a. Provide numerical short-term projections (1-5 years; through 2015). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment.
    b. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    c. Describe this stock's vulnerability to becoming overfished, and how this could affect the choice of ABC.

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

B. Butterfish

1. Characterize the commercial catch including landings, effort and discards by fishery (i.e., *Loligo* fishery vs other fisheries). Characterize recreational landings. Describe the uncertainty in these sources of data. Evaluate the precision of the bycatch data with respect to achieving temporal management objectives throughout the year.
2. Characterize the survey data that are being used in the assessment (e.g., indices of abundance including RV Bigelow data, NEAMAP and state surveys, age-length data, etc.). Describe the uncertainty in these sources of data.
3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and characterize the uncertainty of those estimates.
4. Update or redefine biological reference points (BRPs; estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, and $F_{MSY;}$ and estimates of their uncertainty). Comment on the scientific adequacy of existing and redefined BRPs.

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

6. Evaluate the magnitude, trends and uncertainty of predator consumptive removals on butterfish and associated predation mortality estimates and, if feasible, incorporate said mortality predation estimates into models of population dynamics.

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

e. Provide numerical short-term projections (1-5years). Each projection should estimate and report annual probabilities of exceeding threshold BRPs for F, and probabilities of falling below threshold BRPs for biomass. In carrying out projections, consider a range of assumptions about the most important uncertainties in the assessment.
f. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
g. For a range of candidate ABC scenarios, compute the probabilities of rebuilding the stock by January 1, 2015.
h. Describe this stock's vulnerability to having overfished status (consider mean generation time), and how this could affect the choice of ABC.

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

Appendix to the SAW Assessment TORs:

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

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

On "Acceptable Biological Catch":

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

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

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

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

On "Vulnerability":

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

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Annex 3: Meeting Agenda

49th Northeast Regional Stock Assessment Workshop (SAW 49)
Stock Assessment Review Committee (SARC) Meeting

November 30 – December 3, 2009

Stephen H. Clark Conference Room – Northeast Fisheries Science Center
Woods Hole, Massachusetts

DRAFT AGENDA* (version: 9-11-09)

TOPIC PRESENTER(S) SARC LEADER RAPPORTEUR

Monday, 30 Nov

1:00 – 1:30 PM

Opening
Welcome **James Weinberg**, SAW Chairman
Introduction **TBD**, SARC Chairman
Agenda
Conduct of Meeting

1:30 – 3:30 Assessment Presentation Surfclam (Sp. A)
Larry Jacobson **TBD** **TBD**

3:30 – 3:45 Break

3:45 – 5:30 SARC Discussion of Surfclam
Larry Jacobson, SARC Chairman

Tuesday, 1 Dec

9:00 – 10:30 AM Assessment Presentation Butterfish (Sp. B)
Tim Miller **TBD** **TBD**

10:30 – 10:45 Break

10:45 – Noon SARC Discussion of Butterfish
Tim Miller, SARC Chairman

Noon – 1:15 Lunch

1:15 – 2:15 Continue SARC Discussion of Butterfish
TBD, SARC Chairman

2:15 – 3:30 Revisit Surfclam Assessment with Presenters

3:30 – 3:45 Break

3:45 – 5:30 Revisit Surfclam and/or Butterfish Assessments with Presenters

Wednesday, 2 Dec

9:00 – 10:00 AM Revisit Butterfish Assessment with Presenters

10:00 – 10:15 Break

10:15 - Noon Surfclam follow up + review Assessment Summary Report

Noon – 1:15 PM Lunch

1:15 – 3:00 Butterfish follow up + review Assessment Summary Report

3:00 – 3:15 Break

3:15 – 5:15 SARC Report writing. (closed meeting)

Thursday, 3 Dec

9:00 – 2:00 PM SARC Report writing. (closed meeting)

*Times are approximate, and may be changed at the discretion of the SARC chair. The meeting is open to the public, except where noted.

ANNEX 4: Contents of SARC Summary Report

1. The main body of the report shall consist of an introduction prepared by the SARC chair that will include the background, a review of activities and comments on the appropriateness of the process in reaching the goals of the SARC. Following the introduction, for each assessment reviewed, the report should address whether each Term of Reference of the SAW was completed successfully. For each Term of Reference, the SARC Summary Report should state why that Term of Reference was or was not completed successfully.

   To make this determination, the SARC chair and CIE reviewers 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 reviewers and SARC 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.

   The report may include recommendations on how to improve future assessments.

2. If any existing Biological Reference Point (BRP) proxies are considered inappropriate, include recommendations and justification for alternative proxies. If such alternatives cannot be identified, then indicate that the existing BRPs are the best available at this time.

3. The report shall also include the bibliography of all materials provided during the SAW, and any papers cited in the SARC Summary Report, along with a copy of the CIE Statement of Work.

   The report shall also include as a separate appendix the Terms of Reference used for the SAW, including any changes to the Terms of Reference or specific topics/issues directly related to the assessments and requiring Panel advice.

Appendix 3: Panel membership for SARC 49

Chair of SARC: Prof. Robert Latour, VIMS
Chair of SAW: Jim Weinberg, NEFSC

Reviewers: Henrik Sparholt, ICES, Copenhagen
Mike Smith, Cefas, Lowestoft
John Cotter, FishWorld Science Ltd, Lowestoft

NEFSC Population Dynamics staff including:
Paul Rago, Head of Branch
Larry Jacobson, presenter for surfclams
Tim Miller, presenter for butterfish.