# Final Report

## Summary Report of the 49th Northeast Regional Stock Assessment Review Committee (SARC 49)


### Members of SARC 49

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# Contents

# 1. Introduction

## 1.1 Background

The 49th SARC (Stock Assessment Review Committee) met in Woods Hole, MA from November 30 – December 3, 2009 to review stock assessments for Atlantic surfclam (*Spisula solidissima*) and butterfish (*Peprilus triacanthus*). The review committee was composed of Dr. Robert J. Latour (MAFMC SSC and Virginia Institute of Marine Science, chair) and three scientists affiliated with the Center for Independent Experts: Dr. Henrik Sparholt (ICES), Dr. John Cotter (FishWorld Science Ltd), and Mr. Michael Smith (Cefas).

The SARC was assisted by the NEFSC SAW Chairman, Dr. James Weinberg, his staff, and Dr. Paul Rago (NEFSC). Supporting documentation for the Atlantic surfclam assessment was prepared by the NEFSC Invertebrate Subcommittee, and presentations at the meeting were made by Dr. Larry Jacobson (NEFSC) and Ms. Toni Chute (NEFSC). Written material describing the butterfish assessment was prepared by the NEFSC Coastal/Pelagic Working Group, and presentations were made by Dr. Timothy Miller (NEFSC) and Dr. Jason Link (NEFSC).

## 1.2 Review of Activities

Approximately two weeks before the meeting, assessment documents and supporting materials were made available to the SARC panel via an ftp server on the NEFSC website. On the morning before the meeting, the review panel met with Dr. Weinberg and Dr. Rago to discuss the meeting agenda, reporting requirements, and meeting logistics. During the SARC meeting, all documents were made available electronically and in print. The meeting opened on the afternoon of Monday November 30 with welcoming remarks by Dr. Weinberg and Dr. Latour. Following introductions, the remainder of Monday afternoon was devoted to presentations of the Atlantic surfclam assessment. Tuesday morning opened with presentations of the butterfish assessment, and both the Atlantic surfclam and butterfish assessments were discussed further on Tuesday afternoon. Final follow-up discussion for the Atlantic surfclam assessment took place Wednesday morning, and the remainder of the day was spent reviewing additional butterfish analyses conducted by Dr. Miller and Dr. Rago at the request of the review panel. Thursday was spent reviewing the remaining results from follow-up butterfish analyses, deriving consensus statements about both assessments, and writing report text. The tone of the meeting was collegial, and considerable time was devoted to facilitate dialog among review panel members, working group scientists, NEFSC population dynamics biologists, MAFMC staff, and industry representatives. For butterfish, the meeting participants reconvened via WebEx and teleconference on December 15, 2009 to edit the butterfish Assessment Summary Report.

## 1.3 SARC Process

The review panel was able to reach consensus on both assessments. Since the last assessments for both species (2006 for surfclam and 2004 for butterfish), it was clear

that research advancements have been made, and that the incorporation of new information resulting from these research studies led to improved understandings of the population dynamics of both species. The assessments conducted by the Invertebrate Subcommittee and Coastal/Pelagic Working Group were very thorough, and it was apparent that both groups devoted significant time and effort to data analysis, model fitting, evaluation of uncertainty, and report preparation.

The review panel agreed that the Terms of Reference (ToRs) for the Atlantic surfclam assessment were met by the Invertebrate Subcommittee. Commercial landings and effort data were well characterized and appear to be reliable. Two semi-independent analytical approaches were used to assess the stock, namely, efficiency corrected swept-area biomass and the KLAMZ model. The lack of true independence among the methods is because the efficiency corrected swept-area biomass estimates were included in the KLAMZ model to provide information on the scale of surfclam abundance. The KLAMZ model was used as the primary tool for stock status determination and management advice. Estimates of whole stock biomass from 1981-2008 were fairly stable and followed a 'dome-shaped' pattern, with a gradual decreasing trend in abundance since the late 1990s. Whole stock estimates of fishing mortality (F) were low and fairly stable, while estimates of growth and recruitment showed a consistent decline over the time period of the analysis. Despite these downward trends, there was consensus among the review panel that the Atlantic surfclam stock is not overfished and overfishing is not occurring. Concerns were raised among members of both the review panel and the Invertebrate Subcommittee about the validity of the whole stock assumption, particularly given the sedentary nature of surfclams and the potential for metapopulation dynamics.

The review panel agreed that the ToRs for the butterfish assessment were met by the Coastal/Pelagic Working Group in that the information specified by each ToR was provided, however, the review panel felt that not all of the assessment results could be used to support management. This conclusion was not a result of poor analytical procedures or any particular fault of the Coastal/Pelagic Working Group, rather, it was due to the significant uncertainty associated with the input data, KLAMZ model output, and the apparent lack of information in the available data, other than one survey, regarding the true scale of butterfish biomass. Commercial catch estimates were not precisely known (yearly CVs were > 0.8 due to a lack of precision of the discard estimates), and of the available survey data, only the NEFSC fall index appeared to be a reliable indication of butterfish relative abundance (yearly CVs were 0.2-0.4). Estimates of biomass and F were fairly imprecise (CVs for both were ≥ 0.6 over all years), and the KLAMZ model struggled to capture the scale of butterfish biomass. Ultimately, the review panel accepted the biomass and F estimates only from the perspective that they seemed to reflect the appropriate trends, but recommended that the point biomass and F estimates be interpreted with caution. The review panel did not accept the BRPs, although it was agreed that overfishing was not likely occurring since the stock appeared to be declining in the absence of directed fishing. Determination of an

overfished versus not overfished condition was not resolved at the meeting, which left the status of butterfish abundance unknown.

# 2. Review of Atlantic surfclam

Global comment: The review panel expressed reservation about the stock unit considered in the assessment, since a large portion of the surfclam stock occurs in state waters (i.e., those defined to be ≤ 3 nm from shore). Additionally, the review panel was concerned about the whole stock assumption within the Exclusive Economic Zone or "EEZ" (federal waters between 3 and 200 nm from shore) given documented evidence of regional variation in life history characteristics. These concepts and others regarding the surfclam stock definition are discussed further below.

## 2.1 Background

The Atlantic surfclam (*Spisula solidissima*) is a filter feeding bivalve that inhabits sandy habitats along the continental shelf from the Gulf of St. Lawrence to Cape Hatteras, NC (Merrill and Ropes 1969; Cargnelli et al. 1999). High abundances of surfclams can be found on Georges Bank (GBK) and off the coast of New Jersey (NJ) southward along the Delmarva Peninsula (DMV). In the mid-Atlantic region, surfclams are found from the intertidal zone to depths of about 60 m, although abundance is low in depths greater than 40m. Surfclams can reach sizes > 200 mm shell length and are relatively long-lived with a maximum age in excess of 30 years (Jones et al. 1978). Growth appears to vary seasonally and regionally, with slower growth in southerly habitats presumably due to the physiological effects of higher water temperatures (Weinberg 2005). Sexual maturity varies by region and can occur as early as 3-months of age (~5 mm shell length, SL, Chintala and Grassle 1995) or as late as 4-years of age (~85 mm shell length, Sephton 1987). Surfclams are broadcast spawners and settlement occurs after about a 3-4 week planktonic larval period.

Management of Atlantic surfclams in the EEZ is achieved using an individual transferable quota (ITQ) system, under the auspices of the Mid-Atlantic Fishery Management Council. Fisheries in state waters are managed by state authorities.

## 2.2 Evaluation of Terms of Reference for Atlantic Surfclam

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

The review panel agreed that the Invertebrate Subcommittee met this term of reference. An ITQ management for surfclams was established in 1990 under Amendment 8 to the Fishery Management Plan for the Atlantic Surfclam and Ocean Quahog Fisheries. Management measures include an annual quota for the EEZ waters and mandatory logbooks that describe each fishing trip to a spatial resolution of at least one ten-minute square (TMS, 10' lat. by 10' long.). There appears to be good compliance with the management plan such that the fishery-dependent data are

believed to be of good quality. Discards were assumed to be negligible since the early 1980s, but estimates of total removals were augmented to reflect an assumed 12% incidental mortality rate due to dredging operations. The review panel accepted this approach but recommended that the incidental mortality rate be more formally estimated.

Data on total landings of surfclams within the EEZ were presented from 1965-2008, however, the assessment was based on landings and effort data from 1982-2008 when logbook reporting was mandatory. Landings peaked during the mid 1970s, but declined sharply in the late 1970s and early 1980s before stabilizing by about 1985. EEZ landings have varied between 21,000 and 25,000 mt from 1985-2008, and have not reached the annual quota in recent years due to limited markets. The majority of the landings come from habitats off the coast of NJ and DMV. Despite relatively constant landings over time, fishing effort in these areas has increased considerably since the late 1990s, leading to a marked decline in landings-per-unit-effort (LPUE). Both the review panel and the Invertebrate Subcommittee expressed concern about the status of the surfclam resource in the DMV and NJ regions, particularly given their historical importance of supporting the bulk of the fishery. Spatial patterns in landings indicate that the fishery may be shifting northward to areas that have traditionally not been heavily fished. Since surfclam abundance on GBK is believed to be relatively high (see ToR 3 comments below), such a northward shift in fishing activities may be advisable.

Fishers deliver surfclams in standard industry cages, yet landings were expressed as meat weights for ease of comparison to survey data. One industry cage equals 32 bushels of surfclams, and 1 bushel was assumed to yield 7.7 kg of meat based on a shell-length-to-meat-weight (SLMW) conversion. Given that growth is variable across regions, season, and depth, the review panel suggested that the SLMW conversion be re-evaluated to incorporate variation due to these variables. It was noted, however, that this issue may no longer be problematic if Stock Synthesis 3 (SS3) is used for future assessments since SS3 tracks abundance expressed in numbers rather than biomass.

The review panel noted that some of the surfclam spatial distribution plots may have reflected some coding errors, since there were appreciable abundances of surfclams in deeper than expected locations (along the shelf edge). Were these records ocean quahog? Additional QA/QC of the landings database may be warranted. Lastly, the review panel indicated that it may be useful to include in the assessment report a description of potential interactions with other fisheries, i.e., likely sources of surfclam bycatch/discards and why or why not.

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.*

The panel agreed that the Invertebrate Subcommittee met this term of reference. The dredge survey data appear useful for surfclams > 50mm SL, however, the review panel felt that a sampling program to monitor the abundance of smaller clams (perhaps a subcomponent of the current clam survey) would potentially increase the understanding of trends in surfclam recruitment. Trends in survey data along with confidence intervals were characterized spatially within five regions: GBK, southern New England (SNE), Long Island (LI), NJ, and DMV. Since the mid 1990s, the GBK index of abundance showed an increasing trend, the SNE and LI indices were variable but seemingly constant, and the NJ and DMV indices showed a decreasing trend. Consistent survey coverage of GBK would be helpful since it appears that the bulk of the stock biomass resides in that area.

The review panel applauded the hard work associated with estimation of the dredge selectivity and efficiency; these represent key advancements necessary to increase the reliability of the survey-based swept-area abundance estimates. The age-composition data appear to be informative since they distinguish strong year-class/recruitment events and could be indicative of subpopulation/localized dynamics. Age-validation of the dredge survey data is also a positive step. Although 'borrowing' data from adjacent years to fill in missing survey values is practical, the review panel felt that improvements to this approach could be made through the application of spatial models together with the expectation-maximization algorithm. Alternatively, the application of generalized linear models (GLMs) could prove to be useful.

Although the majority of the surfclam stock resides in the EEZ, the exclusion of survey data from state waters represents a loss of information on trends in stock abundance. To the extent possible, the review panel recommended that these data be included in the development of area-specific and overall fishery-independent indices of relative abundance. Lastly, the review panel recommended that the Invertebrate Subcommittee investigate the feasibility of obtaining estimates of total mortality (Z) from the dredge survey data (perhaps from a catch curve type analysis) as a means of corroborating results from the stock assessment modeling and the assumed value of natural mortality (M). Moving to an explicitly age and length structured assessment approach such as SS3 is likely to involve statistical consideration of F and M by cohort and year.

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.*

The review panel agreed that the Invertebrate Subcommittee met this term of reference. Two semi-independent analytical approaches were used to assess the stock, namely, efficiency corrected swept-area biomass and the KLAMZ model. The lack of true independence among the methods is because the swept-area biomass estimates were included in the KLAMZ model to provide information on the scale of surfclam abundance.

Considerable effort had been applied to collaborative depletion experiments involving the *R/V Delaware II* and industry to estimate survey dredge efficiency and more recently survey dredge selectivity. Although this work indicates that survey *q* estimates are low and variable, it improves confidence in the accuracy of the efficiency corrected swept-area biomass estimates. Probability distributions for the SE metrics sufficiently characterized their uncertainty. The review panel noted that there was a trend in survey dredge efficiency with population density such that median *q* was an overestimate of *q* for high population density areas and an underestimate at low population density. This gives the reverse effect on biomass estimates which would therefore be underestimated for high density areas and overestimated for low density areas. Adjustment for this trend (i.e., using *q* as a function of survey density) would likely be difficult, but perhaps an approach based on binning survey densities and *q*s could be investigated.

The KLAMZ model was used as the primary tool for stock status determination and management advice. Although the KLAMZ model does incorporate some age-structured population dynamics, it lacks spatial structure and therefore cannot account for the potential effects of localized dynamics. The KLAMZ model provided annual estimates of biomass and fishing mortality by fitting to recruitment and biomass indices derived from the dredge survey data. Recruitment was modeled using a smooth random walk function, where recruitment variance was constrained to ensure model convergence and no survey residual patterns. The configuration of the KLAMZ model resulted in biomass and recruitment estimates that were essentially a smoothed time-series of the efficiency corrected swept-area results. Given that, the review panel noted that the trend in KLAMZ model biomass estimates was in good agreement with declining trends in commercial LPUE. The estimates of biomass and fishing mortality were accepted by the review panel in so much as it is reasonable to assume that they represent stock level composites of recruitments that vary regionally.

The review panel agreed that uncertainty in KLAMZ model output was satisfactorily investigated by the Invertebrate Subcommittee. Results of goodness of fit diagnostics were provided and bootstrapped model results showed modest bias in the estimates of biomass and annual fishing mortality. CVs of the estimates of biomass, fishing mortality, and recruitment were based on bootstrapped and delta-method estimates of variance and were below 0.2 for all years.

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.*

The review panel agreed that the Invertebrate Subcommittee met this term of reference. The rationale for reference points in the current assessment has not changed since the previous assessment. The fishing mortality reference point remained the same ($F_{MSY}$=M=0.15), while the biomass reference point was updated with the new

biomass estimate for 1999 ($B_{1999}$=1,086 thousand mt meats). The proxy for $B_{MSY}$ was assumed to be ½$B_{1999}$ (biomass target) and the biomass threshold was taken as ½$B_{MSY}$. Although the review panel accepted the pragmatic approach to setting these reference points, it agreed with comments made by the Invertebrate Subcommittee that the reference points could usefully be re-evaluated in the future with respect to the following points:

1) M=0.15 may be higher than the true natural mortality and thus overstate the productivity of surfclams
2) The existing biomass target can be achieved by the biomass on GBK alone and hence does not provide protection for the stock elsewhere. As stated in the stock assessment report (p.31), "Efficiency corrected swept area biomass estimates indicate that the biomass on GBK in 2008 was 518 thousand mt. Thus, if all surfclams in the SVA, DMV, NJ, LI and SNE regions where the fishery took place prior to 2009 were eliminated, the surfclam stock biomass (518 thousand mt entirely on GBK) would be officially near its biomass target (543 thousand mt). In this hypothetical scenario, the stock would not be overfished ($B<B_{Threshold}$) unless about half of the biomass on GBK were removed as well. These problems are in addition to the technical problems with specifying $F_{MSY}$ and $B_{MSY}$ for sessile spatially heterogeneous stocks like surfclams, ocean quahogs, and Atlantic sea scallops with differences in biological properties (growth, SLMW, etc.)."
3) The rationale that $B_{1999}$ represents $B_0$ could potentially be improved by exploring the population dynamics more extensively once the SS3 age/length structured modeling approach is implemented.

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

The review panel agreed that the Invertebrate Subcommittee met this term of reference, and accepted the status determinations that the surfclam stock was not overfished and that overfishing was not occurring. Although overfishing was not occurring in any region, the review panel noted that fishing mortality was regionally varying and there was small probability (~ 20%) that F in DMV exceeded $F_{MSY}$=0.15. The probability that fishable biomass is less than the $B_{Theshhold}$ (272 thousand mt) was almost zero, but the single stock unit assumption under conditions when patterns in exploitation and biological parameters (growth, etc.) are known to vary regionally, prompted the review panel to express modest concern about the robustness of this conclusion.

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

The review panel agreed that the Invertebrate Subcommittee met this term of reference. The Invertebrate Subcommittee considered a number of potential factors that could be responsible for low surfclam recruitment, although no definitive conclusions could be reached. Specific topics investigated included:

1) predation impacts by teleosts, elasmobranchs, and crustaceans (various crab species)
2) slower growth rates which allows for increased losses of adult surfclams due to natural mortality
3) increased water temperatures due to climatic warming
4) fishing impacts as they relate to habitat disturbance and low regional abundances of surfclams, which could create possible Allee effects
5) parasitic infections
6) impacts due to dumping sewage sludge either through direct mortality or indirect mortality via stimulation of hypoxic events

No single line of inquiry provided a convincing explanation for the observed low surfclam recruitment in the southern range of the stock (DMV, NJ regions). The explanation most supported by the Invertebrate Subcommittee was that surfclam survival was low following settlement, and the production of new recruits was then compounded by slow growth of adults potentially due to increasing water temperatures. Fishing effects were identified as possible but deemed unlikely. The review panel noted that a broad review of existing environmental information for habitats along the continental shelf of the Atlantic Ocean would likely be helpful for management of surfclams even if it did not provide direct answers to the low 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.*

The review panel agreed that the Invertebrate Subcommittee met this term of reference. Two types of projections were conducted using the KLAMZ model: forecasts

assuming that the stock assessment model was correct (M=0.15) and a decision table analysis where uncertainties in M and survey dredge efficiency were evaluated. Projections started at the terminal year in bootstrap runs (2000) assuming autocorrelated (lag 1) recruitment.

For the forecasts, the effects of various F or catch levels were simulated for the whole stock (the FMP minimum, industry estimate, FMP maximum, or $F_{MSY}$ proxy) and for the DMV and NJ regions alone (F=0, F=0.07, catch=2,300 mt). Results of the projections applied only to the DMV and NJ regions showed continued decline in abundance such that $B_{2015}$ would be -43% and -38% of the estimated $B_{2015, F=0}$ in the DMV and NJ regions, respectively. The whole stock projection analyses showed that gradual stock decline was likely for all catch levels except the $F_{MSY}$ proxy, where the projected decline in abundance was much more severe. Related to the projected biomass trends of course are the patterns in projected fishing mortality; all catch levels showed very small changes in F except the $F_{MSY}$ proxy scenario, which resulted in roughly a six-fold increase in fishing mortality relative to $F_{2008}$. The vulnerability of the whole surfclam stock to overfishing or an overfished condition appears to be low except if catch levels are set to correspond to the $F_{MSY}$ proxy. However, the overfishing definition for surfclams is $F_{MSY}$, so this latter result is not surprising and in effect does not represent a viable management strategy. As noted by the Invertebrate Subcommittee, current spatial patterns in fishing dynamics would not likely ever support an overfishing/overfished determination because of the estimated high surfclam abundance on GBK and the whole stock assumption.

The decision table analysis was applied only to the whole stock under nine different states of nature. The specific possibilities considered resulted from combinations of three different assumed natural mortality rates each at three assumed levels of dredge survey catchability. The management scenarios examined were the same as those included in the whole stock forecast analyses. Probabilities of overfishing and achieving an overfished status were calculated for each of the nine states of nature. For the FMP minimum, industry estimate, and FMP maximum management scenarios, the probabilities of $B_{2015}$ falling below $B_{Threshold}$ and the probabilities of overfishing in 2015 were zero for all states of nature. Nonzero probabilities of the stock biomass falling below $B_{MSY}$ were calculated for some combinations of management and states of nature, however, all of these values were less than 0.02. Regardless of the assumed state of nature, overfishing and overfished probabilities were generally high (in several cases equal 1.0) for the $F_{MSY}$ proxy management scenario. But as noted above, the $F_{MSY}$ proxy approach is not viable.

Although the review panel accepted these projections, it noted that the vulnerability conclusions were framed in the current BRP framework, which did create modest concern (see comments regarding ToRs 4, 5)

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.*

The review panel agreed that the Invertebrate Subcommittee met this term of reference. A total of 18 research recommendations were outlined in the stock assessment report; some progress was made on 12 of these and no progress was made on 6. In total, the review panel felt that reasonable research progress had been made since the last assessment. A number of issues that could be framed as research recommendations were raised throughout much of the text above, so only a brief summary is provided here.

i) Given there is evidence of spatial heterogeneity of surclam abundance and life history, the whole stock assumption should be formally re-evaluated. Hypotheses regarding metapopulation dynamics should be formally explored through dedicated field studies, and spatially-structured population dynamics models (implicit or explicit).

ii) The incidental mortality rate during surfclam dredging (assumed to be 12%) should be more formally estimated.

iii) Given that growth is variable across regions, season, and depth, the SLMW conversion should be re-evaluated to incorporate variation due to these variables. It was noted, however, that this issue may no longer be problematic if SS3 is used for future assessments.

iv) The development of a fisheries-independent sampling program to monitor the abundance of smaller clams < 50mm SL, (perhaps a subcomponent of the current clam survey) would potentially increase the understanding of trends in surfclam recruitment.

v) Model based approaches should be investigated for filling in missing gaps in the dredge survey database. These might include the application of spatial models together with the expectation-maximization algorithm, or GLMs.

vi) The BRPs should be re-evaluated in light of the spatial heterogeneity of surclam abundance and life history.

Literature Cited for Surfclam Review

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# 3. Review of Butterfish

## 3.1 Background

The butterfish is a short-lived fast growing schooling pelagic fish that can be found along the eastern seaboard from Newfoundland to Florida, but occurs in relatively high abundance from the Gulf of Maine to Cape Hatteras, NC (Bigelow and Schroeder 1953). Few individuals survive to ages older than 3 years and most are sexually mature at 1-2 years of age (Cross et al. 1999). Butterfish overwinter along the edge of the continental shelf and migrate inshore during spring. In summer and fall months, butterfish are distributed over the entire mid-Atlantic shelf, including in bays and estuaries. Butterfish are broadcast spawners and demonstrate a protracted spawning season ranging from May to October with peak activity occurring in July (Cross et al. 1999). Various teleosts, elamobranchs (sharks), marine mammals, and seabirds prey on butterfish (Duffy 1988, Cross et al. 1999). Butterfish are managed by the Mid-Atlantic Fishery Management Council's Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan.

## 3.2 Evaluation of Terms of Reference for Butterfish

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.*

The review panel agreed that the Coastal/Pelagic Working Group met this term of reference except that effort was not estimated. Estimates of commercial catches (directed landings + discards) were provided for 1887-2008, although the assessment was based on catch data from 1973-2008. Recreational landings appear to be negligible. There was a high degree of uncertainty associated with the commercial catch data, due to a lack of precision for the discard estimates. The review panel felt that limited observer coverage and perhaps the use of ratio estimators to calculate discard estimates were the causes of the uncertainty. Since there is no directed fishery for

butterfish currently, no effort data were available. The species is principally caught as a bycatch in the *Loligo* fishery.

Very little information regarding temporal management objectives was presented by the Coastal/Pelagic Working Group. The review panel noted that effort information associated with the *Loligo* fishery and plots of observer data by month were not provided in the assessment reports, but the latter were ultimately provided during the meeting. Not having time before the meeting to review this information made it difficult for the review panel to evaluate its utility. However, the review panel was able to conclude that observer coverage mid-Atlantic would need to be expanded significantly to effectively monitor seasonal discards. The importance of enhanced observer coverage is perhaps greater now than ever before, since management of the *Loligo* fishery will likely be formally tied to butterfish discard levels in the near future.

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.*

The review panel agreed that the Coastal/Pelagic Working Group met this term of reference. When compared to many other stocks, there appears to be an appreciable amount of fishery-independent data for butterfish. Indices of relative abundance can be derived from three NEFSC bottom trawl surveys (fall, winter, spring), two state surveys (MA, RI), and the NEAMAP survey. The Coastal/Pelagic Working Group considered all of these data sources, but ultimately elected to use only the NEFSC trawl survey data. The spatial coverage of the state surveys relative to the distribution of butterfish was limited and there were no age data available to develop age-structured indices. The NEAMAP data were not used because the program has only been operating since 2007. The review panel agreed with the rationale to exclude state and NEAMAP monitoring data.

There was a lot of uncertainty associated with the NEFSC annual spring and winter trawl survey indices. The review panel commented that the NEFSC survey protocols were not referred to in the documentation, so it was difficult to evaluate the consistency over time of survey design and sampling procedures. The fall survey index appeared to be the most reliable indication of butterfish relative abundance since it had reasonable estimates of precision (yearly CVs were 0.2-0.4). After some discussion regarding the survey, the review panel noted that the relatively low headline height of the trawl used by the NEFSC surveys (~ 2m vertical opening) may make it a suboptimal gear for sampling butterfish and likely contributed to the high CV estimates from the spring and winter surveys.

The Coastal/Pelagic Working Group presented NEFSC survey-based age and length composition data, however, the review panel noted that is was generally difficult to evaluate the degree to which these data were representative of the true butterfish age- and size-structure. No age validation studies have been conducted for butterfish, and given that it was difficult to follow cohorts over time through the survey length

composition data, the review panel was concerned about the possibility of aging error. Additionally, aging error could explain some of the high Z estimates obtained from the survey-based catch curves (see ToR 3 discussion below for more details). Comparisons of survey-based and commercial catch length compositions showed appreciable degrees of dissimilarity. Larger/older butterfish were more frequent in the commercial catch length data than in the survey length data, which generated questions about the selectivity of the survey trawl net, commercial fleet's catchability of large/older fish, and ultimately, the representativeness of the age-1+ survey abundance indices. The larger sample sizes inherent in commercial length compositions may also have caused a wider range of lengths to be discovered. Despite these issues, the review panel acknowledged that the NEFSC survey data likely represented the best available information about butterfish relative abundance.

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.*

Although the review panel agreed that the Coastal/Pelagic Working Group met this term of reference by providing estimates of the specified variables and parameters, there was substantial concern regarding the high uncertainty associated with F and biomass estimates (CVs for both were ≥ 0.6 over all years). The review panel felt that the KLAMZ model was unstable when fitted to butterfish data; that is, many model configurations did not converge and required potentially strong analytical assumptions to achieve fits (e.g., narrow prior on survey *q*). There also was a lack of transparency with respect to the characteristics of the model used to derive estimates and the configurations of model runs. Perhaps a small table could be constructed to convey basic data inputs, model parameters and settings, state variables, and dynamic equations.

The review panel applauded efforts by the Coastal/Pelagic Working Group to derive estimates of M from a variety of methods, but was concerned that there were significant inconsistencies among those estimates. These inconsistencies seemed to be indicative of discrepancies among signals of Z in the input data, which ultimately affected the review panel's ability to develop full confidence in the results of the KLAMZ model. The base KLAMZ model was configured assuming an M value of 0.8 (Murawski and Waring 1979). However, the predator consumption calculations (see ToR 6 for more details) indicated that predation removals were predominately on adult butterfish (age-1+) and comparable in magnitude to the commercial catches, particularly in the most recent couple of years. The KLAMZ model based estimate of $F_{2008}$ was approximately 0.02, which would imply that a consumption based estimate of $M_{2,2008}$ for age-1+ butterfish would be similar (acknowledged as a minimum given that not all predators of butterfish were included in the consumption analysis). Survey-based annual catch curve analyses yielded an average Z of 2.0, which placed M in the range of 1.7 or larger given KLAMZ model F estimates. Lastly, the Hoenig (1983) method yielded an M estimate of 1.4 assuming a max age of 3 years. Despite a great deal of discussion, these inconsistencies were not completely reconciled during the meeting.

The review panel was appreciative of the willingness of the Coastal/Pelagic Working Group to conduct additional analyses during the meeting. The 'envelope' analysis was introduced, and although it was relatively simple, the review panel agreed that it showed promise in terms of providing upper and lower bounds on biomass estimates through prior bounding of F and *q*. However, if the 'envelope' bounds are reasonably correct, then it appears that range of possible fishing mortality and biomass levels are sometimes narrower than those produced by the KLAMZ model (i.e., 95% CIs of the base KLAMZ model results fell outside the limits of the 'envelope').

It was noted at the meeting that the biomass estimates from the current KLAMZ model were 4-6X higher in some years than those obtained from the KLAMZ model used for the 2004 butterfish assessment. The review panel cautioned against comparing the assessments too closely for a couple of reasons. Firstly, although the KLAMZ model was used for both assessments, the configurations of them differed markedly such that they were in effect different assessment models (e.g., use of a prior for the survey *q* in the current and not previous model). Secondly, it was quite clear that both KLAMZ models struggled to capture the appropriate scale of butterfish biomass. Of the available data, the fall trawl survey indices constituted the only potentially viable determinant of the scale of butterfish biomass with respect to its stock dynamics. The commercial catch data and estimated predation removals were very low and generally uninformative measures of scale. The review panel did, however, acknowledge that the development of the prior distribution for the fall survey *q* (although narrow) represented a significant advancement relative to the 2004 butterfish assessment, since previous values of *q* were unrealistically high (> 1.0).

Ultimately, the review panel accepted the biomass and F estimates from the current assessment only from the perspective that they seem to reflect the appropriate trends. Biomass and fishing mortality appear to have declined over most of the time-series and fishing mortality is very low in recent years, as is consistent with the lack of a directed fishery. The review panel recommended that actual point estimates of biomass and F be interpreted with caution.

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.*

The review panel agreed that the assessment team met the term of reference in that redefined BRPs were estimated, however, the review panel did not accept the adequacy of the redefined BRPs or the BRPs used for stock status determination in the 2004 butterfish assessment.

The estimate of $B_{msy}$ from the 2004 butterfish assessment was based on the biomass scale reflected in the result of the 2004 KLAMZ model configuration. Given that the biomass estimates from the current assessment (which was an improved analysis due to

the prior on the survey *q*) reflected an entirely different scale (4-6X larger - see comments in ToR 3 above), the panel concluded that the scale of the biomass estimates from the 2004 assessment was too low. Thus, it is unlikely that that the 2004 estimate of $B_{MSY}$ is valid. Since $F_{MSY}$ is related to $B_{MSY}$, the panel did not accept the 2004 $F_{MSY}$ estimate.

The Coastal/Pelagic Working Group proposed to discard the Fox production model, which was the basis for BRPs from the 2004 butterfish assessment. The rationale in doing this was based on a lack of consistency among modeling approaches (i.e, fitting the Fox model to the estimates of surplus production derived from the delay-difference KLAMZ model). As replacements, The Coastal/Pelagic Working Group proposed to use $F_{0.1}$ as a proxy for $F_{MSY}$. The review panel felt that using an equilibrium yield-per-recruit approach was uninformative because $F_{MAX}$ is not known, leaving open the possibility for $F_{0.1}$ to be unreasonably high. This was in fact the case since the estimate of $F_{0.1}$ was significantly larger than any of the F values ever experienced by the stock. Additionally, this approach yielded a $B_{MSY}$ estimate that was far below the range of historic estimated biomass levels, which was troubling.

The review panel concluded that the butterfish stock dynamics appear to be driven by environmental processes as they affect recruitment, and it appears that environmental conditions have changed such that butterfish abundance has declined. This conclusion was largely based on the fact that the majority of the Z estimates were quite high (>1.3) and combined with the fact that F is low in recent years. Hence, there was a lot of unexplained mortality that presumably can be attributed to non-fishing related processes. An alternative hypothesis is that butterfish become less catchable by demersal trawls with age, leading also to increased apparent Z. The review panel questioned the application of MSY theory (philosophically) for a short-lived recruitment dominated population, particularly the use of equilibrium methods when trends in the data suggest the stock is declining in the absence of fishing. Other criteria could perhaps be used for setting BRPs, for example, thresholds for spawning biomass which have been shown to produce strong year-classes or biomass thresholds set as some fraction of virgin abundance e.g., 30% of $B_0$. Despite lengthy discussion among the review panel and the Coastal/Pelagic Working Group regarding BRPs for butterfish, it was concluded that alternative BRPs could not be formally identified within the time frame of the meeting. Management objectives for this stock might also require clarification.

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

Given the theoretical concerns outlined in the review panel's summary of ToR 4 regarding the chosen BRPs, combined with the uncertainty of the biomass and fishing mortality estimates upon which the BRPs were based, the panel did not consider the Coastal/Pelagic Working Group's stock status determination adequate for management.

The review panel agreed that fishing mortality rates in recent years are very low, and the use of any traditionally accepted F-based reference point would likely conclude that overfishing is not occurring. In addition, the review panel agreed that there is a decreasing trend in biomass and that biomass levels in recent years may be low enough to impair recruitment. The panel felt that the stock abundance is low for reasons other than fishing, but noted that fishing and discarding have, of course, contributed somewhat to the situation.

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*

The review panel agreed that the Coastal/Pelagic Working Group met this term of reference. The NEFSC is fortunate to have such a large-scale and rich stomach contents database to support analyses of predation impacts. It also appears that the NEFSC bottom trawl survey can be used to produce reasonable estimates of predator abundance over time, at least for the six species (smooth dogfish, spiny dogfish, silver hake, summer flounder, bluefish, and goosefish) considered by the Coastal/Pelagic Working Group. Although estimates of uncertainty were not explicitly provided, the Coastal/Pelagic Working Group acknowledged several sources of uncertainty in Appendix A of the butterfish assessment report and personal communication during the meeting indicated that the CVs of the consumption estimates were on the order of 0.5-0.7.

The review panel noted that many other predatory fishes, cetaceans, and seabirds were not included in the consumption analysis, so clearly the estimates represented minimum removals. However, if M is 0.8 (as assumed in the base KLAMZ model), the approximately 6000 mt of butterfish consumed by fish predators only represents about 0.1 of the natural mortality, which leaves a lack of explanation for the rest of the M (0.7). This discrepancy is further exacerbated if total M is higher, as indicated by several other analysis methods (see discussion of ToR 3 above). The review panel agreed that the Coastal/Pelagic Working Group should focus efforts on determining the cause(s) of the unexplained butterfish natural mortality prior to shifting to a multispecies assessment model. The possibility that M is artificially inflated by lowered catchability with age should also be considered.

There was considerable discussion among meeting participants about the possibility that the apparent low butterfish recruitment and biomass may be due to some type of ecosystem regime shift. It should be noted that annual trends in diet composition may not be sufficient to fully address many ecosystem management questions, particularly the effect of climate variability or fishing on, for example, changes in consumption rates, the relationship between consumption/availability of prey and predator growth, prey selectivity and switching, functional responses, and predator movements in response to prey gradients. The lack of a summer bottom trawl survey also represents a potential

gap in terms of having the necessary data to fully address ecosystem-fisheries management questions.

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.*

The review panel agreed that the Coastal/Pelagic Working Group met this term of reference. Stock projections were conducted and their results were summarized in the butterfish stock assessment report and presented at the meeting. However, discussion among the review panel and the Coastal/Pelagic Working Group during the review prompted significant reconsideration of the KLAMZ model output and BRPs used for stock status determination. Since it was ultimately concluded that the current butterfish stock status is unknown, analyses designed to describe the stock's vulnerability to having an overfished status are not practical.

Forecasts of butterfish stock dynamics were configured assuming a recruitment level equal to the average of the last 10 years, a constant natural mortality rate of 0.8, and a persistent constant fishing mortality rate of 0.02. KLAMZ model projections indicated that the butterfish population would increase in the short-term, however, these results should be accepted with caution because of the uncertainty regarding KLAMZ model output, the assumed value of M, and future recruitment levels.

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.*

The review panel agreed that the Coastal/Pelagic Working Group met this term of reference. A total of 8 research recommendations were outlined in the stock assessment report; progress was made on 6 of these, mostly centered about discard

estimation. A number of issues that could be framed as research recommendation were raised throughout much of the text above, so only a brief summary is provided here.

i) The contentious nature of butterfish as a discard species in the *Loligo* fishery could be significantly mitigated through improvements to gear and fishing practices. Strategies to reduce bycatch should be thoroughly investigated, perhaps through cooperative research projects.

ii) Observer coverage in the mid-Atlantic region should be expanded. Following from i) above, if butterfish discards within the *Loligo* fishery remain appreciable despite attempts to minimize them, and if future management of the *Loligo* fishery is tied directly to butterfish discards, improved precision of discard estimates is critical.

iii) MSY theory does not seem appropriate for a short-lived fast growing species, therefore, an entirely new BRP framework should be developed for butterfish.

Literature Cited for Butterfish Review

Bigelow, H. B. and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildlife Service Fisheries Bulletin 53.

Cross, J.N., C.A. Zetlin, P.L. Berrien, D.L. Johnson, and C. McBride. 1999. Essential fish habitat source document: butterfish, Peprilus triacanthus, life history and habitat characteristics. NOAA Technical Memorandum NMFS-NE-145.

Duffy, D.C. 1988. Predator-Prey Interactions between Common Terns and Butterfish *Ornis Scandinavica* 19:160-163.

Murawski, S.A., and G.T. Waring. 1979. A population assessment of butterfish, *Peprilus triacanthus,* in the northwestern Atlantic Ocean. Transactions of the American Fisheries Society 108:427-439.

## 4. Description of SAW Supporting Materials

Prior to the meeting, the reports and supporting materials listed below were provided to the review panel. Drafts of assessment summary reports were edited during the meeting (Atlantic surfclam) and via WebEx teleconference (butterfish); as such, they should be viewed as products of the meeting.

| Working paper | Title | Author(s)/Publisher |
|---|---|---|

| | | |
|---|---|---|
| A1 | 49th SAW Assessment Report: stock assessment for Atlantic surfclams in the EEZ | Invertebrate Subcommittee |
| A1a | 49th SAW Assessment Report: surfclam appendices | Invertebrate Subcommittee |
| A1b | 49th SAW Assessment Report: surfclam tables | Invertebrate Subcommittee |
| A1c | 49th SAW Assessment Report: surfclam figures | Invertebrate Subcommittee |
| A2 | 49th SAW Assessment Report: Atlantic surfclam assessment summary for 2009 | |
| A3 | 44th SAW Assessment Report: Atlantic surfclam assessment summary for 2006 | Invertebrate Subcommittee |
| A4 | 44th SAW Assessment Report: stock assessment for Atlantic surfclams | Invertebrate Subcommittee |
| A5 | Bathymetric shift in the distribution of Atlantic surfclams: response to warmer ocean temperature | Weinberg (2005); ICES Journal of Marine Science |
| A6 | *Essential Fish Habitat Source Document:* Atlantic Surfclam, *Spisula solidissima*, Life History and Habitat Characteristics | Cargnelli et al. (1999); NOAA technical Memorandum |
| A7 | Hydraulic clam dredge effects on benthic habitat off the northeastern United States | Wallace and Hoff (2005); American Fisheries Society Symposium |
| B1 | 49th SAW Assessment Report: stock assessment for butterfish | Coastal/Pelagic Working Group |
| B2 | 49th SAW Assessment Report: stock assessment summary for butterfish | |
| B3 | Report of the 17th Northeast Regional Stock Assessment Workshop | Anthony |
| B4 | 38th SAW Assessment Report: stock assessment summary for butterfish | |
| B5 | 38th SAW Assessment Report: stock assessment for butterfish | |
| B6 | Working paper for vessel calibration analysis review | Miller et al. (2009); NEFSC document |

# 5. Statement of Work

*(T016-07, v 11 September 2009)*

**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.

Foreign National Security Clearance: 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).

Pre-review Background Documents: 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.

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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).
    d. 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.
    e. Comment on which projections seem most realistic, taking into consideration uncertainties in the assessment.
    f. 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).
    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.

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)

## 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

**AGENDA* (version: 11-23-09)**

| TOPIC | PRESENTER(S) | SARC LEADER | RAPPORTEUR |
|---|---|---|---|

**Monday, 30 Nov**
**1:00 – 1:30 PM**

| | |
|---|---|
| Opening | |
| Welcome | **James Weinberg**, SAW Chairman |
| Introduction | **Robert Latour**, SARC Chairman |

Agenda
Conduct of Meeting

**1:30 – 3:30** Assessment Presentation Surfclam
**Larry Jacobson** **Toni Chute, Dan Hennen**

**3:30 – 3:45** Break

**3:45 – 5:30** SARC Discussion of Surfclam
**Robert Latour,** SARC Chairman **Toni Chute, Dan Hennen**

**Tuesday, 1 Dec**

**9:00 – 10:30 AM** Assessment Presentation Butterfish
**Tim Miller** **Julie Nieland**

**10:30 – 10:45** Break

**10:45 – Noon** SARC Discussion of Butterfish
**Robert Latour,** SARC Chairman **Julie Nieland**

**Noon – 1:15** Lunch

**1:15 – 2:15** Continue SARC Discussion of Butterfish
**Robert Latour**, SARC Chairman

**2:15 – 3:30** Revisit Surfclam Assessment with Presenters
**Robert Latour**, SARC Chairman **Toni Chute, Dan Hennen**

**3:30 – 3:45** Break

**3:45 – 5:30** Revisit Surfclam and/or Butterfish Assessments with Presenters
**Robert Latour**, SARC Chairman

**Wednesday, 2 Dec**

**9:00 – 10:00** Revisit Butterfish Assessment with Presenters
**Robert Latour**, SARC Chairman **Julie Nieland**

**10:00 – 10:15** Break

**10:15 - Noon** Surfclam follow up + review Assessment Summary Report
**Robert Latour**, SARC Chairman

**Noon – 1:15 PM** Lunch

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

**Robert Latour**, SARC Chairman

**3:00 – 3:15** Break

**3:15 – 5:30** 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.