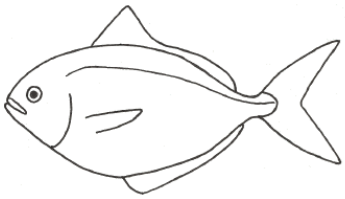
Independent Peer Review Report of the Butterfish and Northern Shortfin Squid (*Illex*) Research Track Peer Review

Robin Cook

Prepared for
Center for Independent Experts
Independent System for Peer Review



Contents

Executive summary

i. A peer review of butterfish and Illex research track assessments was held over WebEx from the 7-11 March 2022. The review panel comprised three experts from the CIE and was chaired by a member of the MAFMC SSC.

Butterfish

ii. The butterfish assessment made use of research vessel survey indices of abundance and catch at age derived from both landings and discards. The data were considered appropriate for the assessment model.

iii. The final stock assessment used the Woods Hole Assessment Model (WHAM) which is a fully age structured state-space model that includes random effects. The assessment was considered the best available though it was noted that there is uncertainty on the scale of the estimated biomass and that survey catchability had to be fixed for the fall survey in order to achieve satisfactory model fit.

iv. A more comprehensive set of sensitivity runs around the final model is needed to understand the range of uncertainty, especially in the scale of the biomass.

v. Output from the model indicates that the stock is likely not over-fished or experiencing over-fishing.

vi. It was proposed that BRPs be based on B50%SPR since BMSY is 0.5*B0 in a surplus production model. However, the calculated BRPs violate the assumptions in the surplus production model and led to an extremely high value of FMSY=6.68. This is not a useful reference point as it implies the stock cannot be over-fished. It would be preferable to continue to use FMSY=2/3M =0.84 as a reference point or use results from recent meta-analyses that give a value of 1.08.

vii. Projections can be obtained from the final assessment simply by using the projection equations in the WHAM model. In its current configuration this would mean that recruitment follows an AR(1) process which is appropriate in the absence of a clear stock-recruitment function.

Illex

viii. Data available for the *Illex* assessment included recorded landings, estimates of discards, federal research vessel surveys, state surveys, commercial landings per unit effort (LPUE) and biological data (i.e., dorsal mantle length, body weight, age and maturity).

ix. Two studies fitted GLMs and GAMs to derive standardized LPUE abundance indices from the commercial fishery data. The standardized indices showed similar trends to the fall NEFSC survey index suggesting a true population signal was detected. Weekly price was shown to be a significant explanatory variate in some models.

x. It was not possible to identify a satisfactory model to estimate fishing mortality and biomass. A range of indirect methods were able to provide plausible ranges for these quantities that suggested the stock was lightly fished.

xi. A general depletion model (GDM) was investigated with a view to applying it for real time management. It proved difficult to estimate model parameters with any precision. In addition, the procedure for model selection requires expert judgement, especially in relation to identifying ingress and egress events. This may compromise consistency in application of the model.

xii. It was not possible to update BRPs using the Hendrickson andHart (2006) per-recruit model due to insufficient numbers of mature females. This, combined with the absence of an assessment model meant that a stock status determination could not be

made. The Panel agreed with the Working Group that the stock was likely to be lightly fished based on the analysis using indirect methods. However, as this term has no formal meaning in terms of MSY it needs to be interpreted with caution.

xiii. It is clear that a substantial amount of research has gone into understanding *Illex* population biology including environmental effects. It is recommended that the results of this work be used to develop an operating model of the stock and fishery in order to test candidate harvest control rules. This might alleviate the problem of needing a full stock assessment model for management advice.

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage the nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products require scientific peer reviews that are strictly independent of all outside influences. External reviews are essential to strengthening scientific quality assurance for fishery conservation and management actions.

This meeting was a Research Track Peer Review by four experts to appraise stock assessments and models. The results of the review will be incorporated into future management track assessments, which serve as the basis for developing fishery management recommendations.

The subjects of this review were butterfish (*Peprilus triacanthus*) and Northern shortfin squid (*Illex illecebrosus*) stocks. A virtual meeting by WebEx was held from the 7-11 March 2022 to evaluate assessments carried out by working groups lead by the NEFSC at Woods Hole, MA.

Description of the individual reviewers' roles in the review activities

Approximately one week prior to the meeting reports and supporting documents for the two assessments were available from the NMFS website. These are listed in Appendix 1. A few days before the full review meeting a preliminary virtual meeting was held with the Panel chair and NEFSC staff to discuss meeting arrangements and any issues of concern. During the main review meeting the reviewer participated fully and contributed to discussions. The meeting attendance and Panel membership is listed in Appendix 3.

The reviewer assisted with preliminary text for the Summary Report on both assessments during the meeting. Following the meeting the reviewer assisted with the finalisation of the Summary Report. The statement of work is given in Appendix 2.

Summary of findings

Butterfish

1. Estimate catch from all sources including landings and discards. *Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data.*

This ToR was fully met. A time series of landings and discards was reported showing the development of catches from the 19th century. Early landed catch values are not regarded as reliable, and it is believed the period during which an international fishery was in operation was subject to substantial under-reporting. Hence only landings from 1989 onwards are regarded as appropriate for analysis. Although widely distributed in the region, a high

proportion of the landings come from a relatively small area close to Rhode Island (statistical areas 525 and 537).

Discards are estimated from an observer program and cover the period 1989 onwards. CVs for the landings and discards are provided and are highly variable reaching a value of 2 in some years.

Age and length data were available for most years, but in some years there are insufficient data to estimate age compositions for the catch (1994-5). These were filled in using samples from adjacent years. While this enables a full time series of age composition data to be estimated, it is probably unnecessary given that the data are input to a state space model that can accommodate missing values. Filling in data *a priori* has the disadvantage of implying higher precision in the data than is merited. It will not only cause the assessment model to under-estimate uncertainty for these years, but also tend to smooth out the recruitment signal.

2. Present the survey data available *(e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.), and describe the basis for inclusion or exclusion of those data in the assessment. Characterize the uncertainty in these sources of data.*

This ToR was fully met. Two federal surveys conducted in the spring and fall by NEFSC are discussed as well as a range of state surveys and the NEAMAP survey. Each of the NEFSC spring and fall surveys is split into two time series due to a change of vessel from the RV Albatross to the Bigelow, giving rise to, in effect, four potential surveys. The spring RV Albatross survey shows a long-term increase in abundance, while the fall RV Albatross survey shows a decline. The difference in trend appears likely to be related to environmental changes (increasing temperature) affecting butterfish availability in the spring survey. Consequently, this survey was not used in the final assessment.

While the NEFSC surveys cover most of the shelf area, state surveys are limited to inshore coastal waters. Furthermore, each survey is restricted to state waters and there are differences in survey design between states. The working group, therefore, used these surveys to construct a young of the year (YOY) index rather than attempting to use full age compositions in the assessment. The YOY index was calculated using the "Conn" method which tries to extract a common abundance trend from the various surveys. This is a well-established approach. There is an argument that because the surveys are spatially distinct, where each one covers a different fraction of the stock area, that a weighted average might be preferable. This would weight the survey by area and is an approach worth considering.

The NEAMAP survey occurs in shallow water and there is a spring and fall component.

Design based CVs for the surveys were provided for evaluation.

3. Estimate annual fishing mortality, recruitment and stock biomass *(both total and spawning stock) for the time series, and estimate their uncertainty. Include*

retrospective analyses (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit.

This ToR was fully met. Estimates of annual fishing mortality, recruitment and stock biomass were obtained from a state space assessment model, WHAM. This is a change from the previous assessment that used ASAP. The change of model is based in part on a change in technical support for the models and also that WHAM can include a range of random effects not supported in ASAP. Initial WHAM models were configured as close a possible to previous ASAP configurations and gave comparable results. Several WHAM models were investigated that differed mainly in assumptions about the error structure of the proportions at age and the way random effects were included. The final model was selected based on convergence criteria, goodness of fit (e.g., AIC), residual patterns and predictive skill (the MASE criterion). I would agree that this procedure is sound but note that:

- It is of concern that simply changing the error assumption for the proportions at age from logistic-normal to multinomial caused model convergence to fail, and
- Using AIC to choose between random walk selectivity or 2 fixed time blocks is probably unreliable without proper consideration of the effective number of parameters in the random walk model.

The working group noted that inclusion of the spring RV Albatross survey resulted in very poor model diagnostics. This is not surprising given the conflicting trend in this survey. However, since the other survey is assumed to have fixed catchability, it should be possible to include the spring RV Albatross survey by allowing time varying catchability, which could, for example, be modelled as a random walk.

An important weakness in the assessment is the problem of scale. Estimating survey catchability for the fall RV Albatross proved problematic and it had to be fixed (to a previous ASAP assessment value). This directly affects the biomass scale. Model output (and the surveys) indicate little contrast in the data, making the scale of the biomass highly uncertain.

Natural mortality was treated as a simple age and time invariant constant. Since the 0-group fish only enter the fishable biomass toward the latter part of the year, more thought should be given to the choice of value to use for these fish since an annual value of M is likely to be inappropriate and may adversely bias estimates of selectivity and BRPs. There is also an argument to run the assessment in half-year time steps (instead of annually) as butterfish are very short lived, and this would make the choice of M for 0 group fish more transparent.

The basis on which the final model was chosen is justifiable from the selection criteria used by the working group. While this may be a “best” model, it is nevertheless subject to greater uncertainty than is implied by the estimated confidence intervals for the quantities of interest (e.g., F, SSB etc.). It would have been useful to see a systematic sensitivity analysis of the final model to help understand this uncertainty. In particular, in view of the ambiguity in scale, an exploration of alternative assumptions on survey catchability, natural mortality and selectivity would have been particularly useful. Some of these alternatives were, no

doubt, run during the model selection process and summary of the key results (ending F and SSB) should be presented.

In the WHAM model the catch data were treated as an aggregate of the landings and discards. It would be desirable to treat the two catch components as separate data streams and fit the model to each with their own error assumptions. This could be done by modelling discards using a post capture selection ogive.

4. Update or redefine status determination criteria *(SDC point estimates or proxies for BMSY, $B_{THRESHOLD}$, FMSY and MSY) and provide estimates of their uncertainty. If analytic model based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.*

This ToR was partially met. The working group proposed BRPs based on the theory that BMSY can be approximated by 0.5*B0, a result that emerges from a standard Schaefer surplus production model. The WG then estimated these quantities from an age structured SPR calculation assuming constant recruitment and fixed schedules of growth, M and maturity. These assumptions are not consistent with the Schaefer model which assumes biological processes are density dependent. Hence the estimated values for both BMSY (B50%SPR) and FMSY are not consistent with the theoretical model on which BMSY was selected. Furthermore, the Schaefer model generally considers total biomass whereas the WG estimate is limited to mature biomass.

Of particular concern is the estimate of FMSY=6.68 that would mean the stock can never be depleted through fishing (since such a high F is barely achievable) and that the SSB would, in effect, be entirely dependent on the incoming year class when fished at FMSY. Stock collapse could therefore occur with a single recruitment failure. It is also worth noting that in a classical Schaefer model FMSY is half the intrinsic rate of increase (r). For such a high value of FMSY, this would imply r may be greater than 2 and lead to chaotic population dynamics (May and Oster, 1976). Such an extreme value for a fishing reference point does not appear very useful or biologically realistic.

The working group argued that the earlier FMSY=2/3M estimate based a review by Patterson (1992) was not reliable in view of the VPA assessments that were in the analysis. However, FMSY≈M is a well-established approximation based on life history theory. Recent meta-analyses by Zhou et al. (2012) suggested FMSY=0.87M=1.09, while the formula given by Sparholt et al. (2021) based on growth and maturity, gives a value of FMSY=1.08. These values are similar and closer to the Patterson estimate of 0.84. They appear more realistic and have a much more transparent biological basis.

It would be desirable to provide estimates of uncertainty for the BRPs and this should be possible to estimate from the WHAM model.

5. Make a recommended stock status determination *(overfishing and overfished) based on new modeling approaches developed for this peer review.*

This ToR was met. Whilst I disagree with the values of FMSY and BMSY estimated under ToR 4, it is unlikely that the lower values of FMSY would change the perception of stock status since current F appears to be very low. It seems likely, therefore, that the stock is not over-fished or experiencing over-fishing.

6. Define the methodology for performing short-term *projections of catch and biomass under alternative harvest scenarios, including the assumptions of fishery selectivity, weights at age, and maturity.*

This ToR was met. Short term projections were based on the final model which assumes recruitment follows a random walk. The assumption should therefore capture information on the level of recent recruitment and its variability for forward projection. While there is some indication that recruitment is lower at lower SSB (Figure 4.1 in the assessment report) there is no identifiable stock recruitment relationship and using a time series approach is appropriate. Other biological parameters such as weights and maturities are based on a recent 5-yr average. This is standard practice in the region and widely used in many jurisdictions.

7. Review, evaluate and report on the status of the Stock Assessment Review Committee (SARC) and Working Group research recommendations *listed in most recent SARC reviewed assessment and review panel reports, as well as the most recent management track assessment report. Identify new research recommendations.*

This ToR was met. The Panel supported the working group recommendations and added a number of new research recommendations. These are listed in the Panel report and are not repeated here. I fully endorse the Panel's recommendations.

8. Develop a "Plan B" *for use if the accepted assessment model fails in the future.*

This ToR was met. The working group recommended "Plan B smooth" as the method to apply if the assessment fails. The method would use four surveys (as used in the WHAM assessment but not the YOY survey). As an example, the WG estimated the catch multiplier to be approximately 1 and this would mean the projected catch would be almost equal to the last observed catch.

It seems unlikely that this approach would be necessary.

Additional Terms of Reference

1. Describe life history characteristics *and the stock's spatial distribution, including any changes over time. Describe ecosystem and other factors that may influence the stock's productivity and recruitment. Consider any strong influences and, if possible, integrate the results into the stock assessment.*

This ToR was met. Working papers were presented that addressed these issues. It was not possible to integrate the results into the stock assessment at this stage.

2. Evaluate consumptive removals of butterfish *by its predators, including (if possible) marine mammals, seabirds, tunas, swordfish and sharks. If possible, integrate results into the stock assessment.*

This ToR was met. Estimates of consumption by marine mammals, birds and other fish (excluding sharks, swordfish and tunas) were provided. These suggested that the consumption of butterfish by the taxa considered was relatively low and did not account for the high value of M used in the assessment. These results could not be integrated into the assessment, but there may be merit in re-evaluating the value of M in the light of these studies.

Illex

1. Estimate catches from all sources, including landings and discards*, and characterize their uncertainty.*

This term of reference was met. A summary of stock-wide landings from 1963 onward is provided with detail about fisheries in Canadian waters.. Reported landings for the international fishery are not regarded as reliable. Catch data for US waters are considered to be reliable from 1997 through 2019 (the terminal year of the assessment) when mandatory reporting was introduced. Estimates of discards from an observer program are available from 1989. Uncertainty in the discards is quantified as a design-based sampling error (CV) and, as expected, is quite large (>30%).

2. Evaluate indices used in the assessment*, including annual abundance and biomass indices based on research survey data and standardized industry CPUE data. Characterize the uncertainty of the abundance and biomass index estimates. Explore the relationship between fishing effort and economic factors (e.g., global market price) in order to determine whether the addition of an economic factor will improve the fit of the CPUE standardization model.*

This ToR was met. A variety of surveys were considered. NESFC surveys in the spring and fall provide indices of abundance covering US waters. Canadian survey data are also available covering the northern component of the stock. There are number of state surveys that individually cover only a small area and time period.

Commercial LPUE was investigated using GLMs with main effects such as week, stat area, vessel type etc. Models with negative binomial errors and a log-link performed best. Standardized indices from these models correlated well with the fall NEFSC indices which gives some confidence that a true signal is being detected.

LPUE was also investigated with GAMs and included effects such as price, port of landing, area fished, etc. Weekly price was found to be a significant factor. The standardized indices from these analyses also showed some correlation with the NEFSC survey indices.

3. Utilize the age, size and maturity dataset, collected from the 2019 landings, to identify the dominant intra-annual cohorts *in the fishery and to estimate growth rates and maturity ogives for each cohort. Also use these data to identify fishery recruitment pulses.*

This ToR was met. Data were collected in 2019 and 2020 but sample sizes of mature females were too small to estimate cohort-specific maturity ogives. The observations of dominant winter (Nov-April) and summer (May-July) cohorts recruiting to the fishery is consistent with previous estimates from 2004.

4. Characterize annual and weekly, in-season spatio-temporal trends in body size *based on length and weight samples collected from the landings by port samplers and provided by Illex processors. Consider the environmental factors that may influence trends in body size and recruitment. If possible, integrate these results into the stock assessment.*

This term of reference was met. Trends in body weight from port sampling and processors show a similar cyclical trend over the period 1997-2019. The body weight as seen in the NEFSC surveys, while showing some of the cyclical trend, indicates an overall decline.

Environmental factors were considered but could not be explicitly related to changes in body size.

5. Develop a model that can be used for estimation of fishing mortality and stock biomass*, for each dominant cohort that supports the fishery, and estimate the uncertainty of these estimates. Compare the results from model runs for years with low, medium and high biomass estimates.*

This ToR was met within the limitations of the data available and the challenges of the species biology. A range of models were attempted to try to estimate biomass and fishing mortality. Simple in season depletion methods struggled with the problem of ingress and egress of squid during the fishing season and did not perform consistently across years. Other methods included a mass balance model, an envelope model, an escapement model and a VMS spatial model. Such approaches require estimates of M and swept area which in turn depends upon assumptions about the sampling gear and area coverage. It was possible by making assumptions about the range of these values to quantify the plausible range of F and biomass. The results of these analyses suggest that the stock was lightly fished during 2019.

Results of a general depletion model (GDM) were presented which has the potential to be used for real time management. The model implemented allows the catch to be a non-linear function of both effort and abundance. While there may be some realism in such an assumption, the exponents (alpha and beta) in the model that express this non-linearity are usually very difficult to estimate and require a substantial amount of good quality data. The model diagnostics showed that estimating these parameters was problematic and it may be better to fix the values=1 for the sake of model stability and parsimony. The five-step model selection procedure was also subject to expert judgement, especially in identifying ingress

and egress events, and thus may lead to different results in the hands of an alternative expert. The results were inconclusive.

6. Describe the data that would be needed to conduct in-season stock assessments *for adaptive management and identify whether the data already exist or if new data would need to be collected and at what frequency.*

This ToR was met. A working paper reviewed the requirements for implementing a GDM model. It identified data needs, procedures and management systems required to support the model. Although some data were already available and further data was likely to be forthcoming, more data would still be required. The data requirements were considered with the GDM discussed in ToR 5 in mind. Alternative, simpler approaches may be possible for adaptive management based on an index of abundance, but extensive simulation testing would be required. This could be done by building an operating model of the stock and fishery and then use a MSE approach to test candidate harvest rules.

7. Update or redefine Biological Reference Points *(BRP point estimates for BMSY, $B_{THRESHOLD}$ and FMSY) or BRP proxies, for each dominant cohort that supports the fishery, and provide estimates of their uncertainty. If analytical model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing and recommended BRPs or their proxies.*

This ToR proved difficult to address. Too few mature females were available to use the Hendrickson and Hart (2006) model to compute new reference points. In the absence of a reliable analytical stock assessment, it was not possible to identify meaningful BRPs. The working group did not provide proxy alternatives.

Some thought needs to be given to the interpretation of FMSY for such a short-lived species that is sensitive to environmental forcing. In a conventional fishery model, FMSY is a biological trait that is directly related to the intrinsic rate of population increase (r). However, given the lifespan of this species, r, is likely to be year specific and related to environmental conditions.

8. Recommend a stock status determination *(i.e., overfishing and overfished), for each dominant cohort supporting the fishery, based on new modeling approaches developed for this peer review.*

This ToR was addressed adequately given the limitations of the analyses available.

In the absence of BRPs and a definitive stock assessment, a formal stock status determination was not possible. I agree with the working group conclusion that the stock was “lightly fished” in 2019 based on the various assessment models discussed during the review. However, the term “lightly fished” needs to be interpreted with caution since it has no specific definition relating to sustainable exploitation. Compared to many other fisheries (many of which are finfish) the values of F are at the lower end of the spectrum, but this does not ensure sustainable exploitation.

9. Define the methodology for performing short-term projections *of catch and biomass under alternative harvest scenarios, including the assumptions of fishery selectivity, weights at age, and maturity.*

This ToR was met. Short term projections are problematic in the light of the biology of the species. The assessment models attempted for this stock do not provide a basis for such projections. The WG suggested using Plan B smooth as an alternative and provided examples of the catch multiplier for 2019 that would be estimated from a range of abundance indices. These multipliers (from different indices) were all close to one and imply that the best estimate of next year's catch is the last observed catch. In effect this means that the abundance indices provide little information on future catches and is not surprising given the short lifespan of *Illex*.

10. Review, evaluate and report on the status of the Stock Assessment Review Committee (SARC) and Working Group research recommendations *listed in the most recent SARC reviewed assessment and review panel reports. Identify new research recommendations.*

This ToR was met. The WG provided an update on the recommendations and prioritised these based on a poll of members. I agree with the WG recommendations, and the additional recommendations identified by the review panel in the summary report.

A key issue with the assessment of this species lies in its short life span and hence obtaining sufficient data over a short time period to apply and parameterize population models. During the meeting it was apparent that a substantial amount of research has been done on the biology of the species that could be used to develop an operating model for the stock and fishery that might be used to test harvesting strategies that might be less data demanding. A particular research recommendation, agreed by the review panel, that I strongly endorse is:

"An operating model for the stock and fishery should be developed to allow the testing of potential assessment models and of simple harvest control rules based on abundance indices that would promote sustainable exploitation. The Panel recommends developing the model around a set of hypotheses of *Illex* and fishery dynamics."

Developing a simulation tool of this type, where simple harvest rules can be tested, may avoid fruitless pursuit of analytical assessment methods for which insufficient data are available or a management cycle that is currently unsuited to detailed real time management.

A recommendation of this type was made in 2005 at SAW42. The WG, however, argued that "*This research recommendation cannot be accomplished until a reliable stock assessment model is available."* I cannot agree with this assertion as it assumes a full population-based assessment model must be available. This need not be the case as harvest control rules can be conditioned purely on abundance indices or even a constant catch or effort approach.

11. Develop a "Plan B" alternate assessment *approach to providing scientific advice to managers if the analytical assessment does not pass review.*

This ToR was addressed adequately given the limitations of the analyses available. The WG suggested the use of "Plan B smooth" (see ToR 9) as a means of making projections. This is only useful with the most up-to-date abundance indices. Thus, the use of the previous year's indices to set limits for the projection year (i.e., 2 years beyond the last abundance index) is unlikely to be useful for such a short-lived species. A more responsive approach to make best use of current data is required.

The WG notes that the SSC has used the Rago indirect method approach to provide annual ABC and OFL advice. This would appear to be the only alternate approach given the current status of the GDM model.

Conclusions

Both assessments were of a very high standard representing the state of the art.

The butterfish assessment uses a new state space age structured model (WHAM) that can integrate catch and survey data in a sound statistical framework. The final model has been chosen according to well established criteria. The main limitation of the assessment is a lack of a full sensitivity analysis to quantify uncertainty in the selected model.

The suggested BRPs for butterfish require further work as the proposed value for FMSY of 6.68 is unrealistic, being nearly an order of magnitude larger than the vast majority of values calculated for other stocks, including forage fish. Such a high value offers very little management value as it is largely unachievable and would never trigger a management intervention. In my opinion a value of FMSY based on meta-analyses would be preferable at present and the Patterson formula of FMSY=2/3M is probably as good as any.

The assessment of a short-lived species such as *Illex* presents great challenges. The analyses presented at the meeting were thorough and informative but unfortunately could not solve the problem of providing management advice based on conventional MSY frameworks. The indirect methods currently used by the MAFMC and NMFS are elegant if somewhat limited in what they can deliver, but do offer some help. In my opinion the GDM model is unlikely to be able to deliver, reliably, the level of detail needed for real time management, but others may disagree. I believe the most promising avenue to pursue is a management strategy evaluation based on an operating model where simple harvest control rules can be tested.

References

May, R.M. and G. F. Oster. (1976). Bifurcations and dynamic complexity in simple ecological models. American Naturalist. 110, 573-599.

Patterson K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Reviews in Fish Biology and Fisheries 2(4):321–338.

Sparholt, H., Bogstad, B., Christensen, V., Collie, J., van Gemert, R., Hilborn, R., Horbowy, J., Howell, D., Melnychuk, M. C., Pedersen, S. A., Sparrevohn, C. R., Stefansson, G., and Steingrund, P. (2021). Estimating Fmsy from an ensemble of data sources to account for density dependence in Northeast Atlantic fish stocks. ICES Journal of Marine Science, doi:10.1093/icesjms/fsaa175

Zhou, Shijie, Shaowu Yin, James T. Thorson, Anthony D.M. Smith, and Michael Fuller (2012). Linking fishing mortality reference points to life history traits: an empirical study. Canadian Journal of Fisheries and Aquatic Science. 69: 1292–1301.

Appendix 1. Bibliography of materials provided for review

These documents can be found at https://apps-nefsc.fisheries.noaa.gov/saw/sasi/sasi_report_options.php

Butterfish

Assessment Report	ButterfishReport.pdf
Figures	WHAM_plots_preferred_model.zip
Models	WHAM_models.zip
Background	background_2020 Management Track Assessment Report Final 6-26-2020.pdf
Background	background_Adams 2018 crd1805.pdf
Background	background_crd1001.pdf
Background	background_crd1003.pdf
Background	background_crd1403.pdf
Background	background_crd1404.pdf
Background	Butterfish_2021_Assessment_Report.pdf
Background	butterfish_wham_paper.pdf
Background	README_roadmap.pdf
Background	supplemental butterfish age determination 1.3.pdf
Background	supplemental Butterfish+I-P+2022-01-27.pdf
Background	TOR1_Butterfish Working Paper Jones et al. 2021.pdf
Background	TOR1_Butterfish_Spatial_Distribution_Catch.pdf
Background	TORA1_Adams 2017 ICES.pdf
Background	TORA1_Butterfish_Condition_Additional TOR 1_2021.pdf
Background	TORA1_Kentner_habitat.pdf
Background	TORA1_Suca et al 2018 PIO.pdf
Background	TORA1_Suca et al 2021 ICES forage.pdf
Background	TORA1_WP_Adams_butterfish_spatial_distribution_update.pdf
Background	TORA2_Butterfish_Consumptive removals from marine mammals_ML_LS.pdf
Background	TORA2_Seabird-Predation-Butterfish-NE-Summary-rv-CFA-20220201.pdf
Background	TORA2_Smith_butter_wp2.pdf

Presentations	Butter-IP 2022-03.pptx
Presentations	Butterfish ageing_robillard.pptx
Presentations	Butterfish_Condition_WG_Oct2021.pptx
Presentations	Butterfish_RT_Peer_Review_ATOR1.pptx
Presentations	Butterfish_RT_Peer_Review_Intro.pptx
Presentations	Butterfish_RT_Peer_Review_TOR1.pptx
Presentations	Butterfish_RT_Peer_Review_TOR2.pptx
Presentations	Butterfish_RT_Peer_Review_TOR3.pptx
Presentations	Butterfish_RT_Peer_Review_TOR4_TOR5_TOR6.pptx
Presentations	Butterfish_RT_Peer_Review_TOR7.pptx
Presentations	Butterfish_RT_Peer_Review_TOR8.pptx
Presentations	MM_fish_consump_butterfish.pptx
Presentations	Seabird-Predation-Butterfish-RV-20220307.pptx

Illex

Assessment Report	2022_ILL_UNIT_Report_Text.pdf
Figures	Illex_2021_RTA_WG_Report_FIGURES_PART1_FINAL_V1.pdf
Figures	Illex_2021_RTA_WG_Report_FIGURES_PART2_FINAL_V1.pdf
Tables	Illex_2021_RTA_WG_Report_TABLES_FINAL_V1.pdf
Models	Illex_2021_RTA_WG_Report_TEXT_FINAL_V1.pdf
Background	Hendrickson_2004_Illex_life_history.pdf
Background	Hendrickson_Hart_2006_Age-based cohort model__Illex.pdf
Background	Illex_1996_SAW21_crd-9605.pdf
Background	Illex_1999-SAW29_crd9914.pdf
Background	Illex_2003-SAW37_crd0316.pdf
Background	Illex_2005-SAW42_crd0609.pdf
Background	Jones_Aging_Trace_Nov_Illex_WG_meeting.pdf
Background	Jones_FI_Fishery.pdf
Background	Jones_Summary FI Fisheries presentation_WP.pdf
Background	Lowman_IllexRTA_WorkingPaper_LPUEstandardization_2022-01-12.pdf

Background	Manderson_2022_AvailabilityAndNetEfficiencyForIllex_AppendixA_v1.pdf
Background	Manderson_2022_AvailabilityAndNetEfficiencyForIllex_Figures_v1.pdf
Background	Manderson_2022_AvailabilityAndNetEfficiencyForIllex_Tables_v1.pdf
Background	Manderson_2022_AvailabilityAndNetEfficiencyForIllex_text_v1.pdf
Background	Manderson_2022_EvaluationOfGeneralizedDepletionModelingIllex_Figures.pdf
Background	Manderson_2022_EvaluationOfGeneralizedDepletionModelingIllex_Tables.pdf
Background	Manderson_2022_EvaluationOfGeneralizedDepletionModelingIllex_Text.pdf
Background	Manderson_etal_b1_AvailabilityAndNetEfficiencyForIllex_2021text_cor.pdf
Background	Manderson_etal_b2_AvailabilityAndNetEfficiencyForIllex_2021Tables_Figures.pdf
Background	Manderson_etal_IllexAssessmentWorkingPaper_ProcessorsMarkets_03292021_TORS26_v2.pdf
Background	Manderson_IllexRTWG_8_GeneralizedDepletion_12152021.pdf
Background	Mercer_etal_WorkingPaper_Processors_Harvesters_01-28-22.pdf
Background	Mercer_Manderson_WP_ComparativeAnatomyIllex_SWA_NWA_02_01_22.pdf
Background	Rago_Analyses of Illex Weight frequencies for evidence of cohorts.pdf
Background	Rago_Biological Reference Points for Illex Squid_extensions.pdf
Background	Rago_Coherence and Persistence of Catch and Survey Indices in NAFO region.pdf
Background	Rago_Goodness of fit analyses for VMS data by 3x3 nm sqr grids 2017-2019.pdf
Background	Rago_Implications+of+an+Alternative+Quota+in+2022+for+Illex+Squid_final.pdf
Background	Rago_Lexis Diagram_application to Illex.pdf
Background	Rago_Mass Balance Approaches for Illex Assessment Dec 17 2021_updated.pdf
Background	Rago_Part 1_Application of Cusum Method -landings-for In-season detection of fishery condition.pdf
Background	Rago_Part 2_Application of Cusum Method -Mean Wt-for In-season detection of fishery condition.pdf

Background	Salois_etal_22_working_paper_Illex_WG.pdf
Background	Standardized LPUE and body weight indices_Hendrickson_3-24-2020 (1).pdf
Presentations	Illex illecebrosus RTA Review Jones.pdf
Presentations	Illex illecebrosus RTA Review_March 10 2022_Lisa Hendrickson.pdf
Presentations	Illex illecebrosus RTA Review_March 9 2022_Lisa Hendrickson.pdf
Presentations	Illex-LPUE-standardization-report-to-CIE-2022-03-09.pdf
Presentations	Illex_RTA_WG_TOR6_Mercer.pdf
Presentations	TOR 5 Res Track Assess 3-9-22.pdf
Presentations	TOR5_IllexRTA_Manderson_GDM_03092022.pdf
Presentations	TOR_4_oceanographic_indicators_salois_report_to_CIE_2022_03_09.pdf

Appendix 2: Performance Work Statement (PWS)

National Oceanic and Atmospheric Administration (NOAA)
National Marine Fisheries Service (NMFS)
Center for Independent Experts (CIE) Program
External Independent Peer Review

Butterfish and Northern Shortfin Squid (Illex)
Research Track Peer Review

Background

The National Marine Fisheries Service (NMFS) is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NMFS science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination, and that peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards[1]. Further information on the Center for Independent Experts (CIE) program may be obtained from www.ciereviews.org.

Scope

The Research Track Peer Review meeting is a formal, multiple-day meeting of stock assessment experts who serve as a panel to peer-review tabled stock assessments and models. The research track peer review is the cornerstone of the Northeast Region Coordinating Council stock assessment process, which includes assessment development, and report preparation (which is done by Working Groups or Atlantic States Marine Fisheries Commission (ASMFC) technical committees), assessment peer review (by the peer review panel), public presentations, and document publication. The results of this peer review will be incorporated into future management track assessments, which serve as the basis for developing fishery management recommendations.

The purpose of this meeting will be to provide an external peer review of butterfish and northern shortfin squid (*Illex*) stocks. The requirements for the peer review follow. This

[1] https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2005/m05-03.pdf

Performance Work Statement (PWS) also includes: **Appendix 1**: TORs for the research track, which are the responsibility of the analysts; **Appendix 2:** a draft meeting agenda; **Appendix 3:** Individual Independent Review Report Requirements; and **Appendix 4:** Peer Reviewer Summary Report Requirements.

Requirements
NMFS requires three reviewers under this contract (i.e. subject to CIE standards for reviewers) to participate in the panel review. The chair, who is in addition to the three reviewers, will be provided by either the New England or Mid-Atlantic Fishery Management Council's Science and Statistical Committee; although the chair will be participating in this review, the chair's participation (i.e. labor and travel) is not covered by this contract.

Each reviewer will write an individual review report in accordance with the PWS, OMB Guidelines, and the TORs below. Modifications to the PWS and ToRs cannot be made during the peer review, and any PWS or ToRs modifications prior to the peer review shall be approved by the Contracting Officer's Representative (COR) and the CIE contractor. All TORs must be addressed in each reviewer's report. The reviewers shall have working knowledge and recent experience in the use and application of both index-based and age-based stock assessment models, including familiarity with retrospective patterns and how catch advice is provided from stock assessment models. In addition, knowledge and experience with simulation analyses is required

Tasks for Reviewers

- Review the background materials and reports prior to the review meeting
    - Two weeks before the peer review, the Assessment Process Lead will electronically disseminate all necessary background information and reports to the CIE reviewers for the peer review.
- Attend and participate in the panel review meeting
    - The meeting will consist of presentations by NOAA and other scientists, stock assessment authors and others to facilitate the review, to provide any additional information required by the reviewers, and to answer any questions from reviewers
- Reviewers shall conduct an independent peer review in accordance with the requirements specified in this PWS and TORs, in adherence with the required formatting and content guidelines; reviewers are not required to reach a consensus.
- Each reviewer shall assist the Peer Review Panel (co)Chair with contributions to the Peer Reviewer Summary Report
- Deliver individual Independent Reviewer Reports to the Government according to the specified milestone dates
- This report should explain whether each research track Term of Reference was or was not completed successfully during the peer review meeting, using the criteria specified below in the "Tasks for Peer Review Panel."
- If any existing Biological Reference Points (BRP) or their proxies are considered inappropriate, the Independent 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 and research topics may be raised. Comments on these questions should be included in a separate section at the end of the Independent Report produced by each reviewer.
- The Independent Report can also be used to provide greater detail than the Peer Reviewer Summary Report on specific stock assessment Terms of Reference or on additional questions raised during the meeting.

Tasks for Review panel

- During the peer review meeting, the panel is to determine whether each research track Term of Reference (TOR) was or was not completed successfully. 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. If alternative assessment models and model assumptions are presented, evaluate their strengths and weaknesses and then recommend which, if any, scientific approach should be adopted. Where possible, the Peer Review Panel chair shall identify or facilitate agreement among the reviewers for each research track TOR.
- If the panel rejects any of the current BRP or BRP proxies (for B_{MSY} and F_{MSY} and MSY), the panel should explain why those particular BRPs or 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 or BRP proxies are the best available at this time.
- Each reviewer shall complete the tasks in accordance with the PWS and Schedule of Milestones and Deliverables below.

Tasks for Peer Review Panel chair and reviewers combined:
Review the Reports of the Butterfish and *Illex* Research Track Working Groups.

The Peer Review Panel Chair, with the assistance from the reviewers, will write the Peer Reviewer Summary Report. Each reviewer and the (co)chair will discuss whether they hold similar views on each research track 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 peer review meeting. For terms where a similar view can be reached, the Peer Reviewer Summary Report will contain a summary of such opinions.

The chair's objective during this Peer Reviewer 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 their opinion on each research track Term of Reference, either as part of the group opinion, or as a separate minority opinion. The Peer Reviewer Summary Report will not be submitted, reviewed, or approved by the Contractor.

Place of Performance
The place of performance shall be held remotely, via WebEx video conferencing.

Period of Performance
The period of performance shall be from the time of award through May 2022. Each reviewer's duties shall not exceed **14** days to complete all required tasks.

Schedule of Milestones and Deliverables: The contractor shall complete the tasks and deliverables in accordance with the following schedule.

Schedule	**Milestones and Deliverables**
Within 2 weeks of award	Contractor selects and confirms reviewers
Approximately 2 weeks later	Contractor provides the pre-review documents to the reviewers
March 7-11, 2022	Panel review meeting
Approximately 2 weeks later	Contractor receives draft reports
Within 2 weeks of receiving draft reports	Contractor submits final reports to the Government

* The Peer Reviewer Summary Report will not be submitted to, reviewed, or approved by the Contractor.

Applicable Performance Standards
The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content (2) The reports shall address each TOR as specified (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel
No travel is necessary, as this meeting is being held remotely.

Restricted or Limited Use of Data
The contractors may be required to sign and adhere to a non-disclosure agreement.

NMFS Project Contact
Michele Traver, NEFSC Assessment Process Lead
Northeast Fisheries Science Center
166 Water Street, Woods Hole, MA 02543
Michele.Traver@noaa.gov

Appendix 1. Research Track Terms of Reference

Butterfish

1. Estimate catch from all sources including landings and discards. Describe the spatial and temporal distribution of landings, discards, and fishing effort. Characterize the uncertainty in these sources of data.

2. Present the survey data available (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.), and describe the basis for inclusion or exclusion of those data in the assessment. Characterize 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 estimate their uncertainty. Include retrospective analyses (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit.

4. Update or redefine status determination criteria (SDC point estimates or proxies for BMSY, $B_{THRESHOLD}$, FMSY and MSY) and provide estimates of their uncertainty. If analytic model based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing BRPs and the "new" (i.e., updated, redefined, or alternative) BRPs.

5. Make a recommended stock status determination (overfishing and overfished) based on new modeling approaches developed for this peer review.

6. Define the methodology for performing short-term projections of catch and biomass under alternative harvest scenarios, including the assumptions of fishery selectivity, weights at age, and maturity.

7. Review, evaluate and report on the status of the Stock Assessment Review Committee (SARC) and Working Group research recommendations listed in most recent SARC reviewed assessment and review panel reports, as well as the most recent management track assessment report. Identify new research recommendations.

8. Develop a "Plan B" for use if the accepted assessment model fails in the future.

Additional Terms of Reference

1. Describe life history characteristics and the stock's spatial distribution, including any changes over time. Describe ecosystem and other factors that may influence the stock's productivity and recruitment. Consider any strong influences and, if possible, integrate the results into the stock assessment.

2. Evaluate consumptive removals of butterfish by its predators, including (if possible) marine mammals, seabirds, tunas, swordfish and sharks. If possible, integrate results into the stock assessment.

Illex

1. Estimate catches from all sources, including landings and discards, and characterize their uncertainty.

2. Evaluate indices used in the assessment, including annual abundance and biomass indices based on research survey data and standardized industry CPUE data. Characterize the uncertainty of the abundance and biomass index estimates. Explore the relationship between fishing effort and economic factors (e.g., global market price) in order to determine whether the addition of an economic factor will improve the fit of the CPUE standardization model.

3. Utilize the age, size and maturity dataset, collected from the 2019 landings, to identify the dominant intra-annual cohorts in the fishery and to estimate growth rates and maturity ogives for each cohort. Also use these data to identify fishery recruitment pulses.

4. Characterize annual and weekly, in-season spatio-temporal trends in body size based on length and weight samples collected from the landings by port samplers and provided by Illex processors. Consider the environmental factors that may influence trends in body size and recruitment. If possible, integrate these results into the stock assessment.

5. Develop a model that can be used for estimation of fishing mortality and stock biomass, for each dominant cohort that supports the fishery, and estimate the uncertainty of these estimates. Compare the results from model runs for years with low, medium and high biomass estimates.

6. Describe the data that would be needed to conduct in-season stock assessments for adaptive management and identify whether the data already exist or if new data would need to be collected and at what frequency.

7. Update or redefine Biological Reference Points (BRP point estimates for BMSY, $B_{THRESHOLD}$ and FMSY) or BRP proxies, for each dominant cohort that supports the fishery, and provide estimates of their uncertainty. If analytical model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs. Comment on the scientific adequacy of existing and recommended BRPs or their proxies.

8. Recommend a stock status determination (i.e., overfishing and overfished), for each dominant cohort supporting the fishery, based on new modeling approaches developed for this peer review.

9. Define the methodology for performing short-term projections of catch and biomass under alternative harvest scenarios, including the assumptions of fishery selectivity, weights at age, and maturity.

10. Review, evaluate and report on the status of the Stock Assessment Review Committee (SARC) and Working Group research recommendations listed in the most recent SARCreviewed assessment and review panel reports. Identify new research recommendations.

11. Develop a “Plan B” alternate assessment approach to providing scientific advice to managers if the analytical assessment does not pass review.

Research Track TORs:

General Clarification of Terms that may be used in the Research Track Terms of Reference

Guidance to Peer Review Panels about "Number of Models to include in the Peer Reviewer Report":

In general, for any TOR in which one or more models are explored by the Working Group, give a detailed presentation of the "best" model, including inputs, outputs, diagnostics of model adequacy, and sensitivity analyses that evaluate robustness of model results to the assumptions. In less detail, describe other models that were evaluated by the Working Group and explain their strengths, weaknesses and results in relation to the "best" model. If selection of a "best" model is not possible, present alternative models in detail, and summarize the relative utility each model, including a comparison of results. It should be highlighted whether any models represent a minority opinion.

On "Acceptable Biological Catch" (DOC Nat. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16-2009):

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" (DOC Natl. Stand. Guidelines. Fed. Reg., v. 74, no. 11, 1-16-2009):

"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 Maximum Sustainable Yield (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)

Participation among members of a Research Track Working Group:

Anyone participating in peer review meetings that will be running or presenting results from an assessment model is expected to supply the source code, a compiled executable, an input file with the proposed configuration, and a detailed model description in advance of the model meeting. Source code for NOAA Toolbox programs is available on request. These measures allow transparency and a fair evaluation of differences that emerge between models.

Appendix 2. Draft Review Meeting Agenda

{Final Meeting agenda to be provided at time of award}

Butterfish and *Illex*
Research Track Assessment Peer Review Meeting

March 7 - 11, 2022

WebEx link: https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dm8a1062743b689f38d340622b4c9367ff&sa=D&source=calendar&ust=1635700378125529&usg=AOvVaw3Ehp4lawC73ceuFcaRdmaC
Phone: +1-415-527-5035 US Toll

DRAFT AGENDA* (v. 11/18/2021)

**All times are approximate, and may be changed at the discretion of the Peer Review Panel chair. The meeting is open to the public; however, during the Report Writing sessions we ask that the public refrain from engaging in discussion with the Peer Review Panel.*

Monday, March 7, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:30 a.m.	Welcome/Logistics Introductions/Agenda/ Conduct of Meeting Butterfish	Michele Traver, Assessment Process Lead Russ Brown, PopDy Branch Chief Mike Wilberg, Panel Chair	
9:30 a.m. - 10:30 a.m.	TORs #1 and A1	Charles Adams, Andrew Jones, Kiersten Curti	Catch Spatial Distribution
10:30 a.m. - 10:45 a.m.	Break		
10:45 a.m. - 11:45 a.m.	TORs #2 and A2	Charles Adams, Laurel Smith, Rob Vincent	Survey Data Consumptive Removals
11:45 a.m. - 12:15 p.m.	Discussion/Summary	Review Panel	
12:15 p.m. - 12:30 p.m.	Public Comment	Public	
12:30 p.m. - 1:30 p.m.	Lunch		
1:30 p.m. - 3:30 p.m.	TORs #3 and A1	Charles Adams, Laurel Smith	F, R, SSB Productivity

3:30 p.m. - 3:45 p.m.	Break		
3:45 p.m. - 4:45 p.m.	TOR #4	Charles Adams	BRPs
4:45 p.m. - 5:15 p.m.	Discussion/Summary	Review Panel	
5:15 p.m. - 5:30 p.m.	Public Comment	Public	
5:30 p.m.	Adjourn		

Tuesday, March 8, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:15 a.m.	Welcome/Logistics	Michele Traver, Assessment Process Lead Mike Wilberg, Panel Chair	
9:15 a.m. - 10:30 a.m.	TORs #4 cont. - 5	Charles Adams	BRPs Stock Determination
10:30 a.m. - 10:45 a.m.	Break		
10:45 a.m. - 11:45 a.m.	TORs #5 cont. - 6	Charles Adams	Stock Determination Projections
11:45 a.m. - 12:15 p.m.	Discussion/Summary	Review Panel	
12:15 p.m. - 12:30 p.m.	Public Comment	Public	
12:30 p.m. - 1:30 p.m.	Lunch		
1:30 p.m. - 3:30 p.m.	TORs #6 cont. - 8	Charles Adams	Projections Research Recommendations Alternative Approach
3:30 p.m. - 3:45 p.m.	Break		
3:45 p.m. - 4:45 p.m.	TOR #6 - 8 cont.	Charles Adams Jason Didden	Projections Research Recommendations Alternative Approach Outreach
4:45 p.m. - 5:15 p.m.	Discussion/Summary	Review Panel	
5:15 p.m. - 5:30 p.m.	Public Comment	Public	
5:30 p.m.	Adjourn		

Wednesday, March 9, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:15 a.m.	Welcome/Logistics *Illex*	Michele Traver, Assessment Process Lead Mike Wilberg, Panel Chair	
9:15 a.m. - 10:45 a.m.	TORs #1 and 2	Lisa Hendrickson	Landings and Discards Surveys and Fishery CPUE
10:45 a.m. - 11 a.m.	Break		
11 a.m. - 12 p.m.	TORs #2 cont. and 3	Brooke Lowman Lisa Hendrickson	Surveys and Fishery CPUE 2019 age, size and maturity data
12 p.m. - 12:30 p.m.	Discussion/Summary	Review Panel	
12:30 p.m. - 12:45 p.m.	Public Comment	Public	
12:45 p.m. - 1:45 p.m.	Lunch		
1:45 p.m. - 3:30 p.m.	TORs #3 cont. and 4	Lisa Hendrickson Kim Hyde and Sarah Salois	2019 age, size, maturity data Fishery body size
3:30 p.m. - 3:45 p.m.	Break		
3:45 p.m. - 4:45 p.m.	TOR #5	Paul Rago	Stock size Fishing mortality
4:45 p.m. - 5:15 p.m.	Discussion/Summary	Review Panel	
5:15 p.m. - 5:30 p.m.	Public Comment	Public	
5:30 p.m.	Adjourn		

Thursday, March 10, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:15 a.m.	Welcome/Logistics	Michele Traver, Assessment Process Lead Mike Wilberg, Panel Chair	
9:15 a.m. - 10:45 a.m.	TOR #5 cont. and 6	Lisa Hendrickson	Fishing mortality In-season data

10:45 a.m. - 11 a.m.	Break		
11 a.m. - 12 p.m.	TORs #7 and 8	Lisa Hendrickson	BRPs Stock status
11:45 a.m. - 12:15 p.m.	Discussion/Summary	Review Panel	
12:15 p.m. - 12:30 p.m.	Public Comment	Public	
12:30 p.m. - 1:30 p.m.	Lunch		
1:30 p.m. - 3 p.m	TORs # 9 - 11	Lisa Hendrickson	Projections Research Recommendations Alternative approach
3 p.m. - 3:15 p.m.	Break		
3:15 p.m. - 3:45 p.m.	Discussion/Summary	Review Panel	
3:45 p.m. - 4 p.m..	Public Comment	Public	
4 p.m. - 5p.m.	Follow-ups/Key Points	Review Panel	
5 p.m.	Adjourn		

Friday, March 11, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 5 p.m.	Report Writing	Review Panel	

Appendix 3. Individual Independent Peer Reviewer Report Requirements

1. The independent Peer Reviewer 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 report must contain a background section, description of the individual reviewers' roles in the review activities, summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs. The independent report shall be an independent peer review, and shall not simply repeat the contents of the Peer Reviewer Summary Report.

   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, but especially where there were divergent views.

   c. Reviewers should elaborate on any points raised in the Peer Reviewer Summary Report that they believe might require further clarification.

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

3. The report shall include the following appendices:

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

Appendix 4. Peer Reviewer Summary Report Requirements

1. The main body of the report shall consist of an introduction prepared by the Research Track Peer Review Panel chair that will include the background and a review of activities and comments on the appropriateness of the process in reaching the goals of the peer review meeting. Following the introduction, for each assessment /research topic reviewed, the report should address whether or not each Term of Reference of the Research Track Working Group was completed successfully. For each Term of Reference, the Peer Reviewer Summary Report should state why that Term of Reference was or was not completed successfully.

   To make this determination, the peer review panel chair and reviewers should consider whether or not the work provides a scientifically credible basis for developing fishery management advice. If the reviewers and peer review panel 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 Points (BRPs) or BRP proxies are considered inappropriate, include recommendations and justification for alternatives. If such alternatives cannot be identified, then indicate that the existing BRPs or BRP proxies are the best available at this time.

3. The report shall also include the bibliography of all materials provided during the peer review meeting, and relevant papers cited in the Peer Reviewer Summary Report, along with a copy of the CIE Performance Work Statement.

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

Appendix 3: *Illex*/Butterfish Research Track Peer Review Attendance

NEFSC - Northeast Fisheries Science Center
GARFO - Greater Atlantic Regional Fisheries Office
NEFMC - New England Fisheries Management Council
MAFMC - Mid-Atlantic Fisheries Management Council
SMAST - University of Massachusetts School of Marine Science and Technology
MIT - Massachusetts Institute of Technology
VIMS - Virginia Institute of Marine Science
SSC - Science and Statistical Committee

~~~~~~

Mike Wilberg - Chair
Robin Cook - CIE Panel
Robin Thomson - CIE Panel
Yong Chen - CIE Panel

Russ Brown - NEFSC
Michele Traver - NEFSC

Abigail Tyrell - NEFSC
Alan Bianchi -North Carolina Department of Environmental Quality
Alex Hansell - NEFSC
Andrew Jones - NEFSC
Anna Mercer - NEFSC
Ben Levy - NEFSC
Brandon Muffley - MAFMC Staff
Brian Linton - NEFSC
Brian Smith - NEFSC
Brooke Lowman - Virginia Marine Resources Commission
Carly Bari - GARFO
Charles Adams - NEFSC
Chris Legault - NEFSC
David Richardson - NEFSC
Eric Reid - Fisheries Consultant
Eric Robillard - NEFSC
Greg DiDomenico - Lunds Fisheries
Jason Boucher - NEFSC
Jason Didden - MAFMC Staff
Jeff Kaelin - Lunds Fisheries
Jessica Jones - NEFSC post doc
Jim Gartland - VIMS
Jon Deroba - NEFSC
John Manderson - Open Ocean Research
Katie Almeida - Town Dock
Kathy Sosebee - NEFSC
Kiersten Curti - NEFSC
Kim Hyde - NEFSC
Larry Alade - NEFSC
~~~~~~

Laurel Smith - NEFSC
Lisa Hendrickson - NEFSC
Mark Terceiro - NEFSC
Meghan Lapp - Sea Freeze Ltd.
Michelle Duval - MAFMC Member/private consultant for Mellivora Consulting
Mike Simpkins - NEFSC
Noelle Olsen - Maryland Sea Grant
Paul Rago - MAFMC SSC
Rob Latour - VIMS
Rob Vincent - MIT
Sam Schiano - Maryland Sea Grant
Sarah Salois - NEFSC
Steve Cadrin - SMAST
Tim Miller - NEFSC
Thomas Swiader - NEFSC
Toni Chute - NEFSC
Tony Wood - NEFSC
Victoria Kentner - NEFSC