Center for Independent Experts independent review of the Gulf of Maine Haddock research track

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Executive Summary

The Haddock Research Track Working Group (hereafter referred to as the research track) has addressed all terms of reference (TORs), has presented the findings in a concise, well written report, and has presented the findings at the review meeting. All TORs are met and the proposed updated assessment model (implemented in ASAP) and derived quantities like reference points and projections are suitable for management of the Gulf of Maine (GoM) haddock. The confidence in the model is based on: model diagnostics, which are not near perfect but acceptable; ASAP being a standard well tested approach, developed at the Woods Hole lab (so plenty of expertise); and that the changes proposed in the model and w.r.t. included data sources, compared to previously accepted assessment model for GoM haddock, are modest. Confidence in the model could have been further strengthened by: running additional sensitivity runs where more of the available fishery independent surveys were included; running one (or more) different explorative assessment models to verify main trends and conclusions. These explorative models should preferably be independent of the proposed model (different platform) and an obvious explorative candidate model could be the recently developed WHAM (Stock & Miller 2021), because it is locally developed, has similar data requirements to ASAP, is rumored to be proposed for Georges Bank haddock, and in addition has capabilities to address some of the still unresolved issues in the GoM haddock assessment.

The catch information gives a consistent picture of stock development and is consistent with the surveys, where it can be expected to be. The recreational part of the catch is increasing (and the recreational discard part within that), which is a slight concern, as it is more difficult to monitor, but jointly the catch observations and surveys included in the assessment appear to be sufficient to inform the assessment model. If the proposed analytic assessment should fail in the future a standard well studied index-based method is suggested (planBsmooth).

The habitat data were analyzed. The report did not reveal much information about making the habitat data useful in the assessment, but the presentation and subsequent discussion developed a couple of plausible paths for doing so in future work.

The recruitment process is interesting, because - like for many haddock stocks - the stock development is largely dictated by occasionally extremely large recruitment events. Fall bloom correlates with Georges Bank Haddock recruitment, but no updated study is available for GoM haddock. Further the research track considered drift of eggs, but that is likely not adding to GoM haddock recruitment. The large cohorts passing through the stock makes potential density dependent growth important to consider. The research track finds evidence indicating density dependent growth, but also a general slowing of growth in the timeseries.

Some previous research recommendations are considered and some are dismissed as more suitably handled by a collaborative effort across different stocks. Additional research recommendations to consider are suggested here (more details available under TOR 7):

- Run an explorative model of a different kind. It seems natural to suggest WHAM (local expertise, alternative to fixing certain parameters, alternative to fixed blocked selectivities, including environmental variables).
- A wider range of sensitivities could be explored (e.g., different assumptions w.r.t. recruitment deviances, observational uncertainties, and natural mortalities; runs including some of the excluded survey series).
- Consider ways to link this assessment with Georges Bank Haddock assessment.
- Prediction based study of the causality of the habitat index.
- Develop a mechanistic alternative to the habitat model.
- Replace Pearson residuals for compositions by randomized-quantile-one-step-ahead residuals.
- Expand the use of the prediction-based approach used to optimize the weight-at-age in the short-term forecast to explore options including density-dependence.

In addition, this reviewer supports the extra research recommendations suggested by the research track, in particular the efforts to include the bottom long-line surveys (BLS) in the assessment model.

Background

This report is the independent review report of the 2021 Haddock Research Track Working Group (for Gulf of Maine). The review meeting was held online (25, 26, and 27 January 2022). The meeting was well organized by the Northeast Fisheries Science Center's (NEFSC) stock assessment process lead, Michele Traver, and by the chief of NEFSC's Population Dynamics Branch, Russell Brown. A special thanks to lead assessment scientists Charles Perretti and Brian Linton, who presented the work and answered numerous questions and a very big thank you to the rapporteurs who helped the panel enormously. The reading material was provided a week in advance and was very focused on addressing the TORs. The analyses were clearly described and of high quality. The panel was chaired by Richard Merrick (New England Fisheries Management Council Scientific and Statistical Committee) and further consisted of CIE selected reviewers: Coby Needle (Marine Scotland), Kevin Stokes (Stokes.Net.NZ Ltd), and this reviewer, Anders Nielsen (Danish Technical University).

The research track has been ongoing since September 2020 and met 21 times, where the typical meeting has consisted of two half-day online meetings. The research track has worked on Eastern Georges Bank, Georges Bank and Gulf of Maine haddock stocks, but this meeting and review was focused only on Gulf of Maine haddock work. The research track peer review was requested by the Northeast Region Coordinating Council.

Description of the individual reviewers' role

This reviewer has independently read the research track report, and referenced documents deemed necessary in preparation for this review, participated in an online pre-meeting, participated actively in online research track review meetings (25, 26, and 27 January 2022) reviewed each individual term of reference, identified key issues, suggested guidance, contributed to the joint panel report, and independently authored this research track review report.

Findings for each TOR:

To ensure that all terms of reference are covered and that comments are interpreted with reference to the correct terms, the terms are listed (with gray highlighting) with corresponding reviewer comments following.

1) *Review existing research efforts, data, and habitat information in the Gulf of Maine and Georges Bank, identify any findings relevant to influences of ecosystem conditions on haddock, and consider those findings, as appropriate, in addressing other TORs. For processes that the working group deems important and promising that are not currently feasible to consider quantitatively, describe next steps for development, testing, and review of quantitative relationships and how they could best inform assessments.*

The research track has met this TOR via the work done in the Friedland et al. 2020 paper. Here a lot of environmental variables (30+) are used to calibrate a random forest algorithm via present/absent observations from survey hauls in the period from 1976 to 2019. In the recent period, the haddock habitat

has increased (doubled its area in spring). The work has identified the variables which best correlate the most with haddock habitat (March chlorophyll concentration, average spring distribution of *Acartia* spp., December distribution of SST fronts, and fall distribution of *Centropages typicus*).

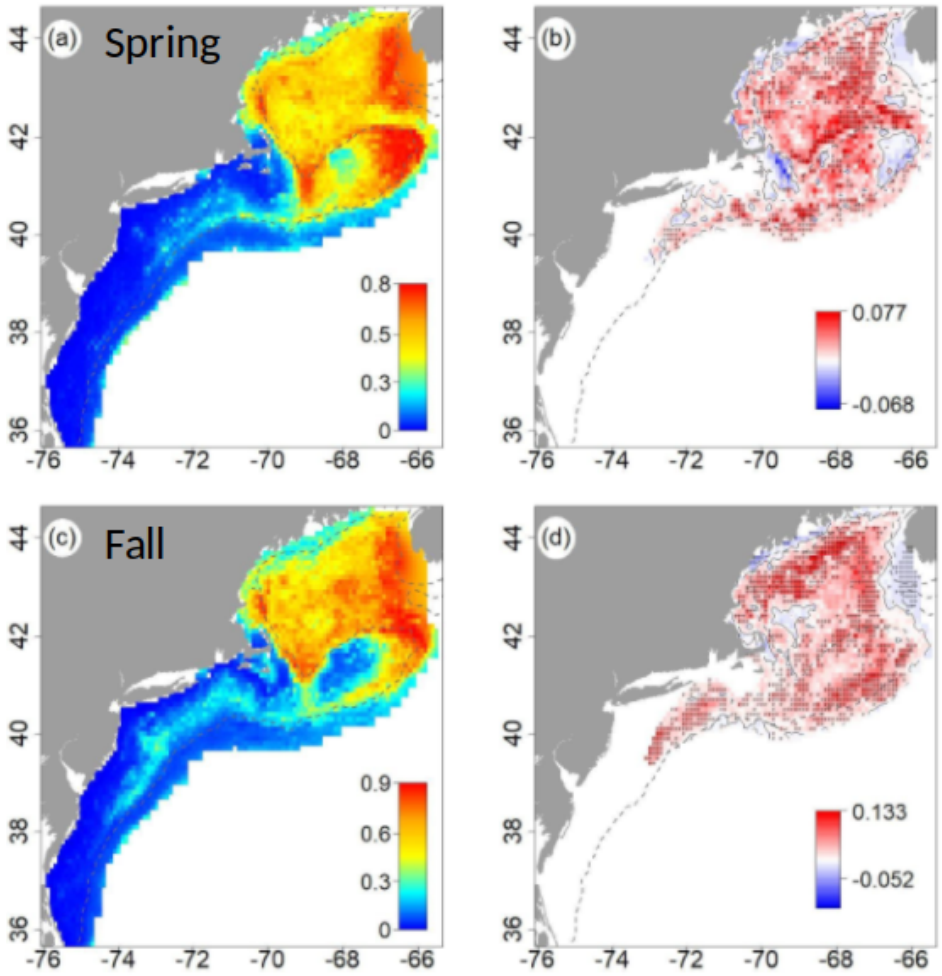

Figure 1(not in the report): Estimated occupancy probability (left) and corresponding gradient field (right).

The research track's written work did not detail how this work could be used to inform future assessment models, but we talked about two paths that could be explored in the future. The gradient of the habitat-field (already estimated, see figure 1) could be used to parameterize advection/taxis/diffusion fields in the same way as described in Thorson et al. 2021, which could then inform a spatial model. A simpler way would be to set up the assessment via the model WHAM (Woods Hole Assessment Model (Stock & Miller 2021)), which has the facility to include environmental variables to inform key parameters. Here it would be natural to start by including the variables identified as most correlated with the haddock occurrence.

The research track expressed some concern about the “black-box” nature of the machine learning techniques applied and suggested developing a more mechanistic model describing the relationship between the few selected influential environmental variables and the haddock occurrence. This would be

helpful for understanding the relationship and would not be too demanding, as it could likely mostly be done with standard software (e.g., glmmTMB (Brooks et al 2017)).

The research track expressed concern about the causality of the identified correlations. Are the changes in habitat scores driven by the abundance changes of haddock, or are higher habitat scores really predicting higher abundance of haddock? This is a relevant question especially because the period includes some unusually numerous cohorts (especially the 2013 cohort). To further study the causality it could be an idea to calibrate the random forest, e.g., with data only up to 2008, and then study the algorithm's ability to predict the recently observed expansion of the habitat. That should reveal if the identified variables are reliable to predict habitat in the future.

2) 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.

The research track has met this TOR and the report describes the work well.

Catch data are combined from four sources: commercial landings, commercial discards, recreational landings, and recreational discards. About half of the total catch is from commercial (landings and discards) and half is from recreational (landings and discards) in the last decade. Before 2000, almost 100% of the total catches were from commercial catches. Commercial discard has overall been a minor part, but recreational discards have increased over the last decade to be larger than recreational landings in a few recent years (figure A12 in the research track report).

The spatial distribution (and temporal changes of it) was described via maps, time series of center of gravity, and (new to this reviewer) time series of the Gini-index as a measure of how concentrated in space the catch is. The temporal aspect was further investigated via time series of different catch components and of allocation within year (by months) of the catch. In the report and in some figures, the landings were summarized by statistical areas, but the report did not show a map of the statistical areas. Such a figure was found online and included here as Figure 2 and similar should be added to the research track report.

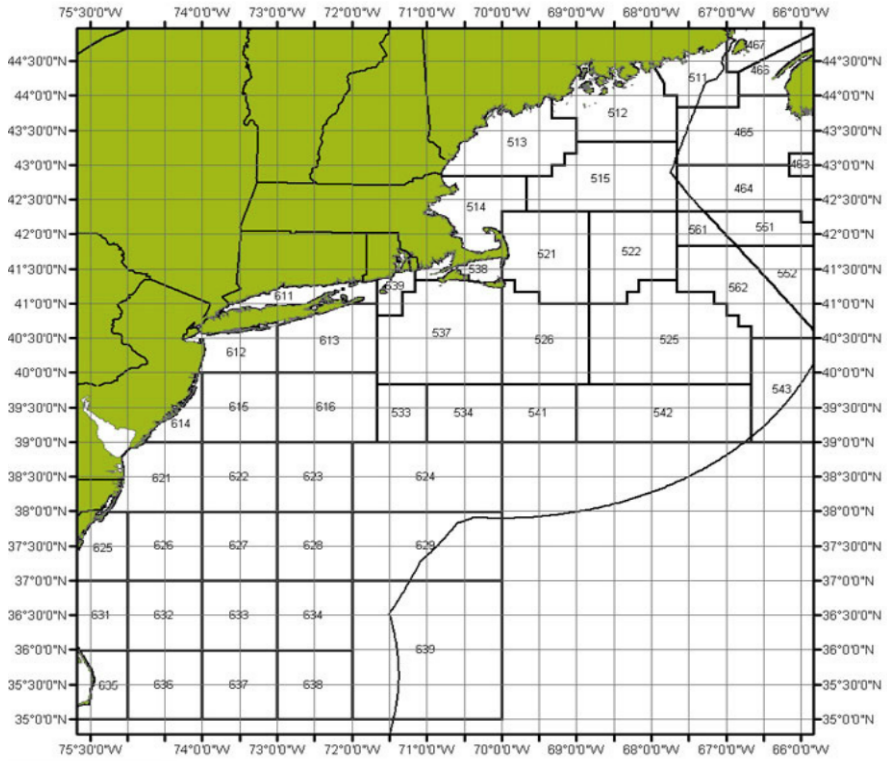

Figure 2 (not in the report): A map of the statistical rectangle.

The biological sampling of lengths and ages has been at a high level for most of the timeseries. For lengths, the unofficial NAFO/ICNAF standard of (200 mt/100 lengths) has been fulfilled since 1983 and in recent years much lower (notice that lower is better) and age sampling from otoliths have followed a similar trend. It was mentioned that misreporting could be an issue, but it is not considered to be problematic. It was mentioned at the review meeting that over-reporting could be a more likely problem (e.g., mis-labeling cod catch as haddock catch).

Commercial discard estimates are based on direct sampling of the commercial fisheries from 1989. Commercial discard rates are overall small and not considered influential on the assessment. The commercial discard observations are hindcasted by a length-based filter method prior to 1989, but the amount of commercial discard in this period is very small compared to the commercial catch, so it is not expected to have any effect on the assessment.

Fishery-dependent abundance indices were considered by the research track, but not carried forward to the assessment due to issues with standardization.

Data on recreational catch has been collected (surveyed) since 1979 with estimates for haddock since 1981. There have been various changes and adjustments in methodology, but since 2004, the CV of the recreational harvest has been estimated to be below 20%, which is also the period where recreational catch has grown to a size where it is important for the assessment.

When considering all the components of the catch from figures and tables a very consistent picture is seen w.r.t. the sizes of different cohorts in the history of this stock. This is helped by the large identifiable

recruitment events (that seems to be characteristic for haddock stocks), but even so, this confirms and strengthens confidence in the individual data parts.

3) Present the survey data being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Characterize the uncertainty in these sources of data.

This TOR has been met. The survey data is well presented along with the reasoning for including or excluding each data source. Further the sources of uncertainty are characterized.

This reviewer was happily surprised to see so many independent surveys available (potentially 9), but discovered that only 2 were selected to be used in the suggested assessment model. The research track report clearly documents the problematic issues with each of the rejected surveys. It is however not uncommon that surveys, or parts of surveys, are included even though they have some problematic aspects. A problematic survey may still contain some valuable information that could be extracted if it was included (e.g., for a subset of the ages). Often it is a trade-off in practical assessment work.

The surveys potentially available for this assessment are four surveys both in spring and fall. NEFSC (bottom trawl), MADMF (bottom trawl), MENH (trawl), and NEFSC (bottom longline). In addition, ASMFC (bottom trawl) is conducted annually in the summer.

Northeast Fisheries Science Center (NEFSC) surveys are bottom trawl surveys and have been conducted since 1936 (fall) and 1968 (spring). The time series are long, it is believed that they cover the main stock area, and observations have good consistency both within each and between fall and spring surveys. There was a calibration issue around 2009, due to vessel and configuration change, but this has been carefully studied and a conversion factor has been estimated. These surveys are used in the proposed assessment model. The effect of the calibration factor could have been studied further by running an explorative/sensitivity assessment model, where these surveys were split in a before and after the vessel change.

The Massachusetts Department of Marine Fisheries (MADMF) surveys are bottom trawl surveys and have been conducted spring and fall since 1978. They have less spatial coverage and are mainly conducted in shallow areas. Age information is not collected from the MADMF surveys, but the length distribution indicates that the survey is mainly catching ages 0 and 1 (and up to age 4 in recent years). The MADMF surveys are not used in the proposed assessment, because of small spatial coverage and lack of ageing. It makes sense to be careful about including these surveys in the main assessment, but a sensitivity run could have illustrated if it could have been used to provide more information on the youngest age classes in the inshore areas less sampled by the NEFSC survey.

Maine-New Hampshire (MENH) inshore groundfish trawl surveys have been conducted spring and fall since 2000. They are shorter, but otherwise similar to MADMF (no age, primarily juvenile, and little spatial coverage). The MENH surveys were also not used in the proposed assessment model.

The Bottom Longline Surveys (BLS) are fairly new surveys, as they have been conducted fall and spring since 2014. They cover the area of the stock well and interestingly they cover both rough and smooth bottom types (where the trawl surveys only cover smooth bottom types). It seems important to cover the rough bottom type also, because haddock may be more abundant on either rough or smooth bottom types. The BLS surveys did have higher catches at rough bottom types, but it is possibly to be attributed to the bottom longline gear being more effective at rough bottom types. The BLS tracked the large 2013 cohort well, but the research track was concerned that since the BLS had only been studied in a high stock period it was unknown if they would also track cohorts well under different stock conditions. The BLS surveys were not included in the final proposed assessment model, but they were included in a sensitivity run, which showed that the results were not overly sensitive to excluding BLS.

The ASMFC Northern Shrimp Bottom Trawl Survey has been conducted since 1983 and covers a large part of the stock area. Using this survey in the assessment model is complicated by the sampling procedure. The haddock part of the catch is not aged and further the individual haddock are not weighed, so the only observations available to estimate the length-weight relationship is the tows with exactly one haddock, which gives low sample size and possibly a bias, because isolated haddock may not be representative of all haddock. To further calculate numbers-at-age an age-length key was borrowed from the BLS. This expected large uncertainty in the composition of the catch caused this survey not to be included in the proposed assessment. Even if a large uncertainty is reasonably expected for this survey it could still have been included in a sensitivity run.

This reviewer mostly agrees with the research track on the conclusions about the individual surveys, but the consequences of leaving out each of these potential sources of information could have been demonstrated by a few additional sensitivity runs.

4) Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Compare the time series of these estimates with those from the previously accepted assessment model, and evaluate the strength and direction of any retrospective pattern(s) in both the current and the previously accepted model. Enumerate possible sources of the retrospective patterns and characterize plausibility, if possible.

This TOR has been met by the research track.

The model proposed by the research track is configured in the ASAP assessment model software (Legault & Restrepo 1999). The ASAP model is a well-tested standard model, which is used for several stocks in the region. It was developed at the Woods Hole lab, so there is plenty of in-house expertise in the model's use and in all internal details of the model. Furthermore, the model software is part of NOAA's toolbox (https://nmfs-general-modeling-tools.github.io/). The modest changes in the model from the previously accepted assessment to the proposed model are all sensible and the steps are well documented. All of this strengthens the confidence in the software and that it has been configured correctly.

The model configured is a one stock, one fleet, age-based model starting from 1977 (the year where catch observations are available from). The plus group is defined to be 9+ based on the age where catches at

age are becoming uncertain. The selectivity is age based and assumed constant within each of three time blocks (1977-1988, 1989-2004, 2005-2019). For the catch fleet and for each of the two used survey fleets (NEFSC spring and fall) the total catch/index is assumed to follow a log-normal distribution and the age-compositions are assumed to follow a multinomial distribution. The recruitment is parameterized via yearly penalized parameters where each of the penalty functions is a log-normal density function with the same mean value in all years and a CV of 50%[1] (except in the last 3 years where the CV was set to 10%).

The variance parameters of the observations are fixed, the penalty on the recruitment parameters are fixed, and the effective sample sizes are fixed. It is important to note that these fixed values determine the relative weight given to the different information sources catch/survey/composition/stock-recruitment and further the absolute value of these fixed parameters determine the uncertainties on the final estimates used in management. This is because it is the (here assumed) uncertainties of the observations that are propagated - via the model - to the uncertainties on all the estimated quantities. It is not uncommon to assume fixed values for such variance parameters in applied fish stock assessment modelling. This reviewer would however make it a high priority to replace - as many as possible of - these assumed variance parameters with model parameters which can be estimated alongside the other model parameters. This would remove some subjectivity and it would allow the estimation uncertainty to be more correctly propagated to the final results.

Some of the assumed variance parameters can to some extent be evaluated from the model validation plots, and it appears that most of the log-normal observation variances have been assigned reasonable values (e.g., bottom left frame of figures A129 and A132 in the research track report (standardized residuals appear to have sd of ca. 1)). It does, however, appear that the assigned variances of the total catches are not resulting in standardized residuals with a standard deviation of one (bottom left frame of figure A124 in the research track report), which would indicate that the assigned value could possibly be improved. Other assigned variances cannot easily be evaluated and should be studied via sensitivity runs. Overall, the variances appear to be appropriately assigned.

The age-composition observations are assumed to follow multinomial distributions. The research track presents Pearson residuals to evaluate this assumption. The multinomial distribution is problematic to evaluate via residuals. The multinomial distribution is discrete, so for low numbers patterns can emerge due to the discretization. The multinomial distribution is multivariate and implies correlation between the individual compositions, so merely subtracting the mean and dividing by the standard deviation (the procedure for calculating the Pearson residuals) will not result in independent residuals — even if the model is perfectly correct. It is, however, possible to compute so-called one-observation-ahead-randomized-quantile-residuals, which will have the desired properties (independent standardized normal if the model is correct) (Thygesen et al. 2017). Applying this to assessment models is part of a larger study, which will be submitted for publication shortly by this reviewer and coauthors from the Woods Hole lab. This technique may become standard in future assessments, but cannot be expected for this one. All of this to say that even if the model was perfect, then the Pearson residuals should not be expected to be perfect. However, we should expect the standard deviation of the Pearson residuals to be the same in all age-groups and that does not appear to be very wrong for the catch (figure A127), but for the spring

[1] In the report submitted by the research track for review there was a misprint w.r.t. this penalty, but it has now been corrected.

and fall NEFSC surveys, we clearly see that bubbles are not similar sizes in all age groups (figures A131 and A134). However, such patterns are not unusual in practical stock assessment work, and so are considered acceptable.

The performance of the proposed model is further investigated via retrospective analysis. There is a retrospective pattern seen, and the Mohn's rho criteria applied in ICES is slightly exceeded. Recent years have less bias and with the recent rapid increase in abundance of the stock some retrospective bias can reasonably be expected. The retrospective pattern is a concern, but evaluated to be at an acceptable level.

The sensitivity runs were helpful to illustrate the robustness to some of the model choices made. A few additional sensitivities could have further explored these things (e.g., different assumptions with respect to recruitment deviances and natural mortalities; runs including some of the excluded survey series).

In addition to the different configurations of the ASAP model already presented, it could have further substantiated the robustness of the assessment approach if model-runs configured in different modelling platforms had been presented. It seems to this reviewer that there is an excellent option available to the research track, which has not been explored. The Woods Hole Assessment Model (WHAM; Stock & Miller 2021; https://timjmiller.github.io/wham/) is developed at the Woods Hole lab (local expertise) and it is developed to work with similar input files to the ASAP model. Furthermore, it is developed with options to configure it to be similar to the ASAP model, which would create a perfect starting point for further model comparisons and extensions.

In addition to validation, a WHAM setup for GoM haddock could be used to investigate the following: 1) the usefulness of environmental variables, which relates to TOR 1; 2) alternative (more flexible and smoother) hypothesis about changing selection patterns; 3) the effect of estimating observation uncertainty parameters instead of using fixed inputs; 4) the effect of estimating a process for recruitment instead of assigning fixed penalties; and 5) alternative hypothesis for natural mortality.

5) Update or redefine status determination criteria (SDC point estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, F_{MSY} and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs.

This TOR has been met and the solution is in line with common practice.

With no clear relationship between spawning population and recruits (figure A151 from the research track report), it is reasonable to suggest use of a proxy for F_{MSY} and the use of 40% SPR (spawning potential ratio) is standard in the region and in line with what has previously been used for GoM haddock. The uncertainty on the proxy is explored via simulations of the input values for the yield per recruit analysis, where the uncertainty is based on the empirical CV's and an assumed CV of 0.1 for the natural mortality.

Corresponding to the F_{MSY}-proxy, a spawning stock biomass proxy is computed by long-term forward projections consistent with the above procedure and setting F to the proxy. The recruitment is sampled

from the empirical cumulative density function (CDF)[2] of all historical recruitment estimates except those from the most recent two years.

The only concern this reviewer has regarding this entire approach is the choice of using the average of the most recent five years for stock- and catch- weights in the calculations. The weights chosen for these calculations should be representative of prevailing conditions. The recent period of unusually high stock size combined with likely density dependent growth (seen in TOR 10) seems to imply that the last five years are not likely to represent prevailing conditions w.r.t. weight information. It is recommended to investigate the effect of using this recent five-year period versus a longer period for average weights.

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, maturity, and recruitment.

This TOR has been met and the previously used approach has been improved.

The method suggested for short-term projections is largely consistent with the projection method described under TOR 5. Compared to the previously used method to perform short-term projections the suggested method is updated in two places.

The sampling of recruitment in the first year after the last year of the assessment (year Y+1) is now made in the same way as all other years (from smoothed empirical CDF of all previously estimated recruitments except the last two). Previously the last two estimates were included, but it seems reasonable to exclude them due to high estimation uncertainty.

The research track made prediction-based analysis to determine the optimal number of years to average weight information over for the purpose of the short-term projections. This led to a change from previously using a five-year average to now suggesting a two year average. The approach is intuitive and, in this reviewer's evaluation, an improvement. Such an approach can be taken further. A broader study on how to optimally predict weight-at-age could be conducted (instead of only focusing on the number of years to average over). This would quickly lead to methods including cohort-strength (density dependence) and as such link with TOR 10.

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. Identify new research recommendations.

This TOR has been met with some reservations.

Many of the research recommendations to be considered were dismissed with a comment about the recommendation being “general to Northeast Region stock assessments, rather than specific to GoM

[2] Discussion at the meeting clarified that a smoothed version is used instead of the raw empirical CDF, but details of this smoothing are unavailable.

haddock". It is understandable that some research recommendations would require a coordinated effort across many stocks, but it would have been useful if the research track had included a comment about how each specific recommendation related to the GoM haddock stock and whether it was important for GoM Haddock or not.

This reviewer would like to support the research recommendations listed by the research track, in particular, the efforts to include the bottom long-line surveys (BLS) in the assessment and the methods to optimally predict weight-at-age and selection pattern. Further, to update the study of a link between algal bloom and recruitment for GoM haddock.

An interesting research recommendation is to study "the contrast in the direction of retrospective patterns between the GoM and GB haddock stocks". This could lead to setting up a full multi-stock assessment model for the stocks, which would be a major task. An alternative to a full-scale multi-stock model is to link single stock assessments in some simple way. This approach is illustrated in Albertsen et al. (2018), where survival/mortality is set up to correlate (negatively or positively) between stocks. This can mimic the situation where two (or more) stocks are competing for the same resources, or are experiencing the same (good or bad) conditions. This approach is particularly applicable to stocks assessed via state-space assessment models (similarly to WHAM), so this is a further recommendation to develop an explorative WHAM assessment for GoM Haddock.

Further research recommendation by this reviewer are:

Run an explorative model of a different kind. It seems natural to suggest WHAM (local expertise), but it could be something else. This would greatly strengthen confidence in the current implementation. If WHAM was selected it would allow further possibilities to explore the following: 1) alternative to fixing penalty on recruitment; 2) alternative to fixed blocked selectivities; 3) including environmental variables on key processes; 4) estimating instead of fixing observational variance parameters; and 5) easier way to link single-stock assessments.

A wider range of sensitivities could be explored (e.g., different assumptions with respect to recruitment deviances, observational uncertainties, and natural mortalities; runs including some of the excluded survey series).

Study the causality of the habitat index (re: TOR 1) by training the random forest only on data up to 2008 and evaluate if it can then predict the habitat increase in recent years.

Set up a more mechanistic alternative to the habitat model (re: Tor 1), and evaluate how (if) it could be used in the assessment (could be inspired by Thorson et al. (2021)).

Pearson residuals from the multinomial distribution are standard procedure, but they are problematic, as correlation is not accounted for, so even a perfect model will not result in independent standardized normal residuals. Residuals with perfect properties can be defined (Thygesen et al. 2017) (by expressing the multinomial as successive binomials and computing randomized-quantile-one-step-ahead residuals).

Expand the use of the prediction-based approach used to find the optimal weight-at-age in the short term forecast to explore options including density-dependence.

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

This TOR has been met.

The suggested plan B, is the same as the previously accepted plan B, which is the so-called "Plan B smooth" (https://github.com/cmlegault/PlanBsmooth), The research track reviewed the recent research (separate research track on Index Based Methods and Control Rules (IBMWG)) and concluded that the Plan B smooth performed as well as any other index based method. Further the research track considered the retrospective performance.

The research track suggests that an alternative analytic assessment procedure could be considered for plan b, and that is a reasonable suggestion given the limitations of index-based methods. Furthermore, it would motivate the investigation of multiple analytic approaches, which would be beneficial on its own.

9) Review and present any research related to recruitment processes (e.g., spawning and larval transport, and retention), and potential hypotheses for large recruitment events.

This TOR has been met.

The recruitment process is one of the most interesting parts of this assessment, because like for many other haddock stocks the stock development is characterized by some extremely large recruitment events. Hence, it will be very useful and interesting if any information can be identified which can explain (and hopefully predict) these recruitment events.

The research track looked at fall bloom. A previous analysis with only seven points showed a correlation for GB (Georges Bank) haddock, but not for GoM haddock. The analysis was updated and confirmed for GB haddock, but not for GoM haddock. It would be useful if future work could also update this analysis for GoM haddock. More data points would help study this correlation, especially because the large recruitment event in 2013 would be fully included in this analysis.

The research track also considered drift of eggs. There is little evidence of transport from GB haddock to GoM haddock, but some evidence for some larval transport from GoM to GB. This was dismissed as less important because historically GB haddock stock has been much more abundant than the GoM haddock stock. However, recently the difference in stock size is less (figure A159), so this could become more important.

10) Review and present any research related to density-dependent growth.

This TOR has been met and furthermore the research track presents its own research.

The research track finds some correlation between neighboring cohorts, some density-dependence (large cohorts tend to grow slower than small cohorts), and some long-term slowdown in growth.

The analysis is mostly descriptive, and it is suggested by the research track to develop a model to quantify the relative importance of the terms identified above. This reviewer strongly supports this suggestion. Once developed, such a model could completely replace the procedure of using averages of recent years to predict weights-at-age in the short-term projections (TOR 6) and if the model is constructed to converge to a reasonable equilibrium state for long-term projections, then that steady-state could be used in the computation of reference points (TOR 5).

Comments on the review process:

The review meeting was efficient and well organized. However, having an assessment review online is not a good substitute for an actual review meeting. The discussion is slower, and hence fewer issues are raised. It is also not possible to stand up and make an illustrative drawing where needed. Furthermore, the sharing of knowledge, which for other review meetings has been substantial (e.g., sharing tips and tricks of modelling, or introduction to new tools or software) does not happen when all breaks are in isolation. Having informal discussions in person is much better for networking between assessment panels and reviewers, and overall makes the physical meetings more productive.

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Thygesen, UH, Albertsen, CM, Berg, CW, Kristensen, K, Nielsen, A. 2017. Validation of ecological state-space models using the Laplace approximation. Environmental and Ecological Statistics 24 (2), 317-339.

Appendix 1: Bibliography of materials provided for review

Northeast Fisheries Science Center. 2014. 59th Northeast Regional Stock Assessment Workshop (59th SAW) Assessment Report. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 14-09; 782 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. CRD14-09

Northeast Fisheries Science Center. 2019. Gulf of Maine haddock 2019 Assessment Update. Unpubl. Rpt. 10 pp. https://apps-nefsc.fisheries.noaa.gov/saw/sasi/sasi_report_options.php

Northeast Fisheries Science Center. In Review. Final Report of the Haddock Research Track Assessment Working Group. Unpubl. Rpt. https://apps-nefsc.fisheries.noaa.gov/saw/sasi/sasi_report_options.php

Assessment Report: Haddock_WG_Report_DRAFT_GOM_ONLY_text_v3.pdf

Figures: Haddock_WG_Report_DRAFT_GOM_ONLY_figures_v2.pdf

Tables: Haddock_WG_Report_DRAFT_GOM_ONLY_tables_v2.pdf

Presentations: GOM_Haddock_RT_Review_TOR1_TOR9_TOR10_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR2_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR3_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR4_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR5_TOR6_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR7_v1.pptx

Presentations: GOM_Haddock_RT_Review_TOR8_v1.pptx

Appendix 2: A copy of this Performance Work Statement

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

Gulf of Maine Haddock
Research Track Peer Review

January 25 -27, 2022

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 the Gulf of Maine haddock stock. The requirements for the peer review follow. This 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 index-based, age-based, and state-space 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 Report of Haddock Research Track Working Group.

1. The Peer Review Panel (co)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. Reviewers are not required to reach a consensus.

The (co)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 (co)chair will take the lead in editing and completing this report. The (co)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 April 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
January 25-27, 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. Haddock Research Track Terms of Reference

1. Review existing research efforts, data, and habitat information in the Gulf of Maine and Georges Bank, identify any findings relevant to influences of ecosystem conditions on haddock, and consider those findings, as appropriate, in addressing other TORs. For processes that the working group deems important and promising that are not currently feasible to consider quantitatively, describe next steps for development, testing, and review of quantitative relationships and how they could best inform assessments.

2. 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.

3. Present the survey data being used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.). Characterize the uncertainty in these sources of data.

4. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) for the time series, and estimate their uncertainty. Compare the time series of these estimates with those from the previously accepted assessment model, and evaluate the strength and direction of any retrospective pattern(s) in both the current and the previously accepted model. Enumerate possible sources of the retrospective patterns and characterize plausibility, if possible.

5. Update or redefine status determination criteria (SDC point estimates or proxies for B_{MSY}, $B_{THRESHOLD}$, F_{MSY} and MSY) and provide estimates of their uncertainty. If analytic model-based estimates are unavailable, consider recommending alternative measurable proxies for BRPs.

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, maturity, and recruitment.

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. Identify new research recommendations.

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

9. Review and present any research related to recruitment processes (e.g., spawning and larval transport, and retention), and potential hypotheses for large recruitment events.

10. Review and present any research related to density-dependent growth.

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}

Gulf of Maine Haddock

Research Track Assessment Peer Review Meeting

January 25 - 27, 2022

WebEx link: https://www.google.com/url?q=https://noaanmfs-meets.webex.com/noaanmfs-meets/j.php?MTID%3Dmac73d9098b946224d02f64d3d429d0b3&sa=D&source=calendar&ust=1633797763460762&usg=AOvVaw12N6T8o0JhfZohwPjxr3UL

Phone: +1-415-527-5035 US Toll

DRAFT AGENDA* (v. 1/5/2022)

**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.*

Tuesday, January 25, 2022

Time	Topic	Presenter(s)	Notes
9 a.m. - 9:30 a.m.	Welcome/Logistics Introductions/Agenda/Conduct of Meeting	Michele Traver, Assessment Process Lead Russ Brown, PopDy Branch Chief Richard Merrick, Panel Chair	
9:30 a.m. - 10:30 a.m.	ToR #2	Charles Perretti	Catch data
10:30 a.m. - 10:45 a.m.	Break		
10:45 a.m. - 11:15 a.m.	ToR #2 cont.	Charles Perretti	Catch data
11:15 a.m. - 11:45 a.m.	Discussion/Summary	Review Panel	
11:45 a.m. - 12 p.m.	Public Comment	Public	
12 p.m. - 1 p.m.	Lunch		
1 p.m. - 2:30 p.m.	ToR #3	Charles Perretti	Survey data
2:30 p.m. -	Break		

2:45 p.m.			
2:45 p.m. - 3:45 p.m.	TORs #1, #9, and #10	Charles Perretti	Ecosystem, Recruitment Processes, and Density Dependent Growth
3:45 p.m. - 4:15 p.m.	Discussion/Summary	Review Panel	
4:15 p.m. - 4:30 p.m.	Public Comment	Public	
4:30 p.m.	Adjourn		

Wednesday, January 26, 2022

Time	**Topic**	**Presenter(s)**	**Notes**
9 a.m. - 9:15 a.m.	Welcome/Logistics	Michele Traver, Assessment Process Lead Richard Merrick, Panel Chair	
9:15 a.m. - 10:15 a.m.	ToR #4	Charles Perretti	Mortality, Recruitment and Biomass Estimates
10:15 a.m. - 10:30 a.m.	Break		
10:30 a.m. - 11:45 a.m.	TORs #5, #6, and #8	Charles Perretti	BRPs, Projections, and Alternative Assessment Approach

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. - 2 p.m.	ToR #7	Brian Linton	Research Recommendations
2 p.m. - 2:30 p.m.	Discussion/Summary	Review Panel	
2:30 p.m. - 2:45 p.m.	Public Comment	Public	
2:45 p.m. - 3 p.m.	Break		
3 p.m. - 4 p.m.	Follow-ups/Key Points	Review Panel	
4 p.m.	Adjourn		

Thursday, January 27, 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: Panel membership

Meeting attendees at the Gulf of Maine Haddock Research Track Stock Assessment Peer Review meeting

NEFSC - Northeast Fisheries Science Center

GARFO - Greater Atlantic Regional Fisheries Office

NEFMC - New England Fisheries Management Council

DFO - Department of Fisheries and Oceans (Canada)

SMAST - University of Massachusetts School of Marine Science and Technology

MADMF - Massachusetts Division of Marine Fisheries

MEDMR - Maine Department of Marine Resources

MAMFI - Massachusetts Marine Fisheries Institute

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Richard Merrick - Chair

Coby Needle - CIE Panel

Anders Nielsen - CIE Panel

Kevin Stokes - CIE Panel

Russ Brown - NEFSC

Michele Traver - NEFSC

Abby Tyrell - NEFSC

Alex Dunn - NEFSC

Alex Hansell - NEFSC

Andy Jones - NEFSC

Angela Forristall - NEFMC Staff
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Ashok Deshpande - NEFSC

Brian Linton - NEFSC

Catriona Regnier-McKellar - DFO

Chad Demarest - NEFSC

Charles Adams - NEFSC

Charles Perretti - NEFSC

Daniel Caless - GARFO

Dave McElroy - NEFSC

Deidre Boelke - NEFMC staff

Elizabeth Etrie - NEFMC Member

George Lapointe - George Lapointe Consulting LLC

Jamie Cournane - NEFMC Staff

Jason Boucher - NEFSC

John Couture - Unama'ki Institute of Natural Resources, Nova Scotia, Canada

Jon Deroba - NEFSC

Julie Nieland - NEFSC

Kathy Sosebee - NEFSC

Kelly Kraska - DFO

Kevin Friedland - NEFSC

Liz Brooks - NEFSC

Liz Sullivan - GARFO

Mark Grant - GARFO

Mark Terceiro - NEFSC

Matthew Cutler - NEFSC

Melanie Griffin - MAMFI

Michael Pierdinock - NEFMC Member (from MA)

Mike Simpkins - NEFSC

Monica Finley - DFO

Paul Nitschke - NEFSC

Rebecca Peters - MEDMR

Rick Bellavance – NEFMC Member; Captain, Priority Fishing Charters (RI)

Robin Frede - NEFMC Staff

Ryan Morse - NEFSC

Scott Large - NEFSC

Steve Cadrin - SMAST

Tara Trinko Lake - NEFSC

Toni Chute - NEFSC

Tom Nies - NEFMC Director

Xavier Mouy - NEFSC

Yanjun Wang - DFO