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2020 Management Track Peer Review Committee Report

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Executive Summary:

The Spring 2020 Management Track cycle originally had six stock assessments scheduled for review. The Assessment Oversight Panel (AOP) review the assessment plans and recommended that four assessments be reviewed during the Management Track Peer Review and two assessments receive Level 1 – Direct Delivery reviews. The AOP held a subsequent meeting to review issues related to the assessment plans for Atlantic Herring and Atlantic Mackerel. As a result of COVID-19 data availability issues, the Atlantic Mackerel assessment was delayed until 2021. The Ocean Quahog assessment was recommended for a Level 1 – Direct Delivery and was not reviewed during the Management Track Peer Review. The four stocks reviewed during the June peer review were Atlantic Herring, Butterfish, Surfclams and Longfin Inshore Squid.

For Atlantic Herring, the review panel concluded that each of the terms of references were satisfactorily addressed. Estimated spawning stock biomass has been declining since 2014 (when SSB was 317,080 mt) and in 2019 was estimated to be 77,883 mt, the lowest value since the late 1980s. The 2019 SSB is 29% of the SSB_{msy} value (269,000 mt) and below the SSB threshold. Therefore, the stock is now overfished. Fishing mortality (F) on the fully-recruited age groups to the USA mobile fleet (ages 7-8) has markedly declined since 2010, and F in 2019 was estimated to be 0.25, the lowest value since the early 1990s, and well below the overfishing threshold F_{msy} proxy value (0.54). Therefore, overfishing is not occurring. Recruitment has shown high variability over the past 50+ years, which is attributed to the episodic nature of herring recruitment. Since 2013, recruitment has declined to record-low levels. Median age 1 recruitment in the stock is 3.43 billion fish at age 1. Recruitment of age 1 fish in 2019 was estimated to be 666 million fish.

For Butterfish, the review panel concluded that each of the terms of references were satisfactorily addressed. The butterfish model estimates the natural mortality rate (M). The revised estimate of M was somewhat higher than the previous estimate (1.29 vs. 1.25), but this was within the range of expected estimation variability. The stock assessment estimated a trend of decreasing biomass, decreasing recruitment, and increasing fishing mortality. The increasing fishing mortality was expected given the substantial increase in catches in recent years. However, the peer review committee found the decline in biomass and recruitment to be of potential concern.

For Surfclams, the review panel concluded that each of the terms of references were satisfactorily addressed. Stock biomass remains slightly above B_{target}, and well above $B_{threshold}$, and fishing mortality remains well below $F_{threshold}$. The conclusions are consistent with previous determinations of stock status and indicate that the stock is neither overfished nor experiencing overfishing. Short-term projections were conducted under three scenarios. These indicated that only at $F_{threshold}$ does the stock show substantial decline. Status quo and quota fishing levels had little effect on stock status, with $B/B_{threshold}$

remaining >2 and $F/F_{threshold}$ well below 1.0, except at $F_{threshold}$, an unlikely fishing level under the present management and market conditions for surfclam.

For Longfin Inshore Squid, the review panel concluded that each of the terms of references were satisfactorily addressed. There are currently no accepted fishing mortality reference points available for this stock. The BRPs for biomass remained the same as the 2010 and 2017 assessments, but spring- and fall-specific biomass reference points were also proposed in the current management track assessment. Given current understanding that longfin squid live approximately 6-8 months and that the summer cohort produces the following winter cohort which subsequently produces the next summer cohort, it is possible that the current averaging approach to determine whether the stock is overfished could fail to detect if biomass falls below the threshold with respect to each cohort. Annual averaging of the spring and fall survey biomasses assumes that a single population is being exploited and does not account for the large difference in apparent productivity of the two intra-annual cohorts. Estimates of squid biomass derived from the fall bottom trawl survey (which mainly catches the summer cohort) are about fivefold higher than those from the spring survey (which mainly catches the winter cohort). In addition, exploitation rates from the January-June fishery (predominantly on the summer cohort) are much higher than those of the July-December fishery (predominantly on the winter cohort). Because the generation time for longfin squid is only 6-8 months, overfishing of a single cohort potentially could jeopardize stock sustainability due to recruitment overfishing.

Peer Review Committee Report:

The Peer Review Committee (PRC) for Management Track Assessments met via webinar on June 22-25, 2020. Attendance at the meeting is provided in Appendix A. The PRC was asked to provide technical reviews of management track assessments for Atlantic herring (*Clupea harengus*), butterfish (*Peprilus triacanthus*), Atlantic surfclam (*Spisula solidissima*) and longfin inshore squid (*Doryteuthis (Amerigo) pealeii*). The assessments for these four species were prepared under guidelines prepared by 2020 Assessment Oversight Panel (AOP). These guidelines provide a pathway for continuing development of previously accepted assessments for each species including incorporation of the most recent data and understanding of biology of the species being assessed. The 2020 Assessment Oversight Panel considered Atlantic herring and butterfish to be Level 2 assessments and Atlantic surfclam and longfin squid as Level 3 assessments. As a result of this designation, the assessments for all four species required peer review.

We thank Russ Brown (Population Dynamics Branch Chief) and Michele Traver (Assessment Process Lead) for their support during the meeting. We thank the staff of the Population Dynamics Branch at NEFSC for the open and collaborative spirit with which they engaged the PRC. Our thanks extend not only to the analysts for each assessment, but also to the rapporteurs for taking extensive notes during the meeting. We also thank the other participants for helping make the meeting productive and collegial. Finally, the PRC thanks the staff at NEFSC for supporting the logistics during the meeting.

The PRC endorsed the assessments for all four species presented at the meeting for use in management. Analytical assessments were produced for Atlantic herring, butterfish, and Atlantic surfclam, each of which used a statistical catch-at-age model (Atlantic herring and butterfish) or a catch-at-age-and-length model (Atlantic surfclam). The assessment for longfin squid uses swept area biomass to estimate stock status. In each case the PRC endorsed the model and the inferences that resulted as representing the best scientific information available (BSIA), thereby providing a foundation for staff and the Mid-Atlantic and New England Fishery Management Councils and their SSCs to evaluate stock status and provide scientific advice.

Atlantic Herring

The 2020 assessment update for Atlantic herring is a Level 2 assessment in accord with the decision at the 29 April 2020 meeting of the AOP. The 2020 assessment is an update from the 2018 benchmark assessment (SAW 65) that used an ASAP modeling framework.

The PRC concludes that the 2020 assessment update for Atlantic herring is technically sufficient to evaluate stock status and provide scientific advice. The assessment represents BSIA for this stock for management purposes. The PRC agrees with the assessment report that the Atlantic herring stock is overfished and overfishing is not occurring. This is a change in status from the results of the 2018 benchmark assessment that indicated that the stock was not overfished and overfishing was not occurring.

The 2020 assessment used different methods to derive biological references points (BRPs) and conduct short-term projections than those in the 2018 benchmark assessment. The BRPs in the 2020 assessment were derived using only the selectivity of the mobile fleet (exclusively a USA fleet) because the fixed gear fleet (>90% Canadian) is not quota regulated and not subject to the same harvest control rules as the USA mobile fleet. However, the short-term projections included catches from both fleets to ensure that the stock dynamics and probability of overfishing and overfished were still subject to the total stock harvests.

Atlantic Herring Terms of Reference (TOR)

1. *Estimate catch from all sources including landings and discards.*

This TOR was satisfactorily addressed. Landings and discard data from 2018 and 2019 were added to those used in the 2018 benchmark. Because Canadian fixed gear catches markedly increased in 2018 (11,912 mt) and remained high in 2019 (5,115 mt) while USA mobile catches declined (45,189 mt in 2018; 12,721 mt in 2019) due to regulatory changes, the percent of the annual total catch taken by the Canadian fishery significantly increased to 21% in 2018 and 29% in 2019. From 2012 to 2017, Canadian catches accounted for between 1% and 7% of the annual total catches.

The age compositions of catches from the two fleets also differ. The USA mobile fleet primarily harvests fish that are age 3 and older, while the Canadian fixed gear fleet generally harvests herring that are age 2 and younger (although in 2019, age 3 fish were also caught).

2. *Evaluate indices used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.).*

This TOR was satisfactorily addressed. All four of the survey indices used in the benchmark assessment (NEFSC spring bottom trawl survey, NEFSC fall bottom trawl survey, NEFSC shrimp bottom trawl survey, and the NEFSC fall survey acoustic index) were updated through 2019. As well, survey age composition and age-length data were updated through 2019 from the NEFSC spring and fall surveys. Age data from the summer shrimp survey were collected for the first time in 2019.

Trends in relative abundance of herring from all four surveys indicate a substantial decline in stock abundance during the past few years. All four of the survey indices in 2019 were at or near record-low values. The most relevant Canadian assessments of the stock show similar trends in abundance.

Although the surveys do not efficiently catch age-0 or age-1 fish, they do track cohorts well from age 2 onwards and thereby provide information on year class strength.

3. *Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) as possible (depending on the assessment method) for the times series using the approved assessment method and estimate their uncertainty. Include retrospective analyses if possible (both historical and within-model) to allow a comparison with previous assessments, and to examine model fit.*

a. Include bridge runs to sequentially document each change from the previously accepted model to the updated model proposed for this peer review.

b. Prepare a "Plan B" assessment that would serve as an alternate approach to providing scientific advice to management if the analytical assessment were to not pass review.

This TOR was satisfactorily addressed. The same ASAP model configuration used in the 2018 benchmark assessment was used in the 2020 update. Diagnostic and residual patterns were evaluated for all of the model input data (fleet catches, fleet age compositions, survey abundance indices and age compositions), as well as for the estimates of fishing mortality, biomass, spawning stock biomass, and recruitment. The diagnostic and residual patterns were acceptable (i.e., residuals generally randomly distributed) and similar to those in the 2018 benchmark assessment.

No retrospective adjustments were needed in the assessment. A Plan B assessment was not necessary because the model-based assessment was accepted.

4. *Re-estimate or update BRP's as defined by the management track level and recommend stock status. Also provide quantitative descriptions of stock status based on simple indicators/metrics (e.g., age-size-structure, temporal trends in population size or recruitment, indices.).*

This TOR was satisfactorily addressed. BRPs were re-estimated in the 2020 assessment using only the selectivity of the USA mobile fishing fleet and exclude any mortality from the catches from the unregulated Canadian fixed gear fleet. This is likely to result in biased reference points to an unknown degree, but there are no widely accepted methods for calculating BRPs when one of the fleets is not controlled. The fixed gear catches are treated as management uncertainty and a risk issue that needs to be addressed by managers. In essence, the re-estimated BRPs are US-based reference points and allow stock status relative to these reference points to be affected by Canadian fixed gear catches, which are unregulated and outside of US control.

The re-estimated BRPs are the following:

F_{msy} proxy = 0.54; SSB_{msy} proxy = 269,000 mt; SSB threshold (1/2 SSB_{msy}) = 134,500 mt; MSY = 99,400 mt.

An F40% proxy was used for the overfishing threshold and the SSB proxy reference points are based on long-term stochastic projections.

Estimated spawning stock biomass has been declining since 2014 (when SSB was 317,080 mt) and in 2019 was estimated to be 77,883 mt, the lowest value since the late 1980s. The 2019 SSB is 29% of the SSB_{msy} value (269,000 mt) and below the SSB threshold. Therefore, the stock is now overfished.

Fishing mortality (F) on the fully-recruited age groups to the USA mobile fleet (ages 7-8) has markedly declined since 2010, and F in 2019 was estimated to be 0.25, the lowest value since the early 1990s, and well below the overfishing threshold F_{msy} proxy value (0.54). Therefore, overfishing is not occurring.

Recruitment has shown high variability over the past 50+ years, which is attributed to the episodic nature of herring recruitment. Since 2013, recruitment has declined to record-low levels. Median age 1 recruitment in the stock is 3.43 billion fish at age 1. Recruitment of age 1 fish in 2019 was estimated to be 666 million fish.

5. *Conduct short-term stock projections when appropriate.*

This TOR was satisfactorily addressed. Short-term (2021-2023) projections were conducted using the harvest control rule described in Amendment 8 of the Atlantic Herring Fishery Management Plan as applied solely to the US mobile gear fleet. Annual catches by the Canadian fixed gear fleet were assumed to be constant at 4,778 mt, the sum of the 10-year (2010-2019) averages of the Canadian (4,669 mt) and US (109 mt) fixed gear catches. For 2020, the total catch was assumed to be 16,319 mt, resulting in an SSB of 56,375 mt and F=0.243 for the US mobile gear fleet.

6. *Respond to any review panel comments or SSC concerns from the most recent prior research or management track assessment.*

This TOR was satisfactorily addressed. However, several uncertainties exist in the stock assessment. These include:

- There is uncertainty in the natural mortality rate (M), which is assumed in the assessment to be constant among ages and years. This assumption is common in stock assessments of many fish species because studies to determine natural mortality rates in exploited fish populations are difficult to conduct. Some insight on M for herring might be gained from the results of multispecies models that incorporate prey and predator relationships.
- The projections are uncertain because (1) recruitment in 2019 is imprecisely estimated and (2) recruitment in 2022 was drawn from the CDF of the long-term recruitment estimates, which results in a mean value about equal to the long term average. The PRC notes that achieving mean recruitment is unlikely given the very low recruitment estimates in the most recent years.
- Continued poor recruitment will be the principal factor influencing stock status in the near future, as fishing mortality is now low compared to historical levels.

Recommendations

1. Because acoustic methods are regularly used to survey and assess herring stocks in other areas of the world, use of a dedicated acoustic survey should be explored further.
2. The reference points assume an absence of fixed gear fishing, which means that fishing at the $F_{40\%}$ rate would not be expected to achieve $SSB_{40\%}$. The panel suggests modifying the current approach to include the effect of catches in the fixed gear fleet. For example, the SSB reference points could be modified to also estimate the F reference point. The approach would involve conducting long-term projections of the population under different assumptions of mobile gear F. The fixed gear catches would remain the same as in the current approach. The unfished condition would have the mobile gear F = 0 and the fixed gear catch = 0. A grid search over the mobile gear F could be used to find the mobile gear

F that achieves 40% of the unfished SSB. The PRC recommends attempting this approach for the next management track or research track stock assessment.

Butterfish

The butterfish stock assessment is an update of the approach adopted in the 2014 benchmark stock assessment (NEFSC 2014) based on the 2017 assessment update. The butterfish assessment is a statistical catch-at-age model implemented in ASAP that assumes catchability of the NEFSC fall trawl survey is known. In addition, the model estimates the natural mortality rate.

The PRC concludes that the 2020 management track assessment for butterfish is technically sufficient to evaluate stock status and provide scientific advice. The assessment represents the BSIA for this stock for management purposes. The PRC agrees with the assessment report that butterfish is not overfished and overfishing is not occurring. However, concerns were expressed because biomass and recruitment have shown a negative trend in recent years.

Butterfish Terms of Reference

1. Estimate catch from all sources including landings and discards.

This TOR was satisfactorily addressed. The landings were updated. The algorithm for calculating discards was modified to that typically used by the Center, so the discard time series changed somewhat from the previous assessment. The PRC believed the change in the protocol to estimate discards is appropriate. The landings have been increasing in recent years as a directed fishery has reemerged, and discards remain an important component of the catch.

2. Evaluate indices used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.).

This TOR was satisfactorily addressed. The NEFSC fall survey and NEAMAP fall survey indices (the only indices included in the assessment model currently) were updated for use in the assessment model. The main change was to use the NEAMAP age-length key for that index instead of applying the NEFSC age-length key. The PRC considers this change in the age-length key to be an improvement and supports its use.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) as possible (depending on the assessment method) for the time series using the approved assessment method and estimate their uncertainty. Include retrospective analyses if possible (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit.
a. Include bridge runs to sequentially document each change from the previously accepted model to the updated model proposed for this peer review.

b. Prepare a "Plan B" assessment that would serve as an alternate approach to providing scientific advice to management if the analytical assessment were to not pass review

This TOR was satisfactorily addressed. The ASAP model from the 2017 update was updated with the most recent data. The model diagnostics indicated that the model results appeared to be stable and reliable. The PRC noted some inconsistencies in the input weights-at-age for cohorts, where mean weights-at-age appeared to decline for ages 3-4+ or remain the same for ages 0-1. These patterns warrant a revisit of how weights-at-age are calculated.

The butterfish model estimates the natural mortality rate (M). The revised estimate of M was somewhat higher than the previous estimate (1.29 vs. 1.25), but this was within the range of expected estimation variability.

The stock assessment estimated a trend of decreasing biomass, decreasing recruitment, and increasing fishing mortality. The increasing fishing mortality was expected given the substantial increase in catches in recent years. However, the PRC found the decline in biomass and recruitment to be of potential concern.

A Plan B assessment was prepared, but because the assessment model was accepted there was no need to review the Plan B approach.

4. Re-estimate or update the BRP's as defined by the management track level and recommend stock status. Also, provide qualitative descriptions of stock status based on simple indicators/metrics (e.g., age- and size-structure, temporal trends in population size or recruitment indices, etc.).

This TOR was satisfactorily addressed. The natural mortality rate is estimated in the stock assessment model, which then directly feeds into the calculation of the maximum fishing mortality threshold. The PRC agrees with the assessment report that butterfish is not overfished ($B>B_{threshold}$) and overfishing ($F<F_{threshold}$) is not occurring. Fishing mortality during 2017-2019 has been the highest in the time series, but in 2019 F still remains 76% below the F_{MSY} proxy 0.86. While SSB has been below the SSB_{MSY} proxy during the same period, it is 38% above the SSB threshold (21,214 mt) in the terminal year.

5. Conduct short-term stock projections when appropriate.

This TOR was satisfactorily addressed. Short-term projections were conducted assuming that the catch limits (DAH) would be fully realized. However, recent catches of butterfish indicate this is unlikely to occur. Therefore, the projections likely overestimate the near-term effects of fishing. In particular, it was noted that if the catch limit in 2020 was achieved, the projections indicate the stock would likely be considered overfished in 2021. However, the catch limits are 5-8 times the observed catches in recent years, which indicates it is extremely unlikely that the limit will be realized. Using the whole time series of recruitment for the projections may result in the projections being overly optimistic if recruitment continues to be in the range of 1/3-1/2 of the long-term average (8,336 million age-0 fish).

6. Respond to any review panel comments or SSC concerns from the most recent prior research or management track assessment.

This TOR was satisfactorily addressed. Changes in model structure were not made in this assessment because a research track assessment is scheduled to start in 2021. Reference points were recalculated to ensure internal consistency with the estimated M.

Recommendations for projections

The PRC thought that the assumptions about recruitment and 2020 catches in the projections were unlikely to be realized and would affect the accuracy of the projections. The assumption of achieving the catch limit was unlikely to occur because the catch limit has been 5-8 times higher than the observed catches during 2017-2019. Adding projections with an estimated catch closer to what is likely to be realized provides additional context for potential dynamics of the stock and performance of the fishery. The PRC noted that recruitment has been trending downward in recent years. However, the projections use the full time series of recruitment. Because the average recruitment for the whole time series is higher than that in recent years, it may cause the projections to overestimate biomass. Using a recent period of recruitment may improve the accuracy of projections.

Recommendations for the upcoming research track assessment

1. Weights-at-age. As described above, the mean weights-at-age for a cohort indicated fish were not growing between ages 0 and 1 or were shrinking between ages 3 and 4+ in some years. Alternative approaches for estimating mean weights at age should be considered (e.g., averaging across years instead of using individual years).
2. Fishery selectivity. Currently fishery selectivity is specified at 1.0 for ages 2-4+. However, a pattern in the age composition residuals indicates that selectivity for age-2 may be lower than that for age-3. The PRC recommends reconsidering a selectivity function that estimates the age-2 fishery selectivity. Changing the fishery selectivity may affect the estimated natural mortality rate.
3. Reconsider the fishing mortality rate reference point. Recent research has suggested that using $F_{MSY} \approx 2/3$ M may not be a robust approximation.
4. Given the observation of declining recruitment with declining stock size, it may be possible to estimate a stock-recruitment function for this stock which could be used for reference point estimation.

Atlantic Surfclam

Several significant changes and updates are described in this assessment, the most notable of which is to assess the current stock areas (Georges Bank, Mid-Atlantic/Southern New England) within a single Stock Synthesis (3.30) model structure. In this Management Track Assessment, the SS3.30 model is configured with two areas to assess overall stock status. The Assessment Oversight Panel (AOP) had endorsed that approach and noted the improved efficiency of assessing the resource within a single model structure. Concerns were expressed by the AOP about potential problems with implementation, but the data and parameterization required only modest changes from those for the separate models in the previous assessments. Owing to the cumulative proposed changes in the ongoing assessment, the AOP recommended an Enhanced Review (Level 3) for surfclams in this Management Track Assessment.

The Management Track Assessment also includes new information from the redesigned Atlantic surfclam/Ocean quahog abundance survey that is conducted using a commercial fishing vessel. Results for Georges Bank suggest a lower abundance there than had been estimated in previous assessments.

The PRC agrees with the assessment's conclusion that the surfclam resource is not overfished and is not experiencing overfishing. The assessment also benefitted from improved survey abundance information obtained in the first implementation of the redesigned NEFSC surfclam survey. This assessment represents the first use of data from the new survey. The PRC concludes that the 2020 management track assessment for surfclam is technically sufficient to evaluate stock status and provide scientific advice. The assessment represents the BSIA for this stock for management purposes.

Atlantic Surfclam Terms of Reference

1. Estimate catch from all sources including landings and discards.

This TOR was satisfactorily addressed. Landings, discards, and their trends, are described in detail. Catches that include both ocean quahog and Atlantic surfclam have become more common in recent years, resulting in significant ocean quahog discards, which could result in changes in catches and discard patterns in the future. Landings data are believed to be accurate, and landings well below quotas are reflective of market conditions more than availability of the resource.

2. Evaluate indices used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.).

This TOR was satisfactorily addressed. The newly implemented NEFSC clam survey effectively reduced "data borrowing" by analyzing the old survey data using the new survey strata. Abundance on Georges Bank is estimated to be substantially lower than in older assessments. This change is largely due to improved survey methods (more efficient dredge, better coverage of the area) in recent years. Index data on age-length composition are adequate to characterize the age-size structure and support growth analyses. Recruitment of young surfclams (< age-5) and its variability are poorly known due to the selectivity of the survey gear. The only ongoing state survey (MA) is not currently included in the assessment.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) as possible (depending on the assessment method) for the time series using the approved assessment method and estimate their uncertainty. Include retrospective analyses if possible (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit.

a. Include bridge runs to sequentially document each change from the previously accepted model to the updated model proposed for this peer review.

b. Prepare a "Plan B" assessment that would serve as an alternate approach to providing scientific advice to management if the analytical assessment were to not pass review

This TOR was satisfactorily addressed. The new management track assessment addressed several of the criticisms of the previous assessment (SAW 61).

As in past assessments, scaling of abundance estimates has been difficult to accomplish, but the trends remain consistent. Scaling is better in this most recent assessment in that results are now more in agreement with the catchability studies and the estimated biomass is more precise. The PRC still has questions about domed survey selectivity in the model because the selectivity experiments largely support flat-topped selectivity.

The increased F now estimated for Georges Bank indicates that fishing may measurably affect biomass of the stock. This outcome should assist analysts in determining effects of fishing on the stock in future assessments.

Time-varying growth was included in the Mid-Atlantic/Southern New England region to account for observed decreases in mean size-at-age. The PRC agrees that including time-varying growth is warranted and represents an improvement in the assessment.

The assessment model appears to be highly dependent on the prior for survey catchability to estimate stock biomass. Previous assessments estimated sufficiently low fishing mortality rates that catches did not provide a sufficient signal in the data to estimate biomass without an informative prior on survey catchability. However, with increasing fishing mortality, catches should have a larger effect on the population, which may be seen in future surveys (particularly on Georges Bank).

Detailed bridge runs and sensitivity analyses were conducted, and detailed diagnostics were presented. The model performs sufficiently well for provision of management advice.

Because the PRC accepted the assessment model results, the Plan B assessment (swept area estimates) was not considered further.

4. Re-estimate or update the BRP's as defined by the management track level and recommend stock status. Also, provide qualitative descriptions of stock status based on simple indicators/metrics (e.g., age- and size-structure, temporal trends in population size or recruitment indices, etc.).

This TOR was satisfactorily addressed. The PRC agrees that stock status has been accurately characterized.

Stock biomass remains slightly above $B_{target,}$ and well above $B_{threshold,}$ and fishing mortality remains well below $F_{threshold}$. The conclusions are consistent with previous determinations of stock status and indicate that the stock is neither overfished nor experiencing overfishing.

5. Conduct short-term stock projections when appropriate.

This TOR was satisfactorily addressed. Short-term projections were conducted under three scenarios. These indicated that only at $F_{threshold}$ does the stock show substantial decline. Status quo and quota fishing levels had little effect on stock status, with $B/B_{threshold}$ remaining >2 and $F/F_{threshold}$ well below 1.0, except at $F_{threshold}$, an unlikely fishing level under the present management and market conditions for surfclam.

6. Respond to any review panel comments or SSC concerns from the most recent prior research or management track assessment.

This TOR was satisfactorily addressed. A long list of recommendations or issues to be addressed emanated from SAW 61. Many were successfully addressed in this management track assessment (including improving growth modeling, reducing "data borrowing", the redesign of the survey strata, and combining the previous two separate models into one model with two areas) or are being addressed. Others, including some that would require substantial research effort, remain to be considered. Overall, continuing progress in addressing issues and concerns is substantial and commendable.

Recommendations

1. The PRC noted that selectivity in the survey is substantially lower for large individuals than intermediate size individuals. There are substantial differences in the selectivity curves generated by the selectivity experiments and those modeled for the fishery. To potentially improve estimates of abundance, the PRC recommends that the possibility of flat-topped selectivity be explored for the survey and include a prior based on the selectivity experiment results.
2. The PRC had questions about the MCMC simulations and diagnostics, and whether effective sample sizes were adequate to provide reliable outcomes. The PRC recommends that additional exploratory runs be conducted with higher sample sizes to improve estimates of selectivity parameters. Specifically, the effective sample sizes for all estimated parameters should be calculated. Also, best practices include running multiple chains from different starting values to determine if they converge to the same stable mixing distributions (e.g., Gelman-Rubin plots).
3. Trends in LPUE and the survey abundance indices in the Mid-Atlantic/Southern New England are not congruent. A review of patterns in commercial LPUE may help to determine if commercial landing statistics support the changes in abundance estimated from the redesigned survey. Commercial LPUE is

an imperfect measure of abundance because it is tightly linked to areas fished and is responsive to harvester fishing strategies that concentrate fishing effort on high-density aggregations of surfclams. Analyses and evaluation of LPUE may be most relevant if the assessment moves to a finer spatial scale.
4. The effects of time-varying growth on reference points and recruitment to the fishery will benefit from more research.

Longfin Inshore Squid

The longfin squid stock assessment is an update of the 2017 operational stock assessment. The assessment uses swept area biomass to estimate stock size. The stock size biological reference points are fixed fractions of estimated swept area biomass. Currently no fishing mortality rate reference points are available for this stock.

The PRC concludes that the 2020 management track assessment is technically sufficient to evaluate stock status for biomass and provide scientific advice. The assessment represents the BSIA for this stock for management purposes. The PRC agrees with the assessment report that longfin squid is not overfished and overfishing is undetermined because there is not an established F reference point. The PRC concurs with the AOP and recommends considering cohort-specific reference points based on the understanding of two dominant and largely non-overlapping intra-year cohorts of longfin squid, at the next management track assessment in 2023.

Longfin Inshore Squid Terms of Reference

1. Estimate catch from all sources including landings and discards.

This TOR was satisfactorily addressed. The approach for calculating discards for 2000 and 2007-2019 was slightly modified from the previous assessment to align with trimester-based quota management during this period, and the PRC agreed that this was an improvement. Since 1987 (when the domestic fishery for longfin squid began) landings of all species of squid have been assigned to individual species, so that the landings for longfin squid used in the assessment are considered to be accurate.

2. Evaluate indices used in the assessment (e.g., indices of relative or absolute abundance, recruitment, state surveys, age-length data, etc.).

This TOR was satisfactorily addressed. The assessment uses the spring and fall bottom trawl surveys with assumptions about catchability and availability to estimate biomass for the cohorts caught in the spring and fall surveys (the winter cohort is predominately present in the spring and the summer cohort predominates in the fall). No changes in the index methods were made from the previous assessments.

3. Estimate annual fishing mortality, recruitment and stock biomass (both total and spawning stock) as possible (depending on the assessment method) for the time series using the approved assessment method and estimate their uncertainty. Include retrospective analyses if possible (both historical and within-model) to allow a comparison with previous assessment results and projections, and to examine model fit.

a. Include bridge runs to sequentially document each change from the previously accepted model to the updated model proposed for this peer review.
b. Prepare a "Plan B" assessment that would serve as an alternate approach to providing scientific advice to management if the analytical assessment were to not pass review

This TOR was satisfactorily addressed. NEFSC spring and fall survey biomasses and exploitation rates were estimated as in the previous assessment. A Plan B assessment was not possible for this stock.

4. Re-estimate or update the BRP's as defined by the management track level and recommend stock status. Also, provide qualitative descriptions of stock status based on simple indicators/metrics (e.g., age- and size-structure, temporal trends in population size or recruitment indices, etc.).

This TOR was satisfactorily addressed. There are currently no accepted fishing mortality reference points available for this stock. The BRPs for biomass remained the same as the 2010 and 2017 assessments, but spring- and fall-specific biomass reference points were also proposed in the current management track assessment. Given current understanding that longfin squid live approximately 6-8 months and that the summer cohort produces the following winter cohort which subsequently produces the next summer cohort, it is possible that the current averaging approach to determine whether the stock is overfished could fail to detect if biomass falls below the threshold with respect to each cohort. Annual averaging of the spring and fall survey biomasses assumes that a single population is being exploited and does not account for the large difference in apparent productivity of the two intra-annual cohorts. Estimates of squid biomass derived from the fall bottom trawl survey (which mainly catches the summer cohort) are about fivefold higher than those from the spring survey (which mainly catches the winter cohort). In addition, exploitation rates from the January-June fishery (predominantly on the summer cohort) are much higher than those of the July-December fishery (predominantly on the winter cohort). Because the generation time for longfin squid is only 6-8 months, overfishing of a single cohort potentially could jeopardize stock sustainability due to recruitment overfishing. In the recommendations, the PRC provides an alternative approach for using cohort-specific reference points to provide annual stock status.

5. Conduct short-term stock projections when appropriate.

Short-term projections were not conducted because there is no accepted assessment model for longfin squid.

6. Respond to any review panel comments or SSC concerns from the most recent prior research or management track assessment.

This TOR was satisfactorily addressed. Several projects to understand longfin squid dynamics are currently underway, and other research priorities would require additional funding. One of the most important assumptions of this stock assessment is the catchability in the spring and fall trawl surveys. A study of catchability would be extremely useful to improve the stock assessment but would require substantial funding resources.

Recommendations

1. The PRC recommends considering cohort-specific reference points for determining stock status. One approach to determine annual stock status using information on two intra-annual cohorts would be to calculate separate stock statuses for the two cohorts sampled in the NEFSC spring and fall surveys. This alternative would involve comparing biomass estimates to the cohort-specific biomass reference points. If either of the cohort-specific biomass estimates fell below its respective biomass threshold, then the stock would be considered overfished in that year. The PRC notes that this recommendation also could apply to other subannual species (e.g., shortfin squid).
2. The PRC recommends continuing development of a stock assessment approach that is specifically tailored to the squid life cycle and data availability. One avenue is to consider if assessment or

management approaches for other semelparous species, for example Pacific salmons, might be useful because they share some life history traits with longfin squid.

3. To assist panelists in future assessment reviews for longfin squid, the PRC recommends including a figure that illustrates spawning and fishing periods that identify the two predominant intra-annual cohorts.

Recommendations for Future Management Track Reviews

1. Include an analysis of projection accuracy for those stocks for which projections are made. This analysis would involve comparing previous projections of biomass, recruitment, and fishing mortality rates to the estimates from later assessments. It would allow for improved understanding of the performance of projections and the validity of assumptions used to make projections (e.g., recruitment, fishing mortality rates).
2. Provide the analysts' presentations in advance of the review meeting. It would be helpful to have the presentations at least one day in advance of the meeting.
3. The analysts organized their presentations using the TORs provided. The PRC appreciated this approach which facilitated its evaluation of the materials and recommends continuing this protocol in future reviews.

Appendix A. 2020 management track peer review meeting attendees.

MT Assessment Peer Review Attendees Monday, June 22, 2020

Allison Murphy (NOAA)

Alyson Pitts (NOAA)

Brandon Muffley (MAFMC)

Brian Linton (NOAA)

Carrie Nordeen (NOAA)

Charles Adams (NOAA)

Chris Kellog (NEFMC)

Chris Legault (NOAA)

Corinne Truesdale

Dan Hennen (NOAA)

David Nelson (NOAA)

Deirdre Bolke (NEFMC)

Edward Houde - panel

Elizabeth Ng

Fred Serchuk - panel

Gary Shepard (NOAA)

Greg Early

Janice Plante (NEFMC)

James Fletcher

Jeff Kaelin

Jessica Coakley (MAFMC)

Jose Montanez (MAFMC)

Jonathan Deroba (NOAA)

Karen Cogliati

Kathy Sosbee (NOAA)

Katie Almeida

Kelly Whitmore (MADMF)

Larry Alade (NOAA)

Laura Solinger

Lisa Hendrickson (NOAA)

M Smith

Mary Beth Tooley

Matthew Cieri

Melanie Griffin

Mike Wilberg - Chair

Michele Traver (NOAA)

Paul Nitschke (NOAA)

Rachel Feeney (NEFMC)

Renee Zobel

Sarah Gaichas (NOAA)

Steve Cadrin (SMAST)

Thao Le (NOAA)

Tom Nies (NEFMC)

Tony fr BumbleBee

Jessica Blaylock (NOAA)

John-Paul Bilodeau

Kiersten Curti (NOAA)

Jason Didden (MAFMC)

Megan Ware

Gerry O'Neill

Richard Kyvlar

Raymond Kane

Cheri Patterson

Mark Terciero (NOAA)

Micheal Simpkins (NOAA)

Greg DiDominico

Andrew Jones (NOAA)

Brian Stock (NOAA)

David Mussina

Erica Fuller

Glenn Chamberlain (NOAA)

Katey Marancik (NOAA)

Sara Weeks (NOAA)

Tara Trinko Lake (NOAA)

Emily Gilbert (NOAA)

Alissa Wilson (NJDEP)

Tony Wood (NOAA)

David Richardson (NOAA)

Douglas Christel (NOAA)

Paul Rago (MAFMC)

Robert Latour

Alicia Miller (NOAA)

Yong Chen

Charles Perretti (NOAA)

Thomas Alspach

John Manderson

Russ Brown (NOAA)

Ariele Baker (NOAA)

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Tuesday, June 23, 2020

Mike Wilberg - Chair

Fred Serchuk - Panel

Edward Houde - Panel

Russ Brown - NOAA

Michele Traver - NOAA

Alicia Miller - NOAA

Alissa Wilson

Anthony Wood - NOAA

Ariele Baker - NOAA

Audy Peoples - NOAA

Brandon Muffley - MAFMC

Brian Linton - NOAA

Brooke Wright - NOAA

Charles Adams - NOAA

Dan Hennen - NOAA

Daphne Munroe

Dave Wallace

David Nelson - NOAA
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David Richardson - NOAA

Douglas Christel - NOAA

Douglas Potts - NOAA

Eric Powell

Gary Shepherd - NOAA

Greg DiDominico

Hannah Welch

Jason Didden - MAFMC

Jeff Kaelin

Jessica Blaylock - NOAA

Jessica Coakley - MAFMC

Jon Deroba - NOAA

Jose Montanez - MAFMC

Kathy Sosebee - NOAA

Kathleen Hemeon

Larry Alade - NOAA

Laura Solinger

Lisa Hendrickson - NOAA

Mark Terceiro - NOAA

Meghan Plourde

Owen Nichols

Paul Rago - MAFMC

Peter Himchak

Roger Mann

Sarah Gaichas - NOAA

Steve Cadrin - SMAST

Susan Wigley - NOAA

Thomas Alspach - SeaWatch processor

Toni Chute - NOAA

Wendy Gabriel - NOAA

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Wednesday, June 24th

Mike Wilberg - Chair

Fred Serchuk - Panel

Edward Houde - Panel

Russ Brown - NOAA

Michele Traver - NOAA

Alicia Miller - NOAA

Ariele Baker - NOAA

Charles Adams - NOAA

Jessica Coakley - MAFMC

Jose Montanez - MAFMC
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