COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON MANAGEMENT FRAMEWORK FOR THE CENTRAL SUBPOPULATION OF NORTHERN ANCHOVY

Introduction

In 2016, the Pacific Fishery Management Council (Council) began a series of meetings and workshops to consider methods for assessing Coastal Pelagic Species (CPS) stocks, the data available for a new central subpopulation of northern anchovy (CSNA) stock assessment, setting overfishing limits (OFL) for CSNA, and the risks associated with the frequency of OFL updates. The last stock assessment for the CSNA was performed over 25 years ago. Although landings since 2000 have been below the acceptable biological catch (ABC), the Council has requested more recent information regarding the status of the stock.

The following summarizes outcomes of previous work leading up to the current flowchart and OFL framework:

- In September 2016, the Council endorsed the technical workshop recommendations that the best approach for providing management advice for the CSNA was development of an integrated stock assessment model and identified the CSNA as a priority stock for assessment (Agenda Item E.2.a, September 2016).
- In November 2016, the Council received a report from the Scientific and Statistical Committee (SSC) on integrated stock assessments and procedures for setting and updating OFL, ABC, and Minimum Stock Size Threshold (MSST). The Council tasked the SSC, Coastal Pelagic Species Management Team (CPSMT), and Coastal Pelagic Species Advisory Subpanel (CPSAS) to work together on developing updated management recommendations based on the report (Agenda item G.4.a, November 2016).
- In April 2017, a joint report by the SSC and CPSMT provided several options for developing an OFL for CSNA. The joint report also noted that the Southwest Fisheries Science Center (SWFSC) had already proposed the Acoustic-Trawl Methodology (ATM) undergo a methodology review in 2018 and there would be a need to derive a nearshore correction factor (Agenda Item G.2.a, April 2017).

These meetings and resulting work culminated in the development of a flowchart in 2019 that serves as a potential framework and timeline for periodically conducting stock assessments and evaluating and updating OFL and ABC rules. This report presents a revised flowchart including recommendations on values to inform the flowchart parameters, and some ideas on how the Council might consider modifying its approach to CSNA management.

Framework/Flowchart

In April 2019, the Council directed the CPSMT, CPSAS, SSC CPS Subcommittee, and the SWFSC to 1) determine the nearshore estimation methodologies necessary to complement the ATM survey, 2) review Dr. André Punt's analysis of frequency to revisit overfishing limits (Agenda Item E.4, Attachment 2, April 2019), 3) recommend the appropriate frequency for assessments and management changes for CSNA, 4) develop alternatives for accountability measures that would be triggered at specific stock levels, and 5) determine which data to use to

analyze whether a trigger has been reached. A meeting to accomplish these objectives was held October 3-4, 2019 at the SWFSC with representatives of the advisory groups and members of the public in attendance.

Subsequently, a joint meeting report (Agenda Item D.4, Attachment 1) and a presentation by Dr. André Punt and Mr. Greg Krutzikowsky (Agenda Item D.4, Supplemental Presentation 1) were provided to the Council for its November 2019 meeting. Under Task 2 in the report, a management framework with a graphical flowchart (hereafter referred to as the flowchart) was provided as one potential path for managing the CSNA fishery. The flowchart specifically examined the frequency, triggers, and accountability measures for revisiting reference points for the stock. The meeting report concluded that the flowchart was appropriate for setting triggers and time intervals to change management reference points in response to changes in biomass, and that the ATM survey with a nearshore correction factor provides the best index of anchovy biomass and is thus the best data to use to determine if a trigger had been reached.

The original flowchart (Figure 1) consists of four basic parts or rows. Each row has parameters that determine what is done and when it is done that are briefly described here from top to bottom. The Y row determines the frequency of stock assessments. The Z row determines the frequency of an OFL update. The X row determines the frequency that short-term biomass is examined for potential modification of the ABC. The bottom row in the flowchart determines whether to evaluate the need for a new assessment the following year. The flowchart process then starts over the next year at the top row. To implement the flowchart, values for each parameter need to be chosen, including those that define long-term and short-term biomass.

Dr. Punt conducted extensive modeling evaluating a variety of scenarios and parameter values for the variables in the flowchart, and provided a summary of the results in a supplemental report (Agenda Item D.4, Supplemental Attachment 2). The Council also received supplemental reports from the SSC (Agenda Item D.4.a, Supplemental SSC Report1), CPSMT (Agenda Item D.4.a, Supplemental CPSMT Report1), and CPSAS (Agenda Item D.4.a, Supplemental CPSAS Report 1) on this agenda item. The SSC report stated that many elements of a management strategy evaluation (MSE) recommended at the 2018 ATM survey methodology review (Agenda Item C.3, Attachment 2, April 2018), to allow use of CSNA ATM abundance estimates directly in management, were contained in the joint report and subsequent modeling work, but that a fuller MSE exploring consequences of various levels of survey bias would be desirable in the future. The CPSMT report noted the flowchart's potential use of biomass estimate information now available from the ATM surveys for providing scientific information for updating OFL and/or ABC values. The CPSMT also pointed out the need for improved clarity on one specific aspect in the flowchart regarding the ABC. The CPSMT also indicated a need for more time to fully evaluate both the modeling results before making any recommendations on parameter value choices and how using the flowchart concepts might align with current management.

With the delays in bringing this topic back to the Council due to the COVID-19 pandemic, the CPSMT has had time to continue working on the CSNA flowchart. In consultation with members from the joint meeting that were key architects of the flowchart, the CPSMT made the necessary clarification related to the ABC and selected a key parameter value that simplifies the flowchart process (Figure 2). The CPSMT also reviewed the modeling results, and considered how the

flowchart concepts compare with the current management framework for this stock and ways to implement them into CSNA management. These were all discussed with the CPSAS to get their feedback at the April 2021 Council meeting. This report consolidates that work and provides information and recommendations for Council consideration.

At our February 2021 meeting the CPSMT selected several parameter values for the flowchart based on criteria that include both practicality and statistical considerations. The practical considerations included the data available for assessing the stock, stability for the fishery, and workload issues for all concerned with management of not only this stock, but all stocks included in the CPS FMP. For the statistical consideration we reviewed the modeling work done by Dr. Punt, which used a wide range of values for each parameter (Table 1) and interpreted the results of the performance metrics in relative rather than absolute terms, as suggested by the SSC. The CPSMT also kept in mind that the modeling assumption that the entire ABC was taken by the fishery each year resulted in an overestimation of the conservation related statistics in the modeling results because the fishery has not reached that level of ABC attainment (See landings, Figure 3). This was also noted by both Dr. Punt in his November 2019 report and by the SSC report.

Table 1. The parameters and the values examined in modeling work conducted by Dr. André Punt in 2019 (see Agenda Item D.4, Supplemental Attachment 2).

Parameter	**Values modeled in 2019**
Frequency of assessment (Y)	4, 8, 16
Frequency of OFL update (Z)	1, 4, 8
Frequency of ABC update (X)	1, 2, 4
Q (ABC buffer)	0.05 to 0.95 in steps of 0.1
x_1 (OFL update threshold)	0, 0.1, 0.2, 0.3
x_2 (ABC update threshold)	0, 0.1, 0.2, 0.3
Definition of long-term biomass (B_{LT})	1, 5, 10, 60
Definition of short-term biomass (B_{ST})	1, 2, 3
MAXCAT	None, 25,000t

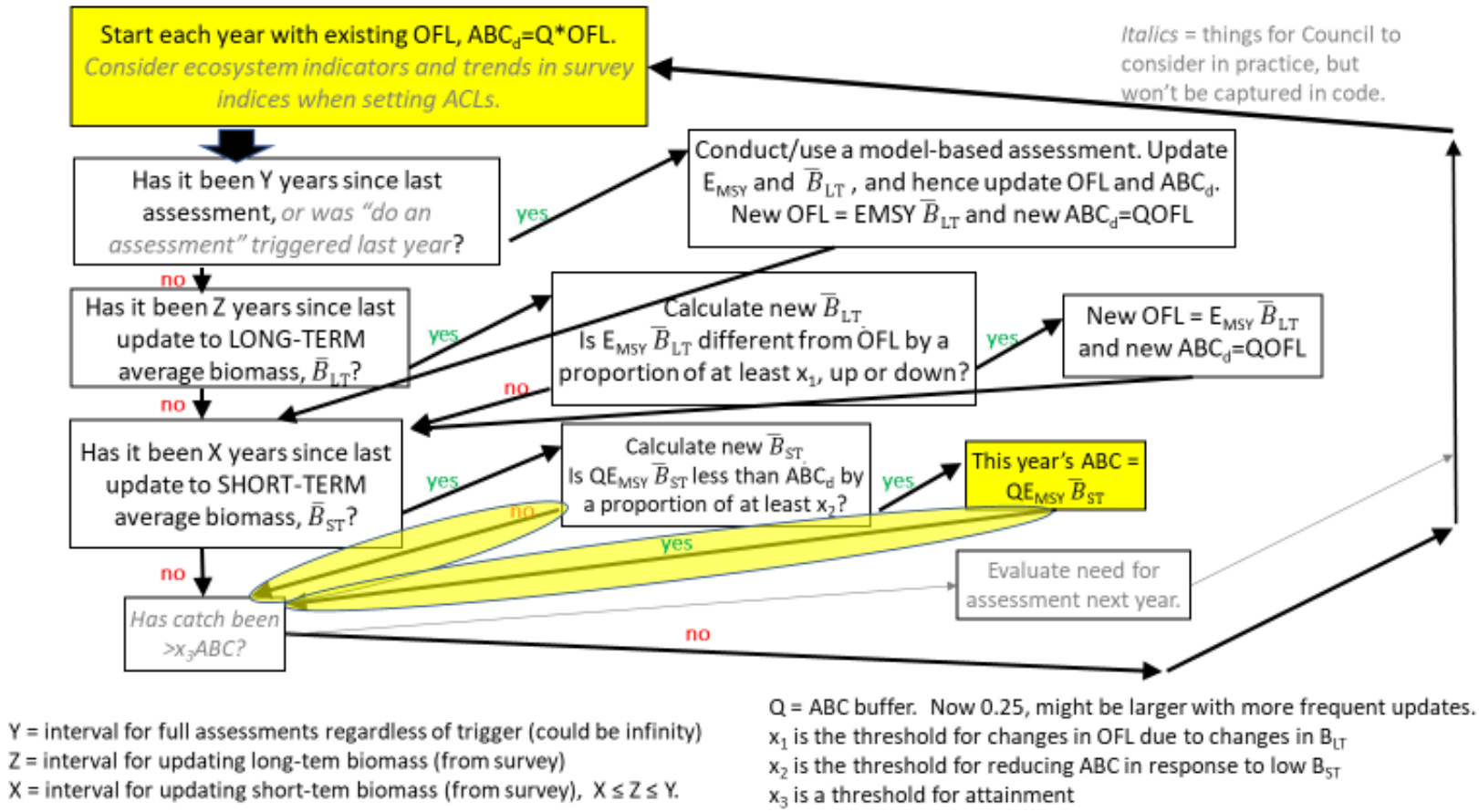

Figure 1. Original flowchart showing the issues identified regarding use of the ABC triggered by a decline in biomass vs. the default ABC (ABC_d) calculated from an assessment in November 2019 highlighted in yellow. The revised flowchart in Figure 2 in this report eliminates the row for updating the OFL in the original flowchart entirely because the recommended parameters for the interval for full assessments, Y, and the interval for updating the OFL, Z, are both equal to 8. Thus, every 8 years a full assessment would be conducted and the OFL and ABC_d would be determined based on the results of those assessments.

short

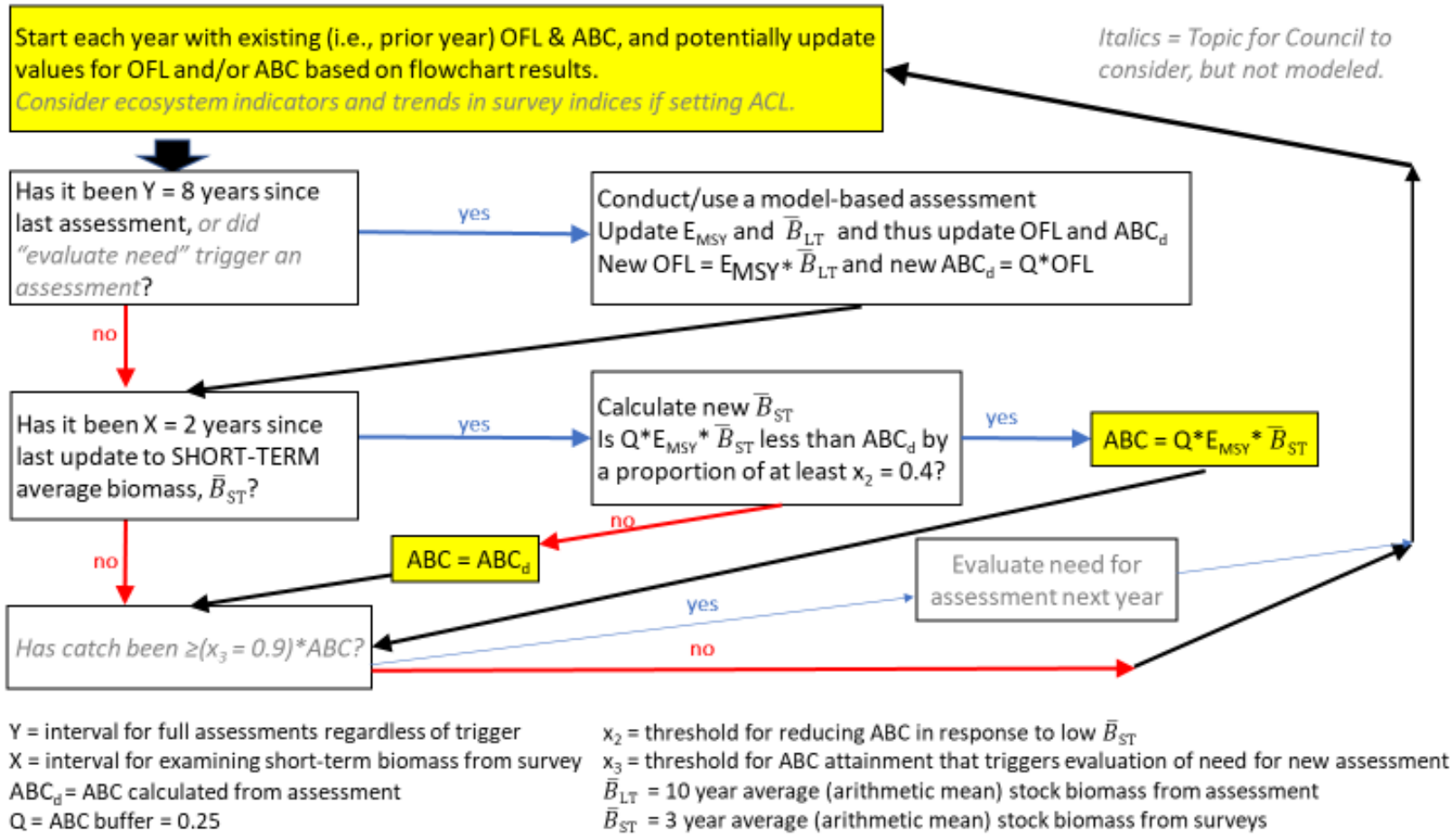

Figure 2. Revised flowchart depicting CPSMT recommendations for parameter values (Y, X, x_2, x_3) and definitions for long-term and short-term biomass (B_{LT}, B_{ST}). This revised flowchart eliminates the row for updating the OFL (Z row) in the original flowchart entirely because the recommended parameters for the interval for full assessments, Y, and the interval for updating the OFL, Z, are both equal to 8. Thus, every 8 years a full assessment would be conducted and the OFL and ABC_d would be determined based on the results of those assessments. The yellow highlighted boxes are the elements identified in November 2019 needing clarification, regarding use of the ABC triggered by a decline in biomass vs. the default ABC (ABC_d) calculated from an assessment.

The CPSMT agreed that the long-term biomass (B_{LT}) definition should be 10 years and the short-term biomass (B_{ST}) definition should be 3 years. The estimate of long-term average biomass would be an output from a stock assessment and the short-term biomass estimate would be computed as a 3-year rolling average from the CPS/ATM survey with a nearshore correction factor. These values were selected for both practical and statistical reasons. Ten years was deemed to be a practical period for the definition of an average long-term biomass from assessments to determine the OFL given the available data which includes ATM surveys and CalCOFI surveys with egg/larvae information. It is also a practical time period to provide stability for the fishery and longer than the 5-year period that was recommended as a minimum value by the SSC. A rolling 3-year average was deemed to be an appropriate period for the definition of short-term biomass to reduce the possibility of "chasing noise" in survey results given the patchy nature of CPS distribution and the identified potential shortcomings from methodology reviews of the ATM survey in accurately estimating CPS biomass in any given year.

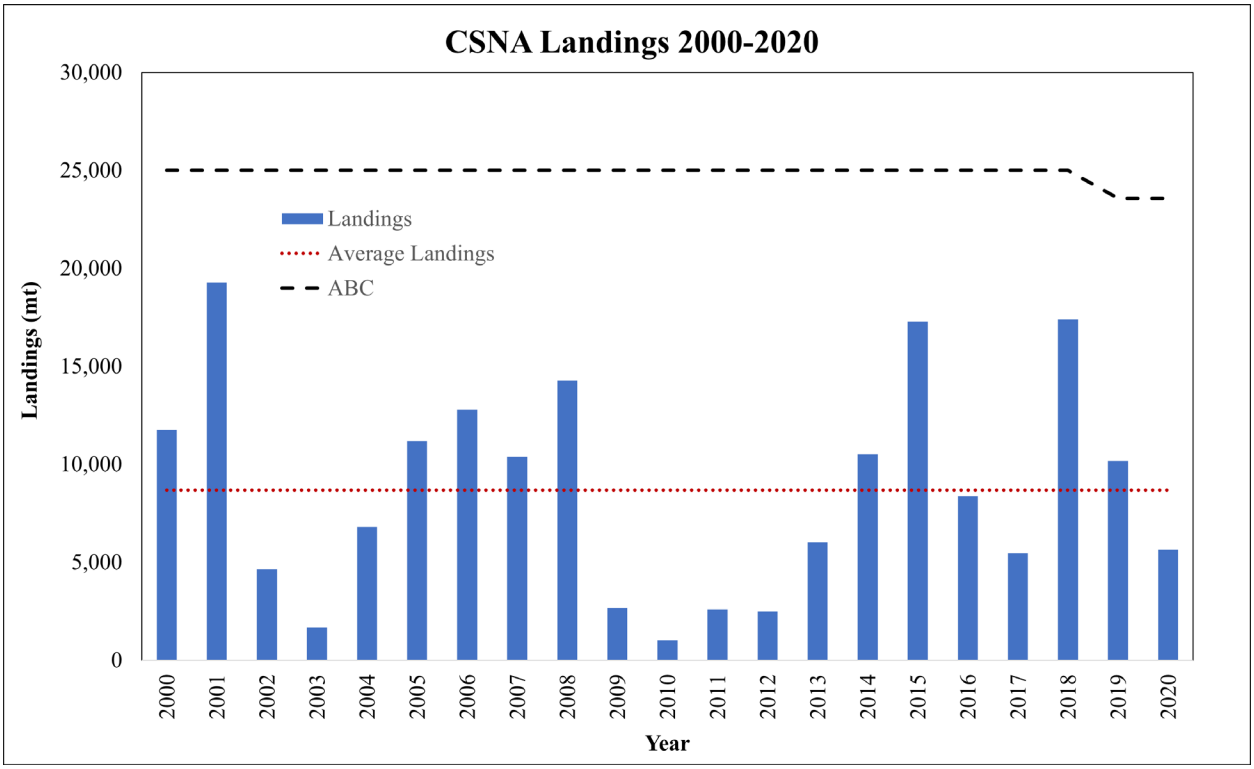

Figure 3. Annual landings and average landings (mt) of CSNA from 2000-2020. Landings of CSNA are influenced by market demand and other CPS fishing opportunities.

From among the modeled choices (4, 8 or 16) for the Y parameter, which determines the frequency at which assessments would be conducted, we opted to set Y equal to 8 years. We also set the frequency of OFL updates - the Z parameter - equal to 8. With Y and Z equal, a benchmark assessment would be done every 8 years to update both the OFL and ABC. The choice of 8 years for both of these parameters simplified the flowchart in that the entire row and process for the Z and x_1 parameters is no longer needed (Figure 2). Planning for assessments and updating management specifications is thus more straightforward and predictable. An 8-year assessment cycle for a species that lives about 7 years and whose interim stock status would be reviewed

biennially with results from surveys provides for a low risk of overfishing based on the modeling results, especially with the very large buffer (Q = 0.25) between the OFL and the ABC. The CPSMT sees no reason to change the current buffer value for Q, as this buffer has been shown to provide excellent conservation results based on the modeling work. In fact, Dr. Punt reported that Q was the most influential parameter in his modeling. Choosing an 8-year interval for CSNA assessments also allows for flexibility for the Council and stock assessment teams to focus on other CPS matters and assessments.

After setting the long-term OFL and ABC_d (default ABC) based on the assessment results, the short-term biomass would also be examined to see if a change to the ABC was warranted based on the established trigger, x_2, in the flowchart. During the interim between assessments, at an interval of every X years (1, 2 or 4), the Council would receive an update on B_{ST}, the average short-term biomass from survey results over the last 3 years. If B_{ST} met or exceeded the x_2 trigger threshold (e.g., 0.1, 0.2, or 0.3), the ABC would be set lower. At the next X interval (1, 2, or 4 years) the Council would either set the ABC back to its default value ABC_d if B_{ST} did not meet the threshold value or set a new ABC based on the formula if B_{ST} again met the threshold.

In the interest of examining and comparing results for higher values of the x_2 trigger, the CPSMT asked Dr. Punt to conduct additional model runs. The CPSMT requested model runs with parameter values x_2 = 0.4 and 0.5, with Y = 8, Z = 8, X = 1 and 2, long-term biomass defined as the average of the last 10 years, short-term biomass defined as the average of the last 3 years, Q = 0.25, and no MAXCAT. After reviewing those results, the CPSMT recommends that the trigger x_2 be set to 0.4. Compared to the other modeled options (i.e., 0.1, 0.2, 0.3) using this value means that a change triggered in the ABC will be larger than if the smaller values were used. On the other hand, the smaller values would reduce the ABC less, but likely entail more frequent changes. The CPSMT also recommends setting the interval between formally examining changes in B_{ST} to X = 2 years. The choice of 2 years rather than 1 year allows for B_{ST} to include 2 years of new data when calculating the 3-year average short-term biomass. Compared to one year, 2 years should also help clarify if there is a trend in biomass but is more responsive than a 4-year interval. Setting x_2 at 0.4 and X at 2 years provides relative stability for the fishery and given the very large buffer between the ABC and the OFL that is already in place, avoids making unnecessary small changes to the ABC at frequent intervals.

The final parameter to complete the flowchart is the x_3 trigger. This parameter could not be modeled as it represents fishery attainment of the ABC. The purpose of this trigger is to evaluate the need for a new assessment based on the fishery catch approaching the ABC. The evaluation would include an examination of market demand, trends in biomass, and ecological indicators, such as those in the IEA reports that the Council receives each March, to determine the need for a new assessment. After consulting with the CPSAS, the CPSMT recommends that the value for the x_3 trigger be set to 0.9. Thus, if the fishery catches 90 percent or more of the ABC an evaluation takes place to see if a new assessment should be planned for the following year. It is understood that it would then take time before the results of the assessment would be available for Council consideration and for subsequent changes to the OFL and ABC.

These are not new concepts; the point-of-concern and socio-economic frameworks in the CPS FMP provide a mechanism for the Council to respond to changes in fishery dynamics. That

mechanism allows for adjustments to be made to harvest parameters as needed to either allow expanded fishing opportunities or cut back on fishing for the stock depending on what is warranted by the fishery dynamics and the stock size. The distinction is that the flowchart expresses the mechanism numerically, with prescriptive triggers.

In summary, the revised flowchart with the parameter values described (Figure 2) provides for: 1) periodic stock assessments to set the OFL and ABC every 8 years, and 2) scheduling a biennial evaluation of B_{ST} as well as fishery attainment of the ABC. The Council would receive this information for possible management action and/or scheduling of a new assessment every 2 years. The trigger for a change to the ABC would be a short-term biomass that is at least 0.4 less that the default ABC from the last assessment. If that ABC trigger is hit, the ABC would be reduced to $Q*E_{msy}*B_{ST}$ for the next two fishing years until B_{ST} is evaluated again. When next evaluated, if B_{ST} is no longer less than $0.4* B_{ST} *ABC_d$ (the ABC that was calculated from the OFL) the ABC for the following two fishing years would revert back to ABC_d. The trigger for evaluating if another assessment is warranted would be fishery attainment of 90 percent or more of the current ABC value during two years. The CPSMT based its parameter recommendations on both practical considerations as well as the relative performance metrics for modeled parameters. Additionally, the CPSMT would keep track of changes in the B_{ST} as well as fishery attainment of the ABC during the interim years when this would not be a scheduled Council agenda item. At a minimum the results would be included in the stock assessment and fishery evaluation (SAFE) document. The CPSMT could also use the point-of-concern framework to bring a sharp decline in CSNA biomass or exceptionally high ABC attainment to the Council's attention for action.

The CPSMT also considered the flowchart in terms of Council process if the Council decides to pursue its use for management. The SWFSC indicates results from their summer ATM surveys should be available by February following the summer survey. This would support a regular agenda item for the Council at its April meeting to look at changes in short-term biomass. Given the proposed timeline of providing the Council with updated stock status information based on recent survey results in April, it may be worth considering a revision to the current calendar fishing year for this stock. If the calendar fishing year is maintained, changes to the ABC triggered by a low B_{ST} estimate could not be implemented until January, more than a year after the ATM survey was conducted. However, if the fishing year were changed to be July 1 to June 30, the revised ABC could be implemented closer to the next fishing year. At a minimum, even if the calendar fishing year is maintained, implementing the flowchart would improve responsiveness to declines in B_{ST} with a formal examination and trigger for changing the ABC.

The dependency of the flowchart on survey results should be viewed in light of what we have recently learned about the need for some level of flexibility to adapt to changes beyond our control (e.g., ATM survey cruises may not be able to take place every year, as occurred in 2020, or may not be able to fully sample the range of CSNA, as occurred in 2017). There are also some aspects presented in the flowchart that will need additional input and/or future scientific review from the SSC if it is adopted. As an example, and as mentioned above, there may be value in exploring a more developed MSE that examines various levels of bias in survey biomass estimates. Also, changes to the ABC indicated by the flowchart would need to be recommended to the Council by the SSC to conform with National Standard 1 guidelines.

As described above, if the Council decides to move forward with the use of the flowchart, the Council would thereby be adopting regularly scheduled Council agenda items and formal reviews of the data utilized in the flowchart by the CPSMT and/or SSC during the same and/or intervening years as those agenda items. However, there are potentially several ways that the Council could more formally adopt the flowchart.

A. In its simplest form the flowchart provides the Council with a transparent decision-making tool for the "when necessary" component in the CPS FMP of revising the OFL and ABC. In the past the CPSMT has suggested tools like this, along with the data informing them, could be described in the SAFE document and presented to the Council at regular meetings. The SAFE is required to be prepared and reviewed annually and is used to summarize the best available scientific information concerning the stocks and fisheries under the CPS FMP as well as other ecosystem information.
B. Similarly, Council Operating Procedure 9, Schedule 3, describes the annual management and activities for CPS, and outlines Pacific mackerel and Pacific sardine specifically. This schedule could be amended to describe the assessment cycle and the monthly schedule of activities, (e.g., preparation of draft assessments, review by Council advisory bodies, Council adoption) to be followed in assessment years for CSNA, and/or expanded to describe the consideration of short-term biomass and potential reduction in ABC should the full flowchart be implemented.
C. The Council could also consider whether the flowchart or aspects of the flowchart could be included in the CPS FMP itself.

Additional CSNA Management Approaches for Consideration

Under existing policy, the Council has the ability to respond to changing CSNA resource and fishery needs through the CPS FMPs point-of-concern and socio-economic frameworks. This existing policy provides the Council a structure to support deliberations, otherwise, the policy does not provide specific, quantitative thresholds to trigger action, nor is it highly prescriptive in terms of the type or frequency of response. Consequently, though the Council currently has latitude in its considerations, there is less "built-in" guidance that might facilitate decision-making.

The CPSMT is providing the flowchart to the Council as an option for a more "built-in" process or tool for revising the OFL and ABC that is also in line with existing policy. However, through the FMP framework, there may be other ways to address the Council's management priorities for CSNA.

A. Instead of adopting the flowchart in its entirety, the Council could select certain portions of the flowchart. For instance, similar to the Y row of the flowchart, a set schedule for revising the OFL could be accomplished through a periodic assessment schedule. With the potential completion of a new stock assessment for CSNA, and the expectation that the data necessary to update that assessment in future years will be available, the Council will likely have the ability to set a new long-term OFL based on this assessment and then revisit that OFL on some defined schedule to either revise or reaffirm those reference points. This would be similar to adopting the top portion of the flowchart (Y row) which the CPSMT currently proposed would occur on an 8-year cycle.
B. If the Council's primary concern was to prescribe the steps to take if and when the CSNA population declines to low levels, such as to automatically lower allowable harvest levels

when the stock is low, aspects of the lower half, or the X row, of the flowchart utilizing short-term biomass to revise the ABC could be adopted. A reduction in allowable harvest could also be triggered through the use of single or multiyear thresholds that only revise the ABC (i.e., increase the buffer on the OFL) when the stock is at very low levels. Similar to the flowchart presented, these types of frameworks could be adopted while maintaining the overall objectives of existing CSNA management but with varying degrees of prescription of when and what action would be taken.

C. Alternatively, the Council might consider deviating from the existing management structure for CSNA and explore an assessment schedule and management framework like that for Pacific mackerel which the Council adopted in response to a low level of landings in that fishery relative to the ACL and biomass, but a desire by industry to maintain the potential to take advantage of high biomass years or increases in demand. Currently, a benchmark assessment is conducted for Pacific mackerel every four years, with catch projections every intervening two years. Harvest specifications, expressed as annual values, are adopted every two years. Compared to the status quo, this approach would deviate from an MSY based OFL approach, but it creates a predictable 4-year schedule for CSNA assessment and would result in a biennial review of the stock's status by the Council and its advisory bodies with the potential to adjust harvest specifications.

Conclusion

It is worth noting that the current and future data available to the Council to make decisions on CSNA management needs, and therefore status quo management, have changed since this process began in 2016. Specifically, the flowchart envisions annual ATM biomass estimates for CSNA. These estimates of biomass were not previously available to the Council, and therefore prior to 2018/2019 the CPSMT and the Council were generally reliant on trends in other indices of relative abundance to understand the general stock status of CSNA. The CPSMT anticipates that on an annual basis the SWFSC will be producing and presenting the ATM survey results to the Council during NMFS reports, for the Council to respond to in the future.

The Council now also has a biennial CPS stock assessment prioritization (SAP) process (Agenda Item F.2, June 2019). This process provides the opportunity for Council deliberations for CPS stock assessments with advice provided by the SSC, Council advisory bodies, management agencies, and the public relative to data quantity and quality and assessment resources. The new process is intended to guide stock assessment priorities, consider impacts to survey design, and the long-term integrity and value of abundance indices. The process is also intended to be sufficiently flexible to allow for revisions in the intervening year based on new information. Originally scheduled for November 2020 but cancelled due to COVID-19 scheduling constraints, the SAP process will start November 2021 and will inform stock assessment priorities beginning in 2023. Finally, the recent modeling analysis by Dr. André Punt (Agenda Item D.4, Supplemental Attachment 2, November 2019) should help the Council make decisions on what steps to take next with regards to the management framework for CSNA. The modeling analysis provides the Council some confirmation that current management for CSNA, with its 75 percent reduction from the OFL to the ABC, is relatively risk averse over time to changes in stock size.

PFMC
6/01/21