Stock Assessment Prioritization
NOAA Alaska Fisheries Science Center
Discussion Paper

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Introduction

In the face of the nationwide demand for timely and efficient delivery of sound stock assessment advice using the best scientific information available, the National Marine Fisheries Service (NMFS) established the Stock Assessment Prioritization (SAP) plan, which serves as a guide for how stock assessments should be prioritized in a given year (Methot et al. 2015). To accommodate regional needs, NMFS tasked each regional fishery Management Council to develop their own prioritization process using methods detailed in Methot et al. (2015) as a starting point. In 2017, the Alaska Fisheries Science Center (AFSC) and the North Pacific Fisheries Management Council (NPFMC, Council) worked together to implement a stock assessment prioritization process for the North Pacific region that improved efficiency in the stock assessment process while maintaining the high quality and timely advice that has guided the NPFMC's ecosystem approach to fisheries management.

The 2017 stock assessment prioritization effort focused on revising the target frequency for the delivery of stock assessment advice. Utilizing input from AFSC staff, the NPFMC Plan Teams, and the NPFMC Science and Statistical Committee (SSC), a suite of scenarios were developed for crab and groundfish stocks based on fishery importance, target frequency, ecosystem importance and stock status (Hollowed et al. 2017). Ultimately, stock assessment frequencies based on 1, 2, or 4 year cycles were considered and adopted for all crab and groundfish stocks with the implementation of partial assessments for select stocks when other assessment products were not required. Scheduling of assessments and determining a revised assessment frequency was accomplished based on optimizing AFSC staff resources relative to the timing of the complementary biennial surveys in the Gulf of Alaska and the Aleutian Islands.

In 2017, both the Plan Teams and the SSC requested a five year review of the stock assessment prioritization decisions (2017 Joint Plan Team Minutes; SSC Report February 2017). In October 2022, the AFSC presented an update on stock assessment prioritization to the Council review bodies and the Council. While difficult to quantify, comparisons of stocks that were recommended for lower frequencies in 2017 had no deleterious effects in response to being assessed at longer intervals (2022 October SSC Presentation). This dialogue resulted in the identification of several decision points to help guide re-evaluation of stock assessment prioritization and assessment frequencies. SSC comments and recommendations from the October 2022 meeting include (SSC Report October 2022):

- "The SSC requests that the AFSC and JGPT develop definitions of partial, full, and benchmark assessments and specify what documentation and level of review are needed for each."

- "The SSC supports the approach presented by the AFSC for the re-evaluation of stock prioritization. Specifically, for the stocks recommended for reduced frequency in 2017, (1) use the 2017 stock prioritization as a starting point, (2) calculate at least the two presented metrics (the ratio of catch to ABC and the average percent change in ABC by year) to compare before and after 2017 and, (3) for stocks with projected biomass, calculate the difference between projected and realized ABC since 2017 (e.g., as presented for yellowfin sole). In addition, the SSC requests a short narrative of key considerations on a stock-by-stock basis for species that are being recommended for a change in assessment frequency."

- "In addition, the SSC requests recommendations on whether partial, full, and benchmark assessments each occur on pre-defined schedules or whether the decision on conducting a full or benchmark assessment might be determined each year at the September GPT meetings."

- "The SSC endorses the reproducibility and streamlining processes. The SSC encourages efforts in automating rote tasks to promote standardization and efficiency in communication."

This document summarizes the AFSC's recommendations for moving forward on stock assessment prioritization. First, this document includes 13 additional groundfish stocks to be considered for reduced stock assessment frequency by the NPFMC. No changes to the stock assessment frequency of crab stocks are considered at this time. Secondly, the AFSC has developed Terms of Reference (TOR) for defining the types of stock assessments AFSC will produce. Clear definitions will help AFSC provide streamlined assessment products that promote efficiency, standardize assessment schedules, and improve the review process. Finally, new Stock Assessment and Fishery Evaluation (SAFE) Guidelines are being developed to provide stock assessment authors detailed guidance on the baseline content and format of the required stock assessment products, based on assessment type.

Assessment Frequency

The 2017 stock assessment prioritization analysis conducted by Hollowed et al. (2017) generated target frequencies for conducting assessments following five themes; fishery importance, stock status, ecosystem importance, assessment information, and stock biology. Target assessment frequency was calculated by taking the best estimate for mean fishery age, multiplying by a regional scaling factor, and then adjusting by three factors; recruitment variability; fishery importance; and ecosystem importance. Five alternative scenarios were considered in the analysis. The base scenario from Methot et al. (2015) provided default values, but this approach resulted in approximately 60% of NPFMC stocks being conducted on an assessment frequency more than every five years. At that time, no NPFMC stock assessment frequency interval was greater than two years. To reduce the recommended interval between assessments, the Plan Teams and SSC chose results from "Scenario 4" which capped the maximum interval between assessments at five years and also used a regional scalar relative to each stock's commercial value. This scalar was adjusted so that high commercial value stocks would be assessed on an annual basis. The adjustments for recruitment variability and ecosystem importance resulted in plus or minus one year frequency increments depending on the ranking and plus or minus two years for fishery importance.

The Plan Team and SSC evaluated the estimated target stock assessment frequencies on a stock by stock basis and developed independent recommendations (Figure 1). The Plan Teams also polled both authors and individual Plan Team members on stock assessment frequency for each stock or stock complex in each area to gather a range of opinions. For some stocks, individual recommendations differed from the Scenario 4 results and were variable among individuals (Figure 2). While the stock assessment authors and Plan Teams largely agreed on the stock assessment frequency for high profile more valuable stocks, there was less agreement for less valuable and lower tier stocks. Nevertheless, the stock assessment authors and the Plan Teams generally recommended a lower stock assessment frequency than the status quo frequencies used prior to 2017. Ultimately, for assessments recommended to be other than annual, the

Teams and the SSC recommended even year (divisible by 2) target frequencies. This was based on the biennial periodicity of the AI and GOA trawl surveys. In keeping with this, the maximum time between assessments was set to 4 years, compared to the S4 maximum of 5 years.

In 2017, of the 53 groundfish stocks for which harvest limits are specified each year (25 BSAI, 28 GOA), 16 stocks were proposed by the Groundfish Plan Teams for reduced stock assessment frequency. The SSC recommended, and the Council agreed, that 11 groundfish stock assessments should be subject to less frequent stock assessments in response to the prioritization process. Additionally, recommendations were provided on how to proceed during stock assessment "off-years" to ensure that stocks would be appropriately monitored. These recommendations characterized the types of analysis that would be required for the SAFE report as a function of the Tier for each stock (i.e., stocks that are categorized as being in one of the six tiers). The type of assessments defined in 2017 included full, partial (exec. summary with updated catch only), and none; the following schedule summarizes the 2017 recommendations:

Assessment Frequency	Tier	Type and timing of assessments
Annual	1-3	Full assessment each year
Every 2 years	1-3 4-6	Full in year 1, partial in year 2 Full in year 1, none in year 2
Every 4 years	1-3 4-6	Full in year 1, partial in years 2-4 Full in year 1, none in years 2 and 4, partial in year 3

In response to the 2017 request for a 5 year review of the existing stock assessment prioritization process, AFSC staff presented a suite of additional stocks to be considered for reduced frequency schedules in October 2022. Following Plan Team, SSC, and Council guidance and recommendations received in October 2022, we provide rationale for reducing the stock assessment frequency for 13 stocks (Table 1). Rationale for stock assessment frequency reductions are based on SSC recommendations made in October, 2022: the 2017 prioritization analysis (Hollowed et al. 2017) based on Methot et al. (2015) guidance; subsequent Plan Team and SSC decisions; catch to ABC and biomass ratios for each stock since 2017; model projected ABC versus model estimated ABC difference since 2017; and primary survey index frequency. Only frequencies between 1-4 years were considered, following review body decisions made in 2017. Scheduling of assessment frequency by year is not provided here. The AFSC will have to balance final decisions on assessment frequency with author workload and scheduling to ensure consistent expectations of assessment products across years, similar to what was done in 2017. While making decisions on benchmark versus update assessments could occur during the October Council meeting (See section below for assessment definitions), a predetermined schedule is necessary for now to ensure the AFSC can maintain the capacity to meet assessment demands. However, it is recommended that the Plan Teams and SSC provide guidance annually in November/December to communicate expectations for an update versus benchmark assessment the following year. There are no changes recommended to type and timing of assessments in off-years, other than redefining assessment types which are presented later in this document.

Bering Sea/Aleutian Islands Atka Mackerel

Overview

Bering Sea Aleutian Islands (BSAI) Atka mackerel is a high value stock in this region, with an average annual ex-vessel value of 43.01 million USD from 2017-2020 (2020 Economic SAFE Report). Atka mackerel in the BSAI are managed as a Tier 3 stock and assessed annually based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments were made to the 2017

analysis for fishery importance and ecosystem importance. The biennial Aleutian Islands bottom trawl survey is the only survey index used in the Atka mackerel assessment. The Total Allowable Catch (TAC) is typically set below the Acceptable Biological Catch (ABC) due to market considerations and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 80% (Table 1, Figure 3). This stock is considered fully utilized with catch typically approaching TAC on an annual basis. The average change in ABC from 2017-2021 was 12%. The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 13%. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI Atka mackerel to a two year assessment frequency schedule. The results of the 2017 stock assessment prioritization used a scalar weighted by value of catch. The BSAI Atka mackerel fishery was set to a one year stock assessment frequency due to the high value fishery for this region and ecosystem importance (Steller sea lion prey species). The single survey used for this stock is conducted on a biennial basis.

Annual assessments of BSAI Atka mackerel are not necessary because of the paucity of data informing the model in off-survey years, in particular the lack of a survey relative index of abundance. During off-survey years only catch, and fishery or survey age composition data (lagged by a year) inform the stock assessment model. The AFSC proposes moving BSAI Atka mackerel to a biennial stock assessment frequency to align with the Aleutian Islands bottom trawl survey schedule. In the off-years updated catch data will be used in a partial assessment. The variation in projected and actual ABCs (13%) is due to many factors including large fluctuations in survey biomass, associated survey index uncertainty, recruitment, etc., rather than stock assessment frequency. The risk of exceeding the OFL is low despite BSAI Atka mackerel being fully utilized, because the TAC is typically set below the ABC. There are no requirements for assessment frequency in the Steller Sea Lion Biological Opinion (2014 Steller sea lion protection measures) thus, changing the assessment frequency from one to two years does not impact requirements under the Steller sea lion recovery plan.

Gulf of Alaska Atka Mackerel

Overview

GOA Atka mackerel are managed as a Tier 6 stock due to the lack of reliable biomass estimates. The GOA Atka mackerel assessment is conducted biennially, aligning with the GOA bottom trawl survey, and based on the outcomes of the 2017 stock assessment prioritization analysis. Lower frequency adjustments were made to the 2017 analysis for fishery importance. As a Tier 6 stock, GOA Atka mackerel are assessed based on catch history. Survey indices are deemed unreliable because of extreme variances due to Atka mackerel's patchy distribution and affinity for untrawlable habitat. Tier 6 of Amendment 56 of the GOA Fishery Management Plan (FMP) defines the overfishing level (OFL) as the average catch from 1978-1995, and the maximum permissible ABC <= 0.75 of the OFL. This method has been used for GOA Atka mackerel harvest specifications since 1997. The TAC for Gulf of Alaska Atka mackerel is set at a level to allow for bycatch in other directed fisheries; there is no directed fishery for GOA Atka mackerel. The average catch/ABC ratio from 2017-2021 was 23% (Table 1, Figure 3). The average change in ABC from 2017-2021 was 0%. No projections are made for Tier 6 stocks. As a Tier 6 stock, no assessment is conducted in off-years, and the harvest recommendations are rolled-over from the last full assessment. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving GOA Atka mackerel to a four year stock assessment frequency. As a Tier 6 stock, the GOA Atka mackerel ABC and OFL are based on the average catch from 1978-1995. Harvest recommendations have remained constant. The stock is not subjected to a target fishery, there is no assessment model, and ABC/OFL is set based on Tier 6 guidelines of historical average catch.

BSAI Flathead sole

Overview

The BSAI flathead sole is a moderate value stock in this region, with an average annual ex-vessel value of 4.99 million USD from 2017-2020 ([2020 Economic SAFE Report](#)). Flathead sole are managed as a Tier 3 stock and assessed biennially based on the outcomes of the 2017 stock assessment prioritization analysis. No frequency adjustments were made to the 2017 analysis. The survey indices used in this assessment are the annual Bering Sea shelf bottom trawl survey and biennial Aleutian Islands bottom trawl survey. The TAC is typically set well below the ABC because of Pacific halibut bycatch considerations and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 17% (Table 1, Figure 3) with an average annual change in ABC from 2017-2021 of 4%. The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 5%. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI flathead sole complex to a four year assessment frequency schedule. The commercial value is moderate and the 2017 stock prioritization exercise did not make any adjustments for fishery importance, ecosystem importance, or recruitment variability. Catch is highly constrained by Pacific halibut bycatch concerns and the catch/ABC ratio is low. In addition, the annual change in ABC and the difference between the projected and actual ABC are low and risk of exceeding OFL is low. The Flathead sole stock includes a morphologically-similar congener Bering flounder, but Bering flounder typically represent less than 3% of the combined biomass of the two species in annual groundfish surveys.

GOA Octopus Complex

Overview

GOA octopus are managed as a Tier 6 stock due to the lack of reliable biomass estimates. At least seven species of octopus are found in the GOA but the giant Pacific octopus *Enteroctopus dofleini* is the most abundant species and makes up the bulk of octopus catches. The GOA octopus assessment is conducted biennially, aligning with the GOA bottom trawl survey, and based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments were made to the 2017 prioritization analysis for fishery importance, a result of octopus being scored moderately across all five fishery importance categories. As a Tier 6 stock, GOA octopus are assessed based on catch history since survey indices are deemed unreliable. Starting in 2018, GOA octopus OFL has been set equal to maximum historical catch from 2003-2018. The TAC for GOA octopus is set at a level to allow for incidental catch in other directed fisheries; there is no directed fishery for GOA octopus but a portion of the catch is retained or sold for human consumption or bait. The average catch/ABC ratio from 2017-2021 was 10% (Table 1, Figure 3). The average change in ABC from 2017-2021 was 0%. No projections are made for Tier 6 stocks. As a Tier 6 stock, no assessment is conducted in off-years, and the harvest recommendations are rolled-over from the last full assessment. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving GOA octopus to a four year stock assessment frequency. As a Tier 6 stock, the GOA octopus ABC and OFL are based on the maximum historical catch. The stock is not subjected to a target fishery, there is no assessment model, the catch/ABC ratio is low, and ABC/OFL is set based on Tier 6 guidelines of maximum historical catch.

BSAI Octopus Complex

Overview

BSAI octopus are managed as a Tier 6 stock. The EBS shelf and AI trawl surveys produce estimates of biomass for octopus, but these estimates are highly variable, do not reflect the same sizes of octopus caught by the fishery, and are therefore not considered reliable. Prior to 2012, catch limits for octopus were set using Tier 6 methods based on the maximum historical incidental catch rate. In 2012, a new, alternative Tier 6 methodology was developed. This approach uses the underlying harvest control rule from Tier 5, where the natural mortality rate is a predation-based estimate of octopus by Pacific cod. At least nine species of octopus are found in the BSAI but the giant Pacific octopus *Enteroctopus dofleini* is the most abundant species and makes up the bulk of octopus catches. The BSAI octopus assessment is conducted biennially based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments were made to the 2017 prioritization analysis for fishery importance, a result of octopus being scored moderately across all five fishery importance categories. The TAC for BSAI octopus is set at a level to allow for incidental catch in other directed fisheries; there is no directed fishery for BSAI octopus. The average catch/ABC ratio from 2017-2021 was 10% (Table 1, Figure 3). The average change in ABC from 2017-2021 was 0%. No projections are made for Tier 6 stocks. As a Tier 6 stock, no assessment is conducted in off-years, and the harvest recommendations are rolled-over from the last full assessment. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC proposes moving BSAI octopus to a four year stock assessment frequency. For BSAI octopus, a predation-based estimate of total natural mortality was first accepted by the SSC in 2011, which is derived from Pacific cod stomach collections. The amount of octopus consumed is considered a conservative estimate of total natural mortality for octopus. The stock is not subjected to a target fishery, the catch/ABC ratio is low, and ABC/OFL is set based on Tier 6 methods.

GOA Shark Complex

Overview

The GOA shark complex is managed as a combination of Tier 5 (for spiny dogfish) and Tier 6 species (for all other sharks). The OFL and ABC for the GOA complex is the sum of the Tier-specific OFL and ABC. The GOA spiny dogfish assessment uses the random effects model based on GOA trawl survey results, while the remaining components (Tier 6) are based on species-specific average catches from 1997-2007. A new data-limited catch only model has been explored but has not been recommended for harvest recommendations at this time. The GOA shark assessment is conducted biennially, aligning with the GOA bottom trawl survey for spiny dogfish, and based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments were made to the 2017 prioritization analysis for fishery importance. There are currently no directed commercial fisheries for shark species in the GOA, and most incidental catch is discarded. The 2017-2021 catch/ABC ratio was 36% and the average annual change in 2017-2021 ABC was 41% (Table 1, Figure 3). This change can be attributed to the adjustments made in spiny dogfish ABC which is updated with new survey biomass information. Catch is dominated by spiny dogfish. As a Tier 5/6 stock, no assessment is conducted in off-years, and the harvest recommendations are rolled-over from the last full assessment. No projections are made for Tier 5 or 6 stocks. The GOA shark complex catch has never exceeded the OFL for this stock.

Rationale for reduced stock assessment frequency

The AFSC proposes moving GOA sharks to a four year stock assessment frequency. For the GOA shark complex, only the spiny dogfish component utilizes GOA trawl survey biomass estimates. The remaining species are based on species-specific average catch from 1997-2007. The stock is not subjected to a target fishery, there is no assessment model for the Tier 6 species, the catch/ABC ratio is consistently low, and

the risk of overfishing is low. Under the proposed frequency, a partial assessment would be provided in year 3 of the cycle, which would include updated Tier 5 estimates to account for the updated GOA bottom trawl survey estimates.

BSAI Shark Complex

Overview

The BSAI shark complex is managed as Tier 6 stock. The OFL is based on the maximum historical catch between the years 2003-2015, and the ABC is 75% of OFL. A new data-limited catch only model has been explored but has not been recommended for harvest recommendations at this time. The BSAI shark assessment is conducted biennially, based on the outcomes of the 2017 stock assessment prioritization analysis. Lower frequency adjustments were made to the 2017 prioritization analysis for fishery importance. There are currently no directed commercial fisheries for shark species in the BSAI, and most incidental catch is discarded. The 2017-2021 catch/ABC ratio was 36% and the average annual change in 2017-2021 ABC was 0% (Table 1, Figure 3). No projections are made for Tier 6 stocks. As a Tier 6 stock, no assessment is conducted in off-years, and the harvest recommendations are rolled-over from the last full assessment. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC proposes moving BSAI sharks to a four year stock assessment frequency. As a Tier 6 stock, the BSAI Shark ABC and OFL are based on the maximum historical catch from 2003-2015. The stock is not subjected to a target fishery, there is no assessment model, ABC and OFL are set based on Tier 6 guidelines of historical maximum catch.

BSAI Arrowtooth Flounder

Overview

The BSAI arrowtooth flounder is a moderate value stock in this region, with an average annual ex-vessel value of 3.69 million USD from 2017-2020 ([2020 Economic SAFE Report](#)). Arrowtooth flounder is managed as a Tier 3 stock and is assessed biennially based on the outcomes of the 2017 stock assessment prioritization analysis. Longer frequency adjustments for fishery importance and shorter frequency adjustments for ecosystem importance were made in the 2017 analysis. The survey indices used in this assessment are the annual EBS shelf bottom trawl survey, EBS slope bottom trawl survey, and biennial AI bottom trawl survey. The TAC is typically set well below the ABC and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 13% with an average annual change in ABC from 2017-2021 of 5% (Table 1, Figure 3). The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 3%. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI arrowtooth flounder stock to a four year assessment frequency schedule. The commercial value is moderate and the catch/ABC ratio is low. In addition, the annual change in ABC, the average difference between projected and actual ABCs, and risk of exceeding OFL are low. Shorter frequency adjustments were made in the 2017 prioritization analysis for ecosystem importance but minimal concerns exist if this stock is moved to a four year frequency schedule considering the general stability in ABC and low utilization of this stock.

GOA Arrowtooth Flounder

Overview

The GOA arrowtooth flounder is a moderate value stock in this region, with an average annual ex-vessel value of 4.13 million USD from 2017-2020 (2020 Economic SAFE Report). Arrowtooth flounder is managed as a Tier 3 stock and is assessed biennially based on the outcomes of the 2017 stock assessment prioritization analysis. Lower frequency adjustments for fishery importance and higher frequency adjustments for ecosystem importance were made to the 2017 analysis. The survey index used in this assessment is the biennial GOA bottom trawl survey. The average catch/ABC ratio from 2017-2021 was 14% (Table 1, Figure 3) with an average annual change in ABC from 2017-2021 of 6%. The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 5%. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the GOA arrowtooth flounder stock to a four year assessment frequency schedule. The commercial value is moderate and the catch/ABC ratio is low. In addition, the annual change in ABC, the average difference between projected and actual ABCs, and risk of exceeding OFL are low. This would also align the arrowtooth flounder complex assessment frequency with the majority of other GOA flatfish assessments.

BSAI Alaska Plaice

Overview

BSAI Alaska plaice are the dominant species in the BSAI other flatfish group and the majority of catch occurs in the yellowfin sole and northern rock sole fisheries. Alaska plaice are managed as a Tier 3 stock and are assessed biennially based on the outcomes of the 2017 stock assessment prioritization analysis. Lower frequency adjustments for fishery importance and ecosystem importance were made to the 2017 prioritization analysis. The survey index used in this assessment is the annual EBS shelf bottom trawl survey. The TAC is typically set well below the ABC and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 55% with an average annual change in ABC from 2017-2021 of 3% (Table 1, Figure 3). The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 4%. The catch has never exceeded the OFL for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI Alaska plaice stock to a four year assessment frequency schedule. The majority of catch is incidental catch in other directed fisheries. The low catch/ABC and the projected to actual ABC ratios alleviate concerns of overfishing if this stock is moved to a four year frequency schedule, even with evidence of changes in spatial distribution of this stock in the northern Bering Sea.

BSAI Northern Rock Sole

Overview

The BSAI northern rock sole is a relatively high value stock in this region, with an average annual ex-vessel value of 12.84 million USD from 2017-2020 (2020 Economic SAFE Report). BSAI northern rock sole is managed as a Tier 1 stock and is assessed biennially based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments for fishery importance were made to the 2017 prioritization analysis. The survey index used in this assessment is the annual EBS shelf bottom trawl survey. The TAC is typically set well below the ABC and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 18% with an average

annual change in ABC from 2017-2021 of 21% (Table 1, Figure 3). The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 7%. It should be noted that in 2022 the author-recommended and SSC-approved ABC was reduced from maxABC due model structural uncertainty indicating that a plausible alternative model exists for which the OFL is smaller than the base model's maxABC. Despite this reduction, projected catch is still well below ABC and the catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI northern rock sole stock to a four year assessment frequency schedule. The catch/ABC is low and the projected to actual ABC ratios alleviate concerns of overfishing if this stock is moved to a four year frequency schedule.

BSAI Yellowfin sole

Overview

BSAI yellowfin sole is a high value stock in this region, with an average annual ex-vessel value of 53.61 USD million from 2017-2020 (2020 Economic SAFE Report). BSAI yellowfin sole is managed as a Tier 1 stock and is assessed annually based on the outcomes of the 2017 stock assessment prioritization analysis. In the 2017 prioritization analysis Scenario 4, yellowfin sole were one of four stocks considered "highest value" which resulted in an annual target frequency being set for all four of these stocks. The survey index used in this assessment is the annual Bering Sea shelf bottom trawl survey. The TAC is typically set well below the ABC and is constrained by the two million ton system cap on BSAI removals. The average catch/ABC ratio from 2017-2021 was 46%, with an average annual change in ABC from 2017-2021 of 9% (Table 1, Figure 3). The absolute percent difference between 2017-2021 projected ABC to 2018-2021 actual ABC was 11%. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC recommends moving the BSAI yellowfin sole stock to a two year assessment frequency schedule. The catch/ABC ratio is 47% and alleviates concerns of overfishing if this stock is moved to a two year frequency schedule. Evidence of climate impacts on this stock are a concern but these types of impacts (eg. changes in distribution, temperature-mediated growth) can likely be adequately monitored on a biennial basis. Additionally, the average annual change in ABC and the projected to actual ABC ratios have been low in recent years.

Aleutian Islands Pacific cod

Overview

Separate harvest specifications for Pacific cod have been set for the Bering Sea and Aleutian Islands (AI) regions since 2014. AI Pacific cod are managed as a Tier 5 stock that utilizes the random effects model applied to survey biomass estimates. AI cod are assessed annually based on the outcomes of the 2017 stock assessment prioritization analysis. Higher frequency adjustments were made to the 2017 analysis for fishery importance and ecosystem importance (Steller sea lions). The biennial AI bottom trawl survey is the only survey index used in the AI Pacific cod assessment. The average catch/ABC ratio from 2017-2021 was 88% (Table 1, Figure 3). The average change in ABC from 2017-2021 was 1%. No projections are made for Tier 5 stocks. The catch has never exceeded the Overfishing Level (OFL) for this stock.

Rationale for reduced stock assessment frequency

The AFSC proposes moving AI cod to a biennial stock assessment frequency to align with the AI bottom trawl survey schedule. The AI Pacific cod assessment frequency was set to an annual schedule by the 2017 stock assessment prioritization exercise due to ecosystem importance (Steller sea lions). Annual

assessments of AI Pacific cod are not necessary because of the paucity of data informing the assessment in off-survey years, in particular the lack of a survey relative index of abundance. The assessment authors have explored and previously put forward an age-structured model for this stock but it still relies on the biennial survey as the main survey index. There are no requirements for assessment frequency in the Steller Sea Lion Biological Opinion, thus, changing the assessment frequency from one to two years does not impact requirements under the Steller sea lion recovery plan.

Assessment Definitions

North Pacific Fishery Management Council Stock Assessment Products

In the past, the nomenclature applied to stock assessment products used by the North Pacific Fishery Management Council (NPFMC) have been somewhat fluid and lacking documentation. The purpose of this document is to explicitly define the types of stock assessment products used by the NPFMC and to illustrate how the NPFMC assessment types translate to national stock assessment definitions used in the NMFS next generation stock assessment improvement plan (NGSAIP, 2018) (Figure 4). This document reflects recommendations from previous participants in the stock assessment process, including Council advisory bodies, and stock assessment teams. Nevertheless, the stock assessment products described here may not address every contingency and will need to be flexible to address new issues as they arise.

Stock assessments are conducted to assess the abundance and trends of fish stocks and provide the fundamental basis for management decisions regarding appropriate harvest levels. In most cases, assessments use statistical population models to integrate and simultaneously analyze survey, fishery, and biological data. Environmental and ecosystem data may also be integrated in stock assessments. Hilborn and Walters (1992) define stock assessments as "the use of various statistical and mathematical calculations to make quantitative predictions about the reactions of fish populations to alternative management choices." In this document, the term "stock assessment" includes activities, analyses and reports, beginning with data collection and continuing through to scientific recommendations presented to the Council and its advisors. To provide the Best Scientific Information Available (BSIA) for fishery managers, stock assessments must attempt to identify and quantify major uncertainties, balance realism and parsimony, and make best use of the available data, with the ultimate goal of producing reliable short term stock predictions of stock status, trends, and catch levels. This document focuses on "operational" stock assessment products for use in management by the NPFMC outlined in the NGSAIP, recognizing that "research" stock assessments eventually can become operational models. The NPFMC harvest control rules are defined by a Tier system described in Amendment 56 in both the BSAI and GOA Fishery Management Plans. The specifications of Acceptable Biological Catch (ABC) and the Overfishing Level (OFL) are defined for a set of 6 Tiers based on data availability. The assessment products described below can be applied to any NPFMC Tier levels. These definitions are focused on the assessment products that will be delivered for NPFMC fishery management, and do not specify specific review processes for each stock assessment product.

Benchmark assessment: In the past, the term "benchmark assessment" was commonly used in the NPFMC process, though it has not been formally defined. The least restricted assessment type is a benchmark assessment, which considers all available data and multiple model configurations or new modeling platforms, and includes any new unreviewed data sources that are not considered in other assessment types. A benchmark assessment can be applied to a stock that has not been previously assessed or re-applied to a previously assessed stock, in which case the benchmark assessment involves a re-examination of the underlying assumptions, data, and model parameters previously used to assess the stock.

A non-exhaustive list of examples of model processes or inputs that could be considered in a Benchmark assessment includes, but isn't limited to:

- The functional form of selectivity curves (e.g. logistic to dome-shaped, a new length at 50% selectivity)

- Priors, parameterizations, or treatment of life history processes (e.g. a new prior on M based on life-history meta-analysis; moving from single-sex to two-sex length-at-age parameters)

- The aggregation or inclusion of datasets (e.g. dropping a survey index, aggregating fixed-gear fisheries)

For review purposes, a benchmark assessment would require the most intensive review of all the assessment types by NPFMC review bodies before being recommended for management advice. All benchmark assessments will be introduced and reviewed at the September/October Plan Team and SSC meetings prior to setting specifications for the next fishing year in November/December. A benchmark assessment may be subjected to in-depth reviews independent of the Council process such as Committee of Independent Expert (CIE) reviews. It's likely that AFSC would produce a benchmark assessment for Council review just prior to, or following a CIE review.

Update assessment: Resource limitations constrain the number of benchmark assessments that can be conducted and reviewed during an assessment cycle. For assessments that have relatively few outstanding modeling or data issues and provide relatively stable results as new data are added, an update assessment may be preferable when more current information is desired and there are other priorities for benchmark assessments. An update assessment is defined as an assessment that maintains the model structure of the previous full assessment, with additions generally restricted to data that have become available since the last assessment added to previously evaluated time series, along with limited allowable minor model changes based on previous Plan Team and SSC recommendations. Prior to this document update stock assessments were sometimes referred to as "full assessments". In the past, the NPFMC process has not always closely followed the update stock assessment criteria described below.

Any changes to the models beyond data revisions are expected to be incremental and should be reviewed at the September Plan Team and October SSC meetings prior to setting specifications at the November/December meetings for the next fishing year. It is expected that these types of accepted models have already been submitted for a thorough review by a CIE or multiple Plan Team/SSC reviews. Update stock assessments must carry forward the fundamental structure of the last benchmark assessment reviewed and endorsed through the NPFMC review process. Assessment structure here refers to the population dynamics model, data sources used as inputs to the model, the statistical platform used to fit the model to the data, and how the management quantities used to set harvest specifications are calculated. Model changes can be made, but are generally minor and based on previous recommendations from the Plan Teams and/or SSC. When an update assessment is developed, no substantial changes should be made to the assessment. Examples of permissible changes include:

1. The updating of data sources used in the previous benchmark assessment. It is common that data sources are updated to correct data entry errors or include additional historical data. It is acceptable to use the most up- to-date data from the sources used in the original assessment.
2. The software used in programming the assessment. It is acceptable to use a newer version of assessment software. A comparison should be provided to illustrate the newer software version produces adequately similar results when used with the same model files as in the original assessment.

Major changes to the assessment should be postponed until the next benchmark assessment. If more substantial changes to the model are contemplated by the authors, the assessment may be elevated to a benchmark stock assessment in the following year.

Authors are encouraged to incorporate methods sections by reference to the previous benchmark assessment where methods do not differ appreciably.

For review purposes, an update assessment would require a less intensive review, compared to a benchmark assessment, by NPFMC review bodies before being recommended for management advice. Update assessments are generally introduced and reviewed at the November Plan Team and December SSC meetings prior to setting specifications for the next fishing year.

Partial Catch Projection Assessment: The number of partial catch projection assessments has increased as stock assessment frequency has decreased as a result of the 2017 prioritization analysis. This assessment product generally applies to stocks with an age-or-length structured model (Tiers 1-3 in groundfish and crab) used to estimate stock status and project ABCs and OFLs for future years. Partial catch projection assessments are stock projections that are updated with recent catch data and do not include the most recent survey abundance index estimates.

In the case of Tiers 4-5 stocks, there is no projection model. Thus, partial assessments for Tiers 4-5 should include catch/biomass ratios, and re-running the random effects model only if there is a new survey data point available. Partial assessments for Tier 6 default to catch monitoring updates (discussed below). Partial catch projection assessment documents are short, consisting of a brief update of biological reference points and management advice. Partial assessments do not impact reference points as the parameter estimates and recruitment time series remain unchanged.

Partial catch projection assessments are reviewed by the NPFMC. Plan Teams and SSCs may request that all partial catch projection assessments be reviewed together, with any large changes in catches or surveys flagged for further consideration. This type of assessment corresponds to the "stock monitoring update" defined in the NGSAIP (Figure 4).

Catch Monitoring Update: In response to Plan Teams and SSC requests to ensure that sudden changes in the fishery or stock are not missed during years when the above stock assessment products are produced, we recommend a new product called a "catch monitoring update". A catch monitoring update tabulates fishery removals over recent years to ensure that they are below specified annual catch limits (ACLs and ABCs) and are not showing a significant change or concern in fishery catch.

This category provides information for the category previously reported as "nothing" or "partial update", and generally applies to Tiers 4 to 6 groundfish stocks. If a substantial change is noted in an un-assessed stock, this could serve as a trigger for an update or benchmark assessment.

Catch monitoring updates should be brief and provide total catch relative to recent catches and ABC (landings and discards). A table and short document would capture all stocks scheduled for a catch monitoring update in one document for a particular year and would be reviewed annually by the Plan Teams and SSC.

SAFE Guidelines

The BSAI and GOA Groundfish FMPs require that SAFE reports be produced each year in time for the October and December meetings of the NPFMC. Over time, the AFSC has developed SAFE Guidelines to outline the contents of each SAFE chapter. The Guidelines are intended to provide a consistent structure and logical flow for stock assessments conducted at the AFSC, with some permissible variation if warranted by data limitations or other extenuating circumstances. However, it is particularly important that certain items be included to the maximum extent possible, in that many of these are critical to legal requirements of the fishery management process. While the current Guidelines for both benchmark and partial catch projection assessment types have been developed for all NPFMC Tier levels, and have evolved over time to address concerns as they arise, they are in need of review and updating to align with the current assessment and Council processes. The new update assessment and catch monitoring update assessment types require the development of new Guidelines.

The Guidelines for stock assessment products need to be closely linked to the complexity of the analysis conducted to produce the stock assessment product and the level of review required to interpret the results. Further, current SAFE Guidelines do not address the newly developed Ecosystem and Socioeconomic Profiles (ESPs) and risk tables included in recent stock assessments. As part of our commitment to reproducibility and standardization, we are adopting new techniques and approaches for delivering stock assessment results electronically through open source internet based platforms. This will allow authors to provide stock assessment model code and model run results, including associated diagnostics, external to the stock assessment document. With these upcoming changes, we envision updated SAFE Guidelines for all stock assessment products that are standardized, consistent, and efficient in nature to ensure the appropriate level of stock assessment products are delivered. We also emphasize that the Guidelines will be revised over time as new products and approaches arise.

Following adoption of new definitions for stock assessment products, the AFSC will work closely with authors to revise and update the SAFE Guidelines. These Guidelines will provide direction to authors on the structure of the stock assessment products, address required contents for new stock assessment products, provide guidance on how to reference new products in the SAFE, and provide direction for streamlining and increasing efficiency in delivery of these products. The overarching goal of this effort will be to promote standardization and efficiency in communicating stock assessment products to the NPFMC audience and review bodies. The AFSC plans to produce revised SAFE Guidelines for NPFMC review in September and October 2023.

Figures and Tables

Table 1. Candidate stocks for reduced frequency assessments.

| Stock	Tier	Current Frequency	Proposed Frequency	2017-2020 ex-vessel value (millions)*	2017-2021 avg catch (t)	2017-2021 avg ABC (t)	2017-2021 catch/ABC	2017-2021 average annual change in ABC	2017- 2021 Projected ABC/ 2018-2022 ABC average absolute percent difference
GOA Atka mackerel	6	2	4	n/a	1,063	4,700	23%	0%	n/a
GOA Octopus	6	2	4	n/a	182	1,758	10%	0%	n/a
BSAI Octopus	6	2	4	n/a	340	3,576	10%	0%	n/a
GOA shark	5/6	2	4	n/a	2,089	5,830	36%	41%	n/a
BSAI Shark	6	2	4	n/a	187	517	36%	0%	n/a
GOA Arrowtooth flounder	3	2	4	4.1	20,411	147,582	14%	6%	5%
BSAI Alaska plaice	3	2	4	n/a	18,404	33,489	55%	3%	4%
BSAI Flathead sole	3	2	4	$4.99	11,130	66,475	17%	4%	5%
BSAI Arrowtooth flounder	3	2	4	$3.69	8,888	70,189	13%	5%	3%
BSAI Atka mackerel	3	1	2	$43.01	62,508	78,278	80%	12%	13%
AI Pacific cod	5	1	2	n/a	18,404	20,960	88%	1%	n/a
BSAI Northern rock sole	1	2	4	$12.84	25,893	142,141	18%	21%	7%
BSAI Yellowfin sole	1	1	2	$53.61	127,073	275,179	46%	9%	11%
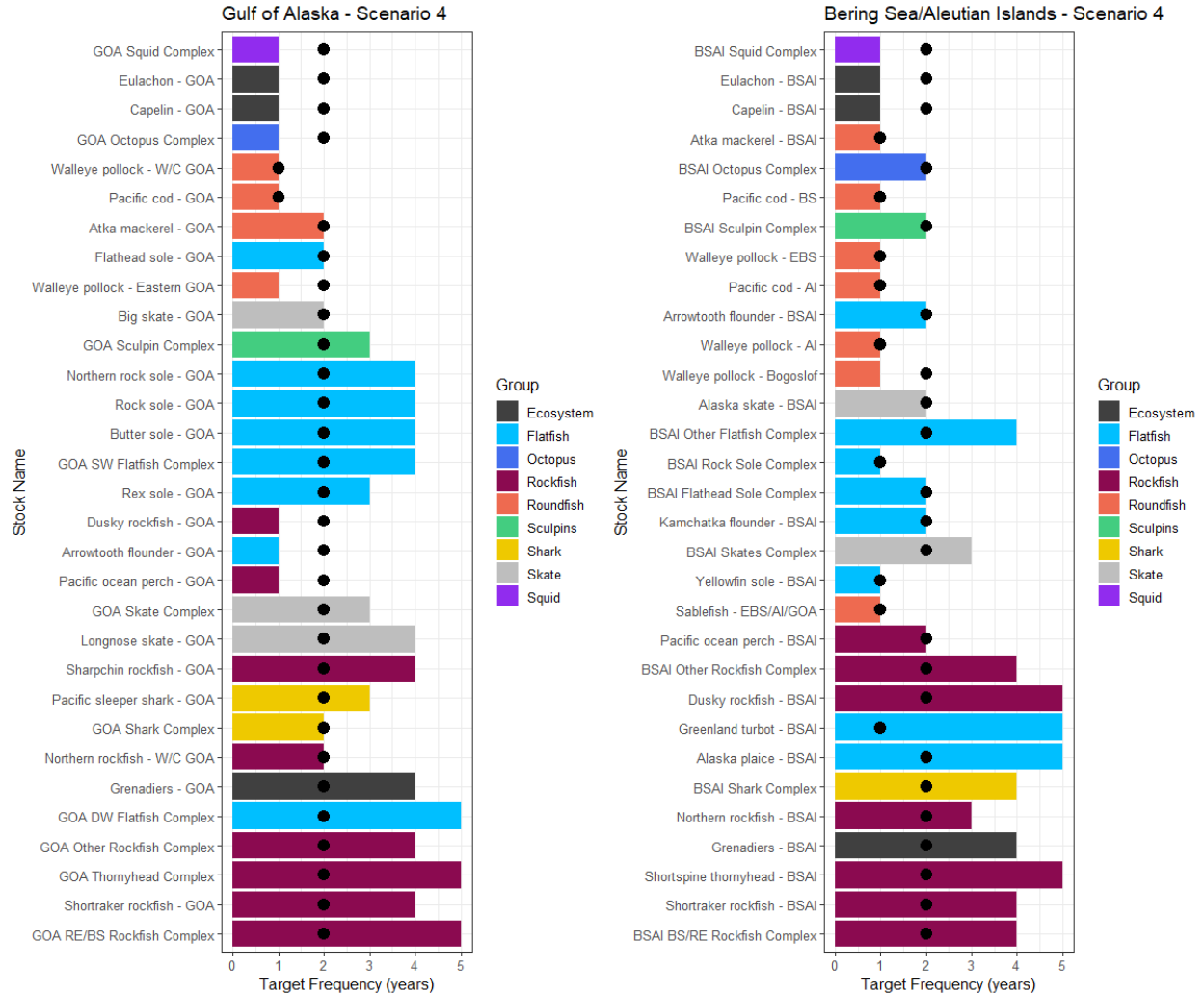
Figure 1. Target frequency scenarios for Scenario 4 for Gulf of Alaska and Bering Sea Aleutian Islands groundfish stocks from the 2017 stock assessment prioritization exercise. Black dots represent status quo target frequencies. From (Hollowed et al 2017).
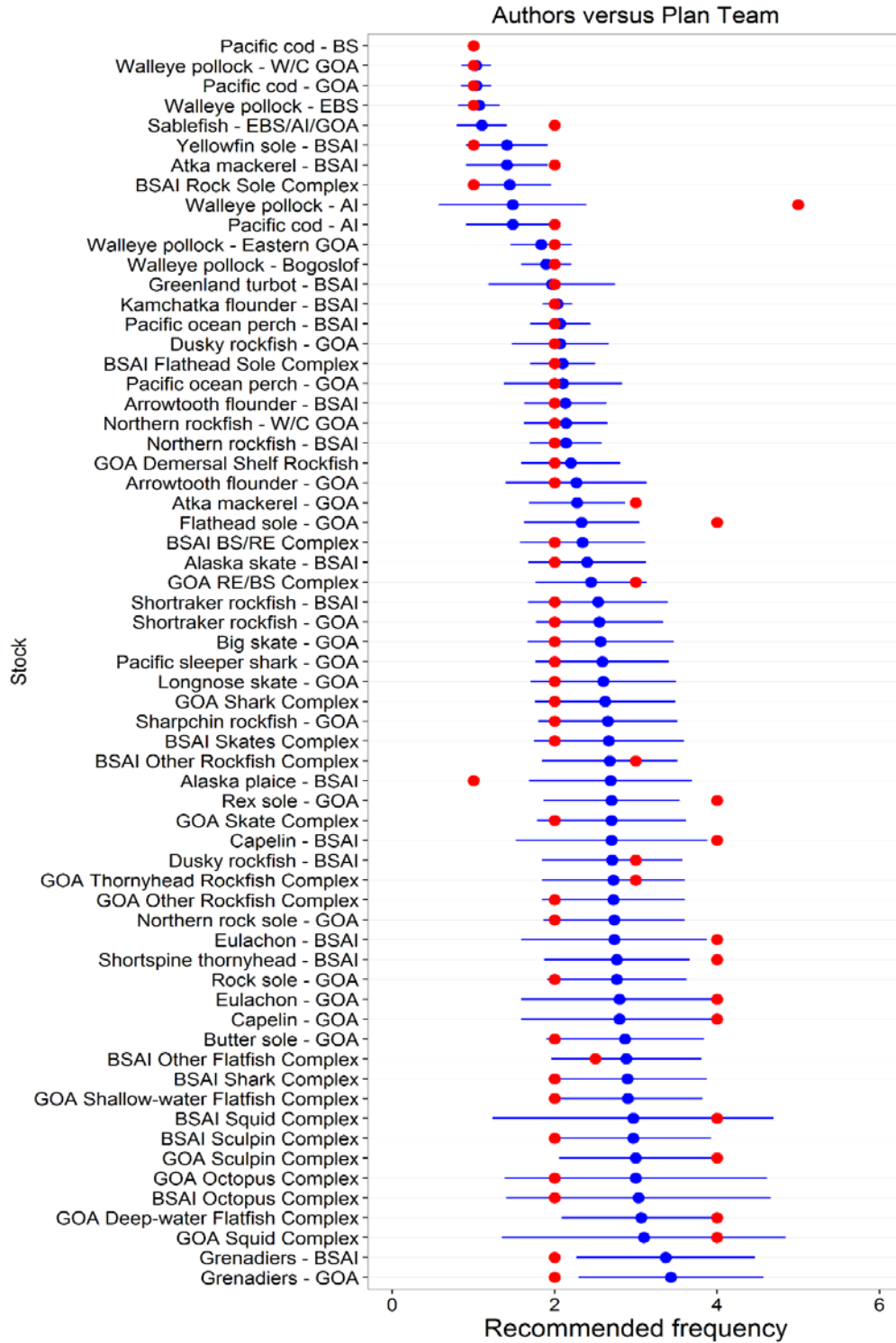
Figure 2. The recommended assessment frequency for all Alaska stocks from the 2017 stock assessment prioritization analysis. The blue dots with error bars are the mean and +/- one standard deviation of the individual Plan Team members recommendations. The red dots are the lead author's recommendation. From: (Joint Groundfish Plan Teams Report, February, 2017).
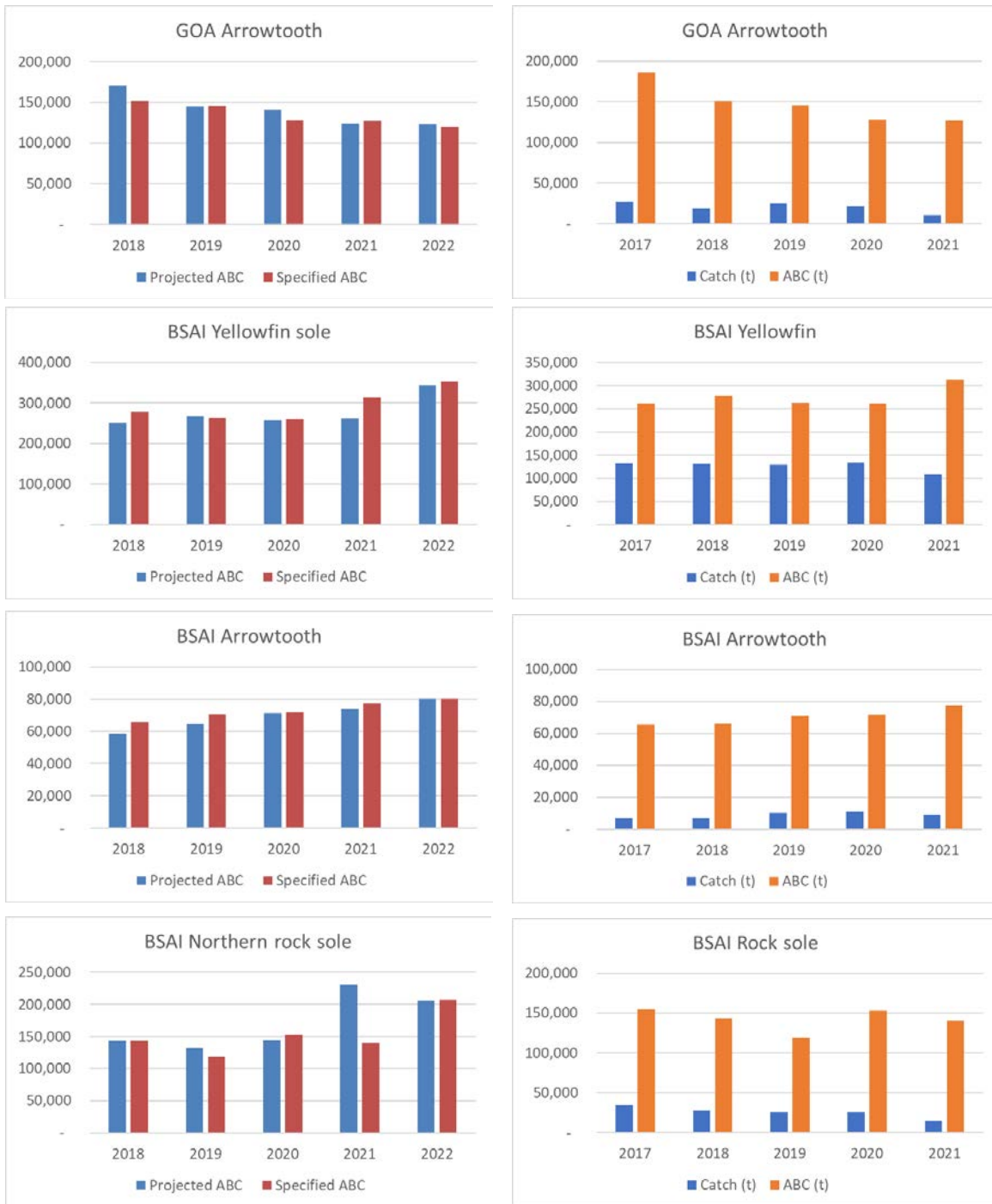
Figure 3. Catch to ABC comparisons from 2017-2021 for all stocks considered for reduced stock assessment frequency and projected ABC to actual ABC comparison from 2017-2021 for stocks that have model projections.
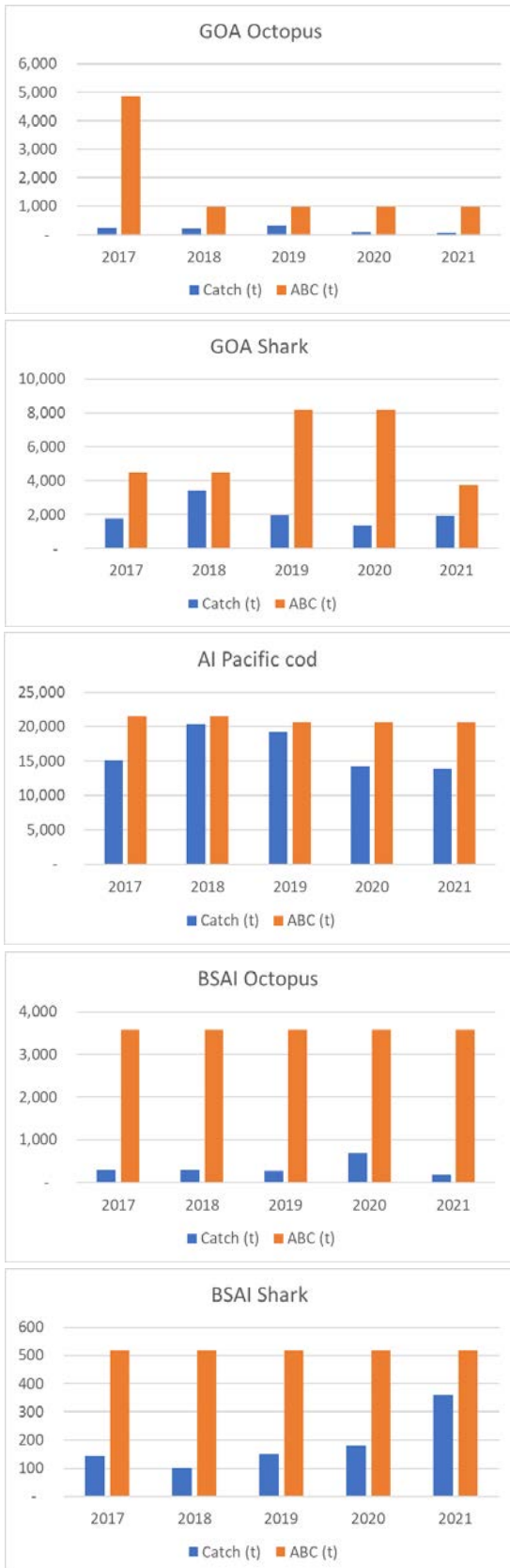
Figure 3 cntd. Catch to ABC comparisons from 2017-2021 for all stocks considered for reduced stock assessment frequency and projected ABC to actual ABC comparison from 2017-2021 for stocks that have model projections.

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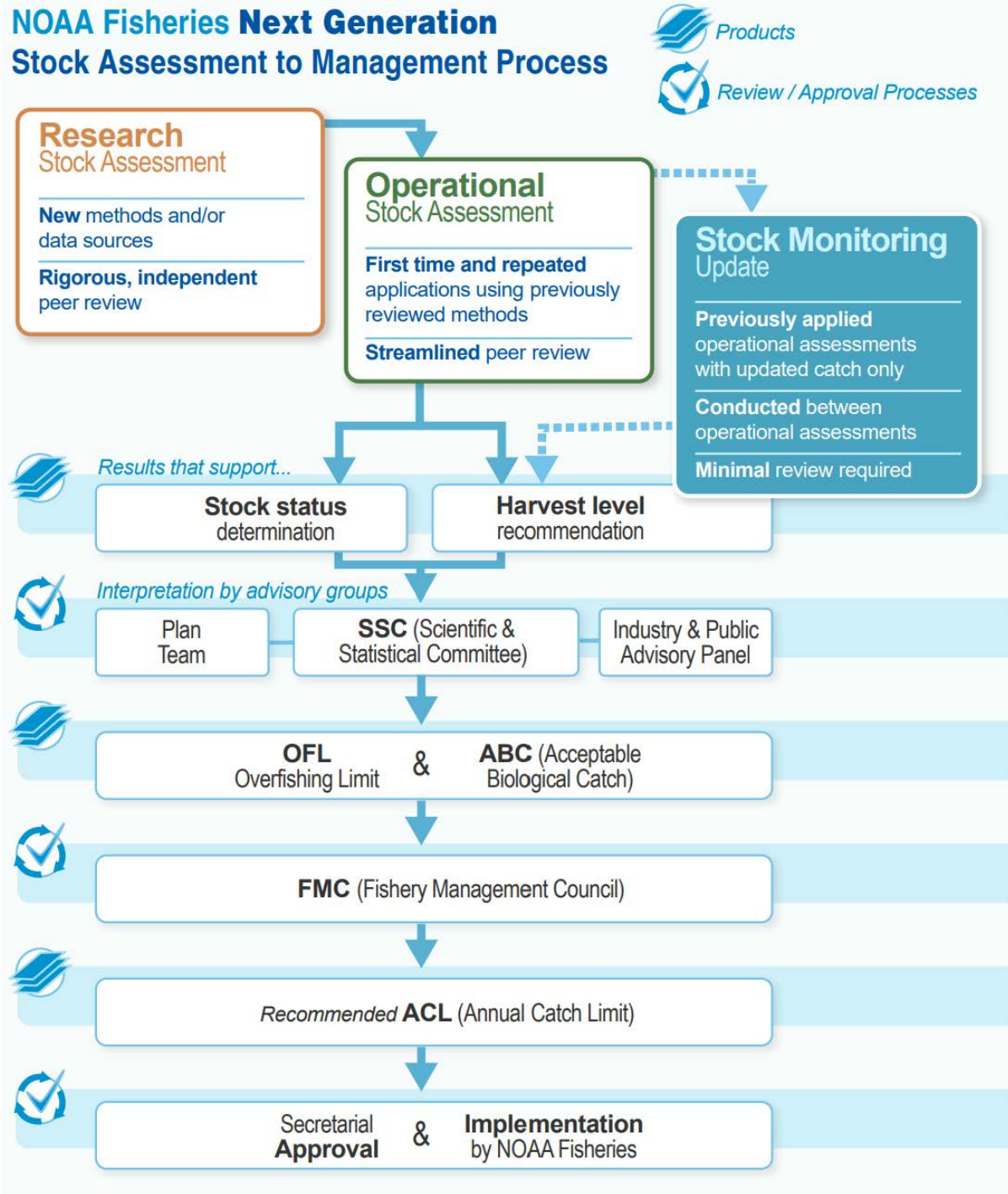
Figure 4. Stock assessment definitions and processes as outlined in the NMFS Next Generation Stock Assessment Improvement Plan (2018).