Stock Assessment and Fishery Evaluation Report
for the
SALMON FISHERIES
of the
Cook Inlet Exclusive Economic Zone Area

2024 Preliminary Salmon SAFE

Compiled by

The Upper Cook Inlet Salmon SAFE Team from NOAA Fisheries' Alaska Fisheries Science Center and Alaska Regional Office (NOAA SAFE Team)

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Executive Summary

This is the first Stock Assessment and Fishery Evaluation (SAFE) for the Federal salmon fisheries in the Cook Inlet exclusive economic zone (EEZ) Area. This SAFE provides the information for the North Pacific Fishery Management Council's (Council) Scientific and Statistical Committee (SSC) to recommend status determination criteria (SDC) and the Council to recommend total allowable catches (TACs) for the salmon harvested in the EEZ salmon fisheries for the 2024 fishing season. This SAFE also provides proposed specifications for SSC and Council consideration. Once NMFS receives the SSC and Council recommendations, NMFS will publish proposed and final harvest specifications in the Federal Register.

This SAFE uses the tier system and harvest specifications process in proposed Amendment 16 to the Salmon FMP to calculate the SDC following the Magnuson-Stevens Fishery Conservation and Management Act and the National Standard 1 guidelines. NMFS prepared this SAFE as part of the process to federally manage the salmon fisheries in the Cook Inlet EEZ. NMFS published a proposed rule and notice of availability for proposed Amendment 16 on October 18, 2023 (88 FR 72314). NMFS is required to implement regulations for this fishery by May 1, 2024 under a court order.

NOAA SAFE Team recommendations to the SSC and Council for the following stocks.

- Kenai River Late Run sockeye salmon: Tier 1, OFL = 1,363,932 fish, buffer[1] = 0.478, ABC and ACL = **652,454 fish.**
- Kasilof River sockeye salmon: Tier 1, OFL = 623,084 fish, buffer = 0.694, ABC and ACL = **432,578 fish**.
- Aggregate Other sockeye salmon: Tier 3, OFL = 887,464 fish, buffer = 0.20, ABC and ACL = **177,493 fish**.
- Kenai River Late Run Large Chinook salmon: Included as part of a combined, Aggregate Chinook salmon stock.
- Aggregate Chinook salmon: Tier 3, OFL = 2,697 fish, buffer = 0.167, ABC and ACL = **450 fish**.
- Aggregate coho salmon: Tier 3, OFL = 357,688 fish, buffer = 0.10, ABC and ACL = **35,769 fish**.
- Aggregate chum salmon: Tier 3, OFL = 441,727 fish, buffer = 0.50, ABC and ACL = **220,864 fish**.
- Aggregate pink salmon: Tier 3, OFL = 270,435 fish, buffer = 0.90, ABC and ACL = **243,392 fish**.

The SSC can recommend alternative buffers.

The NOAA SAFE Team recommends that the annual catch limit (ACL) for each stock be at or below the recommended ABCs. The FMP specifies that the TAC for individual species be equal to the ACL or sum of ACL; as such, for sockeye salmon, the sum of the ACLs would be **1,262,525** fish. When summed across all species, the recommended 2024 TAC would be approximately **1,763,000** salmon.

For Tier 1 and 2 stocks, the lower bound of the State of Alaska's spawning escapement goal is used for establishing available yield (potential EEZ harvest after the achievement of spawning escapement goals), which is the basis for the preseason OFLs and resulting ABC, ACL, and TAC. Should S_{MSY} or another estimate be used instead of the lower bound of the escapement goal, estimates of available yield and associated harvest specifications would be reduced from those recommended in this SAFE.

The Council can consider additional adjustments to species-level TACs, including buffers to account for new management of the fishery (e.g., species-level buffers for the first year(s) of the Federal fishery), and to account for other social, economic, and ecological factors, including to ensure sufficient prey for endangered Cook Inlet beluga whales.

The NOAA SAFE Team recommended SDC and harvest specifications based on sources of uncertainty and

[1] The buffer refers to the multiplier (b) used to define ABC from OFL, rather than the difference between ABC and the OFL (1-b).

the biological attributes of the species being assessed; however, additional sources of uncertainty were not factored into the 2024 recommendations, including: the inability to confirm historical estimates of salmon harvests in the Cook Inlet EEZ Area (which are a substantial basis for the 2024 recommendations); the level of participation in the 2024 EEZ salmon fishery; the spatial distribution of fishing effort within the Cook Inlet EEZ Area in 2024 and effects of that effort on harvests of weaker stocks (Chinook and coho in particular); harvests and harvest rates for individual stocks and species given the new management structure of having both State and Federal salmon fisheries in UCI. There are likely other sources of uncertainty that were also not accounted for in the SAFE recommendations. To the extent practicable, the NOAA SAFE Team will incorporate additional sources of uncertainty into future analyses and welcomes input on assumptions, estimates, and analyses used in the 2024 SAFE.

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Introduction

This stock assessment and fishery evaluation (SAFE) report includes assessments of 5 *Oncorhynchus,* Pacific salmon, species harvested in the Cook Inlet Exclusive Economic Zone Area (EEZ). The following species and stocks are assessed in this SAFE:

- 3 Chinook salmon, *Oncorhynchus tshawytscha,* stocks (Kenai River Late-Run Large Chinook, Aggregate "Other" Chinook salmon, and Aggregate Chinook stocks);
- 3 sockeye salmon, *Oncorhynchus nerka*, stocks (Kenai River Late-Run, Kasilof River, and Aggregate "Other" sockeye salmon),
- 1 coho salmon, *Oncorhynchus kisutch*, stock (Aggregate coho salmon);
- 1 chum salmon, *Oncorhynchus keta*, stock (Aggregate chum salmon); and,
- 1 pink salmon, *Oncorhynchus gorbuscha*, stock (Aggregate pink salmon - divided into even and odd year classes).

This SAFE report is for the Federally-managed salmon fishery in the Cook Inlet EEZ Area under proposed Amendment 16 to the *Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska* (FMP), and a federal requirement [50 CFR part 600]. For 2024, this SAFE provides the best available scientific information on the biological condition of salmon stocks in Cook Inlet and builds on the information and analysis in the Environmental Assessment/Regulatory Impact Review (EA/RIR) prepared for Amendment 16 and the proposed implementing regulations. The EA/RIR also provides information on the social and economic condition of the sport, subsistence, personal use, and commercial fisheries, the fish processing industries, and communities in Cook Inlet and is incorporated here by reference.

The SAFE report summarizes the current biological status of fisheries, reference points, and analytical information used for the Federal Assessment. Additional information on Cook Inlet Salmon fisheries is available on the National Marine Fisheries Service (NMFS) web page at: https://www.fisheries.noaa.gov/action/amendment-16-fmp-salmon-fisheries-alaska. Information pertaining to the adjacent Upper Cook Inlet (UCI) commercial and recreational salmon fisheries managed by the State of Alaska (SOA) is available on the Alaska Department of Fish and Game (ADF&G) website at: https://www.adfg.alaska.gov.

The SAFE report proposes to define those salmon stocks with evidence of historical harvests in the Cook Inlet EEZ Area and proposes to classify these stocks as belonging to one of three "tiers" based on the information available for the stock, which will determine the methods used to set Federal status determination criteria (SDC) and harvests specifications. The three tiers and methods to set Federal SDCs are provided in Amendment 16. Each year, the SAFE Report will recommend the salmon stocks that belong in each tier for SSC consideration.

Currently, there are 43 salmon stocks defined by the SOA for its management of UCI salmon fisheries (Munro 2023[2]). Broadly, the SOA's has defined salmon stocks throughout Alaska, including Upper Cook Inlet, based on the availability and specificity of spawning escapement, harvest, and other data and considerations; and, manages for the achievement of long-term sustainable yields for each stock. When sufficient data are available to define stock recruitment characteristics, and it is practical and achievable to do so, the SOA's management approach also attempts to implement and manage for spawning escapement goals that have the greatest potential to result in maximum sustainable yield in future generations[3,4]. For SOA's salmon management, escapement goal committees—consisting of fisheries scientists, biometricians, biologists, and other fisheries professionals from the Alaska Department of Fish and Game (ADF&G)—review data, model estimates, and associated escapement goal recommendations

[2] https://www.adfg.alaska.gov/FedAidPDFs/FMS23-01.pdf
[3] https://www.akleg.gov/basis/aac.asp#5.39.222
[4] https://www.akleg.gov/basis/aac.asp#5.39.223

for all defined stocks, every three years; a schedule that aligns with the SOA's Board of Fisheries (BOF) cycle for each SOA management area. In proposing Federal definitions of salmon stocks in the Cook Inlet EEZ Area for management under the scope of the MSA, this SAFE also considered data, analyses, and determinations from other sources. After thorough review by the NOAA SAFE Team and for the purposes of recommending status determination criteria and harvest specifications, this SAFE proposes adopting (with some aggregation) the stock definitions used by the SOA for its management in Upper Cook Inlet for the 2024 fishing year. In its review, the NOAA SAFE Team found the SOA's stock definitions and the data, estimates, and analyses used to conduct stock assessment analyses:

- to be accurate, thorough, and complete (including documenting when escapement estimates were partial or missing due to various circumstances);
- to be based upon the best scientific information available, including a rigorous scientific stock assessment and review process;
- that, given the stock assessment results, the resulting escapement goals represent ranges that were likely to result in sustainable returns for all stocks and maximum yield (at the stock level) for those stocks with available spawner-recruitment information;
- and, as used within equations to propose SDC and harvest specifications for this SAFE, that these escapement goals conform to the intent of applicable Federal National Standards.

The definitions of salmon stocks considered in this SAFE align with, or are aggregations of, the stock definitions used by the SOA. The proposed Federal stock definitions are based on several considerations, including the availability and specificity of preseason forecasts[5,6]; the practical limitations, including current genetics limitations, of monitoring and accounting for the harvest of specific stocks of the same species in a mixed-stock fishery; the relative quality of the historical harvest records estimated to have occurred in the Cook Inlet EEZ Area during previous years; and other considerations. Assumptions of the analyses within this SAFE include: that Federal stock definitions align with the SOA definitions for Kenai River Late Run sockeye, Kasilof River sockeye, and Kenai River Late Run Large Chinook salmon; that the Federal stock definitions are aggregations of the SOA stock definitions for Aggregate "Other" sockeye salmon, Aggregate Chinook, Aggregate "Other" Chinook salmon, and Aggregate coho salmon, with the Federal definitions including the harvest of salmon bound for many minor tributaries and drainages, for which the SOA may not have established escapement goals and does not monitor escapements (NOAA does not currently have any salmon escapement monitoring established in Cook Inlet). There is a single SOA chum salmon escapement goal in Upper Cook Inlet and no SOA escapement goals for pink salmon; given that there are known to be many streams in Upper Cook Inlet that contain chum and pink salmon[7], the Federal definitions for chum and pink salmon stocks also represent aggregations of many freshwater drainages and tributaries spread throughout the area. Annually, NOAA will review data and analyses available for each stock and, as determined by NOAA or as recommended by the SSC, propose new stocks, tier determinations, SDC, and harvest specifications for the SSC to consider.

The FMP and this SAFE describes the criteria and considerations used to propose assignments of the Federal salmon stocks to "tier" levels that determine the methods used to set SDC and harvest specifications. Some of the methods described to set these values propose the use of the SOA's preseason forecasts for Cook Inlet salmon stocks. However, due to the required time for ADF&G to collect and process samples for age composition and genetic stock composition estimates used to construct their sibling model-based preseason forecasts, at the February Council meeting it may be necessary for the SSC to recommend SDC and harvest specifications presented within this SAFE that rely on preliminary estimates and other forecast approaches in the absence of the SOA's forecasts.

Based upon the assessment frequency described in Table 1, NOAA provides recommendations on the overfishing limit (OFL), acceptable biological catch (ABC), annual catch limits (ACL), and stock status specifications for review by the SSC in February. Additional information on the OFL and ABC

[5] https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1456866430.pdf
[6] https://www.adfg.alaska.gov/FedAidPDFs/SP23-10.pdf
[7] https://www.adfg.alaska.gov/sf/SARR/AWC/index.cfm?ADFG=main.home. Accessed 25 November 2023

determination process is contained in this report. The justification and options associated with each proposed tier are intended to provide the SSC with the best scientific information available to inform their recommendations of appropriate tier placement and the methods used for the proposed values for OFL, ABC, ACL, and for the Council to consider overall TAC for each species.

The primary goal of this SAFE is to provide the information needed to manage the salmon fisheries in the Cook Inlet EEZ Area, recommend harvest specifications, and prevent overfishing.

Personnel from NOAA's Alaska Fisheries Science Center and Alaska Regional Office assembled this SAFE report. As Federal salmon management in the Cook Inlet EEZ Area has not occurred since Alaska's statehood in 1959, this SAFE report necessarily relies upon data, estimates, and modeling results from ADF&G and the scientific literature. This SAFE report is presented to the North Pacific Fishery Management Council (NPFMC) and is available to the public on the NPFMC web page at: https://www.npfmc.org/fisheries/. To accommodate fishery timing and data availability needs to determine OFL determinations, and ACL requirements, NOAA personnel plan to review assessment data in the fall of each year as post-season harvest and escapement estimates become available. Additional acknowledgements: J. Fortenbery, C. Tide, J. Mondragon, M. Furuness, A. Oliver, and other contributors.

Table 1: The Upper Cook Inlet EEZ Area salmon stocks proposed within this SAFE and reviewed annually. Also included are the current schedule for review by NOAA and SSC and the assessment frequency. Stocks in bold are those recommended by the NOAA SAFE Team to be defined for the 2024 UCI EEZ Area salmon fishery; two Chinook salmon stocks were considered for stock definitions, but these are not recommended for 2024. Recommendations for tier determination can be found within the Stock Status Summary for each stock.

Stock	*NOAA review and recommendations to SSC*	*SSC review and recommendations to Council*	*Assessment frequency*	*Year of next Assessment*
Kenai River Late Run Sockeye Salmon (KNSOCK)	January	February	Annual	2025
Kasilof River Sockeye Salmon (KASOCK)	January	February	Annual	2025
Aggregate Other Sockeye Salmon (AOSOCK)	January	February	Annual	2025
Kenai River Late-Run Large Chinook salmon (KCHIN)				
Aggregate Other Chinook Salmon (AOCHIN)				
Aggregate Chinook Salmon (ACHIN)	January	February	Annual	2025
Aggregate Coho Salmon (COHO)	January	February	Annual	2025
Aggregate Chum Salmon (CHUM)	January	February	Annual	2025
Aggregate Pink Salmon (PINK)	January	February	Annual	2025

Definitions Status Determination Criteria and Harvest Specifications

ABC Control Rule is the specified approach in the three-tier system for setting the maximum permissible ABC for each stock as a function of the scientific uncertainty in the estimate of OFL and any other specified scientific uncertainty.

Acceptable biological catch (ABC) is a level of catch of a stock that accounts for the scientific uncertainty in the estimate of the preseason OFL and any other specified scientific uncertainty. The preseason ABC is set at or below the OFL and, similar to the OFL, represents potential yield in the EEZ for the current year.

Annual catch limit (ACL) is the level of annual catch of a stock that serves as the basis for invoking accountability measures. For all Federally managed salmon stocks in the Upper Cook Inlet EEZ Area, the ACL will be set at or below the ABC.

Escapement goal (G) is the recommended spawning escapement goal for each stock of salmon. By default, the SAFE uses the lower bound of the spawning escapement goal for SDC and proposed harvest specifications.

F_{OFL} control rule is, should stock-specific actual harvest rate (F_{EEZ})in the Cook Inlet EEZ exceed the MFMT in any year, it will be determined that a stock is subject to overfishing.

F_{EEZ} is the realized fishing mortality rate in the EEZ for Tier 1 and 2 stocks, expressed as an exploitation rate, assessed over one generation [(sum of actual harvest for a generation)/(sum of total run size for a generation)]. Preseason estimates of F_{EEZ} are based on actual harvests for the first T-1 years of the generation time plus maximum potential EEZ harvests for the coming fishing season; final, postseason estimates of F_{EEZ} are based on actual harvests for all years of the most recent generation.

Generation time (T) is the average number of years in the life cycle of a salmon and is used in several equations to set SDC. The following generation times applied for each species: sockeye salmon (5 yrs.), Chinook salmon (6 yrs.), coho salmon (4 yrs.), chum salmon (4 yrs.), pink salmon (2 yrs.).

Maximum Fishing Mortality Threshold (MFMT) is the maximum potential fishing mortality rate in the EEZ above which overfishing occurs for Tier 1 and 2 stocks, expressed as an exploitation rate, assessed over one generation [(sum of maximum potential harvest for a generation)/(sum of total run size for a generation)]. MFMT is the residual yield available to be harvested in the EEZ after accounting for non-EEZ harvests and the lower bound of the spawning escapement goal being achieved. MFMT is compared with the actual fishing mortality rate (F_{EEZ}) to assess whether overfishing has occurred (postseason estimates) or is approaching overfishing (preseason estimates).

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological, environmental conditions.

Minimum stock size threshold (MSST) is defined for stocks with escapement goals as one half of the sum of the stock's spawning escapement goal summed across a generation. MSST is compared with cumulative escapement summed across the most recent generation to assess whether a stock has been overfished (postseason estimates) or is approaching an overfished condition (preseason estimates). See "Overfished" definition.

OFL is the overfishing limit and the preseason basis for establishing ABC. For Tier 1 and 2 stocks, the OFL is based on the preseason total run size forecast and defined as the maximum stock-specific EEZ

harvest (number of fish) that could occur while still achieving the lower bound of the spawning escapement goal and estimated non-EEZ (State) harvests for the coming fishing season. For Tier 3 stocks, the OFL is the largest EEZ harvest (number of fish) in the timeseries under consideration, multiplied by the average generation time of the species. For Tier 3 stocks, in addition to being the basis for setting the preseason ABC, the OFL is also the postseason basis for the assessment of overfishing. For Tier 1 and 2 stocks, the OFL is not used to assess overfishing postseason (see "Overfishing" definition).

Overfished is determined postseason by comparing annual spawning estimates to the established MSST. For stocks where MSST (or proxies) are defined, should a stock's realized spawning escapement(s) summed across a generation fall below the MSST in any year, the stock would be declared overfished. Preseason projections of MSST are used to assess if a stock is approaching an overfished condition. For stocks or stock complexes without escapement goals or reliable estimates of escapement, it is not feasible to evaluate overfished status.

Overfishing is defined for Tiers 1 and 2 stocks as occurring when the final, postseason estimate of the actual fishing mortality rate (F_{EEZ}) exceeds the maximum fishing mortality rate (MFMT), with both F_{EEZ} and MFMT calculated across the most recent generation of the species being assessed (e.g., for sockeye salmon, the most recently completed five fishing seasons). For tier 3 salmon stocks, overfishing is defined as occurring when the sum of the stock's postseason EEZ harvests across a generation exceeds the Tier 3 OFL for that stock, also calculated across a generation. Preseason projections are used to assess whether a stock is approaching a harvest rate (Tiers 1-2) or harvest level (number of fish; Tier 3) for which overfishing may occur.

Total allowable catch (TAC) is the annual catch target for the directed fishery for a stock, set to prevent exceeding the ACL(s) for a stock or stocks in accordance with the FMP.

Status Determination Criteria

The FMP defines the following status determination criteria and the methods by which these are set.

Status determination criteria for salmon stocks are calculated using a three-tier system that accommodates varying levels of uncertainty and information. The three-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the three-tier system, overfishing and overfished criteria and ABC levels for stocks are annually formulated. As described below, the ACL for each stock is set at or below the ABC. Each salmon stock is annually assessed to determine its status and whether (1) overfishing is occurring or the rate or level of fishing mortality for the stock is approaching overfishing, (2) the stock is overfished, or the stock is approaching an overfished condition, and (3) the catch has exceeded the ACL.

For salmon stocks, the preseason OFL provides a reference for managers to monitor overfishing inseason, while overfishing is officially assessed postseason in order to account for all realized escapement and harvest in all fisheries. The preseason OFL is derived through the annual assessment process, under the framework of the tier system. For Tiers 1 and 2, the preseason estimate of OFL equals the stock-specific amount of maximum potential harvest available in the EEZ (number of fish) after accounting for the spawning escapement goal and likely harvests outside of the EEZ. For Tier 3 stocks, the preseason OFL equals the maximum annual EEZ catch in the timeseries under consideration multiplied by the average generation time of that species, unless an alternative catch value is recommended by the SSC on the basis of the best scientific information available. For all tiers, overfishing is officially assessed postseason when final harvest and escapement data are available to calculate final values harvest, F_{EEZ}, and MFMT for each stock.

Overfished status for each stock is determined using the spawning escapement estimate, available following the end of each fishing year, and the Minimum Stock Size Threshold (MSST). These quantities are estimated from the current stock assessment. For stocks considered to have reliable estimates of escapements, MSST is defined. If the number of spawners drops below the MSST then the stock is considered to be overfished. For stocks without reliable estimates of escapement, MSST and overfished status are undefined.

If overfishing has occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the NPFMC to immediately end overfishing and rebuild affected stocks.

The Magnuson-Stevens Act requires that FMPs include accountability measures to prevent ACLs from being exceeded. TACs are the principal accountability measures to prevent ACLs from being exceeded for the management of the salmon fisheries in the Cook Inlet EEZ Area. These are described in the FMP and below.

Annually, the NPFMC, SSC, and NOAA will review (1) the stock assessment documents, (2) the OFLs, ABCs, ACLs, and TACs (3) NMFS's determination of whether overfishing occurred in the previous salmon fishing year, (4) NMFS's determination of whether any stocks are overfished and (5) NMFS's determination of whether catch exceeded any ACL or TAC in the previous salmon fishing year.

Three-Tier System

As described in the FMP and this SAFE, harvest specifications, OFL and ABC, are set prior to each fishing season using the three-tier system, detailed in Table 2. A stock is assigned to one of the three tiers based on the availability of information for that stock and model selection choices are made. Tier assignments and model choices are proposed by the NOAA SAFE Team to the SSC. The SSC

recommends tier assignments, the stock assessment and model structure, including whether the best scientific information available is used for calculating the proposed OFLs and ABC/ACLs based on the three-tier system, the buffers used to reduce OFL to proposed values of ABC and, if applicable, buffers considered for proposed values of ACL.

The NOAA SAFE Team prepares the stock assessment and calculates the proposed preseason OFLs. For Tiers 1 and 2 stocks, preseason OFL is calculated from the preseason total run size forecast. For Tier 3 stocks, the OFL is calculated from estimated historical harvests in the EEZ. The ABCs are set by applying a buffer to the preseason OFL to account for scientific uncertainty.

Stock assessment documents shall:

- specify how the OFL is calculated for each stock; and
- specify the factors influencing scientific uncertainty that are accounted for in calculation of the preseason ABC.

The NOAA SAFE Team will annually review stock assessment documents, the most recent abundance estimates, the proposed OFLs, ABCs, ACLs; and compile the SAFE. The NOAA SAFE team then makes recommendations to the SSC on the OFLs, ABCs, ACLs, and any other issues related to the salmon stocks.

The SSC annually reviews the SAFE report, including the stock assessment documents, recommendations from the NOAA SAFE Team, and the methods to address scientific uncertainty. In reviewing the SAFE, NOAA and the SSC shall evaluate and make recommendations, as necessary, on:

- the assumptions made for stock assessment models and estimation of OFLs; and,
- the methods to appropriately quantify scientific uncertainty in the OFL when setting the ABC and ACL.

The SSC will then set the final OFLs, ABCs, and ACLs for the upcoming salmon fishing year.

Accountability Measures

Section 4.2.8 of the FMP describes accountability measures and provides preseason and postseason measures that could be implemented. If total harvest is determined to be above the postseason ACL, NMFS will report on the harvest overages in the SAFE report and make any recommendations on accountability measures to the SSC. If it is necessary to improve the science used in the assessment or methods used to manage TAC in the EEZ, such changes can be considered during the SSC and Council review process. Repeated overages of ACL will trigger NMFS to evaluate and address any systemic bias for the overages. Possible accountability measures could include increasing the buffer of the OFL (to result in a lower ABC and resulting ACL and TAC) to account for scientific or management uncertainty. If implementation error is important in causing the overages, a review and revision of in-season management procedures may also be warranted.

Tier 1

Tier 1 is for salmon stocks that have reliable estimates of annual spawning escapements and stock-specific harvests. Stocks assigned to Tier 1 also have data that is of high quality and complete reliable estimates of the spawner-recruit relationship, thereby enabling the estimation of S_{MSY} and associated parameter estimates, or other approaches (e.g., yield analyses), to inform spawning escapement goals; age estimates for harvest and escapement components; and, preseason forecasts of total run size.

The FMP, Tables 2, and the text below provide description and equations for proposed calculations of MSST, MFMT, F_{EEZ}, F_{OFL}, OFL, ABC, and ACL for Tier 1 stocks.

For Tier 1, MSST and a rule for defining overfishing based on comparing the stock-specific fishing mortality rate in the EEZ (F_{EEZ}) with MFMT are established. The MFMT reference point is established based on potential yield available to fisheries in the EEZ after accounting for required spawning escapement and harvest of exploited salmon stocks in non-EEZ (State managed) fisheries. For this tier, overfishing is assessed with postseason estimates and deemed to occur if F_{EEZ} exceeds MFMT. As described in the FMP, SDC are established based on estimates of harvest and escapement across the most recent generation. For example, for sockeye salmon, the generation time is the most recent 5 years.

Preseason harvest estimates: The NOAA SAFE Team recommends to the SSC that the preseason estimate of likely harvests in State waters in the coming fishing season be based on an autoregressive integrated moving average (ARIMA) model of past state harvest rates using the auto.arima R package to identify the optimal combination of AR and MA lags. The potential harvest rate in the EEZ (F_{EEZ}) in the upcoming season can then be estimated by subtracting expected State harvest from the forecasted run size (minus the escapement goal) and dividing by the total forecasted run size. At the discretion of the SSC, future SAFE analyses can compare other approaches (e.g., a 'default' AR-1) with the model selected by the auto.arima() function or other alternatives, as well as the retrospective accuracy (and resulting buffer factor) of each method used to inform SAFE recommendations.

OFL_{PRE}. The preseason OFL in the EEZ is the estimated maximum harvest that could occur in the EEZ during a single season while still meeting the spawning escapement goal and allowing for harvests in other fisheries. The preseason OFL is calculated from the preseason total run size forecast and accounts for likely harvests in other fisheries (*i.e.* those occurring in State waters) and the lower bound of the spawning escapement goal. OFL_{PRE}(EEZ) = Total run $size_{PRE}$ - (escapement goal) - (non-EEZ harvest estimate).

ABC_{PRE}: Similar to the OFL, the preseason ABC represents predicted potential yield in the EEZ for the coming fishing season. The NOAA SAFE Team proposes that ABC for Tier 1 stocks be reduced from OFL by a buffer to account for scientific uncertainty. The sources of uncertainty in the current model include the error in one-year-ahead forecasts of run size and non-EEZ harvests.

Scientific buffers: In reducing OFL_{PRE} for the purpose of setting ABC, the proposed buffer acknowledges the uncertainty in preseason values for status determination criteria. In the case of Tier 1 stocks, the buffer takes into consideration the retrospective error in preseason ABC and potential yield (based on preseason run size and State harvests) designations relative to realized postseason values. Specifically, the median symmetric accuracy (MSA) (Morley et al., 2018[8]) is calculated for preseason estimates of OFL and potential yield relative to postseason values over a ten year window. Hereafter, the buffer refers to the multiplier, b, used to define ABC from OFL, rather than the difference between ABC and the OFL, 1-b. The MSA is interpretable as a measure of percent error in preseason estimates relative to postseason values. A bound of 10% was imposed such that if the calculated MSA indicated use of a buffer below 10%, a 10% buffer would be used instead. Thus, in setting preseason management targets, preseason estimates of OFL and potential yield are reduced by the percentage indicated by the MSA to generate ABC and ACL.

The NOAA SAFE Team has presented the following options to calculate SDC and harvest specifications

[8] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017SW001669

for Tier 1 stocks.

Tier 1, Option 1 (**T1**): The T1 approach assumes the availability of the SOA's sibling model-based preseason total run size forecasts to be used in this SAFE with SDC and harvest specifications as described in the FMP and this SAFE. However, as the SOA's preseason salmon forecasts were not available in time to be used in this SAFE, this option will not be considered for this SAFE.

Tier 1, Option 2 (**AR**): This approach assumes that a SOA preseason total run size forecast will not be available in time to set SDC and harvest specifications. Thus, total run size for the coming fishing season is based on autoregressive integrated moving average (ARIMA) models fitted to available adult return data. The optimal combination of autoregressive (AR) and/or moving average (MA) lags for the ARIMA models was determined by evaluating a range of alternatives via the auto.arima() function of the *forecast* package (version 8.21.1; Hyndman R, Athanasopoulos G, Bergmeir C, Caceres G, Chhay L, O'Hara-Wild M, Petropoulos F, Razbash S, Wang E, Yasmeen F (2023). *forecast: Forecasting functions for time series and linear models*. R package version 8.21.1.9000[9]). With the AR approach, all SDC and harvest specifications would be set using the same equations as the T1 approach, but the estimates would necessarily be more uncertain because they are not informed by sibling returns.

Tier 2

Tier 2 is for salmon stocks managed as a complex, with specific tributaries or drainages as indicator stocks and stock-specific estimates of harvests. Indicator stocks are stocks for which sufficient data exists to allow for the development of measurable and objective SDC and can be used as a proxy to manage and evaluate data poor stocks within the stock complex.

For Tier 2 stock complexes, F_{EEZ}, MFMT, F_{OFL}, and MSST for indicator stocks will be set using the same equations as Tier 1 stocks with overfishing and overfished determinations also assessed in the same way as Tier 1 stocks.

For Tier 2 stocks, the preseason OFL, ABC, ACL, and the buffer to reduce OFL and potential yield will be set for a stock complex in the same way as Tier 1 stocks.

ACL < or = ABC.

For the 2024 SAFE, The NOAA SAFE Team does not recommend designating any UCI salmon stock as Tier 2. An additional consideration for setting SDC and harvest specifications for stock complexes is that, while there is assumed to be a relatively thorough accounting of all harvests for the stock, there may be many tributaries for which spawning escapements are not assessed or are assessed with methods for which the total numbers of spawners cannot be estimated with high precision. As such, the escapement goals and annual spawning escapement estimates for stock complexes may represent an index of spawners that is an unknown portion of the overall escapements. Because of this, compared to Tier 1 stocks, the calculated MFMT value for Tier 2 stocks may be inflated relative to F_{EEZ} and an overfishing determination may be less likely to occur (vs. a Tier 1 stock) as a result, meaning, an overfishing designation may not be triggered for Tier 2 stock complexes, even if such a designation were warranted.

Explained in more detail at the equation level, the numerator of MFMT represents maximum potential yield after subtracting non-EEZ harvests and the lower bound of the escapement goal. However, since the escapement goals for Tier 2 stocks are only *indices* of abundance, and not *actual* numbers of fish, subtracting this index value (and non-EEZ harvests) from the total run size would result in potential yield that would necessarily be larger than the actual yield available. Therefore, applying Tier 1 methods for SDC and harvest specifications to Tier 2 stock complexes may be less precautionary with respect to overfishing than using these methods to assess Tier 1 stocks.

An alternative consideration for stock complexes, is that, if there is incomplete monitoring of indicator stocks, then an overfishing or overfished determination could be made when it is not warranted for the larger stock complex.

[9] https://pkg.robjhyndman.com/forecast

Recommendation: The NOAA SAFE Team asks for SSC recommendations on the following options, with the second option preferred:

- multiply the summed escapement goal indices for the stock complex by a recommended expansion factor such that the resulting value more closely resembles numbers of fish rather than an index (or indices); or,
- (Recommended) make the determination that, because the estimates of overall total escapement and associated total run size estimates are not "reliable," these stocks be classified as Tier 3 for establishing SDC and harvest specifications for 2024, and until sufficient information is available to form consensus on the tradeoffs associated with a Tier 2 vs. Tier 3 determination.

Note that, compared with Tiers 1 and 2, the proposed method for establishing ABC and ACL for Tier 3 stocks (below) also provides a larger range of buffers for the SSC to consider.

Recommendation: The NOAA SAFE Team recommends additional research to refine estimates of total run sizes and associated components (escapements and mortality) for UCI salmon stocks; particularly for stocks where such estimates do not currently exist. These estimates will facilitate improved management.

Tier 3

Tier 3 is for salmon stocks without reliable estimates of escapement. Stocks in this tier may have at least one tributary monitored to assess spawning escapements, but, relative to Tier 1 and 2 stocks, the escapement goals and associated inseason assessment of escapement represent a coarse and/or unknown index of abundance rather than a true number of fish. For stocks in this tier, because there are no reliable estimates of the total number of spawners, total run size, F_{EEZ}, and MFMT for Tier 3 stocks cannot be verifiably estimable and the F_{OFL} control rule is not applicable. As described in the FMP, historical harvest data is used to set the OFL for this tier. To assess an overfished determination, MSST is only estimable if the stock or stock complex has at least one tributary with a spawning escapement goal, in which case an overfished determination would be the same as for Tier 1 stocks.

OFL: The preseason OFL is the maximum annual EEZ catch of the stock in the timeseries under consideration, multiplied by the average generation time of the species (T years), unless an alternative catch value is recommended by the SSC on the basis of the best scientific information available.

ABC: The preseason ABC is the OFL multiplied by a buffer to account for uncertainty. ABC would be set each year during the annual stock status determination process based on the best available information.

Scientific buffer: Stocks assigned a Tier 3 designation lack sufficient data for a scientifically-informed buffer produced for Tier 1 stocks. As such, a range of naive buffers ranging from 0.1 to 0.9 will be applied and the resulting management quantities under each buffer value will be presented and compared for SSC consideration. The range of buffers available for Tier 3 stocks provides additional flexibility for the SSC to consider, with recommendations by the NOAA SAFE Team based on comparisons of the buffered ABC values with existing harvests and other stock attributes relative to status quo harvests under State management. However, relative to Tiers 1 and 2, for which there is additional information to define and monitor the attributes of a stock and inform SDC (e.g., F_{EEZ} vs. MFMT to assess overfishing), such information is generally limited for Tier 3 stocks.

ACL: The preseason ACL is less than or equal to ABC for Tier 3 stocks. For Tier 3 stocks, because the OFL is based solely on historical harvests, there is limited data on which to base uncertainty estimates for a buffer. The NOAA SAFE Team recommends that no distinction be made between ABC and ACL.

Figure 1. An illustration of the F_{OFL} control rule for Tier 1 and 2 salmon stocks. SDC will allow for acceptable biological catch of a stock in the EEZ until the actual fishing mortality rate (F_{EEZ}) reaches parity with the maximum fishing mortality threshold (MFMT), the largest amount of EEZ harvest that the stock can sustain over a generation while still achieving the spawning escapement goal. At parity with MFMT, F_{EEZ} = F_{OFL}. Overfishing occurs when the actual fishing mortality rate exceeds the maximum fishing mortality rate (above a F_{EEZ} : F_{MFMT} ratio of 1), the spawning escapement goal is not being achieved across a generation. F_{EEZ} and MFMT are normalized to total run size and assessed over a generation using postseason (final) estimates.

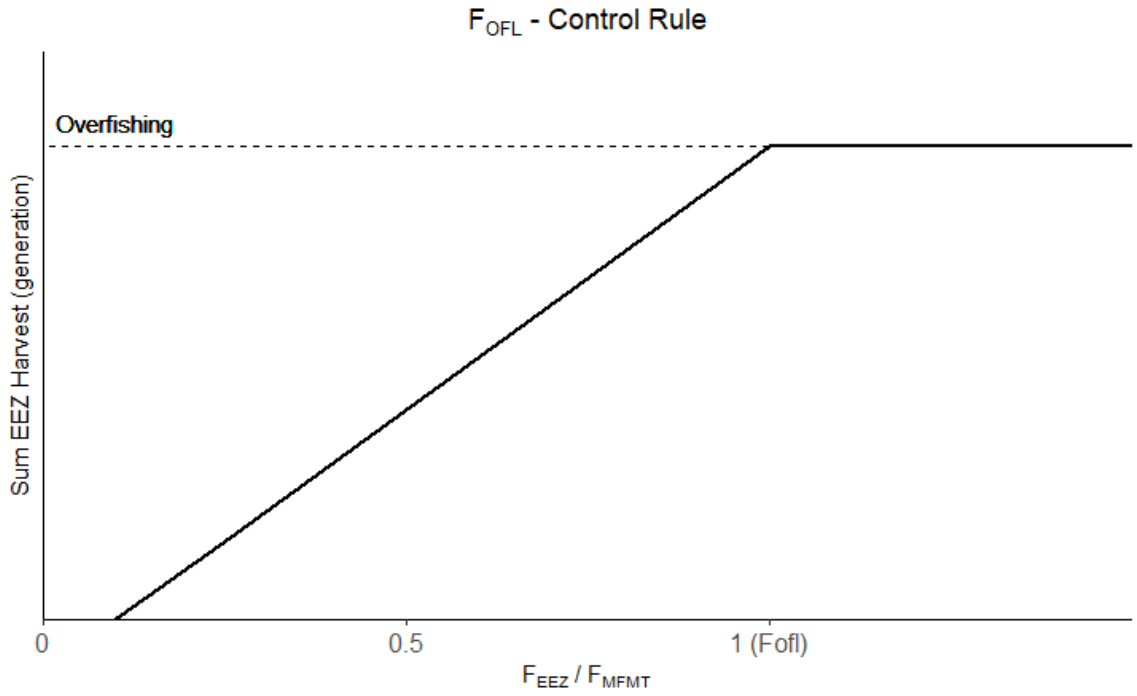


Table 2: Three-Tier System for setting OFLs, ABCs, and ACLs for salmon stocks. The tiers are listed in descending order of information availability.

Tier	Information Available	F_{OFL}	ABC control rule*	Buffers considered	ABC
1	**Escapement goal** spawning escapement for entire stock stock-specific harvests across fisheries total run size estimates	F_{OFL}: harvest rate such that F_{EEZ} = MFMT; where: $F_{EEZ,t} = \frac{\sum_{i=t-T+1}^{t} C_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$ $MFMT_t = \frac{\sum_{i=t-T+1}^{t} Y_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$;	$\text{ABC} \leq OFL$	Median Symmetric Accuracy (MSA) buffer based on accuracy of preseason predictions of OFL and potential yield	$\text{ABC} = \left[\left(\widehat{R_t} - \widehat{C_{state}} - G\right) * Buffer_{MSA}\right.$
2	**Escapement goal for indicator stock(s)** spawning escapements for indictor stock(s) stock-specific harvests across fisheries total run size estimates	F_{OFL}: harvest rate such that F_{EEZ} = MFMT; where: $F_{EEZ,t} = \frac{\sum_{i=t-T+1}^{t} C_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$ $MFMT_t = \frac{\sum_{i=t-T+1}^{t} Y_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$;	$\text{ABC} \leq OFL$	Median Symmetric Accuracy (MSA) buffer based on accuracy of preseason predictions of OFL	$\text{ABC} = \left[\left(\widehat{R_t} - \widehat{C_{state}} - G\right) * Buffer_{MSA}\right.$
3	**Harvests** Any escapement goals	Overfishing assessed with the OFL	$\text{ABC} \leq OFL$	(1) range of 0.1-0.9 considered (2) Additional buffer considerations for "weak" stocks	$\text{OFL} \times Buffer$ (e.g. $0.10 - 0.90$)

The following descriptions are associated with the equations provided in Table 2:

- F_{EEZ}
  - T = generation time expressed as years
  - t = run year
  - R_i = annual run size
  - C_{EEZ} = annual EEZ catch of stock in year t

- MFMT
  - $Y_{EEZ,i} = max(0, R_t - G_t - C_{state,t})$
    - $Y_{EEZ,i}$ – potential yield in the EEZ
  - R_i = annual run size
  - $C_{state,t}$ = harvest in state waters in year *t*
  - *G* = escapement goal for stock
- ABC
  - $\widehat{R_t}$ = total run size
  - $\widehat{C_{state}}$ = harvest in state waters
  - *G* = lower bound of escapement goal
  - *Buffer* = Tier 1&2: MSA, Tier 3: range of 0.1-0.9
- OFL
  - $OFL_{preseason} = \widehat{R_t} - \widehat{C_{state,t}} - G_t$
    - $\widehat{R_t}$ = preseason total run size forecast
    - $\widehat{C_{state,t}}$ = estimated state harvest
    - G_t = escapement goal

NOAA SAFE Team Recommendations

Table 3 contains status determination criteria for the 2023 salmon season; however, since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023 and there were no recommended SDC or harvest specifications, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE.

Table 4 contains NOAA SAFE Team recommendations for 2024 based on recommended tier assignments and resulting modeling approach, estimations of harvest and escapement, model parameterization, OFLs, and ABCs. The NOAA SAFE Team recommends to the SSC that two stocks be assigned to Tier 1 (Kenai Late Run and Kasilof sockeye salmon) with all remaining stocks assigned to Tier 3: Aggregate Other sockeye salmon, Aggregate Chinook salmon, Aggregate Coho salmon, Aggregate Chum salmon, and Aggregate Pink salmon.

The Stock Status Summaries section includes detailed considerations for defining stocks, tier placement, SDC and harvest specifications, and the measurable status of those stocks in comparison to SDC and harvest specifications. Included in that section is a discussion of why the NOAA SAFE Team recommends that a Federal stock definition for Kenai Late Run Large Chinook salmon be aggregated with Other Chinook salmon; and the lack of available information to support Tier 2 determinations for Aggregate Chinook, Aggregate Other sockeye, and Aggregate coho salmon for the 2024 salmon fishery in the Cook Inlet EEZ Area.

The NOAA SAFE Team has a placeholder for general recommendations provided by the SSC for all assessments with specific comments related to individual assessments contained in the Stock Status Summaries and reference tables. All recommendations are for consideration for the next scheduled assessment.

General Recommendations for all Assessments

This section is intentionally left blank and serves as a placeholder for general recommendations from the SSC or from a Salmon Plan Team, if such a group is formed in the future.

Stock Status Summaries

Data and assessments for all stocks

Existing estimates of harvest, escapement, stock assessments, and preseason forecasts used for this SAFE originate from the State of Alaska with data available through its website (www.adfg.alaska.gov) and associated publications (https://www.adfg.alaska.gov/sf/publications/) with additional details provided in the assessments for each stock and in Appendices A1-A10. The most recent stock assessments and escapement goal recommendations for Late-Run Kenai sockeye salmon (Hasbrouck et al. 2022)[10], Kenai Late Run Chinook salmon (Reimer and Fleishman 2017)[11], Susitna River Chinook salmon (Reimer and DeCovich 2020)[12], and assessments for other stocks (McKinley et al. 2020)[13] can be found through the ADF&G publications page and the SOA's Board of Fisheries website[14]. Additional data, estimates, and other relevant information can be found within, or referenced in, annual management reports (e.g., Marston and Frothingham 2022)[15], season summaries[16], preseason forecasts[17,18,19], the Sport Fish harvest survey website[20], the statewide escapement goal reports (e.g., Munro 2023)[21], the Cook Inlet Area commercial salmon fishing regulations[22], and other publications.

Methods used by the NOAA SAFE Team to estimate historical harvests within the Cook Inlet EEZ Area are described in the EA/RIR prepared for Amendment 16 and the implementing regulations[23]. In summary, these estimates were made by considering the geographical overlap between the Federal Cook Inlet EEZ Area and the SOA Statistical Areas where salmon landings were reported by fishers to have occurred, combined with professional judgment of managers regarding the distribution of the drift fleet. Because there has never been a wholly-Federal salmon fishery confined to the Cook Inlet EEZ Area, the accuracy of the historical EEZ harvest proportion estimates are unknown and treated deterministically in the 2024 analyses. At the discretion of the SSC, future analyses could incorporate some measure of agreed-upon uncertainty into the historical EEZ estimates from stock composition studies[24] and other sources. It is the assumption of the NOAA SAFE Team that future EEZ harvests under Federal management will be more precisely known through landings data.

For 2023, the number and proportion of drift gillnet harvest estimated to have occurred in the EEZ were obtained as per the methods described in Section 4.5.1.2.3. of the EA/RIR dated September 2023. Daily harvest data were downloaded from the ADF&G's UCI Commercial fisheries website[25] and descriptions of areas open on each date were pulled from the 2023 UCI commercial fisheries season summary[26]. In following the methods in the EA/RIR, for drift gillnet harvest occurring in statistical area 24460, the 2024 SAFE assumed the following EEZ harvest proportions [(EEZ drift gillnet harvest) / (total drift gillnet harvest)] by date:

[10] https://www.adfg.alaska.gov/FedAidPDFs/FMS22-01.pdf
[11] https://www.adfg.alaska.gov/FedAidPDFs/FMS17-02.pdf
[12] https://www.adfg.alaska.gov/FedAidPDFs/FMS20-01.pdf
[13] https://www.adfg.alaska.gov/FedAidPDFs/FMS20-02.pdf
[14] https://www.adfg.alaska.gov/index.cfm?adfg=fisheriesboard.meetinginfo&date=02-07-2020&meeting=anchorage
[15] https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.salmon#management
[16] https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1546815985.pdf
[17] https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.salmon#forecasts
[18] https://www.adfg.alaska.gov/index.cfm?adfg=ByAreaSouthcentralUpperKenai.fishingInfo#outlook
[19] https://www.adfg.alaska.gov/index.cfm?adfg=ByAreaSouthcentralNorthCookInlet.fishingInfo#outlook
[20] https://www.adfg.alaska.gov/sf/sportfishingsurvey/
[21] https://www.adfg.alaska.gov/FedAidPDFs/FMS23-01.pdf
[22] https://www.adfg.alaska.gov/static/regulations/fishregulations/pdfs/commercial/2020_2022_cf_cook_inlet_salmon.pdf
[23] https://www.fisheries.noaa.gov/action/amendment-16-fmp-salmon-fisheries-alaska
[24] https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2021.04.pdf
[25] https://www.adfg.alaska.gov/index.cfm?adfg=commercialbyareauci.salmon_harvest_current
[26] https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1546815985.pdf

- June 19-July 8th, 50% EEZ harvest;
- July 10 -15, 75% EEZ harvest;
- August 1 - 15, 75% EEZ harvest;
- August 15- September 14, 25% EEZ harvest but no harvest reported.

For drift gillnet harvests from statistical area 24457, the SAFE assumed 6% EEZ harvest. For any remaining drift gillnet harvests, the SAFE assumed that 0% occurred in the EEZ. As with all data and associated estimates, the NOAA SAFE Team welcomes suggestions on improving these historical estimates. The methods described previously resulted in the following estimated number of salmon harvested by species in the EEZ during 2023: Chinook salmon: **51 fish**; sockeye salmon **641.3K**, coho salmon **24.6K**; chum salmon **51.1K**; and, pink salmon **27.5K**; with the Stock Status Summary section and. Appendices A1-A10 provide estimates of stock-specific harvest estimates in the Cook Inlet EEZ.

Appendices A1-A10 also contain a variety of run size, escapement, harvest, yield and other estimates and analysis results, and plots.

The analyses and data estimates used for the stock status summaries in this SAFE, including versions of model updates, are available through the following GitHub repository: https://github.com/afsc-assessments/Cook-Inlet-SAFE.

The NOAA SAFE Team welcomes feedback on the analyses, either through GitHub or by contacting the NOAA SAFE Team author directly via e-mail or phone.

1 Kenai River Late Run Sockeye Salmon

Definition: The NOAA SAFE Team recommends to the SSC that the proposed Federal stock definition for Kenai River Late Run sockeye salmon (KNSOCK) would include harvests, spawning escapements, and associated spawning escapement goals corresponding to the SOA definition for this stock.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Kenai River Late Run sockeye salmon are still preliminary (Table 3, Appendix A1) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated that ~418K fish from this stock were harvested in the EEZ Area. Because the estimated harvest rate in the EEZ over the most recent generation (F_{EEZ}) of 0.08 was substantially lower than the estimated MFMT of 0.37, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessment

The SOA data and stock assessment sources used for the Federal assessment of Kenai Late Run sockeye salmon are described previously, with the additional consideration that Appendix 14 of the EA/RIR includes an examination of density-dependent effects for this stock.

The data used to assess the Kenai Late Run sockeye salmon stocks is considered to be complete and of high quality with estimates of stock-specific harvests, spawning escapements, the resulting recruits from those spawners, and age estimates for harvests and escapements. Historical smolt data also exists for this stock.

The complete spawner and recruitment data for this stock enabled the use of Ricker models and yield analyses to evaluate spawner-recruitment relationships and inform the bounds of the SOA spawning escapement goal.

Sibling model relationships for the dominant age classes inform the SOA's pre-season estimates of total run size, with forecasted returns of minor age classes based on recent average returns.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data (Appendix A1). However, because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024, this SAFE estimated inriver harvests (e.g., sportfish and personal use) for 2023 and estimated the proportion of the overall drift gillnet harvests that consisted of Kenai Late Run sockeye salmon in 2022 and 2023. These estimates were made using 5-year averages and will be updated in future years as data become available.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 1 stocks. In the absence of ADF&G's preseason forecast, the Federal assessment included the AR approach and buffers to account for scientific uncertainty in reducing the preseason OFL to the proposed ABC.

Stock size and recruitment trends

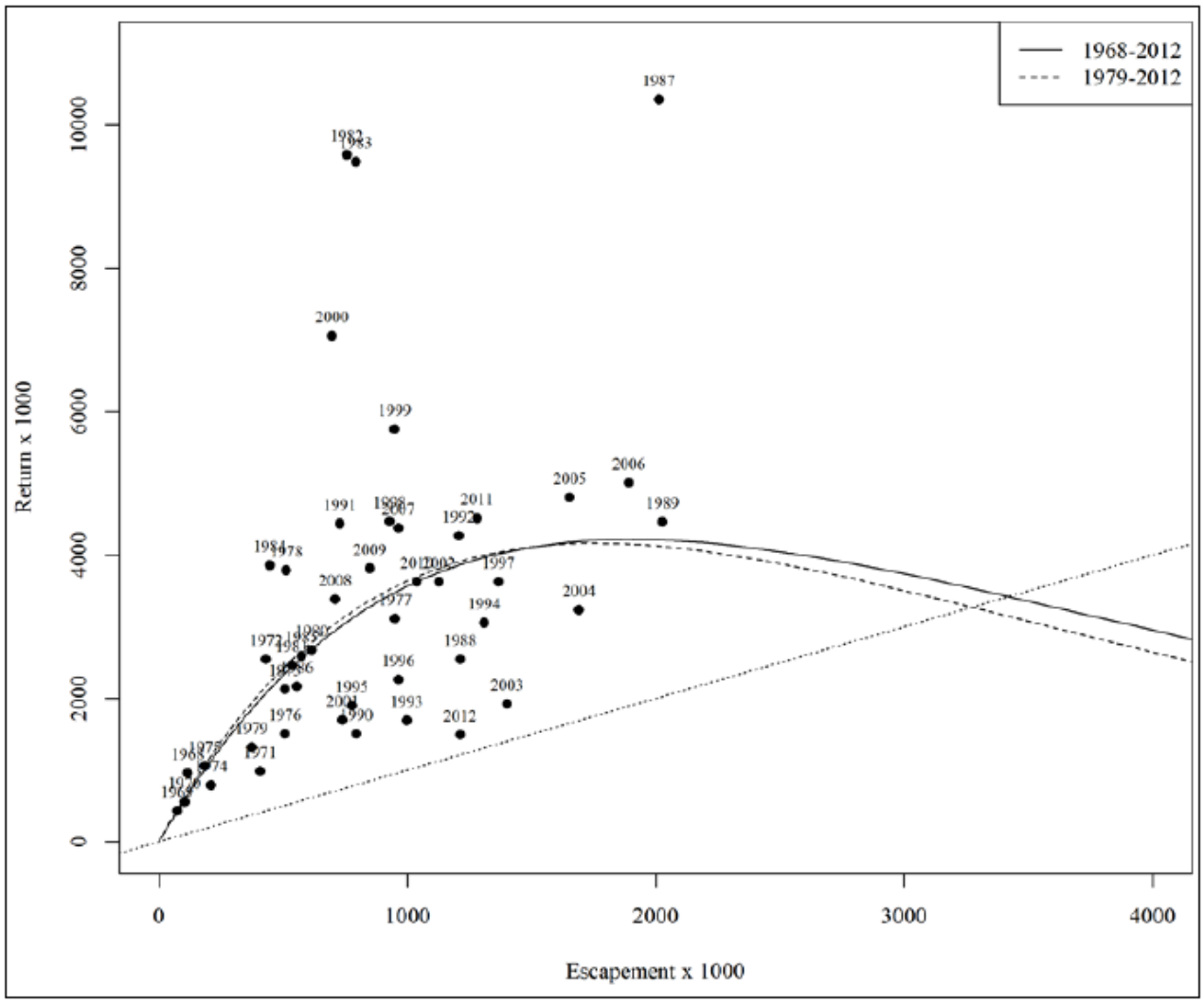
Stock overview: Based on historical estimates, the Kenai Late Run sockeye salmon is the dominant

stock of sockeye salmon harvested in the Cook Inlet EEZ drift gillnet fishery and the largest stock of any salmon species harvested in the Cook Inlet EEZ. During the most recent five year period (2019–2023), an average of ~71% of the entire drift gillnet sockeye salmon harvested in the EEZ is estimated to have been from the Kenai Late Run sockeye salmon stock (Appendix A1), with a range of drift gillnet EEZ harvests of ~50–418K during this period. Total run size during the 2019–2023 period ranged from 2.39–3.99M. As such, the recent EEZ harvest rate, F_{EEZ}, has been a minor portion of the overall run size (0.06–0.08) and well below the MFMT.

Escapement goals: The State of Alaska's Kenai Late Run sockeye salmon spawning escapement goals (2012–2019: 700,000–1.2M; 2020–present: 750,000–1.3M) have been consistently achieved or exceeded during recent years (Appendix A1). From 2019-2023, an average of approximately 1.7 million sockeye salmon were estimated to have spawned in the Kenai River system with a range of ~1.3-2.2M). The current upper bound of the escapement goal has been exceeded several times during recent years. At present, there does not appear to be strong evidence for density dependent effects resulting from these large escapements (EA/RIR Appendix 14)—such as fewer returning adults or substantially reduced productivity (returns-per-spawner). This suggests that the overall watershed has some capacity to absorb more spawners than the current goal range. Returns from recent large escapements will provide additional information to better define density dependent effects in the coming years.

Spawner-Recruitment and yield trends: When examining data from the 1979–2012 brood years, spawner-recruitment analyses conducted by ADF&G suggest that approximately 1.2M spawners would result in maximum sustainable yield for this stock, with a range of 774,000–1.74M resulting in 90% of MSY. The ADF&G assessment of S_{MSY} (1.2M) was corroborated by an analysis available in Appendix 14 of the EA/RIR. The Kenai Late Run sockeye salmon has poorly defined density dependent characteristics (Figure 2), which also result in estimates of S_{MSY} that are fairly broad and variable across modeling methods. Possible reasons for poorly defined density dependence and the large range of escapements to result in S_{MSY} could include: (1) the paucity of large escapements during past years to parameterize spawner-recruitment models, combined with the dynamic nature of (2) harvests in other areas across years (e.g., Shedd et al. 2016); (3) the productive capacity for the Kenai River and ocean environment to spawn and rear sockeye salmon (i.e., time-varying productivity); and/or (4) inriver and marine survival trends across years.

Figure 2. From Hasbrouck et al. 2022, the most recent ADF&G stock assessment for Kenai Late Run sockeye salmon. Classic Ricker model fit to Kenai River late-run sockeye salmon spawner–recruit data from 1968–2012 (solid line) and 1979–2012 (dashed line).



Tier determination and resulting OFL and ABC determination for 2024

NOAA's SAFE Team recommends that Kenai River late run sockeye salmon be designated as a Tier 1 stock. This recommendation is based on the availability of a long history of escapement data believed to represent actual numbers of spawners (rather than an index), spawner-recruitment model estimates of S_{MSY} and yield analyses that inform escapement goals, stock-specific harvest data, age composition data for all stock components, and a sibling model-based preseason forecasts to estimate total run size for the coming year.

This SAFE uses the AR approach to set SDC and harvest specifications with a buffer of 0.478 (based on mean symmetric accuracy described previously) applied to preseason OFL (1.364M) to result in the ABC of 652K (Table 4).The ABC incorporates the achievement of the biologically-based spawning escapement goal, is reduced from a level that represents maximum potential yield for a single year, and is buffered to account for scientific uncertainty. The AR approach was necessary given that ADF&G's pre-season total run size forecast for this stock was not available in time for the SAFE. The mean symmetric accuracy buffer accounts for model uncertainty and is, based on model results and over the long term, to

be sufficiently precautionary to result in the target escapement goal being achieved. As described previously and in the FMP, the preseason values of OFL and ABC represent potential yield of this stock in the EEZ. In other words, these values represent what could be harvested for the coming fishing season in the EEZ while still meeting spawning escapement goals and estimated harvests outside of the EEZ. To be clear, the AR model will not always be correct in allowing sufficient escapement each year, but the scientific uncertainty applied to the OFL to result in the ABC should, according to the model, result in escapements being achieved over the long term.

For Kenai Late Run sockeye salmon, the actual harvest rate (F_{EEZ}) and the preseason ABC represent different approaches to assessing this stock. F_{EEZ} is the actual harvest rate averaged across the most recent generation. As F_{EEZ} is much smaller than the maximum harvest rate for the most recent generation (MFMT), the ratio of these two rates describes a stock and associate ecosystem that, in recent years, has produced an abundance of harvestable yield. These two rates also define overfishing for the stock; which, given the comparatively small actual harvest rate, it would take many years of harvest in excess of the single year spawning escapement goal for overfishing to occur. In contrast, the preseason ABC is not multiyear in nature and only accounts for the achievement of the spawning escapement and estimated non-EEZ harvests for the coming fishing season. In terms of preventing overfishing, the NOAA SAFE Team provides no recommendations about whether the multi-year (F_{EEZ} : MFMT) or single-year (ABC) assessments is more or less precautionary. The NOAA SAFE Team acknowledges that this stock has a sustainable abundance of excess yield as defined by the FMP, while also acknowledging that not achieving the lower bound of the spawning escapement goal during any single year has ramifications for future yield that the SAFE model did not consider. While a generational approach is appropriate for assessing overfishing and overfished determinations, and for showing past performance for this and other salmon stocks, the cumulative yield across a generation may not be an appropriate metric for setting acceptable biological catch for a semelparous species.

As previously mentioned and discussed in the EA/RIR, the lack of evidence for density dependence is an important consideration for assessing necessary escapements, the allowable harvests that will facilitate the achievement of those escapements, and the estimation of potential yield for the Kenai Late Run sockeye salmon stock. This stock has poorly defined density dependent characteristics, as available data indicates that spawning escapements in excess of the upper bound of the escapement goal have resulted in a substantial harvestable surplus of returning fish in future years. Currently, there is not a well-defined upper threshold of spawners that would result in reduced future yield. Because estimates of potential yield account for the achievement of a spawning escapement goal, with bounds that are not statistically well defined the estimates of potential yield in the EEZ presented in this assessment—while thought to be precise with respect to calculations described in the FMP—may be imprecise with respect to the information they provide for maximizing future yield and informing SDC and harvest specifications. In calculating potential yield for this stock for the purpose of defining SDC and harvest specifications, allowing for escapements that are greater than the 750K lower bound of the escapement goal would necessarily result in lower calculated estimates of potential yield in the EEZ and other fisheries for the coming fishing season; however, available evidence does not yet point to a precise range of spawning escapements that will maximize yield in future years or an upper range that will result in greatly reduced productivity for this stock. The Kenai River ecosystem components responsible for spawning, rearing, migration, and other life stages have shown sufficient capacity to absorb spawners well in excess of the SOA escapement goal while also producing harvestable yield. While it is not necessarily rare for sockeye salmon stocks that are the focus of fisheries to have poorly defined density-dependent characteristics, it is rare for a major, exploited, sockeye salmon stock to exhibit only positive yields throughout its entire history. The large escapements to this system during recent years (Appendix A1) may help to define the capacity of the ecosystem to produce yield for this stock, but given the lack of existing data to define the upper range, it may be many years before such data are informative to management.

Given the considerations above, and the fact that recent estimates of harvest of this stock in the EEZ have been below the recommended 2024 preseason ABC during recent years under SOA management (i.e., would appear to provide for sufficient harvest opportunity in the EEZ), and that the Federal management framework largely preserves the State management framework on which the SAFE estimates are based,

it is the recommendation of the NOAA SAFE Team that the 2024 preseason ABC be set at 652K sockeye salmon for this stock.

Status and catch specifications for Tier 1 Kenai River Late Run sockeye salmon. For 2024, a buffer of 0.478 was used to reduce the preseason potential yield ("preseason OFL") to the recommended single-year proposed ABC of ***652K****. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (****MSST****), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (****Cum. Escap****.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (****MFMT****), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (****F_{EEZ}****). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (****EEZ Cum. Harvest****) with the postseason overfishing limit (****OFL****), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC
2019	1,750	5,935	0.24	0.08	3,542	252	1,189		
2020	1,775	6,041	0.25	0.07	2,394	50	1,001		
2021	1,800	7,163	0.31	0.06	3,992	256	857		
2022	1,825	7,355	0.33	0.07	2,682	332	987		
2023	1,850	8,561	0.37	0.08	3,882	418	1,308		
2024	1,875		0.40	0.15	3,485		1,056	1,364	652

2 Kasilof River Sockeye Salmon

Definition: The NOAA SAFE Team recommends to the SSC the proposed Federal stock definition for Kasilof River sockeye salmon (KASOCK) would include harvests, spawning escapements, and associated spawning escapement goals corresponding to the SOA definition for this stock.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Kasilof River Late Run sockeye salmon are still preliminary (Table 3, Appendix A2) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated that ~57K fish from this stock were harvested in the EEZ Area. Because the estimated harvest rate in the EEZ over the most recent generation (F_{EEZ}) of 0.03 was substantially lower than the estimated MFMT of 0.54, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessment

The SOA data and stock assessment sources used for the Federal assessment of Kasilof River sockeye salmon are described previously, with the additional consideration that the EA/RIR includes an examination of density-dependent effects for this stock.

The data used to assess the Kasilof River sockeye salmon stocks is considered to be complete and of high quality with estimates of stock-specific harvests, spawning escapements, the resulting recruits from those spawners, and age estimates for harvests and escapements. Smolt data also exists for the Kasilof River system.

The complete spawner and recruitment data for this stock enabled the use of Ricker models—to evaluate spawner-recruitment relationships—and yield analyses to inform the bounds of the SOA spawning escapement goal.

Sibling model and smolt-to-adult survival relationships for the dominant age classes inform the SOA's pre-season estimates of total run size, with forecasted returns of minor age classes based on recent average returns.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data (Appendix A2). However, because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024, this SAFE estimated the proportion of the overall drift gillnet harvests that consisted of Kasilof River sockeye salmon in 2022 and 2023. These estimates were made using 5-year averages and will be updated in future years as data become available.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 1 stocks. In the absence of ADF&G's preseason forecast, the Federal assessment included the AR approach and buffers to account for scientific uncertainty in reducing the preseason OFL to the proposed ABC

Stock size and recruitment trends

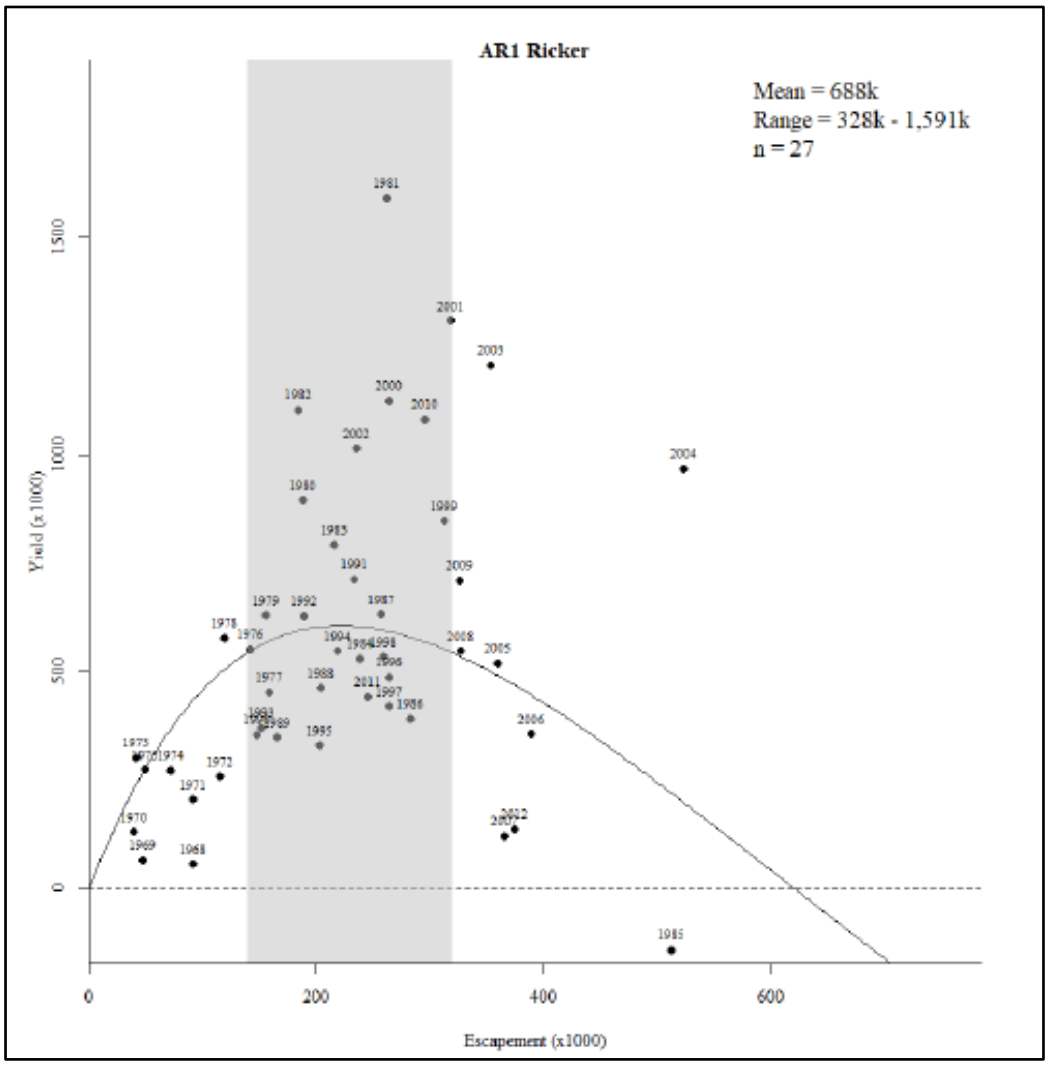
Stock overview: During the most recent five year period (2019–2023), an average of 7% of the drift

gillnet sockeye salmon harvest is estimated to have been from the Kasilof River sockeye salmon stock, with a range of harvests of harvests of this stock in the EEZ of 9,717–57,078 fish during this period. Total run size during the 2019–2023 period ranged from 613K–1.495M.

Escapement goals: The SOA's Kasilof River sockeye salmon spawning escapement goals (2012–2019: 160,000–340,000; 2020–present: 140,000–320,000) have been consistently achieved or exceeded during recent years (Munro 2023; Appendix A2). From 2019-2023, an average of approximately 666,644 sockeye salmon were estimated to have spawned in the Kasilof River system (range of 373,416–968,148). The current upper bound of the escapement goal is estimated to have been exceeded several times during recent years.

Spawner-Recruitment and yield trends: When examining data from the 1968-2012 brood years, the best fit model from the spawner-recruitment analyses (AR1 Ricker model) conducted by ADF&G suggests that approximately 222,000 spawners would result in maximum sustainable yield for this stock, with a range of 140,000–320,000 resulting in 90% of MSY. Similar to many sockeye salmon stocks with relatively high historical harvest rates, this stock has poorly defined density dependent spawner-recruitment characteristics at larger escapements, with only a single brood year (1985) having returns that were below replacement and no strong evidence for density dependent effects (Figure 3; EA/RIR Appendix 14). Returns from recent large escapements will provide additional information to better define density dependent effects and S_{MSY}.

Figure 3. From McKinley et al. 2020, the most recent ADF&G stock assessment for Kasilof River sockeye salmon. Autoregressive lag-1 (AR1) Ricker model of spawning escapements (x-axis) and realized yields (y-axis) from brood years 1968–2012. The line represents the modeled yield and the shaded area is the SOA's recommended biological escapement goal (BEG) range of 140–320K spawners.



Tier determination and resulting OFL and ABC determination for 2024

NOAA's SAFE Team recommends that Kasilof River sockeye salmon be designated as a Tier 1 stock. This recommendation is based on the availability of a long history of escapement data believed to represent actual numbers of spawners (rather than an index), spawner-recruitment model estimates of S_{MSY} and yield analyses that inform escapement goals, stock-specific harvest data, age composition data for all stock components, and a sibling model-based preseason forecasts to estimate total run size for the coming year.

This SAFE uses the AR approach to set SDC and harvest specifications with a buffer of 0.694 (based on mean symmetric accuracy described previously) applied to preseason OFL (623K) to result in the ABC of 432K (Table 4). The ABC incorporates the achievement of the biologically-based spawning escapement goal, is reduced from a level that represents maximum potential yield for a single year, and is buffered to account for scientific uncertainty in the SAFE's 2024 total run size estimate (~1.125M) and

harvest outside of the EEZ. The AR approach was necessary given that ADF&G's pre-season total run size forecast for this stock was not available in time for SAFE. The mean symmetric accuracy buffer would be sufficiently precautionary to result in the target escapement goal being achieved over the long term. As described previously and in the FMP, the preseason values of OFL and ABC represent potential yield of this stock in the EEZ. In other words, these values represent what could be harvested in the EEZ while still meeting spawning escapement goals and estimated harvests outside of the EEZ.

Similar to the Kenai River Late Run sockeye salmon stock, and as discussed in EA/RIR, the Kasilof River sockeye salmon stock also has poorly defined density dependence, but perhaps not as extreme as for Kenai River sockeye salmon. Many of the same considerations discussed for Kenai River sockeye salmon are applicable to Kasilof River sockeye salmon, such as there being a lack of precision in defining the upper limits of escapement that would result in reduced yield and productivity for the stock, while acknowledging that estimates of potential yield are dependent upon the attributes of the spawner-recruitment relationship.

Given the considerations above, the fact that recent estimates of harvest of this stock in the EEZ have been below the proposed 2024 preseason ABC during recent years under SOA management (i.e., the level of harvest should provide sufficient opportunity relative to recent years), and this management framework is largely preserved in the Federal management plan, it is the recommendation of the NOAA SAFE Team that the 2024 preseason ABC be set at 433K.

*Status and catch specifications for Tier 1 Kasilof River sockeye salmon. For 2024, a buffer of 0.694 was used to reduce the preseason OFL (potential yield) to the recommended ABC of **433K**. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (F_{EEZ}). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC
2019	400	1,831	0.30	0.03	613	10	98		
2020	390	1,902	0.35	0.03	845	6	86		
2021	380	2,179	0.39	0.03	925	21	107		
2022	370	2,788	0.47	0.03	1,495	45	113		
2023	360	3,333	0.52	0.03	1,393	57	140		
2024	350		0.55	0.13	1,125		130	623	433

3 Aggregate "Other" Sockeye Salmon, stock complex

Definition: The NOAA SAFE Team recommends to the SSC that the Aggregate "Other" sockeye salon stock complex (AOSOCK) be defined as all sockeye salmon harvested in the Cook Inlet EEZ Area, except for Kenai Late Run and Kasilof stocks of sockeye salmon. For the 2024 SAFE, the proposed Federal stock definition would take into account spawning escapements and associated spawning escapement goals for four index systems for the purposes of SDC, with all sockeye salmon that spawn in unmonitored systems throughout Upper Cook Inlet also being part of the stock definition.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Aggregate Other sockeye salmon are still preliminary (Table 3, Appendix A3-A4) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated that ~183K fish from this stock were harvested in the EEZ Area, resulting in a cumulative harvest for the most recent generation of 457K sockeye salmon. Because this stock could be placed in either Tier 2 or Tier 3 based on the criteria established in the FMP, the NOAA SAFE Team provides the following fishery information relative to the OFL for Tier 2 and Tier 3 determinations:

> Tier 2: Because the estimated harvest rate in the EEZ over the most recent generation (F_{EEZ}) of 0.22 was lower than the estimated MFMT of 0.36, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.
>
> Tier 3: Because the cumulative harvest for this stock across the most recent generation (457K) would be below a recommended 2023 OFL of 1.271M sockeye salmon, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessment

The SOA data and stock assessment sources used for the Federal assessment of Aggregate Other sockeye salmon are described previously with the McKinley et al. 2020 containing the most recent SOA stock assessment and escapement goal review. Recent escapement goals, estimates, and many additional references pertaining to assessments of this stock can be found in Munro 2023.

EEZ harvests estimates for Aggregate Other sockeye sockeye salmon stocks are considered to be complete, with the Federal definition for harvest of this stock in the EEZ generally meaning those sockeye salmon not attributable to either Kenai River Late Run or Kasilof River sockeye salmon stocks.

Spawning escapement data for stocks in the stock complex exists for several tributaries and drainages (described below).

Age data and genetics data and associated stock composition estimates exist for commercial harvests (e.g., Barclay and Chenoweth 2021[27] and Barclay 2020[28]). Age estimates also exist for several tributaries and drainages within the stock complex.

Historically, the total run size for the Susitna River drainage portion of the Aggregate stock complex has been forecasted using mean values of productivity (recruit per spawner) and estimates of spawner

[27] https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2021.04.pdf
[28] https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2020.02.pdf

abundance based mark-recapture studies (DeCino, 2022[29]). However, the 2023 preseason total run size forecast for the Susitna River and Fish Creek were the recent 5-year average estimated total run sizes to these systems.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data (Appendix A3-A4). However, because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024, this SAFE estimated: test fishery harvests in 2022 and 2023; sportfish harvests in 2022 and 2023; personal use harvests in 2023, subsistence and education harvests in 2022 and 2023; and the proportion of the overall drift gillnet harvests that consisted of Aggregate Other sockeye salmon in 2022 and 2023. Estimates for these values were made using 5-year averages and will be updated in future years as data become available.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 2 stocks (same as for Tier 1 stocks) and Tier 3 stocks.

For the Tier 2 approach, in the absence of ADF&G's preseason forecast, the Federal assessment included the AR approach and buffers to account for scientific uncertainty in reducing the preseason OFL to the proposed ABC.

The Tier 3 OFL was calculated by multiplying the largest estimated EEZ harvest in the timeseries (254K) by the average generation time (five years) with a range of buffers from 0.1 to 0.90 considered to result in the ABC. The values presented in the discussion and tables have subtracted the previous T-1 years of cumulative harvest from the OFL to result in a preseason OFL and resulting buffered ABCs. This was done to highlight what could be harvested in the coming fishing season before reaching the OFL and ABC.

Stock size and recruitment trends

Stock overview: During the most recent five year period (2019-2023), an average of 22% of the drift gillnet sockeye salmon harvest is estimated to have been from the Aggregate Other sockeye salmon stock, with a range of harvests from 13-183K from the EEZ during this period. The estimated total run size during the 2019-2023 period ranged from 279-604K, with the caveat, described below, that these estimates are likely missing substantial numbers of spawners due to unmonitored tributaries and drainages and incomplete escapement monitoring during some years.

Escapement goals: The proposed Federal definition of this stock complex includes four indicator stocks for which the SOA has spawning escapement goals (goal ranges in parentheses):

Fish Creek (15,000–45,000); Chelatna Lake (20,000–45,000); Judd Lake (15,000–40,000); and Larson Lake (15,000–35,000).

The sum of the lower bounds of these escapement goals for the stock complex is 65,000, which, overall, has been consistently achieved during recent years (Munro 2023; Appendix A3). However, this 65,000 fish goal was achieved despite escapement monitoring (via weirs) not occurring on the Chelatna River since 2019 and the Judd Lake weir was not operational in 2023. From 2019–2023, an average of approximately 126K sockeye salmon were estimated to have spawned in the tributaries that have been monitored (range of 83–171K).

Escapement goals for some of the four indicator stocks in the stock complex have not been achieved during recent years (Munro 2023); however, none of these stocks are classified as "Stocks of Concern" by the SOA and, as all escapement goals in the stock complex were developed based on the"Percentile Approach" (Clark et al. 2014[30]), not achieving the lower bound of an escapement goal during some years is an expected product of that approach. For example, if the lower bound of an escapement goal is set at

[29] https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1355244301.pdf
[30] https://www.adfg.alaska.gov/FedAidPDFs/FMS14-06.pdf

the 15th percentile of historical escapements, then escapements below that level fall below the lower bound of the goal.

There are many other tributaries and drainages in Upper Cook Inlet where sockeye salmon are known to spawn, but which lack escapement goals and active monitoring. Notably, there was an SOA escapement goal on the Crescent River (west side of Cook Inlet), but this goal no longer exists and the escapement monitoring no longer occurs. Other unmonitored systems where sockeye are known to spawn in Upper Cook Inlet include[31]: Big River, McArthur River, Chilligan River, Coal Creek, Cottonwood Creek, Wasilla Creek, and Eagle River.

Spawner-Recruitment and yield trends: Spawner-recruitment trends for the four index systems in the stock complex were not presented in the most recent SOA stock assessment and escapement goal review (McKinley et al. 2020). The NOAA SAFE Team did not further investigate historical records of spawner-recruitment relationships for the index systems and a full accounting of such relationships is likely to be hampered by the number of systems that are unmonitored. Thus, while genetic analyses are being used by ADF&G to actively monitor the stock contributions of commercial harvests, the lack of escapement data makes it difficult to attribute these harvests to a given number of spawners in order to estimate the productivity (recruit per spawner) of the stock complex with a level of precision that can be used to inform spawning escapement goals or preseason forecasts. However, the Clark et al. 2014 description of the Percentile Approach for informing the bounds of spawning escapement goals provides a variety of model results that justify the choice of percentiles based on the likelihood of maximizing future yield. As such, considerations for maximizing yield are inherent with the approach.

Tier determination and resulting OFL and ABC determination for 2024

Based on the criteria established in the FMP, the Aggregate Other sockeye salmon stock could be designated as Tier 2 or Tier 3. For tier determination and the resulting method used to calculate SDC and harvest specifications, the SSC may wish to consider the extent to which the stock complex has an estimate of escapement that it deems to be "reliable" and the extent to which the assigned tier level is precautionary with respect to protecting the stock from overfishing. The NOAA SAFE Team recommends a Tier 3 determination for the stock complex, but provides the SSC with the following for SDC, harvest specifications, and additional considerations for Tiers 2 and 3.

Tier 2 (Not recommended): Status and catch specifications for Aggregate Other sockeye salmon based on a Tier 2 determination with the AR approaches are provided in Tables 4. Based on a 2024 preseason total run size ARIMA forecast of 314K, and allowing for the achievement of the 65K spawning escapements across the four monitored systems, and harvests outside of the EEZ, would result in a preseason ACL of 169K "Other" sockeye salmon for the Cook Inlet EEZ Area. The AR approach uses a mean symmetric accuracy buffer of 0.736 to reduce the 2024 preseason OFL (230K) to the ABC of 169K.

As a Tier 2 stock, F_{EEZ} and MFMT are normalized to total run size estimates that sum estimated harvests in the EEZ with spawning escapement indices from the four index systems mentioned previously. The index systems have not been consistently monitored during recent years and they likely represent an unknown proportion of the overall spawning escapement to the larger Federally-defined stock complex. As discussed previously, without additional information to scale indices of spawning escapement to actual numbers of fish that spawned, the combination of known harvests (actual numbers of fish) with indices of escapement may result in overfishing occurring for the stock complex but an overfishing determination not being triggered. Alternatively, if there is incomplete monitoring of indicator stocks within the stock complex, then overfishing or overfished determinations could be made when they are not warranted for the larger stock complex.

As indicated by the previous discussion, the NOAA SAFE Team found it difficult to justify SDC and harvest specifications for Aggregate "Other" sockeye salmon that would be precautionary. While the NOAA SAFE Team does not recommend a Tier 2 designation for this stock; a buffered preseason ACL

[31] https://www.adfg.alaska.gov/static/applications/dcfnewsrelease/1355244301.pdf

of 169K is within the range of harvests estimated to have occurred in the EEZ during the previous five years and using this value would be a direct comparison to the recommended harvest specifications for Kenai and Kasilof sockeye salmon stocks and could therefore be appropriate for use by the Council in setting TAC.

Tier 3 (Recommended): Based on the considerations provided above, the NOAA SAFE Team recommends to the SSC a Tier 3 determination for Aggregate Other sockeye salmon.

Status and catch specifications for Aggregate Other sockeye salmon based on a Tier 3 determination is provided in Tables 4 with a range of buffers from 0.1 to 0.9 to reduce the preseason OFL to ABC. Notably, the OFL (1.271M) for Tier 3 stocks is equal to the largest historical harvest in the timeseries (254K) multiplied by the generation time of the species (five years for sockeye salmon). The 2024 preseason OFL is reduced from the overall OFL by the cumulative harvest during the most recent T-1 (four) years in the generation time to result in the maximum harvest that could occur during the final year of the generation time without overfishing occurring.

For Tier 3 Aggregate Other sockeye salmon, the NOAA SAFE Team recommends that ABC be reduced by a 20% buffer from the preseason OFL. As the OFL is a summation of the maximum historical harvests across the generation time (five years) of sockeye salmon, a 20% buffer from the preseason OFL represents an ABC for a single year (⅕ = 0.20) . As such, this buffer is based on the life history characteristics of sockeye salmon and a means of recognizing that maximum harvests are unlikely to occur every year for a generation. Based on the Tier 3 approach and a buffer of 20%, the resulting 2024 preseason ABC would be 177.5K sockeye salmon, which is the NOAA SAFE Team's recommended ABC for this stock.

Having comparable "apples-to-apples" ABCs across stocks of the same species is an important consideration when setting TAC in a mixed stock fishery for which managers are, currently, unable to distinguish between stocks inseason. As the 20% buffer for the Tier 3 "Other" sockeye salmon stock complex represents the equivalent of the maximum number of fish that could be harvested during a single season, it is also comparable with the single season ABCs recommended for the Tier 1 Kenai and Kasilof river stocks of sockeye salmon. For example, based on the Tier 3 approach, a buffer 60% to the OFL would result in the equivalent ABC of 3 years of maximum potential harvest on the stock, which, when summed across the two Tier 1 sockeye salmon stocks, would result a combined TAC that was an amalgamation of different harvest intensities on different stocks. By keeping this Tier 3 stock to a 20% buffer, managers can make the assumption that inseason stock proportions are relatively consistent with recent historical averages—likely a necessary assumption for inseason management—when assessing the achievement of stock-specific ACLs and the overall TAC.

While this stock can be declared overfished if cumulative spawning escapements are determined to be below MSST (similar to Tier 1 and 2), as total run size is not estimable in this tier, MFMT and F_{EEZ} are not calculable; overfishing would be assessed based on the OFL.

*Status and catch specifications for Tier 2 Aggregate Other sockeye salmon (Not recommended). For 2024, a buffer of 0.736 was used to reduce the preseason OFL (230K) (based on the 2024 preseason forecast of 314K) to the single year ABC of 169K. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC
2019	178	822	0.28	0.13	604	73	404		
2020	170	686	0.26	0.13	338	13	346		
2021	163	736	0.27	0.13	538	54	352		
2022	163	695	0.31	0.15	348	133	352		
2023	163	631	0.36	0.22	270	183	457		
2024	163		0.46	0.34	314		384	230	169

*Status and catch specifications for Tier 3 Aggregate Other sockeye salmon (Recommended). For 2024, the OFL (1.271M) has been reduced by the cumulative harvest for the previous T-1 (four) years of the generation (384K), resulting in a preseason OFL of 888K sockeye salmon that could be harvested before overfishing occurred. Buffers of 10%-90% are applied to the preseason OFL to result in proposed preseason values of ABC. A recommended 20% buffer of the preseason OFL would result in a preseason ABC of **177.5K** sockeye salmon. See the Tier 2 caption for a description of the fields and values.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC (10%)	ABC (90%)
2019	178	822	NA	NA	NA	73	404	1,271		
2020	170	686	NA	NA	NA	13	346	1,271		
2021	163	736	NA	NA	NA	54	352	1,271		
2022	163	695	NA	NA	NA	133	352	1,271		
2023	163	631	NA	NA	NA	183	457	1,271		
2024	163		NA	NA	NA		384	888	88	799

4 Kenai River Late Run Large Chinook Salmon

Definition: At the discretion of the SSC, the stock definition for Kenai Late Run Large Chinook salmon (KCHIN) would include harvests, spawning escapements, and associated spawning escapement goals corresponding to the SOA definition for this stock. Due to the reasons discussed in this section, this stock definition is not recommended by the NOAA SAFE Team and is mutually exclusive with a stock definition and associated tier for the UCI-wide Aggregate Chinook salmon stock (ACHIN) described in the following section, which is the preferred option recommended by the NOAA SAFE Team.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Kenai Late Run Large Chinook salmon are still preliminary (Table 3 Appendix A5) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated (but without direct evidence) that ~21 fish from this stock were harvested in the EEZ Area. Because the estimated harvest rate in the EEZ over the most recent generation (F_{EEZ}) of 0.003 was substantially lower than the estimated MFMT of 0.06, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessments

The SOA data and stock assessment sources used for the Federal assessment of Kenai River Late Run Chinook salmon are described previously.

The data used to assess the Kenai River Late Run Chinook salmon stocks are considered to be complete and of relatively high quality with estimates of stock-specific harvests, spawning escapements, the resulting recruits from those spawners, and age estimates for harvests and escapements

The complete spawner and recruitment data for this stock enabled the use of Ricker models—to evaluate spawner-recruitment relationships—and yield analyses to inform the bounds of the SOA spawning escapement goal.

Sibling model relationships for the dominant age classes inform the SOA's pre-season estimates of total run size, with forecasted returns of minor age classes based on recent average returns.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data. However, importantly, the NOAA SAFE Team finds that previous estimates of EEZ harvests of this stock contained in the EA/RIR may not be well supported. As indicated in the footnote of Table B3 of Reimer and Fleishman (2017), the number of fish from this stock harvested in the UCI drift gillnet fishery "Assumes 60% of commercial driftnet harvest is of Kenai-origin fish; uses ESSN harvest fraction of large fish." With 'ESSN' in the attribution meaning fish harvested in the SOA's Eastside set gillnet fishery. In turn, the number of fish from the Kenai Late Run Large Chinook salmon stock that have been harvested in the EEZ portion of the drift gillnet fishery were estimated from the statistical area and locale code combinations described previously and available in the EA/RIR. At the time of publication of this SAFE, the NOAA SAFE Team has not found evidence that EEZ drift gillnet harvests proportions are based on genetic contribution estimates. Total Chinook salmon harvests by the drift gillnet fleet are low (hundreds of fish), and previous estimates could be interpreted as a precautionary maximal attribution of Kenai Late Run Large Chinook. The NOAA SAFE

Team welcomes feedback on assumptions made and methods used.

Because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024 and ADF&G estimates were not yet available, this SAFE estimates the proportion of the overall drift gillnet harvests that consisted of Kenai River Late Run Large Chinook salmon in 2023, with the estimates in the SAFE using the proportion (~40%) that was estimated for 2022. This and other quantities have been flagged for additional evaluation. The NOAA SAFE Team welcomes feedback on assumptions made and methods used.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 1 stocks. In the absence of ADF&G's preseason forecast, the Federal assessment included the AR approach and buffers to account for scientific uncertainty in reducing the preseason OFL to the proposed ABC and a buffer to reduce potential yield in the EEZ for the coming year to the proposed ACL.

Stock size and recruitment trends

Stock overview: During the most recent five year period (2019–2023) an average of 45% of the Kenai Late Run Large Chinook salmon drift gillnet harvest is estimated to have occurred in the EEZ, with a range of 21–32 Chinook salmon harvested in the EEZ from this stock (Appendix A5). Despite historically low overall harvest rates across all fisheries during recent years (including the EEZ), spawning escapement and total run sizes have been at some of the lowest levels in the available timeseries. Total run size during the 2019–2023 period ranged from 12.2–14.7K Kenai River Late Run Large Chinook salmon.

Escapement goals: The SOA's Kenai River Late Run Chinook salmon large fish (>75 cm mid-eye to fork length) spawning escapement goals (2017–2019: 13,500–27,000; 2020–present: 15,000–30,000) has not been achieved during recent years (Munro 2023; Appendix A5). From 2019–2023, an average of approximately 12.8K Chinook salmon from this stock were estimated to have spawned in the Kenai River system, with a range of 11,6–14.5K.

As first implemented during 2017, the large fish goal was primarily justified in order to match the component of Chinook enumerated via sonar and, secondarily, to ensure that sufficient numbers of female Chinook salmon spawn (which tend to be larger) to maintain baseline levels of egg deposition and potential recruitment (Reimer and Fleishman 2017).

Spawner-Recruitment and yield trends: When examining data from 1985-2015 years, results from the state-space spawner-recruitment (Ricker) analyses (Reimer and Fleishman 2017) conducted by ADF&G suggest that approximately 18,477 spawners would result in maximum sustainable yield for the Kenai River Late Run Large Chinook salmon stock, with a range of 11,731–31,832 equating to the 0.05–0.95 percentiles of the posterior distribution. After controlling for density dependent effects, the SOA analyses showed evidence for time varying productivity, with declining stock productivity after 1999, perhaps due to declining marine survival.

Tier determination and resulting OFL and ABC determination for 2024

Based on the criteria set in the FMP, Kenai River Late Run Chinook salmon would appropriately be assigned to Tier 1 based on available data. Information available for this stock includes a spawning escapement goal and a variety of stock-specific data (spawners, harvests, age estimates) that is of high quality and complete across a long timeseries. These data enable the parameterization of spawner-recruitment models, used to inform the establishment and monitoring of escapement goals, and sibling return data, used to inform pre-season forecasts. However, it is the recommendation of the NOAA SAFE Team that there is not sufficient evidence to support historical estimates of EEZ harvest of this stock.

While the NOAA SAFE Team assumes that there is high uncertainty regarding the historical estimates of EEZ harvests, this SAFE uses the AR approach to evaluate SDC and harvest specifications, with a buffer

of 0.47 applied to the OFL; however, the preseason OFL and associated ABC were both zero due to the projected run size (14.7K) being less than the lower bound of the escapement goal of 15K (Table 4). For the years 2019–2023, the postseason estimated EEZ harvest rate of this stock (not including the pre-season model estimate) of 0.003 has been consistently below the MFMT, but the postseason rates could approach parity if the spawning escapement goal is not achieved in 2024.

For this and other stocks, the NOAA SAFE Team requests guidance from the SSC on the threshold of harvests and level of uncertainty for defining a stock and assignment to tiers. As noted previously, relatively few Chinook salmon from this stock are estimated to be harvested in the EEZ and, in recent years, there has been a very low harvest rate of this stock in the EEZ as a proportion of the run size (F_{EEZ}), and a low overall number of Chinook salmon of any stock estimated to be harvested in the EEZ. Moreover, the NOAA SAFE Team has not found evidence that this stock is harvested in the EEZ. Thus, while a Tier 1 determination for this stock could be justified based on available information about the stock beyond the EEZ, the SSC may recommend that the lack of evidence for EEZ harvests warrants a Tier 3 determination for this stock.

Should the SSC recommended that the quality of the Federal harvest estimates in the EEZ is not sufficiently to meet a threshold for Tier 1 determination as a single stock for Federal management purposes, then it is recommended by the NOAA SAFE Team that this stock be included in aTier 3 aggregation of all Chinook salmon harvested in the EEZ. The following section (Aggregate Chinook Salmon, ACHIN) provides NOAA SAFE Team recommendations for SDC and harvest specifications for a UCI-wide stock complex definition with inclusion of Kenai Late Run Chinook salmon to assess SDC.

The NOAA SAFE Team recommends that future research include obtaining genetic stock composition estimates of Chinook salmon harvested in the EEZ fishery.

*Status and catch specifications for Tier 1 Kenai River Late Run large Chinook salmon (Not recommended). Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC
2019	40.5	93	0.13	0.003	13.3	29	347		
2020	41.3	92.9	0.13	0.003	12.2	29	344		
2021	42.0	88.2	0.11	0.003	12.7	25	329		
2022	42.7	87.5	0.11	0.003	14.1	32	259		
2023	43.5	81.5	0.05	0.003	14.7	21	239		
2024	44.2		0.00	0	14.7		136	0	0

5 Aggregate Other Chinook Salmon or Aggregate Chinook Salmon, stock complexes

Definition: The NOAA SAFE Team recommends to the SSC that this Federal stock be defined as either:

Option 1 (Not recommended, AOCHIN), a stock complex that does not include harvests or escapements of Kenai River Late Run Large Chinook salmon, but does include all other Chinook salmon harvested in the Cook Inlet EEZ Area. This option could be selected in addition to a definition and tier determination for Kenai Late Run Large Chinook salmon. However, the NOAA SAFE TEAM does not recommend this option because the assessment would involve unverifiable uncertainty in historical estimates (similar to Kenai River Late Run Large Chinook salmon) and there are no known indicator stocks. Other than to provide a 2023 estimated EEZ harvest of ~30 fish, this option is not considered further in the 2024 SAFE. The SSC could recommend including this stock definition for a future SAFE;

or,

Option 2 (Recommended, ACHIN), a stock complex that includes all Chinook salmon harvested in the EEZ (including Kenai River Late Run Chinook), with considerations for an overfished determination based on spawning escapement and the associated MSST threshold for Kenai Late Run Large Chinook salmon. This option is mutually exclusive with consideration of a stock definition and associated tier for the aforementioned Kenai Late Run Large Chinook (KCHIN) salmon stock.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Aggregate Chinook salmon are still preliminary (Table 3; Appendix A6) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated that 51 fish from this stock were harvested in the EEZ Area, resulting in a cumulative harvest across the most recent generation of 635 Aggregate Chinook salmon harvested. Because the total harvest for this stock would be below a recommended 2023 OFL of 3,072 Chinook salmon it is NOAA's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessments

The sources of SOA data and stock assessment used for the Federal assessment of these proposed Chinook salmon stocks are described previously.

The data used to assess the proposed Chinook salmon stocks in this section include estimates of harvests in the UCI drift gillnet fishery attributed to Kenai Late Run Chinook and all other Chinook, annual spawning escapements and associated escapement goals for 14 stocks that represent drainages and tributaries–as well as differential run timing for some tributaries (Munro 2023), and spawner-recruitment data for Kenai River, Kasilof, Deshka River, Eastside Susitna River, Talkeetna River, and Yentna River stocks.

Spawner-recruitment (Ricker) models were used to inform the bounds of the SOA spawning escapement goals for the stocks with available spawner, recruitment, and age data. The Percentile Approach was used for escapement goal development for nine stocks and a Risk analysis was used for escapement goal development for a single stock. Additional details of these analyses are provided in McKinley et al. 2020,

Reimer and DeCovich 2020[32], and Reimer and Fleishman 2017.

ADF&G provides preseason forecasts of total run size for Kenai River Early and Late Runs, and Deshka River Chinook salmon stocks. Sibling model relationships for the dominant age classes inform the SOA's pre-season estimates of total run size, with forecasted returns of minor age classes based on recent average returns.

For UCI, there are four Chinook salmon stocks of concern listed by the SOA (Munro 2023), all of which are in the far northern portion of UCI: Chuitna River, Theodore River, Alexander Creek, and Eastside Susitna River.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data. However, as stated for the Kenai River Late Run Large Chinook salmon stock, because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024 and ADF&G estimates were not yet available, this SAFE estimates the proportion of the overall drift gillnet harvests that consisted of Kenai River Late Run Large Chinook salmon in 2023, with the estimates in the SAFE using the proportion (~40%) that was estimated for 2022. This and other quantities have been flagged for additional evaluation. The NOAA SAFE Team welcomes feedback on assumptions made and methods used.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 3 stocks.

Stock size and recruitment trends

Stock overview:

During the most recent five year period (2019–2023) an average of 43% of the ACHIN (all UCI Chinook salmon) drift gillnet harvest is estimated to have occurred in the EEZ, with a range of 51–87 Chinook salmon harvested in the EEZ from this stock. Despite historically low overall harvests across all fisheries during recent years (including the EEZ), all UCI Chinook salmon stocks have been at some of the lowest levels of abundance in the available timeseries.

Escapement goals:

Escapement goals pertinent to the ACHIN stock complex could include all UCI Chinook salmon spawning escapement goals. However, as Susitna River stocks of Chinook salmon are not thought to be harvested in significant quantities in the EEZ drift gillnet fishery (Reimer and DeCovich 2020), the only remaining substantial spawning escapement goal that might be pertinent to this ACHIN stock complex is the Kenai River Late Run Large Chinook salmon stock. For the ACHIN stock complex, despite large uncertainty in historical EEZ harvest estimates, the SSC could recommend including the Kenai River Late Run Large Chinook salmon escapement goal (and associated escapements, as described in the previous section) to assess against MSST (overfished determination) using the Tier 3 approach; with reevaluation for future SAFE reports based on updated information.

Spawner-Recruitment and yield trends:

It is the recommendation of the NOAA SAFE Team that, since there is not currently a good basis for knowing which stocks of Chinook salmon are harvested in the Cook Inlet EEZ, there are no applicable stocks to consider for spawner-recruitment and yield trends for the ACHIN stock complex. The spawner-recruitment and yield estimates for Kenai Late Run Large Chinook salmon stock described in the previous section might be applicable to the Cook Inlet EEZ fishery, but this is unknown without genetic stock contribution information for the EEZ fishery.

All Upper Cook Inlet Chinook salmon stocks for which recruitment data are available are in a period of

[32] https://www.adfg.alaska.gov/FedAidPDFs/FMS20-01.pdf

low productivity, recruitment, and abundance that began in the 2000s, with some of the lowest adult abundances observed since the 1970s. The extent of historical harvests of UCI Chinook salmon stocks in the EEZ is unknown.

As an aggregate stock complex, several of the 14 SOA Chinook salmon spawning escapement goals in Upper Cook Inlet are monitored and enumerated with a single aerial, foot survey, and other methods each year that may represent indices of escapements rather than actual numbers of spawners. As such, it is the recommendation of the NOAA SAFE Team that there is not a reliable estimate of spawners for the proposed Federal ACHIN stock complexes as a whole and, as a result, that the overall run size (harvest + escapement) of the stock complexes is not known. However, spawning escapement estimates and indices, and available aggregate harvest data, all indicate that the stock complexes have declined substantially in size concomitant with the stocks defined by the SOA for which spawner-recruitment estimates are available.

Tier determination and resulting OFL and ABC determination for 2024

The NOAA SAFE Team recommends to the SSC that the Aggregate Chinook salmon stock complex be given a Tier 3 determination. As a stock complex with many different drainages and tributaries for which escapement estimates are likely indices of spawners rather than an actual number of fish, these estimates are unlikely to represent "reliable" estimate of spawners or total run size that can be used to calculate MFMT and F_{EEZ} for the overall stock complex.

The precision of Chinook salmon harvest rate estimates in the Cook Inlet EEZ is unknown as the drift gillnet fishery is not thought to have been sampled to obtain genetic stock composition estimates. In addition to the issues raised in the previous section regarding EEZ harvest estimates of Kenai Late Run Chinook, as discussed by Reimer and DeCovich (2020) in their assessment of Chinook salmon stocks of the Susitna River drainage, there is also not good data to support EEZ harvest estimates of other major UCI Chinook salmon stocks: "A drift gillnet fishery targeting sockeye salmon (O. nerka) in Cook Inlet also harvests some Chinook salmon (1966–2016 annual average was 954 Chinook salmon; Shields and Frothingham 2018[33]); however, no stock composition information is available for Chinook salmon harvested in this fishery. We assume it is not significant for the purpose of this study because the fishery largely takes place after Susitna River Chinook salmon have migrated through the area."

For Tier 3 Aggregate Chinook salmon, the NOAA SAFE Team recommends that the preseason OFL (2,697 fish) be reduced by a 0.167% buffer to result in the ABC of 450 fish. As the OFL is a summation of the maximum historical harvests across the generation time (six years) of Chinook salmon, a 0.167% (⅙) buffer from the preseason OFL is the manifestation of the preseason OFL for a single year. As such, this buffer is based on the life history characteristics of Chinook salmon and a means of recognizing that maximum harvests are unlikely to occur every year for a generation. It is the judgment of the NOAA SAFE Team that a 0.167% ABC is precautionary in preventing overfishing and harm to UCI Chinook salmon stocks and an acknowledgement that, while there is little information pertaining to the stocks of Chinook salmon harvested in the EEZ, there are several SOA stocks of concern for Chinook salmon in UCI and a single season ABC provides some measure of protection for ensuring that overfishing does not occur during a single season. Based on the preseason OFL of 2,697 and a buffer of 0.169%, the NOAA SAFE Team recommends a 2024 preseason ABC of **450** Chinook salmon for this stock.

While this stock can be declared overfished if cumulative spawning escapements are determined to be below MSST (similar to Tier 1 and 2) for the proposed Kenai River Late Run Large Chinook salmon indicator stock, as total run size is not estimable in this tier, MFMT and F_{EEZ} are not calculable; overfishing would be assessed based on the OFL.

[33] http://www.adfg.alaska.gov/FedAidPDFs/FMR18-10.pdf

*Status and catch specifications for Tier 3 Aggregate Chinook salmon (ACHIN; recommended). For 2024, the OFL (3,072 fish) has been reduced by the cumulative harvest for the previous T-1 years five years of the generation (375 fish), resulting in a preseason OFL of 2,697 Chinook salmon that could be harvested before overfishing occurred. Buffers of 10% and 90% are applied to the preseason OFL to result in proposed preseason values of ABC. A recommended 0.167% buffer of the preseason OFL would result in an preseason ABC of **450 Chinook salmon**. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC (10%)	ABC (90%)
2019	40.5	93	NA	NA	NA	81	934	3,072		
2020	41.3	92.9	NA	NA	NA	76	879	3,072		
2021	42.0	88.2	NA	NA	NA	87	810	3,072		
2022	42.7	87.5	NA	NA	NA	80	659	3,072		
2023	43.5	81.5	NA	NA	NA	51	635	3,072		
2024	44.2		NA	NA	NA		375	2,697	270	2,427

6 Aggregate Coho Salmon, stock complex

Definition: The NOAA SAFE Team recommends to the SSC that this aggregate coho salmon stock complex (COHO) be defined as the coho salmon harvested in the EEZ, with two indicator stocks (Deshka River and Little Susitna River) considered to be representative of spawning escapements for the larger stock complex. As discussed below, the relevance of spawning escapement goals and associated annual spawning escapements of the indicator stocks and SDC and harvest specifications is dependent upon the tier recommended by the SSC. In addition to the indicator stocks, the overall stock definition would also necessarily include all other drainages and tributaries containing spawning and rearing coho salmon in Upper Cook Inlet.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

The 2023 estimated total harvests, spawning escapements, and total run size of the Aggregate coho salmon are still preliminary (Table 3, Appendix A7-A8) and Federal SDC and harvest specifications were not in effect for the 2023 fishery. However, based on recent historical estimates of the proportions of the overall drift gillnet harvest that occur in the EEZ Area, it is estimated that ~25K fish from this stock were harvested in the EEZ Area, resulting in a cumulative harvest for the most recent generation of 83K coho salmon. Because this stock could be placed in either Tier 2 or Tier 3 based on the criteria established in the FMP, the NOAA SAFE Team provides the following fishery information relative to the OFL for Tier 2 and Tier 3 determinations:

> Tier 2: Because the estimated harvest rate in the EEZ over the most recent generation (F_{EEZ}) of 0.09 was higher than the estimated MFMT of 0.05, it is the NOAA SAFE Team's assessment that overfishing would have occurred during 2023; however, this is the result of missing spawning escapement data, which contributes to the Tier 2 method not being a recommended approach for the 2024 SAFE.
>
> Tier 3: Because the cumulative harvest for this stock across the most recent generation (82K) would be below a recommended 2023 OFL of 439K coho salmon, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023.

Data and assessment methodology

Existing data and assessment

The SOA data and stock assessment sources used for the Federal assessment of aggregate coho salmon are described previously with the most recent SOA stock assessment escapement goal review in McKinley et al. 2020. Recent escapement goals, estimates, and many additional references pertaining to assessments of this stock can be found in Munro 2023.

EEZ harvest estimates for Aggregate coho salmon stocks are considered to be complete, with the Federal definition for harvest of this stock in the EEZ generally meaning all coho salmon estimated to be harvested in the EEZ.

Spawning escapement data for stocks in the stock complex exists for several tributaries and drainages (described below).

Genetics data and associated stock composition estimates exist for commercial harvests during select years (e.g., 2013–2016)[34].

ADF&G's preseason commercial harvest estimates for UCI-wide coho salmon based on recent average

[34] https://www.adfg.alaska.gov/FedAidPDFs/RIR.5J.2019.06.pdf

harvests.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, age, sex, and other data (Appendix A7–A8). However, because of the timeline necessary to produce this SAFE and implement the Federal salmon management in the Cook Inlet EEZ Area in 2024, this SAFE estimated: sportfish harvests in 2022 and 2023 and personal use harvests in 2023. Estimates for these values were made using 5-year averages and will be updated in future years as data become available.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 2 stocks (same as for Tier 1 stocks) and Tier 3 stocks.

For the Tier 2 approach, in the absence of ADF&G's preseason forecast, the Federal assessment included the AR approach and buffers to account for scientific uncertainty in reducing the preseason OFL to the proposed ABC.

The Tier 3 OFL was calculated by multiplying the largest estimated EEZ harvest in the timeseries by the average generation time (four years for coho salmon) with a range of buffers from 0.1 to 0.90 considered to result in the ABC. The values presented in the discussion and tables have subtracted the previous T-1 (three) years of cumulative harvest from the OFL to result in a preseason OFL and resulting buffered ABCs. This was done to highlight what could be harvested in the coming fishing season before reaching the OFL and ABC.

Stock size and recruitment trends

Stock overview: During the most recent five year period (2019–2023), an average of 38% of the drift gillnet coho salmon harvest is estimated to have occurred in the EEZ, with a range of harvests from 1.6–39K coho salmon harvested in the EEZ during period (Appendix A7–A8). Total run size during the 2019–2023 period ranged from 204–288K; however, these estimates are considered to be incomplete due to the escapement indices representing an unknown proportion of overall spawning escapement and incomplete/missing spawning escapement estimates.

Escapement goals: The proposed Federal definition of this stock complex includes 2 indicator stocks for which the SOA has spawning escapement goals (goal ranges in parentheses):

Deshka River (10,200–24,100), and Little Susitna River (9,200–17,700).

The current sum of the lower bounds of these escapement goals for the stock complex is 19,300; which, overall, has not been consistently achieved during recent years (Appendix X; Munro 2023) due to incomplete weir data. From 2019–2023, an average of approximately 9.4K coho salmon were estimated to have spawned in the tributaries that have been monitored (range of 5.0–14.7K).

Individual escapement goals for the two indicator stocks in the stock complex have not been achieved during recent years (Munro 2023); however, none of these stocks are classified as "Stocks of Concern" by the SOA (Munro 2023) and, as all escapement goals in the stock complex were developed based on the"Percentile Approach" (Clark et al. 2014[35]); not achieving the lower bound of an escapement goal during some years is an expected product of this approach.

In addition to the two indicator stocks, there are many other drainages and tributaries in Upper Cook Inlet where coho salmon are known to spawn, but which lack escapement goals and escapement monitoring.

Spawner-Recruitment and yield trends: The NOAA SAFE Team did not further investigate historical records of spawner-recruitment relationships for the index systems and a full accounting of such relationships is likely to be hampered by the number of systems that are unmonitored and other data gaps. For example, while genetic analyses have been used by ADF&G to estimate the stock contributions

[35] https://www.adfg.alaska.gov/FedAidPDFs/FMS14-06.pdf

of commercial harvests during some past years, the NOAA SAFE Team determined that the lack of annual estimates, combined by incomplete escapement data, makes it difficult to attribute these harvests to a given number of spawners in order to estimate the productivity (recruit per spawner) of the overall stock complex.

Tier determination and resulting OFL and ABC determination for 2024

Based on the criteria established in the FMP, the Aggregate coho salmon stock could be designated as Tier 2 or Tier 3. For tier determination, the SSC may wish to consider the extent to which the stock complex has an estimate of escapement that it deems to be "reliable" and the extent to which the assigned tier level is precautionary with respect to ensuring that overfishing does not occur while balancing harvests.

The NOAA SAFE Team found that incomplete spawning escapement data for the indicator systems prevented using these data for calculating SDC for both Tier 2 and Tier 3 approaches and, as a result, also made it difficult to set objective buffers that balance harvest and conservation. For example, data gaps prevented verifiable estimation of MFMT or MSST and therefore data were lacking to compare these SDC with, respectively, F_{EEZ} and cumulative spawning escapements across a generation for the Tier 2 approach. On the one hand, given the absence of data to evaluate SDC, greater precaution may be warranted in setting the buffer to set harvest specifications for fisheries management in the EEZ. On the other hand, neither of the indicator stocks has been designated a "Stock of Concern" by the SOA and the State drift gillnet fishery in the Central District was prosecuted through mid-August as recently as 2023.

The retrospective analysis in the EA/RIR did indicate coho were subject to overfishing in 2013. One or both indicator stocks did not achieve at least the lower bound of the escapement goal in 2016, 2018, and 2019. As noted by State fishery management personnel, reductions in drift gillnet fishing effort in the last several years may have contributed to improved coho salmon escapement and catches in Northern District fisheries.[36],[37]

The NOAA SAFE Team recommends to the SSC a Tier 3 determination for the Aggregate Coho stock complex during 2024 due to the incomplete spawning escapement data for the two indicator systems and the associated inability to verify estimates of total run size estimates that are necessary for obtaining valid SDC estimates under Tier 2. However, the following SDC, harvest specifications, and additional considerations are provided for assessment approaches using Tiers 2 and 3.

Tier 2 (Not recommended): Status and catch specifications for Aggregate coho sockeye salmon based on a Tier 2 determination, with the AR approaches are provided in Tables 4 Based on the SAFE's preseason ARIMA forecast of 253K and accounting for likely SOA harvests and the achievement of the 19.3K spawning escapement goals on the two monitored indicator stocks, the AR approach uses a mean symmetric accuracy buffer of 0.15 to reduce the 2024 preseason OFL (32K) to the ABC of 4.9K.

As a Tier 2 stock, F_{EEZ} and MFMT are normalized to total run size estimates that sum estimated harvests in the EEZ with spawning escapement indices from the four index systems mentioned previously. The index systems have not been consistently monitored during recent years and they likely represent an unknown proportion of the overall spawning escapement to the larger Federally-defined stock complex. As discussed previously, without additional information to scale indices of spawning escapement to actual numbers of fish that spawned, the combination of known harvests (actual numbers of fish) with indices of escapement may result in overfishing occurring for the stock complex but an overfishing determination not being triggered. Alternatively, if there is incomplete monitoring of indicator stocks within the stock complex, then overfishing or overfished determinations could be made when they are not warranted for the larger stock complex.

The NOAA SAFE Team does not recommend a Tier 2 designation for this stock and a buffered preseason ABC of 4.9K is below the range of harvests estimated to have occurred in the EEZ during

[36] https://www.adfg.alaska.gov/FedAidPDFs/FMR21-26.pdf
[37] https://www.adfg.alaska.gov/FedAidPDFs/FMR19-25.pdf

most previous years.

Tier 3 (Recommended): Based on the considerations provided above, the NOAA SAFE Team recommends to the SSC a Tier 3 determination for Aggregate coho salmon.

Status and catch specifications for Aggregate coho salmon based on a Tier 3 determination are provided in Tables 4 with a range of buffers from 0.1 to 0.9 to reduce the OFL to ABC. The Tier 3 OFL (439K) is equal to the largest historical harvest in the timeseries (~110K) multiplied by the generation time of the species (four years for coho salmon). The 2024 preseason OFL is reduced from the overall OFL by the cumulative harvest during the most recent T-1 (three) years in the generation time to result in the maximum harvest that could occur during the final year of the generation time (2024) without overfishing occurring, a pre-season OFL of 358K.

The NOAA SAFE Team's recommendation for a buffer to reduce the preseason OFL for setting harvest specifications while exercising the necessary precaution to avoid overfishing and overfished determinations.

For two other Tier 3 stocks (Chinook, and Other sockeye), the NOAA SAFE Team proposed a buffer that would result in an ABC that was equivalent to allowing maximum potential yield for a single year in the generation time of the species being assessed. For aggregate coho salmon with an average generation time of 4 years, a similar approach would result in a buffer of 25%. Such a buffer is based on the life history characteristics of coho salmon and a means of recognizing that maximum harvests are unlikely to occur every year for a generation. A buffer of 25% of the preseason OFL would result in a 2024 preseason ABC of 89K coho salmon. However, the NOAA SAFE Team recommends a more conservative buffer for aggregate coho salmon during 2024 given: the lack of calculated SDC criteria for the aggregate coho salmon stock complex; the fact that the indicator stocks have not consistently achieved spawning escapement goals during recent years (Munro 2023); genetic evidence showing that significant proportions of the drift gillnet coho salmon harvested are likely bound for Northern Cook Inlet drainages—combined with the intent of the SOA's commercial fishery management plan for UCI, which specifically calls for prioritization of coho salmon passing through Central and Northern Districts.

In addition to considerations applicable to assessing the health yield of the Aggregate coho salmon stock, the NOAA SAFE Team also notes concerns about the prey available to endangered Cook Inlet beluga whales that occupy Northern Cook Inlet, including the far reaches of the Inlet when coho salmon run are present[38]. Coho salmon are listed as one of the preferred prey item of Cook Inlet belugas (Huntington 2000[39], Hobbs and Sheldon 2008[40], Quakenbush et al. 2015[41]).

Given the considerations above, it is the recommendation of the NOAA SAFE Team that a buffer of 10% be applied to the preseason OFL, resulting in a 2024 preseason ABC of 35.8K. It is the judgment of the NOAA SAFE Team that such a buffer would be precautionary in the absence of necessary data to evaluate SDC while also allowing harvest opportunity subject to the constraints of uncertainty. The NOAA SAFE Team will reevaluate this approach during future years and will consider changes to the buffer based on the extent to which spawning escapement goals have been monitored and achieved; Stock of Concern designations by the SOA; ongoing research results on the prey needs of Cook Inlet beluga whales; and other factors considered by NOAA and the SSC. The SSC can recommend a different buffer.

The NOAA SAFE Team recommends prioritizing future research to better characterize the abundance, timing, spatial distribution, and genetic stock composition of the coho salmon harvested in the UCI EEZ Area fishery (e.g., Willette et al. 2003[42]).

[38] https://www.sciencedirect.com/science/article/pii/S0304380023001485
[39] https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/MFR/mfr623/mfr62312.pdf
[40] https://repository.library.noaa.gov/view/noaa/9027
[41] https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/MFR/mfr771/mfr7717.pdf
[42] https://www.adfg.alaska.gov/FedAidPDFs/RIR.2A.2003.20.pdf

While this stock can be declared overfished if cumulative spawning escapements are determined to be below MSST (similar to Tier 1 and 2), as total run size is not estimable for Tier 3, MFMT and F_{EEZ} are not calculable; therefore, as a Tier 3 stock, overfishing would be assessed based on the OFL.

*Status and catch specifications for Tier 2 Aggregate coho salmon (Not recommended) . Values for this aggregate coho salmon stock are based on the AR approach and a mean symmetric accuracy buffer of ~0.15 applied to reduce the preseason OFL (potential yield in the EEZ based on the preseason forecast) to ABC of 4.9K. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC
2019	38.6	106	0.17	0.15	288	39	211		
2020	38.6	101	0.15	0.13	238	2	178		
2021	38.6	57	0.10	0.11	287	33	135		
2022	38.6	41	0.07	0.10	220	24	98		
2023	38.6	32	0.05	0.09	204	25	83		
2024	38.6		0.08	0.12	253		82	32	4.9

Status and catch specifications for Tier 3 Aggregate coho salmon (Recommended). For 2024, the OFL (439K) has been reduced by the cumulative harvest for the previous T-1 years three years of the generation (82K), resulting in a preseason OFL of 358K coho salmon that could be harvested before overfishing occurred. Buffers of 10%–90% are applied to the preseason OFL to result in proposed preseason values of ABC. A 25% buffer of the preseason OFL would result in a preseason ABC of 89K coho salmon while a recommended 10% buffer would result in a preseason ABC of ***35.8K coho salmon****. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC (10%)	ABC (90%)
2019	38.6	106	NA	NA	NA	39	211	439		
2020	38.6	101	NA	NA	NA	2	178	439		
2021	38.6	57	NA	NA	NA	33	135	439		
2022	38.6	41	NA	NA	NA	24	98	439		
2023	38.6	32	NA	NA	NA	25	83	439		
2024	38.6		NA	NA	NA		82	358	36	322

7 Aggregate Chum Salmon, stock complex

Definition: The NOAA SAFE Team recommends to the SSC that the aggregate chum salmon stock complex (CHUM) be defined as the chum salmon harvested in the EEZ. Escapement data for a single indicator stock (Clearwater Creek) could be used to evaluate SDC (overfished determination); however, the NOAA SAFE Team recommends against this since there is not sufficient information to determine if those escapement estimates are suitable as a representative indicator for other chum salmon stocks in Cook Inlet.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2023 is assessed in a manner similar to that proposed in this SAFE and the FMP.

During the 2023 fishery, it is estimated that 51K chum salmon were harvested in the Cook Inlet EEZ. Because the total catch mortality for this stock across the most recent generation (127K) was below a 2023 OFL of 561K chum salmon, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2023 (Table 3).

Data and assessment methodology

Existing data and assessment

Clearwater Creek is the only SOA escapement goal for chum salmon in UCI. Recent escapement indices for this stock are provided in Munro 2023 and in the 2023 UCI commercial salmon fishery season summary (Lipka 2023).

Harvest estimates from this stock includes commercial, personal use, and recreational fisheries, most of which are available from ADF&G reports and through the ADF&G website.

The extent to which escapement indices represent actual numbers of spawners for all freshwater systems is unknown given that a single drainage is monitored. Therefore, estimates of total run size are unavailable.

For UCI, there are no chum salmon Stocks of Concern listed by the SOA.

Additional data and estimates available in Appendix A9.

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, and other data. However, because of the timeline necessary to produce this SAFE in time to implement the Federal drift gillnet fishery in the Cook Inlet EEZ Area, NOAA estimated the following quantities during recent years: 2023 personal use harvests (based on a 5-year 2018–2022 average); 2022–2023 sportfish harvests, with these estimates considered to be minor portions of overall harvests.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 3 stocks.

Stock biomass and recruitment trends

Stock overview:

During the most recent five year period (2019–2023), an average of 44% of the overall drift gillnet chum salmon harvest is estimated to have been harvested in the EEZ, with a range of 7,681–53,994 chum salmon harvested in the EEZ during this period (Appendix A9). For 2023, EEZ harvests were approximately 45% of the overall drift gillnet harvest and approximately 38% of all commercial harvests of chum salmon. No estimates of total run size are available.

Escapement Goal:

Clearwater Creek is the only SOA escapement goal for chum salmon in UCI. For that system, escapement is monitored by aerial survey with the annual escapements set by the peak aerial survey count for the year, with an escapement goal range of 3,500-8,000 chum salmon that was informed by the Percentile Approach (Clark et al. 2014). For the ten years from 2014–2023, escapements at Clearwater Creek have met or exceeded the lower bound of the spawning escapement goal range during all but two years (2014 and 2018).

Spawner-Recruitment and yield trends:

There are no available spawner-recruitment or yield trends for this stock due to the lack of reliable estimates of spawning escapements across all areas in Upper Cook Inlet and lack of age data for harvests or escapements.

While escapement indices are available for 1 system managed by the SOA, it is the recommendation of the NOAA SAFE Team that the single spawning escapement goal and associated index of annual escapements do not provide a reliable estimate of spawning abundance for all tributaries in Upper Cook Inlet.

Tier determination and resulting OFL and ABC determination for 2024

The NOAA SAFE Team recommends to the SSC that this Aggregate chum salmon stock complex be designated as Tier 3. The lack of reliable estimates of spawning abundance or total run size for the stock preclude a Tier 2 determination.

Status and catch specifications for Aggregate chum salmon based on a Tier 3 determination are provided in Table 4. Based on the Tier 3 methods described in the FMP and this SAFE, the NOAA SAFE Team recommends an OFL of 561K chum salmon that reflects the maximum historical harvest (140K) multiplied by a generation time of four years. The 2024 preseason OFL is reduced from the overall OFL by the cumulative harvest during the most recent T-1 (three) years in the generation time to result in the maximum harvest that could occur during the final year of the generation time without overfishing occurring, the preseason OFL of 442K.

In recommending values of OFL and ABC, the NOAA SAFE Team notes that there are no known conservation concerns for UCI chum salmon and they are not listed by the SOA as a Stock of Concern in UCI. It assumed that chum salmon are incidentally harvested (not targeted) in the EEZ, with the majority of harvest estimated to occur outside the EEZ. The NOAA SAFE Team also assumes that the chum salmon stock in UCI is healthy and harvested at a low exploitation rate in the EEZ fishery. Generally, it is understood that conservation and management considerations related to coccuring sockeye and coho salmon stocks constrain the total harvest of chum salmon in Cook Inlet. The NOAA SAFE Team welcomes input and additional information on this and other assumptions.

Given the considerations above, it is the recommendation of the NOAA SAFE Team that a buffer of 50% be applied to the preseason OFL (442K), resulting in a preseason ABC of 221K.

The recommended larger buffer and proportionately larger resulting ABC for this stock compared to recommended buffers for Aggregate Other sockeye salmon and Aggregate Chinook salmon reflect the NOAA SAFE Team's judgment that the Aggregate chum salmon stock is less of a conservation concern than UCI Chinook salmon and less of a focus in the directed fisheries relative to sockeye salmon. If a harvest of 221K chum salmon occurred in a single season, it would be 81K more than any previous estimate of chum salmon harvests in the EEZ. Should the SSC wish to recommend a buffer of 25% to the preseason chum salmon OFL—to be consistent with the justification provided for Aggregate Chinook and Aggregate "Other" sockeye salmon and represent a single year of the generation time—the resulting preseason ABC would be 110K chum salmon, which would be more than double any harvest since 2019.

As with other stocks for which there is a paucity of available information, the NOAA SAFE Team recommends funding research to estimate overall escapement and total run size for this stock, which, in turn, will facilitate improvements in management precision.

*Status and catch specifications for Tier 3 Aggregate chum salmon (Recommended). For 2024, the OFL (561K) has been reduced by the cumulative harvest for the previous T-1 years (three years) of the generation (119K), resulting in a preseason OFL of 442K chum salmon that could be harvested before overfishing occurred. Buffers of 10%–90% are applied to the preseason OFL to result in proposed preseason values of ABC. A recommended 50% buffer of the preseason OFL would result in a preseason ABC of **221K** chum salmon. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC (10%)	ABC (90%)
2019	NA		NA	NA	NA	54	262	561		
2020	NA		NA	NA	NA	8	230	561		
2021	NA		NA	NA	NA	29	155	561		
2022	NA		NA	NA	NA	39	130	561		
2023	NA		NA	NA	NA	51	127	561		
2024	NA		NA	NA	NA		119	442	44.2	397.5

8 Aggregate Pink Salmon, stock complex

Definition: The NOAA SAFE Team recommends to the SSC that the aggregate pink salmon stock complex be defined as the pink salmon harvested in the EEZ. There are no SOA spawning escapement goals for pink salmon in UCI and therefore no indicator stocks available to evaluate an overfished determination. This stock definition makes the assumption that there are many drainages and tributaries throughout UCI that serve as spawning grounds for the Federal definition of this stock, which would also be included as part of the stock definition.

This stock definition is applicable to both even- and odd-year bloodlines of UCI pink salmon, but the even-year bloodline is the focus of the 2024 SAFE.

Retrospective assessment of fishery information relative to overfishing

Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2022, this assessment of overfishing is retrospective in nature and assumes that overfishing for 2022 is assessed in a manner similar to that proposed in this SAFE and the FMP.

During the 2022 fishery (the most recent even-year run), it is estimated that 30K pink salmon were harvested in the Cook Inlet EEZ. Because the total catch mortality for this stock across the most recent generation (60K) was below a 2022 OFL of 300K pink salmon, it is the NOAA SAFE Team's assessment that overfishing would not have occurred during 2022 (Table 3).

Data and assessment methodology

Existing data and assessment

There are no escapement goals or known and reliable estimates of pink salmon escapement in Upper Cook Inlet.

Harvest estimates from this stock includes commercial, personal use, and recreational fisheries, most of which are available from ADF&G reports and through the ADF&G website.

Data and estimates associated with this assessment are available in Appendix A10

Federal data and assessments

After review by NOAA and unless otherwise stated, this SAFE incorporates SOA data and associated estimates of harvest, escapement, and other data. Commercial harvest estimates from 2023 should be considered preliminary for this SAFE and will be checked and updated for future SAFE reports.

To inform status determination criteria and harvest specifications, the Federal stock assessment relied on the method described previously for Tier 3 stocks.

Pink salmon have discreet even- and odd-year bloodlines that do not interact. As per the Tier 3 methodology, the OFL is the maximum historical harvest (150K during 2014) multiplied by the number of years of the generation time (2 years). This would result in an OFL of 300K pink salmon. The SSC may wish to provide input on whether the OFL for pink salmon should be the largest harvest multiplied by two years (as was done for this SAFE) or just a single year.

Stock biomass and recruitment trends

Stock overview:

During the most recent five year period (2019–2023), an average of 35% of the overall drift gillnet pink salmon harvest is estimated to have been from the Aggregate pink salmon stock in the EEZ, with a range of 12–29K pink salmon harvested in the EEZ during this period. For 2023, EEZ harvests were approximately 42% of the overall drift gillnet harvest and approximately 36% of all commercial harvests. No estimates of total run size are available.

Escapement Goal:

There are no SOA spawning escapement goals for pink salmon in Upper Cook Inlet.

Spawner-Recruitment and yield trends:

There are no available spawner-recruitment or yield trends for this stock due to the lack of reliable estimates of spawning escapements across all areas in Upper Cook Inlet.

Tier determination and resulting OFL and ABC determination for 2024

Given the lack of total run size estimates, which preclude a Tier 2 determination for the Aggregate pink salmon stock complex, the NOAA SAFE Team recommends to the SSC that this Aggregate UCI pink salmon stock be designated as Tier 3.

Similar to chum salmon, it is the assumption of the NOAA SAFE Team that the UCI pink salmon stock complex is healthy, are not subject to overfishing and that past estimates of EEZ harvests represent incidental (not targeted) harvests that are not impactful to the overall spawning population. Given the small size of pink salmon relative to other salmon, it is also assumed that many pink salmon would get through gillnets used in the EEZ to target other sockeye salmon. As such, while spawning data are not available, it is the judgment of the NOAA SAFE Team that pink salmon represent a particularly low conservation concern with respect to harm to the stock that could come as a result of fishing activity in the EEZ. The NOAA SAFE Team welcomes feedback, data, and additional information pertaining to the assumptions and analyses presented in this SAFE.

Given the considerations above, it is the recommendation of the NOAA SAFE Team that a buffer of 90% be applied to the preseason OFL of 270K, resulting in a preseason ABC of 243K.

Status and catch specifications for Aggregate pink salmon based on a Tier 3 determination is provided in Table 4 and Appendix A10.

*Status and catch specifications for even-year Tier 3 even-year Aggregate pink salmon (Recommended). For 2024, the OFL (300K) has been reduced by the cumulative harvest for the previous T-1 year (1 year) of the 2 year generation (30K), resulting in a preseason OFL of 270K pink salmon that could be harvested before overfishing occurred. Buffers of 10%–90% are applied to the OFL to result in proposed preseason values of ABC. A recommended 90% buffer of the preseason OFL would result in a preseason ABC of **243K** pink salmon. Values are based on the Tier 3 approach. Description applicable to all stocks: An overfished determination is assessed postseason by comparing the minimum stock size threshold (**MSST**), one half of the sum of the stock's spawning escapement goal summed across a generation, with actual cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing the maximum fishing mortality threshold (**MFMT**), the largest potential harvest rate in the EEZ while still achieving the spawning escapement goal and non-EEZ harvests, with the actual estimated harvest rate assessed over a generation (**F_{EEZ}**). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest summed across a generation (**EEZ Cum. Harvest**) with the postseason overfishing limit (**OFL**), the maximum historical harvest multiplied by the generation time of the species in years. For Tier 1-2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ while still achieving the spawning goal and estimated non-EEZ harvests. Unless otherwise noted, values other than rates are in the thousands of fish. Shaded values are new estimates or projections based on the current assessment, with EEZ Cum. Harvest only including T-1 years of the generation.*

Year	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Harvest	EEZ Cum. Harvest	OFL	ABC (10%)	ABC (90%)
2014	NA	NA	NA	NA	NA	150	283	300		
2016	NA	NA	NA	NA	NA	109	260	300		
2018	NA	NA	NA	NA	NA	39	148	300		
2020	NA	NA	NA	NA	NA	12	51	300		
2022	NA	NA	NA	NA	NA	30	41	300		
2024	NA	NA	NA	NA	NA		30	270	27	243

Figures and Tables

Table 3: Preliminary 2023 stock status in relation to SDC as estimated by the most recent assessment. Since a Federal salmon fishery in the Cook Inlet EEZ was not in place in 2023, this assessment is retrospective in nature, with values calculated with the methods and buffers proposed in this SAFE. A stock is being overfished if (**MSST**) is greater than the cumulative escapement summed across a generation (**Cum. Escap**.). For Tier 1-2 stocks, overfishing is assessed postseason by comparing **MFMT** with the actual harvest rate assessed over a generation ($\mathbf{F_{EEZ}}$). Rates are normalized to total run size. For Tier 3 stocks, overfishing is assessed postseason by comparing the actual harvest across a generation (**EEZ Cum. Harvest**) with the postseason (**OFL**). For Tier 1–2 stocks, the OFL is only applicable to preseason estimates and is the maximum potential EEZ harvest in the EEZ. Unless otherwise noted, values other than rates are in the thousands of fish. Asterisks indicate that estimates are suspect and/or unsupported by existing data. Shaded rows are for stock definition and/or tier not recommended by the NOAA SAFE Team.

Stock	Tier	MSST	Cum. Escap.	MFMT	F_{EEZ}	Total Run	EEZ Catch	Cum. Harvest Gen.	Potential yield EEZ	Tier 3 OFL
Kenai River Late-Run sockeye salmon	1	1,850	8,561	0.37	0.08	3,882	418	1,308	1,761	
Kasilof River sockeye salmon	1	360	3,333	0.52	0.03	460	57	140	850	
Aggregate Other sockeye salmon (T2)	2*	163	631	0.36	0.22*	270*	183	457	201	
Aggregate Other sockeye salmon (T3)	3	163	631				183	457	NA	1,271
Kenai River Late-Run Large Chinook salmon	1*	44	82	0.046	0.003*	14.7	21 fish*	239 fish	0 fish	
Aggregate Other Chinook salmon	3*						30 fish*			
Aggregate Chinook salmon	3	44	82				51 fish	635 fish	NA	3
Aggregate coho salmon (T2)	2*	40	32*	0.05*	0.09*	204*	25	83	11	
Aggregate coho salmon (T3)	3	40	32*				25	83		440
Aggregate chum salmon	3	NA	NA	NA	NA	NA	51	127	NA	561
Aggregate pink salmon	3	NA	NA	NA	NA	NA	30	41	NA	300

Table 4: 2024 preseason NOAA SAFE Team recommendations for Cook Inlet EEZ Area salmon stocks. Tier designations are based on the projected stock status in 2024. Shaded rows indicate stocks/tiers that are not recommended. **Total run size** for Tiers 1-2 is estimated from the AR model. **Escapement goals** are the lower bound of the SOA's spawning escapement goal. For Tiers 1-2, the preseason overfishing limit (**OFL**) is the preseason total run size forecast minus the spawning escapement goal and estimated non-EEZ harvests and represents maximum potential harvest in the EEZ for the coming fishing season. For Tier 3, the preseason OFL is the largest historical EEZ harvest multiplied by the generation time of the species. For Tiers 1-2, the **ABC buffer** is the mean symmetric accuracy of the AR model, which accounts for retrospective error in preseason ABC and potential yield designations relative to realized postseason values. For Tier 3, the recommended ABC buffer is from a range of 0.1 to 0.90. The preseason acceptable biological catch (**ABC**) is the preseason OFL multiplied by the buffer. Except for the tiers and buffer or otherwise noted (Chinook salmon), all other values are in thousands of fish. Shaded rows indicate tiers and associated harvest specifications that are not recommended by the NOAA SAFE Team.

Stock	Tier	Total Run Size	Escapement goal(s)	Preseason OFL	ABC buffer	ABC
Kenai River Late-Run sockeye salmon	1	3,485	750	1,364	0.478	**652.5**
Kasilof River sockeye salmon	1	1,125	140	623	0.694	**432.6**
Aggregate Other sockeye salmon (T2)	2	314	65	230	0.736	169
Aggregate Other sockeye salmon (T3)	3	NA	65	888	0.200	**177.5**
Kenai River Late-Run Large Chinook salmon	1	14.7	15	0	NA	0
Aggregate Other Chinook salmon	NA	NA	NA	NA	NA	NA
Aggregate Chinook salmon	3	NA	15	2,697 fish	0.167	**450 fish**
Aggregate coho salmon (T2)	2	253	19.3	32	0.153	4.9
Aggregate coho salmon (T3)	3	NA	19.3	358	0.100	**35.8**
Aggregate chum salmon	3	NA	3.5	442	0.500	**220.9**
Aggregate pink salmon	3	NA	NA	270	0.900	**243.4**

Recommendations for the SSC

This is the first review by the SSC of the Salmon SAFE under Amendment 16. The authors have highlighted several key decision points to help guide the SSC in setting the harvest specifications, following National Standard Guidelines and best scientific information available under the MSA.

Stock definitions

The NOAA SAFE Team recommends stock definitions as described in the Stock Status Summaries section and shown in Tables 1, 3, and 4; these include: Kenai River Late Run Sockeye Salmon; Kasilof River Sockeye Salmon; Aggregate "Other" Sockeye Salmon; Aggregate Chinook Salmon, Aggregate Coho Salmon, Aggregate Chum Salmon, and Aggregate Pink Salmon.

The NOAA SAFE Team recommends combining all Chinook salmon into an "Aggregate Chinook Salmon" stock for the purpose of Federal management in the EEZ during 2024 with reevaluation in future SAFE reports. This recommendation is based on a lack of evidence for stock-specific harvest of Chinook salmon in the Cook Inlet EEZ and because only 51 Chinook salmon were estimated to have been harvested in the Cook Inlet EEZ during 2023.

Despite the considerations provided above, the NOAA SAFE Team recommends that the Kenai River Late Run Large Chinook salmon escapement goal (and associated escapements) be included as an indicator stock for the Aggregate Chinook Salmon stock definition to assess against MSST (overfished determination) using the Tier 3 approach. Including the escapements of this stock as a Tier 3 indicator stock would be a precautionary management measure in the event that this stock was approaching an overfished condition.

The NOAA SAFE Team requests guidance from the SSC on the threshold of harvest (number of fish) and level of evidence or uncertainty for whether the stock should be included as part of future SAFE reports.

The NOAA SAFE Team recommends research to examine the stock composition of Chinook salmon and other salmon species harvested in the Cook Inlet EEZ Area salmon fishery.

Tier assignments

Recommended tier assignments are described in the Stock Status Summaries section and provided in Tables 1, 3, and 4. Recommended tiers are as follows: Kenai River Late Run Sockeye Salmon, Tier 1; Kasilof River Sockeye Salmon, Tier 1; Aggregate "Other" Sockeye Salmon, Tier 3; Aggregate Chinook Salmon, Tier 3; Aggregate Coho Salmon, Tier 3; Aggregate Chum Salmon, Tier 3; and Aggregate Pink Salmon, Tier 3.

Additional recommendations:
The NOAA SAFE Team recommends assigning Aggregate "Other" Sockeye Salmon and Aggregate Coho Salmon to Tier 3 rather than Tier 2 based on a lack of consistent spawning escapement data and associated inability to estimate total run size, which are required for SDC and harvest specifications for Tier 2. The NOAA SAFE Team also has concerns that a Tier 2 determination for these and other stocks may pose risks in terms of an overfishing determination not being triggered when it was warranted and, in the case of incomplete or missing escapement data, of an overfishing or overfished determination being triggered when such determinations were not warranted.

Recommendations for analysis approach and general model structure

The methods used to calculate SDC and recommended harvest specifications are provided in the Status Determination Criteria Section with model code available in the Github repository referenced in the Stock Status Summaries section. The NOAA SAFE Team welcomes suggestions for improvements to the model used for this first Cook Inlet EEZ Salmon SAFE and aims to incorporate additional sources of uncertainty and continue to refine the scope of uncertainty in future SAFE analyses.

Additional recommendations in the SAFE:

The NOAA SAFE Team recommends that the preseason estimate of likely harvests in State waters in the coming fishing season be based on an autoregressive integrated moving average (ARIMA) model of past State harvest rates using the auto.arima R package to identify the optimal combination of AR and MA lags. The potential harvest rate in the EEZ (F_{EEZ}) in the upcoming season can then be estimated by subtracting expected State harvest from the forecasted run size (minus the escapement goal) and dividing by the total forecasted run size. At the discretion of the SSC, future SAFE analyses could compare other approaches (e.g., a 'default' AR-1) with the model selected by the auto.arima() function or other recommended alternatives, as well as the retrospective accuracy (and resulting buffer factor) of each method used to inform SAFE recommendations.

Recommendations for data, estimates, and assumptions used

Recommended data, estimates, and model assumptions are provided in the Stock Status Summaries with additional details for each stock in Appendices A1–A10 and the github repository for analyses. The NOAA SAFE Team welcomes suggestions and corrections for data, estimates, and assumptions used in this SAFE.

Recommendations for OFL

Methods to calculate the preseason OFL for each Tier are provided in the Status Determination Criteria section with the recommended OFLs provided in the Stock Status Summaries for each stock, Table 4, and Appendices A1–A10.

Recommendations for buffers of OFL and the resulting ABC

The NOAA SAFE Team recommends that buffers be applied to the recommended preseason OFLs for each stock to result in the stock level ABC. The recommended 2024 buffers and resulting ABCs are provided for each stock in the Stock Status Summaries section and Table 4.

Recommendations for ACL

The NOAA SAFE Team recommends that the 2024 ACL for each stock be equal to or less than the recommended ABCs provided in the Stock Status STable 4.

Recommendations for de minimis harvest

As stated in the FMP, if the preseason forecast for a stock projects that the lower bound of the escapement goal is unlikely to be achieved during a given year, de minimis harvest on the stock may be allowed to reduce the risk of fishery restrictions that could impose severe economic consequences to fishing communities without substantive management or conservation benefits. In addition, the maximum allowable de minimis harvest recommended by the SSC must target keeping the postseason fishing mortality rate below MFMT. Section 4.2.5 of the FMP outlines other considerations for the SSC when recommending the level of de minimis catch in a given year.

Based on the assessment within this SAFE, only Kenai Late Run Large Chinook would qualify for de minimis harvest and it is the NOAA SAFE Team recommendation that this stock be part of an Aggregate Chinook Salmon stock for which de minimis harvest is not applicable.

Other recommendations by the NOAA SAFE Team

The NOAA SAFE Team recommends additional research to refine estimates of total run sizes and associated components (escapements and mortality) for UCI salmon stocks; particularly for stocks where such estimates do not currently exist. Estimates of mortality could include harvests in other fisheries, including outside the EEZ. These estimates will facilitate improved assessment and management.

Given the importance of preseason salmon forecasts in establishing estimates of available yield (OFL) and the resulting harvest specifications for Tier 1 and 2 stocks, the NOAA SAFE Team recommends additional research into salmon forecasts and run timing for UCI salmon stocks harvested in the EEZ.

Considerations for Setting TAC (Council)

The NOAA SAFE Team proposes to the Council that ACLs for the 2024 salmon season in the Cook Inlet EEZ Area be equal to the sum of the stock specific recommended ABCs for each species.

Recommended 2024 TAC by species:

Sockeye salmon: **1,262,525 fish**

Chinook salmon: **450 fish**

Coho salmon: **35,769 fish**

Chum salmon: **220,864 fish**

Pink salmon: **243,392 fish**

The Council may recommend TAC amounts that are equal to the ACL (or, for sockeye salmon, the sum of the sockeye salmon ACLs), or are reduced to account for: (1) management uncertainty associated with the prosecution of a newly created Federal fishery for which the accuracy of historical harvest estimates is unknown, (2) the inability to confirm historical estimates of salmon harvests in the EEZ Area (3) the generation time of the species under consideration, (4) the level of precaution warranted to protect weak stocks of salmon that are aggregated into the Federal stock definitions, and (5) additional factors that the Council wishes to consider (e.g., prey available for endangered Cook Inlet beluga whales).

The following example is not a recommendation of the NOAA SAFE Team but is provided to inform the Council's TAC setting discussion. In this example, the species level ACL is reduced by 10% for the first generation of the Federal fishery (e.g., five years for sockeye salmon would result in a 10% reduction of the ACL for 2024-2018) and reduced by an additional 5% (15% total) for the first year of the Federal EEZ fishery (2024).

Example: TAC = (ACL * 0.90 buffer for first generation under Federal management) - (ACL * 0.05 buffer for the first year of the Federal fishery).

Appendix A1. Tier 1 Kenai River Late Run Sockeye Salmon

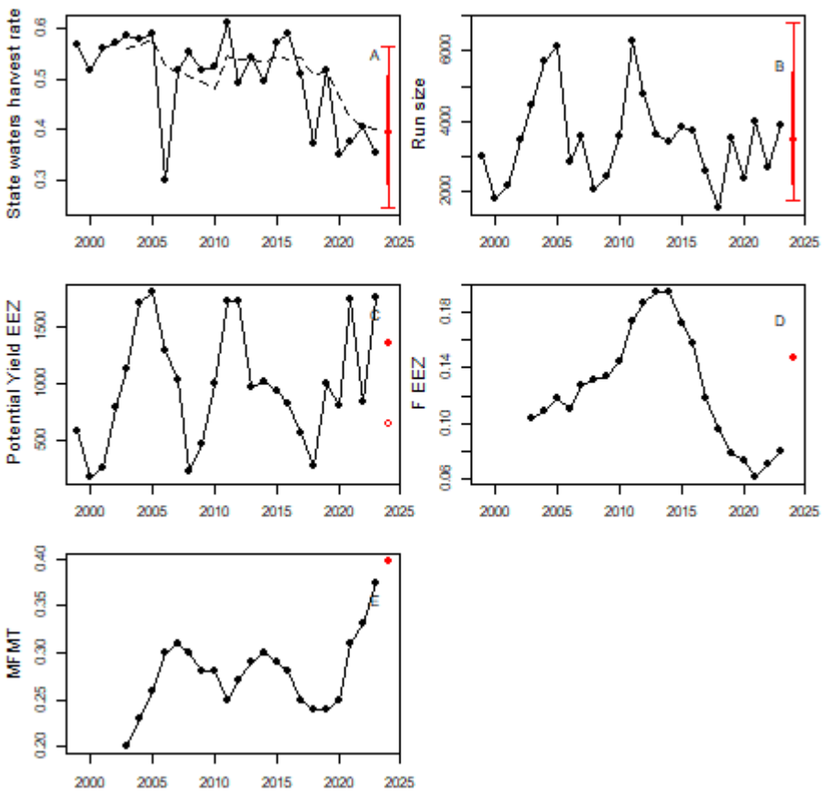
A1.1. 2024 Historical Table for: Tier 1 Kenai River Late Run Sockeye Salmon. Historical information to inform the status determination criteria and harvest specifications for this stock assessment. The table includes year of the salmon run, the estimates total run size, the spawning escapement, the SOA spawning escapement goal, the total catch across all fisheries, the estimate State waters catch, the fraction of the catch estimated to have occurred in State waters, the estimated EEZ catch, the fraction of the total catch estimated to have occurred in the EEZ, the maximum fishing morality threshold, and the potential yield in the EEZ.

Year	Run size	Escapement	Escapement goal	Total catch	State catch	F_state	EEZ Catch	F_EEZ	MFMT	Potential Yield EEZ
1999	2985	949	700	2035	1694	0.568	341	NA	NA	591
2000	1815	697	700	1118	937	0.516	181	NA	NA	178
2001	2190	738	700	1451	1230	0.562	221	NA	NA	260
2002	3467	1127	700	2340	1980	0.571	360	NA	NA	787
2003	4440	1402	700	3037	2606	0.587	431	0.103	0.198	1134
2004	5705	1691	700	4015	3299	0.578	716	0.108	0.231	1706
2005	6109	1654	700	4455	3598	0.589	857	0.118	0.26	1811
2006	2849	1892	700	957	850	0.298	107	0.109	0.298	1299
2007	3602	964	700	2638	1864	0.517	774	0.127	0.308	1038
2008	2082	709	700	1374	1154	0.554	220	0.131	0.299	228
2009	2430	848	700	1582	1254	0.516	328	0.134	0.284	476
2010	3596	1038	700	2558	1886	0.524	672	0.144	0.278	1010
2011	6263	1281	700	4982	3842	0.613	1140	0.174	0.249	1721
2012	4770	1213	700	3557	2343	0.491	1214	0.187	0.27	1727
2013	3628	980	700	2648	1965	0.542	683	0.195	0.285	963
2014	3404	1218	700	2186	1682	0.494	504	0.194	0.297	1022
2015	3819	1400	700	2419	2181	0.571	238	0.173	0.291	938
2016	3712	1120	700	2592	2192	0.591	400	0.157	0.283	820
2017	2596	1071	700	1525	1323	0.51	202	0.118	0.252	573
2018	1566	887	700	679	582	0.372	97	0.095	0.241	284
2019	3542	1457	700	2085	1833	0.518	252	0.078	0.238	1009
2020	2394	1506	750	888	838	0.35	50	0.072	0.253	806
2021	3992	2242	750	1751	1495	0.374	256	0.061	0.314	1747
2022	2682	1263	750	1419	1087	0.405	332	0.07	0.331	845
2023	3882	2093	750	1789	1371	0.353	418	0.079	0.374	1761

A1.2. 2024 ARIMA Model Preseason Table: Tier 1 Kenai River Late Run Sockeye Salmon. This tables includes the estimate harvest rate in State waters (F state preseason), the forecasted total run size, the preseason estimate of potential yield in the EEZ (OFL preseason), the buffer that accounts for scientific uncertainty in reducing the preseason OFL to the ABC, the preseason ABC, preseason estimate of the EEZ harvest rate (Potential F_EEZ), and the preseason estimate of MFMT in the EEZ.

F_state preseason	run preseason	OFL_preseason	OFL to ABC_buffer	ABC_preseason	Potential F_EEZ	MFMT
0.394	3485.806	1363.932	0.478	652.454	0.147	0.397

A1.3. 2024 ARIMA Model Preseason Plots: Tier 1 Kenai River Late Run Sockeye Salmon. In panel A, the dashed line represents the moving average of state harvest across one generation time. The red dots and error bars in panels A and B represent preseason forecasts and uncertainty for state harvest rate (A) and run size (B). The filled red dot in panel C represents the amount of potential yield in the EEZ based on the forecasted state harvest rate and run size (i.e. preseason OFL). The hollow red circle in panel C represents the preseason OFL reduced by the buffer to the preseason ABC value. Panel D shows the EEZ harvest rate over one generation time. The red dot in panel D represents the EEZ harvest rate that would result for the current generation time if the full EEZ potential yield being harvested (i.e. OFL being met) in the upcoming year. The red dot in panel E represents the preseason estimate of MFMT.



Appendix A2. Tier 1 Kasilof River Sockeye Salmon

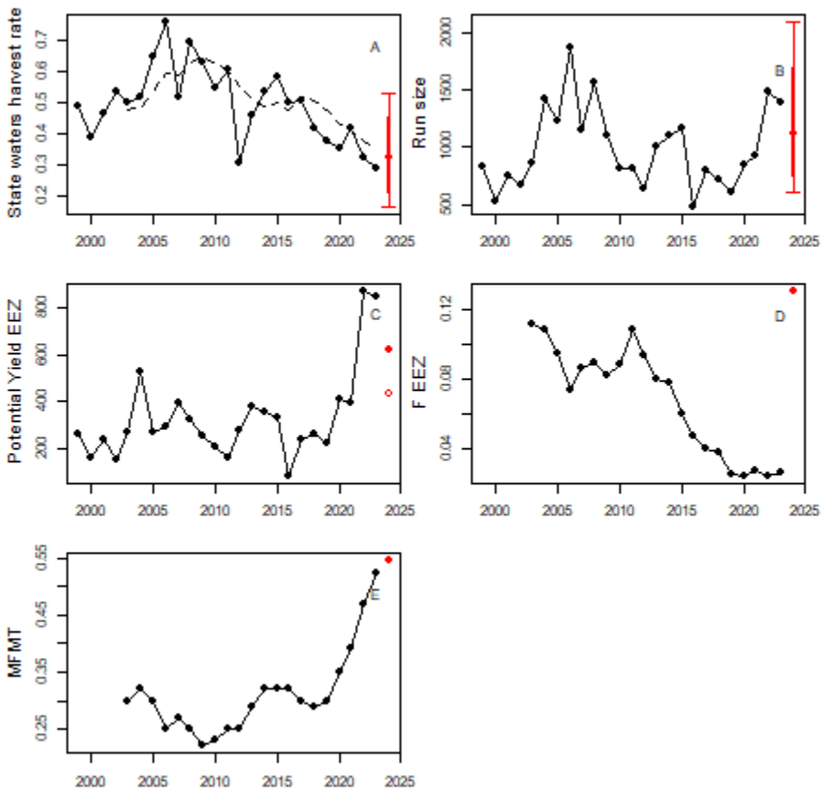
Appendix A2.1. 2024 Historical Table: Tier 1 Kasilof River Sockeye Salmon. Historical information to inform the status determination criteria and harvest specifications for this stock assessment. The table includes year of the salmon run, the estimates total run size, the spawning escapement, the SOA spawning escapement goal, the total catch across all fisheries, the estimate State waters catch, the fraction of the catch estimated to have occurred in State waters, the estimated EEZ catch, the fraction of the total catch estimated to have occurred in the EEZ, the maximum fishing morality threshold, and the potential yield in the EEZ.

Year	Run size	Escapement	Escapement goal	Total catch	State catch	F_state	EEZ Catch	F_EEZ	MFMT	Potential Yield EEZ
1999	826	312	160	514	404	0.489	110	NA	NA	262
2000	531	264	160	267	207	0.39	60	NA	NA	164
2001	751	319	160	432	351	0.467	81	NA	NA	240
2002	667	236	160	432	356	0.534	76	NA	NA	151
2003	862	354	160	509	431	0.5	78	0.111	0.299	271
2004	1421	524	160	897	737	0.519	160	0.108	0.319	524
2005	1227	360	160	867	796	0.649	71	0.095	0.296	271
2006	1880	390	160	1490	1429	0.76	61	0.074	0.249	291
2007	1157	365	160	792	599	0.518	193	0.086	0.268	398
2008	1575	327	160	1248	1088	0.691	160	0.089	0.249	327
2009	1105	326	160	779	692	0.626	87	0.082	0.222	253
2010	819	295	160	523	450	0.549	73	0.088	0.226	209
2011	810	246	160	564	489	0.604	75	0.108	0.247	161
2012	632	375	160	258	193	0.305	65	0.093	0.249	279
2013	1003	490	160	513	462	0.461	51	0.08	0.294	381
2014	1103	440	160	663	589	0.534	74	0.077	0.317	354
2015	1175	471	160	704	686	0.584	18	0.06	0.318	329
2016	481	240	160	241	240	0.499	1	0.048	0.324	81
2017	802	359	160	443	404	0.504	39	0.04	0.303	238
2018	717	388	160	329	299	0.417	30	0.038	0.295	258
2019	613	373	160	240	230	0.375	10	0.026	0.298	223
2020	845	542	140	303	297	0.351	6	0.025	0.349	408
2021	925	517	140	409	388	0.419	21	0.027	0.391	397
2022	1495	968	140	527	482	0.322	45	0.024	0.47	873
2023	1393	933	140	460	403	0.289	57	0.026	0.522	850

Appendix A2.2. 2024 ARIMA Model Preseason Table: Tier 1 Kasilof River Sockeye Salmon. This tables includes the estimate harvest rate in State waters (F state preseason), the forecasted total run size, the preseason estimate of potential yield in the EEZ (OFL preseason), the buffer that accounts for scientific uncertainty in reducing the preseason OFL to the ABC, the preseason ABC, preseason estimate of the EEZ harvest rate (Potential F_EEZ), and the preseason estimate of MFMT in the EEZ.

F_state preseason	run preseason	OFL_preseason	OFL to ABC_buffer	ABC_preseason	Potential F_EEZ	MFMT
0.322	1125.368	623.084	0.694	432.578	0.13	0.545

Appendix A2.3. 2024 ARIMA Model Preseason Plots: Tier 1 Kasilof River Sockeye Salmon. In panel A, the dashed line represents the moving average of state harvest across one generation time. The red dots and error bars in panels A and B represent preseason forecasts and uncertainty for state harvest rate (A) and run size (B). The filled red dot in panel C represents the amount of potential yield in the EEZ based on the forecasted state harvest rate and run size (i.e. preseason OFL). The hollow red circle in panel C represents the preseason OFL reduced by the buffer to the preseason ABC value. Panel D shows the EEZ harvest rate over one generation time. The red dot in panel D represents the EEZ harvest rate that would result for the current generation time if the full EEZ potential yield being harvested (i.e. OFL being met) in the upcoming year. The red dot in panel E represents the preseason estimate of MFMT.



Appendix A3. Tier 2 Aggregate "Other" Sockeye Salmon

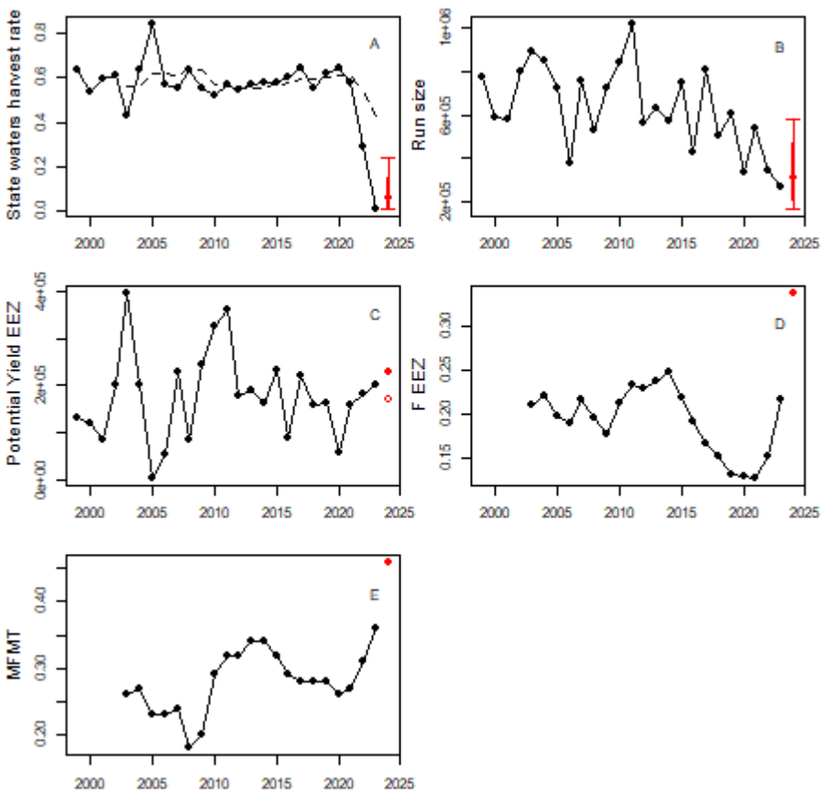
Appendix A3.1. 2024 Historical Table: Tier 2 Aggregate "Other" Sockeye Salmon. Historical information to inform the status determination criteria and harvest specifications for this stock assessment. The table includes year of the salmon run, the estimates total run size, the spawning escapement, the SOA spawning escapement goal, the total catch across all fisheries, the estimate State waters catch, the fraction of the catch estimated to have occurred in State waters, the estimated EEZ catch, the fraction of the total catch estimated to have occurred in the EEZ, the maximum fishing morality threshold, and the potential yield in the EEZ.

Year	Run size	Escapement	Escapement goal	Total catch	State catch	F_state	EEZ Catch	F_EEZ	MFMT	Potential Yield EEZ
1999	774350	125775	150000	648575	491751	0.635	156824	NA	NA	132599
2000	587485	152627	150000	434858	315745	0.537	119113	NA	NA	121740
2001	583082	127001	150000	456081	347070	0.595	109011	NA	NA	86012
2002	803272	169074	110000	634198	490499	0.611	143699	NA	NA	202773
2003	893443	273111	110000	620332	386378	0.432	233954	0.209	0.258	397065
2004	852876	93438	110000	759438	541637	0.635	217801	0.221	0.271	201239
2005	727514	51136	110000	676378	615005	0.845	61373	0.198	0.23	2509
2006	380568	124613	110000	255955	217409	0.571	38546	0.19	0.234	53159
2007	758728	107849	110000	650879	421145	0.555	229734	0.216	0.244	227583
2008	533554	109485	110000	424069	338963	0.635	85106	0.194	0.175	84591
2009	726587	186747	80000	539840	403841	0.556	135999	0.176	0.195	242746
2010	840266	203360	80000	636906	435198	0.518	201708	0.213	0.288	325068
2011	1023813	189165	80000	834648	580438	0.567	254210	0.234	0.32	363375
2012	563588	90821	80000	472767	306619	0.544	166148	0.229	0.323	176969
2013	632105	125376	80000	506729	362845	0.574	143884	0.238	0.343	189260
2014	574123	104948	80000	469175	332737	0.58	136438	0.248	0.335	161386
2015	748286	243324	80000	504962	434473	0.581	70489	0.218	0.318	233813
2016	429528	121327	80000	308201	259211	0.603	48990	0.192	0.289	90317
2017	812132	156052	65000	656080	524215	0.645	131865	0.166	0.281	222917
2018	507948	146090	65000	361858	282595	0.556	79263	0.152	0.283	160353
2019	604263	155558	65000	448705	375656	0.622	73049	0.13	0.281	163607
2020	338369	107527	65000	230842	217700	0.643	13142	0.129	0.257	55669
2021	538072	170757	65000	367315	313012	0.582	54303	0.126	0.272	160060
2022	348305	114546	65000	233759	101030	0.29	132729	0.151	0.309	182275
2023	270412	82833	65000	187579	4167	0.015	183412	0.218	0.363	201245

Appendix A3.2. 2024 ARIMA Model Preseason Table: Tier 2 Aggregate "Other" Sockeye Salmon. This tables includes the estimate harvest rate in State waters (F state preseason), the forecasted total run size, the preseason estimate of potential yield in the EEZ (OFL preseason), the buffer that accounts for scientific uncertainty in reducing the preseason OFL to the ABC, the preseason ABC, preseason estimate of the EEZ harvest rate (Potential F_EEZ), and the preseason estimate of MFMT in the EEZ.

F_state preseason	run preseason	OFL_preseason	OFL to ABC_buffer	ABC_preseason	Potential F_EEZ	MFMT
0.062	314339.974	230003.8	0.736	169318.2	0.339	0.458

Appendix A3.3. 2024 ARIMA Model Preseason Plots: Tier 2 Aggregate "Other" Sockeye Salmon. In panel A, the dashed line represents the moving average of state harvest across one generation time. The red dots and error bars in panels A and B represent preseason forecasts and uncertainty for state harvest rate (A) and run size (B). The filled red dot in panel C represents the amount of potential yield in the EEZ based on the forecasted state harvest rate and run size (i.e. preseason OFL). The hollow red circle in panel C represents the preseason OFL reduced by the buffer to the preseason ABC value. Panel D shows the EEZ harvest rate over one generation time. The red dot in panel D represents the EEZ harvest rate that would result for the current generation time if the full EEZ potential yield being harvested (i.e. OFL being met) in the upcoming year. The red dot in panel E represents the preseason estimate of MFMT.



Appendix A4. Tier 3 Aggregate "Other" Sockeye Salmon

Appendix A4.1. 2024 Historical Table: Tier 3 Aggregate "Other" Sockeye Salmon. Shown are the year of the run, the estimated total catch of this stock across all fisheries, the estimated catch in the EEZ, and the summed cumulative EEZ catch over a generation, which is used to assess overfishing.

Year	Total catch	EEZ catch	Cumulative EEZ catch
1999	648575	156824	NA
2000	434858	119113	NA
2001	456081	109011	NA
2002	634198	143699	NA
2003	620332	233954	762601
2004	759438	217801	823578
2005	676378	61373	765838
2006	255955	38546	695373
2007	650879	229734	781408
2008	424069	85106	632560
2009	539840	135999	550758
2010	636906	201708	691093
2011	834648	254210	906757
2012	472767	166148	843171
2013	506729	143884	901949
2014	469175	136438	902388
2015	504962	70489	771169
2016	308201	48990	565949
2017	656080	131865	531666
2018	361858	79263	467045
2019	448705	73049	403656
2020	230842	13142	346309
2021	367315	54303	351622
2022	233759	132729	352486
2023	187579	183412	456635

Appendix A4.2. 2024 OFL and ABC: Tier 3 Aggregate "Other" Sockeye Salmon. Shown are the range of potential buffers, the OFL, the ABC as reduced by the buffer, the preseason OFL, and the preseason ABC as reduced by the buffer.

buffer	OFL	ABC	Preseason OFL	Preseason ABC
0.1	1271050	127105	887464	88746.4
0.2	1271050	254210	887464	177492.8
0.3	1271050	381315	887464	266239.2
0.4	1271050	508420	887464	354985.6
0.5	1271050	635525	887464	443732
0.6	1271050	762630	887464	532478.4
0.7	1271050	889735	887464	621224.8
0.8	1271050	1016840	887464	709971.2
0.9	1271050	1143945	887464	798717.6

Appendix A5. Tier 1 Kenai Late Run Large Chinook Salmon

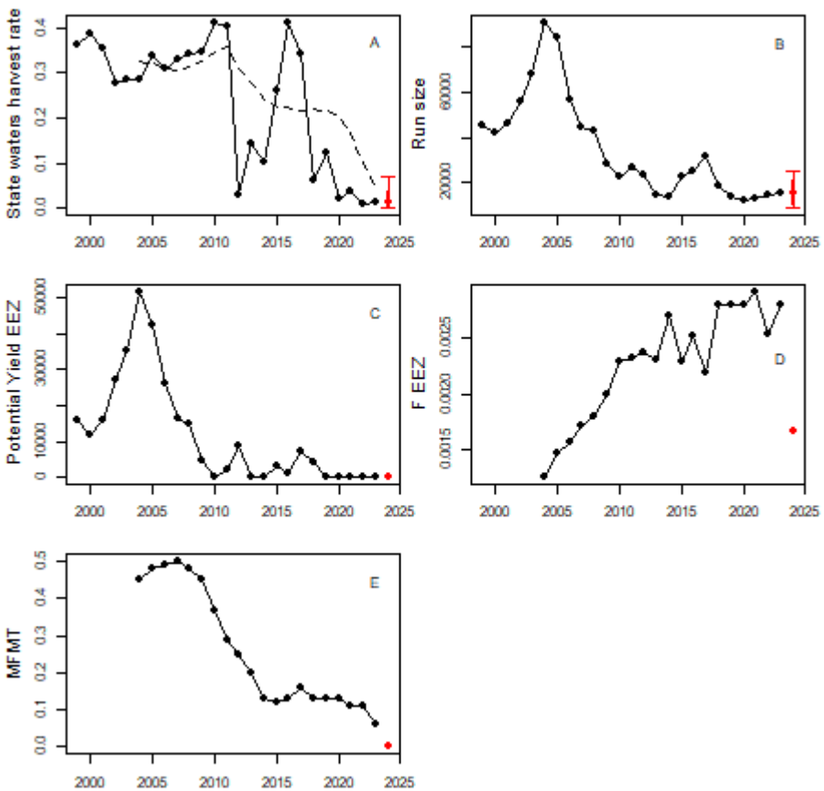
Appendix A5.1. 2024 Historical Table: Tier 1 Kenai Late Run Large Chinook Salmon. Historical information to inform the status determination criteria and harvest specifications for this stock assessment. The table includes year of the salmon run, the estimates total run size, the spawning escapement, the SOA spawning escapement goal, the total catch across all fisheries, the estimate State waters catch, the fraction of the catch estimated to have occurred in State waters, the estimated EEZ catch, the fraction of the total catch estimated to have occurred in the EEZ, the maximum fishing morality threshold, and the potential yield in the EEZ.

Year	Run size	Escapement	Escapement goal	Total catch	State catch	F_state	EEZ Catch	F_EEZ	MFMT	Potential Yield EEZ
1999	45657	29100	13500	16557	16495	0.361	62	NA	NA	15662
2000	41719	25502	13500	16217	16168	0.388	49	NA	NA	12051
2001	45754	29531	13500	16223	16165	0.353	58	NA	NA	16089
2002	55910	40514	13500	15396	15357	0.275	39	NA	NA	27053
2003	67984	48461	13500	19523	19414	0.286	109	NA	NA	35070
2004	91312	65112	13500	26200	26079	0.286	121	0.001	0.453	51733
2005	84189	55688	13500	28501	28307	0.336	194	0.001	0.477	42382
2006	57122	39305	13500	17817	17708	0.31	109	0.002	0.493	25914
2007	44421	29664	13500	14757	14643	0.33	114	0.002	0.495	16278
2008	42680	28094	13500	14586	14537	0.341	49	0.002	0.48	14643
2009	28044	18251	13500	9793	9688	0.345	105	0.002	0.448	4856
2010	22180	13037	13500	9143	9078	0.409	65	0.002	0.374	0
2011	26381	15731	13500	10650	10578	0.401	72	0.002	0.29	2303
2012	23206	22453	13500	753	715	0.031	38	0.002	0.252	8991
2013	14382	12305	13500	2077	2045	0.142	32	0.002	0.196	0
2014	13403	11980	13500	1423	1391	0.104	32	0.003	0.127	0
2015	22796	16825	13500	5971	5931	0.26	40	0.002	0.12	3365
2016	25129	14676	13500	10453	10351	0.412	102	0.003	0.127	1278
2017	31262	20615	13500	10647	10606	0.339	41	0.002	0.16	7156
2018	18511	17289	13500	1222	1119	0.06	103	0.003	0.125	3892
2019	13271	11638	13500	1633	1604	0.121	29	0.003	0.126	0
2020	12219	11909	15000	310	281	0.023	29	0.003	0.127	0
2021	12665	12147	15000	518	493	0.039	25	0.003	0.109	0
2022	14113	13974	15000	139	107	0.008	32	0.003	0.108	0
2023	14742	14502	15000	240	219	0.015	21	0.003	0.046	0

Appendix A5.2. 2024 ARIMA Model Preseason Table: Tier 1 Kenai Late Run Large Chinook Salmon. This tables includes the estimate harvest rate in State waters (F state preseason), the forecasted total run size, the preseason estimate of potential yield in the EEZ (OFL preseason), the buffer that accounts for scientific uncertainty in reducing the preseason OFL to the ABC, the preseason ABC, preseason estimate of the EEZ harvest rate (Potential F_EEZ), and the preseason estimate of MFMT in the EEZ

F_state preseason	run preseason	OFL_preseason	OFL to ABC_buffer	ABC_preseason	Potential F_EEZ	MFMT
0.011	14742.46	0	0.472	0	0.002	0

Appendix A5.3. 2024 ARIMA Model Preseason Plots: Tier 1 Kenai Late Run Large Chinook Salmon. In panel A, the dashed line represents the moving average of state harvest across one generation time. The red dots and error bars in panels A and B represent preseason forecasts and uncertainty for state harvest rate (A) and run size (B). The filled red dot in panel C represents the amount of potential yield in the EEZ based on the forecasted state harvest rate and run size (i.e. preseason OFL). The hollow red circle in panel C represents the preseason OFL reduced by the buffer to the preseason ABC value. Panel D shows the EEZ harvest rate over one generation time. The red dot in panel D represents the EEZ harvest rate that would result for the current generation time if the full EEZ potential yield being harvested (i.e. OFL being met) in the upcoming year. The red dot in panel E represents the preseason estimate of MFMT.



Appendix A6. Tier 3 Aggregate Chinook Salmon

Appendix A6.1. 2024 Historical Table: Tier 3 Aggregate Chinook Salmon. Shown are the year of the run, the estimated total catch of this stock across all fisheries, the estimated catch in the EEZ, and the summed cumulative EEZ catch over a generation, which is used to assess overfishing.

Year	Total catch	EEZ catch	Cumulative EEZ catch
1999	NA	155	NA
2000	NA	116	NA
2001	NA	211	NA
2002	NA	122	NA
2003	NA	428	NA
2004	NA	306	1338
2005	NA	512	1695
2006	NA	410	1989
2007	NA	402	2180
2008	NA	127	2185
2009	NA	480	2237
2010	NA	205	2136
2011	NA	204	1828
2012	NA	94	1512
2013	NA	179	1289
2014	NA	131	1293
2015	NA	156	969
2016	NA	231	995
2017	NA	75	866
2018	NA	260	1032
2019	NA	81	934
2020	NA	76	879
2021	NA	87	810
2022	NA	80	659
2023	NA	51	635

Appendix A6.2. 2024 OFL and ABC: Tier 3 Aggregate Chinook Salmon. Shown are the range of potential buffers, the OFL, the ABC as reduced by the buffer, the preseason OFL, and the preseason ABC as reduced by the buffer.

buffer	OFL	ABC	Preseason OFL	Preseason ABC
0.1	3072	307.2	2697	269.7
0.2	3072	614.4	2697	539.4
0.3	3072	921.6	2697	809.1
0.4	3072	1228.8	2697	1078.8
0.5	3072	1536	2697	1348.5
0.6	3072	1843.2	2697	1618.2
0.7	3072	2150.4	2697	1887.9
0.8	3072	2457.6	2697	2157.6
0.9	3072	2764.8	2697	2427.3

Appendix A7. Tier 2 Aggregate Coho Salmon

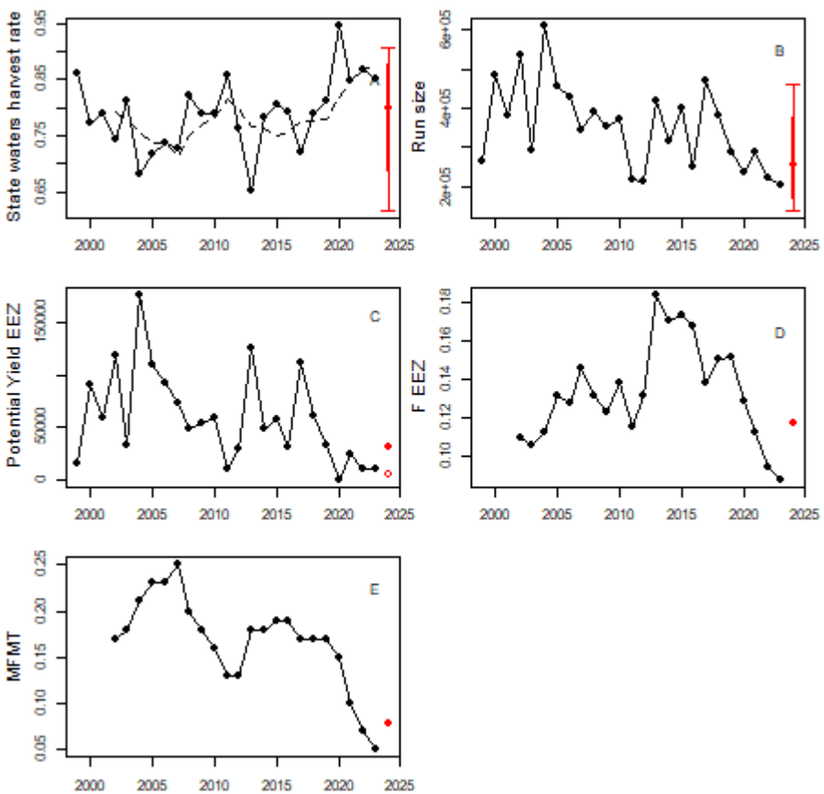
Appendix A7.1. 2024 Historical Table: Tier 2 Aggregate Coho Salmon. Historical information to inform the status determination criteria and harvest specifications for this stock assessment. The table includes year of the salmon run, the estimates total run size, the spawning escapement, the SOA spawning escapement goal, the total catch across all fisheries, the estimate State waters catch, the fraction of the catch estimated to have occurred in State waters, the estimated EEZ catch, the fraction of the total catch estimated to have occurred in the EEZ, the maximum fishing morality threshold, and the potential yield in the EEZ.

Year	Run size	Escapement	Escapement goal	Total catch	State catch	F_state	EEZ Catch	F_EEZ	MFMT	Potential Yield EEZ
1999	265287	7583	20300	257704	228527	0.861	29177	NA	NA	16460
2000	485811	41823	20300	443988	375178	0.772	68810	NA	NA	90333
2001	381499	60514	20300	320985	301601	0.791	19384	NA	NA	59598
2002	537877	72550	20300	465327	399142	0.742	66185	0.11	0.171	118435
2003	290134	28182	20300	261952	235856	0.813	26096	0.106	0.178	33978
2004	612672	103139	20300	509533	416645	0.68	92888	0.112	0.213	175727
2005	456543	64726	20300	391817	327089	0.716	64728	0.132	0.23	109154
2006	428098	68205	20300	359893	315247	0.736	44646	0.128	0.23	92551
2007	345048	28148	20300	316900	251109	0.728	65791	0.145	0.245	73639
2008	388652	31209	20300	357443	319036	0.821	38407	0.132	0.201	49316
2009	352561	36871	20300	315690	278234	0.789	37456	0.123	0.178	54027
2010	373260	19607	20300	353653	294156	0.788	59497	0.138	0.162	58804
2011	216045	12152	20300	203893	185313	0.858	18580	0.116	0.13	10432
2012	211570	13604	20300	197966	161550	0.764	36416	0.132	0.133	29720
2013	418423	35724	20300	382699	272853	0.652	109846	0.184	0.184	125270
2014	316007	35789	20300	280218	247055	0.782	33163	0.17	0.184	48652
2015	401418	23531	20300	377887	323398	0.806	54489	0.174	0.194	57720
2016	248351	16869	20300	231482	196842	0.793	34640	0.168	0.19	31209
2017	470908	54650	20300	416258	339766	0.722	76492	0.138	0.173	110842
2018	383363	20655	20300	362708	302282	0.789	60426	0.15	0.173	60781
2019	287868	14674	20300	273194	233833	0.812	39361	0.152	0.17	33735
2020	237495	10765	20300	226730	225109	0.948	1621	0.129	0.149	0
2021	287943	10923	20300	277020	243973	0.847	33047	0.112	0.099	23670
2022	219575	5061	19300	214514	190503	0.868	24011	0.095	0.065	9772
2023	203590	5543	19300	198047	173409	0.852	24638	0.088	0.047	10881

Appendix A7.2. 2024 ARIMA Model Preseason Table: Tier 2 Aggregate Coho Salmon. This tables includes the estimate harvest rate in State waters (F state preseason), the forecasted total run size, the preseason estimate of potential yield in the EEZ (OFL preseason), the buffer that accounts for scientific uncertainty in reducing the preseason OFL to the ABC, the preseason ABC, preseason estimate of the EEZ harvest rate (Potential F_EEZ), and the preseason estimate of MFMT in the EEZ.

F_state preseason	run preseason	OFL_preseason	OFL to ABC_buffer	ABC_preseason	Potential F_EEZ	MFMT
0.798	253080	31798.32	0.153	4878.215	0.118	0.079

Appendix A7.3. 2024 ARIMA Model Preseason Plots: Tier 2 Aggregate Coho Salmon. In panel A, the dashed line represents the moving average of state harvest across one generation time. The red dots and error bars in panels A and B represent preseason forecasts and uncertainty for state harvest rate (A) and run size (B). The filled red dot in panel C represents the amount of potential yield in the EEZ based on the forecasted state harvest rate and run size (i.e. preseason OFL). The hollow red circle in panel C represents the preseason OFL reduced by the buffer to the preseason ABC value. Panel D shows the EEZ harvest rate over one generation time. The red dot in panel D represents the EEZ harvest rate that would result for the current generation time if the full EEZ potential yield being harvested (i.e. OFL being met) in the upcoming year. The red dot in panel E represents the preseason estimate of MFMT.



Appendix A8. Tier 3 Coho Salmon

Appendix A8.1. 2024 Historical Table: Tier 3 Aggregate Coho Salmon. Shown are the year of the run, the estimated total catch of this stock across all fisheries, the estimated catch in the EEZ, and the summed cumulative EEZ catch over a generation, which is used to assess overfishing.

Year	Total catch	EEZ catch	Cumulative EEZ catch
1999	257704	29177	NA
2000	443988	68810	NA
2001	320985	19384	NA
2002	465327	66185	183556
2003	261952	26096	180475
2004	509533	92888	204553
2005	391817	64728	249897
2006	359893	44646	228358
2007	316900	65791	268053
2008	357443	38407	213572
2009	315690	37456	186300
2010	353653	59497	201151
2011	203893	18580	153940
2012	197966	36416	151949
2013	382699	109846	224339
2014	280218	33163	198005
2015	377887	54489	233914
2016	231482	34640	232138
2017	416258	76492	198784
2018	362708	60426	226047
2019	273194	39361	210919
2020	226730	1621	177900
2021	277020	33047	134455
2022	214514	24011	98040
2023	198047	24638	83317

Appendix A8.2. 2024 OFL and ABC: Tier 3 Aggregate Coho Salmon. Shown are the range of potential buffers, the OFL, the ABC as reduced by the buffer, the preseason OFL, and the preseason ABC as reduced by the buffer.

buffer	OFL	ABC	Preseason OFL	Preseason ABC
0.1	439384	43938.4	357688	35768.8
0.2	439384	87876.8	357688	71537.6
0.3	439384	131815.2	357688	107306.4
0.4	439384	175753.6	357688	143075.2
0.5	439384	219692	357688	178844
0.6	439384	263630.4	357688	214612.8
0.7	439384	307568.8	357688	250381.6
0.8	439384	351507.2	357688	286150.4
0.9	439384	395445.6	357688	321919.2

Appendix A9. Tier 3 Aggregate Chum Salmon

Appendix A9.1. 2024 Historical Table: Tier 3 Aggregate Chum Salmon. Shown are the year of the run, the estimated total catch of this stock across all fisheries, the estimated catch in the EEZ, and the summed cumulative EEZ catch over a generation, which is used to assess overfishing.

Year	Total catch	EEZ catch	Cumulative EEZ catch
1999	179720	80551	NA
2000	133335	62061	NA
2001	90953	36633	NA
2002	245784	116282	295527
2003	126146	53224	268200
2004	151246	64510	270649
2005	73992	33787	267803
2006	67753	33259	184780
2007	79871	46255	177811
2008	53862	23460	136761
2009	86817	41179	144153
2010	233038	122502	233396
2011	134114	48972	236113
2012	274157	140233	352886
2013	145038	76391	388098
2014	122739	57216	322812
2015	281694	116190	390030
2016	127623	39656	289453
2017	249251	103807	316869
2018	118603	64550	324203
2019	132645	53994	262007
2020	33287	7681	230032
2021	73235	29239	155464
2022	102834	38885	129799
2023	130921	51081	126886

Appendix A9.2. 2024 OFL and ABC: Tier 3 Aggregate Chum Salmon. Shown are the range of potential buffers, the OFL, the ABC as reduced by the buffer, the preseason OFL, and the preseason ABC as reduced by the buffer.

buffer	OFL	ABC	Preseason OFL	Preseason ABC
0.1	560932	56093.2	441727	44172.7
0.2	560932	112186.4	441727	88345.4
0.3	560932	168279.6	441727	132518.1
0.4	560932	224372.8	441727	176690.8
0.5	560932	280466	441727	220863.5
0.6	560932	336559.2	441727	265036.2
0.7	560932	392652.4	441727	309208.9
0.8	560932	448745.6	441727	353381.6
0.9	560932	504838.8	441727	397554.3

Appendix A10. Tier 3 Aggregate Pink Salmon

Appendix A10.1. 2024 Historical Table: Tier 3 Aggregate Pink Salmon. Shown are the year of the run (even years only), the estimated total catch of this stock across all fisheries, the estimated catch in the EEZ, and the summed cumulative EEZ catch over a generation, which is used to assess overfishing.

Year	Total catch	EEZ catch	Cumulative EEZ catch
2000	189728	42595	42595
2002	490034	114737	114737
2004	393589	103094	103094
2006	442423	90616	90616
2008	208092	49503	49503
2010	320840	89935	89935
2012	498572	132790	132790
2014	703285	150023	150023
2016	425497	109481	109481
2018	172974	38981	38981
2020	395430	11828	11828
2022	131082	29611	29611

Appendix A10.2. 2024 OFL and ABC: Tier 3 Aggregate Pink Salmon. Shown are the range of potential buffers, the OFL, the ABC as reduced by the buffer, the preseason OFL, and the preseason ABC as reduced by the buffer.

buffer	OFL	ABC	Preseason OFL	Preseason ABC
0.1	300046	30004.6	270435	27043.5
0.2	300046	60009.2	270435	54087
0.3	300046	90013.8	270435	81130.5
0.4	300046	120018.4	270435	108174
0.5	300046	150023	270435	135217.5
0.6	300046	180027.6	270435	162261
0.7	300046	210032.2	270435	189304.5
0.8	300046	240036.8	270435	216348
0.9	300046	270041.4	270435	243391.5

Appendix B. Equations Used

Tier 1: Salmon stocks with escapement goals and stock-specific harvest estimates

Each year, salmon stocks that have escapement goals and stock-specific harvest and escapement estimates would be considered for placement in Tier 1.

The assessment authors and SSC would identify the Tier 1 stocks each year during the annual harvest specification process.

For the Tier 1 stocks, the following calculations would be conducted each year to determine the status of the managed salmon stocks and set the appropriate biological reference points:

Overfishing

Overfishing occurs whenever a stock or stock complex is subjected to a level of fishing mortality or total catch that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. The realized fishing mortality rate in the EEZ for a stock (F_{EEZ}) is expressed as an exploitation rate (harvest/total run size), which is calculated for the stock over one generation (the average length of time between when an individual of that species is born and when it spawns) in years (T), weighted as informed by available data, where t = run year, R = annual run size of a stock, and C_{EEZ} = annual EEZ catch of a stock in year t:

(1) $$F_{EEZ,t} = \frac{\sum_{i=t-T+1}^{t} C_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$$

The level of fishing mortality in the EEZ above which overfishing occurs (MFMT) for a stock is based on an exploitation rate assessed over one generation and is defined as:

(2) $$MFMT_t = \frac{\sum_{i=t-T+1}^{t} Y_{EEZ,i}}{\sum_{i=t-T+1}^{t} R_i}$$; where

(3) $$Y_{EEZ,i} = max\left(0, R_t - G_t - C_{state,t}\right)$$

where Y_{EEZ} is the potential yield in the EEZ, $C_{state,t}$ is the harvest that occurred in state waters in year t and G is the escapement goal or target for a stock. The lower bound of the established escapement goal range is the default used in this tier system; however, NMFS, or the SSC may recommend a different value during the annual stock status determination process based on the best scientific information available. NMFS or the SSC may also recommend additional buffers to account for uncertainty in harvests and escapement estimates. Due to uncertainty inherent to management, the realized yields are unlikely to be equal to the potential yields.

Should F_{EEZ} exceed the MFMT in any year, it will be determined that a stock is subject to overfishing; this definition corresponds to the **F_{OFL} control rule**.

MFMT for a stock would be assessed postseason each year with the most current T years of data.

Overfished

Should a stock's realized spawning escapements summed across a generation fall below the MSST in any year, the stock would be declared overfished. The MSST is defined as one half of the sum of the stock's spawning escapement goal summed across a generation:

(4) $$MSST_t = \frac{\sum_{i=t-T+1}^{t} G_i}{2}$$, evaluated by comparing $\sum_{i=t-T+1}^{t} S_i$ with MSST, where S is spawning escapement in year i.

MSST for a stock would be assessed postseason each year with the most current T years of data used to estimate MSST and S. NMFS or the SSC may recommend buffers to account for uncertainty in escapement estimates or spawning escapement goals.

Overfishing Limit (OFL), Acceptable Biological Catch (ABC), and Annual Catch Limit (ACL)
Specification for OFL, ABC, and ACL will occur as follows:

- The preseason estimates of MFMT would be calculated from the sum of potential yield in the EEZ from the previous *T*-1 years and the preseason estimate of potential yield in the EEZ based on the preseason forecast of run size, projected harvest in other fisheries, and the escapement goal in a given year, G_t using the following equation:

(5) $$MFMT_{pre,t} = \frac{\sum_{i=t-T+1}^{t-1} Y_{EEZ,i} + \hat{Y}_{EEZ,t}}{\sum_{i=t-T+1}^{t-1} R_i + \hat{R}_{,t}}$$

where $\hat{Y}_{EEZ,t}$ is the preseason estimate of potential yield in the EEZ for year *t* used to establish annual harvest specifications and is calculated based on:

(6) $\hat{Y}_{EEZ,t} = max(0, \hat{R}_t - G_t - \bar{F}_{state,t} * \hat{R}_t)$, where $\hat{R}_t$ is the predicted run size in year *t* based on a vetted preseason forecast method and $\bar{F}_{state,t}$ is the predicted harvest rate in State waters based on a preseason forecast of state harvest rate.

The Preseason estimates of F_{EEZ} is calculated from the sum of actual harvests in the EEZ from the previous *T*-1 years and the preseason estimate of potential yield in the EEZ based on the preseason forecast of run size:

(7) $$F_{EEZ,pre,t} = \frac{\sum_{i=t-T+1}^{t-1} C_{EEZ,i} + \hat{Y}_{EEZ,t}}{\sum_{i=t-T+1}^{t-1} R_i + \hat{R}_{,t}}$$

For Tier 1 stocks, the preseason OFL is equivalent to equation 6.

Postseason, overfishing will be determined for each stock based on the F_{OFL} control rule as previously described.

The **ABC control rule**: ABC must be less than or equal to OFL. The SSC may recommend reducing ABC from OFL to account for scientific uncertainty, including uncertainty associated with the assessment of spawning escapement goals, forecasts, harvests, and other sources of uncertainty. The default recommendation of the assessment authors is to reduce OFL to ABC by an amount proportional to the retrospective error in preseason potential yield/OFL ($\hat{Y}_{EEZ,t}$) relative to postseason $Y_{EEZ,i}$ over a ten-year time period. Error in preseason estimates of potential yield represent the combined error in forecasting both run size and state harvest rate. Specifically, the OFL is multiplied by a buffer factor based on the retrospective median symmetric accuracy (MSA; Morley et al., 2018) of the preseason potential yield relative to postseason potential yield:

$$MSA = 100(exp(median(|\log(\frac{\hat{Y}_{EEZ,t}}{Y_{EEZ,t}})|)) - 1)$$

MSA is interpretable as an estimate of the percent error in preseason predictions of potential yield, from which the buffer factor (b) is derived as:

$$b = max(\frac{100 - MSA}{100}, 0.1)$$

A bound of 10% is imposed such that if the calculated MSA indicated use of a buffer below 10%, a 10% buffer would be used instead. ABC is then calculated from OFL as the product of OFL*b.

The ACL will be established equal to or less than the ABC.

Tier 2: Salmon stocks managed as a complex

Tier 2 stocks are salmon stocks managed as a complex, with specific salmon stocks designated as indicator stocks. An indicator stock is a stock for which sufficient data exist to allow for the development of measurable and objective SDC and can be used as a proxy to manage and evaluate data poor stocks within the stock complex. Further, an indicator stock is thought to be representative of the typical vulnerabilities of stocks within the stock complex.

The assessment authors and SSC would identify the Tier 2 stocks each year during the annual harvest specification process.
In general, management of Tier 2 stocks is based on aggregate abundance as previously described. Information on the individual indicator stock is used to inform management actions for the stock complex.

For the Tier 2 stocks, the following calculations would be conducted each year to determine the status of the salmon stocks and set the appropriate biological reference points.

Overfishing

The Tier 1 formulas for *F* and MFMT would be used for Tier 2 indicator stocks. Whenever estimates of *F* or MFMT, as defined under Tier 1, are unavailable for each stock in a stock complex managed under this FMP, a list of indicator salmon stocks for a given stock complex will be established.

Using the same definitions and criteria described under Tier 1, a determination that one or more indicator salmon stocks is subject to overfishing will constitute a determination that the respective stock complex is subject to overfishing, except as provided in the paragraph below.

Overfishing of one or more stocks in a stock complex may be permitted, and may not result in a determination that the entire stock complex is subject to overfishing, under the following conditions established under the National Standard 1 guidelines (50 CFR §600.310(l)):

a) it is demonstrated by analysis that such action will result in long-term net benefits to the Nation;

b) it is demonstrated by analysis that mitigating measures have been considered and that a similar level of long-term net benefits cannot be achieved by modifying fleet behavior, gear selection/configuration, or other technical characteristics in a manner such that no overfishing would occur; and

c) the resulting rate or level of fishing mortality will not cause any stock or stock complex to fall below its MSST more than 50% of the time in the long term.

Overfished

The MSST for a stock complex is equal to one-half the sum of the *G*s for the indicator salmon stocks from the most recent *T* years.

Should a stock complex's cumulative escapements for a generation fall below the MSST in any year, it will be determined that the stock complex is overfished.

OFL, ABC & ACL

The OFL, ACL, and ABC will be set for the indicator stock using the Tier 1 methodology.

Tier 3: Salmon stocks with no reliable estimates of escapement

Tier 3 salmon stocks or stock complexes have no reliable estimates of escapement or total run size, therefore OFL and ABC are based on catch history. Tier 3 stocks may have escapement goals, but, relative to Tier 2 stocks, the goals and associated inseason assessment of escapement represent a coarse and/or unknown index of abundance rather than a true number of fish. The assessment author and SSC would identify the Tier 3 stocks each year during the annual harvest specification process.

For Tier 3 stocks, the following calculations would be conducted each year to determine the status of the salmon stocks and set the appropriate biological reference points.

- OFL = the maximum annual EEZ catch in the timeseries under consideration multiplied by the average generation time (*T* years), unless an alternative catch value is recommended by the SSC on the basis of the best scientific information available.
- ABC = OFL* buffer (e.g. 0.9) to account for uncertainty. As recommended by the SSC, ABC could be set lower by applying a more conservative buffer to the OFL (e.g., 0.75) to account for greater scientific uncertainty regarding the stock. ABC would be set each year during the annual stock status determination process based on the best available information.
- ACL equal to or less than ABC.

Using catch history for Tier 3 stocks is the most appropriate way to set the OFL when there are no reliable estimates of escapement or escapement data and total run size cannot be estimated with a high degree of certainty. Because of this, MFMT and F_{EEZ} also cannot be calculated and the F_{OFL} control rule cannot be used to assess overfishing. For salmon, the summary of catches can be reliably used as an OFL due to the multiple year nature of how the catch data are accumulated over a generation time. Methods that use CPUE (e.g., catch per delivery) would likely not provide sufficient information to assess whether catches had exceeded a level thought to cause overfishing.

Overfishing

For Tier 3 stocks or stock complexes, should the sum of harvest for the most recent generation (T years) be greater than the OFL, then it will be determined that the stock is subject to overfishing. Similar to Tiers 1 and 2, overfishing for Tier 3 stocks is assessed postseason after stock-specific harvest data become available; NMFS or the SSC may recommend additional buffers to account for uncertainty of estimates.

Overfished

For stocks or stock complexes with escapement goals, the MSST is calculated the same as for Tier 1 stocks. Should a stock or stock complex's cumulative escapements for a generation fall below the MSST in any year, it will be determined that the stock complex is overfished. Similar to Tier 1 and 2 stocks, when calculating MSST and comparing spawning escapements summed across the most recent generation, NMFS or the SSC may recommend buffers to account for uncertainty in estimates.

For Tier 3 stocks or stock complexes without escapement goals, it is not possible to calculate MSST.

OFL, ABC & ACL

OFL = the maximum annual EEZ catch in the timeseries under consideration multiplied by the average generation time (*T* years), unless an alternative catch value is recommended by the SSC on the basis of the best scientific information available.

ABC = OFL* buffer (e.g. 0.9) to account for uncertainty. As recommended by the SSC, ABC could be set lower by applying a more conservative buffer to the OFL (e.g., 0.75) to account for greater scientific uncertainty regarding the stock. ABC would be set each year during the annual stock status determination process based on the best available information.

ACL equal to or less than ABC.

References:

Morley, S. K., Brito, T. V., & Welling, D. T. (2018). Measures of model performance based on the log accuracy ratio. *Space Weather*, *16*(1),