# Chum Salmon Bycatch

November 15, 2022[1]



# 1 Introduction and overview

In June 2022, the Council received a series of presentations on Chinook and chum salmon research, bycatch, genetics, and stock status. Those papers and presentations are available on the June 2022 Council agenda (see June 2022 Salmon reports). Following discussion and extensive public commentary in June, the Council moved to request information on multiple aspects of pollock fishery operations, encouraged additional focus on research and issues related to salmon survival in the Bering Sea, and requested a discussion paper focused on chum salmon bycatch and management. The Council motion is attached as Appendix A.

## 1.1 Overview of Council motion and discussion paper

This discussion paper addresses the staff requests for additional information on BSAI chum salmon bycatch, current management and rationale, additional PSC species encountered by the pollock fishery, an overview of the 2012 Chum Bycatch analysis as well as changes in western Alaskan stock status, and Pacific Rim hatchery releases. The other aspects of the Council motion will be covered in the December Council meeting discussions and in public comments from the pollock industry on changes in the B season. As of this discussion paper the State of Alaska Bycatch Recommendations are not yet available.

[1] Prepared by: Diana Stram (NPFMC) and Wes Larson, Pat Barry (TSMARI NMFS), with contributions from Mike Fey (AKFIN) and ADF&G staff

## 1.2 Overview of salmon bycatch numbers

The Eastern Bering Sea (EBS) pollock fishery encounters both Chinook and chum salmon (also referred to as non-Chinook) prohibited species catch (PSC) also referred to as bycatch. While Chinook is encountered in both the A season and B season chum is primarily encountered in the B season (Figure 1-1, Figure 1-3).

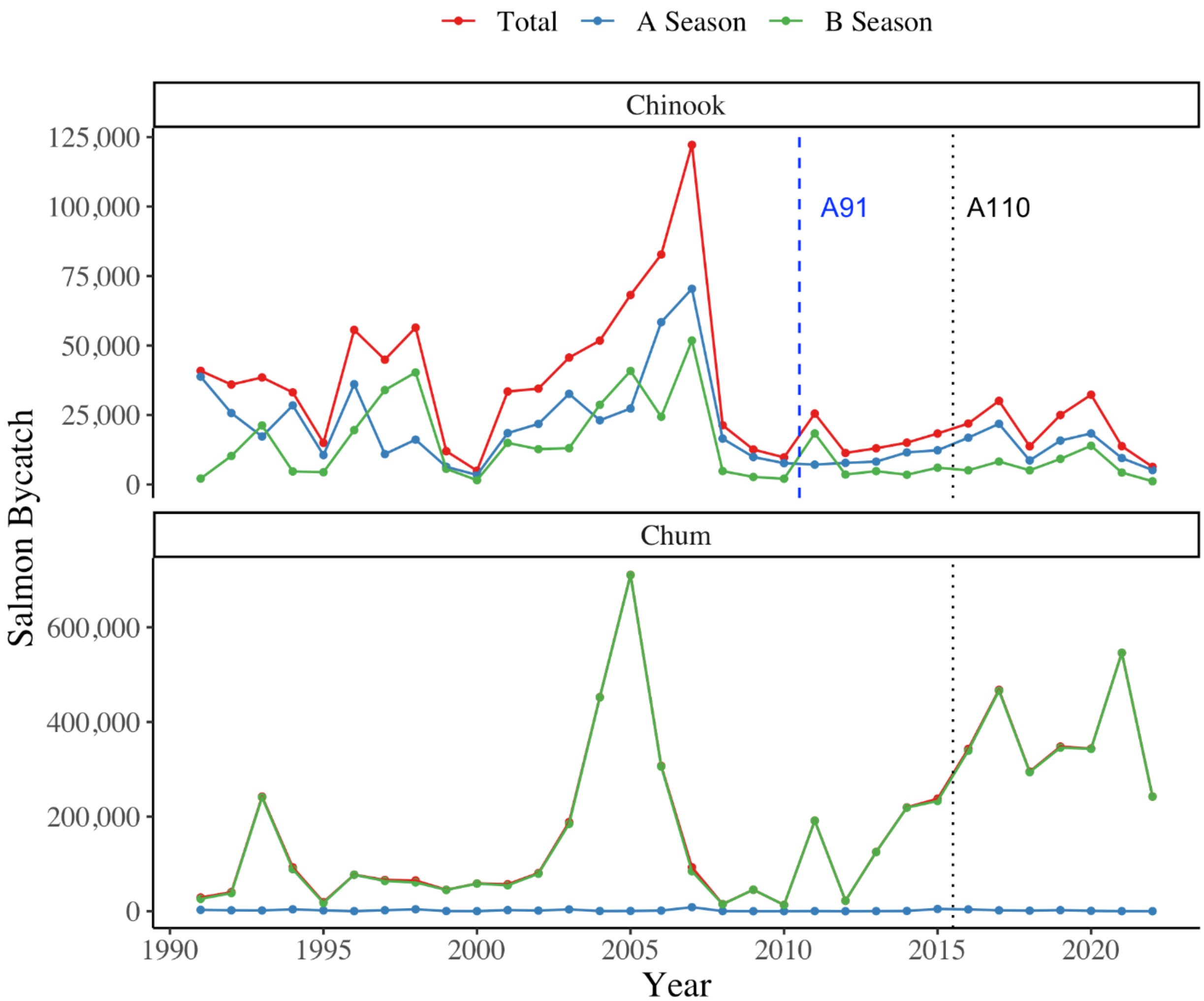


**Figure 1-1 Number of Chinook (top) and chum (bottom) salmon caught as bycatch in the Bering Sea midwater trawl pollock fishery from 1991 to 2022 for the A and B seasons and total (A and B season combined). Source AK regional office** https://www.fisheries.noaa.gov/sites/default/files/akro/chum_salmon_mortality2022.html, https://www.fisheries.noaa.gov/sites/default/files/akro/chinook_salmon_mortality2022.html

Figure 1-1 shows the overall catch of Chinook and chum bycatch in the pollock fishery from 1991-2022. Hereinafter we show data primarily from 2011 to 2022 in accordance with operations since the implementation of Amendment 91. Chinook salmon bycatch in the BSAI typically occurs in the winter/spring (A season) and fall (late B season) (Figure 1-1, Figure 1-3). Chinook bycatch is typically higher in the A season than B season. Since 2011, the B season Chinook salmon bycatch has only exceeded the A season once. Chinook bycatch in the B season typically starts to increase in late September or early October. Provisions put into place by Amendment 110 in the IPAs provide additional incentives to reduce fishing effort before this time.

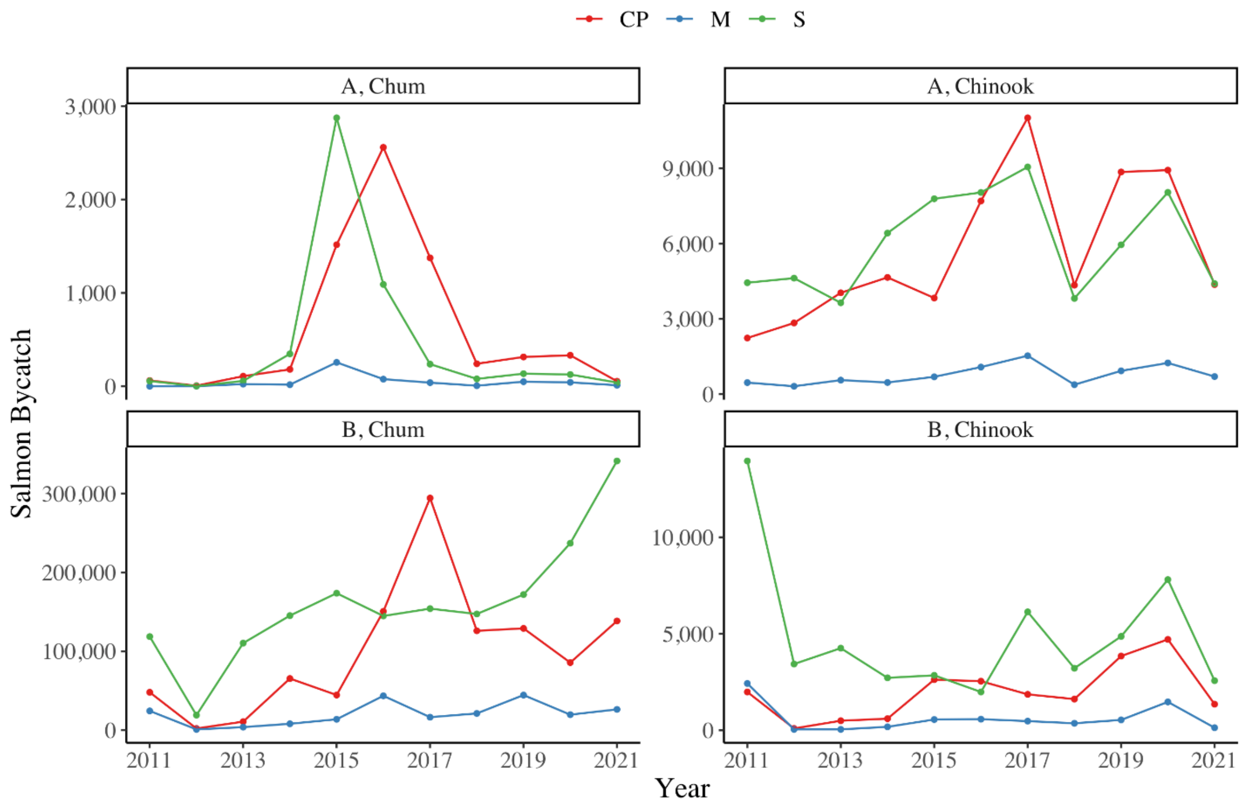


**Figure 1-2 Number of chum (left) and Chinook (right) salmon caught as bycatch in the Bering Sea midwater trawl pollock fishery from 2011 to 2021 for the A (top) and B (bottom) seasons by fishing sector (Catcher processor [CP], Mothership [M], and Shoreside [S]).**

## 1.3 Chum Bycatch

Chum is referred to as 'non-Chinook' for regulatory purposes for accounting as the category includes all other salmon species but Chinook. However, the catch is on average over 95% comprised of chum species. Table 1-1 shows the catch composition in recent years (2016-2022) of the non-Chinook PSC category.

**Table 1-1 Composition by species of salmon in the 'non-Chinook' PSC category by year 2016-2022**

| Salmon Species | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|
| Sockeye | | 150 | 87 | 185 | 228 | 48 | 15 |
| Coho | | 53 | 9 | 169 | 125 | 60 | 36 |
| Pink | 144 | 926 | 125 | 1,600 | 385 | 385 | 47 |
| Chum | 342,789 | 466,549 | 294,841 | 345,928 | 342,887 | 545,549 | 242,259 |
| Total non-Chinook | 342,933 | 467,678 | 295,062 | 347,882 | 343,625 | 546,042 | 242,357 |
| Percent Chum of non-Chinook | 99.96% | 93.73% | 95.48% | 92.78% | 91.24% | 97.45% | 97.41% |

Source: NMFS Alaska Region Catch Accounting System

Total chum salmon bycatch in the EBS pollock fishery ranged from 24,000 to 546,000 total catch annually between 2011-2021.

**Table 1-2 Chum salmon PSC by sector in the EBS pollock fishery 2010-2022**

| Sector | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catcher Processor | 2,627 | 48,119 | 2,135 | 10,900 | 65,662 | 46,173 | 153,302 | 295,915 | 126,327 | 129,381 | 86,067 | 153,641 | 78,173 |
| CV/Mothership | 1,070 | 24,399 | 978 | 3,858 | 8,108 | 14,304 | 43,715 | 16,888 | 21,309 | 45,501 | 19,786 | 50,555 | 32,257 |
| CV/Shoreside | 9,586 | 118,917 | 19,070 | 110,558 | 145,672 | 177,275 | 145,984 | 154,875 | 147,426 | 173,000 | 237,772 | 341,846 | 131,920 |
| **Total** | 13,283 | 191,435 | 22,183 | 125,316 | 219,442 | 237,752 | 343,001 | 467,678 | 295,062 | 347,882 | 343,625 | 546,042 | 242,350 |

Source: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_PSC.

## 1.4 Comparison of Chinook and Chum by week in the B-season

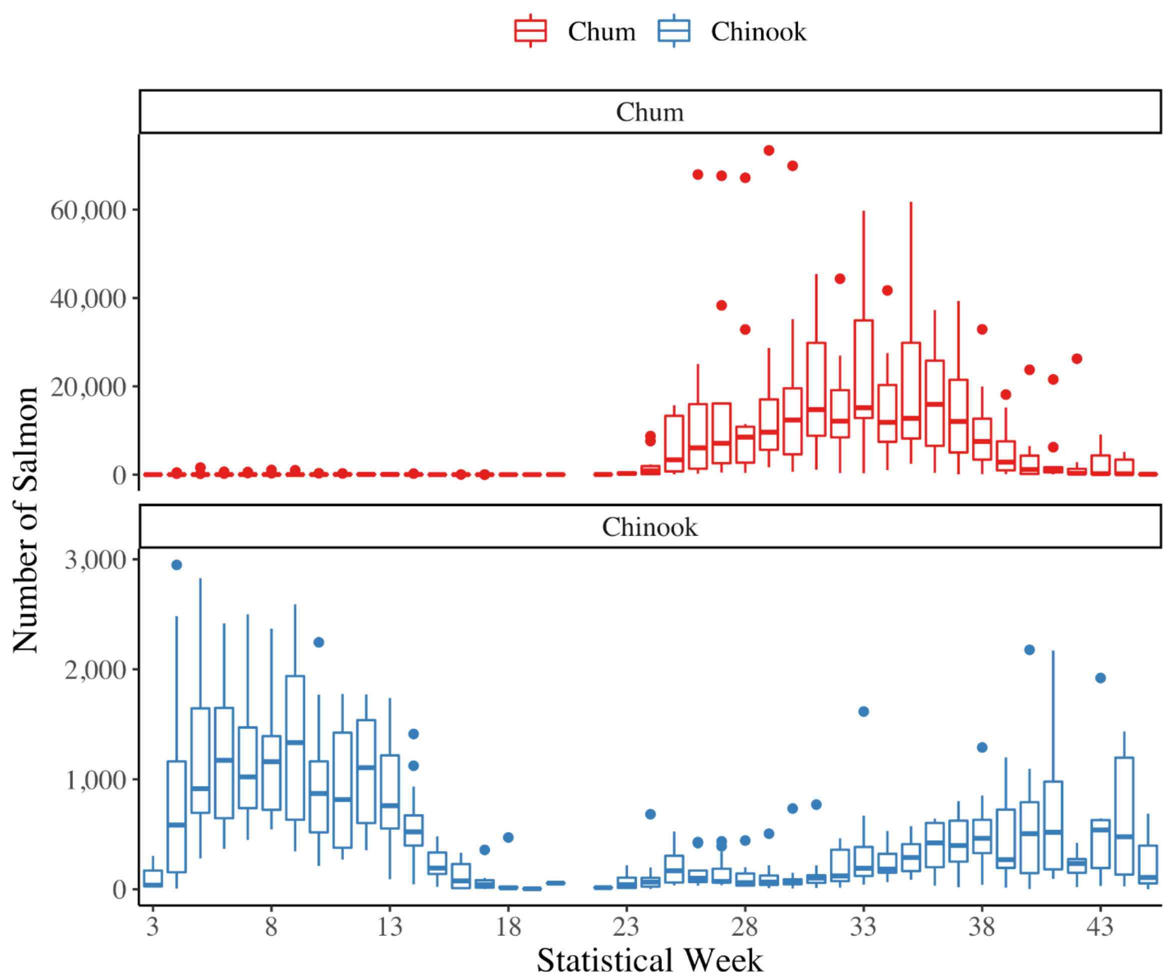


**Figure 1-3 Boxplot of number of salmon caught as bycatch from the Bering Sea trawl fishery by groundfish statical week across the A season (weeks 3-20) and B season (weeks 22-45) 2011-2022. The boxes represent the interquartile range (IQR; from the 25th to 75th percentiles), the horizontal line within the box represents the median value, the vertical lines (whiskers) extend from the IQR to the minimum and maximum values. Values outside of 1.5 times the IQR are plotted as outlying points. The three largest outlying points for each species have been omitted for clarity.**

Typically, over 99% of chum PSC occurs during the pollock B season (June 10 - November 1). Chum bycatch is often characterized by spikes of high bycatch throughout the summer. However, the timing of these high bycatch events in the B season is highly variable (Figure 3-2). For example, in 2016 a high bycatch event occurred in June and over 50% of the total bycatch for that year was caught before July 1. Contrastingly, in 2020, 50% of the bycatch was not caught until well into September. Chum salmon bycatch in 2020 was also characterized by gradual and consistent bycatch rather than spikes. These examples illustrate that, while chum bycatch is generally constrained to the summer (June through September), the specific yearly dynamics are highly variable.

Chinook salmon bycatch occurs primarily in the A season (statistical weeks 3-20). With substantial variability among years, on average the bycatch is largest in mid to late February (week 9) and declines until the end of the A season (Figure 1-3 bottom panel). In the B season (statistical weeks 22-45), Chinook salmon bycatch gradually increases throughout the season and has typically peaked after early October (week 40). Chum salmon bycatch displays an opposite trend, occurring primarily in the B season, typically occurring after June (stat week 23) gradually increasing until early August (week 33) and declining into October (week 40; Figure 1-3 top panel). These trends suggest that Chinook and chum salmon likely use the Bering Sea as important foraging habitat during different periods. The fishing depth of the pollock fleet changes, typically increasing in depth Figure 1-4) as the year progresses but encounter rates of salmon bycatch do not appear to be well correlated with fishing depth.

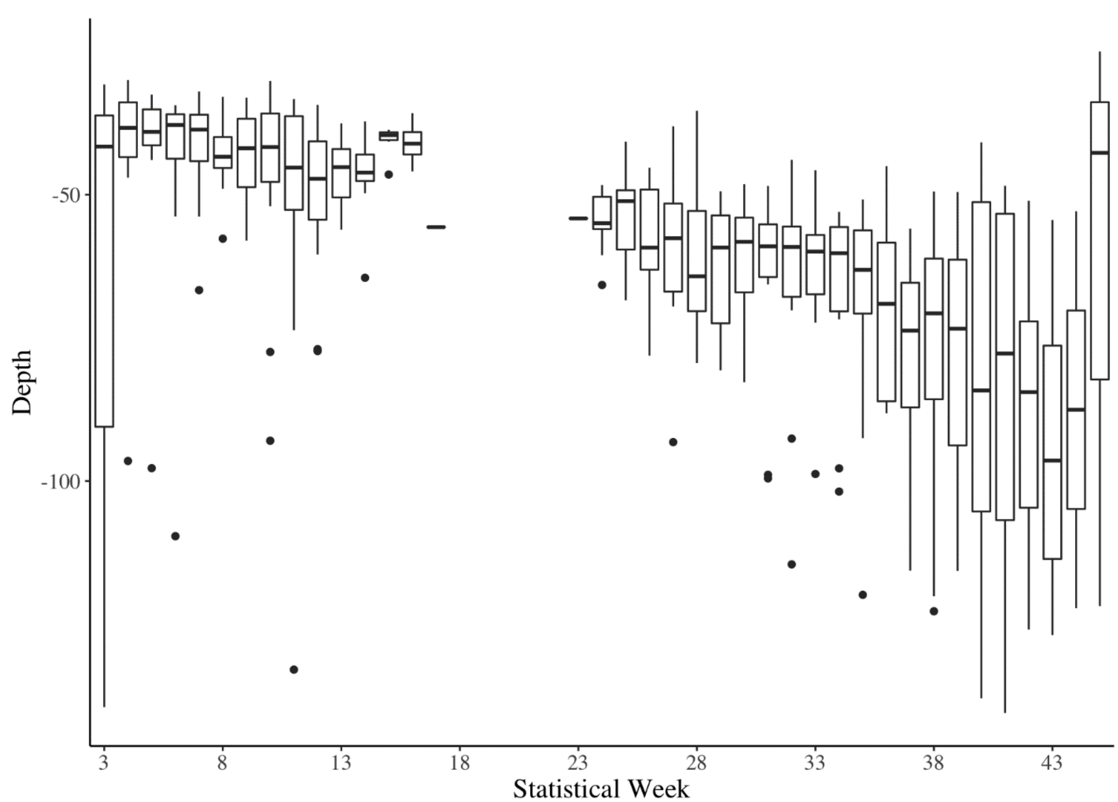


**Figure 1-4 Depth of net sets by the BSAI catcher vessel and mothership sectors of the pollock fleet throughout the year. Depth increases across the year on average but this does not appear to be associated with differences in salmon encounter rates.**

## 1.5 Tradeoffs in additional PSC and incidental species catch

There are additional PSC species as well as incidental catch species that the EBS pollock fleet is also trying to avoid which results in multiple trade-offs in fishing practices and decision making. In addition to avoiding Chinook, the fleet is also focused on balancing avoidance of chum salmon PSC as well as herring PSC and squid[2]. Figure 1-5 shows the annual catch of chum salmon as compared to herring and squid.

Avoidance of Chinook PSC is always the priority for the EBS pollock fleet given the repercussions of reaching a constraining Chinook PSC limit; however, PSC and incidental catches of other species must also be avoided, creating a complicated decision structure. A fleet's last response to constraining PSC limits is to reduce total groundfish harvest. This fishing strategy includes an assumption that fishermen will optimize their harvest in response to constraining limits. For example, prioritizing fishing operations to the best target fishery, area, and time to maximize net revenue, and reducing effort in the target fishery, area, and time that produce less net revenue. This section provides a brief overview of the considerations in the EBS pollock fishery in addition to avoiding Chinook bycatch.  This section is not intended to be comprehensive regarding operational decisions by the pollock fishery as pollock fishery representatives will be providing their own input in conjunction with this agenda items at the December 2022 Council meeting per the Council's request to the fleet.

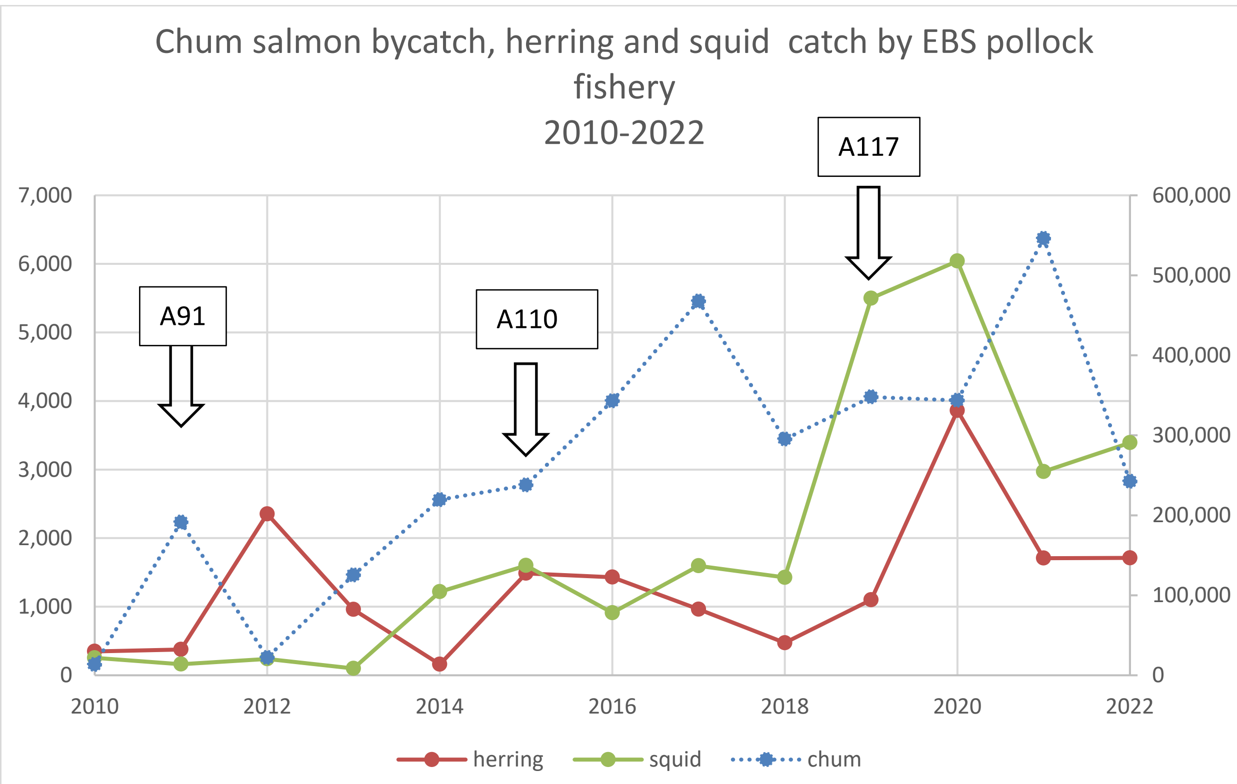


**Figure 1-5** **Catch of chum PSC (right axis), herring PSC and squid (left axis) 2010-2022 and various amendments (as described previous and below) over that time frame.**

[2] In recent years incidental catch of sablefish has increased in the EBS pollock fishery likely due to increasing population of sablefish and increased encounters in the Bering Sea.

Herring is a PSC species. The herring savings areas (HAS) are time/area closures triggered by a PSC limit equal to 1% of the estimated herring biomass established by the State of Alaska. The timing of the PSC limit being reached determines which (or if all) of the HSAs being triggered. The limit is apportioned to fishery categories in conjunction with the harvest specifications each year. When reached, the limit triggers spatial and temporal closures (Figure 1-6). The timing and location of these closures were intended to reflect the best available information at that time on herring migration patterns. To date these areas have been triggered 4 times (1991, 1994, 2012 and 2020). In each of the first three times it was the winter HAS (only) that was triggered. In 2020, initially all 3 HSAs were initially closed, then NMFS opened Area 2 to directed fishing for the AFA mothership, inshore and CDQ sectors. It remained closed to the AFA CP sector.

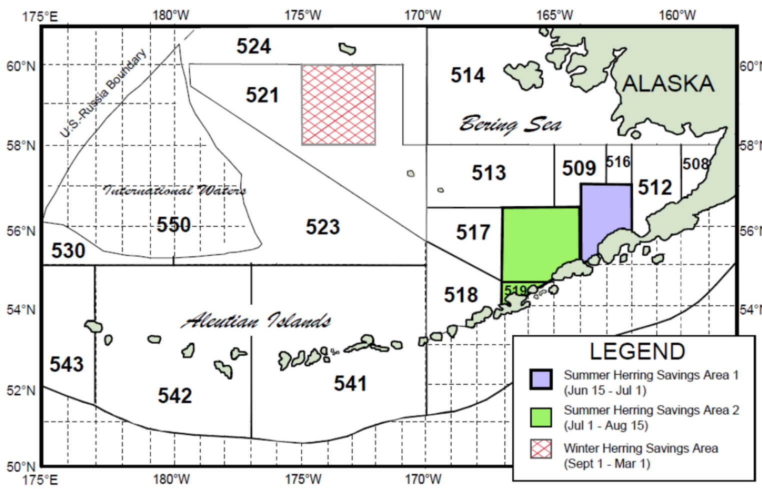


**Figure 1-6 Bering Sea Herring Savings Areas**

Beginning in 2019, the Council moved the squid complex into the Ecosystem Component (EC) under Amendment 117 to the BSAI FMP (and the GOA under Amendment 106). Prior to then they were managed as a target complex with annual harvest specifications established. The rationale for moving the complex into the EC included (1) the lack of a directed fishery for squids in the BSAI or GOA, (2) there is little risk of overfishing in the absence of a directed fishery because squids are highly productive, and (3) current incidental fishing mortality is considered insignificant at a population level. Catch for the complex is monitored and a biennial Forage Fish report is produced under the Stock Assessment Fishery Evaluation report for the BSAI. This report includes herring as well as squid, capelin and other important forage species.

# 2 Current management measures for chum and previous considerations

Chum salmon PSC is currently managed within the Incentive Plan Agreements (IPA) by sector. There is no overall PSC limit for chum, but IPAs are mandated to include avoidance measures within their IPAs. This system was established as part of revisions to the Chinook bycatch management program (first established under Amendment 91) when the Council made a number of modifications under Amendment 110 including modifying the bycatch management for chum salmon (see Section 2.2). IPAs employ hot spot area closures for chum bycatch avoidance within the context of continuing to avoid Chinook bycatch. As noted previously the industry representative will provide the Council an update in December 2022 modifications made for the 2022 B season to ensure that stringent measures were in place to avoid chum salmon PSC.

## 2.1 Consideration of additional chum management measures in 2012

Prior to the development of Amendment 91, the Council had been considering management measures for both chum and Chinook simultaneously. At the time Amendment 84 was approved as an interim measure to the closure of the existing Salmon Savings Areas (based on historical bycatch locations) but information from the portion of the fleet that was not closed to the SSAs was indicating that bycatch rates for both species were higher outside of the closures than inside. Amendment 84 provided an exemption to the SSAs for portions of the fleet that participated in a mandatory rolling hot spot program to mitigate bycatch levels while new management measures were developed. The Council began work on a comprehensive bycatch management package for both chum and Chinook which considered both updated closure areas as well as a range of overall PSC limits by sector, season and species. Following the 2007 spike in Chinook bycatch and continued concerns about the status of western Alaska Chinook stocks, the Council bifurcated the analysis with the indication that management measures for Chinook were the priority action item. Final action on Amendment 91 occurred in 2009 with implementation at the start of the 2011 A season.

Once Amendment 91 was completed the Council restarted development of chum bycatch management measures. After an iterative approach to developing alternatives, an analysis was presented in December 2012 (NPFMC Chum PSC analysis). This analysis evaluated the impacts of a suite of alternative measures to manage chum bycatch in the EBS pollock fishery including a range of PSC limits as well as time area closures. The Council's problem statement for this analysis was as follows:

> *Magnuson-Stevens Act National Standards direct management Councils to balance achieving optimum yield with bycatch reduction as well as to minimize adverse impacts on fishery dependent communities. Non-Chinook salmon (primarily made up of chum salmon) prohibited species bycatch (PSC) in the Bering Sea pollock trawl fishery is of concern because chum salmon are an important stock for subsistence and commercial fisheries in Alaska. There is currently no limitation on the amount of non-Chinook PSC that can be taken in the directed pollock trawl fisheries in the Bering Sea. The potential for high levels of chum salmon bycatch as well as long-term impacts of more moderate bycatch levels on conservation and abundance, may have adverse impacts in fishery dependent communities.*
>
> *Non-Chinook salmon PSC is managed under chum salmon savings areas and the voluntary Rolling Hotspot System (RHS). Hard caps, area closures and perhaps and enhanced RHS may be needed to ensure that non-Chinook PSC is limited and remains at a level that will minimize adverse impacts on fishery dependent communities. The Council should structure non-Chinook PSC management measures to provide incentive for the pollock trawl fleet to improve performance in avoiding non-Chinook salmon while achieving optimum yield from the directed fishery and objectives of the Amendment 91 Chinook salmon PSC management program. Non-Chinook salmon PSC reduction measures should focus, to the extent possible, on reducing impacts to Alaska chum salmon as a top priority.*

Three alternatives (in addition to status quo) were considered at that time each with multiple options and sub-options. The main action alternatives evaluated either a range of hard caps (PSC limits) for chum for either the full B season or for June and July only and revised triggered closures with existing exemptions for RHS program participants. The closures considered included closures for only June-July as well as ones that when triggered would close for the remainder of the B season. The range of hard caps under consideration was from 50,000 to 353,000 chum salmon based upon a range of years with historical bycatch by the pollock fleet. Components and options under all of the alternatives would allocate the caps to sectors as well as to provide for provisions of transferability similar to those considered and adopted under Amendment 91 for Chinook.

The analysis estimated the potential impacts to both Chinook and chum under the range of alternatives. Any alternatives that were estimated to push fishing later in the B season (hard caps or area closures applied for June and July only) would be expected to increase Chinook bycatch as the fishery would be likely to fish later into September and October to catch their quota when Chinook bycatch rates are known to be higher (Figure 1-3). Alternatives which imposed more restrictive hard caps (lower levels) that closed the whole fishery (and by sector) earlier did not appear to exacerbate Chinook or chum bycatch but came at a cost of additional forgone pollock harvest. The following table was included in the analysis as an attempt to summarize the impacts of the alternatives (under a single allocation scenario) between average (2004-2011) chum salmon adult equivalents (AEQ), pollock forgone or diverted, and Chinook salmon PSC change. Values in parentheses for alternative 4 option 1b) and 2b) represent differences due to unknown behavioral responses by the fleet (i.e., whether they would postpone fishing or fish outside of proposed closures). The color scheme is meant to reflect trade-offs (red being "worse" and green being "best" within columns over alternatives and options (rows).

**Table 2-1 Summary table from the Chum 2012 PSC management measures analysis to indicate relative differences between alternatives in terms of changes in Chum, Chinook and Pollock catch**

| | | | **Change in Chum salmon AEQ** (numbers that would have returned to spawn) | | | **Pollock forgone or diverted** | **Chinook PSC change** |
|---|---|---|---|---|---|---|---|
| | Option | Cap | Western Alaska | Asian | Total chum | Pollock | Chinook |
| Alternative 2 | 1a) | 50,000 | 30,279 | 99,013 | 167,610 | 322,620 | 17,304 |
| | | 200,000 | 16,269 | 62,727 | 101,275 | 118,561 | 8,651 |
| | | 353,000 | 6,799 | 34,118 | 51,093 | 53,073 | 5,349 |
| | 1b) | 15,600 | 12,529 | -8,587 | 11,416 | 126,796 | -5,934 |
| | | 62,400 | 10,300 | -3,907 | 12,247 | 66,303 | -3,373 |
| | | 110,136 | 8,584 | -1,199 | 12,339 | 40,388 | -2,142 |
| Alternative 4 | 1a) | 25,000 | 19,529 | 54,252 | 97,071 | 129,898 | 7,805 |
| | | 75,000 | 16,001 | 48,006 | 83,718 | 86,605 | 5,686 |
| | | 200,000 | 8,804 | 35,604 | 57,043 | 39,090 | 3,652 |
| | 1b) | 7,800 | 12,618 (12,194) | 227 (16,986) | 21,709 (40,790) | 47,537 (139,473) | -3,682 (273) |
| | | 23,400 | 12,573 (11,858) | 5,876 (16,001) | 27,579 (38,608) | 31,951 (116,395) | -2,537 (209) |
| | | 62,400 | 10,372 (9,576) | 5,083 (12,575) | 22,657 (30,478) | 20,553 (86,571) | -1,702 (146) |
| | 2a) | 25,000 | 12,085 | 21,651 | 46,274 | 103,527 | 2,716 |
| | | 75,000 | 10,063 | 20,716 | 41,647 | 65,454 | 2,185 |
| | | 200,000 | 4,645 | 14,746 | 25,558 | 28,970 | 1,039 |
| | 2b) | 7,800 | 9,918 (7,762) | 1,958 (10,817) | 19,059 (25,990) | 29,588 (82,323) | -2,464 (84) |
| | | 23,400 | 10,019 (8,210) | 7,321 (10,965) | 25,013 (26,536) | 17,179 (64,890) | -1,496 (57) |
| | | 62,400 | 8,311 (6,914) | 6,486 (8,954) | 20,947 (21,777) | 9,620 (44,300) | -885 (31) |

After consideration of all the alternatives and options and estimated impacts, the Council moved the following:

> *The Council is concerned that the current suite of alternatives does not provide a solution to the competing objectives outlined in the problem statement and purpose and need, recognizing the overall objective to minimize salmon bycatch in the Bering Sea pollock fishery to the extent practicable, while providing for the ability to achieve optimum yield in the pollock fishery. It is clear from the analysis thus far that measures considered to reduce bycatch of Alaska origin chum have a high likelihood of undermining the Council's previous actions to protect Chinook salmon.*
>
> *The Council requests that each sector provide a proposal that would detail how they would incorporate a western Alaska chum salmon avoidance program, with vessel level accountability, within their existing Chinook IPA for Council review. Upon review and public input, the Council would determine whether to further pursue this potential approach to best meet the multiple objectives outlined in the problem statement.*

At the October 2013 Council meeting a representative from the IPAs provided the Council an overview of how chum bycatch measures could be incorporated into the existing IPAs. Upon discussion and consideration of additional salmon bycatch information the Council requested a follow up staff discussion paper to consider both changes to the IPA regulations for chum bycatch avoidance as well as a suite of measures to address refinements to the Chinook Bycatch Management Program (Council motion October 2013). This discussion paper then lead to the development of alternatives and eventually Amendment 110.

## 2.2 Council rationale for current management (Amendment 110)

Following implementation of Amendment 91 in 2011, the Council began to receive annual updates on bycatch numbers, IPA performance and genetic stock composition of both chum and Chinook. In response to both continued concerns with chum bycatch (as discussed in Section 2.1) as well as widespread concerns over the stock status of western Alaska Chinook and indications that vessel level incentives could be strengthened under the Amendment 91 program [Stram and Ianelli, 2014; Amendment 110 EA/RIR], the Council took final action on Amendment 110. This amendment made a number of modifications to the IPA requirements to strengthen incentives for bycatch avoidance, imposed a lower cap in years of estimated low western Alaska Chinook abundance (as estimated by the three-System Index[3]) as well as removed the existing BSAI Am 84 regulations and incorporated chum salmon avoidance into the existing Amendment 91 Incentive Plan Agreements. An annual exemption from the Chum Salmon Savings Area is contingent upon participation in an incentive plan agreement that includes the provisions specified in regulation.

The Council noted in taking final action on Amendment 110 that this approach was appropriate as it meets the purpose and need statement by providing measures to prevent high chum salmon bycatch, while allowing for flexibility to target avoidance of Alaska chum stocks and to adapt to changing conditions on the water quickly. The Council references previous struggles with past proposals to better manage chum PSC which indicated that there was a high potential to undermine Chinook salmon avoidance measures.

Further discussion indicated that the action for chum bycatch strikes an appropriate balance between regulatory requirements and adaptive management. The elements required to be included in the IPAs were very clear relative to Council intent and objectives for minimizing chum bycatch, without mandating directly how industry must achieve that intent. The Council also recognized at that time that the areas and

[3] See Section 2.5.3 of the 2015 Amendment 110 EA/RIR

times of year in which Alaska chum stocks are more predominant in the bycatch has not been the same each year, making it more critical to have flexibility to target avoidance on Alaska stocks. At the time this was only the second year under the new sampling protocol, which showed inconsistency with initial data supporting the notion that limiting chum bycatch in the early part of the B season would have the most impact on Western AK and Yukon River stocks. The Council indicated that it was important to have the ability to respond to new information on distributions without a long regulatory process and that the decision to move chum into the IPAs reflects that. The decisions also retained the existing backstop measure for chum, such that if a sector or vessel does not participate in an incentive plan agreement that includes chum avoidance measures, they are then subject to the existing chum salmon savings area closure. A provision was also included to ensure that some form of a rolling hotspot program continues as a mechanism for the pollock fleet to avoid chum salmon, and that a third party group representative of western AK continues to receive notifications of closure notices and any violations.

# 3 Genetic stock composition data for chum

Scientists use genetic information from chum salmon PSC samples taken in the pollock fishery to estimate the number and proportion of chum salmon originating from six genetic groups (Figure 3-1): Southeast Asia (largely Japan), Northeast Asia (largely Russia), W. Alaska, Upper/Middle Yukon (Yukon River fall chum), Southwest Alaska, and Eastern Gulf of Alaska/Pacific Northwest (EGOA/PNW).

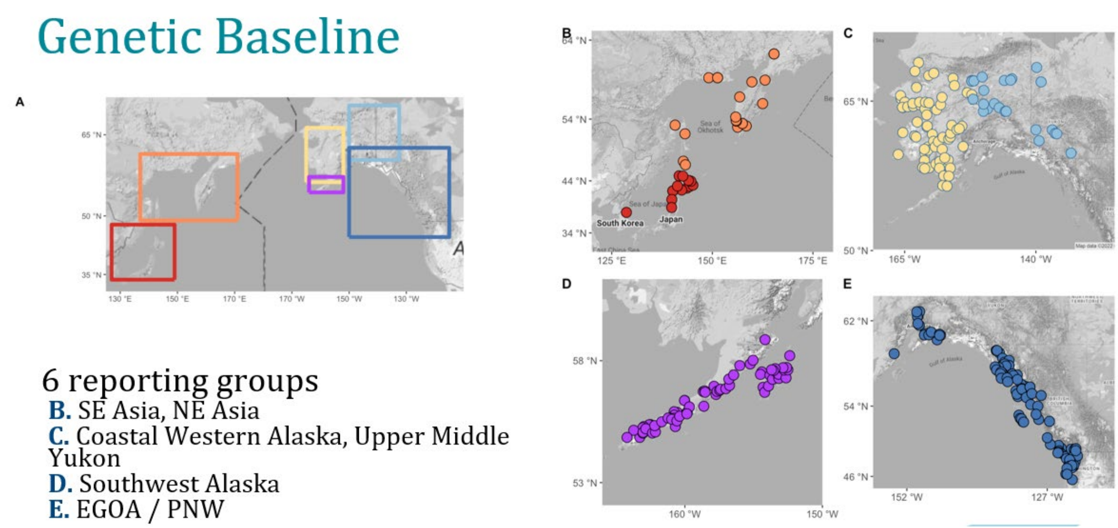


**Figure 3-1 Six regional groups of baseline chum salmon populations used for genetic stock identification (A) and the breakdowns of each by region (B-E).**

Six regional groups of baseline chum salmon populations used for genetic stock identification. Each circle represents one population in the baseline. (A) Range wide distribution of the six regions, (B) SE Asia (red) and NE Asia (orange), (C) W Alaska (yellow) and Up/Mid Yukon (medium blue), (D) SW Alaska (purple), and (E) EGOA/PNW (dark blue).

The cumulative catch and proportions by statistical week for 2011-2021 are shown in Figure 3-2 while the stock proportions and bycatch numbers by stock grouping are shown in Figure 3-3. On average 15% (ranged from 8-19%) of chum PSC in each year was from W. Alaska stocks (coastal western Alaska populations from Kotzebue south through Bristol Bay) and 4% (ranged from 0-9%) was from Upper/Middle Yukon (Yukon River fall) chum salmon stocks. Here “W. Alaska” refers to the genetic reporting group including coastal western Alaska populations from Bristol Bay to Kotzebue, and "Western Alaska" refers to the broader populations of chum salmon in the region, including fall chum salmon from the Upper and Middle Yukon River. Chum salmon PSC in the last two years (2020-2021) showed lower proportions of W. Alaska and Yukon River fall chum salmon (~9% total) compared to the previous nine (~16-25%). Contributions from the Yukon River fall chum stocks were especially low in 2020 and 2021 (1% or less of total PSC). In terms of absolute numbers, between 2011-2021 annual estimates of chum salmon PSC from W. Alaska ranged from 3,061 to 66,199 with an average of 39,904 and estimates from Yukon River fall stocks ranged from 1,044 to 28,061 with an average of 9,448. In 2021, bycatch from the W. Alaska group was estimated to be 48,656 and bycatch from the Yukon River fall stocks was estimated to be 2,854.

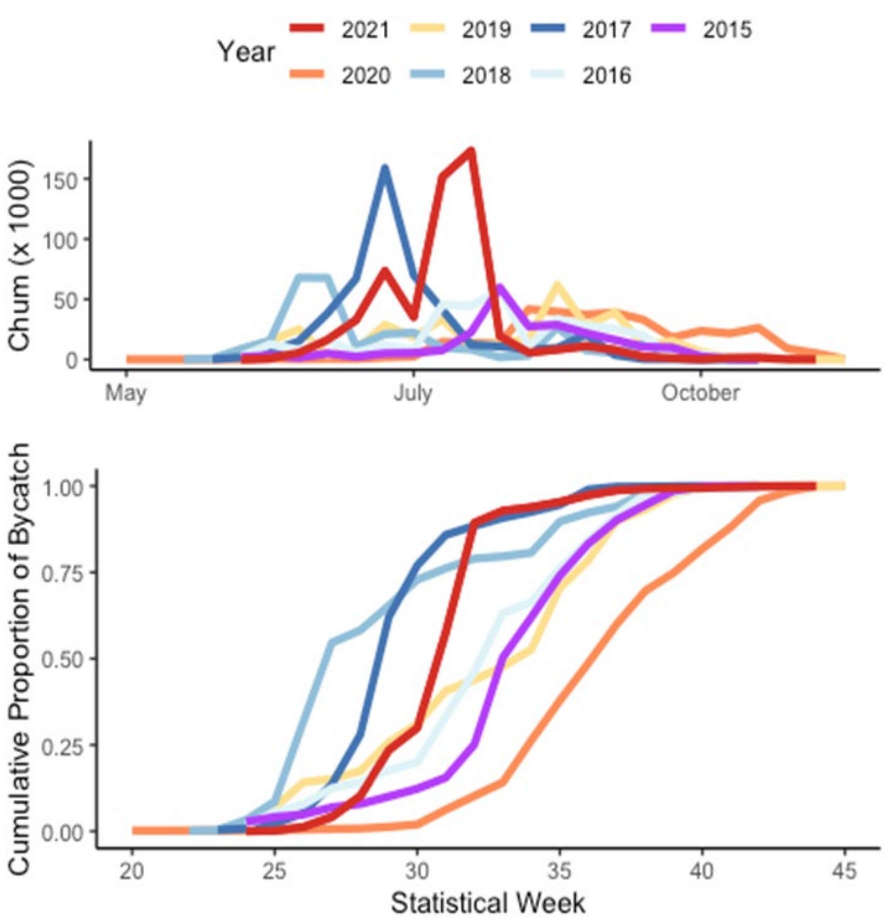


**Figure 3-2 Number of chum salmon caught during the B-season (top) and cumulative proportion of chum salmon catch (bottom) from the Bering Sea pollock trawl fishery by statistical week for years 2016 to 2021.**

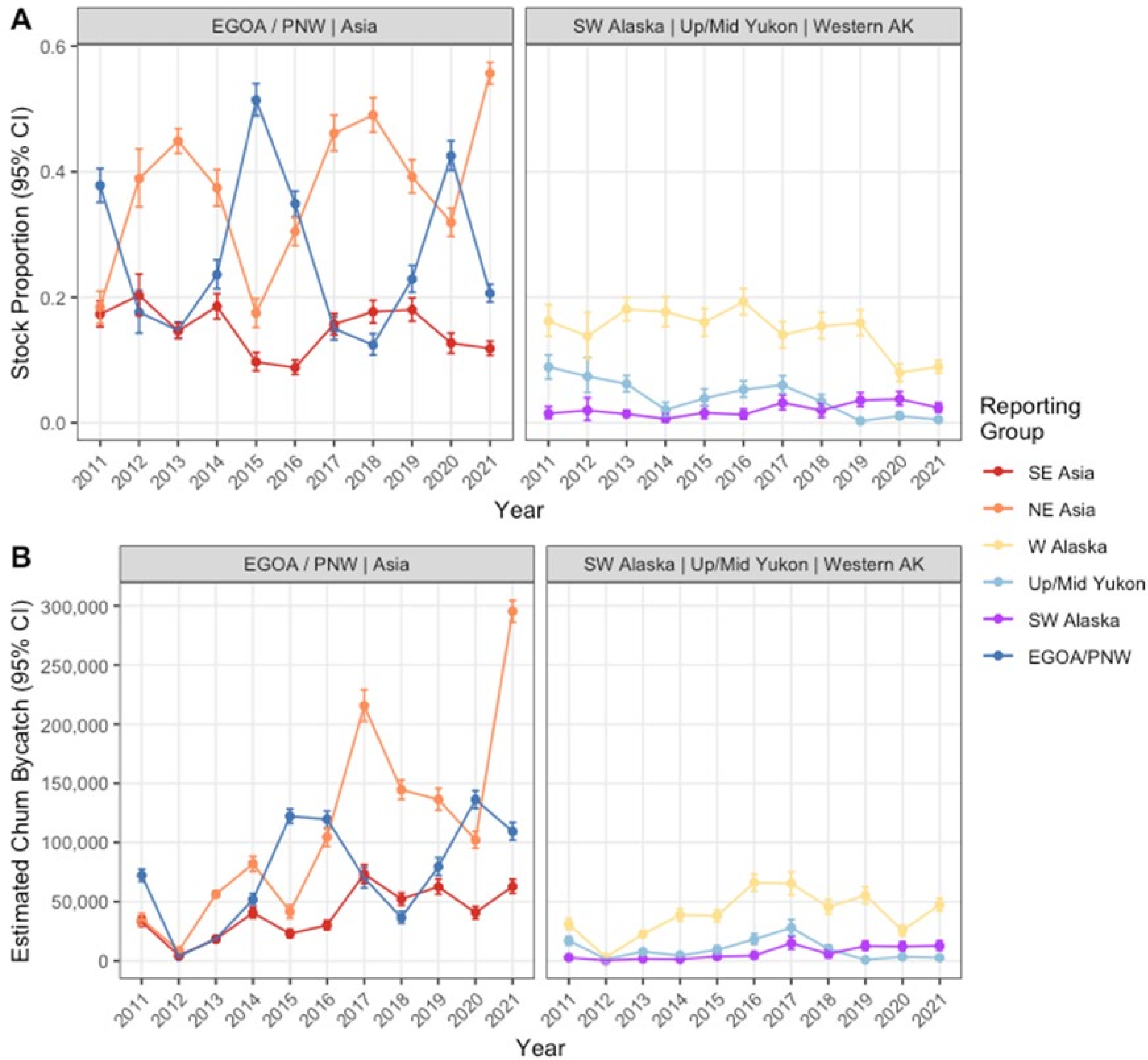


**Figure 3-3 Annual bycatch estimates of B-season chum salmon bycatch from 2011 to 2021; (A) stock proportions with 95% credible intervals and (B) estimated number of chum salmon with 95% credible intervals.**

The relative proportions of the six reporting groups used for analysis of chum bycatch vary substantially across years due to a number of factors including relative run strengths and the timing and location of fishing effort (Figure 3-3). The largest variation is observed in the two reporting groups that contribute the most to the bycatch, NE Asia (average contribution = 37%) and EGOA/PNW (average contribution = 27%). The relative proportions of these two groups appear to be largely associated with the timing of bycatch, with larger proportions of EGOA/PNW fish captured when fishing effort is later. For example, bycatch in 2015 and 2020 largely occurred late in the season, and these two years had the highest contribution of EGOA/PNW fish encountered over the last decade. The proportions of southwest Alaska stocks are relatively low (2%) but appear to have been increasing slightly over the last few years. The proportions from the southeast Asia reporting group have been relatively stable across time with an average of 15%.

## 3.1 Variation in space and time

Genetic analyses have been conducted at multiple spatial and temporal scales, from individual hauls, to four clusters across the Bering Sea analyzed for early and late time periods, to aggregates spanning full years (described above). Here, we begin by describing trends at the individual haul scale and increase in spatial and temporal scope.

*Haul scale*: In July of 2021, three experimental trips were conducted with a trawl equipped with an excluder device (Figure 3-4 N. Yocum RACE division). These analyses provide insight on whether individual hauls are typically comprised of a single stock group or are mixtures or reporting groups and more reflective of the stock composition in a given area and time. Two very important insights from these analyses are that (1) stocks are relatively well mixed even at the haul level and (2) stock proportions at the individual haul level appear to be similar to stock proportions from samples taken across a much broader area. Specifically, samples at the individual haul level display similar stock proportions to those taken in 6 ADF&G statistical areas, an area of approximately 21,000 km2 and sampled over 2 months (stat weeks 25-32). These results were consistent with analyses of excluder device samples from 2015 in which each haul was a mix of stocks and generally more similar to the overall bycatch samples pooled across larger areas and time periods (Kondzela et al, 2017).

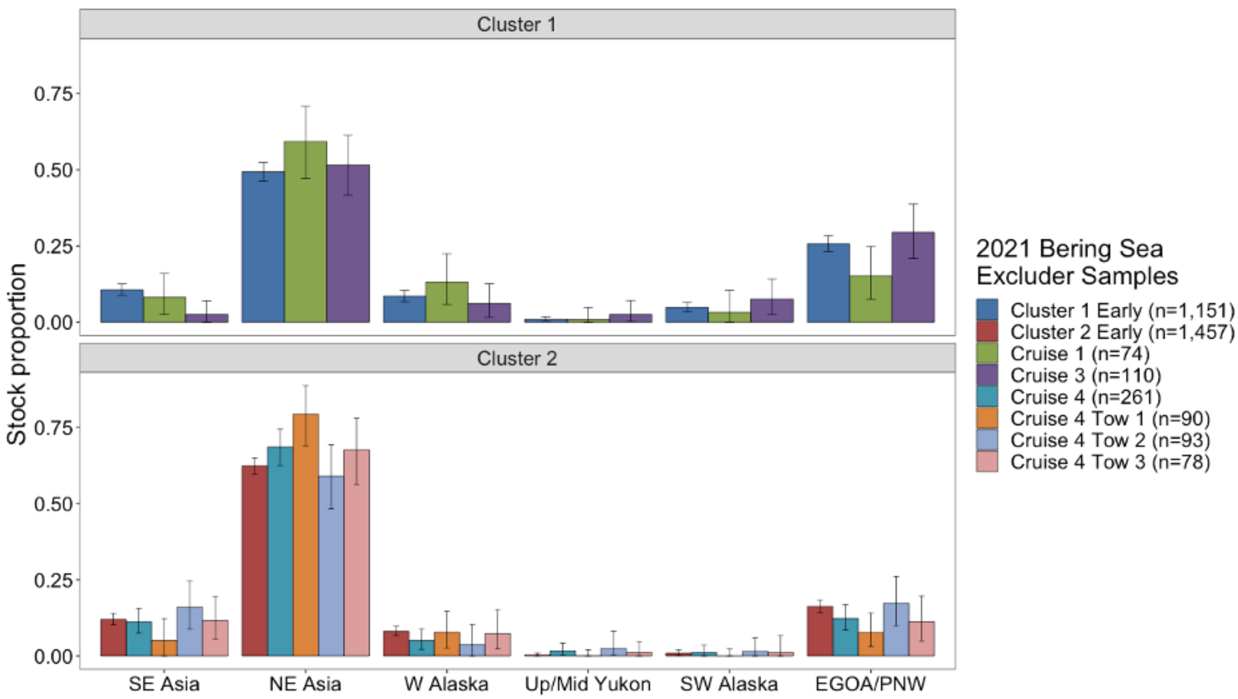


**Figure 3-4 Stock composition estimates for chum salmon caught in experimental salmon excluder device cruises from the Bering Sea in 2021. Sample sizes for mixture analysis are in parentheses**

*Cluster scale*: The ABL genetics program has previously separated the Bering Sea into finer-scale spatial strata (4 clusters of ADF&G statistical areas) and incorporated temporal stratification (Early and Late) to evaluate the spatio-temporal stock specific contributions Figure 3-5). The NE Asia reporting group contributes in high proportions to bycatch from all four spatial clusters in both the early and late time periods. The SE Asia reporting group appears to disperse into the EBS less than the NE Asia reporting group, making up approximately the same proportion of mixtures in the western most cluster (cluster 4) in the early and late time period, but showing a drastic decrease in their contribution to bycatch mixtures further east. They typically comprise a larger proportion of the early mixtures compared to later bycatch mixtures. The W. Alaska reporting group shows the opposite spatial pattern, contributing a larger proportion to mixtures further east, but a similar temporal pattern with higher contributions earlier in the season. The Up/Mid Yukon and SW Alaska regional groups contribute relatively little comparatively and their high variability among years precludes the inference of strong spatiotemporal trends. Generally, these stocks contribute more to mixtures in the eastern portion of the EBS. The E GOA/PNW regional group contributes relatively little to mixtures in the Western portion of the EBS and large proportions to bycatch mixtures from the central and eastern areas, particularly in the later time period.

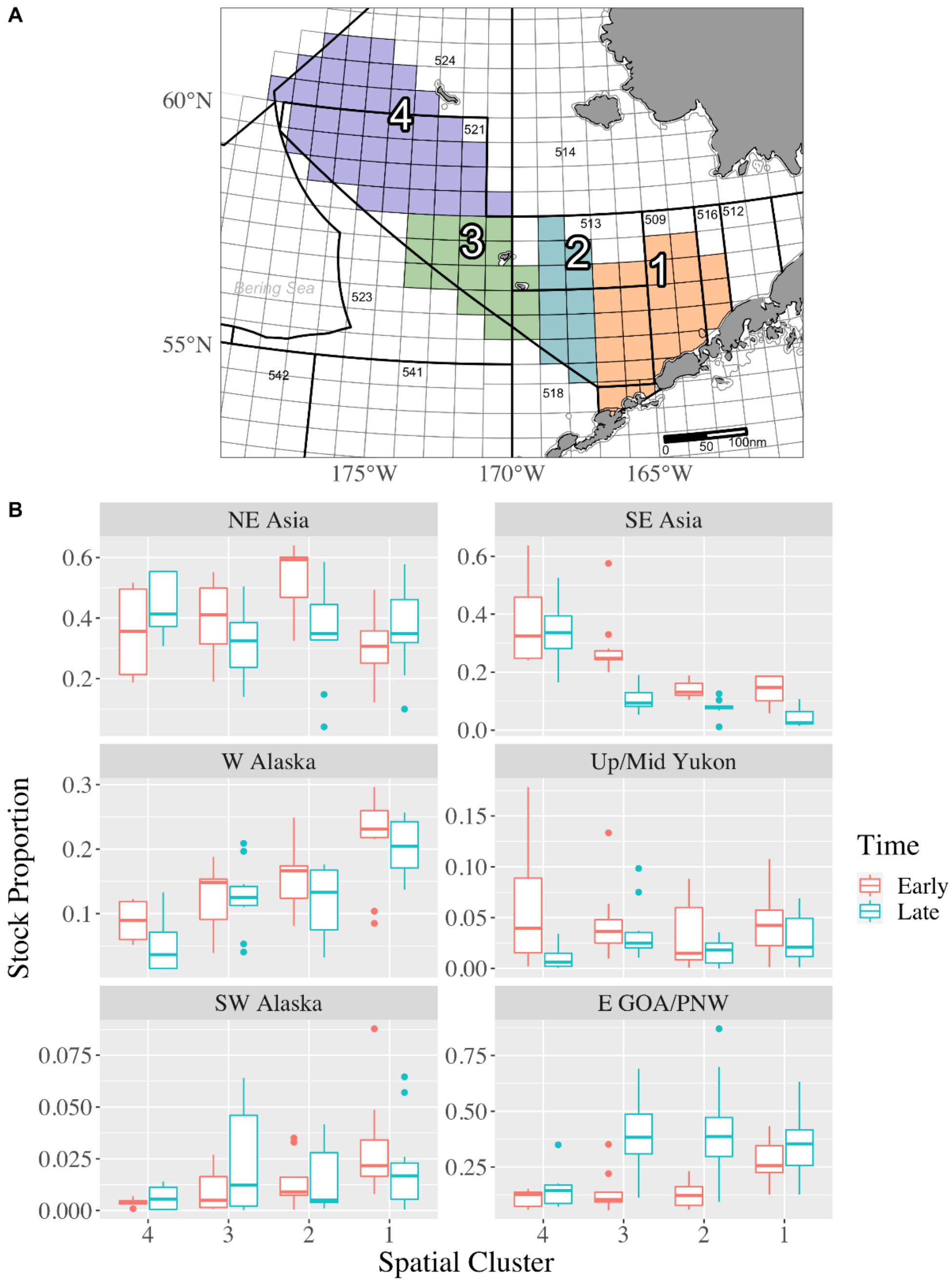


**Figure 3-5 Spatiotemporal variability in regional group contributions to chum salmon bycatch from 2011 to 2021. (A) Four spatial clusters of ADF&G statistical areas in which chum salmon were collected from the Bering Sea, B-season pollock fishery in at least one year from 2011 to 2021. (B) Stock composition estimates for each of the 6 regional groups plotted for the four spatial clusters and colored by time period (Early: weeks 22-32 and Late: weeks 33-45).**

*Major takeaways:* The long-term spatiotemporal trends in these analyses are marked by variability among and within years. However, consistent patterns can be observed. While stock proportions appear to be similar at the scale of 10s to 1000s of kms and days to months, there are substantial differences in stock proportions at larger spatial and temporal scales (Figure 3-4 and Figure 3-5). In terms of space, chum salmon captured further to the north-west (e.g., west of 170° W) are more likely to be from Asian stocks than chum captured further to the southeast. Additionally, chum captured later in the season are more likely to be from E GOA/PNW. In terms of timing, the most striking trends are the decrease in W. Alaska and SE Asia increase in proportion of E GOA/PNW chum salmon later in the season. Importantly, for the W. Alaska stock, the trend that higher proportions of this stock are encountered further to the Southeast, and, to a lesser extent, earlier in the year, seems relatively consistent.

It is important to note that research on the spatiotemporal trends in chum salmon bycatch is in process and that analyses of extremely fine-scale data (e.g, haul data) is still limited. Additional investigations of available data using a quantitative modeling framework will likely provide additional insights. For example, these types of analyses could identify breakpoint areas where stock compositions change rapidly and this information could be used to help avoid certain stocks (i.e., western Alaska).

# 4 Chum conditions that have changed since 2012

## 4.1 Hatchery releases by Country

Hatchery releases across the Pacific Rim are shown in Figure 4-1 by species and country (NPAFC, 2022).

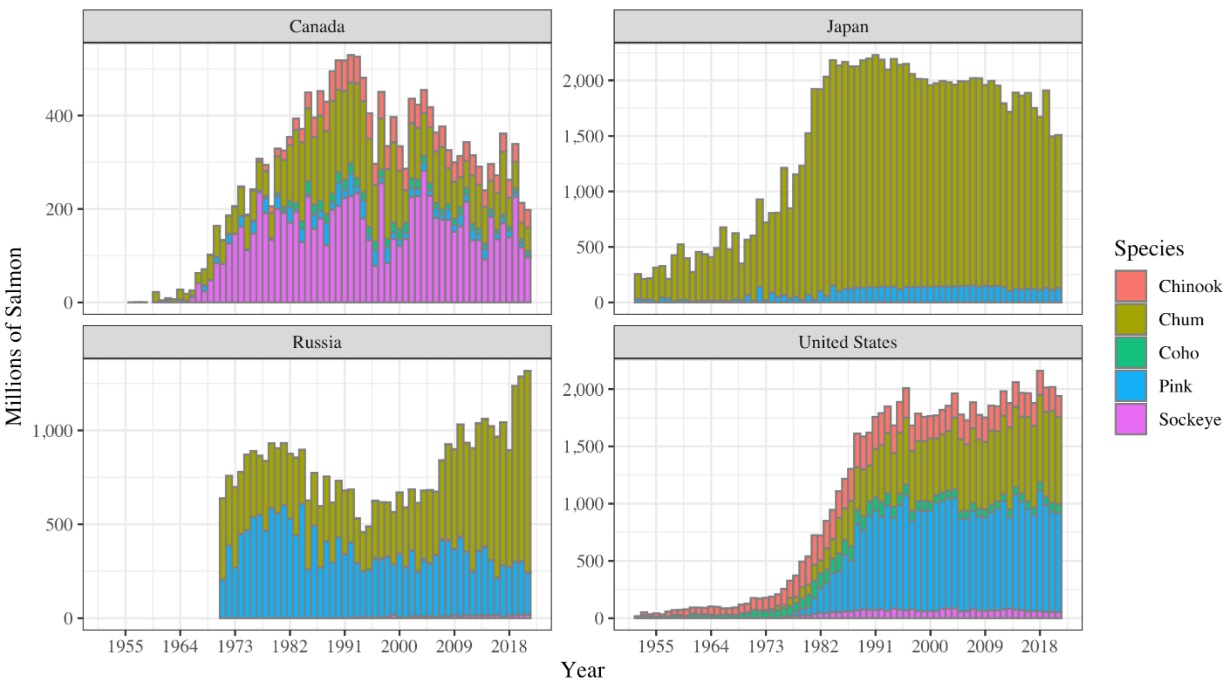


**Figure 4-1 Total number of hatchery salmon (omitting cherry and steelhead) by Japan, Russia, United States and Canada from 1952 to 2021.**

Chum salmon hatchery releases by country have been relatively consistent across the past decade with the exception of Russia, which has increased production by an average of ~0.3 billion over the last 3 years, representing an approximately 43% increase. Japan releases the most hatchery fish (10 year average 1.629 billion), followed by Russia (0.78 billion), and the United States (0.73 billion). Canada and Korea each release less than 0.1 billion.

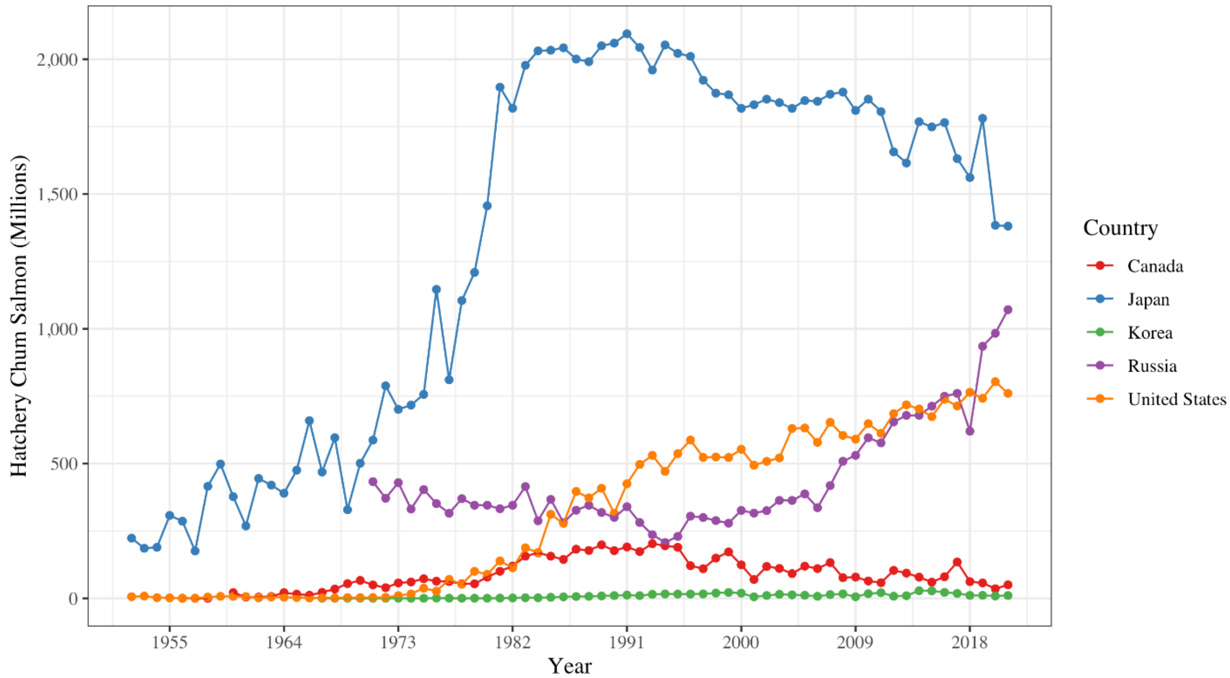


**Figure 4-2 Hatchery chum salmon production around the Pacific rim from 1952 to 2021.**

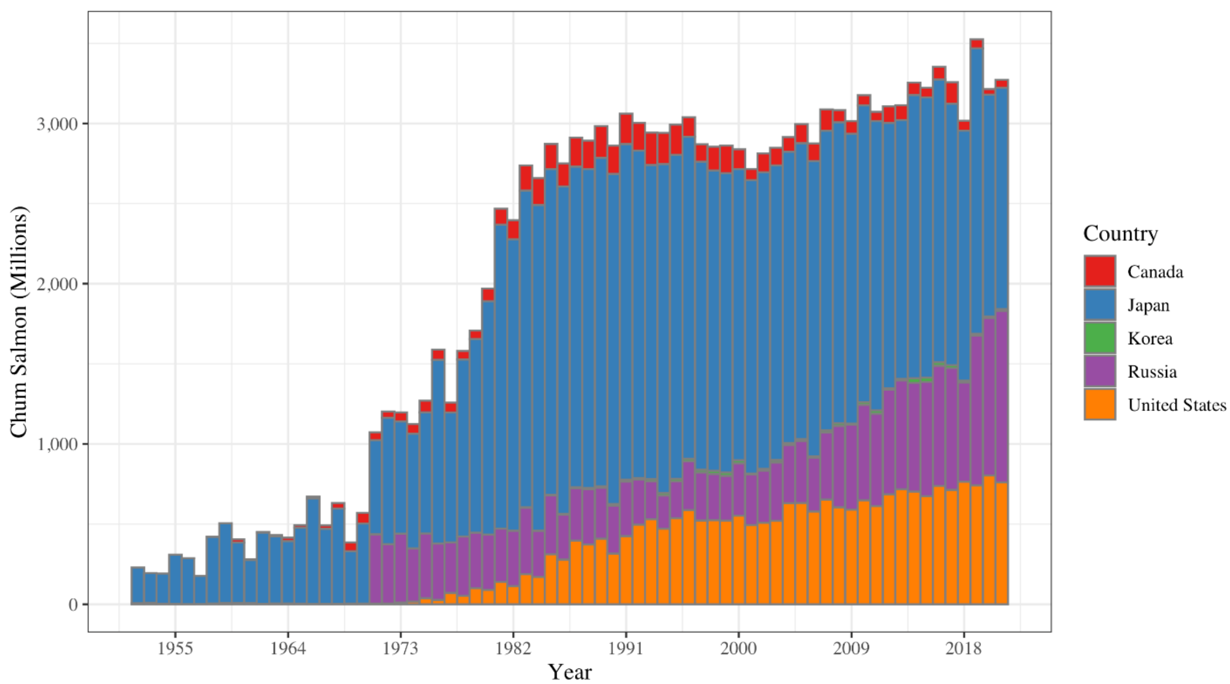


**Figure 4-3 Total hatchery chum salmon production around the Pacific rim from 1952 to 2021.**

## 4.2 Current chum stock status (2022)

Chum salmon (*Oncorhynchus keta*) and Chinook salmon (*Oncorhynchus tshawytscha*) have historically been abundant throughout Western Alaska rivers (Figure 4-4). Western Alaska chum salmon occur from Bristol Bay north through Kotzebue Sound Management areas and include stocks from Bristol Bay, Kuskokwim, Yukon, Norton Sound, and Kotzebue Sound management areas. Major populations of Western Alaska Chinook salmon occur from the Nushagak River north to southeastern Norton Sound. Both Chinook salmon and chum salmon support regionally important commercial, sport and subsistence fisheries although chum salmon are typically not targeted in this region's sport fisheries. Chum salmon traditionally constitute the majority of subsistence salmon harvest in the Arctic-Yukon-Kuskokwim region and have supported the most northerly commercial salmon fishery in Kotzebue Sound. Chinook salmon are a critical component of the subsistence salmon harvest in the Arctic-Yukon-Kuskokwim region, because they tend to migrate earlier than other salmon species, when weather tends to be more conducive to traditional drying preservation methods, and because they tend to migrate farther upriver than many other salmon species. In more interior communities of the larger river systems, Chinook and chum salmon are the only salmon species available.

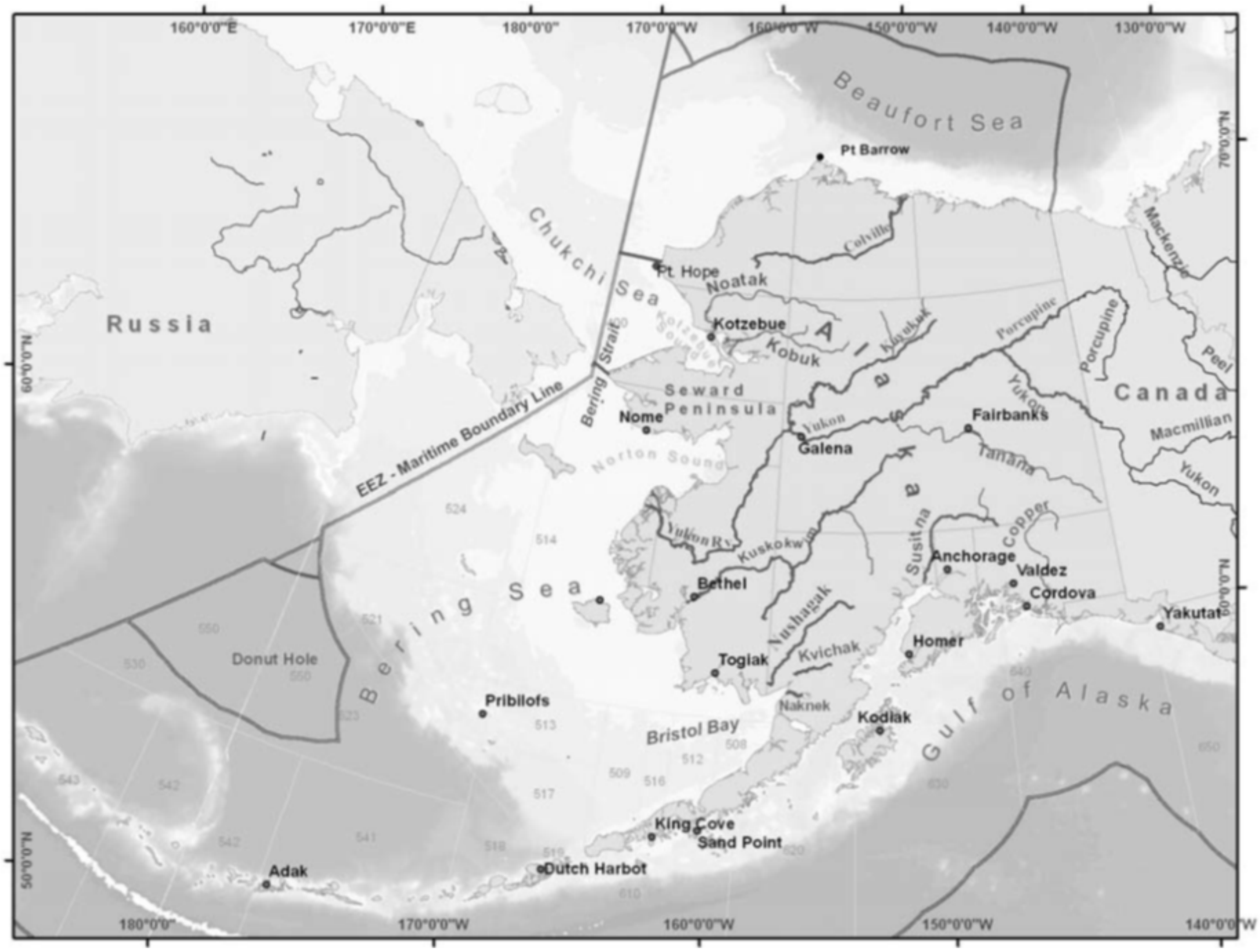


**Figure 4-4 Map of the Bering Sea and major salmon producing rivers (NPFMC 2012).**

## 4.3 Western Alaska chum salmon

In 2020, Western Alaska chum salmon runs declined dramatically, with run sizes similar to those seen in the previous record poor run of 2000 (Figure 4-5). All Western Alaska areas had chum salmon run sizes below recent year averages and many were some of the lowest in the historical dataset (Table 4-1). Commercial chum salmon fisheries were limited for Yukon River summer chum salmon stocks when it became apparent that the run was much poorer than expected; the subsequent Yukon River fall chum salmon commercial fishery was closed. In the Kuskokwim River, there have not been any processors or registered buyers operating in the commercial salmon fishery since 2016 due to Chinook salmon conservation concerns and an accompanying lack of market interest. In the Kuskokwim Bay commercial sockeye salmon (*Oncorhynchus nerka*) fishery, incidental retention of chum salmon was allowed during the 2020 season. Sport fishing for chum salmon was open in all areas of Western Alaska except for Yukon River fall chum salmon. Subsistence chum salmon fisheries were open in all areas but limited in the Yukon River during both the summer and fall chum salmon runs, when runs failed to materialize.

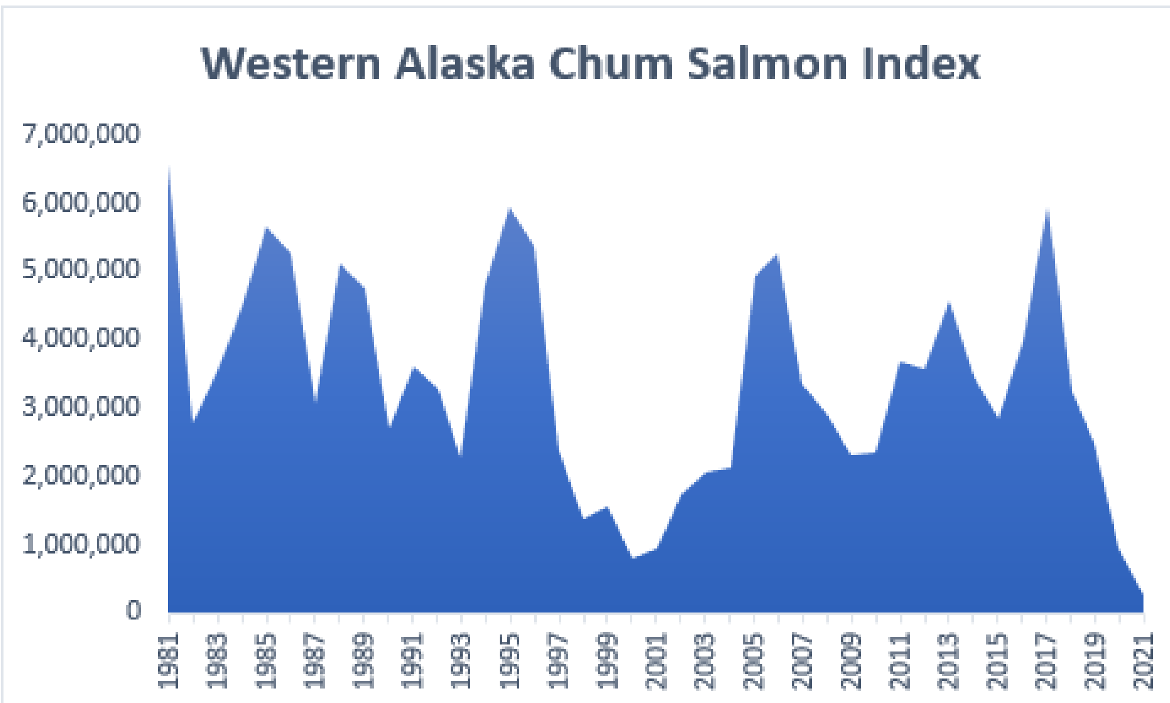


**Figure 4-5 Chum salmon index abundance estimates for Western Alaska stocks**.

The decline in Western Alaska chum salmon abundance was even more extreme in 2021 compared to 2020 across all areas (Table 4-1). An index of Western Alaska chum salmon abundance indicates the 2021 run size was roughly one-third as large as the previous record poor abundance seen in 2000, by far the poorest abundance ever documented (Figure 4-5). Of the 14 chum salmon escapement goals assessed in the Western Alaska region, only two, both in Norton Sound, were met. Chum salmon fishing was closed in multiple areas including fall and summer chum salmon for all user groups (commercial, sport, and subsistence) on the Yukon River; commercial chum salmon fishing in the Kuskokwim River and Bay areas; and sport chum salmon fishing on the Kuskokwim River.

**Table 4-1 Summary of Western Alaska chum salmon stock status, 2020.**

| Stock | Abundance? | Escapement goals met? [a] | Subsistence Fishery? | Commercial Fishery? | Sport Fishery? |
|---|---|---|---|---|---|
| Nushagak River | Below average | 0 of 1 | Yes | Yes | Yes |
| Kuskokwim Bay | Below average | NS[b] | Yes | No | Yes |
| Kuskokwim River | Below average | 1 of 1 | Yes | Limited | Yes |
| Yukon River summer run | Below average | 1 of 1 | Limited | Limited | Yes |
| Yukon River fall run | Below average | 1 of 4[c] | Limited | No | No |
| Norton Sound | Below average | 2 of 4 | Yes | Limited | Yes |
| Kotzebue | Below average | NS[b] | Yes | Limited | Yes |

[a] Includes performance for the subset of goals that were assessed. Some escapement goals were not assessed for various logistical reasons, including funding and weather.

[b] No survey, escapement goal was not assessed.

[c] Includes 2 U.S/Canada goals.

**Table 4-2 Summary of Western Alaska chum salmon stock status, 2021.**

| Stock | Abundance? | Escapement goals met? [a] | Subsistence Fishery? | Commercial Fishery? | Sport Fishery? |
|---|---|---|---|---|---|
| Nushagak River | Below average | 0 of 1 | Yes | Yes | Yes |
| Kuskokwim Bay | Below average | NS [b] | Yes | No | Yes |
| Kuskokwim River | Below average | 0 of 1 | Limited | No | No |
| Yukon River summer run | Below average | 0 of 3 | No | No | No |
| Yukon River fall run | Below average | 0 of 5 [c] | No | No | No |
| Norton Sound | Below average | 2 of 4 | Yes | Limited [d] | Yes |
| Kotzebue | Below average | NS [b] | Yes | Limited | Yes |

[a] Includes performance for the subset of goals that were assessed. Some escapement goals were not assessed for various

[b] No survey, escapement goal was not assessed.

[c] Includes 2 U.S/Canada goals.

[d] Closed in subdistrict 1.

In most of Western Alaska, 2020 and 2021 chum salmon runs were the lowest on record. In 2021, both Yukon River summer and fall chum salmon runs were the lowest in the time series, 1981-2021, with a combined fall and summer chum salmon run size under 250,000 fish (Figure 4-6).

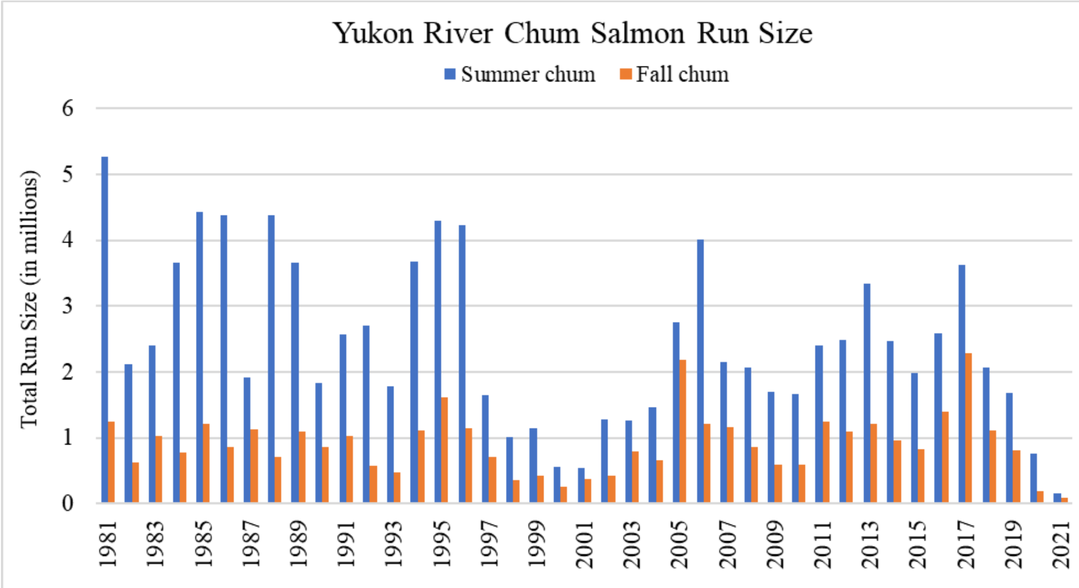


**Figure 4-6 Yukon River chum salmon run size, 1981-2021. Source: Bayesian run reconstructions provided by ADF&G on April 26, 2022.**

While total chum salmon run abundance estimates are not available in the Kuskokwim area, relative indices of abundance are available, including the Bethel Test Fishery in the lower river and the Kogrukluk River weir in the upper river. In 2021, the Bethel Test Fishery cumulative catch per unit effort (CPUE) and the Kogrukluk River weir chum salmon abundance estimates were the lowest in the time series (Figure 4-7).

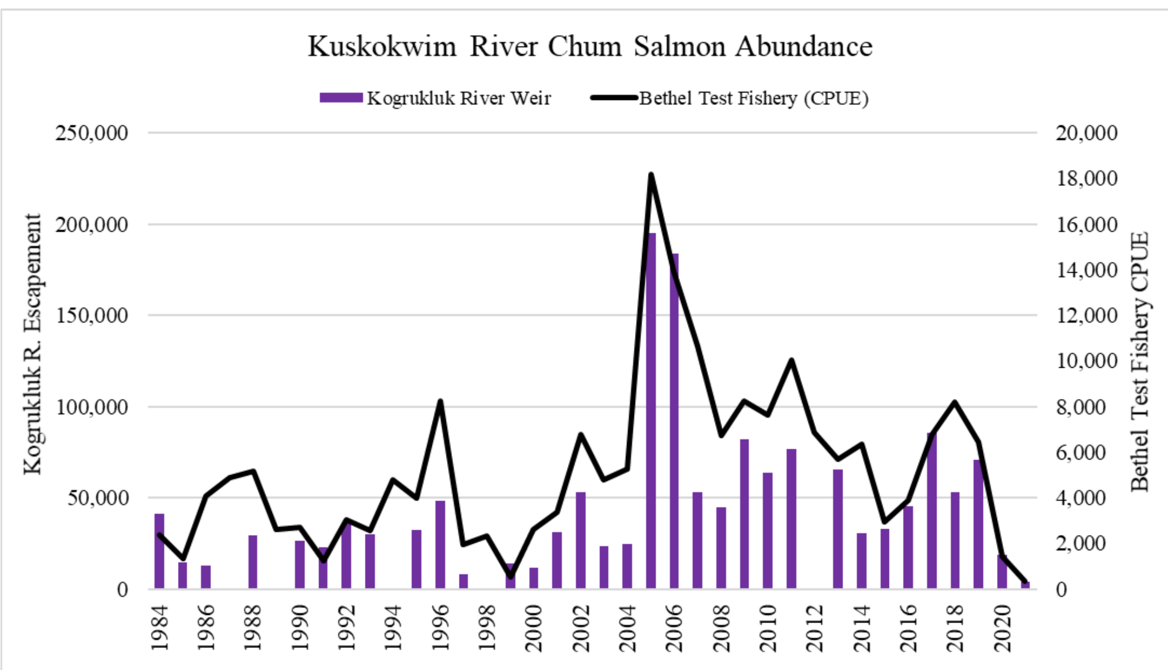


**Figure 4-7 Kuskokwim River chum salmon. Kogrukluk River weir escapement and cumulative CPUE from the in-river Bethel test fishery, 1984-2021.**

In the Norton Sound area, chum escapement goals were met in two of the four rivers in both 2020 and 2021. In 2020, escapement goals were met on the Eldorado River and the Nome River. In 2021, escapement goals were met on the Snake River and Eldorado River; no escapement estimate was made for the Nome River. While important chum salmon stocks exist throughout Norton Sound, the only total run size estimate is for Kwiniuk River chum salmon in northern Norton Sound. Unlike most Western Alaska chum salmon stocks, which have been abundant historically, northern Norton Sound chum salmon abundance has been variable with prolonged periods of poor productivity. Despite this different historical trend, the estimated 2021 Kwiniuk River chum salmon abundance was the poorest in the 1981-2021 time series (Figure 4-8).

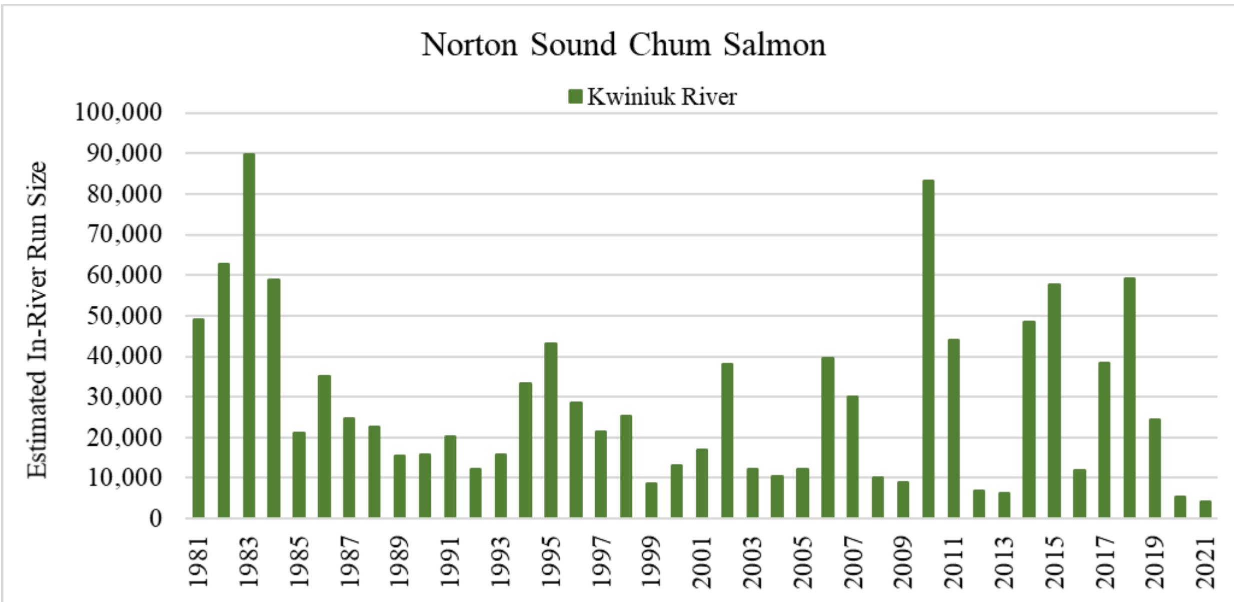


**Figure 4-8 Estimated run size for the Kwiniuk River chum salmon in the Norton Sound area, 1981-2021.**

## 4.4 Stock status of chum stocks in 2012

The 2012 Chum PSC analysis provided an overview of statewide stock status in 2011 as compared to 2010. Focusing on a summary of western Alaskan chum stocks for 2011, average to above average run sizes were seen in Kuskokwim, Yukon, Kotzebue rivers while in Norton Sound, the eastern and northern Norton Sound chum stocks saw above average run sizes in 2011, however Northern Norton Sound remained a Stock of Yield concern. Subsistence and commercial fisheries occurred in all river systems, however the summer chum run Yukon commercial fishery was limited by low returns of Chinook salmon. Sport fisheries were allowed on all chum stocks except chum salmon in the Nome subdistrict of Northern Norton Sound. Escapement goals were met in most river systems.

**Table 4-3 Summary of western Alaskan chum salmon stock status 2011.**

| Chum salmon stock | Total run size? | Escapement goals met?[1] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Below average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim Bay | Average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim River | Above Average | 2 of 2 | Yes | Yes | Yes | No |
| Yukon River summer run | Above Average | 2 of 2 | Yes | Yes, but limited by low Chinook | Yes | No |
| Yukon River fall run | Above average | 7 of 8 | Yes | Yes | Yes | No |
| Eastern Norton Sound | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Northern Norton Sound | Above average | 7 of 7 | Yes | Yes | Yes, except for Nome Subdistrict | Yield concern (since 2007) |
| Kotzebue | Above average | No surveys in 2011 | Yes | Yes | Yes | No |

[1] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions.

In comparison to 2011, in 2010 all western Alaskan chum stocks exhibited average to above average abundance except for the Yukon River fall chum salmon, which were below average. Subsistence restrictions were implemented on the Yukon River fall chum run and six of eight escapement goals were achieved. Two of the four escapement goals in the South Alaska Peninsula were not achieved and the area was closed to commercial fishing from August 4 through September 14 due to low escapements of both pink and chum salmon. Norton Sound 2010 chum salmon runs were some of the strongest on record. More southerly stocks in Kuskokwim Bay and Nushagak River showed above average runs from 2008–2010 and the most northerly stocks in Noatak and Kobuk rivers were also above average.

Commercial fisheries occurred in most areas of western Alaska in 2010. Norton Sound, and Kuskokwim Bay had some of the largest chum salmon commercial harvests on record. Two Yukon River (summer run) and Kuskokwim River chum salmon harvests were more modest owing to potential for incidental harvest of weak Chinook salmon stocks and limited processing capacity in the Kuskokwim River. Generally, these were the largest commercial harvests since 1998 for most of western Alaska, and in Norton Sound, since 1986. Commercial fisheries targeting Yukon River fall chum salmon were limited to a late season terminal fishery in the Tanana River, as some restrictions were placed on subsistence fisheries and the sport fishery was closed.

**Table 4-4 Overview of western Alaskan chum salmon stock performance, 2010**

| Chum salmon stock | Total run size? | Escapement goals met?[1] | Subsistence fishery? | Commercial fishery? | Sport fishery? | Stock of concern? |
|---|---|---|---|---|---|---|
| Bristol Bay | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Kuskokwim Bay | Above average | 2 of 2 | Yes | Yes | Yes | No |
| Kuskokwim River | Average | 2 of 2 | Yes | Yes | Yes | Yield concern discontinued 2007 |
| Yukon River summer run | Average | 2 of 2 | Yes | Yes, but limited by low Chinook | Yes | Management concern discontinued 2007 |
| Yukon River fall run | Below average | 6 of 8 | Restrictions | Limited season (Tanana River) | No | Yield concern discontinued 2007 |
| Eastern Norton Sound | Above average | 1 of 1 | Yes | Yes | Yes | No |
| Northern Norton Sound | Above average | 7 of 7 | Yes | Yes | Yes, except for Nome Subdistrict | Yield concern (since 2000) |
| Kotzebue | Above average | 6 of 6 | Yes | Yes | Yes | No |

[1] Some aerial survey-based escapement goals were not assessed due to inclement weather or poor survey conditions.

# 5 Summary and considerations for the Council

In summary for the major sections the Council requested:

1. Overview of Chum bycatch in the pollock fishery and other PSC and incidental catch issues: Trends in chum bycatch have increased in recent years with 2021 representing the second highest historical catch of chum PSC. Chinook PSC has decreased in recent years. Catches of herring have periodically peaked and closed the Herring Savings Area. Catches of squid have increased well above long-term averages in recent years.

2. Bycatch Management of Chum and rationale: Chum bycatch management measures have varied over the years and particularly since Amendment 91 onwards additional effort has been made to adjust measures such that they do not undermine efforts to prioritize bycatch management for Chinook.

3. Genetic stock composition data and spatial-temporal variation: Western Alaska chum (a combination of the W. Alaska and Up/Mid Yukon regional groups) continue to represent a low proportion of the overall stock composition of the bycatch (average 9% over the last two years, 19% from 2011 to 2021) with the Asian component continuing to represent the highest contribution at 52%. Western Alaska chum salmon are encountered more frequently in the Southeast Bering Sea and earlier in the B season, but all major contributing stocks are encountered in all areas. These data indicate that stock specific avoidance is possible but will not be 100% effective, and that avoidance of western Alaska stocks may be difficult for the shoreside fleet as they are relatively limited to the southeastern Bering Sea. Future research developing stock-specific distribution models could aid in stock-specific avoidance. Hatchery releases by country have been relatively consistent across the past decade with the exception of Russia, which has increased production over the last 3 years. Japan continues to release the most hatchery fish of all countries.

4. Western Alaskan chum stock status: Stock status for western Alaskan stocks remains poor and has declined across all stocks in recent years and since previous consideration of management measures in 2012.

Moving forward:

The Council will review information in this paper as well as other requested aspects of the Council's June 2022 motion including recommendations by the new Salmon Bycatch Committee as well as those resulting from the State of Alaska Bycatch Taskforce. If the Council chooses to initiate some additional management action for chum salmon bycatch in the EBS pollock fishery, they may choose to develop a problem statement similar to previous analyses and begin the process of developing appropriate management alternatives to address that problem statement. There are a range of bycatch management measures that can be considered. In the past for salmon and other PSC species these have included time and area closures, hot spot management, industry avoidance measures, and PSC limits.

As discussed in conjunction with the June 2022 salmon bycatch considerations, analyses related to the impact of chum salmon bycatch on western Alaskan salmon stocks will be at an aggregate level due to the geographic level of stock composition estimates (as discussed in Section 3). While it is possible to do a coarse estimate of an AEQ, or the adult equivalent of the number of chum salmon caught as PSC that would have returned to Western Alaska rivers, several assumptions would need to be made where data are not available (i.e., maturity and natural mortality rate).

However, the number of adult equivalent chum salmon returning to the river is not a complete impact analysis. For a full impact analysis, analysts must calculate an 'impact rate' of PSC on chum salmon stocks as has been done for Chinook (see June 2022 Chinook salmon AEQ update). Calculating this impact rate for the W. Alaska stock group is not possible at this time for reasons that are described below. Future ability to estimate impact rate for the W. Alaska stock group may be possible (see potential future solutions section below).

Run reconstructions that provide an estimation of total run size are more limited for chum salmon than for Chinook salmon in Western Alaska. A scientifically defensible run reconstruction includes a fairly thorough estimate of escapements (the number of fish that are not caught by fisheries and contribute to the spawning population) and harvests. Run reconstructions are currently only available for Yukon River summer and fall chum salmon and Kwiniuk River chum salmon. This excludes large populations in Kuskokwim River and throughout Bristol Bay, Kotzebue Sound, and Norton Sound. Unlike Chinook salmon, the lack of run reconstructions for large populations of W. Alaska chum salmon means that a good approximation of total W. Alaska chum salmon abundance cannot be provided at this time.

While some indices of abundance are available for chum salmon populations without run reconstructions (e.g., aerial surveys, weirs, counting towers, sonars, harvest), a simple summation of these indices of abundance is not equivalent to a run reconstruction and would not provide a scientifically defensible accounting of the total abundance of chum salmon for the W. Alaska stock reporting group. Indices may only provide a partial accounting, with some unmeasured and uncertain components of the run missing, or they may be designed to only provide relative abundance rather than absolute abundance information. For example, aerial surveys provide a relative index of abundance because they assess a standardized portion of the spawning area and not the entire spawning area; they do not provide a census or estimate of total abundance. As another example, in large river systems, it may only be possible to operate sonars upriver of important chum salmon habitats, leaving spawning stretches of the population downstream from the sonar entirely unassessed.

Some of these challenges for estimating total run abundance in the many large river systems in Western Alaska have been overcome for Chinook salmon in this region thanks to a tremendous amount of funding and years of effort to create scientifically defensible run reconstructions. Improving and refining these run reconstructions and developing run reconstructions for other species is an ongoing effort, and this work is prioritized based on current information needs for salmon fishery management. It would be possible to provide a reasonable total estimate of abundance for the W. Alaska chum salmon stock reporting group, but this would require substantial time, staff resources, and the development of a number of important assumptions.

The lack of run reconstructions is an impairment beyond abundance estimates as these run reconstructions also include unbiased estimates of ages at maturity for each run year. Since different stocks have different maturity patterns and trends, this information is important to AEQ and impact rate analyses. Less information on in-river age estimates is available for the W. Alaska chum salmon reporting group to underpin maturation estimates than for Chinook salmon stocks.

Potential future solutions:

- Request a minimum aggregated run size estimate for the W. Alaska chum salmon genetic reporting group. A minimum W. Alaska chum salmon run size estimate would be less precise than the run reconstruction-derived abundance estimates for Chinook salmon, and could include unknown biases based on assumptions used to develop the estimate. However, it would allow a maximum impact rate to be estimated. This is not a small request as information is not readily available to be used for an impact analysis and would require a number of assumptions and intermediate analyses to construct. This would require significant ADF&G staff work and would need to be prioritized over current staff efforts, without knowing how good the end result (product) would be.

- A possible solution for a lack of age at maturity information (without incurring significant staff resources) would be to use a range of high and low estimates that could bracket assumed “true” maturation rates across Western Alaska rivers as a proxy for more precise information.

An AEQ and impact rate could be estimated for the Upper/Mid Yukon chum salmon stock reporting group (Yukon River fall chum salmon) since this is a genetically distinguishable stock and has an existing estimate of total run size that can be used for impact rate analysis. It should be noted that this is a small population and therefore, using an impact rate estimate for this stock as a proxy for impacts to all Western Alaska chum salmon may not be appropriate.

These considerations should be taken into account when moving forward with any analyses related to potential management measures for chum salmon bycatch.

# 6 References

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# Appendix A: Council motion June 2022

**D-1 Salmon reports**
**Council Motion**
**June 13, 2022**

The Council acknowledges the western Alaska salmon crisis and the impact it is having on culture and food security throughout western Alaska. Science indicates climate as the primary driver of poor salmon returns in western Alaska. The Council commits to continued improvements in bycatch management with a goal of minimizing bycatch at all levels of salmon and pollock abundance. Towards this end,

- **The Council requests the pollock industry implement additional chum salmon bycatch avoidance measures beginning immediately**. The Council recognizes that these new chum salmon avoidance measures may have limited ability to target the proportion of chum salmon (9%) destined to return to western Alaska but can reduce overall salmon bycatch.
- **The Council requests a discussion paper updating the 2012 analysis of chum salmon bycatch**. The paper should include:
  - updated chum salmon bycatch and genetic stock composition data, including a discussion of how the genetic composition data vary across space and time;
  - a description of the Council's rationale for establishing the current Bering Sea chum salmon bycatch management program;
  - a discussion of tradeoffs in the Bering Sea pollock fishery associated with avoiding different PSC species (e.g., chum salmon, Chinook salmon, herring); and
  - a summary of conditions that have changed since the 2012 analysis (e.g., increased Asian hatchery releases and western Alaska chum salmon stock status).
- **The Council intends to consider the findings and recommendations of the State of Alaska's Bycatch Task Force as it considers how to improve salmon bycatch management**.
- **The Council intends to collaborate with western Alaska salmon users by forming a working group of Tribal members, scientists, industry representatives, and other experts.** The working group will review and provide recommendations on: 1) the discussion paper on chum salmon bycatch referenced above; 2) the findings and recommendations from the State of Alaska's Bycatch Task Force and the work of the Western Alaska salmon subcommittee; and 3) current information, including Local, Traditional, and Subsistence knowledge, and needed research to determine what is driving western Alaska salmon declines.
- **The Council prioritizes research on Bering Sea salmon**.
  - The Council supports NOAA and ADF&G prioritizing development of models to predict where and when specific salmon stocks will be located in the Bering Sea. This work will inform development of management measures focused on avoiding western Alaska salmon bycatch in the pollock fishery.
  - The Council supports and prioritizes work to reduce the time for analysis of genetic data, increased survey work in the nearshore environment in the Bering Sea as proposed by ADF&G, and continued industry innovation on gear modifications that may reduce bycatch.