2023 Genetic Stock Composition Analysis of Chinook Salmon from the Prohibited Species Catch of the Bering Sea and Gulf of Alaska Walleye Pollock Trawl Fishery

Preliminary Report

P. Barry, K. D'Amelio, J. Whittle, J. Musbach, J. Cornett, J.Whitney, & W. Larson

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Executive Summary[1]

This report provides genetic stock identification results for Chinook salmon Prohibited Species Catch (PSC) samples collected in the 2023 Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) trawl fisheries for walleye pollock (*Gadus chalcogrammus*). All samples were genotyped for 37 single nucleotide polymorphism markers from which stock contributions were estimated using a range-wide Chinook salmon baseline developed by the Alaska Department of Fish and Game (Templin et al. 2011). In the BSAI, genetic samples were collected using a systematic random sampling protocol where one out of every 10 Chinook salmon encountered was sampled. The Chinook salmon PSC in the BSAI was 11,855 fish, down from the long-term average (32,684 1991-2022). Based on analysis of 1,106 Chinook salmon bycatch samples, Coastal Western Alaska (47.2%), North Alaska Peninsula (24.0%) and British Columbia (21.4%) dominated the bycatch with smaller contributions from West Coast US (5.5%) and Northwest GOA (0.9%). Temporal groupings within the pollock "A" and "B" seasons revealed changes in stock composition over the course of the year. The relative percentages by region were greater during the A-season than during the B-season for Coastal Western Alaska (50.0% and 30.4%, respectively) and North Alaska Peninsula (25.6% and 8.9%, respectively) while the relative percentages by stock were less during the A-season than during the B-season for West Coast US stocks (4.2% and 18.9%, respectively) and British Columbia (18.8% and 38.7%, respectively). Despite increasing proportions for these southern stocks, the majority of chinook salmon of southern origin were caught during the A-season because bycatch was nearly ten times larger in the A-season compared to the B-season. In 2023, genetic samples were collected from Chinook salmon taken in the bycatch of the GOA pollock trawl fisheries using a simple random sample protocol with trip being the primary unit. The Chinook salmon PSC in the GOA was 18,302 fish, up from the long-term average (14,730 1991-2022). Based on analysis of 3,138 genetic samples, the vast majority of Chinook salmon that were caught as bycatch in the GOA pollock trawl fishery originated from three regions South and East of the Alaska Peninsula with the British Columbia region contributing the most (42.1%), followed by the West Coast US (30.1%), and Coastal Southeast Alaska (17.5%) regions. This pattern is consistent for samples analyzed across finer-scale area and time strata within the GOA.

[1] *Disclaimer* - These represent preliminary analyses of the 2023 Chinook Salmon genetic data. All estimates are subject to change. Numerous plots in this report display fishery information. All data are non-confidential. Data have been aggregated and any data point with fewer than three unique vessels has been removed.

Bering Sea pollock trawl fishery

Pacific salmon (*Oncorhynchus* spp.) are prohibited species in the federally managed Bering Sea groundfish fisheries, which are subject to complex management rules (NPFMC 2017a). In part, these rules are designed to reduce prohibited species catch, hereafter referred to as "bycatch." Understanding the stock composition of Pacific salmon caught as bycatch in these fisheries is important since they take place in areas that are known feeding habitat for multiple brood years of Chinook salmon (*Oncorhynchus tshawytscha*) from many different localities in North America and Asia (Myers et al. 2007, Davis et al. 2009). Chinook salmon are economically valuable and highly prized in commercial, subsistence, and sport fisheries. Determining the geographic origin of salmon caught in federally managed fisheries is essential to understanding the effects that fishing has on Chinook salmon stocks, especially those with conservation concerns (NPFMC 2017a). This section of the report provides genetic stock identification results for the Chinook salmon bycatch samples collected from the Bering Sea walleye pollock (pollock) (*Gadus chalcogrammus*) trawl fishery. National Marine Fisheries Service (NMFS) geographical statistical areas (NMFS area) associated with the Bering Sea groundfish fishery (NMFS areas 509-524) and Alaska Department of Fish and Game (ADF&G) statistical areas grids are shown in Figure 1 and are used to describe the spatial distribution of the Chinook salmon bycatch and genetic samples. All analyses used a single nucleotide polymorphism (SNP) baseline provided by ADF&G (Templin et al. 2011; Appendix 1), the same baseline used to estimate previous stock compositions of samples from the Chinook salmon bycatch of the federally managed BSAI trawl fisheries.

Amendment 91 to the North Pacific Fishery Management Council (NPFMC) Fishery Management Plan (FMP) for groundfish of the BSAI Management Area was enacted in 2010 and included retention of all salmon caught in the pollock fishery. In 2011, a systematic random sampling design recommended by Pella and Geiger (2009) was implemented by the Alaska Fisheries Science Center's (AFSC) Fisheries Monitoring and Analysis Division's (FMA) North Pacific Groundfish and Halibut Observer Program (Observer Program) to collect genetic samples from one out of every 10 Chinook salmon encountered as bycatch in the Bering Sea pollock fishery.

Catch Summary

In 2023, 11,855 Chinook salmon were caught in the BSAI pollock trawl fisheries (NMFS 2023). This was substantially lower than the average bycatch from 1991 to 2022 (32,684) (Figure 1). While this represented a slight increase in bycatch from the previous year, it is still lower than the average bycatch post-Amendment 91 (18,864). The majority of the bycatch of Chinook salmon occurred in the A-season when 10,685 Chinook salmon were caught compared to the 1,170 caught in the B-season.

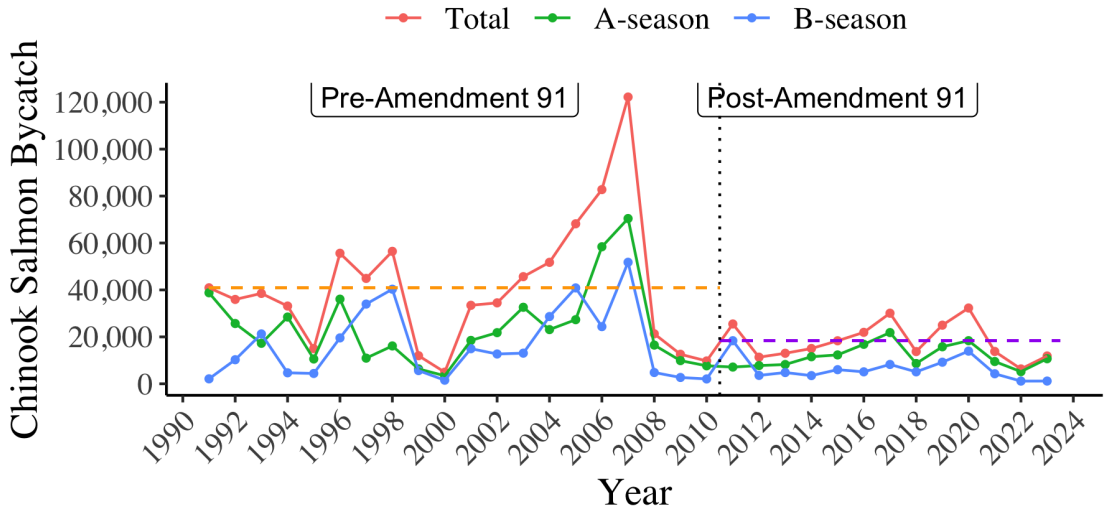

Figure 1: Chinook salmon prohibited species catch (PSC) for the Bering Sea and Aleutian Islands (BSAI) pollock-directed trawl fisheries for the A, B, and both seasons. The horizontal dashed lines represent the mean PSC pre- and post-Amendment 91.

Spatial & Temporal Trends

There were clear spatial differences in the distribution of the Chinook salmon bycatch by season. In the A-season, most of the bycatch occurred within, and just outside of, the eastern portion of the catcher vessel operational area (CVOA; Figure 2 - shaded green box). Additionally, some bycatch occurred around the Pribilof Islands. In the B-season, bycatch was smaller in magnitude and distributed along the shelf to 179°W.

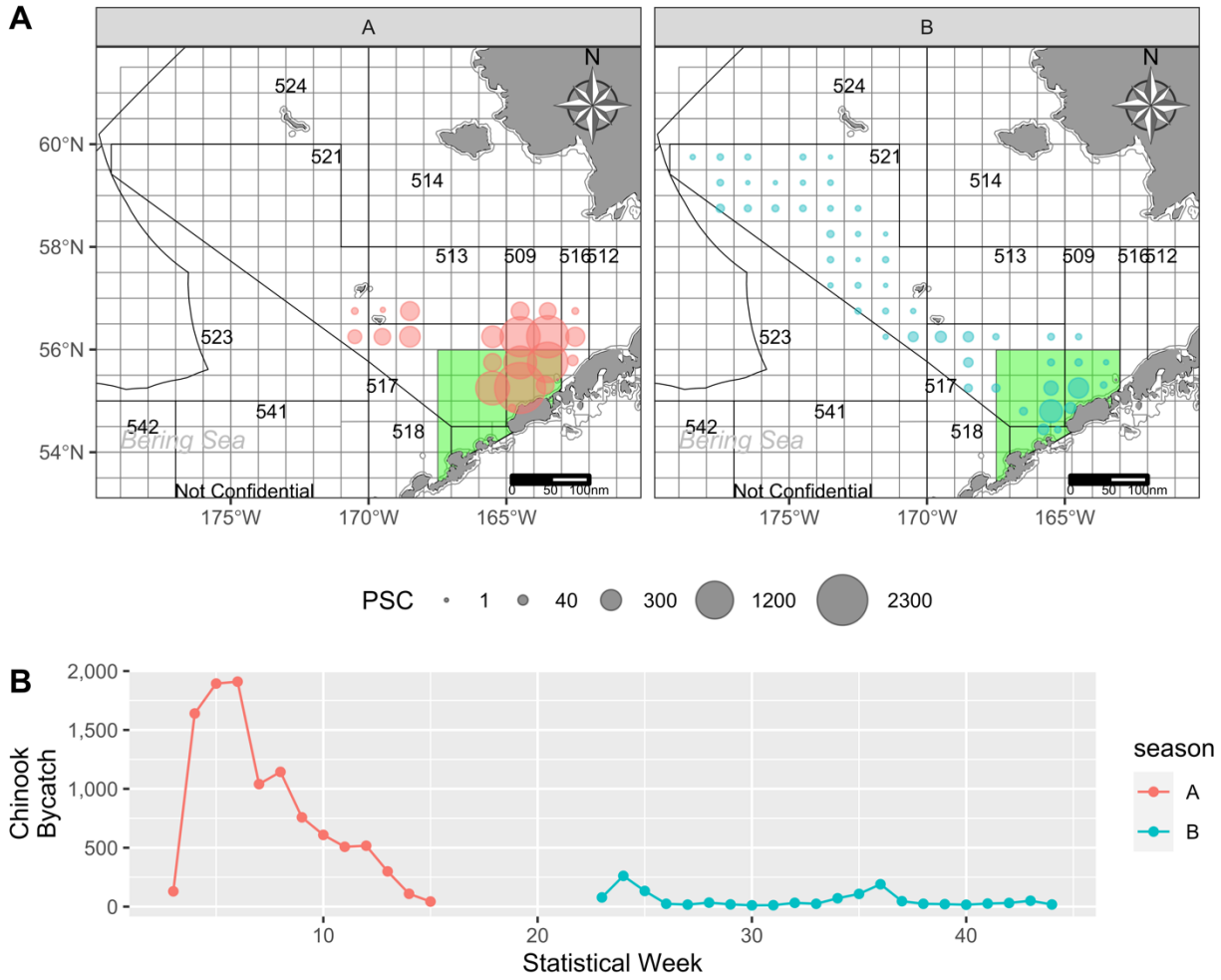

Figure 2: Location and timing of Chinook salmon bycatch in the Bering Sea & Aleutian Islands pollock trawl fishery in the A- and B-seasons. (A) Map of Chinook salmon bycatch by NMFS management areas (outlined in black) and ADF&G groundfish statistical areas (outlined in light gray) where circles represent the amount of total bycatch. The catcher vessel operational area is shaded green. (B) Timing of the Chinook salmon bycatch by statistical week.

The timing of the Chinook salmon bycatch occurred early with the majority encountered in the first half of the A-season (Figure 2B). In fact, ~50% of the bycatch was taken in three statistical weeks (4-6). After the 8th statistical week, bycatch of Chinook salmon declined throughout the remainder of the A-season. The B-season bycatch was characterized by two peaks in statistical weeks 24 and 36. These peaks did not correspond to increases in Chinook salmon bycatch rates (Chinook salmon bycatch per metric ton of pollock). The start and end of the B-season were characterized by the highest Chinook salmon bycatch rates. Bycatch rates averaged 0.002 Chinook per metric ton of pollock between statistical weeks 25 and 41, after which it rose to 0.013. This is consistent with the observation that Chinook salmon bycatch rates typically increase when fishing is extended late into the B-season.

Sampling & Genotyping Summary

Caudal fin clips and scales were collected from Chinook salmon bycatch by the Observer Program throughout 2023 for analysis at AFSC's Auke Bay Laboratories (ABL). Caudal fin clips were dried, stored in labeled coin envelopes, and shipped to ABL for analysis. Scales were collected as an additional source for genetic analysis and aging.

In 2023, of the 11,855 Chinook salmon that were taken in the bycatch of BSAI pollock trawl fisheries (NMFS 2020), 1,170 were sampled by the Observer Program; of those samples, 1,106 were successfully genotyped for an overall genotyped sampling rate of 9.3% (A-season N = 1,002 fish, 9.5% sampling rate; B-season N = 104 fish, 8.4% sampling rate).

Potential biases primarily introduced through spatial and temporal aspects of genetic sample collection from bycatch are well documented and have the potential to affect resulting stock composition estimates (Pella and Geiger 2009). The distributions of 2023 Chinook salmon bycatch genetic samples were evaluated by comparing the collection of genetic samples among NMFS statistical areas and throughout the fishing season (Figure 3).

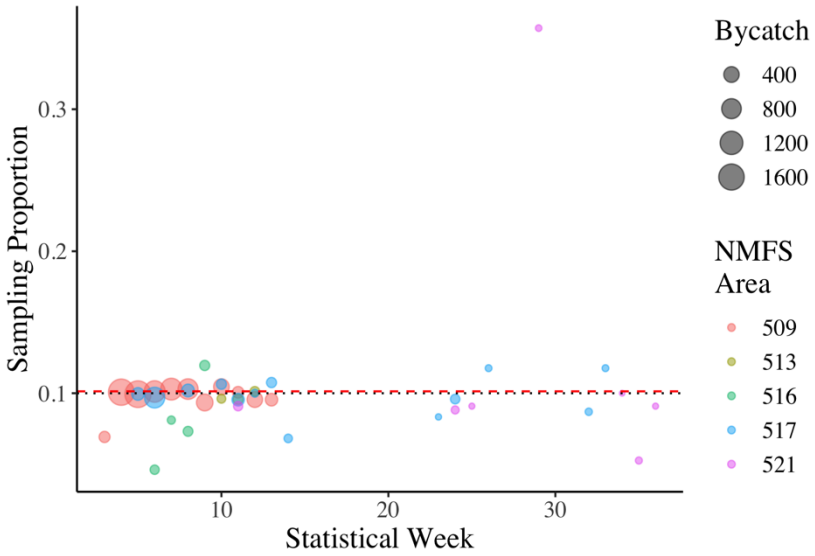

Figure 3: Proportion of BSAI Chinook salmon bycatch sampled for genetic analysis by statistical week and NMFS Statistical Areas. The size of the circles corresponds to the number of fish caught. The red dashed line is the realized mean sampling proportion over NMFS areas and statistical weeks, and the black dotted line is the target of 10%.

The spatial and temporal distribution of the genetic samples from the 2023 Bering Sea pollock fishery were representative of the total bycatch. While there was slight undersampling in some NMFS areas early, and oversampling of NMFS area 521 late, the average sampling proportion was 10.1%.

Genetic Stock Composition

Overall

The stock composition results indicate that 71.5% of the Chinook salmon bycatch from the A- and B-seasons originated from Alaska river systems flowing into the Bering Sea with the largest contributions from Coastal Western Alaska region (47.2%) and the North Alaska Peninsula (24.0%; Table 1). With a total bycatch of 11,855 Chinook salmon, this equates to an estimated 5,596 Coastal Western Alaska and 2,840 North Alaska Peninsula Chinook salmon. The remaining 28.5% were from southern regions with British Columbia (21.4%) contributing the most, followed by the West Coast US (5.5%).

Table 1: Regional stock composition estimates of Chinook salmon from the 2023 Bering Sea and Aleutian Island pollock trawl fishery (PSC = 11,855; n = 1,106). The estimated number of Chinook salmon bycatch, 95% CI for the estimated number, and mean proportion are provided with 95% credible intervals, P = 0 statistic, and the Gelman-Rubin shrink factor (SF).

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-23	0.000	0.000	0.002	0.81	1.00
Coast W AK	5,596	5,167-6,018	0.472	0.436	0.508	0.00	1.00
Mid Yukon	0	0-32	0.000	0.000	0.003	0.81	1.00
Up Yukon	31	10-87	0.003	0.001	0.007	0.00	1.00
N AK Pen	2,840	2,483-3,214	0.240	0.209	0.271	0.00	1.00
NW GOA	105	8-334	0.009	0.001	0.028	0.00	1.01
Copper	13	0-76	0.001	0.000	0.006	0.45	1.00
NE GOA	34	0-95	0.003	0.000	0.008	0.04	1.00
Coast SE AK	44	0-166	0.004	0.000	0.014	0.20	1.00
BC	2,532	2,229-2,850	0.214	0.188	0.240	0.00	1.00
West Coast US	656	490-847	0.055	0.041	0.071	0.00	1.00

Stock composition estimates were mostly similar to the long-term trends observed in prior years (2011-2022; Figure 4). The proportion of Coastal Western Alaska has decreased from a high of 68.0% in 2011 to a low of 23.7% in 2017 and has since increased and has fluctuated around ~47% since 2020. The proportion of the North Alaska Peninsula has increased in recent years, averaging 13.5% between 2011 and 2020 and 31.9% since. Despite the increase in relative proportion for this group, because of the overall declining bycatch numbers, the number of fish has remained consistent averaging 3,160 fish. Coastal Southeast Alaska appears to have gone through three cycles of increase and decrease, but 2023 marks the lowest proportion of this regional group to the bycatch across the time period (0.4%). Southern stock proportions peaked in 2017, with British Columbia accounting for 36.0% of the bycatch and West Coast US representing 18.8%. While the

proportion of West Coast US has since declined to levels similar to pre-2015, in 2023 there was a substantial increase in the proportion of bycatch attributed to British Columbia.

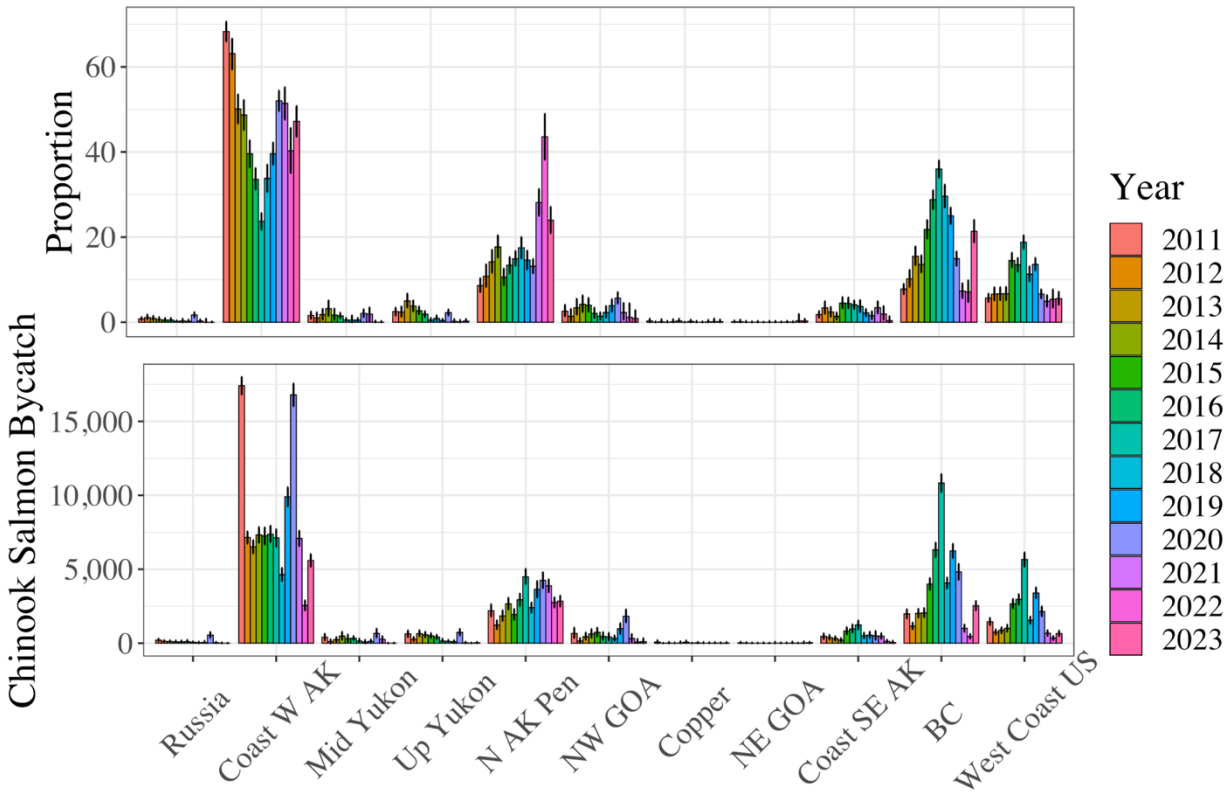

Figure 5: Annual (2011-2023) stock composition estimates (top) and estimated total number of Chinook salmon bycatch (bottom) with their 95% credible intervals from the Bering Sea Chinook salmon bycatch.

In addition to the large decrease in total bycatch numbers between seasons, there was variability in the relative proportion of regional groups contributing to the bycatch between the A- and B-seasons (Figure 6). Coastal Western Alaska decreased from 50.0% to 30.4% while the North Alaska Peninsula declined from 25.6% to 8.9%. Alternatively, stocks from the south showed increases between the A- and B-seasons. British Columbia increased from 18.8% to 38.7% and West Coast US increased from 4.2% to 18.9%.

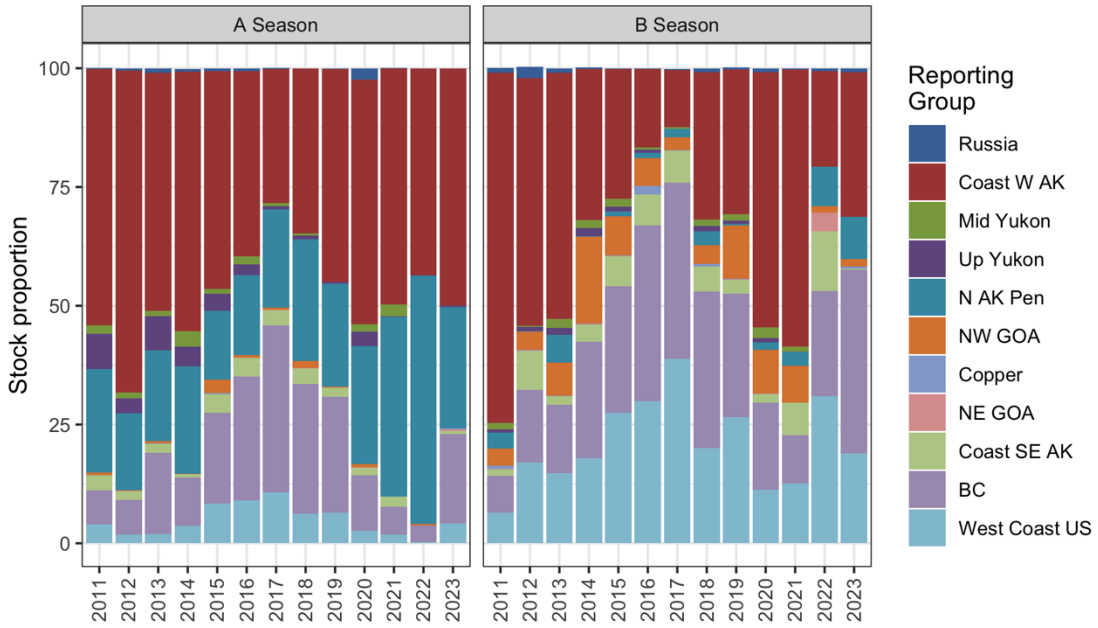

Figure 6: Regional stock composition estimates of Chinook salmon from the 2023 Bering Sea and Aleutian Island pollock trawl fishery (PSC = 11,855; n = 1,106). The estimated number of Chinook salmon bycatch, the 95% CI for the estimated number, mean proportion, 95% credible intervals, median estimate, P = 0 statistic, and the Gelman-Rubin shrink factor (SF).

Season specific stock composition estimates appear to be similar to prior years estimates from 2011 to 2022 (Figure 6) with some exceptions. The contribution of Southeast Alaska stocks in 2023 was the lowest of the time series, 0.6% and 0.2% in the A- and B-seasons respectively. Other stocks show shifts from the prior year, but appear to be relative shifts returning to proportions observed in prior years. Estimates for British Columbia showed a large increase in both seasons from last year, but are similar to proportions from 2016 to 2018. Similarly, the proportion of West Coast US shows an increase from last year in the A-season, but a decrease in the B-season.

Spatial Trends

To evaluate differences in the stock composition of bycatch in different areas within the Bering Sea the bycatch was divided into four subareas based on prior analyses: CVOA, NMFS Statistical Area 509, Northwest (West of 167°W), and Southeast (East of 167°W; Figure 2).

Estimates for the CVOA, NMFS 509 and Southeast (SE) strata are all similar when analyzed for the A- and B-seasons combined (Figure 7; left column). This stems from the fact that there is overlap in these spatial strata, and they make use of overlapping sets of genetic samples within each mixture. By contrast, the Northwest spatial group is composed of less West Coast US (0%) and British Columbia (7.5%) stocks than all other spatial strata considered where West Coast US comprised ~6.0% and British Columbia comprised ~22.0% of the bycatch.

Spatiotemporal Trends

Of the five spatial areas considered (BSAI, CVOA, NMFS Area 509, Northwest, and Southeast; Figure 2), there were sufficient sample sizes to estimate the stock composition for the A- and B-season for three areas: BSAI, CVOA and Southeast. All of these areas displayed a consistent trend of decreasing proportions of Coastal Western Alaska and North Alaska Peninsula stocks and increasing proportions of British Columbia and West Coast US stocks from the A to the B-season (Figure 7).

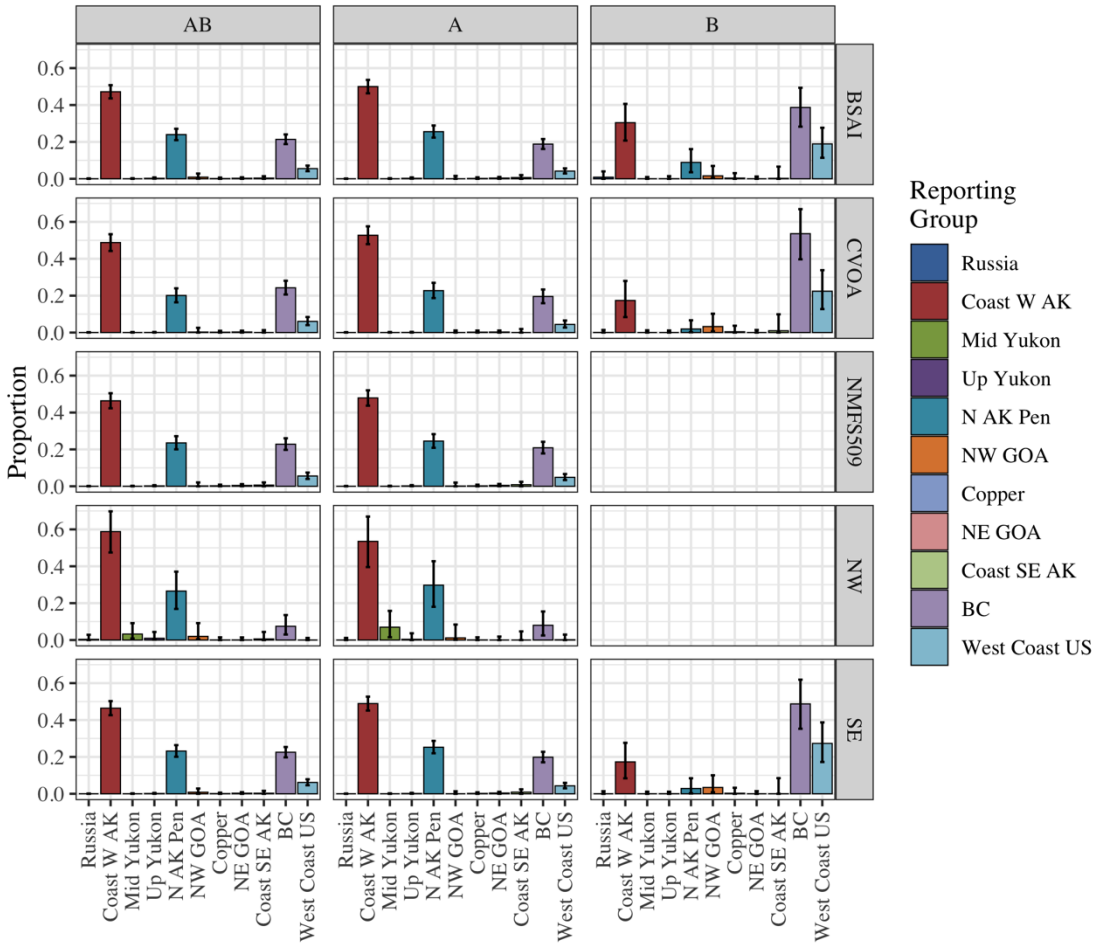

Figure 7: Stock composition estimates with 95% credible intervals of Chinook salmon bycatch for five spatial strata (Bering Sea and Aleutian Islands [BSAI], Catcher Vessel Operation Area [CVOA], NMFS statistical area 509 [NMFS509], Northwest Bering [NW], and Southeast Bering [SE]) for the A- and B-seasons combined [AB], the A-season [A], and the B-season [B].

Within the CVOA, the proportion of Coastal Western Alaska decreased from 52.8% in the A-season to 17.4% in the B-season. The Northern Alaska Peninsula stock group showed a similar decline, dropping from 22.7% to 1.9%. In contrast, the West Coast US and British Columbia groups increased from 4.4% and 19.6% to 22.4% and 53.6% respectively.

BSAI Summary

Stock composition estimates of the Chinook salmon bycatch inform pollock and salmon fishery managers of the biological effects of the incidental take of salmon in the trawl fishery (Ianelli and Stram 2015). The incidental harvest of Chinook salmon in the Bering Sea pollock fishery averaged 32,684 salmon per year between 1991 and 2022 (31-year average), with a peak of 122,195 in 2007 and a low of 4,961 in 2000 (Figure 1; NMFS 2023). The Bering Sea Chinook salmon bycatch has abated in more recent years. In 2023, a total of 11,855 Chinook salmon were caught, below the 31-year average. The incidental harvest between 1991 and 2010 averaged 40,976 and after the implementation Amendment 91 between 2011 and 2023 the average dropped to 18,325 (Figure 1; NMFS 2023). The proportions of Chinook salmon originating from Alaska Rivers, particularly Coastal Western Alaska and North Alaska Peninsula, accounted for most of the catches in early years, but southern regions accounted for an increasing proportion of the bycatch through 2017. Since then, this trend has reversed leading to increasing proportions of Coastal Western Alaska and decreasing proportions of southern stocks. However, in 2023, there was an uptick in the proportion of British Columbia relative to the last three years. The proportion of Coastal Western Alaska fish was relatively similar to the last three years while the proportion of North Alaska Peninsula has increased. Despite the overall increase in proportion of North Alaska Peninsula, because of the overall decrease in the total Chinook salmon bycatch, the total number of North Alaska Peninsula fish caught as bycatch has remained relatively stable through time. The relative proportion of Alaska and southern stocks in the total bycatch is a product of the relative proportion of bycatch occurring in the A- and B-seasons. In 2023, we continued to observe the pattern of higher proportions of Alaska stocks in the A-season and increasing relative proportions of southern stocks in the B-season. We also observed increasing proportions of southern stocks from 2014 to 2017, years in which the Gulf of Alaska experienced a marine heatwave which may have influenced the marine distribution of Chinook salmon stocks.

Gulf of Alaska trawl fisheries

The Gulf of Alaska (GOA) is known as a feeding habitat for multiple brood years of Chinook salmon (*Oncorhynchus tshawytscha*) originating from many different localities in North America and Asia. Determining the stock composition of bycatch in federally managed fisheries is essential to understanding the effects that these fisheries have on Chinook salmon stock groups. This section of the report provides genetic stock identification results for Chinook salmon Prohibited Species Catch (hereafter referred to as bycatch) samples collected in the GOA from the trawl fisheries for walleye pollock (*Gadus chalcogrammus*). The National Marine Fisheries Service (NMFS) and Alaska Department of Fish and Game (ADF&G) geographical statistical areas associated with the groundfish fishery (Figure 8) are used to describe the spatial distribution of the Chinook salmon bycatch and genetic samples. All analyses used a single nucleotide polymorphism (SNP) baseline provided by ADF&G (Templin et al. 2011; Appendix 1), the same baseline used to estimate previous stock compositions of samples from the Chinook salmon bycatch of the federally managed GOA trawl fisheries (Guthrie et al. 2013, 2016, 2017b-2020b, 2021; Guyon et al. 2014, 2015a,b; Larson et al. 2013).

The objective of this report is to present stock composition estimates for samples collected from the bycatch of the 2023 GOA federal trawl fisheries. Stock composition estimates have been applied to bycatch numbers; however, it is important to understand the limitations of each sample set for applying estimates to the entire bycatch or comparing estimates among sample sets or years. Amendment 93 to the GOA groundfish fishery management plan required industry to retain all Chinook salmon caught as bycatch in the GOA pollock trawl fishery. This retention requirement was aimed at providing observers with complete access to the bycatch to support genetic stock composition analyses. However, Amendment 93 did not mandate complete observer coverage, and not all GOA pollock trips were observed at-sea. Consequently, the North Pacific Groundfish and Halibut Observer Program (Observer Program) lacked the ability to know in advance the times and locations of all GOA pollock deliveries. Recognizing these limitations in the GOA, starting in 2014, the Observer Program implemented a simple random sampling protocol with respect to trip for the collection of genetic samples in the GOA (Faunce et al. 2014). This method randomly samples from trips and censuses the salmon bycatch encountered in each associated delivery to the processor (Faunce 2015). Fin clips and scales were collected for genetic analysis throughout 2023 from the GOA bottom and midwater pollock trawl fishery. Tissues were stored in coin envelopes that were labeled, dried, and shipped to the AFSC's Auke Bay Laboratories (ABL). Scales were collected as an additional source of tissue for genetic analysis, and for aging.

Catch Summary

Temporal Trends

In 2023, an estimated 18,302 Chinook salmon were caught in the GOA pollock trawl fisheries (NMFS 2023). This estimate is about two-fifths of the highest overall Chinook bycatch of 44,769 in 2010 and slightly larger than the historical mean of 14,730 between 1991-2022 (Figure 8).

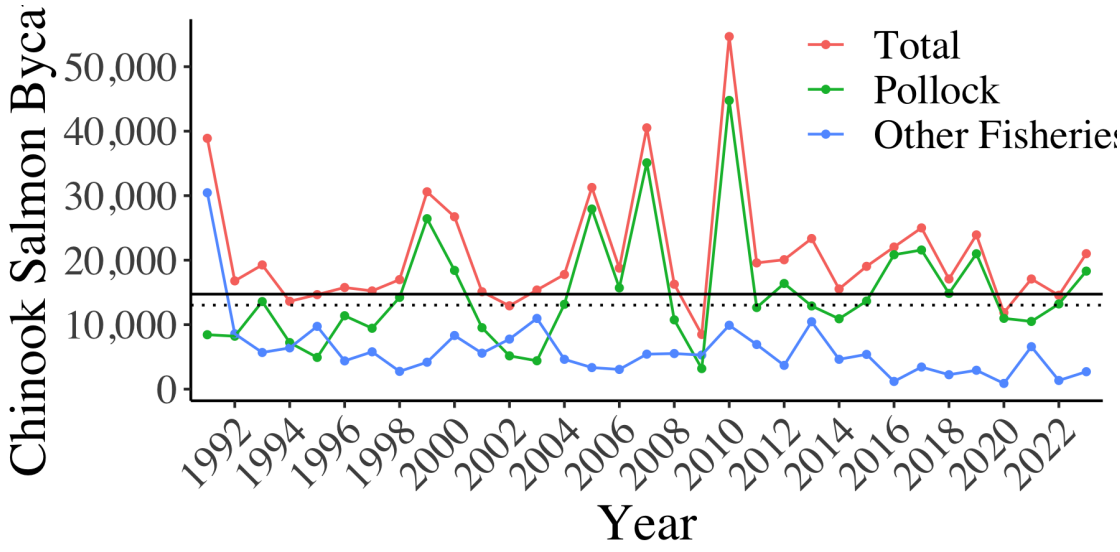

Figure 8: Chinook salmon prohibited species catch (PSC) for Gulf of Alaska pollock-directed trawl, other ground fish, and all fisheries. The solid horizontal line represents the mean PSC and the dashed line represents the median PSC from 1992 to 2023 for the pollock-directed trawl fishery.

Spatial Trends

Of the 18,302 Chinook salmon bycatch from the GOA pollock trawl fishery, the majority occurred in three areas: Shumagin Islands (Figure 9B), Shelikof Strait (Figure 9C), and southeast of Kodiak Island (Figure 9C). There was also some bycatch that occurred south of Akutan in the Western GOA and south of Middleton Island in NMFS Area 640. Plotted but not analyzed as part of the GOA bycatch, is the bycatch of Chinook salmon that occurred within Prince William Sound (NMFS Area 649, part of the Inside [INSD] FMP Area).

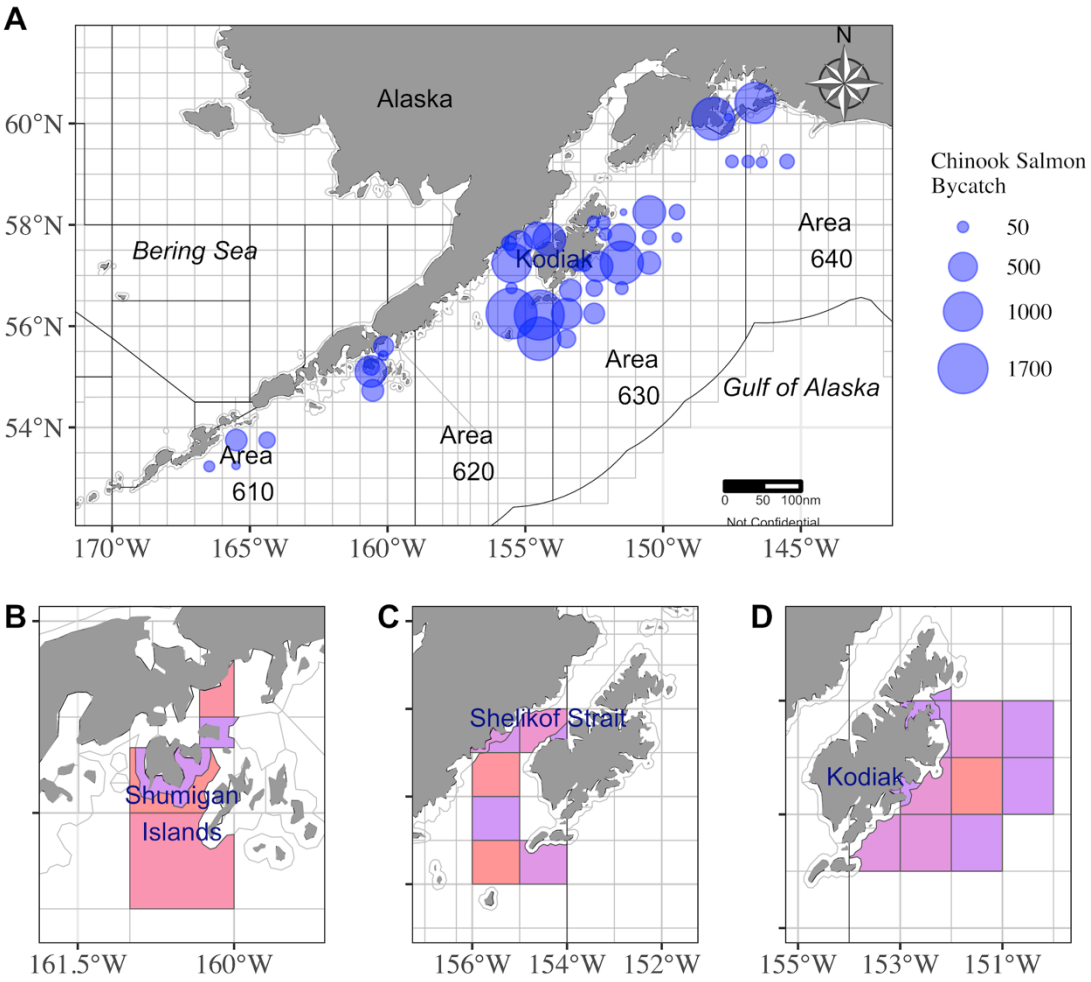

Figure 9: Location of sample strata used in comparative stock composition estimates from the 2023 Gulf of Alaska Chinook salmon bycatch. Circles represent the amount of total bycatch (A). Locations (shaded) of the strata used: (B) Shumagin Islands (n = 439); (C) Shelikof Strait (n = 1,412); (D) Southeast Kodiak Island (n=755).

Sampling & Genotyping Summary

Potential spatial and temporal biases associated with the 2023 Chinook salmon GOA bycatch sample sets were evaluated visually by comparing the genetic sample distribution with the estimated overall bycatch distribution. The distributions of the numbers of samples and overall bycatch were similar by week and by statistical area and week (Figure 10). The sampling rate was variable, but mostly over 10%, with a mean realized sampling proportion of 21.5%. There was some bias where large catches had large sampling rates, particularly for NMFS Area 620. Additionally, some large catches were undersampled late in the year (Figure 10).

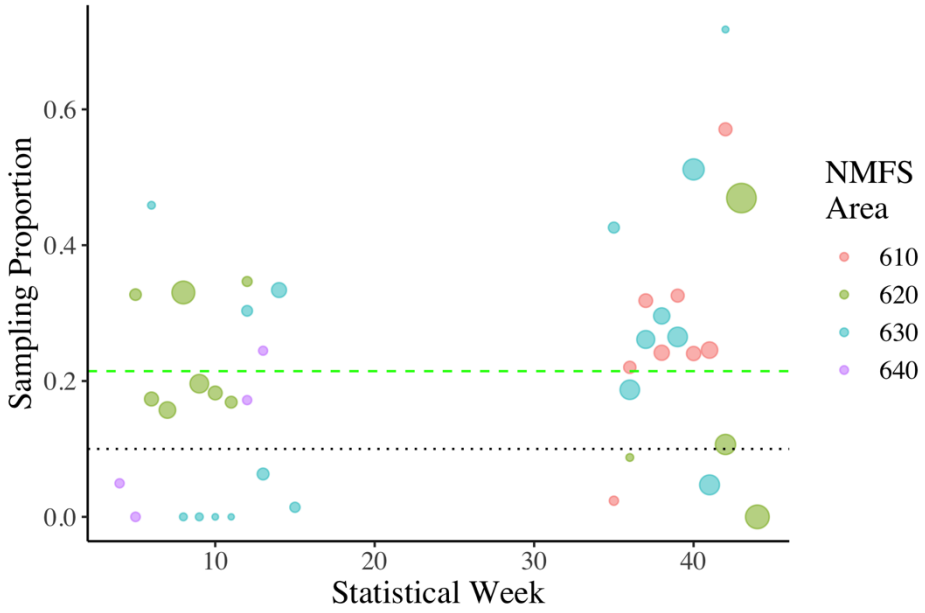

Figure 10: Proportion of GOA Chinook salmon bycatch sampled for genetic analysis by statistical week and NMFS Statistical Areas. The size of the circles corresponds to the number of fish caught. The green dashed line is the realized mean sampling proportion over NMFS areas and statistical weeks, and the black dotted line is the target of 10%.

The genotyped (genetic) sample set for the 2023 GOA Chinook salmon bycatch was 3,274 fish, which represents 18% of the total bycatch. There was, however, some variability in genotyping success with 82.5% of all samples being genotyped successfully.

Genetic Stock Composition

Overall

The stock composition results indicate that almost 90% of the 3,138 samples from the GOA originated from three regions South and East of the Alaska Peninsula with the British Columbia region contributing the most (42.1%), followed by the West Coast US (30.1%), and Coastal Southeast Alaska (17.5%) regions (Table2). When multiplied by the total bycatch, we estimated that of the 18,302 Chinook salmon in the GOA bycatch, 7,702 were from British Columbia, 5,517 were from West Coast US, 3,208 were from Southeast Alaska, and 1,353 were from NW GOA. The stock composition estimates in 2023 were similar to estimates from the previous nine years with a slight decrease in British Columbia and increases in Coastal Southeast Alaska and NW GOA regions from the previous year (Figure 11).

Table 2: Regional stock composition estimates of Chinook salmon from the 2023 Gulf of Alaska pollock trawl fishery (PSC = 18,302; n = 3,138). The estimated number of Chinook salmon bycatch, 95% CI for the estimated number, and mean proportion are provided with 95% credible intervals, P = 0 statistic, and the Gelman-Rubin shrink factor (SF).

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-9	0.000	0.000	0.000	0.83	1.00
Coast W AK	9	0-89	0.001	0.000	0.005	0.65	1.00
Mid Yukon	0	0-5	0.000	0.000	0.000	0.84	1.00
Up Yukon	0	0-5	0.000	0.000	0.000	0.84	1.00
N AK Pen	4	0-49	0.000	0.000	0.003	0.69	1.00
NW GOA	1,353	1,126-1,587	0.074	0.062	0.087	0.00	1.00
Copper	273	173-386	0.015	0.009	0.021	0.00	1.00
NE GOA	233	80-450	0.013	0.004	0.025	0.00	1.01
Coast SE AK	3,208	2,859-3,565	0.175	0.156	0.195	0.00	1.00
BC	7,702	7,281-8,127	0.421	0.398	0.444	0.00	1.00
West Coast US	5,517	5,198-5,846	0.301	0.284	0.319	0.00	1.00

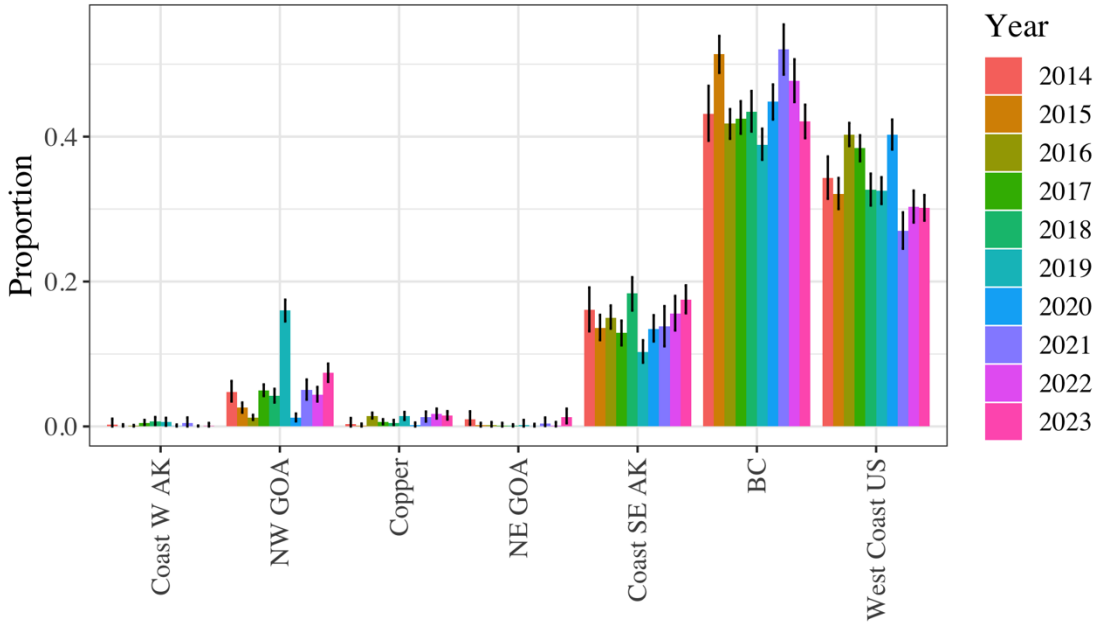

Figure 11: Yearly stock composition estimates (2014-2023) with 95% credible intervals of Chinook salmon bycatch based on available genetic samples from the Gulf of Alaska (GOA) pollock trawl fishery. The same genetic baseline and general regional groupings were used in all analyses.

Spatial Trends

Analyses were performed on the three areas where bycatch has historically been highest within the trawl fishery: Shumagin Islands, Shelikof Strait and southeast of Kodiak Island (Figure 9). Bycatch from the Shumagin Islands was composed of a higher proportion of British Columbia fish (59.1%) compared to Shelikof Strait (36.9%) and SE Kodiak Island (43.1%; Figure 12). Whereas, both SE Kodiak Island and Shelikof Strait bycatch were characterized by higher proportions of West Coast US Chinook salmon (31.2% and 30.2% respectively) than Shelikof Strait (20.0%). Shelikof Strait had the highest proportion of NW GOA bycatch (10.5%; Figure 12).

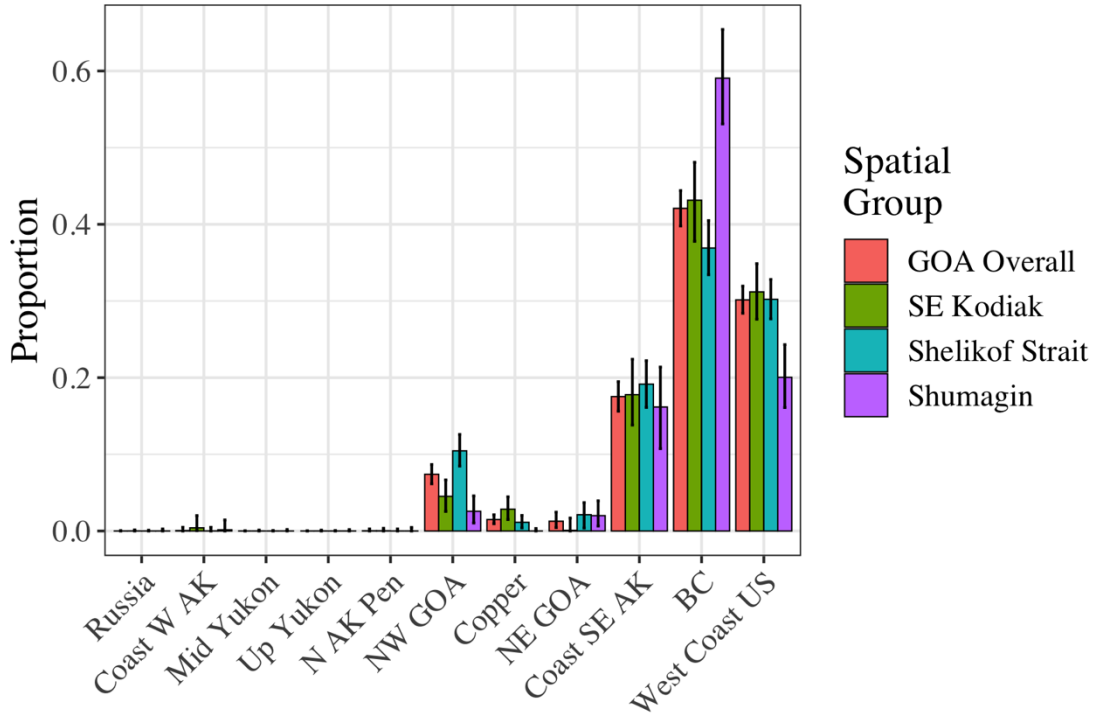

Figure 12: Stock composition estimates with 95% credible intervals of Chinook salmon bycatch samples from four area strata from the 2023 GOA pollock trawl fishery: GOA overall (3,138 samples); Shumagin Islands overall (n = 439); Shelikof Strait overall (n = 1,412); and Southeast Kodiak Island overall (n = 755).

Spatiotemporal Trends

In order to better understand shifts in stock composition through time the three spatial analyses were analyzed for two time strata (Early and Late). These time periods differ slightly by area to reflect the fishing pressure and resulting bycatch in the area. Early bycatch in the Shumagin Islands area occurred prior to week 30, while late bycatch occurred from statistical week 30 to the end of the year. Early bycatch in both the Shelikof Strait and SE Kodiak occurred prior to week 21, while late bycatch includes all fish after week 20.

All of the bycatch from the Shumagin Islands occurred in the Late time strata, so we focused on comparisons between the early and late catches from Shelikof Strait and SE Kodiak, but provide late Shumagin estimates for comparisons among the areas in the late time period.

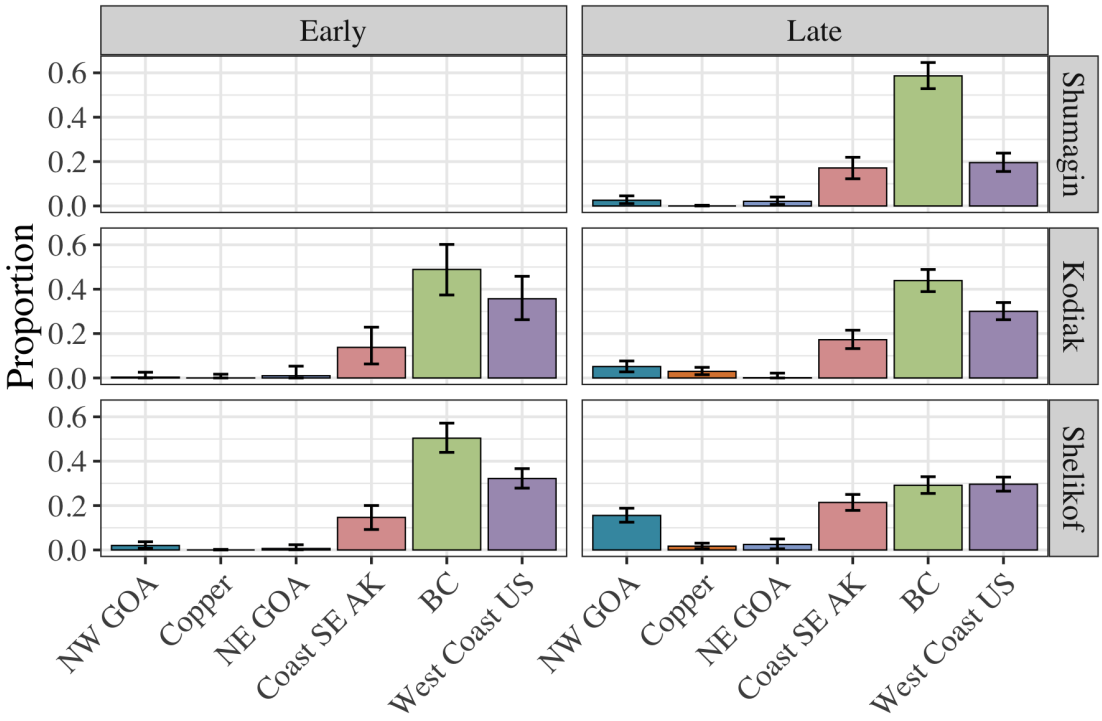

Figure 13: Stock composition estimates with 95% credible intervals for samples from the Shumagin Islands area and time strata (Late n = 165), Southeast Kodiak Island area (Early time strata n = 102, Late strata n = 653), and from the Shelikof Strait area and time strata (Early time strata n = 518, Late n = 894).

Between the early and late periods there was a subtle shift in stock composition around SE Kodiak Island (Figure 13). Both the NW GOA and Copper groups increased in relative proportions through the year. NW GOA comprised only 0.4% of the bycatch in the early period while in the late it increased to 5.0%. The Copper regional group similarly increased from 0% to 3.0%. Bycatch from the Shelikof area showed similar increases in NW GOA (2.0% to 15.6%) and Copper stocks (0% to 1.7%), and a substantial decrease in the proportion of British Columbia stocks (50.4% to 29.1%).

GOA Summary

In 2023, genetic samples were collected from Chinook salmon taken in the bycatch of the GOA pollock trawl fisheries using a simple random sample protocol with trip being the primary unit. Based on analysis of 3,138 samples from a total bycatch of 18,302 Chinook salmon, British Columbia (42.1%), West Coast US (30.1%), and Coastal Southeast Alaska (17.5%) stock groups were the largest contributors to Chinook salmon bycatch. The stock composition estimates for Chinook salmon bycatch samples collected from federally

managed trawl fisheries in the GOA continue to show that the vast majority of Chinook salmon that are encountered originate from three stock groups that are located South and East of the Alaska Peninsula. This pattern is consistent for samples analyzed across finer-scale area and time strata within the GOA.

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Appendix I - BSAI GSI Estimates

Regional stock composition estimates of Chinook salmon samples from the 2023 Bering Sea pollock trawl fishery. The estimated number of chum salmon bycatch, the 95% CI for the estimated number, mean proportion, 95% credible intervals, P = 0 statistic (the probability that the estimated proportion is 0), and the Gelman-Rubin shrink factor (SF; convergence diagnostic).

A/B-season (PSC = 11,855; n = 1106)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-23	0.000	0.000	0.002	0.81	1.00
Coast W AK	5,596	5,167-6,018	0.472	0.436	0.508	0.00	1.00
Mid Yukon	0	0-32	0.000	0.000	0.003	0.81	1.00
Up Yukon	31	10-87	0.003	0.001	0.007	0.00	1.00
N AK Pen	2,840	2,483-3,214	0.240	0.209	0.271	0.00	1.00
NW GOA	105	8-334	0.009	0.001	0.028	0.00	1.01
Copper	13	0-76	0.001	0.000	0.006	0.45	1.00
NE GOA	34	0-95	0.003	0.000	0.008	0.04	1.00
Coast SE AK	44	0-166	0.004	0.000	0.014	0.20	1.00
BC	2,532	2,229-2,850	0.214	0.188	0.240	0.00	1.00
West Coast US	656	490-847	0.055	0.041	0.071	0.00	1.00

A-season (PSC = 10,609; n = 1002)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-11	0.000	0.000	0.001	0.84	1.00
Coast W AK	5,302	4,917-5,689	0.500	0.464	0.536	0.00	1.00
Mid Yukon	0	0-31	0.000	0.000	0.003	0.81	1.00
Up Yukon	27	8-79	0.003	0.001	0.007	0.00	1.00
N AK Pen	2,710	2,369-3,065	0.256	0.223	0.289	0.00	1.00
NW GOA	0	0-164	0.000	0.000	0.015	0.76	1.00
Copper	20	0-84	0.002	0.000	0.008	0.28	1.00
NE GOA	41	4-104	0.004	0.000	0.010	0.01	1.00
Coast SE AK	68	0-211	0.006	0.000	0.020	0.14	1.00
BC	1,994	1,715-2,285	0.188	0.162	0.215	0.00	1.00
West Coast US	442	306-597	0.042	0.029	0.056	0.00	1.00

B-season (PSC = 1,246; n = 104)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	10	0-50	0.009	0.000	0.040	0.26	1.00
Coast W AK	378	258-506	0.304	0.207	0.406	0.00	1.00
Mid Yukon	0	0-12	0.000	0.000	0.009	0.83	1.00
Up Yukon	0	0-18	0.000	0.000	0.014	0.81	1.00
N AK Pen	110	44-201	0.089	0.035	0.161	0.00	1.00
NW GOA	19	5-87	0.016	0.004	0.070	0.00	1.00
Copper	4	0-38	0.004	0.000	0.031	0.59	1.00
NE GOA	0	0-15	0.000	0.000	0.012	0.84	1.00
Coast SE AK	2	0-82	0.002	0.000	0.066	0.62	1.01
BC	482	352-615	0.387	0.283	0.493	0.00	1.00
West Coast US	235	142-345	0.189	0.114	0.277	0.00	1.00

CVOA A/B-season (PSC = 6,181; n = 618)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-10	0.000	0.000	0.002	0.84	1.00
Coast W AK	3,015	2,732-3,295	0.488	0.442	0.533	0.00	1.00
Mid Yukon	0	0-15	0.000	0.000	0.002	0.83	1.00
Up Yukon	1	0-18	0.000	0.000	0.003	0.75	1.00
N AK Pen	1,241	1,013-1,482	0.201	0.164	0.240	0.00	1.00
NW GOA	17	0-158	0.003	0.000	0.026	0.66	1.03
Copper	11	0-58	0.002	0.000	0.009	0.36	1.00
NE GOA	19	0-62	0.003	0.000	0.010	0.06	1.00
Coast SE AK	0	0-79	0.000	0.000	0.013	0.55	1.00
BC	1,499	1,275-1,735	0.243	0.206	0.281	0.00	1.00
West Coast US	373	247-520	0.060	0.040	0.084	0.00	1.00

CVOA A-season (PSC = 5,603; n = 545)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-9	0.000	0.000	0.002	0.84	1.00
Coast W AK	2,955	2,685-3,226	0.528	0.479	0.576	0.00	1.00
Mid Yukon	0	0-15	0.000	0.000	0.003	0.83	1.00
Up Yukon	2	0-19	0.000	0.000	0.003	0.00	1.00
N AK Pen	1,272	1,047-1,511	0.227	0.187	0.270	0.00	1.00
NW GOA	0	0-62	0.000	0.000	0.011	0.83	1.00
Copper	12	0-59	0.002	0.000	0.011	0.33	1.00
NE GOA	16	0-61	0.003	0.000	0.011	0.13	1.00
Coast SE AK	0	0-107	0.000	0.000	0.019	0.64	1.00
BC	1,095	891-1,307	0.196	0.159	0.233	0.00	1.00
West Coast US	246	150-364	0.044	0.027	0.065	0.00	1.00

CVOA B-season (PSC = 578; n = 73)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-8	0.000	0.000	0.014	0.82	1.00
Coast W AK	100	48-162	0.174	0.084	0.280	0.00	1.00
Mid Yukon	0	0-7	0.000	0.000	0.012	0.84	1.00
Up Yukon	0	0-6	0.000	0.000	0.011	0.84	1.00
N AK Pen	11	1-38	0.019	0.001	0.066	0.00	1.00
NW GOA	18	3-59	0.033	0.006	0.102	0.00	1.00
Copper	2	0-21	0.004	0.000	0.037	0.60	1.00
NE GOA	0	0-8	0.000	0.000	0.014	0.84	1.00
Coast SE AK	5	0-57	0.010	0.000	0.099	0.55	1.01
BC	309	230-387	0.536	0.397	0.669	0.00	1.00
West Coast US	129	74-195	0.224	0.127	0.338	0.00	1.00

NMFS 509 A/B season (PSC = 8,406; n = 800)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-10	0.000	0.000	0.001	0.84	1.00
Coast W AK	3,897	3,556-4,242	0.464	0.423	0.505	0.00	1.00
Mid Yukon	0	0-21	0.000	0.000	0.002	0.81	1.00
Up Yukon	15	5-49	0.002	0.001	0.006	0.00	1.00
N AK Pen	1,978	1,684-2,283	0.235	0.200	0.272	0.00	1.00
NW GOA	14	0-176	0.002	0.000	0.021	0.68	1.00
Copper	20	2-75	0.002	0.000	0.009	0.00	1.00
NE GOA	37	3-97	0.005	0.000	0.012	0.02	1.00
Coast SE AK	53	0-176	0.006	0.000	0.021	0.16	1.00
BC	1,918	1,661-2,188	0.228	0.198	0.260	0.00	1.00
West Coast US	469	334-625	0.056	0.040	0.074	0.00	1.00

NMFS 509 A-season (PSC = 8,054; n = 770)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-10	0.000	0.000	0.001	0.84	1.00
Coast W AK	3,858	3,521-4,190	0.479	0.437	0.520	0.00	1.00
Mid Yukon	0	0-22	0.000	0.000	0.003	0.81	1.00
Up Yukon	14	4-49	0.002	0.001	0.006	0.00	1.00
N AK Pen	1,974	1,681-2,279	0.245	0.209	0.283	0.00	1.00
NW GOA	8	0-162	0.001	0.000	0.020	0.72	1.00
Copper	15	0-70	0.002	0.000	0.009	0.31	1.00
NE GOA	39	4-100	0.005	0.000	0.012	0.01	1.00
Coast SE AK	68	0-196	0.009	0.000	0.024	0.10	1.00
BC	1,681	1,435-1,943	0.209	0.178	0.241	0.00	1.00
West Coast US	392	271-535	0.049	0.034	0.066	0.00	1.00

NW A/B-season (PSC = 1,122; n = 100)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	4	0-32	0.004	0.000	0.028	0.55	1.00
Coast W AK	659	533-783	0.588	0.475	0.698	0.00	1.00
Mid Yukon	36	9-103	0.032	0.008	0.092	0.00	1.00
Up Yukon	10	3-49	0.010	0.002	0.044	0.00	1.00
N AK Pen	297	189-416	0.265	0.169	0.371	0.00	1.00
NW GOA	22	5-103	0.020	0.004	0.092	0.00	1.00
Copper	0	0-16	0.000	0.000	0.014	0.82	1.00
NE GOA	0	0-16	0.000	0.000	0.014	0.82	1.00
Coast SE AK	6	0-49	0.006	0.000	0.044	0.55	1.00
BC	83	34-152	0.075	0.030	0.135	0.00	1.00
West Coast US	0	0-13	0.000	0.000	0.011	0.83	1.00

NW A-season (PSC = 799; n = 72)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-9	0.000	0.000	0.011	0.84	1.00
Coast W AK	427	316-535	0.535	0.396	0.670	0.00	1.00
Mid Yukon	55	12-126	0.070	0.015	0.158	0.00	1.00
Up Yukon	3	0-29	0.004	0.000	0.036	0.63	1.00
N AK Pen	237	144-341	0.298	0.180	0.427	0.00	1.00
NW GOA	9	1-67	0.012	0.001	0.084	0.00	1.00
Copper	0	0-12	0.000	0.000	0.015	0.81	1.00
NE GOA	0	0-15	0.000	0.000	0.019	0.83	1.00
Coast SE AK	0	0-37	0.000	0.000	0.047	0.77	1.00
BC	63	20-124	0.080	0.025	0.155	0.00	1.00
West Coast US	1	0-24	0.001	0.000	0.030	0.78	1.00

SE A/B-season (PSC = 10,733; n = 1006)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-10	0.000	0.000	0.001	0.83	1.00
Coast W AK	4,984	4,576-5,394	0.464	0.426	0.503	0.00	1.00
Mid Yukon	0	0-23	0.000	0.000	0.002	0.81	1.00
Up Yukon	14	4-49	0.001	0.000	0.005	0.00	1.00
N AK Pen	2,487	2,155-2,832	0.232	0.201	0.264	0.00	1.00
NW GOA	92	0-306	0.009	0.000	0.029	0.32	1.02
Copper	10	0-66	0.001	0.000	0.006	0.49	1.00
NE GOA	32	0-92	0.003	0.000	0.009	0.05	1.00
Coast SE AK	33	0-169	0.003	0.000	0.016	0.31	1.00
BC	2,418	2,121-2,723	0.225	0.198	0.254	0.00	1.00
West Coast US	660	498-845	0.062	0.046	0.079	0.00	1.00

SE A-season (PSC = 9,810; n = 930)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-11	0.000	0.000	0.001	0.84	1.00
Coast W AK	4,801	4,426-5,167	0.489	0.451	0.527	0.00	1.00
Mid Yukon	0	0-23	0.000	0.000	0.002	0.81	1.00
Up Yukon	14	4-49	0.001	0.000	0.005	0.00	1.00
N AK Pen	2,477	2,155-2,814	0.253	0.220	0.287	0.00	1.00
NW GOA	0	0-132	0.000	0.000	0.013	0.78	1.00
Copper	18	0-75	0.002	0.000	0.008	0.26	1.00
NE GOA	40	3-103	0.004	0.000	0.011	0.01	1.00
Coast SE AK	88	0-237	0.009	0.000	0.024	0.09	1.00
BC	1,945	1,675-2,233	0.198	0.171	0.228	0.00	1.00
West Coast US	424	291-578	0.043	0.030	0.059	0.00	1.00

SE B-season (PSC = 923; n = 76)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-13	0.000	0.000	0.014	0.83	1.00
Coast W AK	159	78-255	0.173	0.084	0.276	0.00	1.00
Mid Yukon	0	0-11	0.000	0.000	0.011	0.83	1.00
Up Yukon	0	0-10	0.000	0.000	0.011	0.82	1.00
N AK Pen	26	2-78	0.029	0.002	0.084	0.00	1.00
NW GOA	31	8-93	0.034	0.008	0.100	0.00	1.00
Copper	2	0-30	0.003	0.000	0.033	0.67	1.00
NE GOA	0	0-13	0.000	0.000	0.014	0.84	1.00
Coast SE AK	0	0-78	0.000	0.000	0.085	0.62	1.01
BC	450	325-571	0.488	0.353	0.619	0.00	1.00
West Coast US	252	159-357	0.273	0.172	0.387	0.00	1.00

Appendix II - GOA GSI Estimates

Regional stock composition estimates of Chinook salmon samples from the 2023 Gulf of Alaska pollock trawl fishery. The estimated number of chum salmon bycatch, the 95% CI for the estimated number, mean proportion, 95% credible intervals, P = 0 statistic (the probability that the estimated proportion is 0), and the Gelman-Rubin shrink factor (SF; convergence diagnostic).

GOA (PSC = 18,302; n = 3138)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-9	0.000	0.000	0.000	0.83	1.00
Coast W AK	9	0-89	0.001	0.000	0.005	0.65	1.00
Mid Yukon	0	0-5	0.000	0.000	0.000	0.84	1.00
Up Yukon	0	0-5	0.000	0.000	0.000	0.84	1.00
N AK Pen	4	0-49	0.000	0.000	0.003	0.69	1.00
NW GOA	1,353	1,126-1,587	0.074	0.062	0.087	0.00	1.00
Copper	273	173-386	0.015	0.009	0.021	0.00	1.00
NE GOA	233	80-450	0.013	0.004	0.025	0.00	1.01
Coast SE AK	3,208	2,859-3,565	0.175	0.156	0.195	0.00	1.00
BC	7,702	7,281-8,127	0.421	0.398	0.444	0.00	1.00
West Coast US	5,517	5,199-5,846	0.301	0.284	0.319	0.00	1.00

South East of Kodiak (PSC = 3,017; n = 755)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-4	0.000	0.000	0.001	0.80	1.00
Coast W AK	12	1-61	0.004	0.000	0.020	0.00	1.00
Mid Yukon	0	0-4	0.000	0.000	0.001	0.84	1.00
Up Yukon	0	0-3	0.000	0.000	0.001	0.81	1.00
N AK Pen	0	0-11	0.000	0.000	0.004	0.75	1.00
NW GOA	136	77-201	0.045	0.026	0.067	0.00	1.00
Copper	85	45-135	0.028	0.015	0.045	0.00	1.00
NE GOA	2	0-51	0.001	0.000	0.017	0.76	1.03
Coast SE AK	536	417-676	0.178	0.138	0.224	0.00	1.00
BC	1,301	1,140-1,451	0.431	0.378	0.481	0.00	1.00
West Coast US	940	833-1,052	0.312	0.276	0.349	0.00	1.00

South East of Kodiak Early (PSC = 448; n = 102)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-9	0.002	0.000	0.021	0.69	1.00
Coast W AK	0	0-8	0.000	0.000	0.017	0.81	1.00
Mid Yukon	0	0-4	0.000	0.000	0.008	0.84	1.00
Up Yukon	0	0-4	0.000	0.000	0.008	0.83	1.00
N AK Pen	0	0-4	0.000	0.000	0.010	0.80	1.00
NW GOA	1	0-12	0.004	0.000	0.026	0.00	1.00
Copper	0	0-8	0.000	0.000	0.017	0.82	1.00
NE GOA	4	0-24	0.010	0.000	0.053	0.43	1.00
Coast SE AK	61	28-103	0.138	0.063	0.229	0.00	1.00
BC	219	168-270	0.489	0.374	0.602	0.00	1.00
West Coast US	160	118-205	0.357	0.263	0.458	0.00	1.00

South East of Kodiak Late (PSC = 2,568; n = 653)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-4	0.000	0.000	0.002	0.84	1.00
Coast W AK	15	2-65	0.006	0.001	0.025	0.00	1.00
Mid Yukon	0	0-4	0.000	0.000	0.001	0.83	1.00
Up Yukon	0	0-3	0.000	0.000	0.001	0.83	1.00
N AK Pen	0	0-10	0.000	0.000	0.004	0.79	1.00
NW GOA	132	70-197	0.051	0.027	0.077	0.00	1.00
Copper	76	38-123	0.030	0.015	0.048	0.00	1.00
NE GOA	2	0-56	0.001	0.000	0.022	0.79	1.02
Coast SE AK	442	340-553	0.172	0.132	0.215	0.00	1.00
BC	1,127	1,000-1,256	0.439	0.389	0.489	0.00	1.00
West Coast US	771	675-873	0.300	0.263	0.340	0.00	1.00

South of Shumagin (PSC = 1,256; n = 439)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-3	0.000	0.000	0.003	0.83	1.00
Coast W AK	1	0-18	0.001	0.000	0.014	0.65	1.00
Mid Yukon	0	0-3	0.000	0.000	0.002	0.84	1.00
Up Yukon	0	0-2	0.000	0.000	0.002	0.84	1.00
N AK Pen	0	0-6	0.000	0.000	0.005	0.83	1.00
NW GOA	32	13-58	0.026	0.010	0.046	0.00	1.00
Copper	0	0-4	0.000	0.000	0.003	0.84	1.00
NE GOA	25	8-49	0.020	0.006	0.039	0.00	1.00
Coast SE AK	203	135-269	0.162	0.107	0.214	0.00	1.01
BC	741	667-822	0.591	0.531	0.654	0.00	1.00
West Coast US	251	202-305	0.200	0.161	0.243	0.00	1.00

South of Shumagin Late (PSC = 1,256; n = 439)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-3	0.000	0.000	0.003	0.83	1.00
Coast W AK	0	0-16	0.000	0.000	0.013	0.74	1.00
Mid Yukon	0	0-2	0.000	0.000	0.002	0.84	1.00
Up Yukon	0	0-2	0.000	0.000	0.002	0.84	1.00
N AK Pen	0	0-6	0.000	0.000	0.005	0.83	1.00
NW GOA	32	13-57	0.026	0.011	0.046	0.00	1.00
Copper	0	0-4	0.000	0.000	0.003	0.84	1.00
NE GOA	26	9-51	0.021	0.007	0.040	0.00	1.00
Coast SE AK	215	154-276	0.171	0.123	0.219	0.00	1.01
BC	736	664-812	0.586	0.529	0.646	0.00	1.00
West Coast US	245	195-299	0.195	0.155	0.238	0.00	1.00

Shelikof Strait (PSC = 3,692; n = 1412)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-4	0.000	0.000	0.001	0.84	1.00
Coast W AK	0	0-18	0.000	0.000	0.005	0.79	1.00
Mid Yukon	0	0-2	0.000	0.000	0.001	0.84	1.00
Up Yukon	0	0-2	0.000	0.000	0.001	0.84	1.00
N AK Pen	0	0-10	0.000	0.000	0.003	0.82	1.00
NW GOA	385	313-465	0.105	0.085	0.126	0.00	1.00
Copper	41	15-75	0.011	0.004	0.020	0.00	1.00
NE GOA	78	14-137	0.021	0.004	0.037	0.00	1.00
Coast SE AK	707	595-820	0.192	0.161	0.222	0.00	1.00
BC	1,362	1,234-1,495	0.369	0.334	0.405	0.00	1.00
West Coast US	1,115	1,021-1,212	0.302	0.277	0.328	0.00	1.00

Shelikof Strait Early (PSC = 1,846; n = 518)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-3	0.000	0.000	0.002	0.84	1.00
Coast W AK	1	0-15	0.001	0.000	0.008	0.66	1.00
Mid Yukon	0	0-3	0.000	0.000	0.002	0.83	1.00
Up Yukon	0	0-3	0.000	0.000	0.002	0.83	1.00
N AK Pen	0	0-7	0.000	0.000	0.004	0.82	1.00
NW GOA	37	14-68	0.020	0.007	0.037	0.00	1.00
Copper	0	0-5	0.000	0.000	0.003	0.83	1.00
NE GOA	12	2-43	0.007	0.001	0.023	0.00	1.00
Coast SE AK	270	170-370	0.147	0.092	0.200	0.00	1.01
BC	930	812-1,056	0.504	0.440	0.572	0.00	1.01
West Coast US	594	515-677	0.322	0.279	0.366	0.00	1.00

Shelikof Strait Late (PSC = 1,845; n = 894)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
Russia	0	0-4	0.000	0.000	0.002	0.79	1.00
Coast W AK	0	0-13	0.000	0.000	0.007	0.77	1.00
Mid Yukon	0	0-2	0.000	0.000	0.001	0.84	1.00
Up Yukon	0	0-2	0.000	0.000	0.001	0.84	1.00
N AK Pen	0	0-8	0.000	0.000	0.004	0.77	1.00
NW GOA	287	231-347	0.156	0.125	0.188	0.00	1.00
Copper	31	11-57	0.017	0.006	0.031	0.00	1.00
NE GOA	45	10-91	0.025	0.005	0.050	0.00	1.00
Coast SE AK	395	329-462	0.214	0.178	0.250	0.00	1.00
BC	537	470-609	0.291	0.255	0.330	0.00	1.00
West Coast US	546	489-606	0.296	0.265	0.328	0.00	1.00

Appendix III - GSI Methods

DNA was extracted from axillary process tissues with Chelex. SNP genotyping was performed using Genotyping-in-Thousands by Sequencing (GTseq; Campbell et al. 2015) chemistry that uses short-read sequencing on an Illumina platform to interrogate the 37 SNP DNA markers represented in the Chinook salmon baseline (Templin et al. 2011; Appendix 5). The SNP baseline contains genetic information for 172 populations of Chinook salmon grouped into 11 geographic regions (also known as stock groups or reporting groups; Appendix 1). Proof tests performed previously have shown the baseline to be suitable for stock composition analysis using the regional reporting groups defined in Appendix 1 (Templin et al. 2011).

Sequencing libraries were prepared using the GT-seq protocol (Campbell et al. 2015). PCR was performed on extracted DNA with primers that amplify 37 SNP loci (Templin et al. 2011). These PCR products were then indexed in a barcoding PCR, normalized using SequalPrep plates (Invitrogen) and each 96 well plate was subsequently pooled after Sequel prep normalization. Next, a double-sided bead size selection was performed using AMPure XP beads (Beckman Coulter), using ratios of beads to library of 0.5× to remove non-target larger fragments and then 1.2× to retain the desired amplicon. Libraries were sequenced on a MiSeq (Illumina) using a single 150-cycle lane run with 2 × 75 bp paired-end (PE) chemistry. PE reads for each individual were joined with FLASH2 (Magoč & Salzberg, 2011; https://github.com/dstreett/FLASH2). Merged reads were genotyped with the R package GTscore (McKinney; https://github.com/gjmckinney/GTscore). Individuals with low quality multilocus genotypes (< 80% of loci scored) were discarded. We re-genotype 3% of all individuals as quality control measures. The successfully genotyped samples had genetic information for an average of 36 of 37 markers. Mixtures were created by separating sampled fish into spatial and temporal groups from observer data from the AKFIN database. Genetic stock identification was performed with the conditional genetic stock identification model in the R package rubias (Moran and Anderson 2019). For all estimates, the Dirichlet prior parameters for the stock group proportions were defined by region to be 1/(GCg), where Cg is the number of baseline populations in region g, and G is the number of regions (i.e., flat over reporting groups). To ensure convergence to the posterior distribution, 11 separate chains of 70,000 iterations (burn-in of 35,000) of the non- bootstrapped model were run, with each chain starting at disparate values of stock group proportions; configured such that for each chain 95% of the mixture came from a single designated reporting group (with probability equally distributed among the populations within that reporting group) and the remaining 5% equally distributed among remaining reporting groups. The convergence of chains for each reporting group estimate was assessed with the Gelman-Rubin statistic (Gelman and Rubin 1992) estimated with the gelman.diag function in the coda library (Plummer et al. 2006) within R. Once chain convergence was confirmed, inference was conducted with the conditional genetic stock identification model with bootstrapping over reporting groups (70,000 MCMC iterations, burn-in of 35,000 and 100 bootstrap iterations). The stock composition estimates were summarized by the mean, standard deviation, median, 95% credible interval (2.5th and 97.5th percentile of the MCMC iterates in the posterior output), and P=0, which is the probability that a stock composition estimate is effectively zero (Munro et al. 2012). The

P=0 statistic is the frequency of the last half of the MCMC iterates of each chain for which the individual regional contribution to the mixture was less than a threshold of . This statistic may be more useful than the credible interval for assessing the presence or absence of minor stocks. Estimated numbers of fish caught from each stock group were calculated from the mean of the posterior distribution of stock composition estimates and the estimated total bycatch of Chinook salmon from observer data within AFKIN.

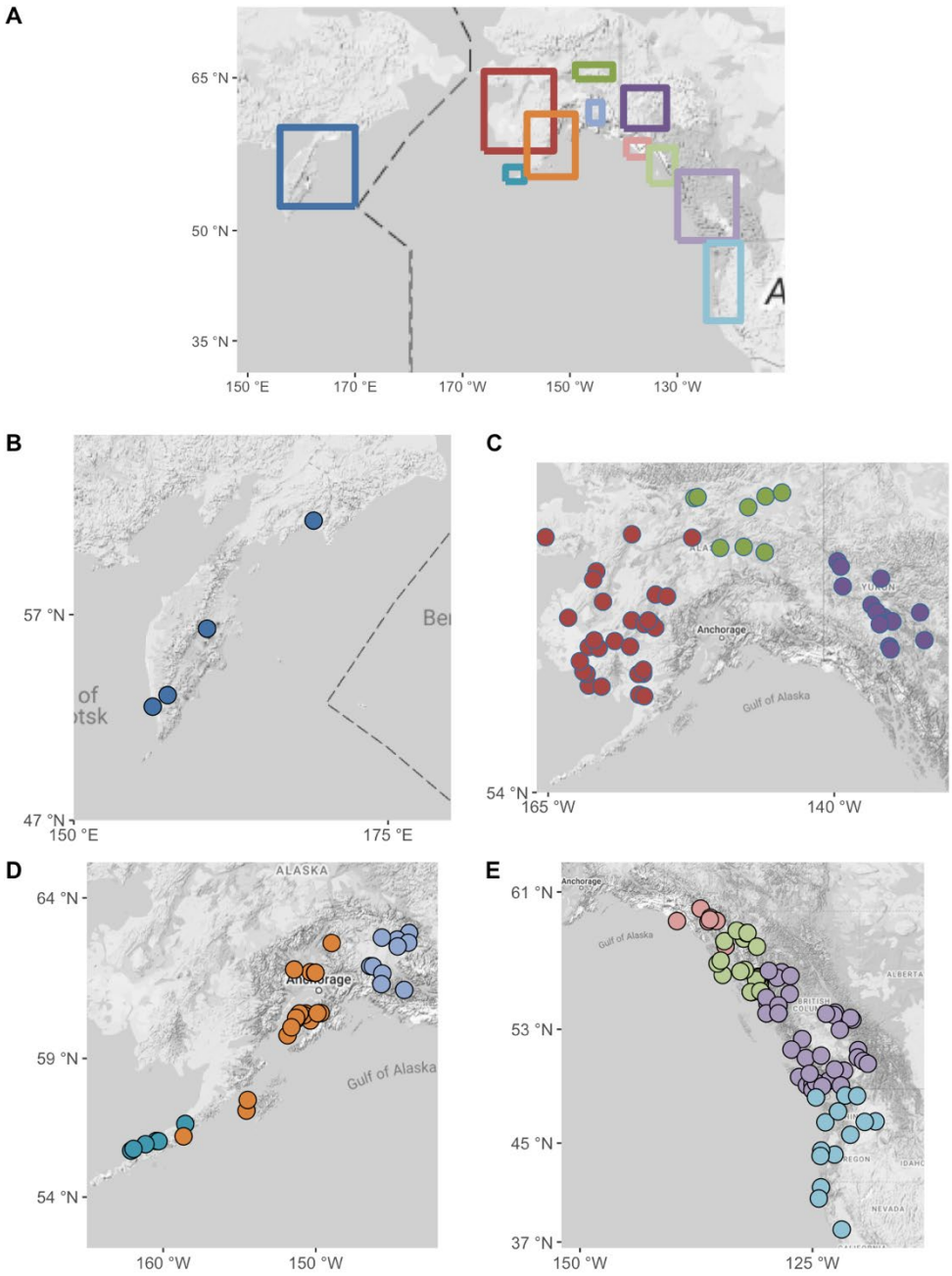

Figure A1: Eleven reporting groups of baseline Chinook salmon populations used in this report, circles represent individual populations represented in the baseline. (A) Range-wide distribution of the eleven reporting groups. (B) Russia (dark blue), (C) Coastal Western Alaska (red), Middle Yukon (green), and Upper Yukon (dark purple), (D) Northern Alaska Peninsula (blue), NW GOA (orange), Copper (light purple), (E) NE GOA (pink), Southeast Alaska (light green), British Columbia (light purple), West Coast US (light blue) reporting group.

Appendix II Table A2: Chinook salmon populations in the Alaska Department of Fish and Game (ADF&G) single nucleotide baseline grouped by eleven reporting groups used in the analyses of this report.

Reporting Group	Population	Samples	Reporting Group	Population	Samples
Russia	Bistraya River	94	Coast W AK	Tozitna River	290
Russia	Bolshaya River	77	Coast W AK	Unalakleet River	82
Russia	Kamchatka River late	119	Mid Yukon	Beaver Creek	100
Russia	Pakhatcha River	50	Mid Yukon	Chandalar River	175
Coast W AK	Kanektok River	244	Mid Yukon	Chena River	193
Coast W AK	Kogrukluk River	149	Mid Yukon	Henshaw Creek	147
Coast W AK	Nushagak River	57	Mid Yukon	Kantishna River	187
Coast W AK	Andreafsky River	236	Mid Yukon	Salcha River	188
Coast W AK	Anvik River	95	Mid Yukon	South Fork Koyukuk River	56
Coast W AK	Arolik River	147	Mid Yukon	Sheenjek River	51
Coast W AK	Big Creek	66	Up Yukon	Big Salmon River	117
Coast W AK	Cheeneetnuk River	117	Up Yukon	Blind River	134
Coast W AK	Eek River	173	Up Yukon	Chandindu River	249
Coast W AK	Gagaryah River	190	Up Yukon	Klondike River	79
Coast W AK	George River	191	Up Yukon	Little Salmon River	100
Coast W AK	Gisasa River	188	Up Yukon	Mayo River	133
Coast W AK	Golsovia River	112	Up Yukon	Nisutlin River	56
Coast W AK	Goodnews River	368	Up Yukon	Nordenskiold River	55
Coast W AK	Takotna River	176	Up Yukon	Pelly River	140
Coast W AK	Mulchatna River	97	Up Yukon	Stewart River	99
Coast W AK	Stony River	93	Up Yukon	Takhini River	161
Coast W AK	Stuyahok River	87	Up Yukon	Tatchun Creek	169
Coast W AK	Togiak River	159	Up Yukon	Whitehorse Hatchery	242
Coast W AK	Tuluksak River	195	N AK Pen	Black Hills Creek	51
Coast W AK	Kisaralik River	191	N AK Pen	King Salmon River	131
Coast W AK	Kwethluk River	96	N AK Pen	Meshik River	42
Coast W AK	Naknek River	110	N AK Pen	Milky River	67
Coast W AK	Pilgrim River	72	N AK Pen	Nelson River	95
Coast W AK	Aniak River	252	N AK Pen	Steelhead Creek	93
Coast W AK	Salmon River - Pitka Fork	96	NW GOA	Deception Creek	67
Coast W AK	Tatlawiksuk River	191	NW GOA	Anchor River	200

Appendix II Table A2 continued

Reporting Group	Population	Samples	Reporting Group	Population	Samples
NW GOA	Benjamin Creek	205	NE GOA	Kelsall River	96
NW GOA	Chignik River	75	NE GOA	Klukshu River	174
NW GOA	Crescent Creek	164	NE GOA	King Salmon River	144
NW GOA	Crooked Creek Hatchery	306	NE GOA	Situk River	143
NW GOA	Deshka River	251	Coast SE AK	Crystal Lake Hatchery	397
NW GOA	Funny River	220	Coast SE AK	Deer Mountain Hatchery	147
NW GOA	Ayakulik River	136	Coast SE AK	Whitman Lake Hatchery	331
NW GOA	Karluk River	140	Coast SE AK	Andrew Creek	152
NW GOA	Juneau Creek	119	Coast SE AK	Blossom River	95
NW GOA	Kasilof River mainstem	321	Coast SE AK	Butler Creek	95
NW GOA	Kenai River mainstem	302	Coast SE AK	Chickamin River	56
NW GOA	Killey Creek	266	Coast SE AK	Clear Creek	166
NW GOA	Ninilchik River	162	Coast SE AK	Cripple Creek	143
NW GOA	Prairie Creek	52	Coast SE AK	Dudidontu River	86
NW GOA	Slikok Creek	95	Coast SE AK	Genes Creek	95
NW GOA	Talachulitna River	58	Coast SE AK	Hidden Falls Hatchery	155
NW GOA	Willow Creek	73	Coast SE AK	Humpy Creek	94
Copper	Bone Creek	78	Coast SE AK	Little Port Walter Hatchery	126
Copper	E. Fork Chistochina River	133	Coast SE AK	Kerr Creek	151
Copper	Tonsina River	75	Coast SE AK	Keta River	144
Copper	Gulkana River	211	Coast SE AK	King Creek	143
Copper	Indian River	50	Coast SE AK	Kowatua River	138
Copper	Kiana Creek	75	Coast SE AK	Little Port Walter Hatchery	150
Copper	Manker Creek	62	Coast SE AK	Little Tatsemenie River	143
Copper	Mendeltna Creek	144	Coast SE AK	Macaulay Hatchery	94
Copper	Otter Creek	128	Coast SE AK	Medvejie Hatchery	273
Copper	Sinona Creek	157	Coast SE AK	Nakina River	140
Copper	Tebay River	68	Coast SE AK	Tahltan River	95
NE GOA	Big Boulder Creek	178	Coast SE AK	Upper Nahlin River	130
NE GOA	Tahini River	169	BC	Big Qualicum River	144
NE GOA	Pullen Creek Hatchery	83	BC	Birkenhead River (Sp)	93

Appendix II Table A2 continued

Reporting Group	Population	Samples	Reporting Group	Population	Samples
BC	Bulkley River	91	BC	Sustut River	130
BC	Chilko River (Su)	246	BC	Torpy River (Su)	105
BC	Clearwater River (Su)	153	BC	Wannock River	144
BC	Conuma River	110	West Coast US	Alsea River (Fa)	93
BC	Damdochax Creek	65	West Coast US	Carson Hatchery (Sp)	96
BC	Ecstall River	86	West Coast US	Eel River (Fa)	88
BC	Harrison River	96	West Coast US	Forks Creek (Fa)	150
BC	Kateen River	96	West Coast US	Hanford Reach	191
BC	Kincolith Creek	115	West Coast US	Lower Deschutes River (Fa)	96
BC	Kitimat River	141	West Coast US	Lyons Ferry Hatchery (Su/Fa)	191
BC	Klinaklini River	83	West Coast US	Makah National Fish Hatch. (Fa)	94
BC	Kwinageese Creek	73	West Coast US	McKenzie River (Sp)	95
BC	Lower Adams River (Fa)	46	West Coast US	Sacramento River (Wi)	95
BC	Lower Atnarko River	144	West Coast US	Siuslaw River (Fa)	95
BC	Lower Kalum River	142	West Coast US	Soos Creek Hatchery (Fa)	119
BC	Louis River (Sp)	179	West Coast US	Klamath River	52
BC	Lower Thompson River (Fa)	100	West Coast US	Upper Skagit River (Su)	93
BC	Marble Creek	144			
BC	Morkill River (Su)	154			
BC	Middle Shuswap River (Su)	144			
BC	Nanaimo River	93			
BC	Nechako River (Su)	120			
BC	Nitinat River	104			
BC	Oweegee Creek	81			
BC	Porteau Cove	154			
BC	Quesnel River (Su)	144			
BC	Quinsam River	127			
BC	Robertson Creek	106			
BC	Salmon River (Su)	94			
BC	Sarita River	160			
BC	Stuart River (Su)	161			

Appendix II Table 1A: Single nucleotide polymorphisms included in the 84-SNP panel used for stock composition analysis of chum salmon bycatch samples from the 2023 Bering Sea B-season pollock trawl fishery.

Locus	Ploidy	SNPpos	Allele1	Allele2	Probe1	Probe2	Primer	Primer Conc. (uM)
Ots_AsnRS-60	2	1	T	C	TGAGTCCCTGACCAGC	AGTCCCCGACCAGC	CCGACGCCTCACTGAGT	0.16
Ots_E2-275	2	1	A	G	CCCCCATATTGCTG	CCCCACATTGCTG	GGTGCCACTTTAGTATAGCTGCTTA	0.16
Ots_ETIF1A	2	1	A	C	CAACTGAAGAAAATAATATG	CTGAAGAAAAGAATATG	TCTGAACTCACCAAAGGAACACTTG	0.16
Ots_FARSLA-220	2	1	G	A	CCTTGGATGGGATGTG	CCTTGGATAGGATGTG	GTTCGTGGGATTGTTCAATGTTCAT	0.16
Ots_FGF6A	2	1	G	T	CACGATTAGCAATGAACAA	CACGATTAGCAATTAACAA	TCAAAAATGTCTATCCAACAAATACTCTGAAAAATATTG	0.16
Ots_GH2	2	1	A	T	TGACTCTCAGCA[TA]CTG	TGACTCTCTGCA[TA]CTG	GCGTACTGAGCCTGGATGACA	0.08
Ots_GPDH-338	2	1	G	A	CCACTACTTAACGTGCTTT	CCACTACTTAACATGCTTT	CACTAAATATTCCTTATCATTTCATACTAAGTCTGAAGAA	0.32
Ots_GPH-318	2	1	C	T	ATCAAGCTGACGAACCA	CAAGCTGACAAACCA	GGTGATAACAGGTGTTGCACCAA	0.08
Ots_GST-207	2	1	C	T	ATGAGAGAGTCTTTCTCTGTT	ATGAGAGAGTCTTTTTCTGTT	GGAGAACATGCATCACCATTCAAG	0.16
Ots_GST-375	2	1	C	T	TTTCTTGTAGGCGTCAGAG	TCTTGTAGGCATCAGAG	CAGCCCGTCCCAAAATCAAG	0.16
Ots_GTH2B-550	2	1	C	G	ATAACATCTGCAGCATTAA	ATAACATGTGCAGCATTAA	CACAGGAAGGACGTGTTTTGATG	0.32
Ots_hnRNPL-533	2	1	A	T	CATTTACCAGTTCTCACACAC	TTTACCAGTTCACACACAC	TCTTTGATATTGAGCTCATAAAAGCAAGGT	0.16
Ots_HSP90B-100	2	1	C	T	TCTATGGTGTGATTCATT	TTCTATGGTGTAATTCATT	CACCTTAGTTCCACGCAACATG	0.16
Ots_IGF-I.1-76	2	1	A	T	CTGCCTAGTTAAATAAAATA	CTGCCTAGTTAAATTAAATA	GGTAGGCCGTCAGTGTAAAATAAGT	0.32
Ots_Ikaros-250	2	1	G	A	ACAGAAGATTTTCGGCTGC	ACAGAAGATTTTCGACTGC	GAGGCTGACTTGGACTTTGC	0.16
Ots_LEI-292	2	1	G	A	CATCATGTCAGGCCTG	ATCATGTCAAGCCTG	CACCTGAACCTCCACTGTGT	0.16
Ots_LWSop-638	2	1	T	C	TTTAACAAGAAAATTATACATTTC	CAAGAAAGTTATACATTTC	CAATTACTCTTTCTCAGCCCTGTGT	0.16
Ots_MHC1	2	1	G	A	CATCATCCCGTGAGCAG	TCATCATCCCATGAGCAG	GTCCACATTCTCCAGTACATGTATGG	0.16
Ots_MHC2	2	1	T	G	CTGGAGCGTTTCTGTA	CTGGAGCGTGTCTGTA	GTCCTCAGCTGGGTCAAGAG	0.16
Ots_NOD1	2	1	C	G	CCAACGGCGACTTG	CCAACGCCGACTTG	GTGCTGCAGGAACCATGTG	0.08
Ots_P450	2	1	T	A	CCCCGAAGTACTTTT	CCCGAAGAACTTTT	TGAGCGAGATTTATCAAACTGTCAAAGA	0.32
Ots_Prl2	2	1	A	G	ATGTATTGTTCATTTAATG	TGTATTGTTCGTTTAATG	CCTGGTCTGTTTGTGATCAAGATG	0.16
Ots_RAG3	2	1	C	T	CTCTACAGTATGAACTATG	CTCTACAATATGAACTATG	CATTTCCACGAAAAGCCAGATGAC	0.32
Ots_RFC2-558	2	1	A	-	TGCATGTAACAAATAACAT	TGCATGTAACATAACAT	AAGGTCTACTCCGGTTGTATTCGGT	0.08
Ots_S7-1	2	1	T	C	TACAGGAGATAAGGTCGCA	CAGGAGATAGGGTCGCA	TGCCATCATAAACAACCTAACAAGTAACT	0.32
Ots_SClkF2R2-135	2	1	A	T	ATTCAAAGTCAAATTTT	ATTCAAAGTCTAATTTT	CCAAATACAGACCAGCTACTTGTGT	0.16
Ots_SERPC1-209	2	1	A	T	CATTCAGCTTTTTTTC	ATTCAGCATTTTTTC	CTAAGTTCTTCCTGCCTAATGTGGAT	0.16
Ots_SL	2	1	A	G	TCAAAGATATGATTCAATTAA	AAGATATGGTTCAATTAA	AATATTGGCTTTCTGAGAATGCATTTGG	0.16
Ots_SWS1op-182	2	1	T	A	ATGTACTTTAACGATTCATTT	ATGTACTTTAACGTTTCATTT	TCAAAGACATCGAACACAAGAACGA	0.32
Ots_TAPBP	2	1	C	T	CAGCTGTCCAGTTCTG	CAGTTGTCCAGTTCTG	TTTCTCATCCTTCTCTCTTCCAGTCT	0.08
Ots_Tnsf	2	1	A	G	TGCTCCAGATCTC	TGCTCCAGGTCTC	GCCAATACGGGTTCTGAACTGT	0.16
Ots_u202-161	2	1	T	A	AGCTAGTGCTTAGCAGCTA[AC]	AGCTAGTGCATAGCAGCTA[AC]	CACTTTTGACTTTACATGGAACTTAACTCAT	0.32
Ots_u211-85	2	1	C	T	TCCCAAAGTCGAGTGTG	CCCAAAGTCAAGTGTG	TGGTGAGAGCAGCTTTAAATGTCTT	0.16
Ots_U212-158	2	1	G	A	CTGGAAGAAGGCCTC	CTGGAAAAAGGCCTC	CCCCATATGAGACGCTACAGTAATG	0.16
Ots_u4-92	2	1	T	C	CTGTGTTGAATTTAACATAAT	TCTGTGTTGAATTTAACGTAAT	ATCCAAGGAGCCCCATTAAAGATTT	0.16
Ots_u6-75	2	1	C	T	TTAGTCAACTGTTGTTTTT	TTAGTCAACTGTTATTTTT	GAAAAAGTAAAGTAAAAGTAAAGTATTATACCACTAAAGACAAT	0.32
Ots_zP3b-215	2	1	G	T	CCAAATATCCTACCCGTGATG	CAAATATCCTACCAGTGATG	TGCTGAGGACCATCTGCAATTC	0.16