Inseason analysis of chum salmon (*Oncorhynchus keta*) bycatch from the shoreside sector of the Bering Sea Aleutian Islands walleye pollock (*Gadus chalcogrammus*) trawl fishery

Results from Statistical Week 38

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Summary

This is the thirteenth inseason analysis of the 2025 chum salmon *Oncorhynchus keta* bycatch from the shoreside sector of the Bering Sea and Aleutian Islands (BSAI) walleye pollock *Gadus chalcogrammus* trawl fishery. In statistical week 38 there were 38,674 chum salmon caught by the shoreside sector. Of that total catch, 2338 were sampled, 615 were selected for genotyping, and 581 (1.5% of the total catch) were successfully genotyped to determine the genetic stock composition of the bycatch. E GOA/PNW comprised the largest proportion of the chum salmon bycatch (79.4%), 30,703 chum salmon. Western Alaska (Coastal Western Alaska and Upper/Middle Yukon combined) comprised 2.3% of the bycatch (898 fish). Since statistical week 24 a total of 64,211 chum salmon have been caught by the shoreside sector. Of those chum salmon, an estimated 4387 were of Western Alaska (Coastal Western Alaska and Upper/Middle Yukon River) origin.

Chum salmon bycatch from statistical week 38 from the shoreside sector of the BSAI walleye pollock trawl fishery and the cumulative catch over all statistical weeks analyzed from the B season. For individual week estimates see Appendix I.

	Stat Week 38 (PSC = 38,674; n = 694)					B season
Region	Est. num.	Est. CI	Mean	2.5%	97.5%	Est. num.
SE Asia	1,864	1,175-2,663	0.048	0.030	0.069	5956
NE Asia	4,870	3,817-6,030	0.126	0.099	0.156	13269
W Alaska	893	460-1,456	0.023	0.012	0.038	3576
Up/Mid Yukon	5	0-133	0.000	0.000	0.003	811
SW Alaska	338	0-876	0.009	0.000	0.023	868
E GOA/PNW	30,703	29,351-31,981	0.794	0.759	0.827	39730

Introduction

Chum salmon (*Oncorhynchus keta*) incidental catch occurs within the Federally Managed midwater trawl fishery for walleye pollock (*Gadus chalcogrammus*) in the Bering Sea and Aleutian Islands (BSAI). Salmon are managed as a prohibited species catch (referred to as bycatch) and are highly regulated. The fishery is composed of three distinct processing sectors, each with different operational constraints. Within the shoreside sector, smaller vessels which lack the ability to process hauls at-sea often fish closer to the Alaska Peninsula. Differences in the stock specific distribution of chum salmon within the Bering Sea result in the shoreside sector often catching the largest proportion and number of Western Alaska (Coastal Western Alaska and Upper/Middle Yukon River genetic groups combined) chum salmon bycatch relative to the catcher processor and mothership sectors (Kondzela et al. 2017). Currently, annual estimates of genetic stock composition are produced by the genetics program of NOAA's Alaska Fishery Science Center (AFSC) and presented to the North Pacific Fisheries Management Council (NPFMC) at their April Council meeting (~3 months after the end of the B season). Within the fishery, all chum salmon bycatch is enumerated by the North Pacific Observer Program and 1 in 30 are sampled for length, weight, sex, and a tissue sample and a scale are sent to the AFSC genetics program for analysis. In 2024, a project was initiated by Bristol Bay Science Research Institute (BBSRI) to sample the bycatch from the shoreside sector of the fleet in order to obtain weekly estimates of genetic stock composition. This report outlines the results the analysis of the chum salmon bycatch from statistical week 38 (14 Sep - 20 Sep).

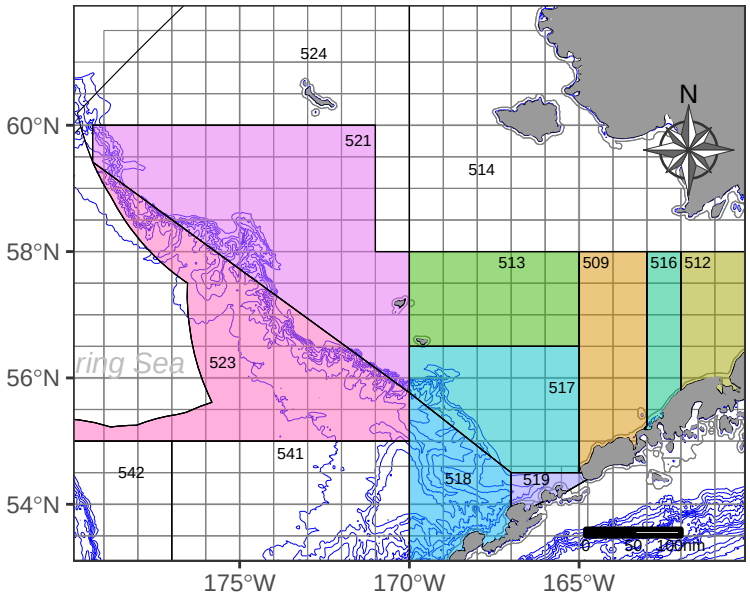

Figure 1: Map of National Marine Fisheries Service management areas within the Bering Sea and Aleutian Islands. Colored areas indicate management areas where chum salmon bycatch has historically occurred.

Methods

Bycatch Sampling

Port samplers, employed by BBSRI, sampled pollock hauls delivered to processing plants in Dutch Harbor and Akutan. The target sampling rate for statistical week 38 was variable rates ranging from to 1 in 20 to 1 in 5 chum salmon (Table 1). After NMFS observers had processed the offload, BBSRI technicians took

a length measurement, scale sample for age estimation, and a fin clip for genetic analyses. Fin clips were stapled onto a Whatman card labelled with haul-level information from the delivery. Scale samples were mounted on gum cards and stored for post-season analysis. Sampling and genotyping data were sent to the AFSC genetics program for analysis.

Genotyping

All tissue samples collected were sent to the BBSRI staffed genetics laboratory in Dutch Harbor for processing. Genomic DNA was extracted from dried fin clips with Macherey-Nagel (Allentown, PA) NucleoSpin Tissue kits. Extracted DNA was amplified for 96 single nucleotide polymorphism markers (SNPs) with a Fluidigm (San Francisco, CA) BioMark X9 system with 96.96 Dynamic Array integrated fluidic circuit (IFC). Each of the 9,216 parallel reactions consisted of 50–500 $\eta g/\mu l$ DNA, 1X Fast GT Sample Loading Reagent (Fluidigm), 1X TaqMan GTXpress Master Mix (Applied Biosystems), 10X Custom ABI TaqMan SNP Genotyping Assay (Applied Biosystems), 1X Assay Loading Reagent (Fluidigm), and 2.5X ROX Reference Dye (Invitrogen). The temperature profile for amplification was thermal mixing at 60°C for 10 min and 70°C for 30 min followed by "Hot-Start" denaturation at 95°C for 2 min and 40 cycles of amplification (denaturation at 95°C for 2 s and annealing at 60°C for 20 s). After amplification, genotypes were scored with BioMark Genotyping Analysis software.

Genetic Stock Identification

Mixtures were created by grouping sampled fish into temporal groups (statistical week) from non-debriefed observer data provided by the Alaska Regional Office and linked to genetic samples by BBSRI. Individual samples with fewer than 80% of their multilocus genotype scored were dropped from analyses. Additionally, if individuals are identified to have matching multilocus genotypes (>95% similarity) the individuals with fewer scored loci was dropped. Genetic stock identification was performed with the conditional genetic stock identification model in the R package *rubias* (Moran and Anderson 2019) following the methods used in NOAA's annual bycatch reports. Briefly, baseline populations were grouped into seven regions adapted from (2010): Southeast Asia (SE Asia), Northeast Asia (NE Asia), Coastal Western Alaska (W Alaska), Upper/Middle Yukon (Up/Mid Yukon), Southwest Alaska (SW Alaska), and the Eastern GOA/Pacific Northwest (E GOA/PNW). For all estimates, the Dirichlet prior parameters for the stock proportions were defined by region to be $1/(GC_g)$, where C_g is the number of baseline populations in region g, and G is the number of regions. To ensure convergence to the posterior distribution, seven separate MCMC chains of 100,000 iterations (burn-in of 50,000) of the non-bootstrapped model were run, with each chain starting at disparate values of stock 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 (MCMC chains of 100,000 iterations, burn-in of 50,000, 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 $0.5E^{-6}$. This statistic may be more useful than the credible interval for assessing the presence or absence of minor stocks. The estimated number of fish for each genetic group, and associated uncertainty, is estimated as the mean stock proportion and 95% credible intervals multiplied by the total bycatch in a given statistical week.

Results

Chum Salmon Bycatch

In statistical week 38 of the BSAI pollock trawl fishery there were 38,674 chum salmon caught by the shoreside sector. The majority of these chum salmon were caught in NMFS area 517. Since statistical week 24 a total of 64,211 chum salmon have been caught by the shoreside sector. Chum have been caught in six statisical areas. The majority of chum salmon caught have come from NMFS area 517 (Figure 2).

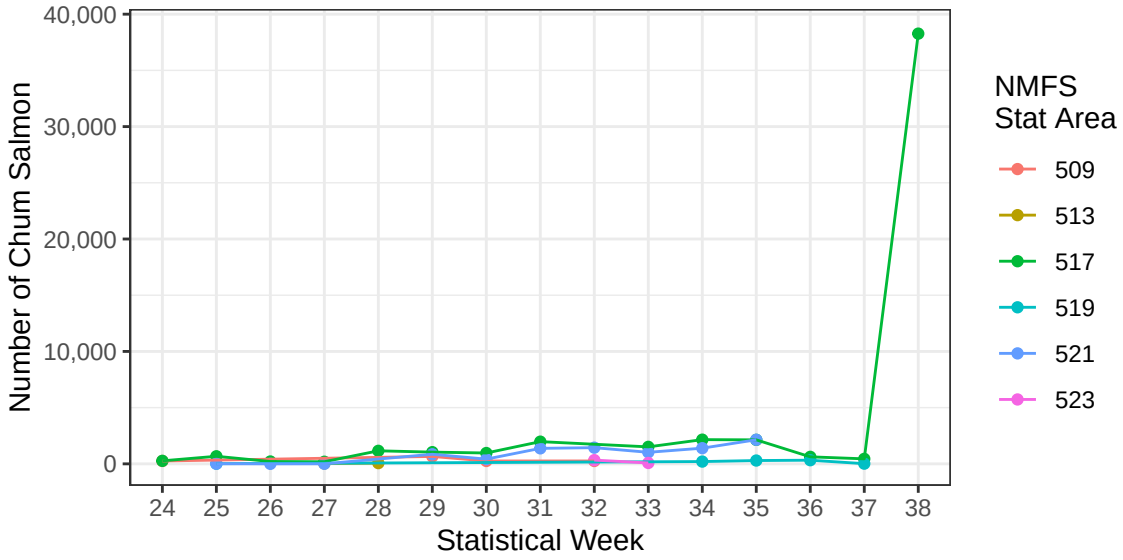

Figure 2: Number of chum salmon caught by the shoreside sector of the Bering Sea pollock trawl fishery by statistical week. Weekly totals for which fewer than 4 vessels made deliveries have been omitted.

Sampling & Genotyping

In statistical week 38, BBSRI technicians sampled hauls delivered to Dutch Harbor and Akutan. A total of 2,338 chum salmon were sampled for an overall sampling rate of 0.06 or ~1/15. Not all chum salmon sampled were genotyped. Of the 2,338 samples collected, 615 were selected for genotyping with 581 (24.9% of those sampled) successfully genotyped.

Table 1: Chum salmon bycatch sampling and genotyping information for statistical week 38 for the shoreside processing plants. Sampling is grouped by processing plant and target sampling rate. Chum genotyped is the number of chum that were amplified for the marker panel. Chum analyzed are those chum that were genotyped for at least 80% of the genetic markers after potential duplicate samples were removed.

Plant	Target Sample Rate	Total Chum	Chum Sampled	Sample Rate	Chum Genotyped	Chum Analyzed	Genotype Rate
P1	0.20	275	54	0.196	6	6	0.022
P2	0.05	2686	127	0.047	51	44	0.016
P2	0.20	83	16	0.193	3	3	0.036
P3	0.05	16773	828	0.049	255	247	0.015
P3	0.10	1646	164	0.100	26	26	0.016
P3	0.20	996	199	0.200	15	15	0.015
P4	0.05	10170	508	0.050	159	145	0.014
P4	0.20	247	49	0.198	3	3	0.012
P5	0.05	5120	256	0.050	87	84	0.016
P5	0.20	678	137	0.202	10	8	0.012
Total		38674	2338	0.060	615	581	0.015

Stock Specific Catches

In statistical week 38, 6 of the six genetic groups were present in the bycatch. The E GOA/PNW reporting group comprised the largest proportion of the chum salmon bycatch (79.4%), 30,703 of the total bycatch of 38,674 chum salmon. The second largest contributing regional group to the bycatch was NE Asia with 12.6% or 4870 fish. Western Alaska (Coastal Western Alaska and Upper/Middle Yukon combined) comprised 2.3% of the bycatch (898 fish). Asia (NE Asia and SE Asia combined) comprised 17.4% of the bycatch (6734 fish).

Table 2: Chum salmon bycatch from statistical week 38 of the shoreside sector BSAI trawl fishery (PSC = 38,674; n = 694)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	1,864	1,175-2,663	0.048	0.030	0.069	0.00	1.00
NE Asia	4,870	3,817-6,030	0.126	0.099	0.156	0.00	1.00
W Alaska	893	460-1,456	0.023	0.012	0.038	0.00	1.00
Up/Mid Yukon	5	0-133	0.000	0.000	0.003	0.74	1.00
SW Alaska	338	0-876	0.009	0.000	0.023	0.04	1.00
E GOA/PNW	30,703	29,351-31,981	0.794	0.759	0.827	0.00	1.00

Of the 64,211 chum salmon caught by the shoreside sector since statistical week 24, the largest contributing genetic group to the bycatch has been the E GOA/PNW, with a point estimate of 39,730 chum salmon. Since

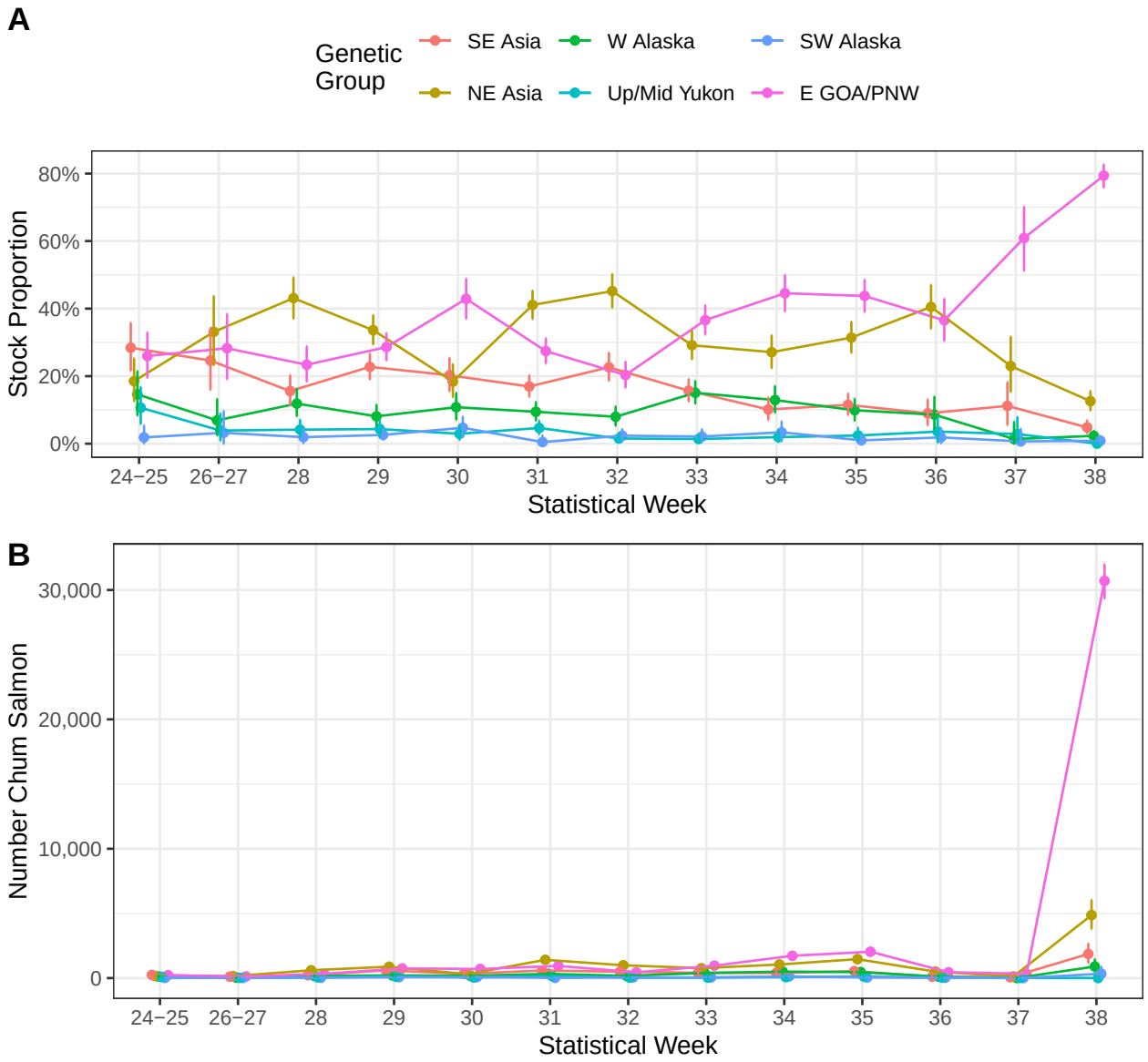

Figure 3: Chum salmon bycatch proportion (A) and total number of fish (B) for the B season of the shoreside sector pollock trawl fishery. Error bars represent 95% credible intervals.

the start of the B season, the Coastal Western Alaska (W Alaska) group has comprised an average of 9.2% of the bycatch, with the shoreside sector having caught a total of 3,576 chum salmon from this genetic group. The Southwest Alaska (SW Alaska) regional group made up an average of 2.1% of the bycatch over the 15 weeks, with a total of 868 chum salmon harvested to date. The Upper/Middle Yukon (Up/Mid Yukon) group accounted for an average of 3.4% of the chum salmon bycatch, with 811 fish harvested since statistical week 24-25.

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Appendix I - 2025 GSI Results

Prior week stock composition estimates of chum salmon bycatch from the 2025 shoreside sector's Bering Sea and Aleutian Islands, B-season pollock trawl fishery.

Stat Week 24-25 (PSC = 855; n = 169)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	243	185-305	0.284	0.216	0.357	0.00	1.00
NE Asia	158	108-216	0.185	0.126	0.252	0.00	1.00
W Alaska	125	72-184	0.146	0.084	0.215	0.00	1.00
Up/Mid Yukon	91	50-143	0.106	0.059	0.167	0.00	1.00
SW Alaska	16	0-47	0.018	0.000	0.054	0.06	1.00
E GOA/PNW	222	167-281	0.260	0.195	0.329	0.00	1.00

Stat Week 26-27 (PSC = 451; n = 87)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	111	72-154	0.246	0.160	0.342	0.00	1.00
NE Asia	149	105-197	0.331	0.233	0.437	0.00	1.00
W Alaska	31	11-60	0.069	0.025	0.132	0.00	1.00
Up/Mid Yukon	18	4-40	0.039	0.009	0.090	0.00	1.00
SW Alaska	15	0-43	0.032	0.000	0.096	0.08	1.00
E GOA/PNW	127	86-173	0.283	0.191	0.384	0.00	1.00

Stat Week 28 (PSC = 1,404; n = 277)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	219	160-285	0.156	0.114	0.203	0.00	1.00
NE Asia	605	520-691	0.431	0.370	0.492	0.00	1.00
W Alaska	167	114-227	0.119	0.081	0.162	0.00	1.00
Up/Mid Yukon	58	27-99	0.042	0.019	0.071	0.00	1.00
SW Alaska	27	2-63	0.019	0.001	0.045	0.01	1.00
E GOA/PNW	328	258-404	0.234	0.184	0.288	0.00	1.00

Stat Week 29 (PSC = 2,618; n = 505)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	596	498-698	0.227	0.190	0.267	0.00	1.00
NE Asia	880	770-995	0.336	0.294	0.380	0.00	1.00
W Alaska	212	137-301	0.081	0.052	0.115	0.00	1.00
Up/Mid Yukon	113	52-183	0.043	0.020	0.070	0.00	1.00
SW Alaska	68	31-116	0.026	0.012	0.044	0.00	1.00
E GOA/PNW	749	646-857	0.286	0.247	0.327	0.00	1.00

Stat Week 30 (PSC = 1,644; n = 280)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	333	256-417	0.203	0.156	0.253	0.00	1.00
NE Asia	302	227-387	0.184	0.138	0.235	0.00	1.00
W Alaska	178	117-247	0.108	0.071	0.150	0.00	1.00
Up/Mid Yukon	48	18-91	0.029	0.011	0.055	0.00	1.00
SW Alaska	78	32-132	0.047	0.020	0.080	0.00	1.00
E GOA/PNW	705	609-803	0.429	0.370	0.488	0.00	1.00

Stat Week 31 (PSC = 3,434; n = 607)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	582	478-694	0.169	0.139	0.202	0.00	1.00
NE Asia	1,411	1,268-1,555	0.411	0.369	0.453	0.00	1.00
W Alaska	324	236-423	0.094	0.069	0.123	0.00	1.00
Up/Mid Yukon	160	97-233	0.046	0.028	0.068	0.00	1.00
SW Alaska	16	0-84	0.005	0.000	0.024	0.35	1.01
E GOA/PNW	941	816-1,072	0.274	0.238	0.312	0.00	1.00

Stat Week 32 (PSC = 2,194; n = 427)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	496	409-590	0.226	0.186	0.269	0.00	1.00
NE Asia	991	884-1,101	0.452	0.403	0.502	0.00	1.00
W Alaska	175	117-241	0.080	0.053	0.110	0.00	1.00
Up/Mid Yukon	34	10-69	0.015	0.005	0.031	0.00	1.00
SW Alaska	52	21-94	0.024	0.009	0.043	0.00	1.00
E GOA/PNW	446	364-532	0.203	0.166	0.243	0.00	1.00

Stat Week 33 (PSC = 2,622; n = 515)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	411	328-501	0.157	0.125	0.191	0.00	1.00
NE Asia	764	656-877	0.292	0.250	0.335	0.00	1.00
W Alaska	395	311-486	0.151	0.119	0.185	0.00	1.00
Up/Mid Yukon	36	15-69	0.014	0.006	0.026	0.00	1.00
SW Alaska	55	12-112	0.021	0.005	0.043	0.00	1.00
E GOA/PNW	959	847-1,075	0.366	0.323	0.410	0.00	1.00

Stat Week 34 (PSC = 3,873; n = 354)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	392	274-529	0.101	0.071	0.137	0.00	1.00
NE Asia	1,050	866-1,241	0.271	0.224	0.320	0.00	1.00
W Alaska	500	357-660	0.129	0.092	0.170	0.00	1.00
Up/Mid Yukon	75	20-151	0.019	0.005	0.039	0.00	1.00
SW Alaska	130	28-255	0.034	0.007	0.066	0.00	1.00
E GOA/PNW	1,725	1,518-1,936	0.446	0.392	0.500	0.00	1.00

Stat Week 35 (PSC = 4,657; n = 436)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	536	398-691	0.115	0.085	0.148	0.00	1.00
NE Asia	1,463	1,255-1,680	0.314	0.269	0.361	0.00	1.00
W Alaska	462	317-619	0.099	0.068	0.133	0.00	1.00
Up/Mid Yukon	113	41-219	0.024	0.009	0.047	0.00	1.00
SW Alaska	46	0-120	0.010	0.000	0.026	0.04	1.00
E GOA/PNW	2,038	1,819-2,260	0.438	0.391	0.485	0.00	1.00

Stat Week 36 (PSC = 1,232; n = 239)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	111	68-161	0.090	0.055	0.131	0.00	1.00
NE Asia	499	420-579	0.405	0.341	0.470	0.00	1.00
W Alaska	106	53-171	0.086	0.043	0.139	0.00	1.00
Up/Mid Yukon	44	4-96	0.036	0.003	0.078	0.01	1.00
SW Alaska	23	2-56	0.018	0.001	0.046	0.00	1.00
E GOA/PNW	450	375-528	0.365	0.305	0.429	0.00	1.00

Stat Week 37 (PSC = 553; n = 105)

Region	Est. num.	Est. CI	Mean	2.5%	97.5%	P=0	SF
SE Asia	62	31-101	0.112	0.055	0.182	0.00	1.00
NE Asia	127	85-175	0.230	0.154	0.317	0.00	1.00
W Alaska	8	0-36	0.014	0.000	0.065	0.40	1.00
Up/Mid Yukon	16	2-44	0.028	0.004	0.079	0.00	1.00
SW Alaska	4	0-24	0.007	0.000	0.044	0.46	1.00
E GOA/PNW	337	283-388	0.609	0.512	0.702	0.00	1.00