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ABSTRACT

A genetic analysis of samples from the Chinook salmon (*Oncorhynchus tshawytscha*) Prohibited Species Catch (bycatch) of the 2016 Gulf of Alaska (GOA) trawl fisheries for walleye pollock (*Gadus chalcogrammus*) and rockfish (*Sebastes* spp.), was undertaken to determine the stock composition of the sample sets. Samples were genotyped for 43 single nucleotide polymorphism (SNP) DNA markers and results were estimated using the Alaska Department of Fish and Game SNP baseline. In 2016, 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. This was the third year for this sampling protocol and which resulted in the largest available genetic sample set to date with 24% of the estimated salmon bycatch from the pollock fishery successfully genotyped. Based on analysis of 4,962 Chinook salmon bycatch samples, British Columbia (42%), West Coast US (40%), and Coastal Southeast Alaska (15%) comprised the largest stock groups, at an estimated 8,602, 8,301, and 3,080 Chinook salmon, respectively, out of 20,589 fish total. In 2016, genetic samples from the bycatch of the GOA rockfish CV fishery were collected by the fishing industry using a census sampling protocol. Based on the genotyping of 493 Chinook salmon bycatch samples collected from this fishery in NMFS Statistical Areas 620 and 630, West Coast US stocks represented the largest stock group (62%) with smaller contributions from British Columbia (27%), Coastal Southeast Alaska (7%), and Northwest GOA (4%) stock groups.

CONTENTS

INTRODUCTION

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 geographic origin and stock composition of salmon caught in federally managed fisheries is essential to understanding whether fisheries management could address conservation concerns. This report provides genetic stock identification results for Chinook salmon Prohibited Species Catch (bycatch) samples collected in the GOA from the trawl fisheries for walleye pollock (*Gadus chalcogrammus*) and catcher vessel (CV) trawl fisheries for rockfish (*Sebastes* spp.). The National Marine Fisheries Service (NMFS) and Alaska Department of Fish and Game (ADF&G) geographical statistical areas associated with the groundfish fishery are shown in Figure 1 and are used later in the report 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, 2017; Guyon et al. 2014, 2015a,b; Larson et al. 2013). For additional information regarding background and methodology refer to the Chinook salmon bycatch report prepared previously for the 2008 Bering Sea trawl fishery (Guyon et al. 2010).

The goal of this report is to present stock composition estimates for samples collected from the bycatch of the 2016 GOA federal trawl fisheries. Owing to robust sample sizes, stock composition estimates have been applied to bycatch numbers for the first time. 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.

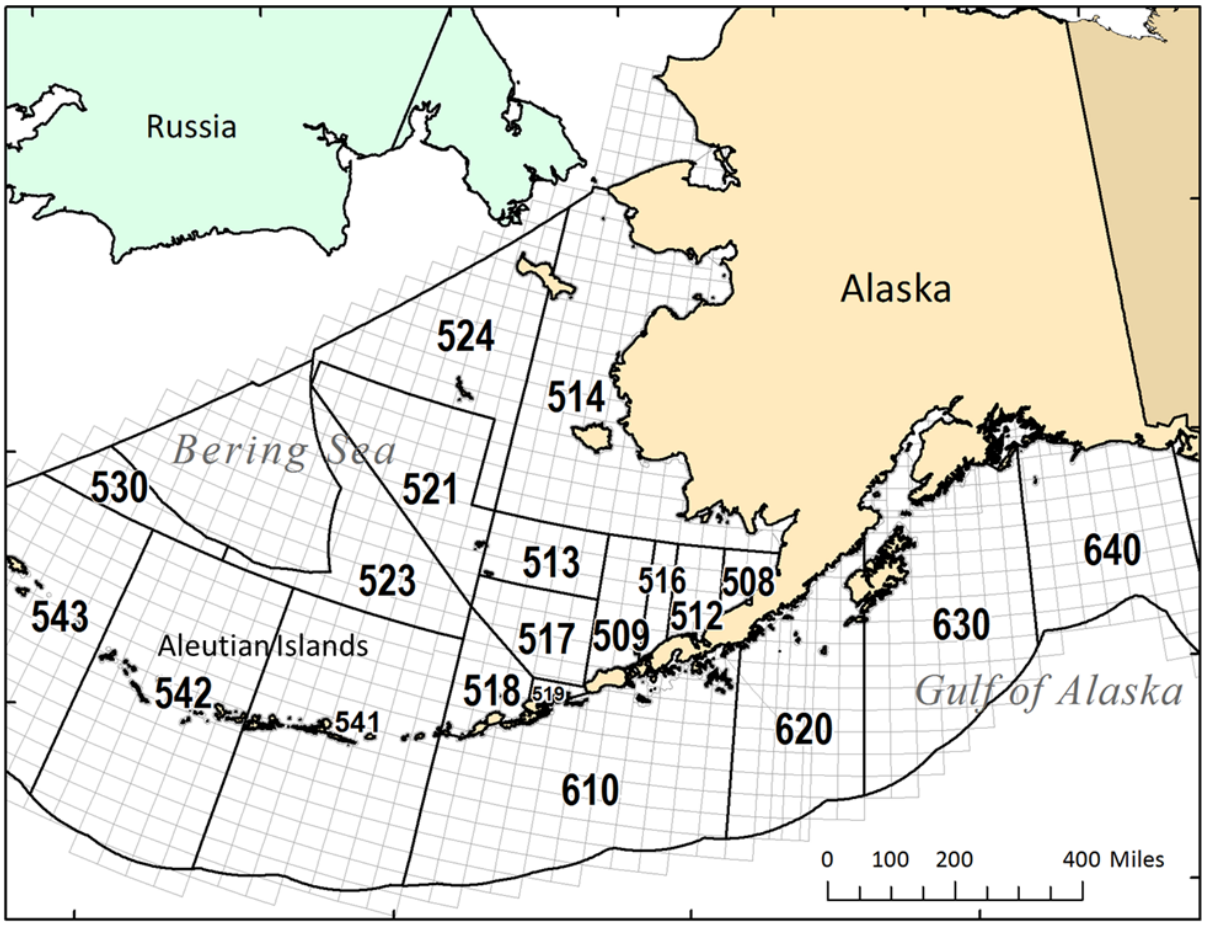

Figure 1. -- NMFS (outlined in black) and ADF&G (outlined in light gray) statistical areas associated with the Bering Sea and Gulf of Alaska (Areas 610-640) groundfish fisheries.

SAMPLE DISTRIBUTION

GOA Pollock Trawl Fishery

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 Observer Program (Observer Program) lacked the ability to know in advance

the delivery 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). Samples of axillary process tissue (AXP) for genetic analysis were collected throughout 2016 from the GOA. AXPs were stored in coin envelopes which were labeled, frozen, and shipped to the AFSC's Auke Bay Laboratories (ABL). Scales were collected as an additional source of tissue for genetic analysis, and for ageing pending available funding. The majority of the Chinook salmon bycatch genetic tissue samples were derived from the bottom and midwater pollock trawl fishery. The 11 samples identified as originating from a non-pollock fishery (from trips in which the predominant target species by weight was not pollock) were removed from the analyses.

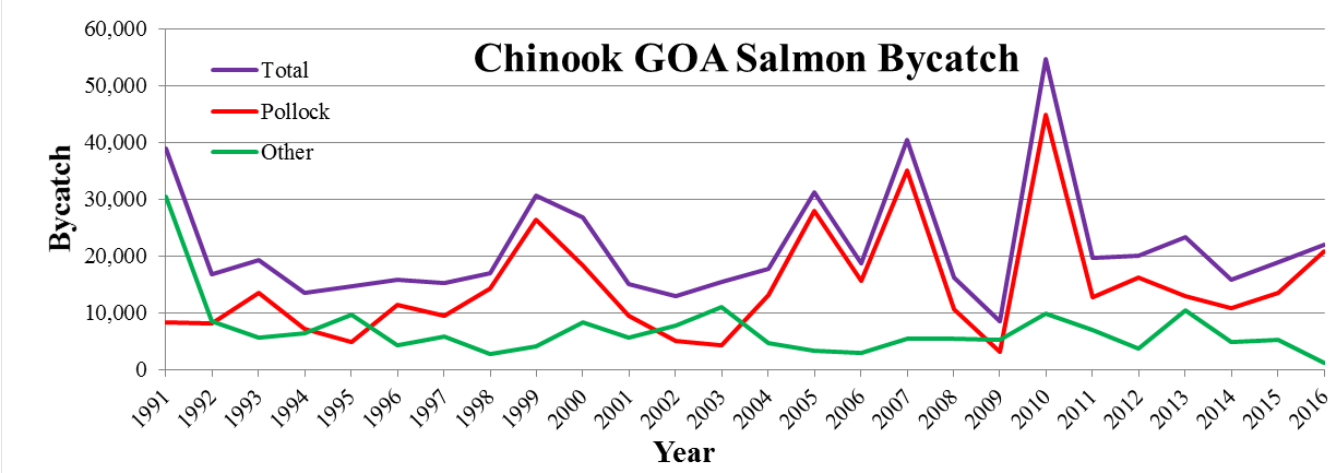

Figure 2. -- Yearly estimates for Chinook salmon bycatch from the Gulf of Alaska (GOA) trawl fisheries (NMFS 2018).

In 2016, an estimated 20,882 Chinook salmon were caught in the GOA pollock trawl fisheries (NMFS 2018). The year with the highest overall Chinook bycatch in the GOA was 2010 (Fig. 2) when an estimated 44,819 fish were caught. The genotyped (genetic) sample set for the

2016 Chinook salmon bycatch was 4,962 fish, a sampling rate of 23.76% of the estimated catch of the pollock trawl fishery. This is the largest sample set to date by both number and proportion in the GOA pollock trawl fishery.

Potential spatial and temporal biases associated with the 2016 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 (Fig. 3) and by statistical area and week (Fig. 4). The 293 Chinook salmon caught from NMFS Area 649 were not sampled.

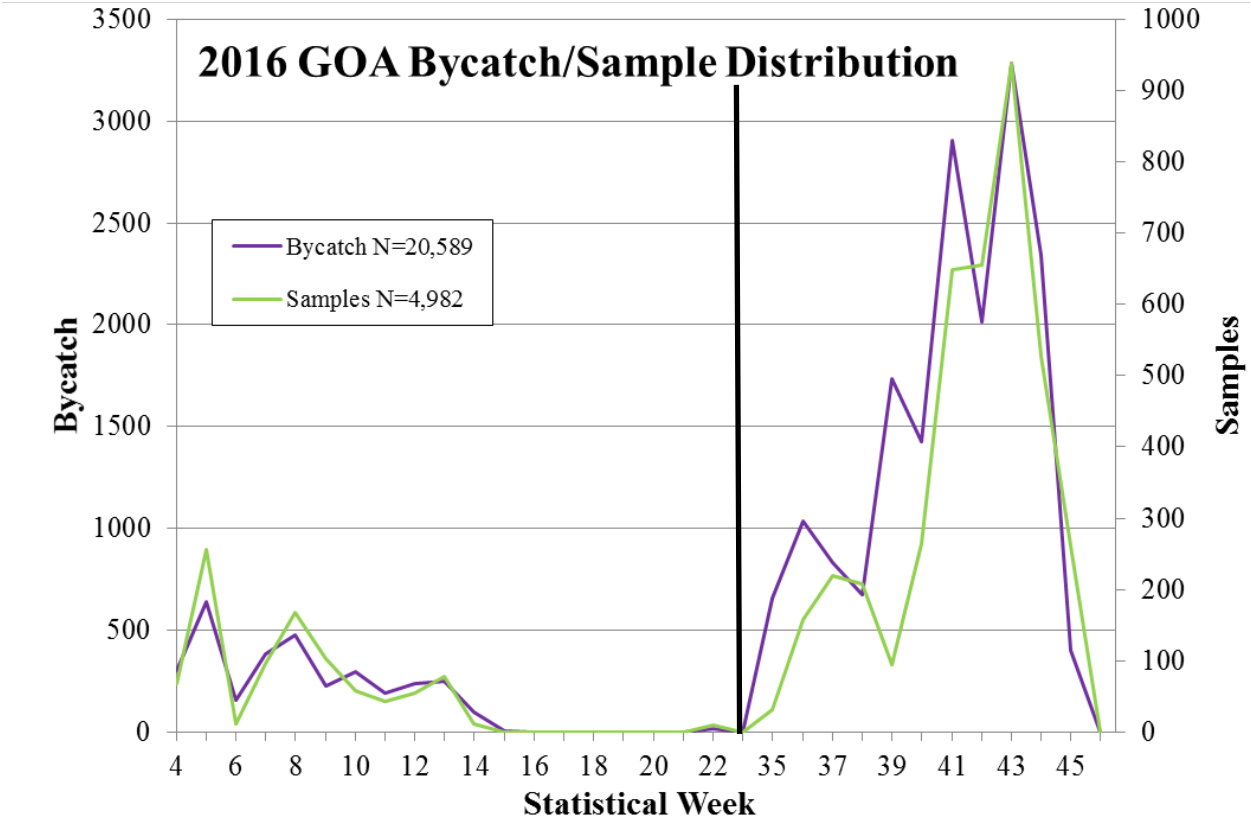

Figure 3. -- Estimated number of Chinook salmon bycatch and genetic samples by statistical week. from the 2016 Gulf of Alaska pollock trawl fishery. The line separates weeks 22 and 35 when no fishing occurred.

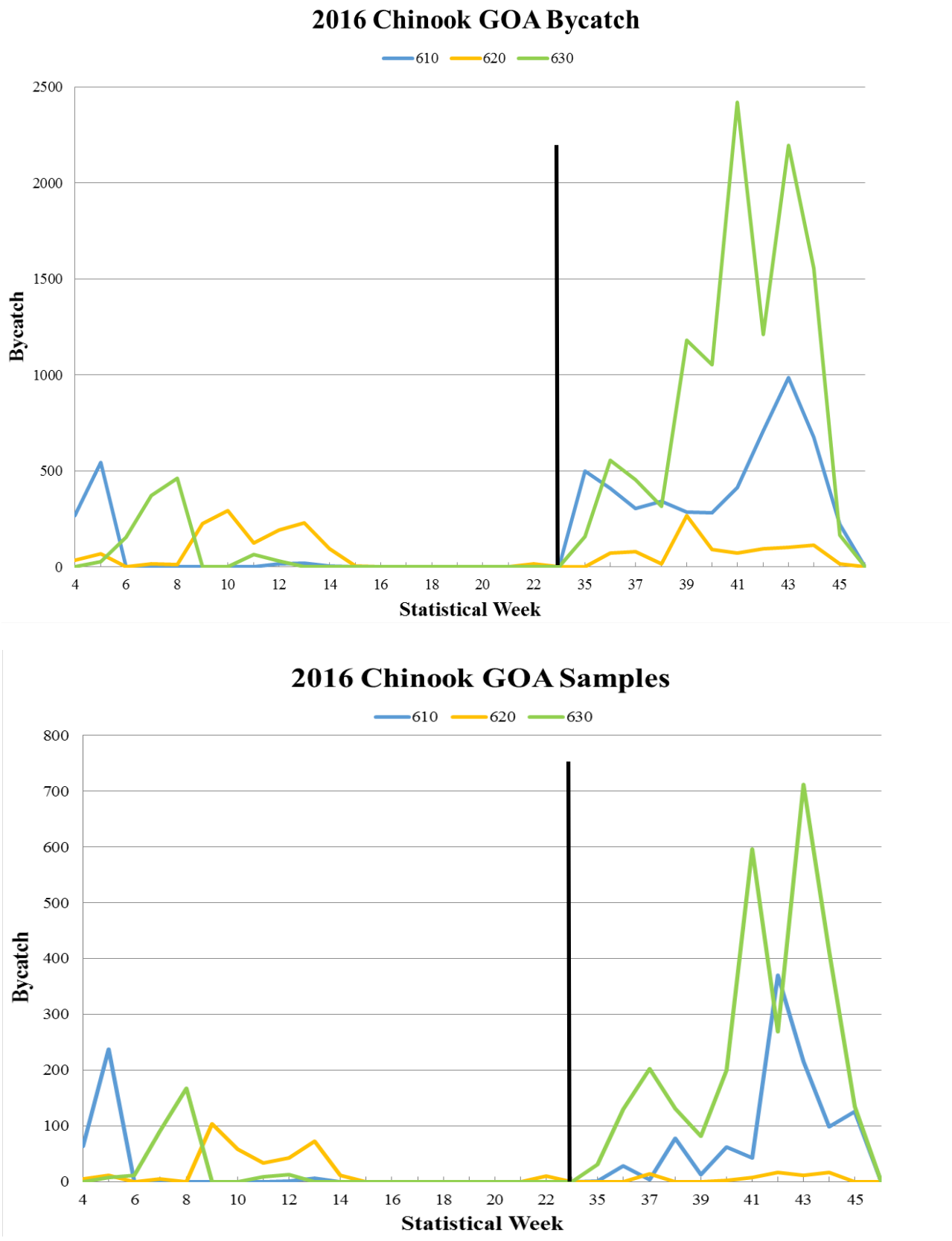

Figure 4. -- Estimated number of Chinook salmon bycatch (top) and available genetic samples (bottom) by statistical week and NMFS area from the 2016 Gulf of Alaska pollock trawl fishery. The line separates weeks 22 and 35 when no fishing occurred.

GOA Rockfish CV Trawl Fishery

Samples were collected from the Chinook salmon bycatch of the federally managed 2016 GOA CV rockfish trawl fishery by the Alaska Groundfish Data Bank (AGDB) for analysis at the ABL. Although there was no requirement for sample collection, the AGDB implemented a census approach in 2013 (Guyon et al. 2015b), 2014 (Guthrie et al. 2016), 2015 (Guthrie et al. 2017), and 2016 whereby genetic samples (AXPs) and biological information were collected from every Chinook salmon encountered in the bycatch. Between 2 May and 15 November 2016 (week numbers 19-47), genetic samples were collected from 496 Chinook salmon of which one sample was missing (N = 495). Because samples were taken from the entire bycatch, the sample distribution is considered to be the bycatch distribution. The bycatch enumeration by statistical week is shown in Figure 5 and the sample collection area is approximated in Figure 6.

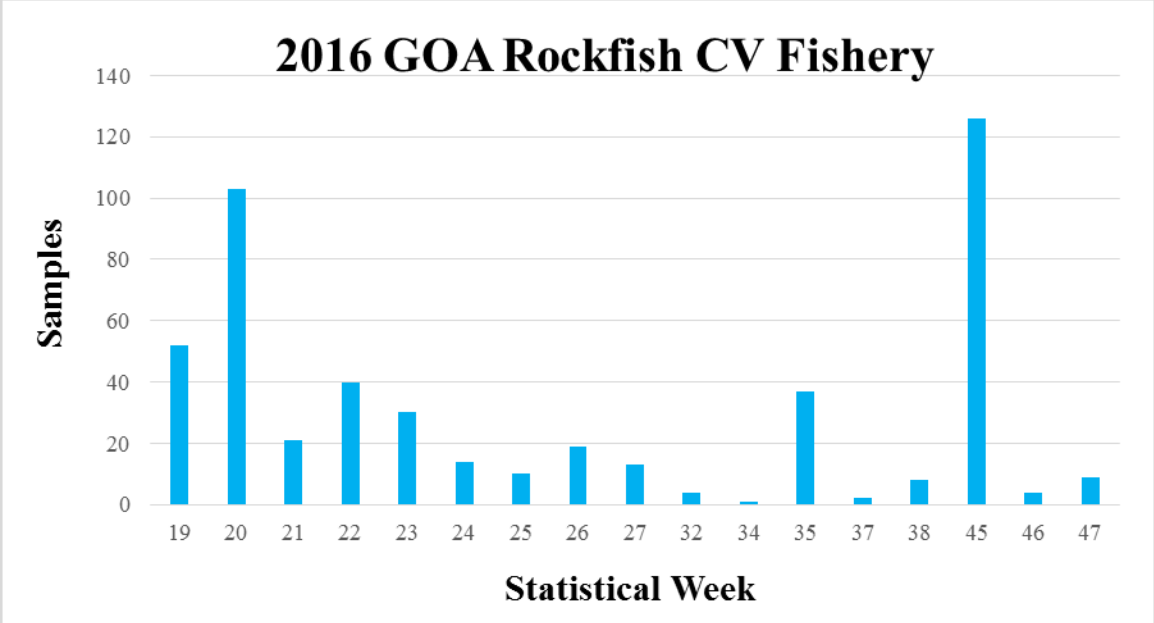

Figure 5. -- Genetic samples collected by Alaska Groundfish Data Bank from the census of the Chinook salmon bycatch in the 2016 Gulf of Alaska (GOA) rockfish catcher vessel (CV) trawl fishery plotted by statistical week.

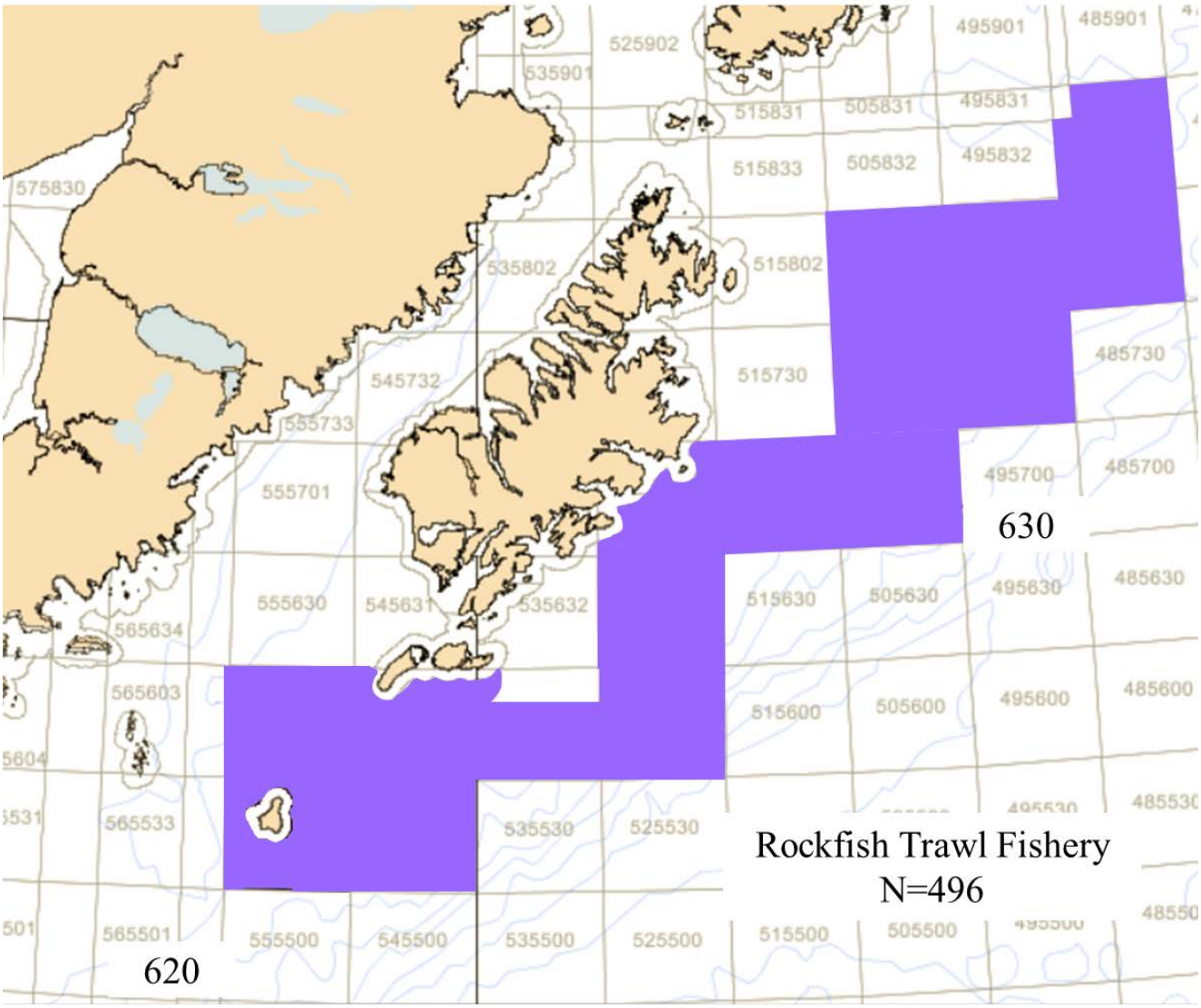

Figure 6. – Relative location (shaded) of the 496 Chinook salmon bycatch samples collected in NMFS Statistical Areas 620 and 630 by Alaska Groundfish Data Bank in the 2016 Gulf of Alaska rockfish trawl fishery.

GOA non-pollock Catcher Processors Trawl Fishery

Samples (N = 82) were collected from the Chinook salmon bycatch of the federally managed 2016 Alaska GOA non-pollock catcher processors trawl fisheries by the Alaska Seafood Cooperative for analysis at ABL. The small number of samples precluded accurate stock composition analysis; therefore, these samples were not analyzed.

GENETIC STOCK COMPOSITION - PROCEDURE

DNA was extracted from AXP tissue and genotyping was performed by using Taqman™ chemistries from Applied Biosystems Inc. on a Life Technologies QuantStudio™ or by matrix-assisted laser desorption/ionization - time of flight (MALDI-TOF) (Guyon et al. 2010) on a Sequenom MassARRAY iPLEX platform (Gabriel et al. 2009) for the 43 SNP DNA markers represented in the Chinook salmon baseline (Templin et al. 2011). 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 (Templin et al. 2011). Taqman™ assays were compared to internal controls for both open array (OA) and 384-well formats using the QuantStudio™. The concordance rate between OA and 384 formats was 99.99%. In addition to internal MALDI-TOF chip controls, 10 (out of 384 on a chip) previously genotyped samples from ADF&G, which used TaqMan™ chemistries, were included on each chip during the analyses and resulting genotypes were compared. Concordance rates of 99.9% between the two chemistries for the 2016 controls confirmed the utility and compatibility of both genotyping methods.

From the Chinook salmon bycatch from the 2016 GOA pollock trawl fishery, a total of 4,962 of 5,473 samples (91%) were successfully genotyped for 35 or more of the 43 SNP loci. The successfully genotyped samples had genetic information for an average of 42 of 43 markers.

From the Chinook salmon bycatch from the 2016 GOA rockfish CV trawl fishery, 493 of 495 samples received (99.6%) were successfully genotyped for 35 or more of the 43 SNP loci. The successfully genotyped samples had genetic information for an average of 42 of 43 markers.

Stock composition estimates were derived using BAYES (Bayesian analysis). SPAM (maximum likelihood analysis) software (ADF&G 2003) was also used to produce stock composition estimates and as in the past (Guthrie et al. 2013, 2016, 2017), results were almost identical to BAYES results, consequently the SPAM estimates are not included here. BAYES software uses a Bayesian algorithm to produce stock composition estimates and can account for missing alleles in the baseline (Pella and Masuda 2001). For each BAYES analysis, 11 Monte Carlo chains starting at disparate values of stock proportions were configured such that 95% of the stocks came from one designated stock group (region) with weights equally distributed among the stocks of that region. The remaining 5% was equally distributed among remaining stocks from all other regions. For all estimates, a flat prior of 0.005814 (calculated as 1/172) was used for all 172 baseline populations. The analyses were completed for a chain length of 10,000 with the first 5,000 deleted during the burn-in phase when determining overall stock compositions. Convergence of the chains to posterior distributions of stock proportions was determined with Gelman and Rubin (Gelman and Rubin 1992) shrink statistics, which were 1.10 or less for all the estimates, conveying strong convergence to a single posterior distribution (Pella and Masuda 2001).

Estimated numbers of fish were calculated from mean stock composition estimates and catch estimates. Stock composition catch estimates for strata are not additive, this being most apparent for small contributors, for strata with smaller sample sizes, or both. This is because the confidence intervals are bounded by zero resulting in skewed BAYES posterior distributions. For example, the mean number of Chinook salmon originating from the Coastal W AK region in the South of Akutan Island stratum is 17 fish (Appendix 2), whereas in the overall GOA bycatch the contribution from this region is only 10 fish. The estimated number of fish from the Coastal W

AK region in the smaller stratum is within the 95% confidence intervals (0-41 fish) of the estimated number of fish from the overall GOA bycatch.

GENETIC STOCK COMPOSITION - RESULTS

GOA Pollock Trawl Fishery

The stock composition results indicate that 99.9% of the 4,962 samples from the GOA originated from GOA/Pacific coastal regions, with the British Columbia group contributing the

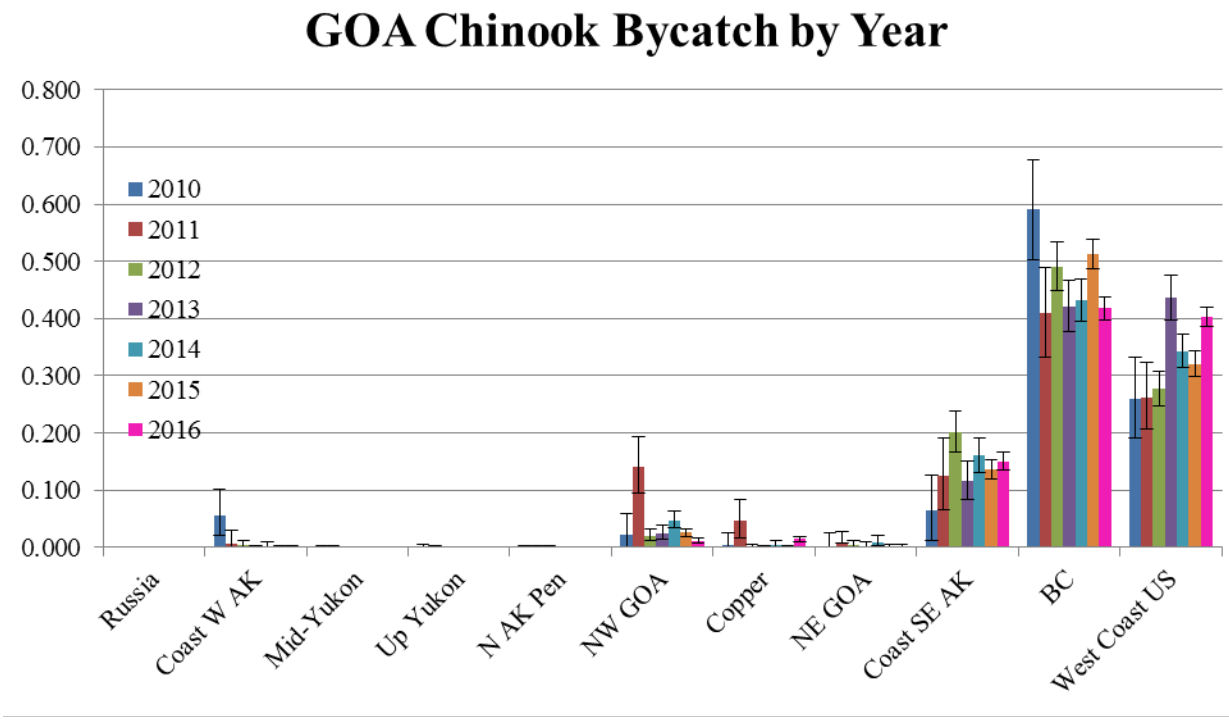

Figure 7. -- Yearly stock composition estimates (2010-2016) with BAYES 95% credible intervals of Chinook salmon bycatch based on available genetic samples from the Gulf of Alaska (GOA) pollock trawl fishery . The same genetic baseline and general regional groupings were used in all analyses.

most (42%; 8,602 fish), followed by the West Coast US (40%; 8,301 fish), and Coastal Southeast Alaska (15%; 3080 fish) (Appendix 2). The sample distribution was similar to the overall distribution (Figs. 3 and 4); except for the lack of samples from the bycatch (N = 293) from NMFS Area 649. Although care must be taken when comparing estimates across years due to

the differences in sampling, the stock composition estimates in 2016 were very similar to estimates from the previous six years (Fig. 7).

Using information from the ANSWERS tool provided by AKFIN (NMFS 2017), geographical (ADF&G statistical areas) aggregations were developed to provide stock compositions with greater spatial precision than the existing NMFS statistical areas. We looked at ten additional (other than overall and rockfish) bycatch sample strata (Appendix 2) using this tool including South of Akutan Island (Fig 8.); Shumagin Islands Early (statistical weeks 4-13), Late (statistical weeks 35-45), and overall (Fig. 9); Shelikof Strait (SS) Early (statistical weeks 4-22) and overall (Fig. 10); and Southeast Kodiak Island (SKI) Late (statistical weeks 35-45), weeks 35-39, weeks 40-45, and overall (Fig. 11). Additionally, nine weekly stock composition estimates were made for the SKI stratum for weeks 36-38, 40-45 (Appendix 3).

The western-most geographical stratum, South of Akutan Island, was a small sample set (N = 140) which had its largest stock composition estimate contribution from the West Coast US (44%), followed by the NW GOA (18%), British Columbia (17%), and Copper (12%) regions (Appendix 2). To the east of Akutan Island, the Shumagin Islands (SI) had its largest stock estimates from British Columbia (49%) and the West Coast US (43%) with a smaller component from Coastal Southeast Alaska (6%) (Appendix 2; Fig. 9). There were temporal differences in stock estimates between the SI Early and Late seasons. For example, the British Columbia region accounted for 71% and 42% of the bycatch in the Early and Late seasons, respectively, and the West Coast US contributed 19% and 51% of the bycatch in the Early and Late seasons, respectively (Appendix 2). For Shelikof Strait (SS) overall and the Early season, British Columbia contributed the most (47%), followed by West Coast US (41%) and Coastal Southeast Alaska (11%) (Appendix 2). For the Southeast Kodiak Island (SKI) overall, Late, weeks 35-39,

and weeks 40-45 strata, the stock estimates were similar (Fig. 11, Appendix 2). The British Columbia composition estimates were the largest, 42%-38% followed by the West Coast US, 39%-33%, and Coastal Southeast Alaska, 22%-20%. A summary of stock estimates for the ten spatial and temporal strata is provided in Figure 12.

Due to the large number of samples from the SKI Late season, we were able to develop weekly stock composition estimates for weeks 36-38 and 40-45 (Appendix 3, Fig 13). Across this series of weeks, the West Coast US stock composition estimates ranged from 49% in week 45 to 29% in week 38. The British Columbia contributions ranged from 45% in week 37 to 34% in week 42. Coastal Southeast Alaska ranged from 29% in week 38 to 14% in week 45. The largest estimated Chinook salmon catches were 997 fish from the West Coast US region in week 41, 926 and 928 from British Columbia in weeks 41 and 43, respectively, and 504 for Coastal Southeast Alaska region in week 43.

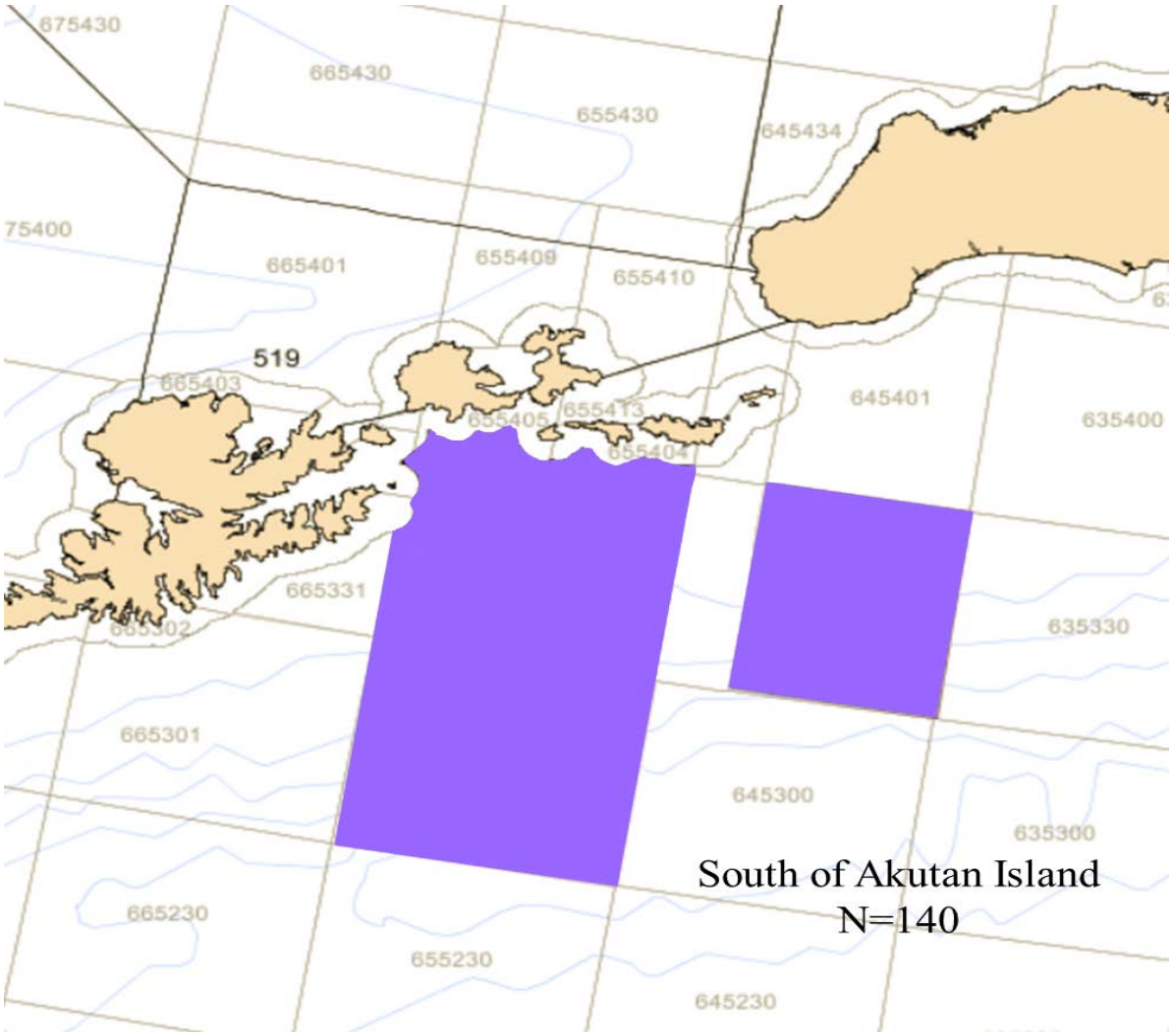

Figure 8. -- Location (shaded) of the South of Akutan Island stratum used in comparative stock composition estimates from the 2016 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2017).

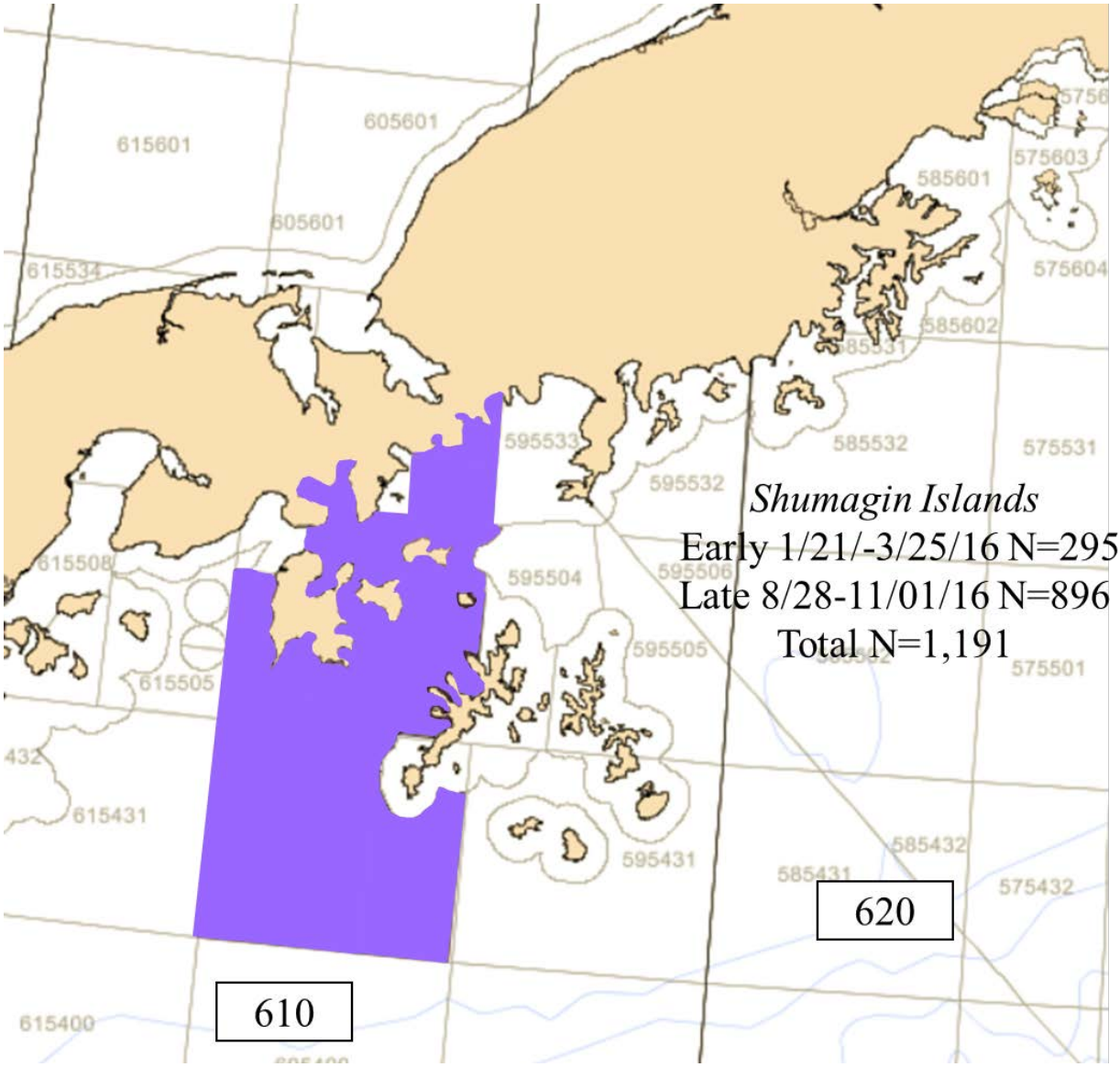

Figure 9. -- Location (shaded) of the Shumagin Islands Early and Late strata used in comparative stock composition estimates from the 2016 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2017).

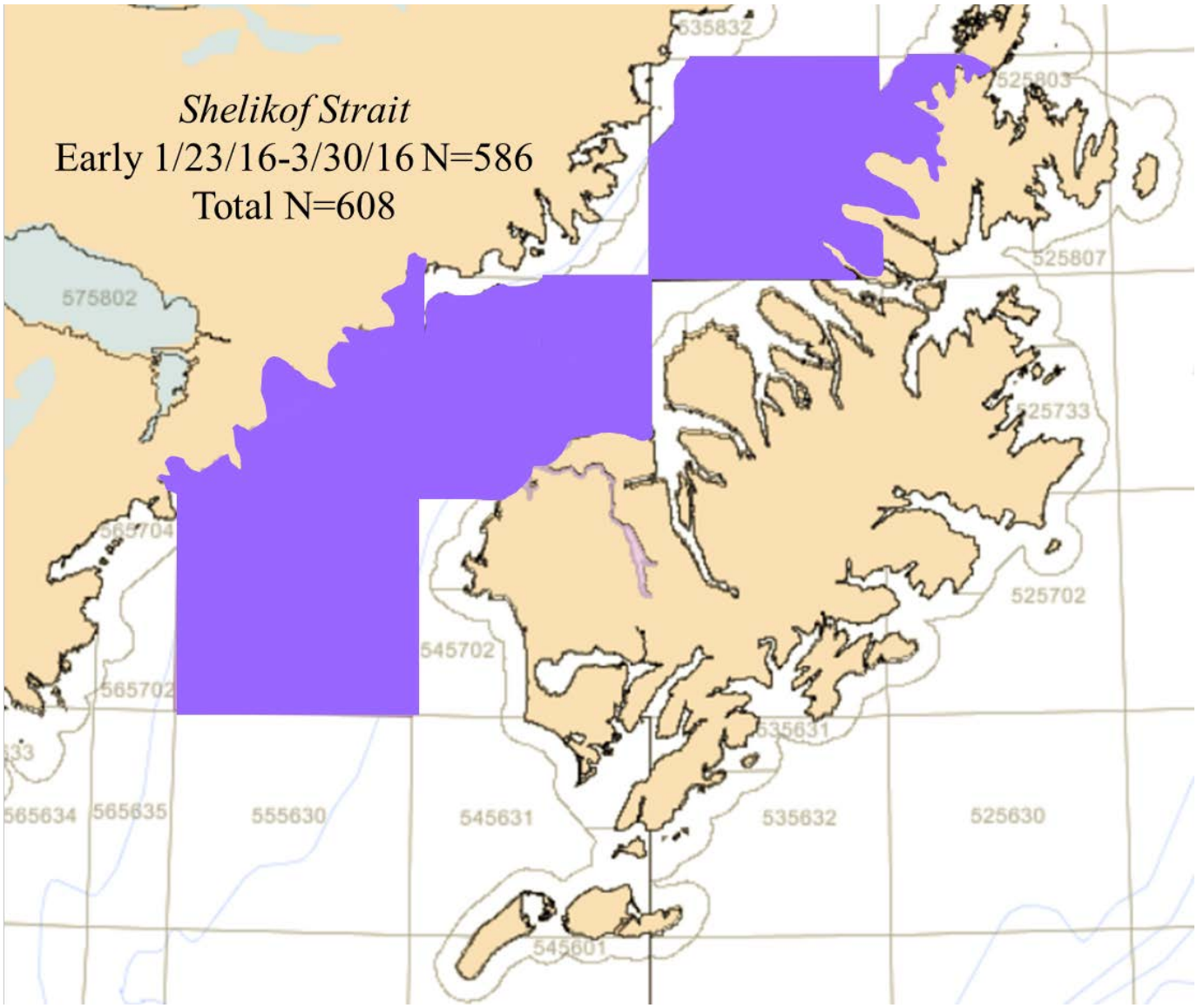

Figure 10. -- Location (shaded) of the Shelikof Strait strata used in comparative stock composition estimates from the 2016 Gulf of Alaska Chinook salmon bycatch (from the pollock trawl fishery (NMFS 2017).

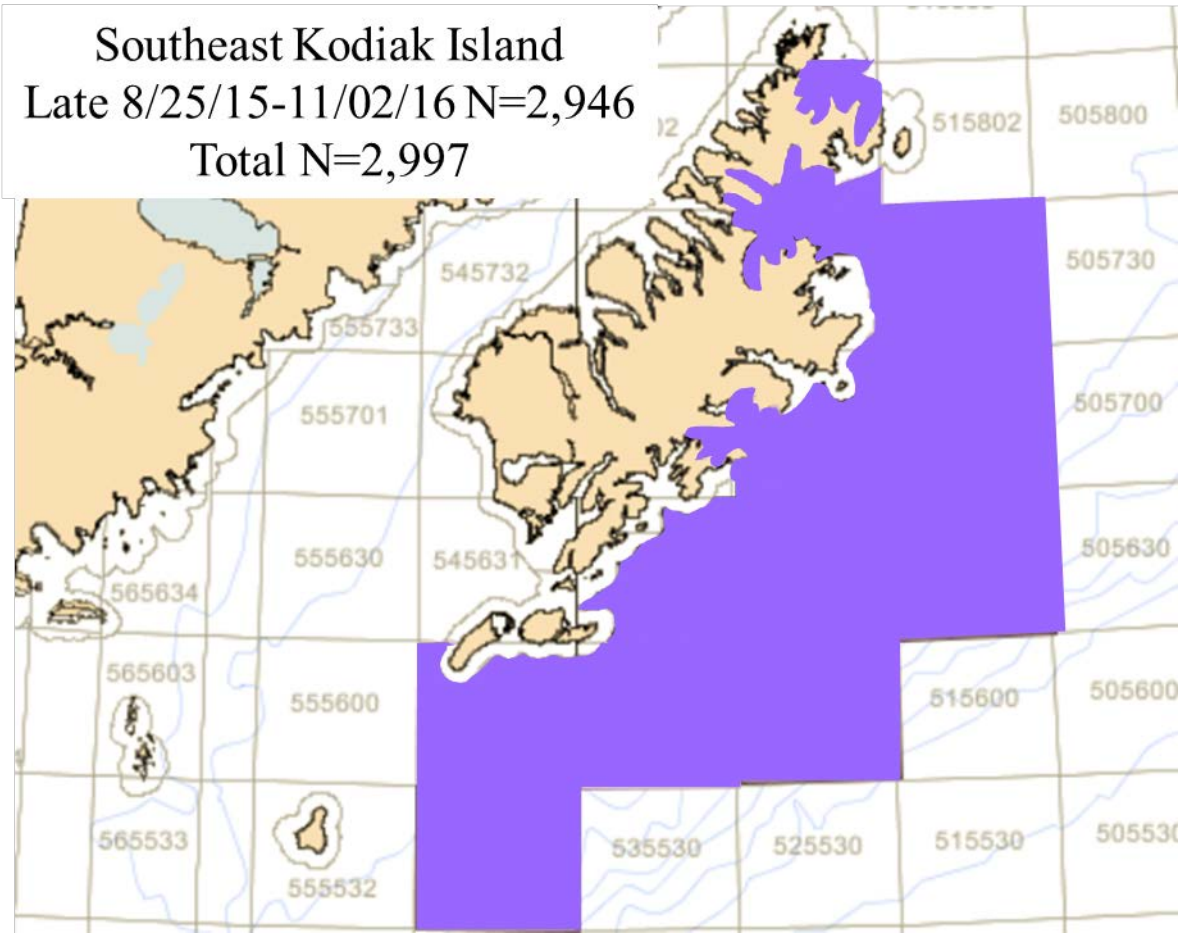

Figure 11. – Location (shaded) of the Kodiak Island strata used in comparative stock composition estimates from the 2016 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2017).

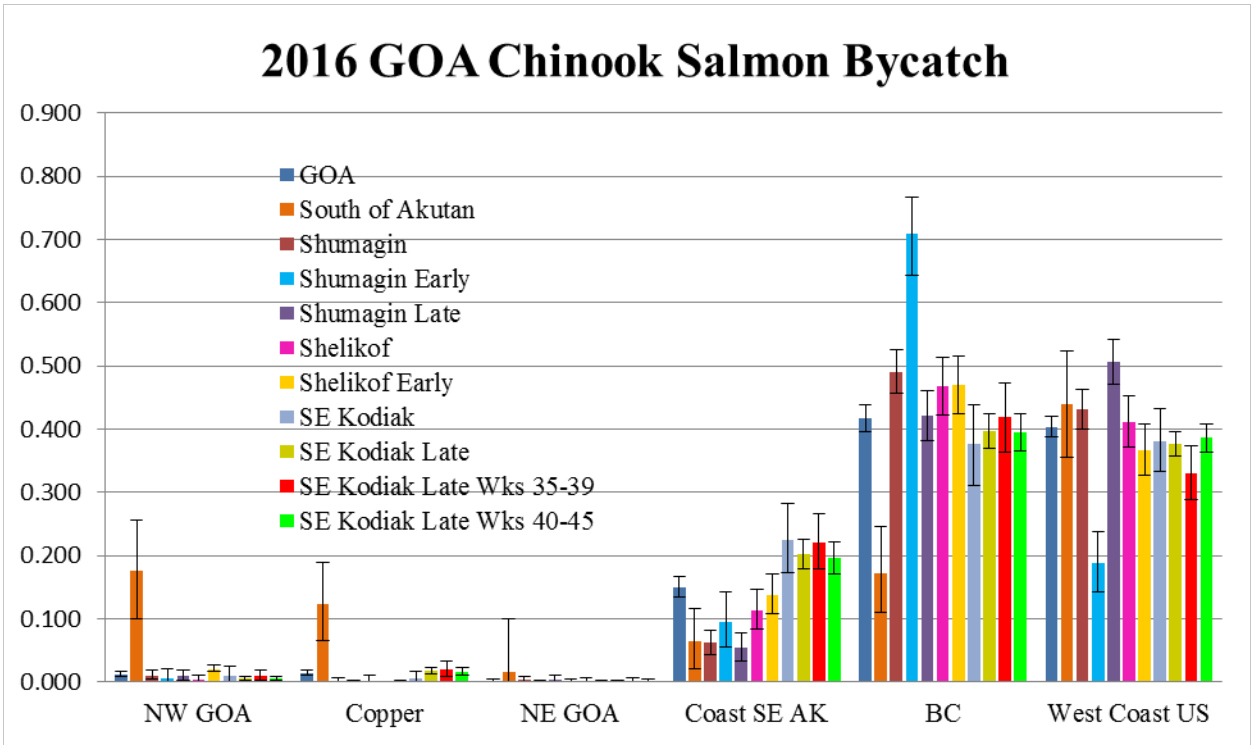

Figure 12. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from 11 area and time strata from the 2016 Gulf of Alaska (GOA) pollock trawl fishery: All GOA (4,962 samples); South of Akutan Island (140, Fig. 8); Shumagin Islands (Fig. 9) Early (295), Late (896), and overall (1,191); Shelikof Strait (Fig. 10) Early (586) and overall (608); and Southeast Kodiak Island (Fig. 11) overall (2,997), Late (2,946), weeks 35-39 (577), and weeks 40-45 (2,369).

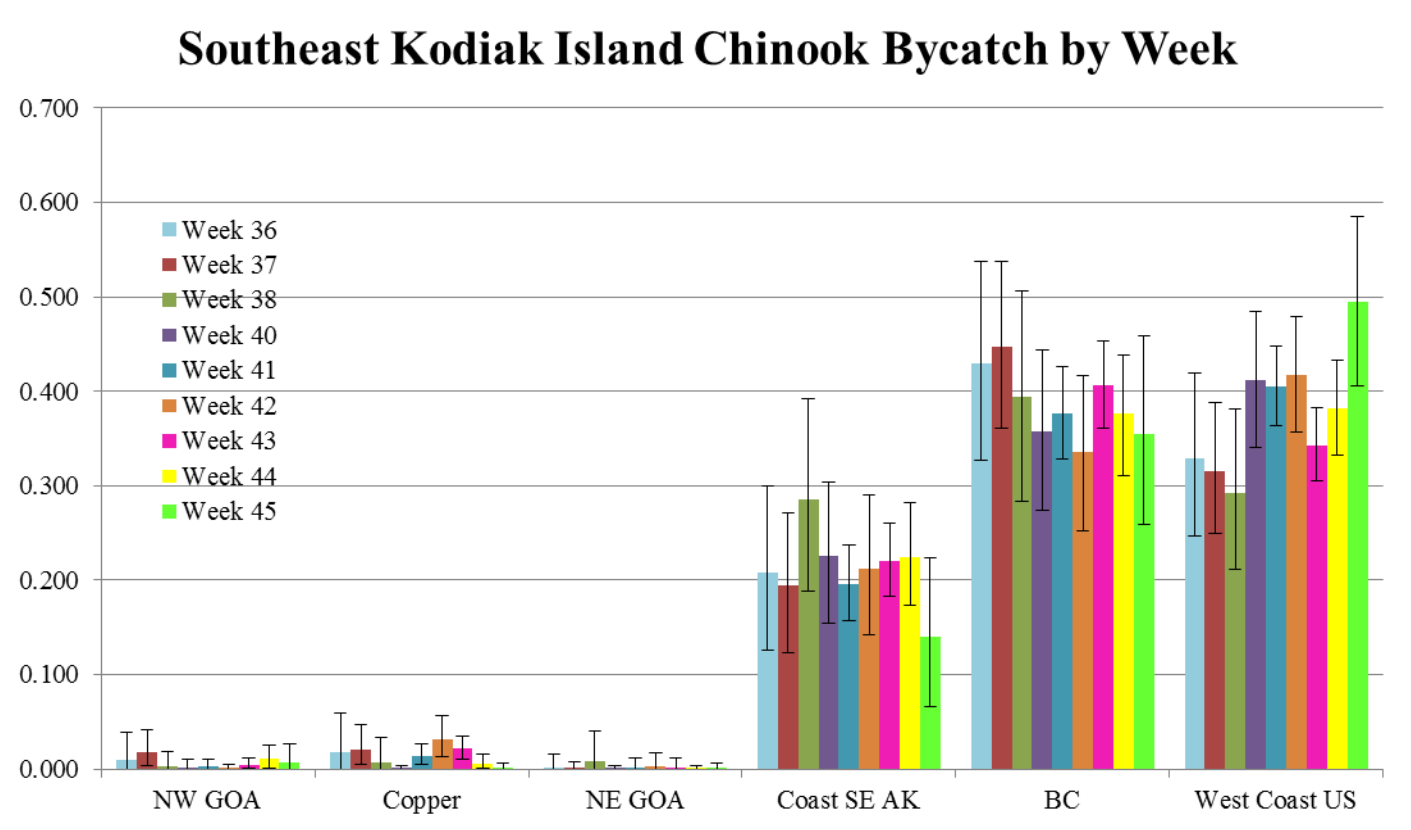

Figure 13. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples collected from the 2016 Gulf of Alaska (GOA) pollock trawl fishery from the Southeast Kodiak Island, Late season (2,946, Fig. 11, Appendix 3).

Gulf of Alaska Rockfish CV Trawl Fishery

The stock composition results indicate that almost all of the 493 Chinook salmon samples from the bycatch of the 2016 GOA rockfish CV trawl fishery originated from GOA/Pacific coastal regions (99%), primarily from West Coast US (62%), British Columbia (27%), and Coastal Southeast Alaska (7%) regions (Appendix 2). When comparing stock estimates across all years (2013-16), over 99% of the fish were from GOA/Pacific coastal regions (Fig. 14). For the two highest contributing regions, British Columbia and West Coast US, the results in 2016 were most similar to those in 2013 , and differed from the estimates in 2015 and 2014, which were almost identical.

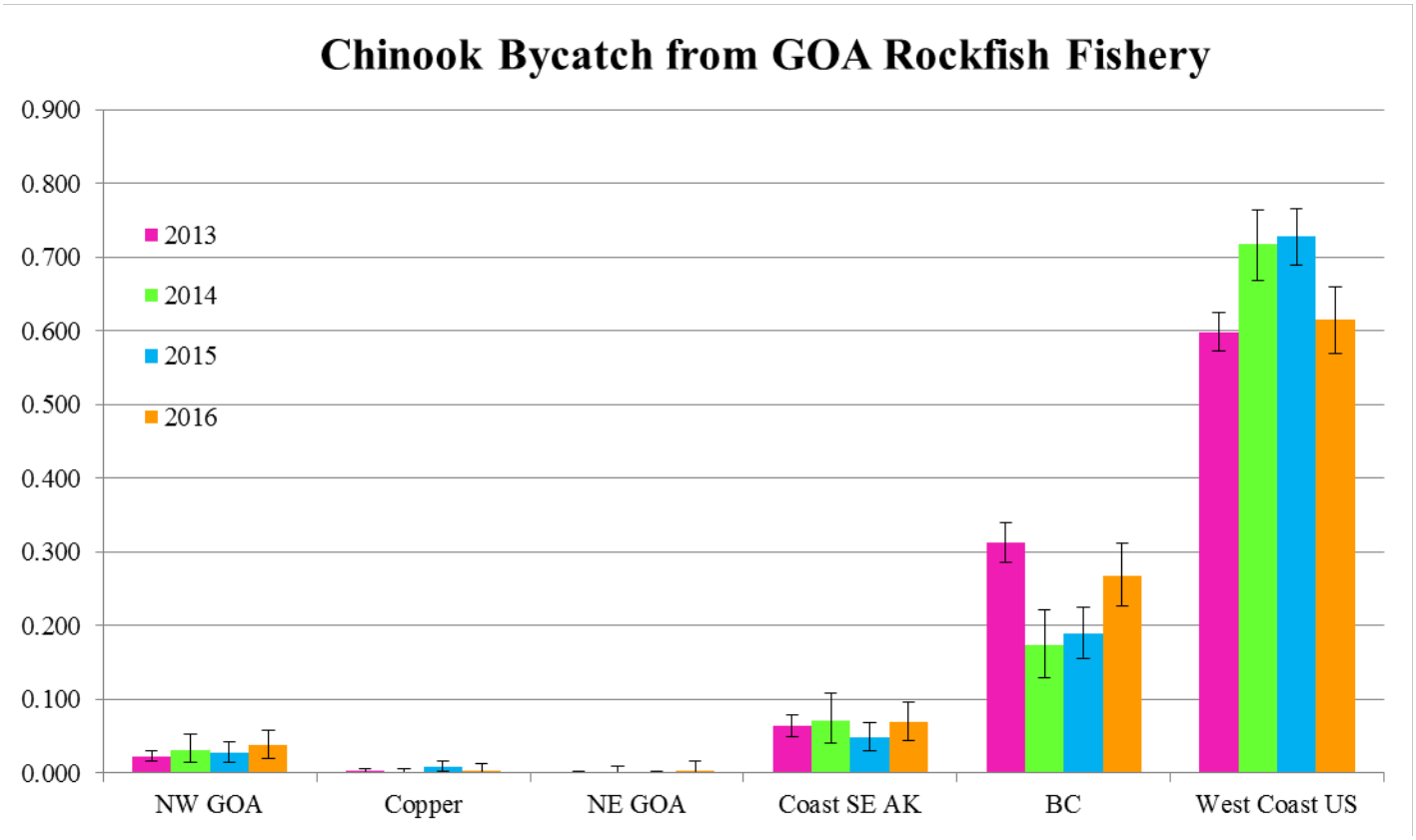

Figure 14. -- Stock composition estimates with 95% BAYES credible intervals of Chinook salmon bycatch samples collected from the 2013-2016 Gulf of Alaska rockfish trawl fishery.

SUMMARY

The incidental harvest of Chinook salmon from federally managed groundfish fisheries in the GOA averaged 21,521 salmon per year during 1991-2016, with an estimated peak of 54,678 in 2010. In 2016, the bycatch from pollock trawl fishery is the largest component of the salmon bycatch in the GOA in 2016. The GOA Chinook salmon estimated bycatch of 22,078 was above the 1991-2016 average of 21,521 in 2016; 20,882 were estimated from the pollock trawl fishery and 1,196 from other fisheries including the rockfish and arrowtooth flounder trawl fisheries.

Stock composition estimates of the Chinook salmon bycatch are needed for pollock and salmon fishery managers to understand the biological effects of the incidental take of salmon in

the trawl fishery. However, results should be interpreted judiciously; the limitations of these analyses are summarized below.

Sampling Issues

Due to efforts from the observer program and the many observers who collected samples, the number of available samples from the 2016 GOA pollock trawl fishery was higher than in any previous year, representing almost 24% of the total bycatch. The samples in 2016 were collected in similar proportions to the overall bycatch (Fig. 3), although small differences in spatial and temporal distributions remain (Fig. 4). Because the sample set represents such a large proportion of the total bycatch, and stock compositions separated spatially within seasons were similar (Fig. 12), the exception being the small sample South of Akutan, the overall estimate can be considered the bycatch stock composition from the 2016 GOA pollock trawl fishery.

While sampling has improved, there were some issues with overall estimates in some stratum. For example, the SI Early catch estimate was smaller (N = 703) than the SI Late estimate (N = 3,347), but had a disproportionally larger sample size (41% vs. 26% of the catch estimates respectively) skewing the stock composition estimates for the overall. Similar issues are apparent with Shelikof Strait overall.

Similar to the 2013-15 GOA rockfish CV trawl fisheries, the fishing industry conducted a census approach in 2016 to collect genetic samples from every Chinook salmon encountered. Consequently, the reported stock composition can be considered the overall stock composition for that fishery with the stipulation that samples were provided outside of the NMFS Observer Program (Appendix 2).

Stock Composition Estimates

The derived 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 are derived from river systems that flow into the Gulf of Alaska and the Eastern Pacific Ocean.

Application of These Estimates

The extent to which any salmon stock is impacted by the bycatch of the GOA trawl fisheries is dependent on many factors including 1) the overall size of the bycatch, 2) the age of the salmon caught in the bycatch, 3) the age of the returning salmon, and 4) the total escapement of the affected stocks taking into account lag time for maturity and returning to the river. As such, a higher contribution of a particular stock one year does not necessarily imply greater impact than a smaller estimate the next.

ACKNOWLEDGMENTS

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CITATIONS

ADF&G (Alaska Department of Fish and Game). 2003. SPAM Version 3.7b: Statistics Program for Analyzing Mixtures. Alaska Department of Fish and Game, Commercial Fisheries Division, Gene Conservation Laboratory, Anchorage, Alaska.

Faunce, C., J. Cahalan, J. Gasper, T. A'mar, S. Lowe, F. Wallace, and R. Webster. 2014. Deployment performance review of the 2013 North Pacific groundfish and halibut observer program. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-281, 74 p.

Faunce, C.J. 2015. Evolution of observer methods to obtain genetic material from Chinook salmon bycatch in the Alaska pollock fishery. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-288, 28 p.

Gabriel, S., L. Ziaugra, and D. Tabbaa. 2009. SNP genotyping using the Sequenom MassARRAY iPLEX platform. Current Protocols in Human Genetics *Chapter 2*, Unit 212.

Gelman, A., and D. B. Rubin. 1992. Inference from iterative simulation using multiple sequences. Stat. Sci. 7:457-511.

Guthrie, C. M. III, H. Nguyen, and J. R. Guyon. 2013. Genetic stock composition analysis of Chinook salmon bycatch samples from the 2011 Bering Sea and Gulf of Alaska trawl fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-244, 28 p.

Guthrie, C. M. III, Hv. T. Nguyen, and J. R. Guyon. 2016. Genetic stock composition analysis of the Chinook salmon bycatch samples from the 2014 Gulf of Alaska trawl fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-311, 31 p.

Guthrie, C. M. III, Hv. T. Nguyen, A. E. Thomson, and J. R. Guyon. 2017. Genetic stock composition analysis of Chinook salmon bycatch samples from the 2015 Gulf of Alaska trawl fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-343, 33 p.

Guyon, J. R., C. M. Guthrie, and H. Nguyen. 2010. Genetic stock composition analysis of Chinook salmon bycatch samples from the 2008 Bering Sea pollock fishery, 32 p. Report to the North Pacific Fishery Management Council, 605 W. 4th Avenue, Anchorage AK 99510.

Guyon, J. R., C.M. Guthrie III, A. R. Munro, J. Jasper, and W. D. Templin. 2014. Extension of genetic stock composition analysis to the Chinook salmon bycatch in the Gulf of Alaska walleye pollock (*Gadus chalcogrammus*) trawl fisheries, 2012. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-285, 26 p.

Guyon, J. R., C.M. Guthrie, III, A.R. Munro, J. Jasper, and W. D. Templin. 2015a. Genetic stock composition analysis of the Chinook salmon bycatch in the Gulf of Alaska walleye pollock (*Gadus chalcogrammus*) trawl fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-291, 26 p.

Guyon, J. R., Hv.T. Nguyen, C.M. Guthrie III, J. Bonney, K. McGauley, K. Hansen, and J. Gauvin. 2015b. Genetic stock composition analysis of Chinook salmon bycatch samples from the rockfish and arrowtooth flounder 2013 Gulf of Alaska trawl fisheries and the Gulf of Alaska salmon excluder device test. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-289, 19 p.

Larson, W. A., F. M. Utter, K. W. Myers, W. D. Templin, J. E. Seeb, C. M. Guthrie III, A. V. Bugaev, and L. W. Seeb. 2013. Single-nucleotide polymorphisms reveal distribution and migration of Chinook salmon (*Oncorhynchus tshawytscha*) in the Bering Sea and North Pacific Ocean. Can. J. Fish. Aquat. Sci. 70(1):128-141.

NMFS (National Marine Fisheries Service). 2017. Catch Accounting System data. NMFS Alaska Regional Office. Data compiled by Alaska Fisheries Information Network for Alaska Fisheries Science Center, Juneau. [URL not publicly available as some information is confidential.]

NMFS (National Marine Fisheries Service). 2018. GOA Chinook salmon mortality estimates, 1991-present, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Regional Office, Juneau, AK. https://alaskafisheries.noaa.gov/sites/default/files/reports/goasalmonmort2017.pdf

Pella, J., and M. Masuda. 2001. Bayesian methods for analysis of stock mixtures from genetic characters. Fish. Bull., U. S. 99, 151-167.

Templin, W. D., J. E. Seeb, J. R. Jasper, A. W. Barclay, and L. W. Seeb. 2011. Genetic differentiation of Alaska Chinook salmon: the missing link for migratory studies. Mol. Ecol. Res. 11 (Suppl. 1): 226–246.

APPENDICES

Appendix 1. -- Chinook salmon populations in the ADF&G SNP baseline with the regional designations used in the analyses of this report. S.=South, R.=River, H.=Hatchery, and L.=Lake.

Population name	Reg Num.	Region	Population name	Reg Num.	Region
Bistraya River	1	Russia	Henshaw Creek	3	Mid Yukon
Bolshaya River	1	Russia	Kantishna River	3	Mid Yukon
Kamchatka River late	1	Russia	Salcha River	3	Mid Yukon
Pakhatcha River	1	Russia	Sheenjek River	3	Mid Yukon
Andreafsky River	2	Coast W AK	S. Fork Koyukuk River	3	Mid Yukon
Aniak River	2	Coast W AK	Big Salmon River	4	Up Yukon
Anvik River	2	Coast W AK	Blind River	4	Up Yukon
Arolik River	2	Coast W AK	Chandindu River	4	Up Yukon
Big Creek	2	Coast W AK	Klondike River	4	Up Yukon
Cheeneetnuk River	2	Coast W AK	Little Salmon River	4	Up Yukon
Eek River	2	Coast W AK	Mayo River	4	Up Yukon
Gagaryah River	2	Coast W AK	Nisutlin River	4	Up Yukon
George River	2	Coast W AK	Nordenskiold River	4	Up Yukon
Gisasa River	2	Coast W AK	Pelly River	4	Up Yukon
Golsovia River	2	Coast W AK	Stewart River	4	Up Yukon
Goodnews River	2	Coast W AK	Takhini River	4	Up Yukon
Kanektok River	2	Coast W AK	Tatchun Creek	4	Up Yukon
Kisaralik River	2	Coast W AK	Whitehorse Hatchery	4	Up Yukon
Kogrukluk River	2	Coast W AK	Black Hills Creek	5	N AK Pen
Kwethluk River	2	Coast W AK	King Salmon River	5	N AK Pen
Mulchatna River	2	Coast W AK	Meshik River	5	N AK Pen
Naknek River	2	Coast W AK	Milky River	5	N AK Pen
Nushagak River	2	Coast W AK	Nelson River	5	N AK Pen
Pilgrim River	2	Coast W AK	Steelhead Creek	5	N AK Pen
Salmon R. -Pitka Fork	2	Coast W AK	Anchor River	6	NW GOA
Stony River	2	Coast W AK	Ayakulik River	6	NW GOA
Stuyahok River	2	Coast W AK	Benjamin Creek	6	NW GOA
Takotna River	2	Coast W AK	Chignik River	6	NW GOA
Tatlawiksuk River	2	Coast W AK	Crescent Creek	6	NW GOA
Togiak River	2	Coast W AK	Crooked Creek	6	NW GOA
Tozitna River	2	Coast W AK	Deception Creek	6	NW GOA
Tuluksak River	2	Coast W AK	Deshka River	6	NW GOA
Unalakleet River	2	Coast W AK	Funny River	6	NW GOA
Beaver Creek	3	Mid Yukon	Juneau Creek	6	NW GOA
Chandalar River	3	Mid Yukon	Karluk River	6	NW GOA
Chena River	3	Mid Yukon	Kasilof River mainstem	6	NW GOA

Population name	Reg Num.	Region	Population name	Reg Num.	Region
Kenai River mainstem	6	NW GOA	Kowatua River	9	Coast SE AK
Killey Creek	6	NW GOA	Little Tatsemenie River	9	Coast SE AK
Ninilchik River	6	NW GOA	Macaulay Hatchery	9	Coast SE AK
Prairie Creek	6	NW GOA	Medvejie Hatchery	9	Coast SE AK
Slikok Creek	6	NW GOA	Nakina River	9	Coast SE AK
Talachulitna River	6	NW GOA	Tahltan River	9	Coast SE AK
Willow Creek	6	NW GOA	Unuk R.-Deer Mountain H.	9	Coast SE AK
Bone Creek	7	Copper	Unuk River - LPW	9	Coast SE AK
E. Fork Chistochina River	7	Copper	Upper Nahlin River	9	Coast SE AK
Gulkana River	7	Copper	Big Qualicum River	10	BC
Indian River	7	Copper	Birkenhead River spring	10	BC
Kiana Creek	7	Copper	Bulkley River	10	BC
Manker Creek	7	Copper	Chilko River summer	10	BC
Mendeltna Creek	7	Copper	Clearwater River summer	10	BC
Otter Creek	7	Copper	Conuma River	10	BC
Sinona Creek	7	Copper	Damdochax Creek	10	BC
Tebay River	7	Copper	Ecstall River	10	BC
Tonsina River	7	Copper	Harrison River	10	BC
Big Boulder Creek	8	NE GOA	Kateen River	10	BC
Kelsall River	8	NE GOA	Kincolith Creek	10	BC
King Salmon River	8	NE GOA	Kitimat River	10	BC
Klukshu River	8	NE GOA	Klinaklini River	10	BC
Situk River	8	NE GOA	Kwinageese Creek	10	BC
Tahini River	8	NE GOA	Louis River spring	10	BC
Tahini River - Pullen Creek H.	8	NE GOA	Lower Adams River fall	10	BC
Andrews Creek	9	Coast SE AK	Lower Atnarko River	10	BC
Blossom River	9	Coast SE AK	Lower Kalum River	10	BC
Butler Creek	9	Coast SE AK	Lower Thompson River fall	10	BC
Chickamin River	9	Coast SE AK	Marble Creek	10	BC
Chickamin River-LPW	9	Coast SE AK	Middle Shuswap R. summer	10	BC
Chickamin R.Whitman L. H.	9	Coast SE AK	Morkill River summer	10	BC
Clear Creek	9	Coast SE AK	Nanaimo River	10	BC
Cripple Creek	9	Coast SE AK	Nechako River summer	10	BC
Crystal Lake Hatchery	9	Coast SE AK	Nitinat River	10	BC
Dudidontu River	9	Coast SE AK	Oweegee Creek	10	BC
Genes Creek	9	Coast SE AK	Porteau Cove	10	BC
Hidden Falls Hatchery	9	Coast SE AK	Quesnel River summer	10	BC
Humpy Creek	9	Coast SE AK	Quinsam River	10	BC
Kerr Creek	9	Coast SE AK	Robertson Creek	10	BC
Keta River	9	Coast SE AK	Salmon River summer	10	BC
King Creek	9	Coast SE AK	Sarita River	10	BC

Population name	Reg Num.	Region
Stuart River summer	10	BC
Sustut River	10	BC
Torpy River summer	10	BC
Wannock River	10	BC
Alsea River fall	11	West Coast US
Carson Hatchery spring	11	West Coast US
Eel River fall	11	West Coast US
Forks Creek fall	11	West Coast US
Hanford Reach	11	West Coast US
Klamath River	11	West Coast US
Lower Deschutes R. fall	11	West Coast US
Lyons Ferry H. summer/fall	11	West Coast US
Makah National Fish H. fall	11	West Coast US
McKenzie River spring	11	West Coast US
Sacramento River winter	11	West Coast US
Siuslaw River fall	11	West Coast US
Soos Creek Hatchery fall	11	West Coast US
Upper Skagit River summer	11	West Coast US

Appendix 2. -- Regional BAYES stock composition percentage estimates, standard deviations (SD), 95% credible intervals (CI), and estimated numbers of Chinook salmon from the 2016 GOA pollock fishery, different strata of the pollock fishery, and the rockfish trawl fishery. Sample sizes are adjacent to stratum designation. Total catch is the estimated catch from AKFIN reports (NMFS 2017). GOA, pollock (upper, left) encompasses other strata except the rockfish trawl fishery. Stock composition estimates may not sum to 100% and stock-specific catch estimates may not sum to the total catch due to rounding error. Note: for smaller sample sets, the estimated numbers of fish from small contributors may be higher than for the overall GOA.

	Gulf of Alaska, pollock (N=4,962)				Shelikof Strait Early (N=586)				Shelikof Strait (N=608)				South of Akutan Island (N=140)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	8	0.0	0.03	(0.0,0.1)	0	0.0	0.03	(0.0,0.0)	0	0.0	0.03	(0.0,0.0)	0	0.0	0.11	(0.0,0.2)
Coast W AK	10	0.1	0.07	(0.0,0.2)	6	0.3	0.34	(0.0,1.2)	8	0.3	0.32	(0.0,1.1)	17	1.1	1.44	(0.0,5.0)
Mid Yukon	0	0.0	0.00	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)	1	0.0	0.18	(0.0,0.4)
Up Yukon	0	0.0	0.01	(0.0,0.0)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	1	0.1	0.23	(0.0,0.7)
N AK Pen	0	0.0	0.01	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)	1	0.0	0.20	(0.0,0.5)
NW GOA	247	1.2	0.18	(0.9,1.6)	7	0.3	0.34	(0.0,1.2)	11	0.3	0.33	(0.0,1.1)	280	17.6	3.98	(10.0,25.6)
Copper	296	1.4	0.21	(1.1,1.9)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	195	12.2	3.14	(6.6,18.9)
NE GOA	41	0.2	0.15	(0.0,0.6)	1	0.1	0.18	(0.0,0.6)	2	0.1	0.15	(0.0,0.5)	25	1.6	2.93	(0.0,9.9)
Coast SE AK	3,080	15.0	0.81	(13.5,16.7)	234	11.0	1.62	(8.0,14.3)	365	11.4	1.59	(8.4,14.6)	101	6.4	2.46	(2.0,11.6)
BC	8,602	41.8	1.07	(39.7,43.8)	998	47.0	2.34	(42.4,51.6)	1,506	46.8	2.29	(42.3,51.3)	272	17.1	3.49	(10.9,24.6)
West Coast US	8,301	40.3	0.82	(38.7,41.9)	877	41.3	2.11	(37.2,45.5)	1,325	41.2	2.08	(37.1,45.3)	700	44.0	4.27	(35.6,52.3)
Total Catch	20,589				2,124				3,217				1,593			
	Shumagin Islands Early (N=295)				Shumagin Islands Late (N=896)				Shumagin Islands (N=1,191)				Rockfish Trawl Fishey (N=493)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	0	0.0	0.05	(0.0,0.1)	0	0.0	0.02	(0.0,0.0)	0	0.0	0.01	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)
Coast W AK	1	0.1	0.21	(0.0,0.7)	9	0.3	0.28	(0.0,1.0)	6	0.2	0.20	(0.0,0.7)	3	0.5	0.55	(0.0,1.9)
Mid Yukon	0	0.0	0.08	(0.0,0.2)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.02	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)
Up Yukon	0	0.0	0.09	(0.0,0.3)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.02	(0.0,0.1)	0	0.0	0.06	(0.0,0.2)
N AK Pen	1	0.2	0.33	(0.0,1.2)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.05	(0.0,0.2)	0	0.0	0.10	(0.0,0.3)
NW GOA	4	0.6	0.61	(0.0,2.2)	32	1.0	0.38	(0.3,1.8)	41	1.0	0.37	(0.4,1.8)	19	3.7	1.00	(2.0,5.9)
Copper	0	0.0	0.09	(0.0,0.2)	8	0.3	0.28	(0.0,1.0)	6	0.2	0.19	(0.0,0.7)	1	0.3	0.37	(0.0,1.3)
NE GOA	0	0.0	0.12	(0.0,0.3)	13	0.4	0.33	(0.0,1.2)	11	0.3	0.24	(0.0,0.8)	1	0.3	0.44	(0.0,1.6)
Coast SE AK	66	9.4	2.22	(5.6,14.3)	179	5.4	1.11	(3.4,7.7)	250	6.2	1.00	(4.3,8.3)	34	6.9	1.34	(4.4,9.6)
BC	498	70.9	3.15	(64.4,76.7)	1,409	42.1	1.98	(38.2,46.0)	1,987	49.1	1.72	(45.7,52.5)	133	26.8	2.20	(22.6,31.2)
West Coast US	132	18.7	2.43	(14.3,23.8)	1,695	50.7	1.83	(47.1,54.2)	1,746	43.1	1.57	(40.1,46.2)	305	61.5	2.32	(56.9,66.0)
Total Catch	703				3,347				4,049				496			
	Southeast Kodiak Island (N=2,997)				Southeast Kodiak I. Late (N=2,946)				SE Kodiak I. Weeks 35-39 (N=577)				SE Kodiak I. Weeks 40-45 (N=2,369)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	1	0.0	0.04	(0.0,0.1)	9	0.1	0.05	(0.0,0.2)	5	0.2	0.18	(0.0,0.7)	4	0.1	0.05	(0.0,0.2)
Coast W AK	7	0.1	0.14	(0.0,0.5)	6	0.1	0.06	(0.0,0.2)	1	0.1	0.12	(0.0,0.4)	4	0.1	0.07	(0.0,0.2)
Mid Yukon	1	0.0	0.05	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)
Up Yukon	2	0.0	0.06	(0.0,0.2)	0	0.0	0.01	(0.0,0.0)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)
N AK Pen	1	0.0	0.05	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.02	(0.0,0.1)
NW GOA	123	1.0	0.63	(0.1,2.5)	64	0.6	0.16	(0.3,0.9)	23	0.9	0.43	(0.2,1.9)	42	0.5	0.17	(0.2,0.9)
Copper	74	0.6	0.41	(0.1,1.6)	199	1.7	0.26	(1.2,2.3)	51	1.9	0.64	(0.8,3.3)	146	1.6	0.28	(1.1,2.2)
NE GOA	4	0.0	0.12	(0.0,0.3)	3	0.0	0.06	(0.0,0.2)	1	0.0	0.17	(0.0,0.6)	5	0.1	0.11	(0.0,0.4)
Coast SE AK	2,660	22.4	2.75	(17.4,28.2)	2,348	20.3	1.21	(17.9,22.6)	591	22.1	2.26	(17.8,26.7)	1,740	19.5	1.27	(17.1,22.1)
BC	4,462	37.6	3.24	(31.1,43.8)	4,596	39.7	1.41	(37.0,42.5)	1,120	41.8	2.75	(36.4,47.2)	3,522	39.5	1.51	(36.6,42.5)
West Coast US	4,525	38.2	2.56	(33.3,43.3)	4,360	37.6	1.02	(35.6,39.6)	883	33.0	2.21	(28.8,37.4)	3,444	38.7	1.14	(36.4,40.9)
Total Catch	11,858				11,586				2,676				8,911			

Appendix 3. -- Regional BAYES stock composition percentage estimates, standard deviations (SD), 95% credible intervals (CI), and estimated numbers of Chinook salmon from the weekly Southeast Kodiak Is. strata of the 2016 GOA pollock fishery. Sample sizes are adjacent to stratum designation. Total catch is the estimated catch from AKFIN reports (NMFS 2017). Stock composition estimates may not sum to 100% and stock-specific catch estimates may not sum to the total catch due to rounding error. Note: for smaller sample sets, the estimated numbers of fish from small contributors may be higher than for the overall GOA.

	Week 36 (N=130)				Week 37 (N=203)				Week 38 (N=131)			
Region	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI
Russia	0	0.0	0.16	(0.0,0.3)	0	0.0	0.08	(0.0,0.1)	3	0.8	0.78	(0.0,2.9)
Coast W AK	1	0.2	0.43	(0.0,1.5)	1	0.3	0.47	(0.0,1.7)	1	0.2	0.40	(0.0,1.4)
Mid Yukon	0	0.0	0.17	(0.0,0.4)	0	0.0	0.11	(0.0,0.3)	0	0.0	0.16	(0.0,0.4)
Up Yukon	0	0.1	0.22	(0.0,0.6)	0	0.0	0.14	(0.0,0.4)	0	0.1	0.21	(0.0,0.6)
N AK Pen	0	0.0	0.20	(0.0,0.4)	0	0.0	0.10	(0.0,0.2)	0	0.0	0.15	(0.0,0.3)
NW GOA	5	1.0	1.11	(0.0,3.9)	8	1.8	0.97	(0.4,4.1)	1	0.2	0.54	(0.0,1.9)
Copper	10	1.8	1.68	(0.0,5.9)	9	2.1	1.12	(0.4,4.7)	2	0.7	0.98	(0.0,3.4)
NE GOA	1	0.1	0.49	(0.0,1.6)	0	0.1	0.24	(0.0,0.7)	3	0.8	1.19	(0.0,4.0)
Coast SE AK	116	20.9	4.46	(12.5,30.0)	88	19.4	3.78	(12.3,27.1)	95	28.6	5.20	(18.9,39.3)
BC	238	42.9	5.36	(32.7,53.7)	203	44.7	4.53	(36.0,53.7)	131	39.4	5.70	(28.3,50.6)
West Coast US	182	32.9	4.42	(24.6,42.0)	143	31.6	3.54	(24.9,38.8)	97	29.3	4.35	(21.2,38.1)
Total Catch	554				453				333			

	Week 40 (N=200)				Week 41 (N=598)				Week 42 (N=284)			
Region	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI
Russia	0	0.0	0.08	(0.0,0.1)	7	0.3	0.23	(0.0,0.9)	0	0.0	0.05	(0.0,0.1)
Coast W AK	1	0.1	0.28	(0.0,1.0)	1	0.0	0.09	(0.0,0.3)	1	0.1	0.16	(0.0,0.6)
Mid Yukon	0	0.0	0.10	(0.0,0.3)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.08	(0.0,0.2)
Up Yukon	0	0.0	0.14	(0.0,0.4)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.10	(0.0,0.3)
N AK Pen	1	0.1	0.35	(0.0,1.2)	0	0.0	0.07	(0.0,0.2)	0	0.0	0.08	(0.0,0.2)
NW GOA	1	0.1	0.30	(0.0,1.0)	7	0.3	0.28	(0.0,1.0)	1	0.1	0.15	(0.0,0.5)
Copper	0	0.0	0.13	(0.0,0.4)	35	1.4	0.54	(0.5,2.6)	40	3.1	1.12	(1.3,5.6)
NE GOA	0	0.0	0.12	(0.0,0.3)	4	0.2	0.33	(0.0,1.2)	3	0.3	0.48	(0.0,1.7)
Coast SE AK	238	22.6	3.79	(15.4,30.4)	482	19.6	2.05	(15.7,23.8)	267	21.2	3.75	(14.2,29.0)
BC	377	35.8	4.32	(27.4,44.3)	926	37.7	2.48	(32.8,42.6)	423	33.5	4.17	(25.3,41.6)
West Coast US	434	41.2	3.68	(34.1,48.4)	997	40.6	2.17	(36.3,44.8)	527	41.7	3.10	(35.7,47.8)
Total Catch	1,055				2,459				1,262			

	Week 43 (N=723)				Week 44 (N=429)				Week 45 (N=135)			
Region	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI
Russia	0	0.0	0.02	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.11	(0.0,0.2)
Coast W AK	7	0.3	0.26	(0.0,1.0)	1	0.1	0.14	(0.0,0.5)	0	0.1	0.32	(0.0,1.1)
Mid Yukon	0	0.0	0.03	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.17	(0.0,0.4)
Up Yukon	0	0.0	0.04	(0.0,0.1)	0	0.0	0.06	(0.0,0.2)	0	0.1	0.20	(0.0,0.6)
N AK Pen	0	0.0	0.03	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.19	(0.0,0.4)
NW GOA	10	0.4	0.29	(0.0,1.1)	17	1.0	0.63	(0.1,2.5)	1	0.6	0.75	(0.0,2.6)
Copper	48	2.1	0.63	(1.0,3.5)	10	0.6	0.41	(0.1,1.6)	0	0.1	0.23	(0.0,0.7)
NE GOA	4	0.2	0.32	(0.0,1.1)	1	0.0	0.12	(0.0,0.3)	0	0.1	0.22	(0.0,0.6)
Coast SE AK	504	22.1	1.96	(18.3,26.0)	374	22.4	2.75	(17.4,28.2)	25	14.1	4.04	(6.6,22.3)
BC	928	40.6	2.36	(36.0,45.3)	628	37.6	3.24	(31.1,43.8)	64	35.5	5.09	(25.9,45.8)
West Coast US	783	34.3	1.96	(30.5,38.2)	637	38.2	2.56	(33.3,43.3)	89	49.4	4.61	(40.5,58.4)
Total Catch	2,285				1,669				181			

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366 WHITTLE, J. A., C. M. KONDZELA, HV. T. NGUYEN, K. HAUCH, D. CUADRA, and J. R. GUYON. 2018. Genetic stock composition analysis of chum salmon from the prohibited species catch of the 2016 Bering Sea walleye pollock trawl fishery and Gulf of Alaska groundfish fisheries, 56 p. NTIS No. PB2018-100474.

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