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Genetic Stock Composition Analysis of Chinook Salmon Bycatch Samples from the 2018 Gulf of Alaska Trawl Fisheries

C. M. Guthrie III, Hv. T. Nguyen, M. Marsh and J. R. Guyon

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C. M. Guthrie III, Hv. T. Nguyen, M. Marsh and J. R. Guyon

Alaska Fisheries Science Center
Auke Bay Laboratories
17109 Pt. Lena Loop Road
Juneau, AK 99801

ABSTRACT

A genetic analysis of samples from the Chinook salmon (*Oncorhynchus tshawytscha*) Prohibited Species Catch (bycatch) of the 2018 Gulf of Alaska (GOA) trawl fisheries for walleye pollock (*Gadus chalcogrammus*) and rockfish (*Sebastes* spp.) was undertaken to determine stock composition. Samples were genotyped for 43 single nucleotide polymorphism (SNP) DNA markers and results were estimated using the Alaska Department of Fish and Game's SNP baseline. In 2018, 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 fifth year for this sampling protocol with 15% of the estimated salmon bycatch from the pollock fishery successfully genotyped. Based on analysis of 2,226 Chinook salmon samples from a total bycatch of 14,820 fish, British Columbia (43%; 6,433), West Coast US (33%; 4,846), and Coastal Southeast Alaska (18%; 2,728) stock groups comprised the largest regional contributions. In 2018, genetic samples from the bycatch of the GOA rockfish catcher vessel fishery were collected by the fishing industry using a census sampling protocol. Based on the genotyping of 504 Chinook salmon bycatch samples collected from this fishery in NMFS Statistical Area 630, West Coast US region had the largest contribution (53%: 264) with smaller contributions from British Columbia (28%; 141), and Coastal Southeast Alaska (11%; 54) regions. The 2018 GOA stock composition estimates for Chinook salmon bycatch in both the trawl and rockfish fisheries follow a similar trend observed in recent years with most (>90%) Chinook salmon encountered originating from three large southern regions between coastal Southeast Alaska and northern California. This pattern also holds for samples collected across finer-scale time and area strata within the GOA.

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 potential 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, 2016-19; 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 objective of this report is to present stock composition estimates for samples collected from the bycatch of the 2018 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.
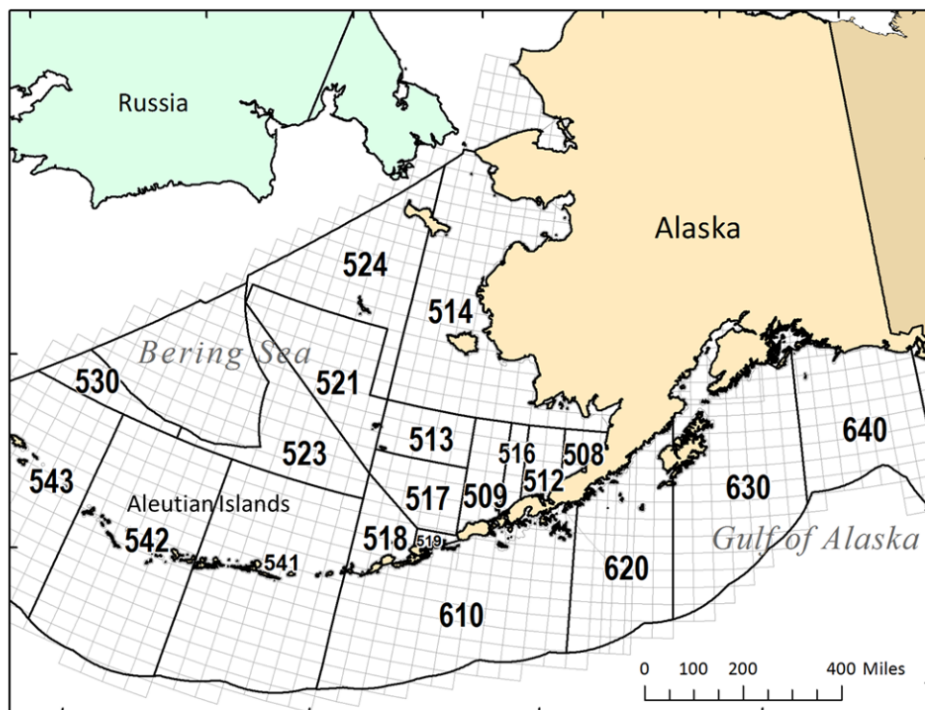
Figure 1. -- NMFS (outlined in black) and ADF&G (outlined in light gray) statistical areas associated with the Bering Sea and Gulf of Alaska (Areas 610-640) groundfish fisheries.

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 and Halibut 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 for genetic analysis were collected throughout 2018 from the GOA bottom and

midwater pollock trawl fishery. Tissues were stored in coin envelopes that 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 funding).

In 2018, an estimated 14,820 Chinook salmon were caught in the GOA pollock trawl

fisheries (NMFS 2019), which is one-third of the highest overall Chinook bycatch of 44,819 in

2010 (Fig. 2). The genotyped (genetic) sample set for the 2018 Chinook salmon bycatch was

2,226 fish which equates to 15% of the estimated catch of the pollock trawl fishery.
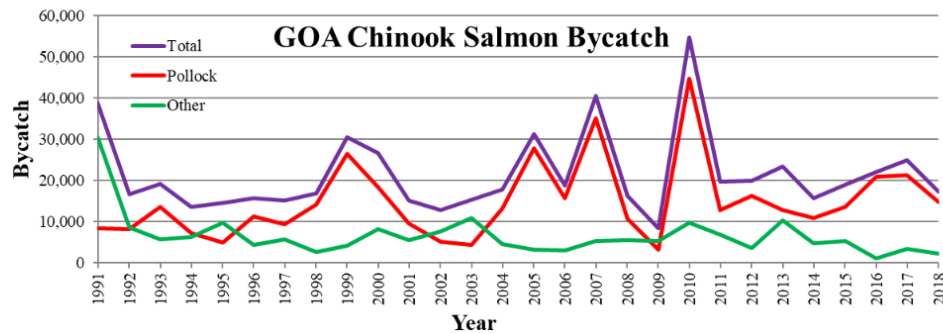
Figure 2. -- Yearly estimated Chinook salmon bycatch in the Gulf of Alaska pollock and non-
pollock trawl fisheries (NMFS 2019).

Potential spatial and temporal biases associated with the 2018 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

sampling rate (Fig. 5) was variable, but mostly over 10%, with an average of 15%.
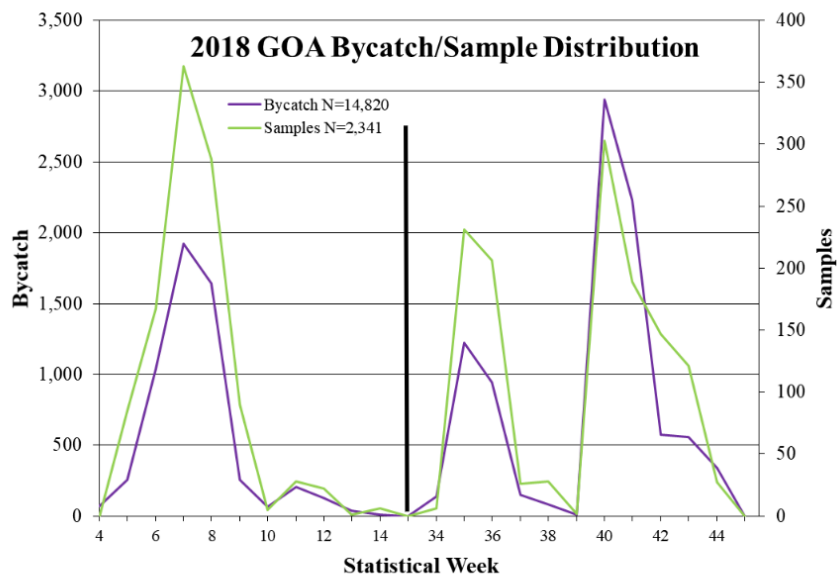
Figure 3. -- Estimated number of Chinook salmon bycatch and genetic samples by statistical
week from the 2018 Gulf of Alaska pollock trawl fishery. The line separates weeks
14 to 33 between which no fishing occurred.

2018 Chinook GOA Bycatch

2018 Chinook GOA Samples
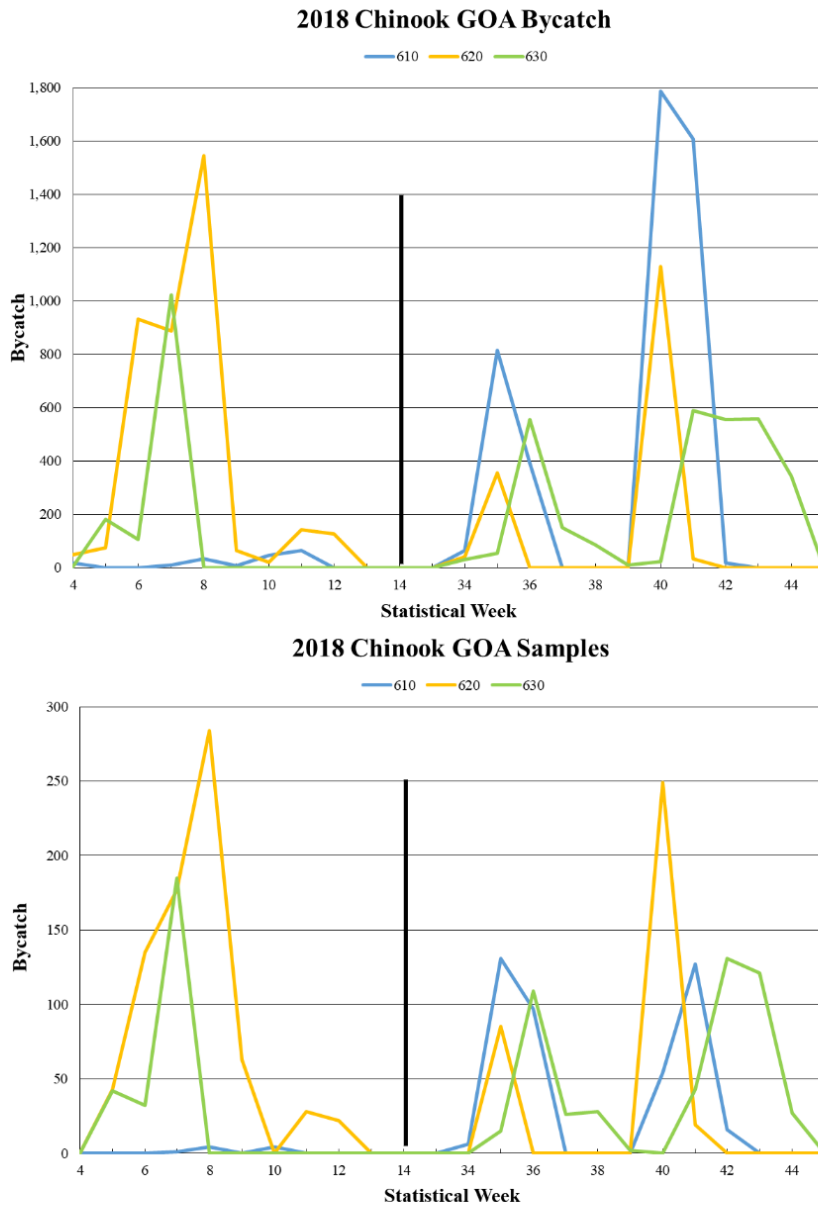
Figure 4. -- Estimated number of Chinook salmon bycatch (top) and available genetic samples (bottom) by statistical week and NMFS area from the 2018 Gulf of Alaska pollock trawl fishery. The line separates weeks 14 to 33 between which no fishing occurred.

2018 Chinook GOA Samples
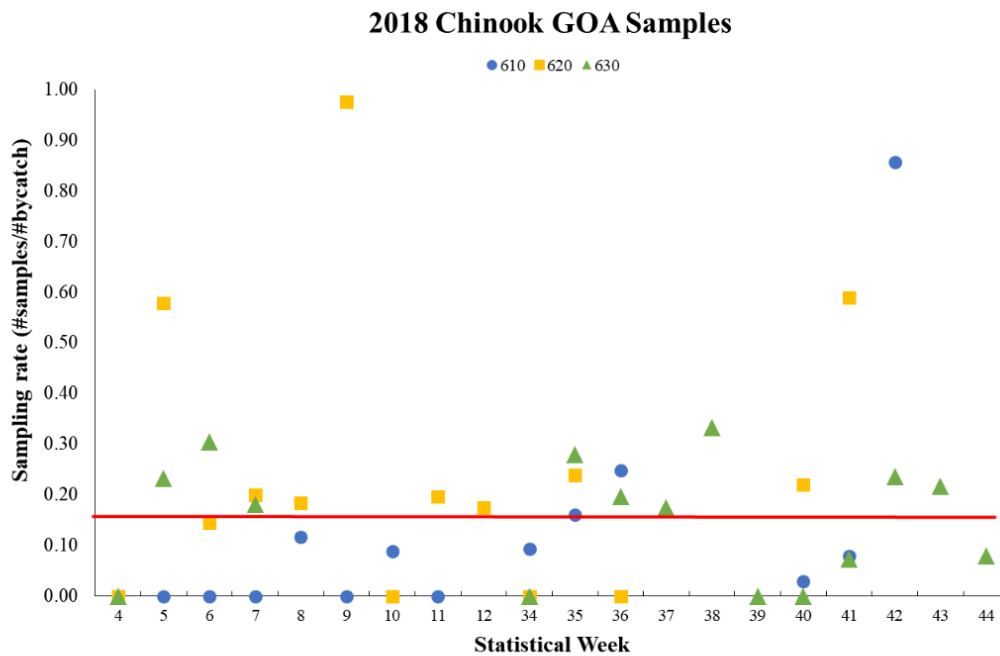
Figure 5. -- Sampling rate of Chinook salmon bycatch by statistical week and NMFS area from the 2018 Gulf of Alaska pollock trawl fishery. The red line shows the average sampling rate (15%) across Statistical Areas and Weeks.

GOA Rockfish CV Trawl Fishery

Samples were collected from the Chinook salmon bycatch of the federally managed 2018 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), 2016 (Guthrie et al. 2018), 2017 (Guthrie et al. 2019), and 2018 whereby genetic samples and biological information were collected from every Chinook salmon encountered in the bycatch. Between 9 May and 15 November 2018 (NMFS statistical week numbers 18-46), genetic samples were collected from 504 Chinook salmon. 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 6 and the sample collection area is

approximated in Figure 7.

Figure 6. -- Genetic samples collected by Alaska Groundfish Data Bank from the census of the Chinook salmon bycatch in the 2018 Gulf of Alaska rockfish catcher vessel (CV) trawl fishery by statistical week.

Figure 7. -- Relative location (shaded) of the 504 Chinook salmon bycatch samples collected in NMFS Statistical Area 630 by Alaska Groundfish Data Bank in the 2018 Gulf of Alaska rockfish trawl fishery.

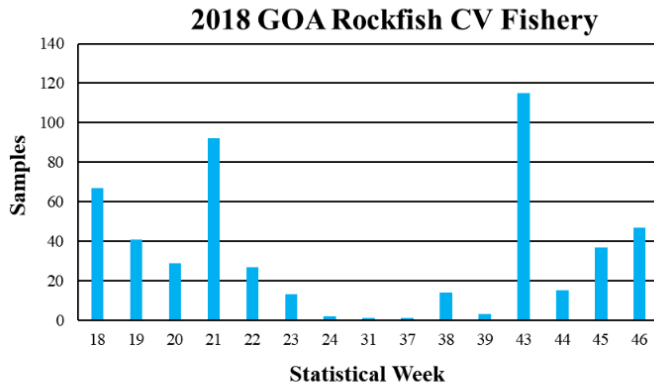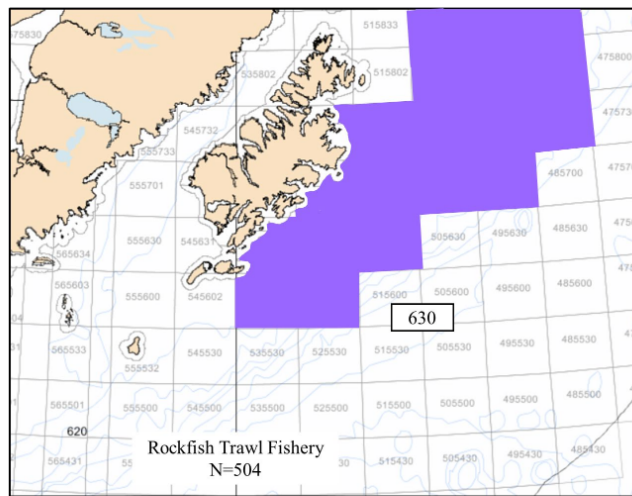GENETIC STOCK COMPOSITION – PROCEDURE

DNA was extracted from axillary tissue and genotyping was performed by using Taqman^{TM} chemistries from Applied Biosystems Inc. on a Life Technologies QuantStudio^{TM} 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). Replicate samples using 384-well format Taqman^{TM} assays were compared with MALDI-TOF assays, with a concordance rate of 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^{TM} chemistries, were included on each chip during the analyses and resulting genotypes were compared. Concordance rates of 100% between the two chemistries for the 2018 controls confirmed the utility and compatibility of both genotyping methods.

A total of 2,226 of 2,341 samples (95%) were successfully genotyped for 35 or more of the 43 SNP loci from the Chinook salmon bycatch from the 2018 GOA pollock trawl fishery,. and 499 of 504 samples received (99%) were successfully genotyped for 35 or more of the 43 SNP loci from the 2018 GOA rockfish CV trawl fishery. The successfully genotyped samples had genetic information for an average of 42 of 43 markers.

Stock composition estimates were derived using BAYES software which 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 for each chain 95% of the stocks came from a single designated stock group (region) with weights equally distributed among the stocks of that region. The designated region was unique in each chain. 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 shrink statistics (Gelman and Rubin 1992), 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 the mean of the posterior distribution of stock composition estimates and the estimated total bycatch of Chinook salmon. 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 estimated mean number of Chinook salmon originating from the Coastal Southeast Alaska region in the Southeast Kodiak Late stratum is 690 fish (Appendix 2), whereas in the overall Coastal Southeast Alaska bycatch the contribution from this region is only 662 fish. The 95% confidence interval of the estimated number of fish (545-842 fish) from the Coastal Southeast Alaska region in the smaller Late stratum is within the estimated number of fish from the overall Southeast Kodiak bycatch.

GENETIC STOCK COMPOSITION - RESULTS

GOA Pollock Trawl Fishery

The stock composition results indicate that 95% of the 2,226 samples from the GOA

originated from three southern regions (for the purposes of this report, West Coast US, BC and

Coastal SEAK are considered southern regions) with the British Columbia region contributing

the most (43%; 6,434 fish), followed by the West Coast US (33%; 4,846 fish), and Coastal

Southeast Alaska (18%; 2,768 fish) regions (Appendix 2). For years (2014-2018) the Observer

Program implemented a simple random sampling protocol with respect to trip for the collection

of genetic samples, the stock composition estimates in 2018 were very similar to estimates from
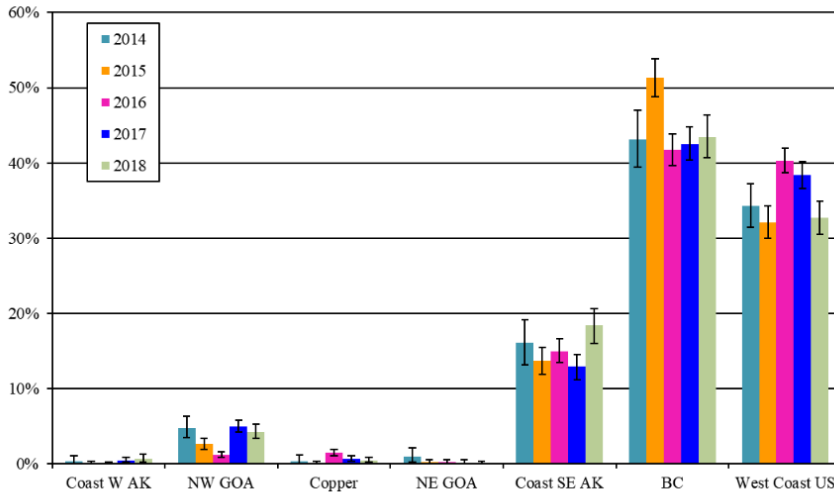
the previous 4 years (Fig. 8).

Figure 8. -- Yearly stock composition estimates (2014-2018) 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.

Using information from the ANSWERS tool provided by AKFIN (NMFS 2020), geographical (ADF&G statistical areas) aggregations were developed to provide stock compositions with greater spatial precision than the existing NMFS statistical areas. We analyzed 7 additional (other than overall and rockfish) bycatch sample strata (Appendix 2) including Shumagin Islands Late (statistical weeks 36-42) (Fig. 9); Shelikof Strait Early (statistical weeks 5-12), Late (statistical weeks 35-41), and overall (Fig. 10); and Southeast Kodiak Island Early (statistical weeks 5-7), Late (statistical weeks 35-44), and overall (Fig. 11).

For the western-most geographical stratum, the largest stock composition estimates in the Shumagin Islands Late (Fig. 9) were equally composed of Chinook salmon from British Columbia (42%) and the West Coast US (42%) with smaller contributions from Coastal Southeast Alaska (7%) and Northwest GOA (7%) (Appendix 2; Fig 12). For Shelikof Strait overall (Fig. 10), British Columbia contributed the most (45%), followed by the West Coast US (31%), and Coastal Southeast Alaska (20%) (Appendix 2; Fig. 12). The Early and Late season Shelikof Strait strata exhibited temporal differences in stock estimates. British Columbia accounted for 48% and 39% of the bycatch in the Early and Late seasons, respectively, while the West Coast US contributed 32% and 27% of the bycatch in the Early and Late seasons, respectively (Appendix 2; Fig 13). Contributions from both Coastal Southeast Alaska (19% to 24%) and NW GOA (1% to 9%) increase from Shelikof Strait Early to Late (Appendix 2, Fig. 13). All fish from Shelikof Strait Late were from the most southwestern portion (ADF&G Statistical Areas 555600 and 555630) of the stratum (Fig. 10). For the Southeast Kodiak Island overall stratum (Fig. 11), the large stock contribution estimates were from the British Columbia region (49%), followed by the West Coast US (29%) and Coastal Southeast Alaska (17%) regions (Appendix 2; Fig. 12). There were temporal differences of stock composition estimates
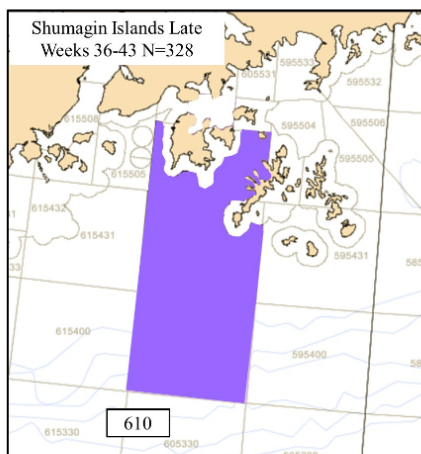
Figure 9. -- Location (shaded) of the Shumagin Islands Late stratum used in comparative stock composition estimates from the 2018 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2020).
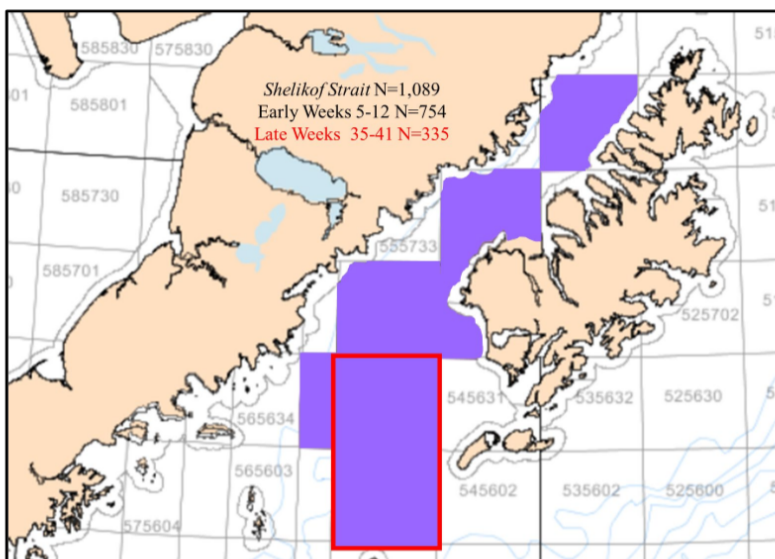
Figure 10. -- Location (shaded) of the Shelikof Strait strata used in comparative stock composition estimates from the 2018 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2020). Location of Late samples is outlined in red.
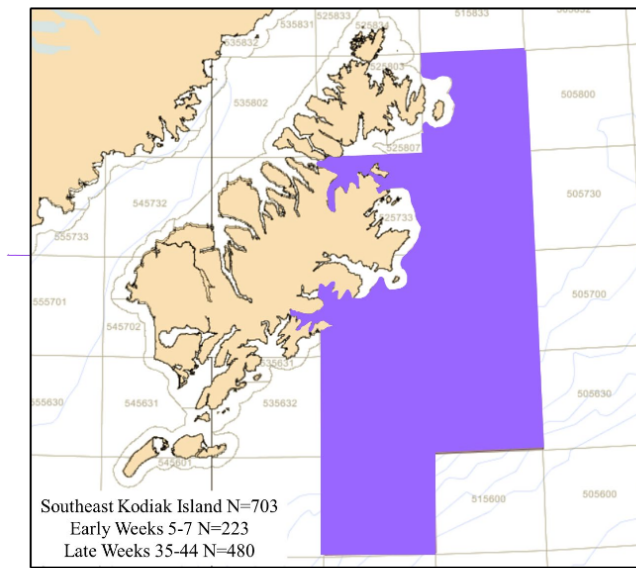
Figure 11. -- Location (shaded) of the Kodiak Island strata used in comparative stock composition estimates from the 2018 Gulf of Alaska Chinook salmon bycatch from the pollock trawl fishery (NMFS 2020).

Figure 12. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from four area strata from the 2018 GOA pollock trawl fishery: GOA overall (2,226 samples); Shumagin Islands Late (328, Fig. 9); Shelikof Strait overall (1,089, Fig. 10); and Southeast Kodiak Island overall (703, Fig. 11).

2018 Shelikof Chinook Salmon Bycatch

Figure 13. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from Shelikof Strait (Fig. 10) area and time strata from the 2018 Gulf of Alaska pollock trawl fishery: Early (754), Late (335) and overall (1,089).

2018 SE Kodiak Chinook Salmon Bycatch

Figure 14. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from Southeast Kodiak Island (Fig. 11) area and time strata from the 2018 Gulf of Alaska pollock trawl fishery: Early (323), Late (197), and overall (540).

between the Early and Late strata (Fig.14). The British Columbia contribution decreased (64% to 42%), the West Coast US contribution increased (20% to 33%), and Coastal Southeast Alaska contribution increased (15% to 19%) for the Early and Late strata, respectively (Fig.14).

Comparison of Strata Stock Composition and

Catch Estimates From Previous Years

Stock composition estimates from strata where there were available data were compared across years. The Shumagin Late stratum (Appendix 3; Fig. 15) showed an interesting pattern in alternating years; British Columbia was most prevalent at 61% in 2015 and 67% in 2017, while in 2016 and 2018 British Columbia and the West Coast US had similar proportions all at 42%; except for West Coast US at 51% in 2018. Catch estimates overall from this stratum were fairly consistent, with a low of 2,529 (2017) and a high of 3,347 (2016). (Appendix 3). The stock composition estimates for Shelikof Strait (Appendices 2 and 3; Fig. 16) and Southeast Kodiak strata (Appendices 2 and 3; Fig. 17) were similar across all years. Catch estimates were quite variable for Shelikof Strait and Southeast Kodiak strata (Appendix 3). Shelikof Strait catch estimates in 2017 (11,130) were almost double those of the next highest year 2015 (6,400), while 2016 and 2018 had catch estimates of 3,217 and 5,481 respectively (Appendix 3). The Southeast Kodiak catch estimate in 2016 was four times larger (11,851) than the next largest, 3,207 (2018) which was larger than 2015 (2,247) and 2017 (2,443) (Appendix 3).

Shumagin Late 2015-2018
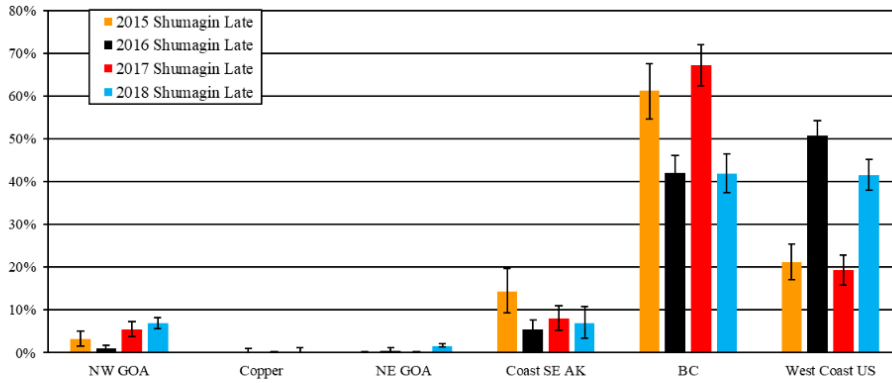
Figure 15. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from Shumagin Islands Late (Fig. 9) strata for 2015-2018 (Appendix 3) from the Gulf of Alaska pollock trawl fishery.

Shelikof Strait 2015-2018
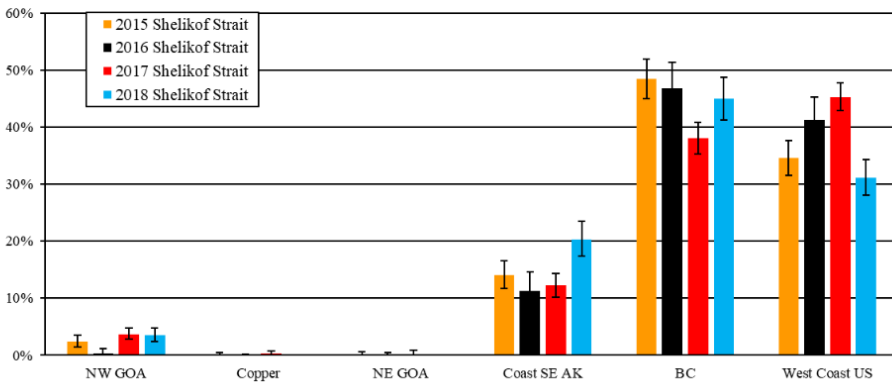
Figure 16. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from Shelikof (Fig. 10) strata for 2015-2018 (Appendix 3) from the Gulf of Alaska pollock trawl fishery.
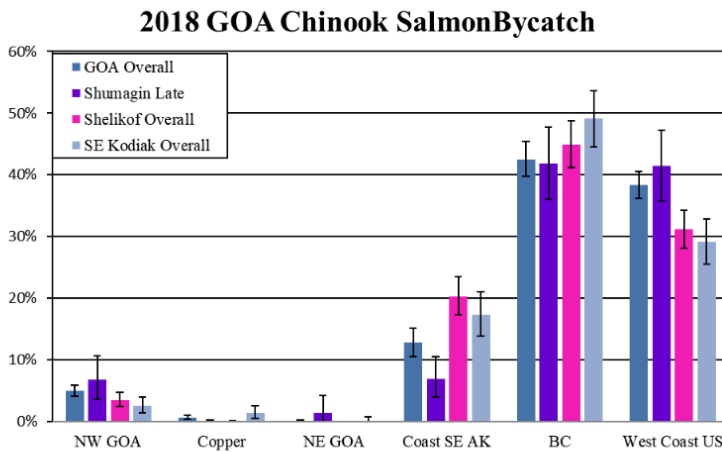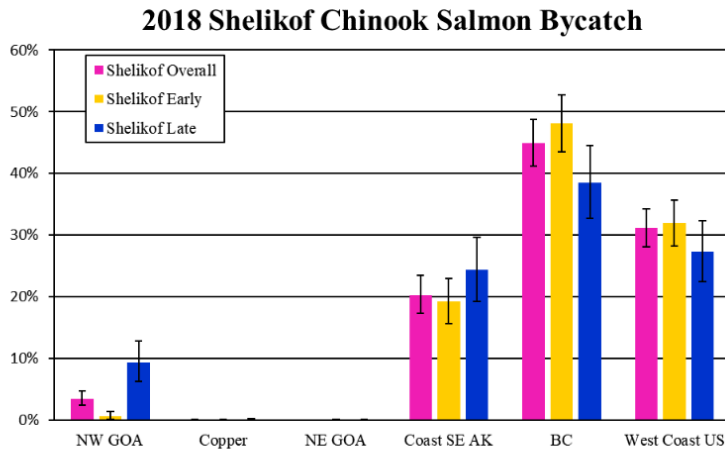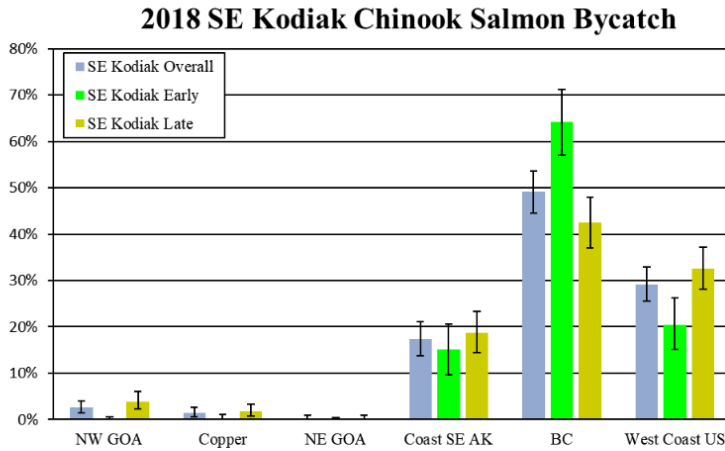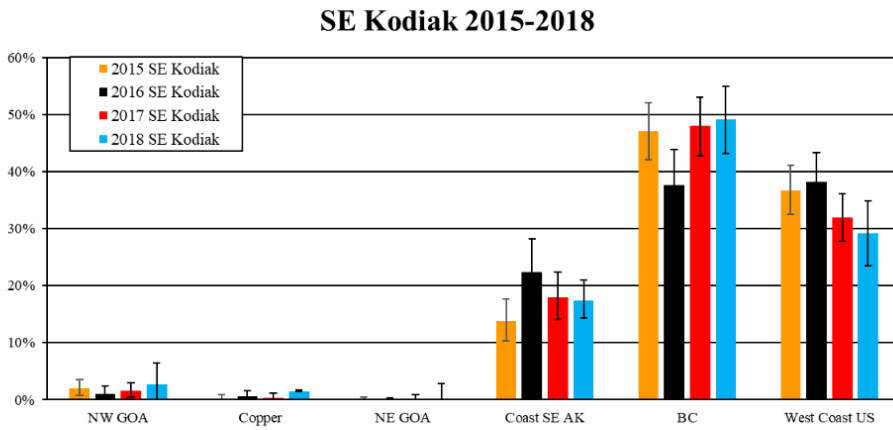
SE Kodiak 2015-2018

Figure 17. -- Stock composition estimates with BAYES 95% credible intervals of Chinook salmon bycatch samples from Southeast Kodiak (Fig. 11) strata for 2015-2018 (Appendix 3) from the Gulf of Alaska pollock trawl fishery.

Gulf of Alaska Rockfish CV Trawl Fishery

The stock composition results indicate that almost all of the 499 Chinook salmon samples successfully genotyped from the bycatch of the 2018 GOA rockfish CV trawl fishery originated from southern regions (99%), primarily from West Coast US (53%), British Columbia (28%), and Coastal Southeast Alaska (11%) regions (Appendix 2). When comparing stock estimates across all years (2013-2018), these same three reporting groups consistently accounted for over 99% of the bycatch (Fig. 18). For the two highest contributing regions, British Columbia and West Coast US, the relative proportions in 2018 were most similar to those in 2013, 2016 and 2017, and differed slightly from the estimates in 2014 and 2015, which were almost identical. Catch levels were highest in 2013 Temporal differences were also examined in the rockfish fishery for early (statistical weeks 18-30) and late (statistical weeks 31-47) seasons (Appendix 4; Figs. 19 and 20). Early season stock compositions were similar to the overall which is probably driven by the greater abundance of Chinook salmon bycatch in the early season (Appendix 4;

Figs. 18 and 19). When comparing early versus late, the West Coast US fish are more abundant

early, while British Columbia increases in the late season (Appendix 4; Figs. 20 and 21).
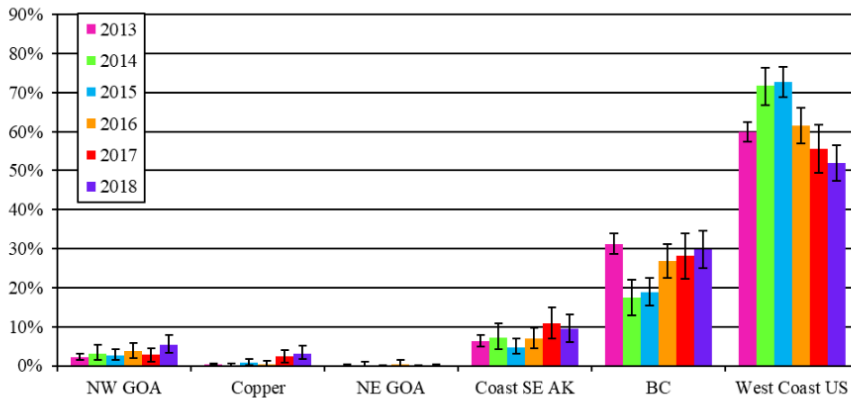
Figure 18. -- Stock composition estimates with 95% BAYES credible intervals of Chinook salmon bycatch from the 2013-2018 Gulf of Alaska rockfish CV trawl fishery.
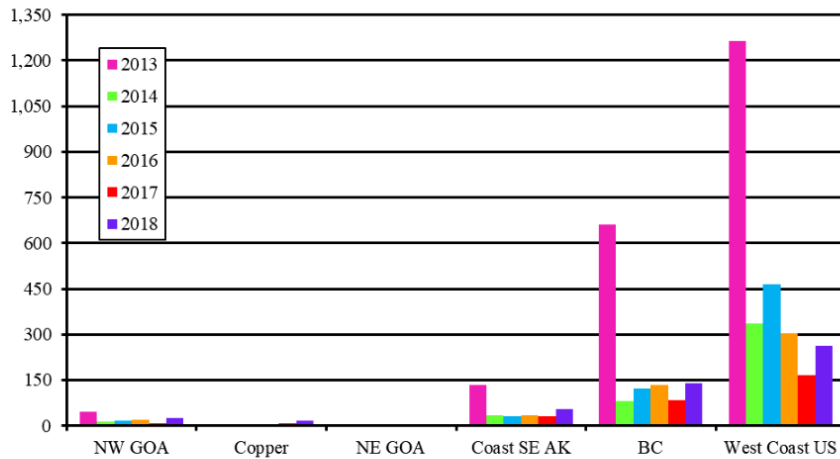
Figure 19. – Harvest estimates derived from stock composition estimates with of Chinook salmon bycatch from the 2013-2018 Gulf of Alaska rockfish CV trawl fishery.

Chinook Bycatch from GOA Rockfish Early
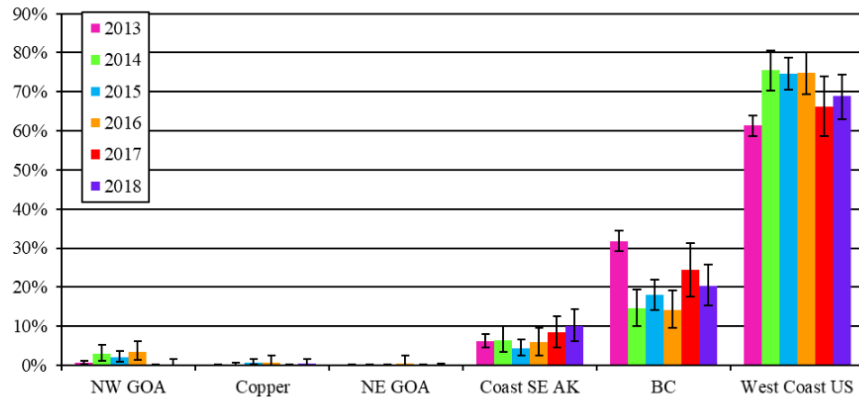
Figure 20. -- Stock composition estimates with 95% BAYES credible intervals of Chinook salmon bycatch from the 2013-2018 Gulf of Alaska rockfish Early (Statistical Weeks 18-30) CV trawl fishery.

Chinook Bycatch from GOA Rockfish Late
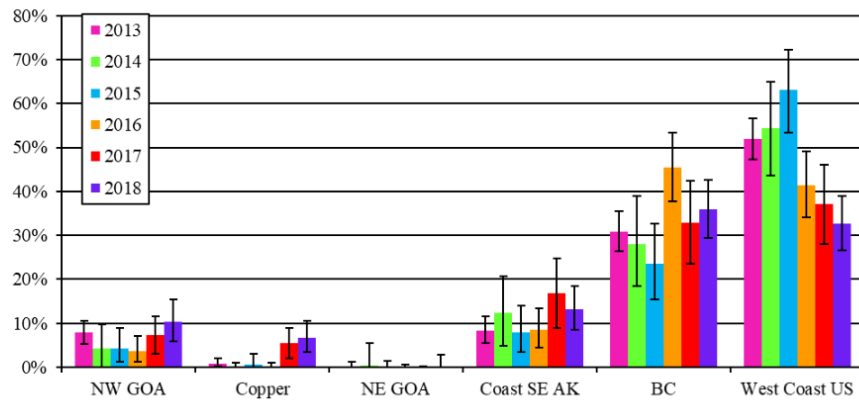
Figure 21. -- Stock composition estimates with 95% BAYES credible intervals of Chinook salmon bycatch from the 2013-2018 Gulf of Alaska rockfish Late (Statistical Weeks 31-47) CV trawl fishery.

SUMMARY

The incidental harvest of Chinook salmon from federally managed groundfish fisheries in the GOA averaged 21,646 salmon per year during 1991-2017, with an estimated peak of 54,678 in 2010. In 2018, the largest component of the Chinook salmon bycatch in the GOA was from the pollock trawl fishery with an estimated 14,820 fish. An additional 2,364 fish from other fisheries, including the rockfish trawl fisheries, bring the GOA 2018 Chinook salmon bycatch total to an estimated 17,184 fish.

Stock composition estimates of the Chinook salmon bycatch help pollock and salmon fishery managers 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 2018 GOA pollock trawl fishery was almost 15% of the total bycatch. The samples in 2018 were collected in similar proportions to the overall bycatch (Fig. 3), although small differences in spatial and temporal distributions remain (Figs. 4, 5). A similar sampling protocol has been in place since 2014; comparisons with stock composition estimates prior to 2014 should be interpreted with caution.

Similar to the 2013-2017 GOA rockfish CV trawl fisheries, the fishing industry conducted a census approach in 2018 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 (Appendices 2-4).

Stock Composition Estimates

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 large southern regions between coastal Southeast Alaska and northern California. This pattern also holds for samples analyzed across finer-scale area and time strata within the GOA, including bycatch collected from the Shumagin Islands, Shelikof Strait, and Southeast Kodiak Island.

Application of 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 number of fish caught as bycatch, 2) the age of the salmon caught in the bycatch, 3) the age of the returning salmon, and 4) the total run size 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 in one year does not necessarily imply greater impact than a smaller estimate the next.

ACKNOWLEDGMENTS

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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 2018 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 2019). 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.

Region	Gulf of Alaska, pollock (N=2,226) Est. #	Mean	SD	95% CI	Shelikof Strait Early (N=754) Est. #	Mean	SD	95% CI	Shelikof Strait Late (N=335) Est. #	Mean	SD	95% CI	Shelikof Strait (N=1,089) Est. #	Mean	SD	95% CI
Russia	9	0.1	0.06	(0.0,0.2)	0	0.0	0.02	(0.0,0.0)	0	0.0	0.13	(0.0,0.4)	1	0.0	0.03	(0.0,0.1)
Coast W AK	99	0.7	0.27	(0.2,1.3)	1	0.0	0.07	(0.0,0.2)	5	0.3	0.51	(0.0,1.8)	3	0.1	0.11	(0.0,0.4)
Mid Yukon	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.06	(0.0,0.2)	0	0.0	0.02	(0.0,0.1)
Up Yukon	0	0.0	0.02	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)	0	0.0	0.08	(0.0,0.2)	1	0.0	0.03	(0.0,0.1)
N AK Pen	1	0.0	0.03	(0.0,0.1)	1	0.0	0.07	(0.0,0.2)	1	0.1	0.27	(0.0,0.9)	1	0.0	0.06	(0.0,0.2)
NW GOA	628	4.2	0.49	(3.3,5.2)	25	0.6	0.34	(0.1,1.4)	146	9.4	1.70	(6.3,12.9)	191	3.5	0.59	(2.4,4.7)
Copper	67	0.5	0.18	(0.2,0.9)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.10	(0.0,0.3)	1	0.0	0.03	(0.0,0.1)
NE GOA	7	0.1	0.09	(0.0,0.3)	0	0.0	0.06	(0.0,0.3)	0	0.0	0.10	(0.0,0.2)	1	0.0	0.04	(0.0,0.1)
Coast SE AK	2,728	18.4	1.17	(16.0,20.6)	756	19.3	1.86	(15.7,23.0)	379	24.3	2.67	(19.2,29.7)	1,115	20.3	1.55	(17.4,23.5)
BC	6,433	43.4	1.43	(40.7,46.3)	1,887	48.1	2.38	(43.5,52.8)	600	38.5	3.00	(32.8,44.5)	2,462	44.9	1.93	(41.2,48.7)
West Coast US	4,846	32.7	1.12	(30.5,34.9)	1,251	31.9	1.90	(28.2,35.7)	425	27.3	2.54	(22.5,32.4)	1,707	31.2	1.57	(28.1,34.3)
Total Catch	14,820				3,923				1,558				5,481			

Region	Shumagin Islands Late (N=328) Est. #	Mean	SD	95% CI	SE Kodiak I. Early (N=223) Est. #	Mean	SD	95% CI	Southeast Kodiak I. Late (N=480) Est. #	Mean	SD	95% CI	Southeast Kodiak Island (N=703) Est. #	Mean	SD	95% CI
Russia	0	0.0	0.07	(0.0,0.1)	0	0.1	0.00	(0.0,0.1)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.02	(0.0,0.0)
Coast W AK	35	1.1	0.93	(0.0,3.2)	1	0.2	0.00	(0.0,1.5)	10	0.3	0.44	(0.0,1.5)	8	0.2	0.28	(0.0,1.0)
Mid Yukon	1	0.0	0.08	(0.0,0.2)	0	0.1	0.00	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)
Up Yukon	2	0.1	0.18	(0.0,0.6)	0	0.1	0.00	(0.0,0.2)	1	0.0	0.06	(0.0,0.2)	0	0.0	0.04	(0.0,0.1)
N AK Pen	3	0.1	0.29	(0.0,1.0)	0	0.1	0.00	(0.0,1.3)	0	0.0	0.07	(0.0,0.2)	0	0.0	0.05	(0.0,0.1)
NW GOA	219	6.8	1.81	(3.6,10.7)	0	0.2	0.00	(0.0,7.5)	111	3.9	0.96	(2.2,6.0)	101	2.6	0.65	(1.5,4.0)
Copper	1	0.0	0.11	(0.0,0.3)	1	0.3	0.00	(0.0,5.2)	50	1.8	0.68	(0.7,3.3)	55	1.4	0.52	(0.6,2.6)
NE GOA	48	1.5	1.20	(0.0,4.2)	0	0.2	0.00	(0.0,1.1)	4	0.1	0.25	(0.0,0.9)	6	0.2	0.24	(0.0,0.8)
Coast SE AK	224	7.0	1.68	(4.1,10.6)	148	2.8	9.69	(15.0,14.0)	532	18.8	2.27	(14.5,23.3)	662	17.3	1.84	(13.8,21.1)
BC	1,343	41.9	3.00	(36.0,47.8)	632	3.6	57.02	(64.1,32.4)	1,203	42.4	2.77	(37.1,47.9)	1,876	49.1	2.32	(44.6,53.6)
West Coast US	1,331	41.5	2.91	(35.9,47.3)	202	2.8	15.18	(20.3,57.0)	925	32.6	2.30	(28.2,37.2)	1,113	29.1	1.86	(25.5,32.8)
Total Catch	3,207				986				2,836				3,822			

Region	Rockfish Trawl Early (N=268) Est. #	Mean	SD	95% CI	Rockfish Trawl Late (N=231) Est. #	Mean	SD	95% CI	Rockfish Trawl Fishery (N=499) Est. #	Mean	SD	95% CI
Russia	0	0.0	0.06	(0.0,0.1)	0	0.0	0.07	(0.0,0.1)	0	0.0	0.03	(0.0,0.1)
Coast W AK	0	0.1	0.20	(0.0,0.7)	2	0.7	0.95	(0.0,3.3)	1	0.3	0.42	(0.0,1.5)
Mid Yukon	0	0.0	0.08	(0.0,0.2)	0	0.0	0.11	(0.0,0.3)	0	0.0	0.05	(0.0,0.1)
Up Yukon	0	0.0	0.10	(0.0,0.3)	0	0.0	0.12	(0.0,0.4)	0	0.0	0.06	(0.0,0.2)
N AK Pen	0	0.0	0.13	(0.0,0.3)	1	0.3	0.64	(0.0,2.3)	1	0.2	0.37	(0.0,1.3)
NW GOA	1	0.3	0.47	(0.0,1.6)	24	10.3	2.41	(5.9,15.3)	25	5.0	1.18	(2.9,7.5)
Copper	1	0.4	0.42	(0.0,1.5)	15	6.6	1.86	(3.4,10.6)	17	3.3	0.89	(1.7,5.2)
NE GOA	0	0.0	0.17	(0.0,0.5)	1	0.3	0.78	(0.0,2.8)	0	0.0	0.32	(0.0,1.1)
Coast SE AK	27	10.0	2.08	(6.1,14.3)	31	13.2	2.58	(8.4,18.5)	54	10.7	1.62	(7.7,14.0)
BC	55	20.2	2.70	(15.2,25.9)	84	35.9	3.38	(29.4,42.6)	141	28.0	2.22	(23.7,32.4)
West Coast US	187	68.9	2.91	(63.0,74.5)	76	32.6	3.14	(26.7,38.9)	264	52.5	2.32	(47.9,57.0)
Total Catch	271				233				504			

Appendix 3. -- Regional BAYES stock composition percentage estimates, standard deviations (SD), 95% credible intervals (CI), and estimated numbers of Chinook salmon from the 2015-17 GOA pollock fishery, and different strata of the pollock fishery. Sample sizes are adjacent to stratum designation. Total catch is the estimated catch from AKFIN reports (NMFS 2019). GOA, pollock (left) encompasses other strata. 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.

2017	Gulf of Alaska, pollock (N=3,571)				Shumagin Islands Late (N=712)				Shelikof Strait (N=1,922)				Southeast Kodiak Island (N=540)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	6	0.0	0.03	(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	0.03	(0.0,0.0)
Coast W AK	96	0.5	0.18	(0.2,0.9)	3	0.1	0.16	(0.0,0.6)	22	0.2	0.25	(0.0,0.9)	3	0.1	0.24	(0.0,0.9)
Mid Yukon	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)	0	0.0	0.04	(0.0,0.1)
Up Yukon	0	0.0	0.01	(0.0,0.0)	0	0.0	0.05	(0.0,0.2)	0	0.0	0.02	(0.0,0.0)	0	0.0	0.05	(0.0,0.2)
N AK Pen	0	0.0	0.02	(0.0,0.1)	0	0.0	0.07	(0.0,0.2)	1	0.0	0.03	(0.0,0.1)	1	0.1	0.20	(0.0,0.7)
NW GOA	1,065	5.0	0.41	(4.2,5.8)	137	5.4	0.88	(3.8,7.2)	415	3.7	0.50	(2.8,4.8)	37	1.5	0.64	(0.5,3.0)
Copper	137	0.6	0.18	(0.3,1.0)	1	0.0	0.06	(0.0,0.2)	35	0.3	0.21	(0.0,0.8)	9	0.4	0.35	(0.0,1.2)
NE GOA	13	0.1	0.13	(0.0,0.5)	1	0.0	0.04	(0.0,0.3)	23	0.2	0.29	(0.0,0.9)	2	0.1	0.24	(0.0,0.9)
Coast SE AK	2,762	12.9	0.86	(11.2,14.6)	202	8.0	1.51	(5.2,11.1)	1,359	12.2	1.04	(10.2,14.3)	440	18.0	2.12	(14.0,22.4)
BC	9,096	42.5	1.14	(40.4,44.9)	1,700	67.2	2.42	(62.4,71.9)	4,234	38.0	1.41	(35.3,40.8)	1,172	48.0	2.61	(42.8,53.0)
West Coast US	8,215	38.4	0.92	(36.6,40.2)	486	19.2	1.80	(15.8,22.8)	5,041	45.3	1.24	(42.9,47.7)	779	31.9	2.14	(27.8,36.1)
Total Catch	21,392				2,529				11,130				2,443			
2016	Gulf of Alaska, pollock (N=4,962)				Shumagin Islands Late (N=896)				Shelikof Strait (N=608)				Southeast Kodiak Island (N=2,997)			
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	0.02	(0.0,0.0)	0	0.0	0.03	(0.0,0.0)	1	0.0	0.04	(0.0,0.1)
Coast W AK	10	0.1	0.07	(0.0,0.2)	9	0.3	0.28	(0.0,1.0)	8	0.3	0.32	(0.0,1.1)	7	0.1	0.14	(0.0,0.5)
Mid Yukon	0	0.0	0.00	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)	1	0.0	0.05	(0.0,0.1)
Up Yukon	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)	2	0.0	0.06	(0.0,0.2)
N AK Pen	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)	1	0.0	0.05	(0.0,0.1)
NW GOA	247	1.2	0.18	(0.9,1.6)	32	1.0	0.38	(0.3,1.8)	11	0.3	0.33	(0.0,1.1)	123	1.0	0.63	(0.1,2.5)
Copper	296	1.4	0.21	(1.1,1.9)	8	0.3	0.28	(0.0,1.0)	0	0.0	0.05	(0.0,0.2)	74	0.6	0.41	(0.1,1.6)
NE GOA	41	0.2	0.15	(0.0,0.6)	13	0.4	0.33	(0.0,1.2)	2	0.1	0.15	(0.0,0.5)	4	0.0	0.12	(0.0,0.3)
Coast SE AK	3,080	15.0	0.81	(13.5,16.7)	179	5.4	1.11	(3.4,7.7)	365	11.4	1.59	(8.4,14.6)	2,660	22.4	2.75	(17.4,28.2)
BC	8,602	41.8	1.07	(39.7,43.8)	1,409	42.1	1.98	(38.2,46.0)	1,506	46.8	2.29	(42.3,51.3)	4,462	37.6	3.24	(31.1,43.8)
West Coast US	8,301	40.3	0.82	(38.7,41.9)	1,695	50.7	1.83	(47.1,54.2)	1,325	41.2	2.08	(37.1,45.3)	4,525	38.2	2.56	(33.3,43.3)
Total Catch	20,589				3,347				3,217				11,858			
2015	Gulf of Alaska, pollock (N=2,414)				Shumagin Islands Late (N=450)				Shelikof Strait (N=1,143)				Southeast Kodiak Island (N=566)			
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	0.01	(0.0,0.0)	0	0.0	0.07	(0.0,0.2)	0	0.0	0.02	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)
Coast W AK	5	0.0	0.08	(0.0,0.3)	5	0.2	0.29	(0.1,1.0)	10	0.2	0.21	(0.0,0.7)	7	0.3	0.36	(0.1,1.2)
Mid Yukon	0	0.0	0.02	(0.0,0.0)	0	0.0	0.05	(0.0,0.1)	1	0.0	0.04	(0.0,0.1)	0	0.0	0.05	(0.0,0.1)
Up Yukon	0	0.0	0.01	(0.0,0.0)	1	0.0	0.06	(0.0,0.2)	1	0.0	0.02	(0.0,0.1)	0	0.0	0.05	(0.0,0.2)
N AK Pen	3	0.0	0.05	(0.0,0.2)	1	0.0	0.11	(0.0,0.3)	1	0.0	0.03	(0.0,0.1)	2	0.1	0.20	(0.0,0.7)
NW GOA	353	2.6	0.36	(1.9,3.3)	100	3.2	0.89	(1.6,5.1)	156	2.4	0.51	(1.5,3.5)	44	1.9	0.70	(0.8,3.5)
Copper	16	0.1	0.10	(0.0,0.4)	1	0.0	0.06	(0.0,0.2)	8	0.1	0.14	(0.0,0.5)	3	0.1	0.24	(0.0,0.9)
NE GOA	23	0.2	0.13	(0.0,0.5)	1	0.0	0.10	(0.0,0.3)	12	0.2	0.17	(0.0,0.6)	1	0.0	0.16	(0.0,0.5)
Coast SE AK	1,857	13.6	0.90	(11.9,15.4)	451	14.2	2.64	(9.4,19.6)	904	14.1	1.23	(11.8,16.6)	309	13.8	1.88	(10.3,17.6)
BC	6,990	51.4	1.30	(48.8,53.9)	1,944	61.2	3.27	(54.7,67.5)	3,098	48.4	1.77	(45.0,51.9)	1,057	47.0	2.54	(42.0,52.0)
West Coast US	4,365	32.1	1.11	(30.0,34.3)	671	21.1	2.11	(17.2,25.4)	2,211	34.6	1.57	(31.5,37.6)	824	36.7	2.18	(32.5,41.1)
Total Catch	13,612				3,175				6,400				2,247			

Appendix 4. -- Regional BAYES stock composition percentage estimates, standard deviations (SD), 95% credible intervals (CI), and estimated numbers of Chinook salmon from the 2013-17 GOA rockfish trawl fishery. Genotyped sample sizes are adjacent to the year designation.

2017	Rockfish Trawl Early (N=173)				Rockfish Trawl Late (N=107)				Rockfish Trawl Fishery (N=280)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	0	0.0	0.09	(0.0,0.1)	0	0.0	0.18	(0.0,0.3)	0	0.0	0.07	(0.0,0.1)
Coast W AK	1	0.3	0.54	(0.0,1.9)	0	0.2	0.51	(0.0,1.7)	0	0.1	0.21	(0.0,0.7)
Mid Yukon	0	0.0	0.14	(0.0,0.3)	0	0.1	0.21	(0.0,0.6)	0	0.0	0.08	(0.0,0.2)
Up Yukon	0	0.0	0.16	(0.0,0.5)	0	0.1	0.25	(0.0,0.8)	0	0.0	0.10	(0.0,0.3)
N AK Pen	0	0.0	0.11	(0.0,0.3)	0	0.1	0.44	(0.0,1.2)	0	0.0	0.15	(0.0,0.4)
NW GOA	0	0.1	0.21	(0.0,0.7)	8	7.2	2.60	(3.0,13.0)	8	2.7	1.03	(1.1,5.1)
Copper	0	0.2	0.36	(0.0,1.3)	6	5.5	2.24	(2.0,10.6)	7	2.4	0.95	(0.8,4.6)
NE GOA	0	0.1	0.31	(0.0,1.0)	0	0.1	0.38	(0.0,0.8)	0	0.0	0.22	(0.0,0.5)
Coast SE AK	16	8.5	2.33	(4.5,13.6)	18	16.8	4.31	(9.0,25.8)	33	10.9	2.21	(6.9,15.5)
BC	46	24.5	3.62	(17.7,31.8)	36	32.9	5.06	(23.5,43.2)	84	28.1	3.07	(22.3,34.3)
West Coast US	126	66.3	3.79	(58.6,73.5)	40	37.0	4.77	(28.0,46.6)	166	55.6	3.11	(49.4,61.6)
Total Catch	190				109				299			

2016	Rockfish Trawl Early (N=302)				Rockfish Trawl Late (N=191)				Rockfish Trawl Fishery (N=493)			
Region	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI	Est. #	Mean	SD	95% PI
Russia	0	0.0	0.06	(0.0,0.1)	0	0.0	0.08	(0.0,0.1)	0	0.0	0.04	(0.0,0.1)
Coast W AK	1	0.5	0.57	(0.0,2.0)	2	0.9	1.01	(0.0,3.6)	3	0.5	0.55	(0.0,1.9)
Mid Yukon	0	0.0	0.07	(0.0,0.2)	0	0.0	0.17	(0.0,0.4)	0	0.0	0.05	(0.0,0.1)
Up Yukon	0	0.0	0.09	(0.0,0.3)	0	0.0	0.15	(0.0,0.5)	0	0.0	0.06	(0.0,0.2)
N AK Pen	0	0.0	0.17	(0.0,0.5)	0	0.0	0.20	(0.0,0.6)	0	0.0	0.10	(0.0,0.3)
NW GOA	10	3.4	1.25	(1.3,6.2)	7	3.6	1.50	(1.2,7.0)	19	3.7	1.00	(2.0,5.9)
Copper	2	0.7	0.75	(0.0,2.5)	0	0.1	0.29	(0.0,0.9)	1	0.3	0.37	(0.0,1.3)
NE GOA	2	0.6	0.73	(0.0,2.6)	0	0.0	0.21	(0.0,0.5)	1	0.3	0.44	(0.0,1.6)
Coast SE AK	18	5.9	1.77	(2.5,9.6)	16	8.4	2.28	(4.4,13.3)	34	6.9	1.34	(4.4,9.6)
BC	43	14.1	2.45	(9.6,19.2)	87	45.4	3.99	(37.7,53.3)	133	26.8	2.20	(22.6,31.2)
West Coast US	228	74.9	2.74	(69.3,80.1)	79	41.4	3.86	(34.0,49.1)	305	61.5	2.32	(56.9,66.0)
Total Catch	304				192				496			

2015	Rockfish Trawl Early (N=524)				Rockfish Trawl Late (N=111)				Rockfish Trawl Fishery (N=635)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	0	0.0	0.03	(0.0,0.1)	0	0.0	0.15	(0.0,0.2)	0	0.0	0.03	(0.0,0.0)
Coast W AK	0	0.1	0.21	(0.0,0.7)	0	0.2	0.43	(0.0,1.4)	0	0.1	0.13	(0.0,0.5)
Mid Yukon	0	0.0	0.04	(0.0,0.1)	0	0.0	0.20	(0.0,0.5)	0	0.0	0.03	(0.0,0.1)
Up Yukon	0	0.0	0.05	(0.0,0.2)	0	0.1	0.24	(0.0,0.7)	0	0.0	0.04	(0.0,0.1)
N AK Pen	0	0.0	0.06	(0.0,0.2)	0	0.1	0.25	(0.0,0.6)	0	0.0	0.05	(0.0,0.1)
NW GOA	11	2.1	0.70	(0.9,3.6)	5	4.4	1.99	(1.3,8.9)	17	2.7	0.70	(1.5,4.2)
Copper	4	0.7	0.41	(0.1,1.7)	1	0.6	0.89	(0.0,3.1)	5	0.8	0.39	(0.2,1.7)
NE GOA	0	0.0	0.08	(0.0,0.2)	0	0.1	0.48	(0.0,1.3)	0	0.0	0.07	(0.0,0.2)
Coast SE AK	23	4.4	1.10	(2.4,6.7)	9	8.0	2.75	(3.4,14.1)	31	4.8	1.01	(3.0,6.9)
BC	95	18.0	1.97	(14.2,22.0)	26	23.6	4.42	(15.4,32.7)	121	18.9	1.79	(15.5,22.5)
West Coast US	394	74.7	2.08	(70.5,78.7)	70	63.0	4.83	(53.4,72.3)	464	72.8	1.92	(68.9,76.5)
Total Catch	527				111				638			

2014	Rockfish Trawl Early (N=299)				Rockfish Trawl Late (N=99)				Rockfish Trawl Fishery (N=435)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	1	0.2	0.30	(0.0,1.0)	0	0.0	0.18	(0.0,0.3)	1	0.1	0.23	(0.0,0.8)
Coast W AK	1	0.3	0.41	(0.0,1.5)	0	0.3	0.63	(0.0,2.2)	1	0.3	0.37	(0.0,1.3)
Mid Yukon	0	0.0	0.07	(0.0,0.2)	0	0.1	0.23	(0.0,0.6)	0	0.0	0.06	(0.0,0.1)
Up Yukon	0	0.0	0.09	(0.0,0.3)	0	0.1	0.27	(0.0,0.8)	0	0.0	0.07	(0.0,0.2)
N AK Pen	0	0.0	0.12	(0.0,0.3)	0	0.1	0.31	(0.0,0.7)	0	0.0	0.12	(0.0,0.3)
NW GOA	10	2.9	1.04	(1.2,5.2)	6	4.2	2.38	(0.9,9.6)	15	3.2	0.96	(1.5,5.3)
Copper	0	0.1	0.17	(0.0,0.6)	0	0.1	0.38	(0.0,1.1)	0	0.1	0.19	(0.0,0.6)
NE GOA	0	0.0	0.10	(0.0,0.2)	1	0.5	1.43	(0.0,5.4)	0	0.1	0.27	(0.0,1.0)
Coast SE AK	21	6.4	1.68	(3.5,10.0)	17	12.4	4.01	(4.9,20.7)	33	7.1	1.70	(4.1,10.8)
BC	48	14.5	2.37	(10.1,19.4)	38	28.1	5.22	(18.4,38.9)	82	17.4	2.32	(13.0,22.1)
West Coast US	252	75.6	2.65	(70.2,80.6)	73	54.4	5.44	(43.6,64.9)	336	71.7	2.41	(66.9,76.3)
Total Catch	333				135				468			

Appendix 4. -- Continued

2013	Rockfish Trawl Early (N=1,550)				Rockfish Trawl Late (N=231)				Rockfish Trawl Fishery (N=2,029)			
Region	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI	Est. #	Mean	SD	95% CI
Russia	0	0.0	0.01	(0.0,0.0)	0	0.0	0.03	(0.0,0.1)	0	0.0	0.01	(0.0,0.0)
Coast W AK	1	0.1	0.10	(0.0,0.4)	0	0.1	0.12	(0.0,0.4)	1	0.0	0.05	(0.0,0.2)
Mid Yukon	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)
Up Yukon	0	0.0	0.02	(0.0,0.1)	0	0.0	0.06	(0.0,0.2)	0	0.0	0.02	(0.0,0.1)
N AK Pen	0	0.0	0.02	(0.0,0.0)	0	0.0	0.07	(0.0,0.2)	0	0.0	0.02	(0.0,0.0)
NW GOA	10	0.6	0.23	(0.2,1.1)	40	7.9	1.35	(5.4,10.7)	47	2.2	0.36	(1.6,3.0)
Copper	0	0.0	0.06	(0.0,0.2)	4	0.8	0.47	(0.2,1.9)	5	0.3	0.13	(0.1,0.6)
NE GOA	0	0.0	0.07	(0.0,0.2)	0	0.1	0.36	(0.0,1.2)	0	0.0	0.08	(0.0,0.3)
Coast SE AK	99	6.2	0.85	(4.6,7.9)	43	8.4	1.52	(5.6,11.5)	134	6.4	0.73	(5.0,7.8)
BC	508	31.8	1.39	(29.1,34.5)	157	30.8	2.33	(26.4,35.5)	660	31.3	1.37	(28.5,33.9)
West Coast US	981	61.3	1.35	(58.6,63.9)	265	52.0	2.40	(47.2,56.7)	1,263	59.9	1.31	(57.3,62.4)
Total Catch	1,601				510				2,111			

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