THE STATE of ALASKA

GOVERNOR BILL WALKER

Department of Fish and Game

DIVISION OF SPORT FISH
Southcentral Regional Office

333 Raspberry Road
Anchorage, Alaska 99518-1565
Main: 907.267.2212
Main: 907.267.2401

MEMORANDUM

TO: Tom Brookover, Director
Division of Sport Fish

And

Scott Kelley, Director
Division of Commercial Fisheries

DATE: January 30, 2017

THROUGH: Tim McKinley, Research Coordinator
Division of Sport Fish, Region II

SUBJECT: NCI Chinook salmon marine harvest stock composition

FROM: Adam St. Saviour, Fishery Biologist III
Division of Sport Fish, Region II

And

Andrew Barclay, Fishery Biologist III
Division of Commercial Fisheries, Statewide

ABSTRACT

Genetic tissue samples were collected from Chinook salmon harvested in the Northern District set gillnet commercial and the Tyonek subsistence fisheries in 2014, 2015, and 2016 to determine stock composition of marine harvests in Northern (Upper) Cook Inlet (NCI). Sufficient samples were collected to represent 97% (2014), 80% (2015), and 100% (2016) of commercial harvests and 100% (2014–2016) of subsistence harvests. Genetic mixed-stock analysis was performed to produce stock composition and stock-specific harvest estimates by reporting group for each fishery. The 4 reporting groups chosen for these analyses were: 1) *NCI Northwest*, 2) *Susitna-Matanuska*, 3) *Knik-Turnagain*, and 4) *Kenai Peninsula*. In all 3 years of the study, *NCI Northwest*, *Susitna-Matanuska*, and *Knik-Turnagain* reporting groups comprised over 98% of the total harvests in both the Northern District Commercial and Tyonek subsistence fisheries. The *NCI Northwest* and *Susitna-Matanuska* reporting groups comprised a majority of harvests in the General Subdistrict (south) (88–96%) and the *Knik-Turnagain* reporting group comprised the majority of harvests in the General Subdistrict (north) (71–89%) in all 3 years. The *NCI Northwest*, *Susitna-Matanuska*, and *Knik-Turnagain* reporting groups comprised over 98% of the Eastern Subdistrict commercial harvest in all 3 years, with similar contributions of the 3 reporting groups in 2014 (28–36%) and higher contributions from the *Knik-Turnagain* reporting group in 2015 (56%) and 2016 (70%). In the Tyonek subsistence fishery, the *NCI Northwest* (56%) and *Susitna-Matanuska* (39%) reporting groups comprised the majority of the harvest in 2014 and the *NCI Northwest* reporting group dominated the harvest in 2015 (79%) and 2016 (72%). These results represent the first mixed-stock analysis using genetic information of Chinook salmon captured in NCI fisheries. Caution should be used when interpreting the estimates from years where harvests are not fully represented.

BACKGROUND

All 5 North American species of Pacific salmon are harvested in Northern District of Upper Cook Inlet (NCI). Sockeye salmon (*Oncorhynchus nerka*) make up the majority of the harvest, but Chinook salmon (*O. tshawytscha*) are also harvested (Shields and Dupuis 2016).

Chinook salmon returning to Cook Inlet streams are harvested in the mixed stock marine fisheries of NCI, primarily the Tyonek subsistence set gillnet and Northern District commercial set gillnet fisheries (Figure 1). The *Northern District King Salmon Management Plan* (5 AAC 21.366) was created by the Alaska Board of Fisheries (BOF) in 1986 and was most recently modified in 2011. This plan provides direction to ADF&G regarding management of the Northern District for the directed commercial harvest of Chinook salmon. The directed Chinook salmon commercial fishing season opens on the first Monday on or after May 25 and remains open for all Mondays through June 24. Fishing periods are 12 hours per day, from 7:00 AM to 7:00 PM unless altered by emergency order. The commercial fishery is limited to an annual harvest not to exceed 12,500 Chinook salmon. Each permit holder is allowed to fish one 35-fathom, maximum 6-inch mesh set gillnet, with a minimum separation of 1,200 feet between nets.

There are 7 Chinook salmon stocks of concern in Northern Cook Inlet, which are susceptible to harvest in NCI marine fisheries (Chuitna, Theodore, and Lewis rivers, and Alexander, Willow, Goose, and Sheep creeks). Under the management plan, if sport fishing restrictions are imposed on Theodore, Ivan, Lewis, Chuitna, or Deshka rivers, time and area restrictions will be placed on the commercial fishery. The Northern District set gillnet fishery has been closed from the wood chip dock, adjacent to Tyonek, to the Susitna River due to a sport fish closure on the Chuitna River since 2011 (Shields and Dupuis 2016). Following the directed Chinook salmon fishery, the set gillnet fishery in the Northern District opens by regulation on or after June 25 for regular Monday and Thursday 12-hour periods to target other salmon species. This fishery is managed primarily by 5 AAC 21.358. *Northern District Salmon Management Plan* and the *Susitna River Sockeye Salmon Action Plan*.

Under the statewide subsistence fishery regulations for Upper Cook Inlet (5 AAC 01.560), the Tyonek subsistence fishery is open for 2 seasons per year. The early season, May 15 through June 15, is open 3 days per week (Tuesday, Thursday, and Friday) for 16 hours per day (4:00 AM to 8:00 PM). The late season, June 16 through October 15, is open for 1 day per week (Saturday) for 12 hours (7:00 AM to 7:00 PM; 5AAC 01.560). Subsistence fishing targeting Chinook salmon occurs from May 15 until approximately June 30. The fishery extends from a point 1 mile south of the southern edge of the Chuitna River to the easternmost tip of Granite Point (Figure 1).

Little information regarding stock-specific harvests of Chinook salmon in these mixed-stock marine fisheries is currently available. Genetic mixed-stock analysis (MSA) has been used in Cook Inlet to estimate the stock composition of sockeye salmon in the commercial fishery since the 1990s (Seeb et al. 2000; Habicht et al. 2007; Barclay et al. 2010a, 2010b, 2013, 2014). With the development of comprehensive genetic baselines for Upper Cook Inlet Chinook salmon (Barclay et al. 2012; Barclay and Habicht 2015), this method has more recently been used to estimate the stock composition of Chinook salmon harvested in the Upper Subdistrict set gillnet fishery (Eskelin et al. 2013; Eskelin and Barclay 2015, 2016, Barclay et al. 2016).

Here we report genetic baseline evaluation tests for MSA and MSA results of Chinook salmon harvested in the Tyonek subsistence and Northern District commercial marine fisheries in 2014–2016.

METHODS

SAMPLE COLLECTION

Genetic tissue samples and age, sex, and length data were collected from Chinook salmon harvested in the Northern District set gillnet commercial fishery and the Tyonek subsistence fishery from 2014 through 2016 to estimate stock composition of marine harvest in NCI. Samples were collected at ports, processors, buying stations, and set gillnet sites in Anchorage, Tyonek, and the Soldotna area during and after fishery openings. Crews were directed to maximize the number of samples collected to meet sample size requirements. Target sampling rates were 70% of the reported commercial harvest and 40% of the reported subsistence harvest (St. Saviour et al. 2016).

Tissue samples were preserved for DNA analysis using 2 methods. In 2014 and 2015, tissues were placed in individually labeled 2 mL plastic vials and preserved in 95% ethanol. In 2016, tissues were placed and stapled onto numbered Whatman® (GE Healthcare Life Sciences) paper cards. Samples were placed into numbered grid locations on cards that were then placed in an airtight case with desiccant beads to preserve samples. Vial numbers and/or Whatman paper card and grid numbers were recorded on data sheets. Genetic tissues were sent to the Alaska Department of Fish and Game (ADF&G) Gene Conservation Laboratory for long-term storage and genetic analysis.

LABORATORY ANALYSIS

Assaying Genotypes

We extracted genomic DNA from tissue samples using a NucleoSpin® 96 Tissue Kit by Macherey-Nagel (Düren, Germany). DNA was screened for 39 SNP markers for all 3 years; however, to ensure that DNA concentrations were high enough with the dry sampling method used to preserve samples in 2016, a preamplification step was added before screening the DNA.

DNA from the 2014 and 2015 samples was genotyped using Fluidigm® 192.24 Dynamic Array™ Integrated Fluidic Circuits (IFCs), which systematically combine up to 24 assays and 192 samples into 4,608 parallel reactions. The components were pressurized into the IFC using the IFC Controller RX (Fluidigm). Each reaction was conducted in a 9 nL volume chamber consisting of a mixture of 20X Fast GT Sample Loading Reagent (Fluidigm), 2X TaqMan® GTXpress™ Master Mix (Applied Biosystems™), Custom TaqMan® SNP Genotyping Assay (Applied Biosystems), 2X Assay Loading Reagent (Fluidigm), 50X ROX Reference Dye (Invitrogen™), and 60–400 ng/µl DNA. Thermal cycling was performed on a Fluidigm FC1™ Cycler using a Fast PCR protocol as follows: an initial "Hot-Start" denaturation of 95°C for 2 min followed by 40 cycles of denaturation at 95°C for 2 s and annealing at 60°C for 20 sec, with a final "Cool-Down" at 25°C for 10 sec. The Dynamic Array IFCs were read on a Biomark™ or EP1™ System (Fluidigm) after amplification and genotyped using Fluidigm SNP Genotyping Analysis software.

The concentration of template DNA from the 2016 samples was increased using a multiplexed preamplification PCR of 42 screened SNP markers. Reactions were conducted in 10 µL volumes consisting of 4 uL of genomic DNA, 5 µL of 2X Multiplex PCR Master Mix (QIAGEN) and 1 µL each (2 µM SNP unlabeled forward and reverse primers). Thermal cycling was performed on a Dual 384-

Well GeneAmp® PCR system 9700 (Applied Biosystems) at 95°C hold for 15 min followed by 20 cycles of 95°C for 15 s, 60°C for 4 min, and a final extension hold at 4°C. We screened preamplified DNA from the 2016 samples using the same methods as described for the 2014 and 2015 samples.

Genotypes were imported and archived in the Gene Conservation Laboratory's Oracle database, LOKI.

Laboratory Failure Rates and Quality Control

Overall failure rate was calculated by dividing the number of failed single-locus genotypes by the number of assayed single-locus genotypes. An individual genotype was considered a failure when a locus for a fish could not be satisfactorily genotyped.

Quality control (QC) measures were used to identify laboratory errors and to determine the reproducibility of genotypes. In this process, 8 of every 96 fish (1 row per 96-well plate) were reanalyzed for all markers by staff not involved with the original analysis. Laboratory errors found during the QC process were corrected, and genotypes were corrected in the database. Inconsistencies not attributable to laboratory error were recorded, but original genotype scores were retained in the database.

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

We retrieved genotypes from LOKI and imported them into *R*[a] with the *RJDBC* package (Urbanek 2014). All subsequent analyses were performed in *R*, unless otherwise noted.

Prior to statistical analysis, we performed 2 analyses to confirm the quality of the data. First, we used the 80% rule (missing data at 20% or more of loci; Dann et al. 2009) to identify individuals missing substantial genotypic data. We removed these individuals from further analyses. The inclusion of individuals with poor quality DNA might introduce genotyping errors and reduce the accuracy of MSA.

The final QC analysis identified individuals with duplicate genotypes and removed them from further analyses. Duplicate genotypes can occur as a result of sampling or extracting the same individual twice and were defined as pairs of individuals sharing the same alleles in 95% of screened loci. The sample with the most missing genotypic data from each duplicate pair was removed from further analyses. If both samples had the same amount of genotypic data, the first sample was removed from further analyses.

Subsampling for Mixed-Stock Analysis

Daily commercial harvests were derived from fish tickets (5 AAC 21.355). Daily subsistence harvest was derived from returned permits (5 AAC 01.015) and Tyonek household surveys. Tissue samples were subsampled in proportion to reported Chinook salmon harvests to form mixtures for MSA. Before selection, we set a minimum sample size requirement of 100 fish per mixture. When insufficient samples were collected for a given day to select samples in proportion to harvest, excess samples from the next closest day were used to represent the harvest, provided that samples were collected within 7 days of each other.

---

[a] *R* Development Core Team. 2016. *R*: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. http://www.R-project.org/.

The commercial fishery was separated into 3 geographic areas: 1) General Subdistrict (south)[b], including stat areas 247-10 (Trading Bay) and 247-20 (Tyonek), 2) General Subdistrict (north), including stat areas 247-41 (Susitna Flats), 247-42 (Pt. McKenzie), and 247-43 (Fire Island), and 3) Eastern Subdistrict, including stat areas 247-70 (Pt. Possession), 247-80 (Birch Hill) and 247-90 (#3 Bay; Figure 1). Within each of these geographic areas the goal was to produce mixtures representing the first two targeted Chinook salmon fishing periods: from May 29 to June 12 (early); and, the last two targeted Chinook salmon fishing periods plus incidental Chinook harvest during commercial fishing periods primarily targeting sockeye salmon from June 13 to 30 (late). When the samples size requirement could not be met for early and late mixtures, samples were combined to form a single mixture representing the entire season for that geographic area.

The subsistence fishery for Chinook salmon only occurs in 1 geographic area (Tyonek), so only temporal stratification was possible (May 16–31; and June 1–30). The early subsistence fishing temporal stratum was selected to represent early season subsistence harvest that occurs before any commercial fishing in May. The late subsistence fishing temporal stratum was selected to represent subsistence Chinook salmon harvest through the remainder of June. Similarly to the commercial fishery, when the sample size requirement could not be met for early and late mixtures, samples were combined to form a single mixture for the entire season.

Genetic Baseline

The genetic baseline used in this analysis was derived from roughly 7,900 samples collected from Chinook salmon spawning locations throughout Cook Inlet. These collections were analyzed for 42 single nucleotide polymorphism (SNP) markers; genetic variation was sufficient at 39 SNPs to characterize 55 Cook Inlet populations, with a minimum sample size of 50 fish per population (Table 1; Figure 2; Barclay and Habicht, 2015). A Cook Inlet-only baseline was chosen because marine harvests in NCI are believed to contain only fish of Cook Inlet origin.

Baseline Evaluation for Mixed Stock Analysis

Four reporting groups that were of interest to management and would likely perform adequately for MSA were identified at the beginning of the study (Table 1; Figure 2). These groups are:

1) *NCI Northwest* (Western Cook Inlet, Alexander Creek, and Yentna River populations)
2) *Susitna-Matanuska* (Susitna River and Matanuska River populations)
3) *Knik-Turnagain* (Cook Inlet populations from Turnagain Arm and Knik Arm)
4) *Kenai Peninsula* (Kenai Peninsula populations from the Kenai River south to the Anchor River)

100% Proof Tests

The first method to assess the identifiability of reporting groups in mixtures was "100% proof tests", in which we selected 200 individuals in a reporting group in the baseline without replacement, and analyzed them as a mixture against the reduced baseline (1 reduced reporting group and 3 complete reporting groups). These tests provided an indication of the power of the baseline for MSA under the

[b] Stat area 247-30 (Beluga) is closed to commercial fishing for Chinook salmon.

assumption that all of the populations from a reporting group were represented in the baseline. To assess the precision and accuracy of reporting group assignments, this process was repeated to produce 10 replicate proof tests for each reporting group. The Gene Conservation Laboratory uses the common guideline that correct allocation for these single-reporting group tests should exceed 90% to be considered adequate (Seeb et al. 2000). However, deviation from this guideline is permitted if stakeholders are willing to accept higher levels of MSA uncertainty in order to include specific reporting groups (Habicht et al. 2012). In this study, the stakeholders consulted were department management and research staff.

Fishery Scenario Tests

The second, more stringent method to assess the identifiability of reporting groups in mixtures was the "fishery scenario tests," in which we tested a hypothetical fishery scenario of equal representation for each reporting group. In these tests, we selected 50 individuals without replacement from each of the 4 reporting groups, for a total of 200 individuals, and analyzed them as a mixture against the reduced baseline. This process was repeated to produce 10 replicates. These tests provided an unbiased indication of the power of the baseline for MSA without the potential issue of overestimation of power seen with 100% proof tests (Anderson et al. 2008). Fishery scenario tests provide information on the accuracy and precision of MSA with this baseline with regard to potential biases in misallocation.

Bayes Protocol

The stock composition of the proof test mixtures was estimated using the software package *BAYES* (Pella and Masuda 2001). *BAYES* employs a Bayesian algorithm to estimate the most probable contribution of the baseline populations to explain the combination of genotypes in the mixture sample. We ran 1 Markov Chain Monte Carlo chain with 40,000 iterations and discarded the first 20,000 iterations to remove the influence of starting values. The prior parameters for each reporting group were defined to be equal (i.e., a *flat* prior). Within each reporting group, the population prior parameters were divided equally among the populations within that reporting group. Stock proportion estimates and the 90% credibility intervals for each proof test mixture were calculated by taking the mean and 5% and 95% quantiles of the posterior distribution from the single chain output. Mean bias, root mean square error (RMSE), and mean 90% credibility intervals width were calculated for all proof tests to compare the predictive power of the baseline for each reporting group in terms of precision and accuracy. Mean bias indicates if there is a directional bias in the mean point estimate of the posterior (i.e., accuracy of the mean), RMSE shows the variability in the central tendency of the mean between replicates (i.e., precision of the posterior between replicates), and mean 90% credibility intervals width shows variation within the posterior for each replicate (i.e., precision of posterior within replicates).

Mixed-Stock Analysis

We estimated the stock composition of the commercial and subsistence fishery samples selected for MSA (mixtures) using the same BAYES protocol as was used for the proof tests, except that we ran 4 Markov Chain Monte Carlo chains of 40,000 iterations each and used informative Dirichlet priors. Informative Dirichlet priors were defined using a similar *step-wise* prior protocol as reported in Barclay et al. (2010) except that, for the first time/area stratum within a fishery for each year, the prior parameters were the posterior means from the first time/area of the same fishery from the previous year. For the initial time/area strata for the 2014 samples, we used the same *flat* prior as was used in the proof tests. We formed the BAYES posterior distribution for each mixture from the last 20,000 iterations of each chain for a total length of 80,000 iterations. We assessed the among-chain convergence of these estimates in BAYES using the Gelman-Rubin shrink factor, which compares the variation of estimates within a chain to the total variation among chains (Gelman and Rubin 1992). If a shrink factor for any stock group estimate was greater than 1.2, we reanalyzed the mixture with 80,000-iteration chains following the same protocol. Stock proportion estimates and 90% credibility intervals for each mixture were calculated by taking the mean and 5% and 95% quantiles of the posterior distribution.

Stock-specific harvest estimates and 90% credibility intervals for each mixture were calculated by multiplying the reported harvest from that mixture by its unrounded estimates of reporting group proportions (obtained from MSA) and the upper and lower bounds of that estimate. Results were rounded to the nearest fish. We calculated the probability that a harvest estimate for a given reporting group is greater than or equal to 1 fish ($P \geq 1$) as the proportion of iterations in the posterior distribution of harvest estimates where the reporting group harvest was at least 1 fish.

Stratified Estimates

Estimates from early and late mixtures were combined into yearly harvest estimates for each area and each reporting group by weighting them by their respective harvests (stratified estimator) following the methods of Dann et al. (2009). These harvest estimates, including their upper and lower bounds, were divided by the total harvest from each area to derive the overall proportion and credibility interval of each reporting group in harvest. This same method was used to combine mixture estimates from each area into annual stock-specific harvest estimates for the entire Northern District and the Tyonek subsistence fishery. The stratified estimates were calculated using the following method:

The number of Chinook salmon from reporting group g ($\hat{H}^g$) harvested in the Northern District commercial fishery between the first opening as early as late May and the last opening on or before June 24 was estimated as:

$$\hat{H}^g = \sum_{i=1}^{T} \sum_{j=1}^{S} H_{i,j} \hat{p}^g_{i,j} \qquad (1)$$

where

$\hat{p}^g_{i,j}$ = estimated proportion of NCI harvest in time stratum i and geographic stratum j comprising Chinook salmon from reporting group g (*NCI Northwest, Susitna-Matanuska, Knik-Turnagain,* or *Kenai Peninsula*). Obtained based on Bayesian mixed-stock analysis as described in the previous section.

$H_{i,j}$ = NCI Chinook salmon harvest in time stratum i and geographic stratum j obtained from fish ticket data.

T = number of time strata (May 29 – June 12, and June 13-30)

S = number of geographic strata (Trading Bay and Tyonek stat areas/ General Subdistrict (north)/ Eastern Subdistrict).

The variance of the estimated number of Chinook salmon harvested from reporting group g, $\text{var}(\hat{H}^g)$, was estimated as:

$$\text{var}(\hat{H}^g) = \sum_i \sum_j (H_{i,j})^2 \text{var}(\hat{p}^g_{i,j}) \tag{2}$$

where $\text{var}(\hat{p}^g_{i,j})$ will be available from the Bayesian mixed-stock analysis (Pella and Masuda, 2001).

Annual harvest of Chinook salmon by reporting group g, ($\hat{H}^g$) from the General Subdistrict (south), General Subdistrict (north), and the Eastern Subdistrict were estimated using equations (1) and (2) with the appropriate substitutions for each fishing area.

Harvest of Chinook salmon by reporting group g, ($\hat{H}^g$) from the Tyonek subsistence fishery was estimated using equations (1) and (2) with the appropriate substitutions for the Tyonek fishery.

RESULTS

SAMPLE COLLECTION

Sampling rates increased after 2014 as crews learned the best times and locations to intercept fish and built relationships with processors and fisherman. From 2014 through 2016, a total of 3,374 samples were collected from the commercial fishery and 812 were collected from the subsistence fishery (grand total = 4,186; Table 2). The overall proportion of reported harvest sampled across all areas in the commercial fishery though 30 June was 48.6% in 2014, 65.5% in 2015, and 68.2% in 2016. The reported harvest was 1,430 in 2014, 1,794 in 2015, and 2,137 in 2016. The proportion of reported harvest sampled in the Tyonek subsistence fishery was 27.0% in 2014, 35.2% in 2015, and 35.9%[c] in 2016. Estimated harvest in the Tyonek subsistence fishery was 712 in 2014, 929 in 2015, and 805[c] in 2016 (Table 2).

In the General Subdistrict (south), separate mixtures for Trading Bay and Tyonek stat areas were produced because sampling rates in Trading Bay were much lower than Tyonek in 2014 and 2015. To produce a single harvest-proportional mixture of samples from both stat areas in these years, samples would have been excluded from the Tyonek stat area to match the sampling rate from Trading Bay, causing the mixture to drop below the minimum sample size requirement. Although sufficient samples were collected in 2016 to combine Trading Bay and Tyonek stat areas into a single mixture, they were kept separate to be consistent with 2014 and 2015. In the General Subdistrict (north) and Eastern Subdistrict, samples were combined across stat areas to estimate stock composition for each area.

LABORATORY ANALYSIS

Assaying Genotypes

A total of 3,952 fish from the 2014–2016 Northern District commercial and Tyonek subsistence fisheries harvest samples were assayed for 39 SNP markers.

[c] Harvest reported as of December 9, 2016.

Laboratory Failure Rates and Quality Control

Genotyping failure rates among the commercial and subsistence collections ranged from 0.30% to 1.41%. Discrepancy rates between original and QC analyses were uniformly low and ranged from 0.00% to 1.50%. Assuming equal error rates in the original and the QC analyses, estimated error rates in the samples is half of the discrepancy rate (0.00–0.75%).

STATISTICAL ANALYSIS

Data Retrieval and Quality Control

Fifty-three of the assayed harvest individuals (1.34%) were removed from further analyses, based upon the 80% rule. Twenty tissue samples were identified as duplicates and were removed from further analysis. After removing fish based on the 80% rule and duplicates, 3,879 fish were available to subsample for MSA.

Subsampling for Mixed Stock Analysis

Of the 3,879 genotyped fish available for MSA, 3,491 were subsampled in proportion to harvest to create 22 mixtures for MSA: 17 commercial and 5 subsistence (Table 2; Figure 3). Sufficient samples were available to represent early and late commercial fishing periods in all but the following: the Trading Bay stat area in all 3 years and the Tyonek stat area, General Subdistrict (north), and Eastern Subdistrict in 2014. In these cases, samples were combined to form mixtures representing the entire season. In 2015, the sample size requirement was not met over the entire season for Trading Bay; therefore, no mixture was created for MSA. For the Tyonek subsistence fishery, sufficient samples were available to represent early and late subsistence fishing periods in all years except 2014, and all the samples from that year were combined to form a mixture representing the entire season.

Baseline Evaluation for Mixed-Stock Analysis

100% proof tests

The mean correct allocation for all 10 repeated 100% proof tests for each of the 4 reporting groups ranged from 85.0% to 95.5% (Table 3; Figure 4). The *Knik-Turnagain* and *Kenai Peninsula* reporting groups had the highest mean correct allocations across all repeated tests, averaging 93.7% (RMSE = 6.7%; 90% credibility interval width = 14.4%) and 95.5% (RMSE = 5.8%; 90% credibility interval width = 9.8%) for each group, respectively. The *NCI Northwest* and *Susitna-Matanuska* allocations had more variation with correct allocations averaging 89.1% (RMSE = 12.7%; 90% credibility interval width = 26.6%) and 85.0% (RMSE = 16.4%; 90% credibility interval width = 33.6%) for each group, respectively. *NCI Northwest* and *Susitna-Matanuska* fish misallocated primarily to each other at 8.3% and 11.3%, respectively. *Knik-Turnagain* fish misallocated primarily to *NCI Northwest* (2.7%) and *Susitna-Matanuska* (2.3%), while *NCI Northwest* and *Susitna-Matanuska* fish misallocated similarly to *Knik-Turnagain* at 2.0% and 2.8%, respectively. *Kenai Peninsula* fish misallocated small percentages to *Susitna-Matanuska* (2.3%), *Knik-Turnagain* (1.5%) and *NCI Northwest* (0.6%), and misallocations of fish from these groups to *Kenai Peninsula* were less than 1.3%.

Fishery scenario tests

The average stock compositions to each reporting group for all 10 repeated fishery scenario tests were within 3.1% of their true values (25%; Table 4; Figure 5). Stock composition estimates for *NCI*

Northwest and *Knik-Turnagain* were biased higher than their true percentage averaging 27.4% (RMSE = 7.4; 90% credibility interval width = 32.5%) and 26.9% (RMSE = 7.5; 90% credibility interval width = 33.0%) for each group, respectively. Stock composition estimates for *Susitna-Matanuska* and *Kenai Peninsula* were biased lower than their true percentage averaging 21.9% (RMSE = 9.8; 90% credibility interval width = 34.1%) and 23.8% (RMSE = 4.0; 90% credibility interval width = 19.3%) for each group, respectively.

Mixed-Stock Analysis

MSA was performed on the 22 mixtures created during the subsampling process to produce stock composition and stock-specific harvest estimates. Stock composition estimates, stock-specific harvest estimates, and 90% credibility intervals by time and area are detailed in Tables 5 through 18 and Figures 6 through 10. Figure 3 shows the lowest-level strata where MSA was performed and how those strata were combined into higher-level strata using the stratified estimator. This figure also guides the reader to the tables containing results for each of these analysis levels.

Estimates by time and area

In most cases, the lower-level temporal stock composition estimates (early and late) within a year and area were similar (Tables 5–13). However, in 2015, the dominant reporting group in the Tyonek commercial fishery shifted from *Susitna-Matanuska* in the early period (57.6%) to *NCI Northwest* in the later period (72.2%; Table 6). A similar shift in dominant reporting group occurred in the 2015 Tyonek subsistence fishery, where the contribution of *Susitna-Matanuska* and *Knik-Turnagain* were a substantial proportion of the harvest in the early period (24.0% and 26.1% respectively) and dropped off to a minimal proportion of the harvest in the late period (7.2% and 4.4% respectively) making *NCI Northwest* highly dominant (49.8% in the early period to 88.1% in the late period; Table 12).

Annual estimates

The MSA estimates from initial MSA mixtures were stratified to produce annual stock composition and stock-specific harvest estimates for the General Subdistrict (south) (2014–2016), General Subdistrict (north) (2015 and 2016), and Eastern Subdistrict (2015 and 2016), for the entire Northern District (2014-2016), and for the entire Tyonek subsistence fishery (2015 and 2016; Figure 3). The estimates reported in the following sections include these stratified estimates and annual estimates from the initial MSA mixtures.

Annual commercial estimates by area

From 2014 through 2016 annual Chinook salmon harvests in the General Subdistrict (south) area were 814, 750, and 1,150, respectively (Table 2). Stock composition estimates were highest for the *NCI Northwest* (range: 47.2–61.4%) and *Susitna-Matanuska* (range: 35.0–49.1%) reporting groups followed by the *Knik-Turnagain* (range 3.5-10.1%) and *Kenai Peninsula* (range: 0.0-1.7%) reporting groups (2014 – 2016; Tables 14 – 16; Figures 6 – 8). In 2015, the contribution of *NCI Northwest* (61.4%) was higher and *Susitna-Matanuska* (35.0%) was the lower than in 2014 and 2016; however, only 51% of the harvest was represented in 2015 (Tables 14 – 16; Figures 6 – 8).

From 2014 through 2016 annual Chinook salmon harvests in the General Subdistrict (north) were 398, 674, and 464 respectively (Table 2). Harvests were dominated by the *Knik-Turnagain* reporting group (71.2% – 89.4%; Tables 14 – 16; Figures 6 – 8), particularly in the late fishing periods, where nearly all of the harvest was the *Knik-Turnagain* reporting group (≥ 95.8%; Tables 8 and 9). The remaining harvests were represented by smaller contributions of *Susitna-Matanuska* (range: 8.1– 18.7%) and by NCI Northwest (0.9% to 9.1%; Tables 14 – 16; Figures 6 – 8).

From 2014 through 2016 annual Chinook salmon harvests in the Eastern Subdistrict were 326, 360, and 523 respectively (Table 2). The contribution of *Knik-Turnagain* (range: 27.6–69.8%) increased and *NCI Northwest* (range: 17.2–36.3%) and *Susitna-Matanuska* (12.9–34.3%) decreased from 2014 to 2016 (Tables 14 – 16; Figures 6 – 8). In 2014, the *NCI Northwest*, *Susitna-Matanuska*, and *Knik-Turnagain* reporting groups had similar stock contributions (range: 27.6–36.6%). In 2015 and 2016, the *Knik-Turnagain* reporting group comprised the majority of the harvest (56.0% and 69.8%, respectively) and the remaining contributions to the harvest were from the *NCI Northwest* (26.7% and 17.2%, respectively) and *Susitna-Matanuska* reporting groups (17.1% and 12.9%, respectively). The contribution of the *Kenai Peninsula* reporting group was 1.8% in 2014 and less than 1% in 2015 and 2016 (Tables 14 – 16; Figures 6 – 8).

Annual Northern District commercial estimates

In the overall 2014, 2015, and 2016 Northern District commercial fishery harvests, *NCI Northwest*, *Susitna-Matanuska*, and *Knik-Turnagain* were the dominant reporting groups, with combined contributions of 98.4%, 99.9% and 99.9% for each year, respectively (Table 17; Figure 10). In 2014, contributions of *NCI Northwest*, *Susitna-Matanuska*, and *Knik-Turnagain* reporting groups were similar, ranging from 30.3% to 34.9%. In 2015, the greatest contribution of the harvest was represented by the *Knik-Turnagain* reporting group (58.0%), followed by *NCI Northwest* (24.4%) and *Susitna-Matanuska* (17.6%); however, a large portion of the harvest (Trading Bay; 368 fish) was not represented, and likely influenced these overall stock composition estimates. In 2016, harvest had nearly equal contributions from *NCI Northwest* (29.9%) and *Susitna-Matanuska* (32.3%) and a slightly higher contribution from *Knik-Turnagain* (37.7%).

Annual Tyonek subsistence estimates

From 2014 through 2016 annual Chinook salmon harvests by Tyonek subsistence users were 712, 929, and 805[d] respectively (Table 2). In the 2014, 2015 and 2016 Tyonek subsistence harvests, the *NCI Northwest* reporting group was the largest contributor (56.6%, 79.0%, and 73.6%, respectively) followed by the *Susitna-Matanuska* (39.2%, 11.2%, and 18.7%, respectively) and *Knik-Turnagain* reporting groups (2.5%, 9.6%, 7.6% , respectively; Table 18; Figure 10).

DISCUSSION

This memo includes baseline evaluation test results for the Cook Inlet Chinook salmon baseline (Barclay and Habicht 2015) and the MSA of harvest samples collected from the Northern District commercial set gillnet and the Tyonek subsistence fisheries. Analyses were performed on harvest samples collected from commercial and subsistence fisheries in 2014, 2015, and 2016. These results represent the first mixed stock analysis using genetic information of Chinook salmon captured in NCI fisheries.

BASELINE EVALUATION TESTS

A key objective of this project was to estimate harvest of NCI Chinook salmon stocks including stocks from the west side of Cook Inlet and the Susitna River drainage. Data available when this project was

[d] Harvest reported as of December 9, 2016.

proposed (Barclay et al. 2012) indicated that Kenai Peninsula stocks were genetically distinct enough to represent a reporting group for MSA applications. However, these data also indicated that one of the major tributaries of the Susitna River drainage, the Yentna River, was genetically too similar to western Cook Inlet stocks to be estimated separately in MSA, leading to the broader reporting group *NCI Northwest*. These initial tests also indicated that misallocation occurred between this broader reporting group and the remaining NCI reporting groups *Susitna-Matanuska* and *Knik-Turnagain*. At the time, all of these reporting groups were missing baseline populations and we anticipated improved MSA performance once the baseline was augmented. During the period of this project, the baseline for these areas was augmented in other studies (Barclay and Habicht 2015). This new augmented baseline was used for the MSA analyses and misallocations among NCI reporting groups persist, but *Knik-Turnagain* performance improved and *Kenai Peninsula* continued to perform well (Table 3). Although our standard criteria for defining reporting groups is greater than 90% correct allocation in 100% proof tests, we decided to retain all 4 reporting groups despite the subpar performance of the *NCI Northwest* (89.1%) and *Susitna-Matanuska* (85.0%), because of the value of estimating the contribution of Susitna River mainstem in NCI fisheries.

The biases in misallocations observed in the baseline evaluation tests provide valuable information when interpreting results from this study (Tables 3 and 4). Estimates for *Kenai Peninsula* and *Knik-Turnagain* contain low bias, while estimates for the *NCI Northwest* and *Susitna-Matanuska* suggest they may be trading misallocations with each other. These differences in MSA performance among these reporting groups is captured in the increased credibility intervals observed for *NCI Northwest* and *Susitna-Matanuska* reporting group estimates compared with *Kenai Peninsula* and *Knik-Turnagain* reporting group estimates (Tables 5–18).

REPRESENTATION OF HARVESTS

Due to the small relative sizes of the Northern District commercial and Tyonek subsistence Chinook salmon fisheries as compared to other commercial fisheries sampled by ADF&G, minimum sample size requirements of 100 representative samples per *a priori* strata (early and late within a year and area) were sometimes difficult to achieve. To aid in achieving sample size goals, we allowed the use of surplus samples from one collection day to represent harvest on other days provided it was within 7 days and within the same stratum. The general stability in stock composition estimates over entire seasons gave us confidence that this procedure accurately represented harvest.

In most cases harvests were fully represented for time and area strata, with the following exceptions. In 2014 and 2015, annual stratified stock composition and stock-specific harvest estimates for the General Subdistrict (south) and the whole Northern District do not represent the entire harvest, and caution should be used when interpreting these results (Figure 3). In the Trading Bay statistical area, harvest samples were only available to represent the first half of the season 2014 and the minimum sample size of 100 harvest samples could not be met to represent the entire season in 2015. This lack of samples to represent harvests likely influenced the General Subdistrict (south) and Northern District stratified stock composition estimates in these years (Tables 14, 15, and 17; Figures 6, 7 and 9). The greatest unrepresented harvest occurred in 2015, where only the Tyonek statistical area harvest samples could be used to represent the General Subdistrict (south) (Table 15, Figure 7). The difference in annual stock composition patterns observed in 2015 compared to 2014 and 2016 may be attributed to this unrepresented harvest (Tables 14–16, Figures 6–8).

Making Inferences Outside the Study Years

These analyses are derived from environmental and fishery conditions during a specific period of time. Nonetheless, these studies are conducted so that future scientific and regulatory activities may be better informed. We expect that these results will be cited in the future as the most comprehensive data set available to examine stock composition of Chinook salmon captured in the Northern District commercial and Tyonek subsistence fisheries. However, while this 3-year data set provides represents some measure of interannual variability in stock composition, some caution must be exercised when extrapolating the results to years not analyzed because changes in relative abundance among reporting groups, prosecution of fisheries, or migratory behavior due to ocean conditions might affect the distribution of stock-specific harvests by time and area.

Future Work

Additional samples will be collected in 2017 under a grant funded by the Pacific States Marine Fishery Commission (PSMFC), adding an additional year of data to the data set reported here; a report on the analysis of these samples is scheduled for release in June 2018.

Additional analyses are planned in the future that may increase the power of the baseline for detecting finer-scale reporting groups. The inability of the current baseline to distinguish between some NCI Chinook salmon stocks prompted a new study, funded by PSMFC, which proposes to develop a new baseline dataset with up to 500 new genetic markers for 26 Cook Inlet populations. One of the objectives of the new baseline study is to improve the genetic identifiability of Cook Inlet stocks, and allow for finer resolution of MSA in Cook Inlet.

Unanticipated efficiencies in sample collection during this study have left a portion of the Alaska Sustainable Salmon Fund (AKSSF) monies unspent. An extension has been granted by AKSSF that will continue this study through 2017 and add an additional 16 populations to the 26 populations in the PSMFC study being analyzed for the new set of markers. If tests of the new baseline are successful in demonstrating that west side Cook Inlet and Yentna River stocks can be separated for MSA, the Northern District commercial and Tyonek subsistence samples from 2016 (this study) and 2017 (PSMFC study) will be analyzed for the new set of genetic markers and MSA will be conducted using the finer-scale reporting groups. If baseline tests are unsuccessful, an additional 12 Cook Inlet Chinook salmon populations will be analyzed for the new set of markers and MSA of the 2017 samples will be conducted using the most informative reporting groups possible. Results from these analyses will be released by summer of 2018.

REFERENCES CITED

Anderson E. C., R. S. Waples, and S. T. Kalinowski. 2008. An improved method for predicting the accuracy of genetic stock identification. Canadian Journal of Fisheries and Aquatic Sciences 65:1475–1486.

Barclay, A. W., B. J. Failor, and C. Habicht. 2016. Report to the Alaska Board of Fisheries: Progress report on genetic and coded wire tag mixed stock analysis of Chinook salmon harvested in Cook Inlet marine sport fishery, 2014–2016. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J16-09, Anchorage.

Barclay, A. W., and C. Habicht. 2015. Genetic baseline for Upper Cook Inlet Chinook salmon: 42 SNPs and 7,917 fish. Alaska Department of Fish and Game, Fishery Manuscript Series No. 15-01, Anchorage. http://www.adfg.alaska.gov/FedAidPDFs/FMS15-01.pdf

Dann, T. H., C. Habicht, J. R. Jasper, H. A. Hoyt, A. W. Barclay, W. D. Templin, T. T. Baker, F. W. West, and L. F. Fair. 2009. Genetic stock composition of the commercial harvest of sockeye salmon in Bristol Bay, Alaska, 2006–2008. Alaska Department of Fish and Game, Fishery Manuscript Series No. 09-06, Anchorage. http://www.adfg.alaska.gov/FedAidPDFs/FMS09-06.pdf

Gelman, A., and D. B. Rubin. 1992. Inference from iterative simulation using multiple sequences. Statistical Science 7:457–511.

Habicht, C., J. R. Jasper, T. H. Dann, N. DeCovich, and W. D. Templin. 2012. Western Alaska Salmon Stock Identification Program Technical Document 11: Defining reporting groups. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 5J12-16, Anchorage.

Shields, P., and A. Dupuis. 2016. Upper Cook Inlet commercial fisheries annual management report, 2015. Alaska Department of Fish and Game, Fishery Management Report No. 16-14, Anchorage.

St. Saviour, A., N. Logelin, B. Jones, and A. W. Barclay. 2016. Operational Plan: Northern Cook Inlet Chinook salmon marine harvest stock composition. Alaska Department of Fish and Game, Regional Operational Plan ROP.SF.2A.2016.06, Anchorage.

Urbanek, S. 2014. RJDBC: Provides access to databases through the JDBC interface. R package version 0.2-5. http://CRAN.R-project.org/package=RJDBC

Table 1. – Populations of Chinook salmon in the Upper Cook Inlet genetic baseline, including the sampling location, collection years, the number of individuals sampled from each population, and the reporting groups for mixed stock analysis of the Tyonek subsistence fishery and Northern District commercial fishery harvests. Populations and reporting groups match those in Figure 1.

Pop. No.	Reporting Group	Geographic Region	Location	Collection Year(s)	n
1	*NCI Northwest*	West Side Cook Inlet	Straight Creek	2010	95
2			Chuitna River	2008, 2009	134
3			Coal Creek	2009, 2010, 2011	118
4			Theodore River	2010, 2011, 2012	191
5			Lewis River	2011, 2012	87
6		Yentna River	Red Creek	2012, 2013	111
7			Hayes River	2012, 2013	50
8			Canyon Creek	2012, 2013	91
9			Talachulitna River	1995, 2008, 2010	178
10			Sunflower Creek	2009, 2011	123
11			Peters Creek	2009, 2010, 2011, 2012	107
12	*Susitna-Matanuska*	Susitna River	Portage Creek	2009, 2010, 2011, 2013	162
13			Indian River	2013	79
14			Chulitna River middle fork	2009, 2010	169
15			Chulitna River east fork	2009, 2010, 2011, 2013	77
16			Byers Creek	2013	55
17			Spink Creek	2013	56
18			Troublesome Creek	2013	71
19			Bunco Creek	2013	99
20			Upper Talkeetna trib	2013	69
21			Prairie Creek	1995, 2008	162
22			Iron Creek	2013	57
23			Disappointment Creek	2013	64
24			Chunilna Creek	2009, 2012	80
25			Montana Creek	2008, 2009, 2010	213
26			Little Willow Creek	2013	54
27			Willow Creek	2005, 2009	170
28			Deshka River	1995, 2012, 2005	303
29	*NCI Northwest*		Sucker Creek	2011, 2012	144
30	*Knik-Turnagain*	Knik Arm	Little Susitna River	2009, 2010	124
31	*Susitna-Matanuska*		Moose Creek	1995, 2008, 2009, 2012	149
32	*Knik-Turnagain*		Eagle River	2009, 2011, 2012	77
33			Ship Creek	2009	268

-continued-

Table 1. – page 2 of 2.

Pop. No.	Reporting Group	Geographic Region	Location	Collection Year(s)	n
34	*Knik-Turnagain*	Turnagain Arm	Campbell Creek	2010, 2011, 2012	110
35			Carmen River	2011, 2012	50
36			Resurrection Creek	2010, 2011, 2012	97
37			Chickaloon River	2008, 2010, 2011	128
38	*Kenai Peninsula*	Kenai River	Grant Creek	2011, 2012	55
39			Quartz Creek	2006, 2007,2008, 2009, 2010, 2011	131
40			Crescent Creek	2006	163
41			Juneau Creek	2005, 2006, 2007	142
42			Russian River	2005, 2006, 2007, 2008	214
43			Kenai Upper Mainstem	2009	191
44			Benjamin Creek	2005, 2006	204
45			Killey River	2005, 2006	255
46			Funny River	2005, 2006	219
47			Kenai Middle Mainstem	2003, 2004, 2006	299
48			Kenai Lower Mainstem	2010, 2011	126
49			Slikok Creek	2004, 2005, 2008	137
50		Kasilof River	Kasilof River Mainstem	2005	316
51			Crooked Creek	2005, 2011	306
52		Coastal Kenai Peninsula	Ninilchik River	2006, 2010	209
53			Deep Creek	2009, 2010	196
54			Stariski Creek	2011, 2012	99
55			Anchor River	2006, 2010	250

Table 2. – Chinook salmon collection details by time and area, used in genetic mixed-stock analysis (MSA) of northern Cook Inlet marine fisheries, 2014-2016.

Geographic area[a]	Date range	Reported harvest	Number sampled	Proportion sampled	Number analyzed for MSA	Proportion analyzed for MSA
	2014					
Trading Bay	May 29-June 16	491	133	27.0%	131	26.7%
Trading Bay	June 17-30	51	0	0.0%	-	-
Tyonek commercial	May 29-June 30	272[b]	174	64.0%	121	44.5%
General Subdistrict (north)	May 29-June 30	398	302	75.9%	236	59.3%
Eastern Subdistrict	May 29-June 30	326	138	42.3%	130	39.9%
Tyonek subsistence	May 16-June 30	712	196	27.0%	196	27.5%
	2015					
Trading Bay	May 29-June 30	368	68[c]	18.5%	-	-
Tyonek commercial	May 29-June 12	114	118[d]	103.5%[d]	118	103.5%[d]
Tyonek commercial	June 13-30	268	201	75.0%	173	64.6%
General Subdistrict (north)	May 29-June 12	343	234	68.2%	134	39.1%
General Subdistrict (north)	June 13-22	331	228	68.9%	133	40.2%
Eastern Subdistrict	May 29-June 12	208	213[d]	102.4%[d]	188	90.4%
Eastern Subdistrict	June 13-30	152	107	70.4%	100	65.8%
Tyonek subsistence	May 16-31	226[e]	105	45.3%	105	45.3%
Tyonek subsistence	June 1-20	703[e]	222	30.5%	201	27.6%
	2016					
Trading Bay	May 29-June 30	581	202	34.8%	146	25.1%
Tyonek commercial	May 29-June 12	346	198	57.2%	194	56.1%
Tyonek commercial	June 13-30	223	212	95.1%	156	70.0%
General Subdistrict (north)	May 29-June 12	166	128	77.1%	125	75.3%
General Subdistrict (north)	June 13-27	298	267	89.6%	217	72.8%
Eastern Subdistrict	May 29-June 12	257	196	76.3%	186	72.4%
Eastern Subdistrict	June 13-30	266	255	95.9%	220	82.7%
Tyonek subsistence	May 16-31	305[f]	140	44.4%	137	43.5%
Tyonek subsistence	June 1-25	500[f]	149	32.1%	144	31.0%
Totals/ Averages		7,795	4,186	53.7%	3,491	44.8%

[a] Refers to the Northern District commercial fishery unless subsistence is explicitly stated.
[b] Includes an additional unreported harvest of 108 fish known to have occurred.
[c] Minimum sample size (100) was not met, so no MSA was conducted.
[d] More fish were sampled than were reported as harvest.
[e] 2015 subsistence harvest numbers include 210 fish with unknown harvest dates, these were divided into early and late strata by the proportion of the total known harvest for early (0.24) and late (0.76) fishing periods.
[f] 2016 subsistence harvest numbers as of December 9, 2016.

Table 3.- Results from 10 replicates each of 100% proof tests of the Cook Inlet Chinook salmon genetic baseline using 39 loci. Each replicate was a sample of 200 individuals removed from the genetic baseline. Bold indicates correct allocations. Stock composition estimates (percentage) may not sum to 100 due to rounding error.

Reporting Group	Mean Contribution	Bias	RMSE	CI Width	Mean Contribution	Bias	RMSE	CI Width
	NCI Northwest				*Susitna-Matanuska*			
NCI Northwest	**89.1**	-10.9	12.7	26.6	11.3	11.3	12.8	30.1
Susitna/Matanuska	8.3	8.3	10.4	24.1	**85.0**	-15.0	16.4	33.6
Knik/Turnagain	2.0	2.0	2.3	7.4	2.8	2.8	3.3	10.1
Kenai Peninsula	0.6	0.6	0.7	2.9	0.9	0.9	0.9	3.9
	Knik-Turnagain				*Kenai Peninsula*			
NCI Northwest	2.7	2.7	3.2	9.7	0.6	0.6	0.7	2.9
Susitna/Matanuska	2.3	2.3	2.5	8.5	2.3	2.3	3.7	7.0
Knik/Turnagain	**93.7**	-6.3	6.7	14.4	1.5	1.5	1.8	5.8
Kenai Peninsula	1.3	1.3	1.6	4.8	**95.5**	-4.5	5.8	9.8

Table 4.- Estimates of average stock composition, bias, root mean square error (RMSE), and 90% credibility interval (CI) width for 10 replicates of fishery scenario proof tests of the Cook Inlet Chinook salmon genetic baseline with 39 loci. Each replicate was a sample of 50 individuals from each reporting group (200 individuals) removed from the genetic baseline.

Reporting Group	True Percentage	Average	Bias	RMSE	CI Width
NCI Northwest	25.0	27.4	2.4	7.4	32.5
Susitna-Matanuska	25.0	21.9	-3.1	9.8	34.1
Knik-Turnagain	25.0	26.9	1.9	7.5	33.0
Kenai Peninsula	25.0	23.8	-1.2	4.0	19.3

Table 5.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Trading Bay and Tyonek statistical areas of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2014**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Trading Bay (n=131)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 16		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	48.9	19.9	73.8	16.6	240	98	362	1.00
Susitna-Matanuska	37.3	11.7	68.3	17.5	183	57	335	1.00
Knik-Turnagain	11.6	0.1	26.0	8.1	57	0	128	0.93
Kenai Peninsula	2.2	0.0	8.4	2.9	11	0	41	0.68
Harvest represented					491			
Harvest not represented					51[a]			
Total harvest					542			

Tyonek (n=121)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 30		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	45.5	23.4	70.0	14.3	124	64	190	1.00
Susitna-Matanuska	46.3	22.0	69.0	14.4	126	60	188	1.00
Knik-Turnagain	7.3	0.4	18.5	5.7	20	1	50	0.95
Kenai Peninsula	0.9	0.0	3.9	1.5	2	0	11	0.41
Harvest represented					272			
Harvest not represented					-			
Total harvest					272			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

[a] Trading Bay not represented by harvest samples after June 16.

Table 6.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Trading Bay and Tyonek statistical areas of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2015**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Trading Bay (n=61)[a]	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 30		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥ 1
UCI Northwest	-	-	-	-	-	-	-	-
Susitna/Matanuska	-	-	-	-	-	-	-	-
Knik/Turnagain	-	-	-	-	-	-	-	-
Kenai Peninsula	-	-	-	-	-	-	-	-
Harvest represented					-			
Harvest unanalyzed					368			
Total harvest					368			

Tyonek (n=118)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥ 1
UCI Northwest	36.0	11.2	62.6	15.6	41	13	71	0.99
Susitna/Matanuska	57.6	29.9	83.5	16.2	66	34	95	1.00
Knik/Turnagain	6.3	0.0	17.0	5.6	7	0	19	0.79
Kenai Peninsula	0.1	0.0	0.0	0.5	0	0	0	0.02
Harvest represented					114			
Harvest unanalyzed					-			
Total harvest					114			

Tyonek (n=173)	Stock composition (%)				Stock-specific harvest			
Dates: June 13-30 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥ 1
UCI Northwest	72.2	54.2	87.0	10.1	194	145	233	1.00
Susitna/Matanuska	25.4	11.2	43.5	9.9	68	30	117	1.00
Knik/Turnagain	2.4	0.0	11.4	4.1	6	0	30	0.43
Kenai Peninsula	0.0	0.0	0.0	0.4	0	0	0	0.02
Harvest represented					268			
Harvest unanalyzed					-			
Total harvest					268			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

[a]The minimum sample size of 100 fish was not available to perform MSA.

Table 7.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Trading Bay and Tyonek statistical areas of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2016**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Trading Bay (n=146)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 30		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	37.0	14.4	62.4	14.6	219	85	369	1.00
Susitna-Matanuska	57.0	29.7	81.3	15.7	337	175	480	1.00
Knik-Turnagain	5.8	0.0	15.9	5.4	34	0	94	0.77
Kenai Peninsula	0.2	0.0	0.7	0.9	1	0	4	0.07
Harvest represented					591			
Harvest not represented					0			
Total harvest					591			

Tyonek (n=194)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	55.7	34.2	77.3	13.1	193	118	267	1.00
Susitna-Matanuska	43.1	21.4	64.4	13.1	149	74	223	1.00
Knik-Turnagain	1.2	0.0	7.3	2.8	4	0	25	0.29
Kenai Peninsula	0.1	0.0	0.2	0.7	0	0	1	0.04
Harvest represented					346			
Harvest not represented					0			
Total harvest					346			

Tyonek (n=156)	Stock composition (%)				Stock-specific harvest			
Dates: June 13-30 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	61.1	36.8	84.0	14.3	136	82	187	1.00
Susitna-Matanuska	37.7	13.9	62.6	14.8	84	31	140	1.00
Knik-Turnagain	1.1	0.0	9.2	3.4	3	0	21	0.15
Kenai Peninsula	0.0	0.0	0.0	0.3	0	0	0	0.02
Harvest represented					223			
Harvest not represented					0			
Total harvest					223			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 8.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **General Subdistrict (north) of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2015**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

General Subdistrict (north) (n= 134)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	4.3	0.0	18.2	6.4	15	0	63	0.52
Susitna-Matanuska	14.4	0.9	29.0	8.2	49	3	100	0.96
Knik-Turnagain	81.3	67.2	93.4	8.0	279	231	320	1.00
Kenai Peninsula	0.0	0.0	0.0	0.3	0	0	0	0.02
Harvest represented					343			
Harvest not represented					0			
Total harvest					343			

General Subdistrict (north) (n= 133)	Stock composition (%)				Stock-specific harvest			
Dates: June 13-22 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	0.7	0.0	4.7	2.6	2	0	16	0.16
Susitna-Matanuska	1.7	0.0	9.8	4.1	6	0	34	0.37
Knik-Turnagain	97.6	87.3	100.0	4.8	333	298	341	1.00
Kenai Peninsula	0.0	0.0	0.0	0.3	0	0	0	0.02
Harvest represented					341			
Harvest not represented					0			
Total harvest					341			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 9.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **General Subdistrict (north) of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2016**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

General Subdistrict (north) (n=125)								
	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	1.6	0.0	11.6	4.8	3	0	19	0.18
Susitna-Matanuska	26.9	11.2	43.6	9.9	45	19	72	0.99
Knik-Turnagain	71.5	55.5	86.1	9.4	119	92	143	1.00
Kenai Peninsula	0.0	0.0	0.0	0.3	0	0	0	0.02
Harvest represented					166			
Harvest not represented					0			
Total harvest					166			

General Subdistrict (north) (n=217)								
	Stock composition (%)				Stock-specific harvest			
Dates: June 13-27 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	0.5	0.0	3.4	1.9	1	0	10	0.10
Susitna-Matanuska	3.7	0.0	13.5	4.7	11	0	40	0.68
Knik-Turnagain	95.8	85.7	100.0	4.9	285	255	298	1.00
Kenai Peninsula	0.0	0.0	0.0	0.2	0	0	0	0.02
Harvest represented					298			
Harvest not represented					0			
Total harvest					298			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 10.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2015**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Eastern Subdistrict (n=188)								
	Stock composition (%)				Stock-specific harvest			
May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	35.2	12.7	55.5	12.9	73	26	115	1.00
Susitna-Matanuska	12.5	0.0	34.9	11.4	26	0	73	0.88
Knik-Turnagain	52.2	37.3	67.1	9.0	109	78	139	1.00
Kenai Peninsula	0.1	0.0	0.1	0.4	0	0	0	0.03
Harvest represented					208			
Harvest not represented					0			
Total harvest					208			

Eastern Subdistrict (n=100)								
	Stock composition (%)				Stock-specific harvest			
Dates: June 13-30 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	15.1	0.0	39.1	13.0	23	0	59	0.86
Susitna-Matanuska	23.4	0.0	49.9	15.9	36	0	76	0.88
Knik-Turnagain	61.2	42.3	79.2	11.2	93	64	120	1.00
Kenai Peninsula	0.3	0.0	1.7	1.1	0	0	3	0.08
Harvest represented					152			
Harvest not represented					0			
Total harvest					152			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 11.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2016**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Eastern Subdistrict (n=186)	Stock composition (%)				Stock-specific harvest			
Dates: May 29-June 12 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	20.0	2.9	37.8	10.4	51	8	97	0.98
Susitna-Matanuska	20.1	2.5	38.9	10.8	52	7	100	0.97
Knik-Turnagain	59.9	45.4	75.1	9.1	154	117	193	1.00
Kenai Peninsula	0.0	0.0	0.0	0.3	0	0	0	0.02
Harvest represented					257			
Harvest not represented					0			
Total harvest					257			

Eastern Subdistrict (n=220)	Stock composition (%)				Stock-specific harvest			
Dates: June 13-30 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	14.5	0.7	28.0	8.0	39	2	74	0.96
Susitna-Matanuska	6.0	0.0	20.7	7.2	16	0	55	0.69
Knik-Turnagain	79.4	66.9	90.8	7.3	211	178	242	1.00
Kenai Peninsula	0.0	0.0	0.0	0.2	0	0	0	0.01
Harvest represented					266			
Harvest not represented					0			
Total harvest					266			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 12.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Tyonek subsistence set gillnet fishery of Cook Inlet, Alaska, in 2015**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Tyonek Subsistence (n=105)	Stock composition (%)				Stock-specific harvest			
Dates: May 16-31 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	49.8	26.3	74.9	14.7	113	59	169	1.00
Susitna-Matanuska	24.0	6.6	48.9	13.3	54	15	110	1.00
Knik-Turnagain	26.1	0.0	47.3	14.2	59	0	107	0.89
Kenai Peninsula	0.1	0.0	0.2	0.7	0	0	1	0.04
Harvest represented					226			
Harvest not represented					0			
Total harvest					226			

Tyonek Subsistence (n=201)	Stock composition (%)				Stock-specific harvest			
Dates: June 1-20 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	88.3	73.1	98.1	7.8	621	514	689	1.00
Susitna-Matanuska	7.2	0.0	23.4	8.0	50	0	164	0.82
Knik-Turnagain	4.4	0.0	11.7	3.9	31	0	83	0.87
Kenai Peninsula	0.1	0.0	0.6	0.8	1	0	4	0.07
Harvest represented					703			
Harvest not represented					0			
Total harvest					703			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 13.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Tyonek subsistence set gillnet fishery of Cook Inlet, Alaska, in 2016**. Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Tyonek Subsistence (n=137)	Stock composition (%)				Stock-specific harvest			
Dates: May 16-31 (Early)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	81.6	67.2	92.4	7.9	249	205	282	1.00
Susitna-Matanuska	14.1	5.1	27.2	6.9	43	16	83	1.00
Knik-Turnagain	4.0	0.0	13.4	4.6	12	0	41	0.75
Kenai Peninsula	0.2	0.0	1.5	0.9	1	0	5	0.12
Harvest represented					305			
Harvest not represented					0			
Total harvest					305			

Tyonek Subsistence (n=144)	Stock composition (%)				Stock-specific harvest			
Dates: June 1-15 (Late)		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	65.9	37.8	89.3	16.0	330	189	446	1.00
Susitna-Matanuska	23.1	0.0	55.0	17.7	116	0	275	0.90
Knik-Turnagain	10.9	0.0	22.8	7.0	55	0	114	0.88
Kenai Peninsula	0.0	0.0	0.0	0.4	0	0	0	0.03
Harvest represented					500			
Harvest not represented					0			
Total harvest					500			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 14.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2014**. Estimates for General Subdistrict (south) were calculated using a stratified estimator for combined area strata (see Figure 3). Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

General Subdistrict (south) (n=196)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	47.7	27.9	65.4	11.5	364	213	499	1.00
Susitna-Matanuska	40.5	22.0	61.8	12.1	309	168	471	1.00
Knik-Turnagain	10.1	1.8	19.8	5.5	77	14	151	1.00
Kenai Peninsula	1.7	0.0	5.8	2.0	13	0	44	0.83
Harvest represented					763			
Harvest not represented					51[a]			
Total harvest					814			

General Subdistrict (north) (n=196)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	9.1	0.0	23.2	7.9	36	0	92	0.84
Susitna-Matanuska	18.7	6.0	34.6	9.0	74	24	138	1.00
Knik-Turnagain	71.2	58.7	82.9	7.3	283	234	330	1.00
Kenai Peninsula	1.1	0.0	4.2	1.5	4	0	17	0.56
Harvest represented					398			
Harvest not represented					0			
Total harvest					398			

Eastern Subdistrict (n=130)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	36.3	16.6	57.6	12.5	118	54	188	1.00
Susitna-Matanuska	34.3	15.5	54.8	12.1	112	50	179	1.00
Knik-Turnagain	27.6	12.5	45.1	9.9	90	41	147	1.00
Kenai Peninsula	1.8	0.0	6.8	2.4	6	0	22	0.63
Harvest represented					326			
Harvest not represented					0			
Total harvest					326			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

[a] Trading Bay not represented by harvest samples after June 16.

Table 15.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2015.** Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3). Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

General Subdistrict (south) (n=291)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	61.4	47.0	74.3	8.3	235	180	284	1.00
Susitna-Matanuska	35.0	22.1	49.5	8.3	134	84	189	1.00
Knik-Turnagain	3.6	0.0	10.4	3.3	14	0	40	0.88
Kenai Peninsula	0.0	0.0	0.1	0.3	0	0	1	0.04
Harvest represented					382			
Harvest not represented					368[a]			
Total harvest					750			

General Subdistrict (north) (n=267)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	2.5	0.0	9.9	3.5	17	0	68	0.60
Susitna-Matanuska	8.1	0.9	16.3	4.6	55	6	112	0.98
Knik-Turnagain	89.4	81.0	96.2	4.7	611	554	658	1.00
Kenai Peninsula	0.0	0.0	0.1	0.2	0	0	0	0.04
Harvest represented					684			
Harvest not represented					0			
Total harvest					684			

Eastern Subdistrict (n=288)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	26.7	11.4	41.8	9.2	96	41	150	1.00
Susitna-Matanuska	17.1	2.9	33.7	9.3	62	10	121	0.99
Knik-Turnagain	56.0	44.3	67.6	7.1	202	159	243	1.00
Kenai Peninsula	0.1	0.0	1.0	0.5	1	0	4	0.10
Harvest represented					360			
Harvest not represented					0			
Total harvest					360			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

[a] Insufficient samples to analyze Trading Bay

Table 16.–Stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3). Sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

General Subdistrict (south) (n=496)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	47.2	33.2	62.1	8.8	548	385	720	1.00
Susitna-Matanuska	49.1	33.4	63.8	9.3	570	387	740	1.00
Knik-Turnagain	3.5	0.0	9.0	3.0	41	0	104	0.86
Kenai Peninsula	0.1	0.0	0.9	0.5	1	0	10	0.12
Harvest represented					1,160			
Harvest not represented					0			
Total harvest					1,160			

General Subdistrict (north) (n=342)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	0.9	0.0	5.6	2.1	4	0	26	0.27
Susitna-Matanuska	12.0	5.1	20.2	4.7	56	24	94	1.00
Knik-Turnagain	87.1	78.9	93.8	4.6	404	366	435	1.00
Kenai Peninsula	0.0	0.0	0.1	0.2	0	0	0	0.03
Harvest represented					464			
Harvest not represented					0			
Total harvest					464			

Eastern Subdistrict (n=406)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥1
NCI Northwest	17.2	6.7	28.3	6.6	90	35	148	1.00
Susitna-Matanuska	12.9	3.3	24.5	6.5	68	17	128	0.99
Knik-Turnagain	69.8	60.3	79.4	5.8	365	315	415	1.00
Kenai Peninsula	0.0	0.0	0.1	0.2	0	0	0	0.03
Harvest represented					523			
Harvest not represented					0			
Total harvest					523			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

Table 17.–Annual stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Northern District set gillnet fishery of Cook Inlet, Alaska, in 2014, 2015, and 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3). Within each year, sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Year: 2014 (n=618)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥1
NCI Northwest	34.9	23.0	45.9	6.9	518	342	682	1.00
Susitna-Matanuska	33.3	22.0	45.9	7.3	495	327	682	1.00
Knik-Turnagain	30.3	23.8	37.1	4.0	450	354	551	1.00
Kenai Peninsula	1.6	0.2	3.9	1.2	23	2	59	0.98
Harvest represented					1,487			
Harvest not represented					51[a]			
Total harvest					1,538			

Year: 2015 (n=846)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥1
NCI Northwest	24.4	18.4	30.5	3.7	348	262	434	1.00
Susitna-Matanuska	17.6	11.4	24.4	4.0	250	162	349	1.00
Knik-Turnagain	58.0	52.9	62.6	3.0	827	755	893	1.00
Kenai Peninsula	0.1	0.0	0.4	0.2	1	0	6	0.17
Harvest represented					1,426			
Harvest not represented					368[b]			
Total harvest					1,794			

Year: 2016 (n=1,244)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	P≥1
NCI Northwest	29.9	21.9	38.3	5.0	642	470	823	1.00
Susitna-Matanuska	32.3	23.3	40.8	5.3	693	500	876	1.00
Knik-Turnagain	37.7	34.0	41.7	2.3	810	730	894	1.00
Kenai Peninsula	0.1	0.0	0.5	0.3	2	0	11	0.18
Harvest represented					2,147			
Harvest not represented					0			
Total harvest					2,147			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

[a] Trading Bay not represented by harvest samples after June 16.

[b] Insufficient samples to analyze Trading Bay

Table 18.–Annual stock composition (%) and stock-specific harvest estimates based on genetic data for Chinook salmon harvested in the **Tyonek subsistence set gillnet fishery of Cook Inlet, Alaska, in 2014, 2015, and 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3). Within each year, sample sizes (n), means, 90% credibility intervals (CI), standard deviation of the proportions (SD), and probability that the stock-specific harvest estimate is greater than or equal to 1 fish (P≥1) are provided.

Year: 2014 (n=196)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥ 1
NCI Northwest	56.6	25.2	86.3	18.9	403	180	615	1.00
Susitna-Matanuska	39.2	9.9	70.8	18.7	279	71	504	1.00
Knik-Turnagain	2.5	0.0	11.9	4.5	18	0	85	0.64
Kenai Peninsula	1.8	0.0	6.7	2.3	13	0	48	0.69
Harvest represented					712			
Harvest not represented					0			
Total harvest					712			

Year: 2015 (n=306)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥ 1
NCI Northwest	79.0	66.2	88.9	7.0	733	614	825	1.00
Susitna-Matanuska	11.2	2.7	24.6	6.9	104	26	229	1.00
Knik-Turnagain	9.6	2.0	17.1	4.5	90	19	160	0.99
Kenai Peninsula	0.1	0.0	0.8	0.6	1	0	7	0.10
Harvest represented					929			
Harvest not represented					0			
Total harvest					929			

Year: 2016 (n=281)	Stock composition (%)				Stock-specific harvest			
		90% CI				90% CI		
Reporting Group	Mean	5%	95%	SD	Mean	5%	95%	*P*≥ 1
NCI Northwest	73.6	57.7	87.3	9.1	579	432	703	1.00
Susitna-Matanuska	18.7	4.9	36.0	9.7	159	32	322	1.00
Knik-Turnagain	7.6	0.5	15.1	4.3	67	4	132	0.97
Kenai Peninsula	0.1	0.0	0.9	0.5	1	0	6	0.14
Harvest represented					805			
Harvest not represented					0			
Total harvest					805			

Note: Stock-specific harvest estimates may not sum to the total harvest represented due to rounding error and their 90% credibility intervals may not include the point estimate for the very low stock-specific harvest numbers because fewer than 5% of iterations had values above zero.

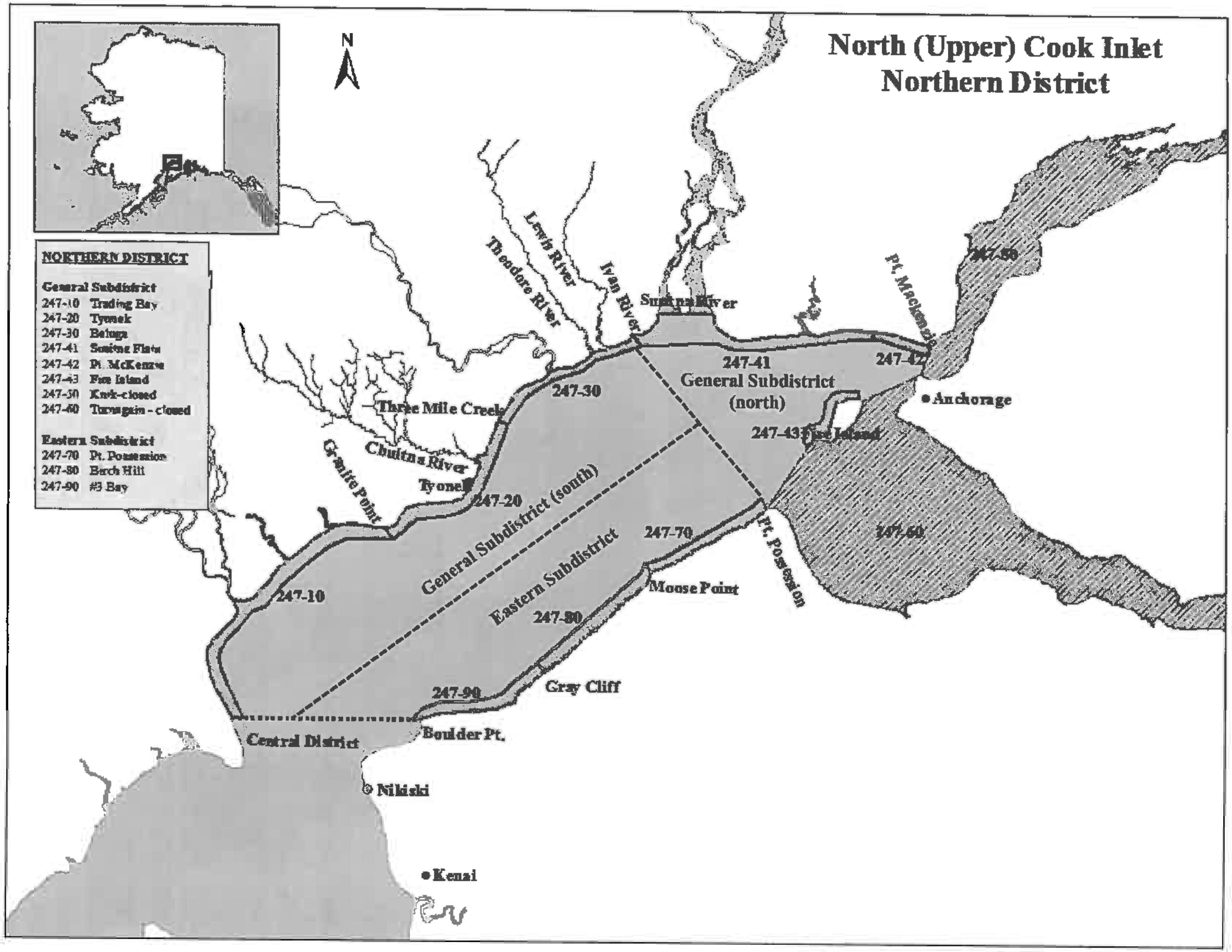

Figure 1.- Map of statistical areas for set gillnet commercial fishing in the Northern District of Upper Cook Inlet.

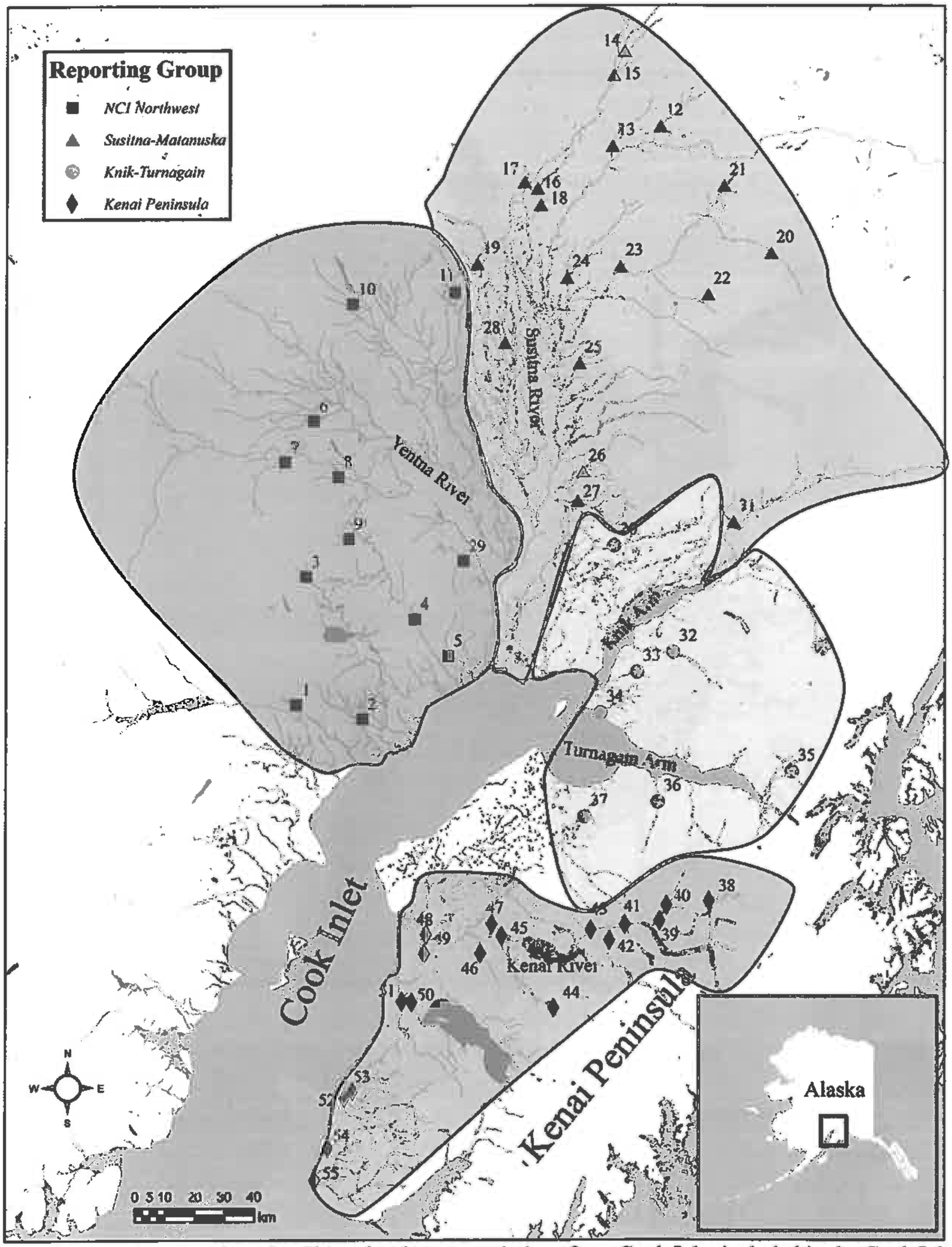

Figure 2.- Sampling locations for Chinook salmon populations from Cook Inlet included in the Cook Inlet genetic baseline. Numbers correspond to map numbers on Table 1. Location dot shape and color matches reporting group assignment.

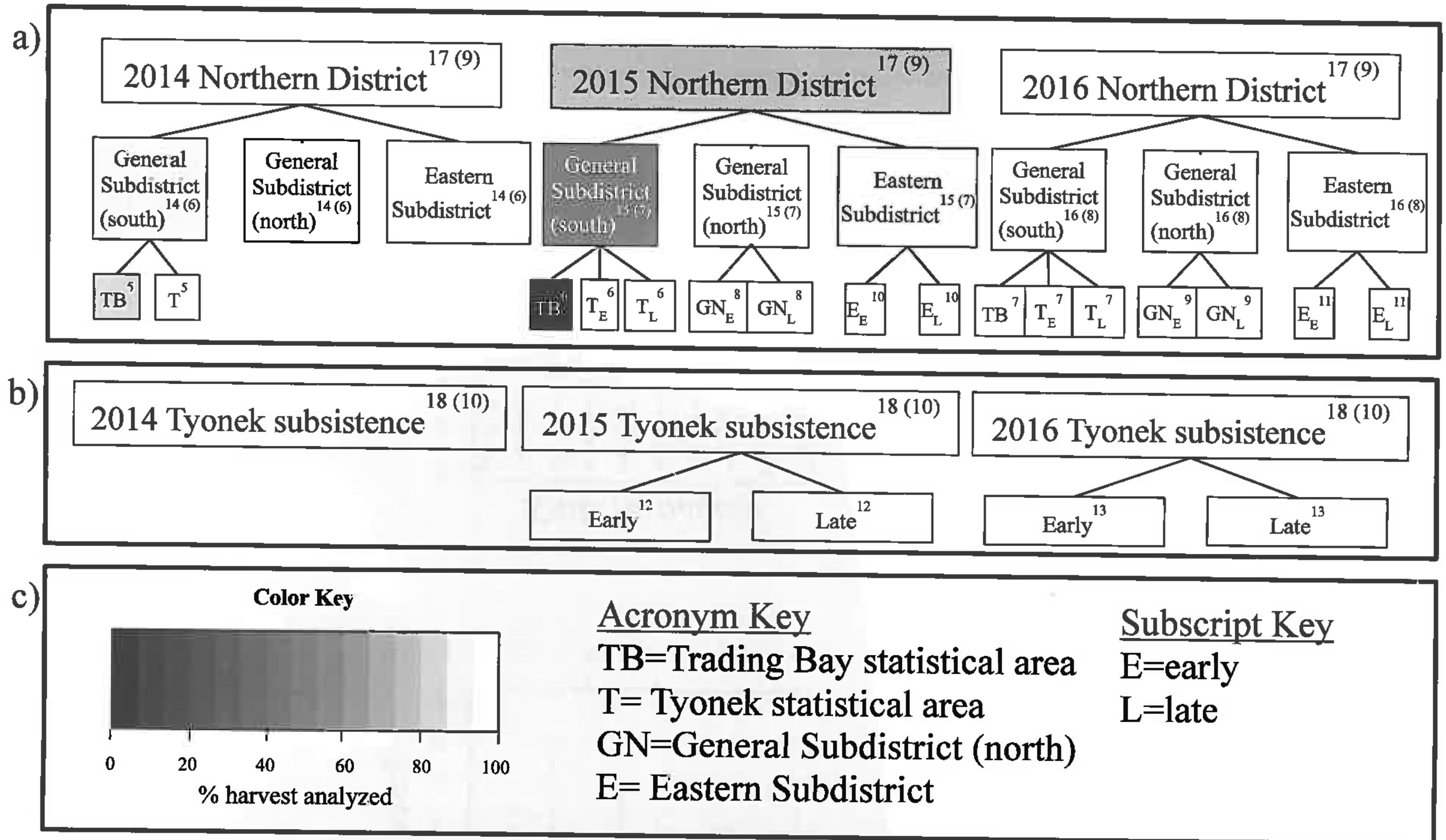

Figure 3.-Graphical depictions of temporal and area strata (boxes) in the a) Northern District set gill net and b) Tyonek Subsistence set gillnet fisheries, in which stock composition and stock-specific harvest was estimated and c) keys for the colors indicating percentage of the harvest analyzed in each analysis, acronyms of each area stratum, and subscripts used to indicate temporal strata. Lines connecting smaller strata to larger strata indicate which estimates were stratified to calculate larger strata. Superscript numbers next the name/acronym of each temporal and area stratum indicate the table number and figure number (parentheses) where their estimates can be found.

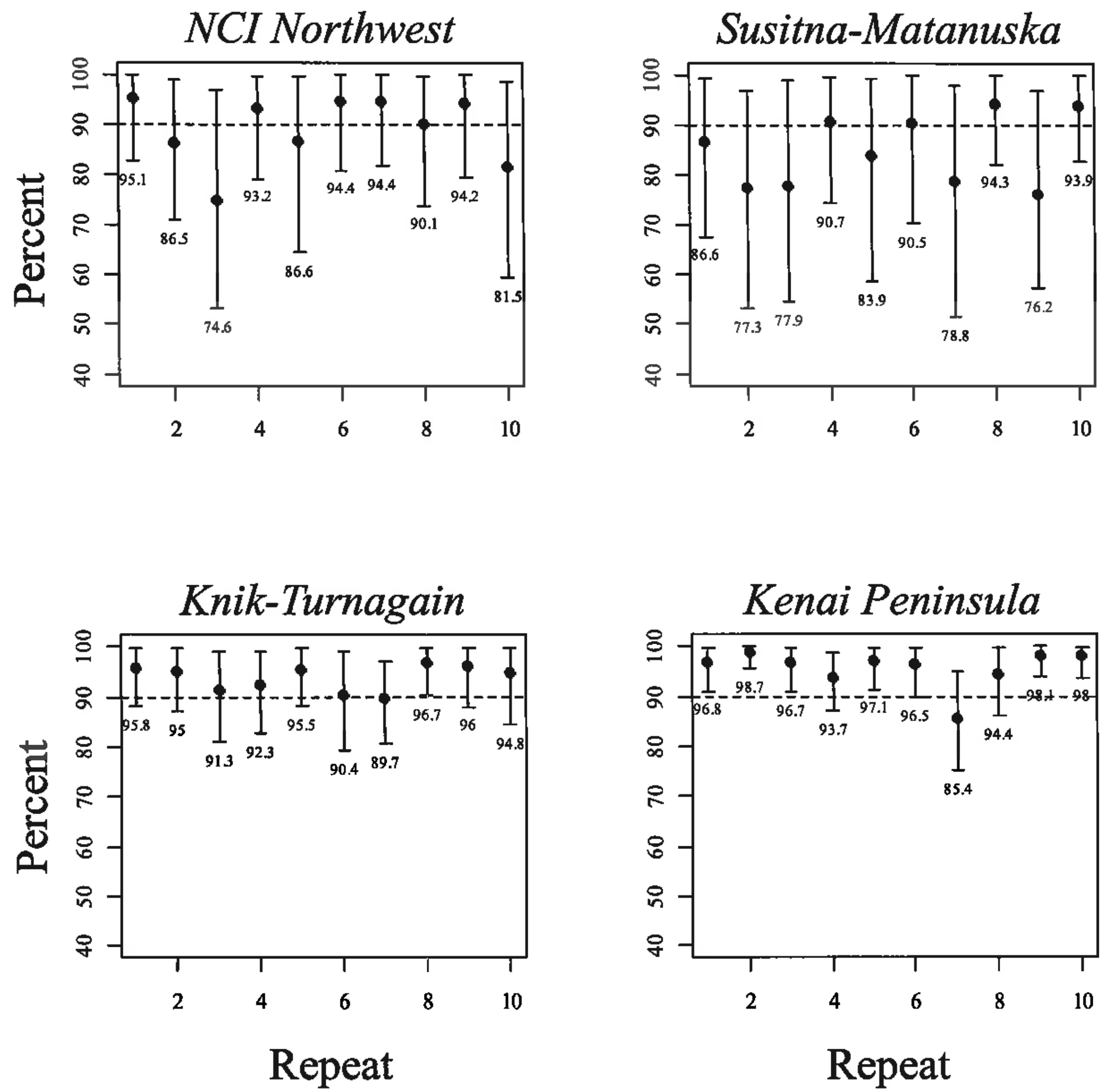

Figure 4.–Results of repeated 100% proof tests for 4 reporting groups. The points represent the mean correct allocation from each repeat with 90% credibility intervals for each point and the dotted line indicates 90% correct allocation. Point estimates for each repeat of the tests are included below the lower credibility interval.

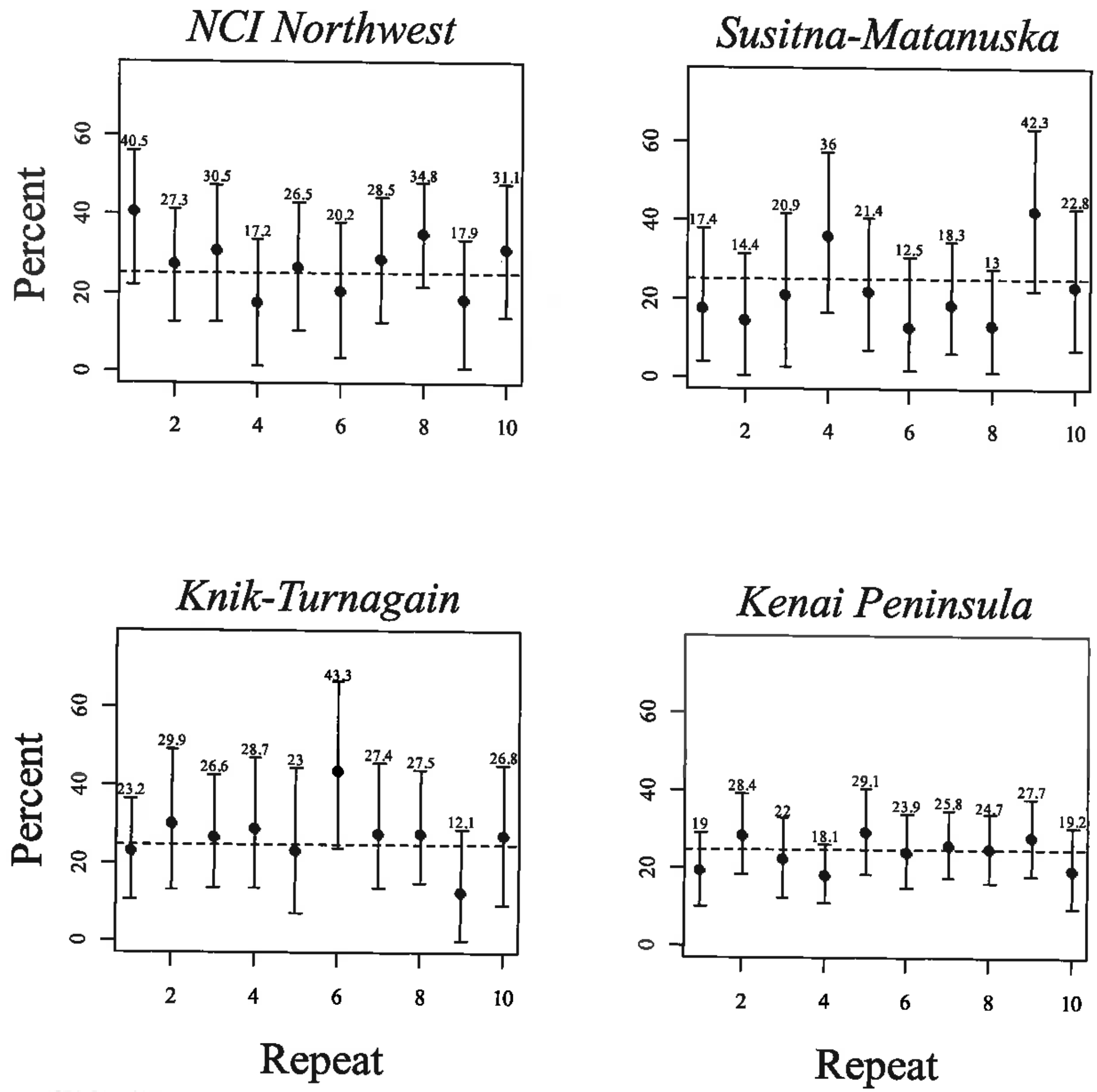

Figure 5.–Results of repeated fishery scenario tests for 4 reporting groups. The points represent the mean stock composition estimate from each repeat with 90% credibility intervals for each point and the dotted line indicates the actual percentage. Point estimates for each repeat of the tests are included above the upper credibility interval.

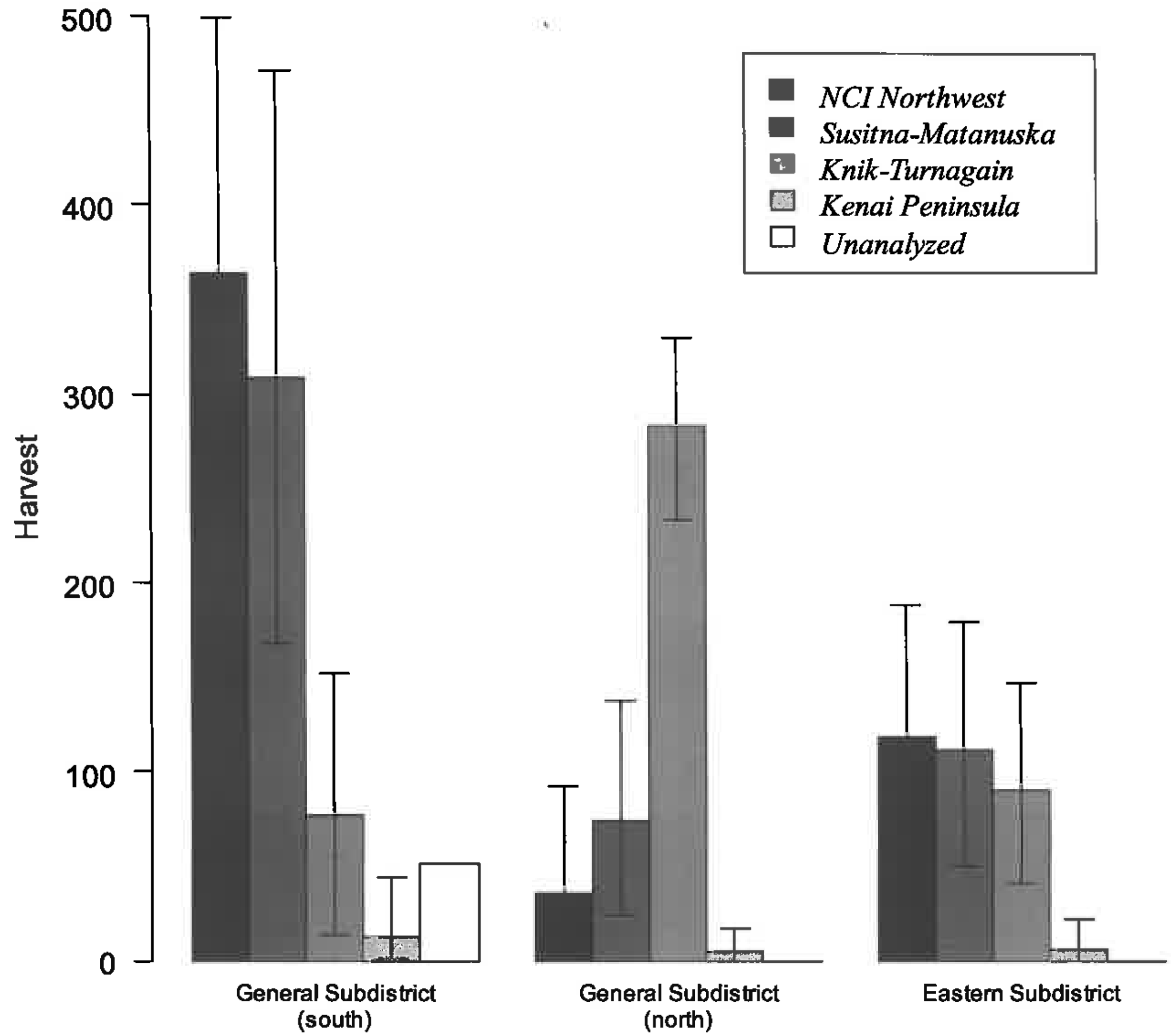

Figure 6.- Annual stock-specific harvest estimates and 90% credibility intervals based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2014**. Estimates for General Subdistrict-south were calculated using a stratified estimator for combined area strata (see Figure 3).

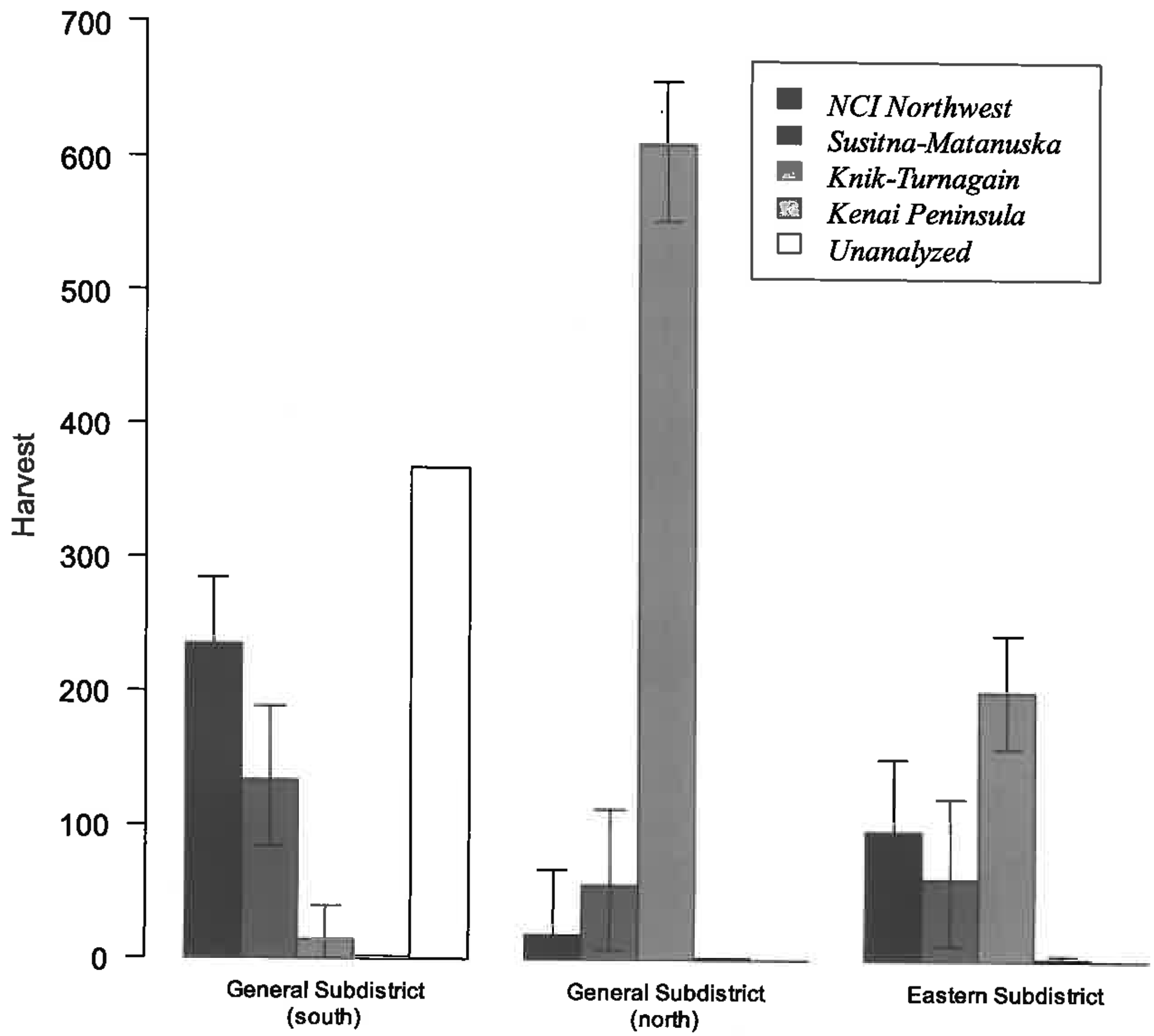

Figure 7.-Annual stock-specific harvest estimates and 90% credibility intervals based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2015**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3).

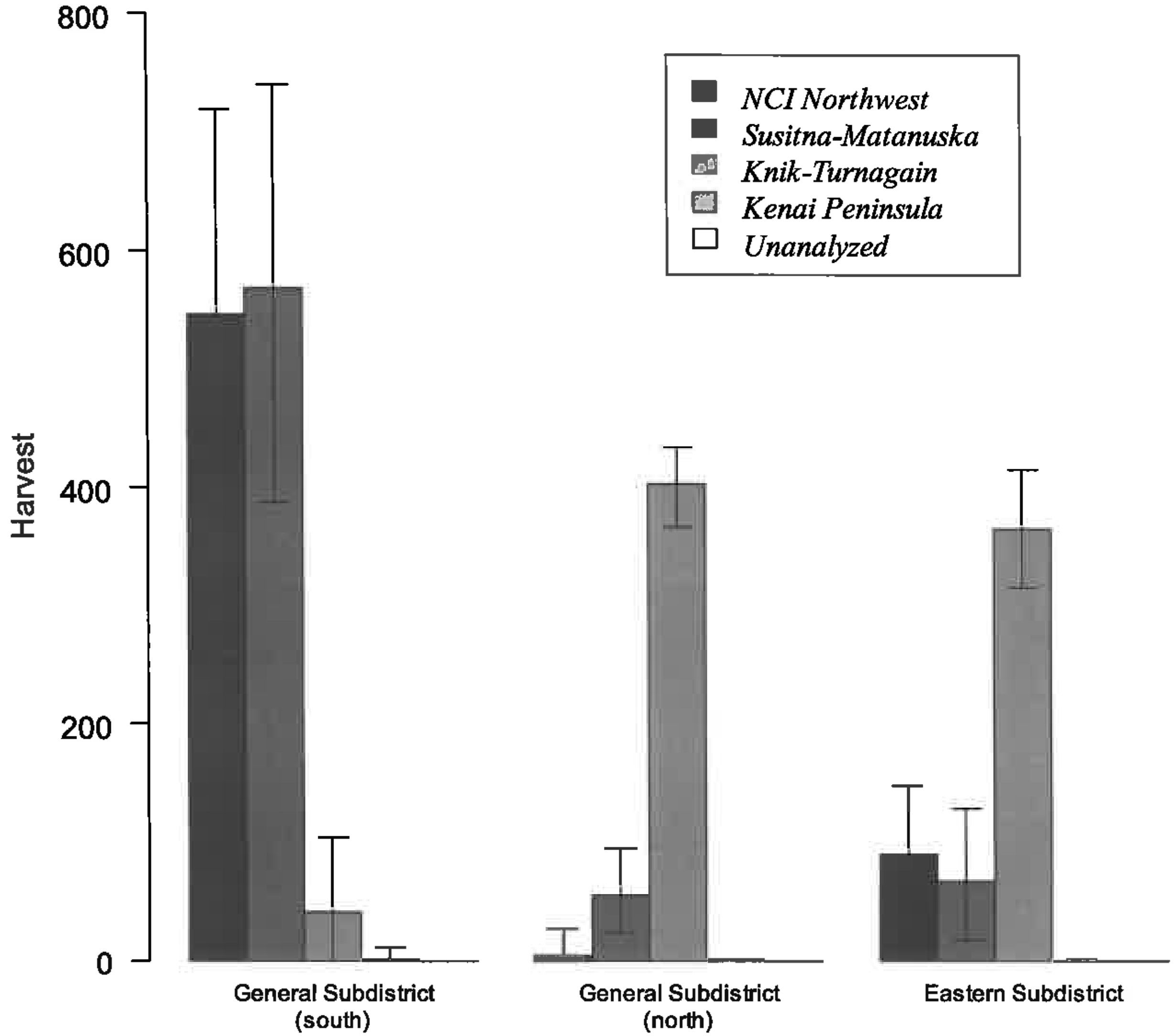

Figure 8.- Annual stock-specific harvest estimates and 90% credibility intervals based on genetic data for Chinook salmon harvested in the **General Subdistrict (south), General Subdistrict (north), and Eastern Subdistrict of the Northern District set gillnet fishery of Cook Inlet, Alaska, in 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3).

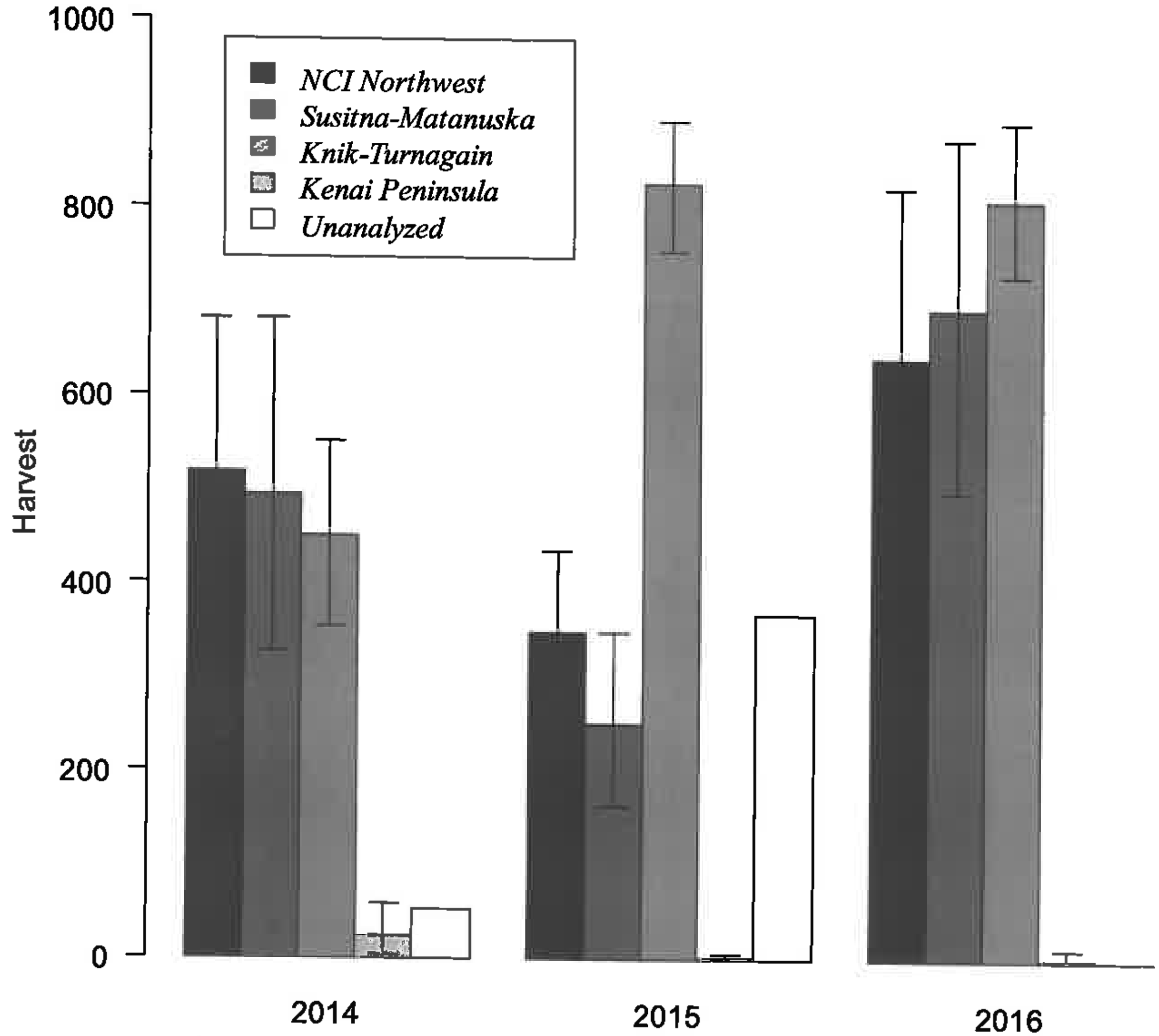

Figure 9.- Annual stock-specific harvest estimates and 90% credibility intervals based on genetic data for Chinook salmon harvested in the **Northern District set gillnet fishery of Cook Inlet, Alaska, in 2014, 2015, and 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3).

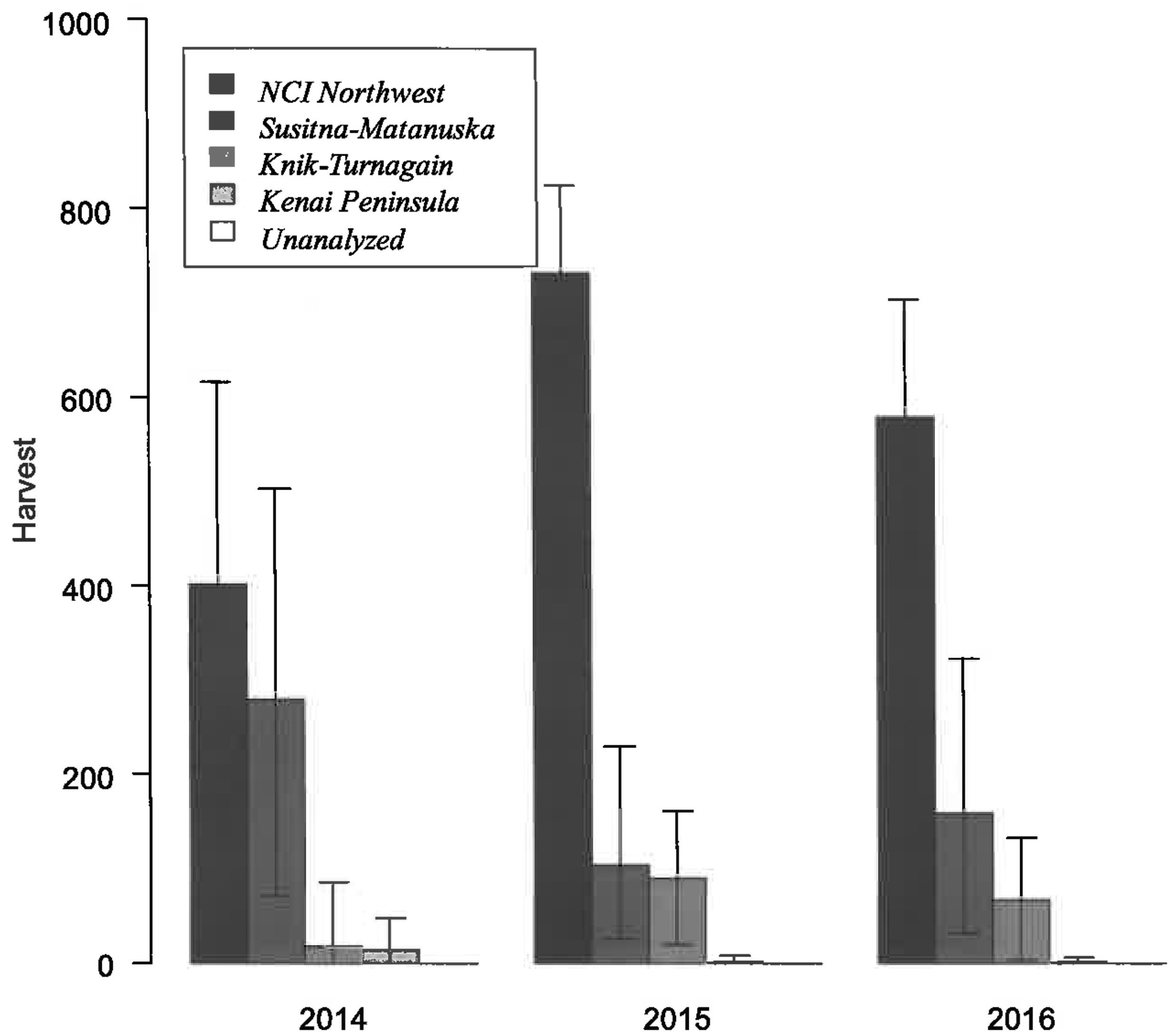

Figure 10.-Annual stock-specific harvest estimates and 90% credibility intervals based on genetic data for Chinook salmon harvested in the **Tyonek subsistence set gillnet fishery of Cook Inlet, Alaska, in 2014, 2015, and 2016**. Estimates were calculated using a stratified estimator for combined temporal and area strata (see Figure 3).