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Project Title: Estimating the Chinook salmon stock composition of Southeast Alaska District 108 & 111 fisheries, 2010

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Abstract:
Since 1999, the Alaska Department of Fish and Game has used genetic stock identification to estimate the stock composition of Chinook salmon harvests in Southeast Alaska commercial and sport fisheries. This project extended genetic stock identification to Chinook salmon harvested or encountered in the 2010 directed drift gillnet harvests and sport fishery harvests in districts 108 and 111 by screening 13 microsatellite markers in 1,016 Chinook salmon. Mixed stock analysis indicatee that the Andrew Creek and Upper Stikine reporting groups were the largest contributors in the District 108 fisheries, and the Taku River and Andrew Creek reporting groups were the largest contributors in the District 111 fisheries. These estimates provide an independent estimate of the stock composition of the harvests for comparison with estimates provided by coded-wire tag data and the PSC Chinook salmon model.

Introduction:
Since 1999, the Chinook Technical Committee (CTC) of the Pacific Salmon Commission (PSC) has explored the inclusion of genetic stock identification estimates of the Alaska sport and commercial harvest as part of the decision-making process. Between 1999 and 2003, the Alaska Department of Fish and Game (ADF&G) used genetic stock identification based on a coastwide allozyme database (Teel et al. 1999) to estimate the composition of the commercial troll fishery harvest (Crane et al. 2000; Templin et al. 2011). At the same time, samples were collected from sublegal-sized Chinook salmon encountered in the summer troll fishery, providing important information for evaluating assumptions of stock-specific survival rates. Initial estimates demonstrated that the stock composition of the sublegal encounters was substantially different than assumptions used for management purposes (Bloomquist and Carlile 2002).

Advances in genetic methods and technologies using DNA-based markers have increased the potential utility of genetic stock identification for estimating harvest composition over the previous set of allozyme markers. Beginning in 2002, a standardized baseline of genetic markers was developed through collaboration between 10 laboratories and it was made available for use during the summer of 2005 (Moran et al. 2005; Seeb et al. 2007). This baseline has continued to be improved through the addition of more genetic markers and more populations. Version 2.1 of the CTC baseline contains allele frequencies for 13 microsatellite markers from 176 populations contributing to PSC fisheries, ranging from the Situk River in Alaska to the Central Valley of California (Tables 1, 2; Appendix A). Expansion of the baseline continues and the next version will include additional populations provided by both ADF&G and the Department of Fisheries and Oceans Canada. Initial results indicate that 44 regional groups can be identified in mixtures with acceptable accuracy and precision (Seeb et al. 2007). Results from this and other genetic

stock identification analyses could be integrated into a coordinated coast-wide management system. This was the subject of recent workshops held by the PSC (PSC 2008).

Beginning in 2003 genetic stock identification was extended to cover the troll, seine, drift gillnet, and sport fishery harvests of Chinook salmon in Southeast Alaska waters for a period of two years with the intent to use the baseline of DNA-markers. Between 2006 and 2009, coverage of the Chinook salmon harvest was reduced to just the troll and sport fisheries and the directed gillnet fisheries in districts 108 and 111. This project extended genetic stock identification to Chinook salmon harvested or encountered in the 2010 directed drift gillnet harvests and sport fishery harvests in districts 108 and 111.

Objectives:

The goal of this project was to estimate the stock composition of selected 2010 Southeast Alaska Chinook salmon fisheries using genetic stock identification. This was accomplished by meeting the following objectives:

1. Sample Chinook salmon harvested in the following fisheries
   a. Directed fisheries – sample from the harvest from the directed fisheries operating in districts 108 and 111 beginning May 2010.
   b. Sport fishery – sample from the districts 108 and 111 sport fishery harvests between April and September 2010.
2. Assay 1,600 individual genotypes from sampled Chinook salmon at the loci in the current PSC baseline of genetic markers.
3. Estimate the relative stock composition of the Southeast Alaska fisheries using genetic stock identification such that the estimated stock composition is within 5% of the true value 90% of the time.

Approach:

Fishery sampling

Chinook salmon were collected from commercial gillnet landings at processors in Southeast Alaska (Figure 1). Legal-sized Chinook salmon were sampled in the sport fishery by onboard participants and by creel census samplers. Sampling goals are listed in Tables 3 and 4.

Chinook salmon were selected for sampling without regard to size, sex, adipose fin-clip, or position in the hold. Axillary process tissue was dissected from sampled fish and placed in alcohol in individually labelled 2ml cryovials. Along with each individual sampled, basic information was recorded such as size, sex, date, vessel, and age (from scale samples). At the end of the fishery, samples were transported back to the ADF&G Gene Conservation Laboratory, Anchorage, for analysis. Associated data are archived in the ASL database maintained by ADF&G.

Due to the nature of the fisheries in 2010, no subsampling was conducted for genetic analysis. Typically, when possible, representative tissue collections of individuals for mixture analysis are created by subsampling individuals from the collected samples in proportions weighted by harvest in the ports and quadrants that comprise the mixture composition to be estimated (Table 3). Due to the vagaries of fisheries and fishery sampling, target sample sizes were not available for every time and space stratum; however, sample sizes smaller than the target were analyzed.

Laboratory analyses

Samples were assayed for DNA loci included in the CTC standardized baseline for use in Treaty fisheries (Table 1). DNA was extracted from fin and muscle tissue using DNeasy 96 tissue kits (QIAGEN, Valencia CA). Polymerase chain reaction (PCR) was carried out in 10ul reaction

volumes (10mM Tris-HCl, 50mM KCl, 0.2 mM each dNTP, 0.5 units Taq DNA polymerase (Promega, Madison, WI)) using an Applied Biosystems (AB, Foster City CA) thermocycler. Primer concentrations, $MgCl_2$ concentrations and the corresponding annealing temperature for each primer are available upon request. PCR fragment analysis was done on an AB 3730 capillary DNA sequencer. A 96-well reaction plate was loaded with 0.5ul PCR product along with 0.5ul of GS500LIZ (AB) internal lane size standard and 9.0ul of Hi-Di (AB). PCR bands were visualized and separated into bin sets using AB GeneMapper software v4.0. All laboratory analyses followed protocols accepted by the Chinook Technical Committee of the Pacific Salmon Commission.

Data Collection

Genetic data were collected as individual multi-locus genotypes for the 13 microsatellite loci currently included in the CTC standardized baseline (Table 1). According to the convention implemented by the CTC, at each locus, a standardized allele is one that has a recognized holotype specimen from which the standardized allele can be reproduced using commonly applied fragment analysis techniques. By the process of sizing the alleles from the holotype specimens, any individual laboratory should be able to convert allele sizes obtained in the laboratory to standardized allele names. Genotype data were stored as GeneMapper (*.fsa) files on a network drive that was backed up nightly, and long term storage of the data is on a network drive maintained by ADF&G computer services.

Quality Control

Several measures were implemented to ensure the quality of data produced.

1) Each individual tissue sample was assigned a unique accession identifier. At the time DNA was extracted or analyzed from each sample, a sample sheet was created that linked each individual sample's code to a specific well number in a uniquely numbered 96-well plate. This sample sheet then followed the sample through all phases of the project, minimizing the risk of misidentification of samples through human-induced errors.

2) Genotypes were assigned to individuals using a system in which two individuals score the genotype data independently. Discrepancies between the two sets of scores were then resolved with one of three possible outcomes: 1) one score was accepted and the other rejected, 2) both scores were rejected and the score was blanked, or 3) the sample was rerun.

3) Approximately 8% of the individuals, eight samples from each 96-well DNA extraction plate, were reanalyzed for all loci. This ensured that the data are reproducible and any errors created from the processing of individual plates were corrected.

Mixture Analysis

Stock composition estimates for the 44 reporting groups were generated using BAYES (Pella and Masuda 2001) software package. For BAYES analysis, the estimation was run using three independent MCMC chains of 15,000 iterations with different starting values. A flat prior distribution was used, in which each reporting group was given equal contribution. The sum of all prior parameters were set to one (prior weight), which is equivalent to adding one fish to each mixture (Pella and Masuda 2001). Estimates and 90% credibility intervals were tabulated from the posterior distribution formed by combining the second half of three chains.

Results/Findings:

Fishery sampling

A total of 387 Chinook salmon were sampled in the gillnet fisheries in districts 108 and 111 during the 2010 PSC Accounting Year (Oct 2008 – Sept 2009; Table 3). Due to weak returns of Chinook salmon to both the Stikine River and Taku River in 2010, no directed gillnet fisheries

occurred and all Chinook salmon sampled in commercial fisheries were incidental to harvest of other salmon species. A total of 867 Chinook salmon were sampled from the 2010 sport fishery in the Juneau, Petersburg, and Wrangell ports, of which 629 were harvested in either district 108 or 111 (Table 4). Due to the weak returns in 2010, sample goals were not met at any of the ports; however, sample sizes were deemed sufficient for total season composition estimates for each district and fishery.

Laboratory analyses

A total of 1,016 samples were analyzed at all 13 markers. During quality control procedures a total of 104 fish were reanalyzed for all 13 markers for a total of 1,352 comparisons. The average failure rate across collections was 1.8%. The few inconsistencies found (2.8% across all samples) were due primarily to incorrect scoring of one locus, *Ots201b*, during quality control procedures.

Mixture analysis

Stock composition estimates generated using BAYES can be found in Tables 5 and 6. The most commonly occurring stock in the District 108 gillnet fishery was the Andrew Creek reporting group (57%), followed by the Upper Stikine reporting group (13%). The District 108 sport fishery harvest was dominated by the Upper Stikine reporting group (49%) followed by the Andrew Creek (27%) and Southern Southeast (14%) reporting groups. In District 111, the gillnet harvest was comprised primarily of the Taku River (44%) and Andrew Creek (41%) reporting groups. Similarly, the District 111 sport harvest was dominated by the Andrew Creek (43%) and Taku River (39%) reporting groups. Due to small sample sizes, estimates are not weighted by harvest by either statistical week or port.

Evaluation:

We accomplished the following:

- A total of 1,016 Chinook salmon were sampled from districts 108 and 111 gillnet and sport fisheries during Accounting Year 2010. Sample goals were not met due to weak Chinook returns, but sample sizes were deemed sufficient for overall season composition estimates.
- A total of 1,016 samples of Chinook salmon were assayed for genotypes for the 13 microsatellite loci in the CTC standardized baseline, and quality control procedures revealed a low rate of inconsistencies. Missing data for some samples resulted in 966 individuals available for mixture estimates.
- Mixture analyses estimated the contributions of 44 reporting groups of Chinook salmon to two gillnet and two sport fishery strata in Southeast Alaska in 2010.

Project Products:

Results from this project will be presented to ADF&G Commercial Fisheries and Sport Fish management staff and will be presented to the PSC Chinook Technical Committee. A report published in the ADF&G Fishery Data Series is expected in 2012.

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Table 1.—Microsatellite loci standardized for Chinook salmon genetic stock identification among laboratories participating in the Genetic Analysis of Pacific Salmon project.

Locus	Primer Sequence (5'→ 3') **F** > Forward, **R** > Reverse	Citation	Curator Agency[1]
Ots201b	F- CAGGGCGTGACAATTATGC R- TGGACATCTGTGCGTTGC	OSU unpublished	ADF&G
Ots208b	F- GGATGAACTGCAGCTTGTTATG R- GGCAATCACATACTTCAACTTCC	Greig et al. 2003	CRITFC
Ots211	F - TAGGTTACTGCTTCCGTCAATG R - GAGAGGTGGTAGGATTTGCAG	Greig et al. 2003	ADF&G
Ots212	F- TCTTTCCCTGTTCTCGCTTC R- CCGATGAAGAGCAGAAGAGAC	Greig et al. 2003	OSU
Ogo4	F- GTCGTCACTGGCATCAGCTA R- GAGTGGAGATGCAGCCAAAG	Olsen et al. 1998	WDFW
Ogo2	F- ACATCGCACACCATAAGCAT R- GTTTCTTCGACTGTTTCCTCTGTGTTGAG	Olsen et al. 1998	ADF&G
Ots3M	F- TGTCACTCACACTCTTTCAGGAG R- GAGAGTGCTGTCCAAAGGTGA	Banks et al. 1999	WDFW
Ots213	F- CCCTACTCATGTCTCTATTTGGTG R- AGCCAAGGCATTTCTAAGTGAC	Greig et al. 2003	OSU
Omm1080	F- GAGACTGACACGGGTATTGA R- GTTATGTTGTCATGCCTAGGG	Rexroad et al. 2001	SWFSC
Ssa408UOS	F- AATGGATTACGGGTACGTTAGACA R- CTCTTGTGCAGGTTCTTCATCTGT	Cairney et al. 2000	NWFSC
Ots9	F- ATCAGGGAAAGCTTTGGAGA R- CCCTCTGTTCACAGCTAGCA	Banks et al. 1999	DFO
OtsG474	F- TTAGCTTTGGACATTTTATCACAC R- CCAGAGCAGGGACCAGAAC	Williamson et al. 2002	CRITFC
Oki100	F- CCAGCACTCTCACTATTT R- CCAGAGTAGTCATCTCTG	DFO unpublished	DFO

[1] Laboratory abbreviations: OSU, Oregon State University; SWFSC, Southwest Fisheries Science Center – National Marine Fisheries Service; DFO, Department of Fisheries and Oceans Canada; NWFSC, Northwest Fisheries Science Center – National Marine Fisheries Service; CRITFC, Columbia River Inter-Tribal Fish Commission; ADF&G, Alaska Department of Fish & Game; WDFW, Washington Department of Fish & Wildlife.

Table 2.–Broad-scale reporting groups for the Chinook salmon coastwide baseline (Seeb et al. 2007) used to report stock composition of Southeast Alaska troll fishery harvests. Population numbers are listed in Appendix A.

	Reporting groups	Population numbers
1	Central Valley fall	1-4
2	Central Valley spring	5-8
3	Central Valley winter	9
4	California Coast	10-11
5	Klamath River	12-14
6	N California/S Oregon Coast	15
7	Rogue River	16-17
8	Mid Oregon Coast	18-26
9	North Oregon Coast	27-36
10	Lower Columbia R. spring	37-39
11	Lower Columbia R. fall	40-42
12	Willamette River	43-44
13	Mid Columbia R. Tule fall	45
14	Mid and Upper Columbia R. spring	46-51
15	Deschutes River fall	52-53
16	Upper Columbia R. summer/fall	54-57
17	Snake River fall	58
18	Snake River spring/summer	59-66
19	Washington Coast	67-73
20	Hood Canal	74-75
21	South Puget Sound	76-81
22	North Puget Sound	82-96
23	Juan de Fuca	97-99
24	Lower Fraser River	100-102
25	Lower Thompson River	103-104
26	South Thompson River	105-107
27	North Thompson River	108-111
28	Mid Fraser River	112-116
29	Upper Fraser River	117-120
30	East Vancouver Island	121-125
31	West Vancouver Island	126-132
32	South BC Mainland	133-134
33	Central BC Coast	135-137
34	Lower Skeena River	138-139
35	Upper Skeena River	140-142
36	Nass River	143-146
37	Upper Stikine River	147-151
38	Taku River	152-158
39	Southern Southeast Alaska	159-164
40	Andrews Creek	165-168
41	King Salmon River	169
42	Chilkat River	170-171
43	Alsek River	172-175
44	Situk River	176

Table 3.—Sampling goals by port from gillnet harvests in the directed Chinook salmon fisheries in districts 108 and 111 during 2010.

		Samples	
District	Port	Goal	Actual
108	Petersburg	520	161
	Wrangell	1,000	11
	Total	1,520	172
111	Juneau	880	215
	TOTAL	2,400	387

Table 4.—Sampling goals by port from sport harvests in Chinook salmon fisheries during the spring and summer of 2010. Not all fish sampled in these ports were expected to be from districts 108 and 111.

		Samples		Actual by district	
Size class	Port	Goal	Actual	Dist 108	Dist 111
Legal	Juneau	600	444	0	351
	Petersburg	450	307	170	0
	Wrangell	200	116	108	0
	TOTAL	1,250	867	278	351

Table 5.– Estimated contributions of 44 reporting groups of Chinook salmon to directed gillnet fishery harvests in Southeast Alaska in 2010. Run timing components are abbreviated as Sp (spring), Su (summer), Fa (fall), and Wi (winter). Sample sizes after removing individuals with missing data are indicated (N).

		District 108 Gillnet N = 163 Relative Contribution			**District 111 Gillnet** N = 205 Relative Contribution		
	Reporting Group	Est.	SD	90% CI	Est.	SD	90% CI
1	Central Valley Fa	0.000	0.001	(0.000-0.000)	0.000	0.002	(0.000-0.002)
2	Central Valley Sp	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
3	Central Valley Wi	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
4	California Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
5	Klamath R Basin	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
6	N CA, S OR Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
7	Rogue River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
8	Mid Oregon Coast	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
9	N Oregon Coast	0.000	0.002	(0.000-0.001)	0.000	0.001	(0.000-0.000)
10	Lower Columbia Sp	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
11	Lower Columbia Fa	0.000	0.002	(0.000-0.001)	0.000	0.001	(0.000-0.000)
12	Willamette River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
13	Mid Columbia Tule	0.000	0.002	(0.000-0.002)	0.000	0.001	(0.000-0.000)
14	Mid and Upp Columbia	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
15	Deschutes R Fa	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
16	Upp Columbia Su/Fa	0.012	0.009	(0.002-0.029)	0.000	0.001	(0.000-0.000)
17	Snake R Fa	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
18	Snake River Sp/Su	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
19	Washington Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
20	Hood Canal	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.001)
21	South Puget Sound	0.002	0.006	(0.000-0.013)	0.000	0.001	(0.000-0.000)
22	North Puget Sound	0.001	0.004	(0.000-0.009)	0.000	0.001	(0.000-0.001)
23	Juan de Fuca	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
24	Lower Fraser	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
25	Lower Thompson	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
26	South Thompson	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
27	North Thompson R	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
28	Mid Fraser	0.000	0.002	(0.000-0.002)	0.000	0.001	(0.000-0.000)
29	Upper Fraser	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
30	East Vancouver	0.012	0.009	(0.002-0.029)	0.000	0.001	(0.000-0.000)
31	West Vancouver	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
32	South BC Mainland	0.000	0.001	(0.000-0.001)	0.022	0.011	(0.007-0.042)
33	Central BC Coast	0.053	0.022	(0.021-0.092)	0.000	0.002	(0.000-0.001)
34	Lower Skeena	0.012	0.009	(0.002-0.029)	0.000	0.001	(0.000-0.001)
35	Upper Skeena	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
36	Nass River	0.005	0.007	(0.000-0.019)	0.000	0.001	(0.000-0.000)
37	Upper Stikine R	0.131	0.058	(0.047-0.231)	0.101	0.034	(0.048-0.162)
38	Taku River	0.104	0.051	(0.027-0.187)	0.435	0.045	(0.362-0.509)
39	S Southeast AK	0.090	0.030	(0.046-0.143)	0.001	0.003	(0.000-0.003)
40	Andrew Creek	0.573	0.046	(0.497-0.649)	0.412	0.037	(0.352-0.473)
41	King Salmon	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
42	Chilkat R	0.000	0.001	(0.000-0.001)	0.024	0.011	(0.010-0.044)
43	Alsek R	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
44	Situk R	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)

Table 6.– Estimated contributions of 44 reporting groups of Chinook salmon to legal-sized sport fishery harvests in districts 108 and 111 in Southeast Alaskam, 2010. Run timing components are abbreviated as Sp (spring), Su (summer), Fa (fall), and Wi (winter). Sample sizes after removing individuals with missing data are indicated (N).

		District 108 Sport **N =** 260 Relative Contribution			**District 111 Sport** **N =** 338 Relative Contribution		
	Reporting Group	Est.	SD	90% CI	Est.	SD	90% CI
1	Central Valley Fa	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
2	Central Valley Sp	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
3	Central Valley Wi	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
4	California Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
5	Klamath River Basin	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
6	N CA, S OR Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
7	Rogue River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
8	Mid Oregon Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
9	N Oregon Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
10	Lower Columbia Sp	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
11	Lower Columbia Fa	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
12	Willamette River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
13	Mid Columbia Tule	0.000	0.001	(0.000-0.000)	0.002	0.003	(0.000-0.008)
14	Mid and Upp Columbia	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
15	Deschutes River Fa	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
16	Upp Columbia Su Fa	0.010	0.007	(0.002-0.023)	0.000	0.001	(0.000-0.000)
17	Snake River Fa	0.001	0.003	(0.000-0.007)	0.000	0.000	(0.000-0.000)
18	Snake River Sp Su	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
19	Washington Coast	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
20	Hood Canal	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
21	South Puget Sound	0.000	0.001	(0.000-0.001)	0.000	0.001	(0.000-0.000)
22	North Puget Sound	0.000	0.002	(0.000-0.001)	0.000	0.001	(0.000-0.001)
23	Juan de Fuca	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
24	Lower Fraser	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.001)
25	Lower Thompson	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
26	South Thompson	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)
27	North Thompson R	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
28	Mid Fraser	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
29	Upper Fraser	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
30	East Vancouver Is.	0.009	0.006	(0.002-0.022)	0.000	0.001	(0.000-0.000)
31	West Vancouver Is.	0.004	0.004	(0.000-0.012)	0.006	0.004	(0.001-0.014)
32	South BC Mainland	0.006	0.005	(0.000-0.016)	0.011	0.007	(0.001-0.025)
33	Central BC Coast	0.011	0.007	(0.002-0.024)	0.024	0.009	(0.011-0.041)
34	Lower Skeena	0.035	0.012	(0.018-0.057)	0.015	0.009	(0.005-0.034)
35	Upper Skeena	0.000	0.002	(0.000-0.002)	0.000	0.001	(0.000-0.000)
36	Nass River	0.001	0.003	(0.000-0.005)	0.004	0.005	(0.000-0.013)
37	Upper Stikine R	0.494	0.045	(0.416-0.564)	0.084	0.029	(0.040-0.133)
38	Taku River	0.012	0.025	(0.000-0.073)	0.390	0.037	(0.330-0.450)
39	S Southeast AK	0.141	0.027	(0.100-0.188)	0.006	0.008	(0.000-0.022)
40	Andrew Creek	0.271	0.035	(0.215-0.330)	0.425	0.029	(0.377-0.474)
41	King Salmon River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
42	Chilkat River	0.000	0.001	(0.000-0.000)	0.030	0.009	(0.016-0.047)
43	Alsek River	0.000	0.001	(0.000-0.000)	0.000	0.001	(0.000-0.000)
44	Situk River	0.000	0.001	(0.000-0.000)	0.000	0.000	(0.000-0.000)

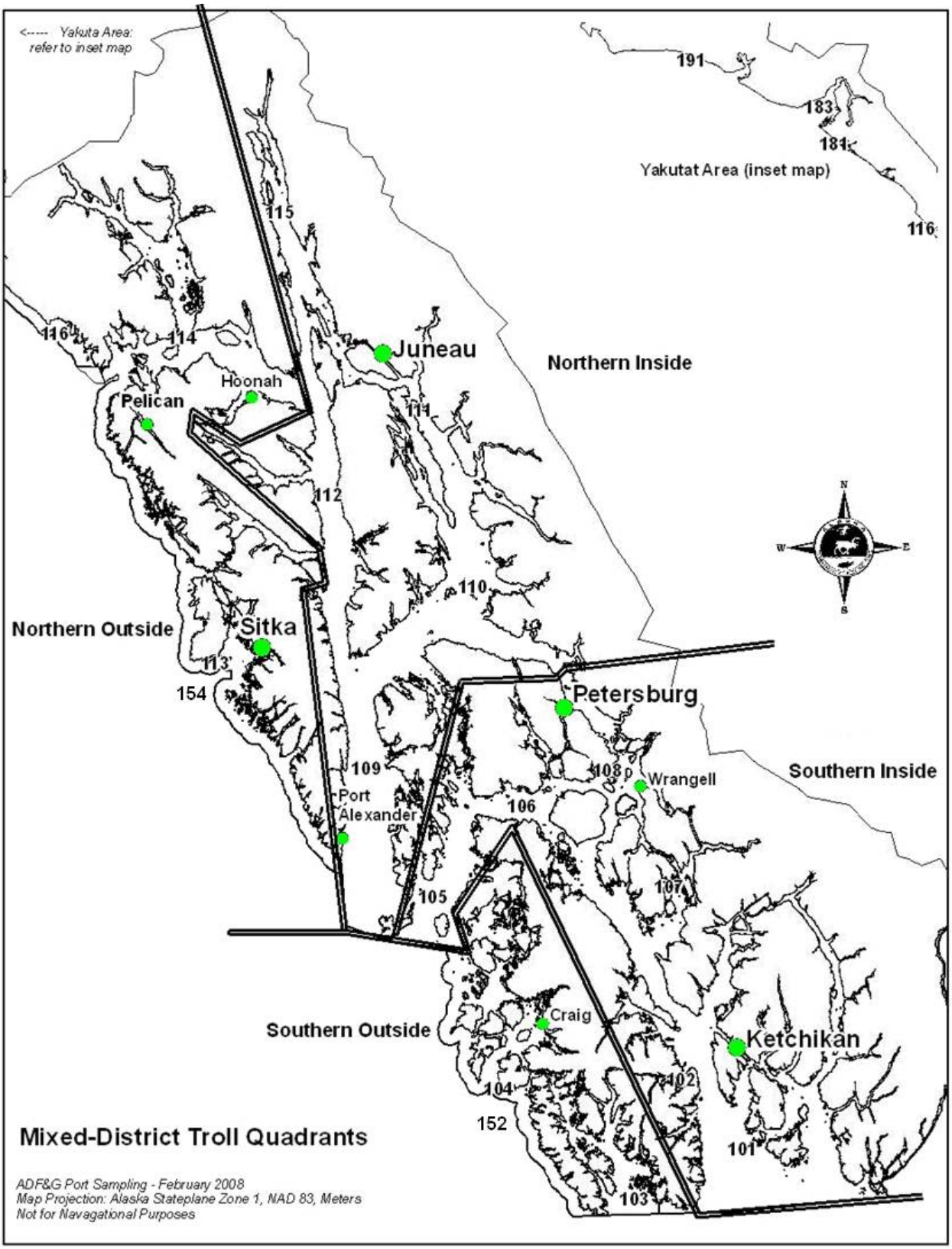

Figure 1. Location of Southeast Alaska ports and commercial fishing quadrants.

Appendix A.–Location and collection details for each population of Chinook salmon included in the coastwide baseline of microsatellite data. Population numbers given correspond to the population numbers referenced in Table 2.

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
1	Central Valley fall	1	Battle Creek	Fa	W	Adult	2002, 2003
		2	Butte Creek	Fa	W	Adult	2002, 2003
		3	Feather Hatchery fall	Fa	H	Adult	2003
		4	Stanislaus River	Fa	W	Adult	2002
2	Central Valley spring	5	Butte Creek	Sp	W	Adult	2002, 2003
		6	Deer Creek	Sp	W	Adult	2002
		7	Feather Hatchery	Sp	H	Adult	2003
		8	Mill Creek	Sp	W	Adult	2002, 2003
3	Central Valley winter	9	Sacramento River winter	Wi	W/H	Adult	1992, 1993, 1994, 1995, 1997, 1998, 2001, 2003, 2004
4	California Coast	10	Eel River	Fa	W	Adult	2000, 2001
		11	Russian River	Fa	W	Juvenile	2001
5	Klamath River	12	Klamath River	Fa	W	Adult	2004
		13	Trinity Hatchery	Fa	H	Adult	1992
		14	Trinity Hatchery	Sp	H	Adult	1992
6	N California/S Oregon Coast	15	Chetco	Fa	W	Adult	2004
7	Rogue River	16	Applegate	Fa	W	Adult	2004
		17	Cole Rivers Hatchery	Sp	H	Adult	2004
8	Mid Oregon Coast	18	Coos Hatchery	Fa	H	Adult	2005
		19	South Coos	Fa	W, H	Adult	2000, 2005
		20	Coquille	Fa	W	Adult	2000
		21	Elk River	Fa	H	Adult	2004
		22	Millicoma River	Fa	W	Adult	2000
		23	Sixes River	Fa	W	Adult	2000, 2005
		24	Siuslaw	Fa	W	Adult	2001
		25	South Umpqua	Fa	H,W	Adult	2002
		26	Umpqua	Sp	W	Adult	2004
9	North Oregon Coast	27	Alsea	Fa	W	Adult	2004
		28	Nehalem	Fa	W	Adult	2000, 2002-1, 2002-2

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
		29	Kilchis River	Fa	Unk	Adult	2000, 2005
		30	Necanicum Hatchery	Fa	H,W	Adult	2005
		31	Nestucca Hatchery	Fa	H	Adult	2004, 2005
		32	Salmon River	Fa	Unk	Adult	2003
		33	Trask River	Fa	W	Adult	2005
		34	Wilson River	Fa	W	Adult	2005
		35	Yaquina River	Fa	W	Adult	2005
		36	Siletz	Fa	W	Adult	2000
10	Lower Columbia R. spring	37	Cowlitz H. spring	Sp	H		2004
		38	Kalama H. spring	Sp	H		2004
		39	Lewis H. spring	Sp	H		2004
11	Lower Columbia R. fall	40	Cowlitz H. fall	Fa	H		2004
		41	Lewis fall	Fa	W	Adult	2003
		42	Sandy	Fa	W	Adult	2002, 2004
12	Willamette River	43	McKenzie	Sp	H	Adult	2002, 2004
		44	North Santiam	Sp	H	Adult	2002, 2004-1, 2004-2
13	Mid Columbia R. Tule fall	45	Spring Creek	Fa	H		2001, 2002
14	Mid and Upper Columbia R. spring	46	Carson H.	Sp	H		2001, 2004
		47	John Day	Sp	W	Juvenile, Adult	2000-1, 2000-2, 2000-3, 2000-4, 2000-5, 2000-6, 2004
		48	Upper Yakima	Sp	H	Adult, Mixed	1998, 2003
		49	Warm Springs Hatchery	Sp	H		2002, 2003
		50	Wenatchee Hatchery	Sp	H	Adult	1998, 2000
		51	Wenatchee River	Sp	W	Adult	1993, 1998, 2000
15	Deschutes River fall	52	Upper Deschutes River	Su/Fa	W	Juvenile	1998, 1999, 2002

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
		53	Lower Deschutes R.	Fa	W		1999-1, 1999-2, 2001, 2002
16	Upper Columbia R. summer/fall	54	Hanford Reach CR	Su/Fa	W	Adult, ?	1999, 2000-1, 2000-2, 2000-3, 2001-1, 2001-2, 2001-3
		55	Methow R. summer	Su/Fa	W		1992, 1993, 1994
		56	Wells Dam	Su/Fa	H		1993-1, 1993-2
		57	Wenatchee River	Su/Fa	W	Adult	1993-1, 1993-2
17	Snake River fall	58	Lyons Ferry	Fa	W	Adult	2002-1, 2002-2, 2003-1, 2003-2
18	Snake River spring/summer	59	Imnaha R.	Sp/Su	W		1998, 2002, 2003
		60	Minam R.	Sp/Su	W		1994, 2002, 2003
		61	Newsome Creek	Sp/Su	W	Adult	2001, 2002
		62	Rapid River H.	Sp/Su	H		1997, 1999, 2002
		63	Sesech R.	Sp/Su	W		2001, 2002, 2003
		64	Tucannon	Sp/Su	W	Adult	2003-1, 2003-2
		65	Tucannon	Sp/Su	H	Adult	2003
		66	West Fork Yankee Fork	Sp/Su	W		2005
19	Washington Coast	67	Forks Creek	Fa	H	Adult	2005
		68	Hoh River	Fa	W	Adult	2004, 2005
		69	Humptulips	Fa	H	Adult	1990
		70	Makah Hatchery	Fa	H	Adult	2001, 2003
		71	Queets	Fa	W	Adult	1996, 1997
		72	Quillayute/ Bogachiel	Fa	W	Adult	1995-1, 1995-2, 1995-3, 1996-1, 1996-2
		73	Sol Duc	Sp	H	Adult	2003
20	Hood Canal	74	George Adams Hatchery	Fa	H	Adult	2005
		75	Hamma Hamma River	Fa	W	Adult	1999, 2000, 2001
21	South Puget Sound	76	Clear Creek	Fa	H	Adult	2005

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
		77	Hupp Sp Hatchery	Sp	H	Adult	2002
		78	South Prairie Creek	Fa	W	Adult	1998, 1999, 2002
		79	Soos Creek	Fa	H	Adult	1998-1, 1998-2, 2004
		80	Voights Hatchery	Fa	H	Adult	1998
		81	White River	Sp	H	Adult	1998-1, 1998-2, 2002
22	North Puget Sound	82	L. Sauk River	Su	W		1998
		83	Marblemount Hatchery	Sp	H		1997
		84	Marblemount Hatchery	Su	H		1997
		85	NF Nooksack	Sp	H,W	Adult	1999
		86	NF Stilliguamish	Su	H,W	Adult	1996, 2001-1, 2001-2
		87	Samish Hatchery	Fa	H	Adult	1998
		88	Skagit summer	Su	W	Adult	1994, 1995
		89	Suiattle (Skagit)	Sp	W	Adult	1989, 1998, 1999
		90	Skykomish River		W		2004, 2005
		91	Snoqualmie River		W		2005
		92	Stillaguamish Hatchery	Su	H	Adult	2004
		93	Upper Cascade River	Sp	W		1998
		94	Upper Sauk River	Sp	W		1998
		95	Upper Skagit River	Su	W		1998
		96	Wallace Hatchery	Su	H		2004, 2005
23	Jaun de Fuca	97	Dungeness River		W	Adult	2004-1, 2004-2
		98	Elwha Hatchery	Fa	H	Adult/Juv	1996-1, 1996-2, 2004
		99	Elwha River		W	Adult/Juv	2004-1, 2004-2
24	Lower Fraser River	100	Birkenhead River	Sp	H	Adult	1996, 1997, 1999, 2001, 2002, 2003
		101	Maria Slough	Su	W	Adult	1999, 2000, 2001
		102	West Chilliwack Hatchery	Fa	H	Adult	1998, 1999
25	Lower Thompson River	103	Nicola	Sp	H		1998, 1999
		104	Spius River	Sp	H	Adult	1996, 1997, 1998

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
26	South Thompson River	105	Lower Adams	Fa	H	Adult	1996
		106	Lower Thompson	Fa	W	Adult	2001
		107	M.Shuswap	Fa	H	Adult	1997
27	North Thompson River	108	Clearwater	Fa	W	Adult	1997
		109	Deadman Hatchery	Sp	H	Adult	1996, 1997, 1998, 1999
		110	Louis River	Fa	W	Adult	2001
		111	Raft River	Su	W	Adult	2001, 2002
28	Mid Fraser River	112	Chilko	Fa	W	Adult	1995, 1996, 1999, 2002
		113	Nechako	Fa	W	Adult	1996
		114	Quesnel	Fa	W	Adult	1996
		115	Stuart	Fa	W	Adult	1996
		116	Upper Chilcotin River	Sp	W	Adult	2001
29	Upper Fraser River	117	Morkill River	Fa	W	Adult	2001
		118	Salmon River (Fraser)	Sp	W	Adult	1997
		119	Swift	Fa	W	Adult	1996
		120	Torpy River	Fa	W	Adult	2001
30	East Vancouver Island	121	Big Qualicum	Fa	H	Adult	1996
		122	Cowichan Hatchery	Fa	H	Adult	1999, 2000
		123	Nanaimo Hatchery	Fa	H	Adult	1998, 2002
		124	Puntledge Hatchery	Fa	H	Adult	2000, 2001
		125	Quinsam	Fa	H	Adult	1996, 1998
31	West Vancouver Island	126	Conuma	Fa	H	Adult	1997, 1998
		127	Marble at NVI	Fa	H	Adult	1996, 1999, 2000
		128	Nitinat	Fa	H	Adult	1996
		129	Robertson	Fa	H	Adult	1996, 2003
		130	Sarita	Fa	H	Adult	1997, 2001
		131	Tahsis River	Fa	W	Adult	1996, 2002, 2003
		132	Tranquil River	Fa	W	Adult	1996, 1999
32	S BC Mainland	133	Klinaklini	Fa	W	Adult	1997
		134	Porteau Cove	Fa	H	Adult	2003
33	Central BC Coast	135	Atnarko	Fa	H	Adult	1996

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
		136	Kitimat	Fa	H	Adult	1997
		137	Wannock	Fa	H	Adult	1996
34	Lower Skeena River	138	Ecstall	Fa	W	Adult	2000, 2001, 2002
		139	Lower Kalum	Fa	W	Adult	2001
35	Upper Skeena River	140	Babine	Fa	H	Adult	1996
		141	Bulkley	Fa	W	Adult	1999
		142	Sustut	Fa	W	Adult	2001
36	Nass River	143	Damdochax	Fa	W	Adult	1996
		144	Kincolith	Fa	W	Adult	1996
		145	Kwinageese	Fa	W	Adult	1996
		146	Owegee	Fa	W	Adult	1996
37	Upper Stikine River	147	Christina		W	Adult	2000, 2001, 2002
		148	Craig River		W	Adult	2001
		149	Little Tahltan River		W	Adult	1989, 1990
		150	Shakes Creek		W	Adult	2000, 2001, 2002
		151	Verrett River		W	Adult	2000, 2002, 2003
38	Taku River	152	Dudidontu		W	Adult	2005, 2006, 2008
		153	Kowatua Creek		W	Adult	1989, 1990
		154	Little Tatsamenie		W	Adult	2007
		155	Little Trapper		W	Adult	1999
		156	Nakina River		W	Adult	1989, 1990
		157	Tatsatua Creek		W	Adult	1989, 1990
		158	Upper Nahlin River		W	Adult	1989, 1990, 2004
39	Southern Southeast Alaska	159	Chickamin River		W	Adult	1990, 1993
		160	Chickamin River – Whitman		H	Adult	2005
		161	Clear Creek (Unuk R.)		W	Adult	1989, 2003, 2004
		162	Cripple Creek (Unuk R.)		W	Adult	1988, 2003
		163	Keta River		W	Adult	1989, 2003
		164	King Creek		W	Adult	2003
40	Andrews Creek	165	Andrews Creek		W	Adult	1989, 2004
		166	Andrews Creek – Crystal		H	Adult	2005
		167	Andrews Creek – MaCaulay		H	Adult	2005
		168	Andrews Creek – Medvejie		H	Adult	2005

Region #	Reporting Group	Population #	Population	Run time	Origin	Life Stage	Collection Date
41	King Salmon River	169	King Salmon River		W	Adult	1989, 1990, 1993
42	Chilkat River	170	Big Boulder Creek		W	Adult	1992, 1995, 2004
		171	Tahini River		W	Adult	1992, 2004
43	Alsek River	172	Blanchard River		W		2000, 2001, 2002, 2003
		173	Klukshu River		W	Adult	1989, 1990, 1991
		174	Takhanne		W	Adult	2000, 2001, 2002, 2003
		175	Klukshu		W	Adult	1987, 2000, 2001
44	Situk River	176	Situk River		W	Adult	1988, 1990, 1991, 1992