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Final Report

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Project Title: Mixed stock analysis of U.S. Districts 101, 102 and 103 sockeye salmon seine fisheries, 2018

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Abstract:
Sockeye salmon are harvested by commercial fishers in the Northern Boundary Area (NBA) in U.S. Districts 101 through 104 and 106 in Southeast Alaska. In these fisheries, mixed stocks of sockeye salmon are harvested, including salmon originating from Alaska and British Columbia. Thus, the salmon fisheries in these districts are managed in accordance with the current PST Annex IV, Chapter 2 NBA provisions. The Northern Boundary Annex to the 1999 Pacific Salmon Treaty agreement requires detailed accounting of the harvests for Nass and Skeena sockeye salmon stocks. This project continues the use of genetic stock identification (GSI) of sockeye salmon harvested in Districts 101, 102, and 103 seine fisheries by screening 96 single nucleotide polymorphic genetic markers in 1,470 sockeye salmon. For the purpose of this analysis, fishery samples were proportionally allocated to four aggregate groups of collections (reporting groups) defined based on a combination of the genetic distinctions in the baseline and the resolution necessary to meet management needs: *Alaska*, *Nass*, *Skeena*, and *Other*. In District 101, the *Alaska* and *Other* reporting groups were both important contributors in the first part of the season, and the harvest was dominated by the *Skeena* group for the second stratum. The *Alaska* reporting group was the largest overall contributor in all strata in districts 102 and 103.

Introduction:
Significant numbers of Canada- and Alaska-origin sockeye salmon are harvested in NBA fisheries. This includes harvests in U.S. Districts 101, 102, 103, 104, and 106 net fisheries, and Canadian Areas 1, 3, 4, and 5 net fisheries. The Northern Boundary chapter of Annex IV of the Pacific Salmon Treaty agreement requires detailed accounting of the harvests for Nass and Skeena sockeye salmon stocks. This information is used to calculate total returns to the Nass and Skeena rivers, to determine the Annual Allowable Harvest (AAH) of Nass and Skeena stocks in Alaskan fisheries, and to calculate the Alaska catch for these stocks.

Annual stock-specific run reconstructions (catch plus escapements) are required to accurately estimate relative contribution of each stock caught in NBA fisheries (English et al. 2004; Alexander et al. 2010). Estimates of origin of contributing stocks provides the most reliable information currently available to complete these run reconstructions and are used to evaluate stock-specific productivity and revise pre-season forecasts. While the catch of Nass and Skeena sockeye salmon is only subject to treaty harvest-sharing annexes in the Alaska District 101 gillnet and Alaska District 104 purse seine fisheries, the harvest of these stocks in all fisheries, and their escapements, is necessary in order to calculate the total run and the percentage caught in the annexed fisheries.

In the past, matched samples collected from these fisheries had been analyzed using scale pattern analysis (SPA). Since 2005, the Alaska Department of Fish and Game (ADF&G) and the NOAA Auke Bay Laboratories (ABL) have conducted GSI to determine the stock composition of NBA fishery harvests. ADF&G and the Department of Fisheries and Oceans Canada (DFO) compared SPA and GSI in limited sample sets from District 101 gillnet samples and found that although the two methods provide similar estimates, GSI analysis was slightly more accurate and was able to discriminate stocks at a finer resolution than SPA (PSC NBTC 2005). After 2010, SPA was discontinued and run reconstructions and subsequent AAH calculations were conducted using GSI only.

This project completes GSI analysis on sockeye salmon tissue samples collected from the 2018 commercial purse seine fisheries in U.S. Districts 101, 102, and 103 in Southeast Alaska. This project is a complement to the ongoing project at ABL for NBA sockeye salmon GSI in Districts 101 and 104 and continuing work by DFO in Areas 3, 4, and 5, and will allow for complete assessment of the catches of Nass and Skeena sockeye salmon in all major NBA fisheries for run reconstructions.

Objectives:
The objective of this project is to estimate the stock composition of Southeast Alaska sockeye seine fisheries in U.S. Districts 101, 102, and 103 in 2018 using genetic stock identification for 4 reporting groups (*Alaska*, *Nass*, *Skeena*, and *Other*) such that the estimates are within 7% of the true value 90% of the time. This will be accomplished by estimating the stock composition of 2018 sockeye harvests for the following:

- District 101 seine: up to 3 time strata;
- District 102 seine: up to 3 time strata; and
- District 103 seine: total season.

Approach:
Fishery Sampling
Landings from purse seine fisheries were sampled by ADF&G at fish processing facilities in Petersburg and Ketchikan. Sampling protocols ensured that the fish sampled were as representative of catches as possible. Axillary processes were excised and placed onto Whatman filter paper for dry preservation. Associated data for each sample including fishery and capture date were recorded, and the tissue sample for each fish was paired with age, sex, and length (ASL) information.

Laboratory Analysis
A single nucleotide polymorphism (SNP) baseline for Southeast Alaska (SEAK) and British Columbia (BC) including 45 markers was first completed in 2007. The baseline included all major sockeye salmon-producing systems in SEAK and in BC (north of and including the Skeena River) and from representative sockeye salmon producing systems in BC south of the Skeena River. A cooperative project between ADF&G and Department of Fisheries and Oceans (DFO) Canada in

2007-2009 added several collections to the baseline for transboundary rivers (Northern Fund project no. NF-2008-I-15A). In addition, these and existing collections have been analyzed at a total of 96 SNP markers in order to further enhance the baseline for fishery applications. The current baseline includes 238 populations and 96 markers (Table 1; Rogers Olive et al. 2018).

Samples were analyzed for 96 SNP loci. Genomic DNA was extracted using a NucleoSpin® 96 Tissue Kit by Macherey-Nagel (Düren, Germany). All SNPs were detected using a TaqMAN SNP Genotyping Assay (Applied Biosystems). SNP assays were generally performed using the BioMark 96.96 Dynamic Array (Fluidigm). The data collected was individual genotypes for each locus. Genotype data were stored in an *Oracle* database (*LOKI*) on a network drive maintained by ADF&G computer services. Quality control measures included reanalysis of 8% of each collection for all markers to ensure that genotypes were reproducible and to identify laboratory errors and measure rates of inconsistencies during repeated analyses.

Mixture Analysis

Mixtures of fish representing catches by statistical week from the U.S. Districts 101, 102 and 103 fisheries were screened for genetic variation at 96 SNPs for a goal of 1,500 samples total. For 2018 fisheries, analysis goals were to provide estimates for 1) District 101, up to 3 time strata; 2) District 102, up to 3 time strata; 3) District 103, total season estimate. Samples were weighted by harvest by statistical week whenever possible, and samples were divided between strata to maximize the number of estimates while still staying within precision and accuracy goals.

The stock composition of fishery mixtures was estimated using the *R* package *rubias* (Moran and Anderson 2019). We used reporting groups necessary for NBA harvest sharing agreements: 1) *Alaska*, 2) *Nass*, 3) *Skeena*, and 4) *Other*. The *rubias* package is a Bayesian approach to the conditional genetic stock identification model based upon computationally efficient C code implemented in R. It uses cross-validation and simulation to quantify and correct for biases in reporting group estimates. Each mixture was analyzed for 1 Markov Chain Monte Carlo chain with 25,000 iterations and the first 5,000 iterations were discarded 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.

Results/Findings:

Fishery sampling

In 2018, 4,613 samples were collected from sockeye salmon harvested in the seine fisheries in U.S. Districts 101, 102, and 103, of which 1,475 were selected for analysis (Table 2). In District 102, estimates were provided for 3 distinct temporal strata, and in District 101 and District 103, estimates for 2 distinct temporal strata were provided.

Laboratory analyses

Of the samples collected in District 101, 561 samples were genotyped at 96 SNP genetic markers. During quality control procedures a total of 48 fish were reanalyzed at all 96 markers for a total of

4,608 comparisons. The average failure rate for District 101 was 1.3%. Few inconsistencies were found (<1% across all comparisons).

Of the samples collected in District 102, 553 samples were genotyped at 96 SNP genetic markers. During quality control procedures a total of 47 fish were reanalyzed at all 96 markers for a total of 4,512 comparisons. The average failure rate for District 102 was 1.6%. Few inconsistencies were found (<1% across all comparisons).

Of the samples collected in District 103, 406 samples were genotyped at 96 SNP genetic markers. During quality control procedures a total of 32 fish were reanalyzed at all 96 markers for a total of 3,072 comparisons. The average failure rate for District 103 was 2%. Few inconsistencies were found (<1% across all comparisons).

Mixture analysis

Mixtures of fish representing catches by statistical week from the Districts 101, 102 and 103 seine fisheries were analyzed. Of the samples extracted and genotyped, genotypes from 1,411 fish were used for GSI. We used the 80% rule (Dann et al. 2009) to exclude individuals missing genotypes for 20% or more of loci to avoid using individuals with poor quality DNA. Stock composition estimates can be found in Figures 1–3.

In District 101, 547 samples were available for analysis after quality control (Table 2). These samples were divided into 2 temporal strata that included: statistical weeks 27-31 and weeks 32-33 (Figure 1, Table 3). The *Alaska* reporting group contributed the most in weeks 27-31 (30%), before dropping to 7% in weeks 32-33, while the *Skeena* group went from 26% in the early weeks to the largest contributor (80%) in later weeks. The *Nass* reporting group contributed 12% and then 7%, while the *Other* reporting group contributed 30% in statistical weeks 27-31 and then 5% in weeks 32-33.

In District 102, 532 samples were available for analysis after quality control (Table 2). These samples were divided into 3 temporal strata that included: statistical weeks 25-29, weeks 30-31, and weeks 32-33 (Figure 2, Table 4). The *Alaska* reporting group contributed between 66% and 89% to the sample mixtures throughout the 2018 season. The *Skeena* reporting group contributed <1% in statistical weeks 25-29, but increased to 12% and then 28% in the following weeks. The *Other* reporting group contributed 10% in weeks 25-29, but declined to <5% for the remainder of the season, and the *Nass* reporting group contribution to the sample mixtures was <5% throughout the season.

In District 103, 391 were available for analysis after quality control (Table 2). These samples were divided into 2 temporal strata that included: statistical weeks 30-32 and statistical weeks 33-34 (Figure 3, Table 5). The *Alaska* reporting group was the largest contributor in both strata (90% and 78%, respectively). The *Skeena* group contributed 9% in weeks 30-32 and 15% in weeks 33-34. The *Other* group contributed <1% in weeks 30-32, but increased to 6% in weeks 33-34. The *Nass* reporting group contribution to the sample mixture was <1% throughout the season.

Evaluation:

We accomplished the following:

- A total of 4,613 sockeye salmon were sampled from U.S. Districts 101, 102, and 103 seine fisheries during the 2018 season.
- A total of 1,475 samples were assayed for genotypes for the 96 SNP loci in the sockeye salmon baseline, and quality control procedures revealed a low rate of inconsistencies. The genotypes for 547 samples were used for analysis of U.S. District 101, 532 samples for District 102, and 391 for District 103.
- Mixture analyses estimated the contributions of 4 reporting groups to 3 temporal strata in U.S. District 102 and 2 temporal strata in Districts 101 and 103.
- Results were provided to the Northern Boundary Technical Committee (NBTC) by mid-December to facilitate run reconstructions.

Project Products:
Results from this project have been presented both to ADF&G Commercial Fisheries management staff and to the bilateral PSC NBTC. A multi-year report published in the ADF&G Fishery Data Series is expected in 2020.

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Table 1. Reporting groups and collection locations defined for use in genetic stock identification of sockeye salmon caught in seine fisheries in U.S. Districts 101, 102, and 103 in 2018.

	Reporting	Region	Populations	Year(s) Collected	N
1	***Alaska***	Prince William	Bainbridge Lake	2010	95
2		Sound	Coghill Lake	1991, 1992, 2010	378
3			Eshamy Lake	1991, 2008	185
4			Main Bay	1991	96
5			Miners Lake	1991, 2009	191
6		Copper	Eyak Lk. - Middle Arm	2007	95
7			Eyak Lk. - Beaches	2007	87
8			Eyak Lk. - Hatchery Cr.	2010	95
9			Mendeltna Creek	2008, 2009	188
10			Swede Lake	2008	95
11			Gulkana R. – Fish Cr	2008	95
12			Gulkana River – E. Fork	2008	75
13			Paxson Lake	2009	75
14			Mentasta Lake	2008	95
15			Tanada Creek	2005	94
16			Tanada Lake - lower	2009	95
17			Tanada Lake - shore	2009	93
18			Klutina River	2008	95
19			Klutina Lake	2008, 2009	95
20			Bear Hole - Klutina	2008	94
21			Banana Lake - Klutina	2008	80
22			St. Anne Creek	2005, 2008	186
23			Mahlo River	2008	94
24			Tonsina Lake	2009	94
25			Long Lake	2005	95
26			Tebay River	2008	93
27			Bremner - Steamboat	2008	95
28			Bremner – Salmon Cr.	2008	93
29			Clear Creek	2007	87
30			McKinley Lake	2007	95
31			McKinley Lake	2008	95
32			McKinley Lake	1991	95
33			Salmon Creek	2007	93
34			Martin Lake	2007, 2008	187
35			Martin River Slough	2008	95
36			Tokun Lake	2008, 2009	189
37			Bering Lake	1991	95
38			Kushtaka Lake	2007, 2008	189
39		Yakutat	Mountain Stream	2007	159
40			Situk Lake	2013	190
41			Old Situk River	2007	163
42			Lost/Tahwah Rivers	2003	93
43			Ahrnklin River	2007	90

	Reporting	Region	Populations	Year(s) Collected	N
44	***Alaska (cont.)***	Yakutat	Dangerous River	2009	95
45		(cont.)	Akwe River	2009	95
46			East Alsek River	2003	94
47	***Other***	Alsek	Datlasaka Creek	2012	95
48			Goat Creek	2007, 2012	56
49			Border Slough	2007, 2008	71
50			Border Slough	2009, 2011	70
51			Tweedsmuir	2007	48
52			Tweedsmuir	20099	46
53			Vern Ritchie	2009, 2010	114
54			Neskataheen Lake	2007	195
55			Klukshu River	2006	95
56			Klukshu River	2007	94
57			Kudwat Creek	2009, 2010, 2011	100
58			Tatshenshini – Bridge	2011, 2012	105
59			Tatshenshini - Stinky	2011	40
60			Upper Tatshenshini	2003	95
61			Little Tatshenshini Lk.	2001, 2003	65
62			Kwatini River	2011	65
63			Blanchard River	2007	89
64			Blanchard River	2009	62
65	***Alaska (cont.)***	N. Southeast	Chilkat - Bear Flats	2007	190
66			Chilkat - Mule Meadows	2003, 2007	189
67			Chilkat - Mosquito	2007	159
68			Chilkat Lake	2007	233
69			Chilkat Lake	2013	251
70			Chilkoot River	2003	159
71			Chilkoot Lk. - Bear Cr.	2007	233
72			Chilkoot Lk. - beaches	2007	251
73			Vivid Lake	1993	48
74			Seclusion Lake	2014	117
75			North Berg Bay Inlet	1991	53
76			North Berg Bay Inlet	1992	100
77			Bartlett River	2013	69
78			Neva Lake	2008	94
79			Neva Lake	2009, 2013	255
80			Hoktaheen - inlet	2004	47
81			Hoktaheen - outlet	2004	49
82			Hoktaheen - marine	2014	47
83			Klag Bay Stream	2009	200
84			Ford Arm Lake	2004	207
85			Ford Arm Creek	2013	199
86			Redoubt Lake	2013	200
87			Salmon Lake	2007, 2008	185
88			Benzeman Lake	1991, 1993	95
89			Falls Lake	2003, 2010	190

	Reporting	Region	Populations	Year(s) Collected	N
90	***Alaska (cont.)***	N. Southeast	Redfish Lake	1993	94
91			Kutlaku	2003	95
92			Kutlaku	2012	78
93			Kutlaku	2013	50
94			Lace River	2013	63
95			Berners Bay	2003, 2013	165
96			Antler-Gilkey River	2013	53
97			Windfall Lake	2003, 2007	142
98			Steep Creek	2003	91
99			Lake Cr. (Auke Cr. Weir)	2013, 2014	318
100			Crescent Lake	2003	194
101			Speel Lake	2003	95
102			Snettisham Hatchery	2006, 2007	190
103			Snettisham Hatchery	2013	146
104			Pavlof River	2012, 2013	174
105			Kook Lake Late	2007, 2010, 2012	194
106			Kook Lake early	2012, 2013	148
107			Sitkoh Lake	2003, 2011, 2012	351
108			Lake Eva	2012	115
109			Hasselborg Lake	2012, 2013	209
110			Kanalku Lake	2007, 2010, 2013	319
111	***Other***	Taku	Kuthai Lake	2006	171
112			King Salmon Lake	2010, 2011	214
113			Little Trapper Lake	1990, 2006	237
114			Little Tatsamenie	2011	59
115			Tatsamenie Lake	2005, 2006	288
116			Hackett River	2008	52
117			Nahlin River	2003, 2007, 2012	179
118			Taku River	2007	95
119			Takwahoni/Sinwa	2009	67
120			Shustahini Slough	2008, 2009	185
121			Tuskwa/Chunk Slough	2008, 2009	356
122			Yellow Bluff Slough	2008, 2010, 2011	81
123			Tulsequah River	2007, 2008, 2009	156
124			Fish Creek	2009, 2010	160
125			Yehring Creek	2007, 2009	171
126		Stikine	Chutine River	2008	94
127			Chutine Lake	2009, 2011	224
128			Andy Smith slough	2007, 2008, 2009	54
129			Porcupine	2007, 2011	74
130			Devil's Elbow	2007, 2008	148
131			Devil's Elbow	2009	53
132			Scud River	2007, 2008, 2009	192
133			Iskut River	1985-86, 2002, 2006,	153
134			Iskut - Craigson Slough	2007	42
135			Craig River-CAN	2006 - 2008	38

	Reporting	Region	Populations	Year(s) Collected	N
136	***Other (cont.)***	Stikine (cont.)	Bronson Slough	2008, 2009	78
137			Shakes Slough	2006, 2007, 2009	67
138			Christina Lake	2011, 2012	70
139			Little Tahltan	1990	95
140			Tahltan Lake06	2006	196
141	***Alaska (cont.)***	S. Southeast	Petersburg Lake	2004	95
142			Kah Sheets Lake	2003	96
143			Mill Creek Weir Early	2007	94
144			Mill Creek Weir Late	2007	95
145			Kunk Lake	2003	96
146			Thoms Lake	2004, 2014	93
147			Red Bay Lake	2004	95
148			Salmon Bay Lake	2004, 2007	170
149			Shipley Lake	2003	94
150			Sarkar Lakes	2000, 2005	91
151			Hatchery Creek	2003, 2007	142
152			Luck Lake	2004	94
153			Big Lake	2010, 2014	161
154			McDonald Lake	1992, 2003, 2007, 2013	369
155			Karta River	1992, 2003, 2004, 2016	472
156			Unuk River07	2007	95
157			Unuk River08	2008	69
158			Helm Lake	2005	94
159			Heckman Lake	2004, 2007	189
160			Mahoney Creek	2003, 2007	154
161			Kegan Lake	2004	95
162			Fillmore Lake	2005	52
163			Klawock - Three Mile	2004, 2010	181
164			Klawock - Inlet Creek	2003, 2008	212
165			Hetta Lake	2003, 2008, 2009	281
166			Hetta Creek - middle	2009	95
167			Hetta Creek - early	2010	95
168			Eek Creek	2004, 2007	50
169			Klakas Lake	2004	95
170			Essowah Lake	2004	95
171			Hugh Smith	1992, 2013	155
172			HS - Buschmann	2004	151
173			HS - Cobb Creek	2007	99
174	***Nass***	Nass	Kwinageese	2001, 2012	76
175			Bowser Lake	2001	94
176			Bonney Creek	2001, 2012	164
177			Damdochax Creek	2001	93
178			Meziadin Lake	2001, 2006	186
179			Hanna Creek	2006	93
180			Tintina Creek	2006	94
181			Gingit Creek	1997	94

	Reporting	Region	Populations	Year(s) Collected	N
182	***Skeena (cont.)***	Skeena (cont.)	Alastair Lake	1987, 2006	118
183			Lakelelse Lake	2006	93
184			Sustut River	2001	79
185			Salix Bear	1987, 1988	94
186			Motase Lake	1987	47
187			Slamgeesh River	2006	95
188			Babine River	2006	95
189			Four Mile Creek	2006	85
190			Pinkut Creek	1994	187
191			Grizzly Creek	1987	76
192			Pierre Creek	2006	95
193			Fulton River	2006	95
194			Morrison	2007	92
195			Lower Tahlo River	1994	78
196			Tahlo Creek	2007	95
197			McDonell Lake	2002, 2006	131
198			Kitsumkalum Lake	2006	56
199			Kitsumkalum Lake	2012	94
200			Kitwanga River	2012	92
201			Stephens Creek	2001	95
202			Nangeese River	2006	40
203			Kispiox River	2002	53
204			Swan Lake	2006	93
205			Nanika River	1988, 2007	114
206	***Other (cont.)***	Fraser	Trembleur - Kynock	1997	94
207			Tachie River	2001	94
208			Stellako River	2007	94
209			Fraser Lake	1996	85
210			Horsefly River	2001, 2007	274
211			Nahatlatch River	2002	92
212			Cultus Lake	2002	91
213			Chilliwack Lake	2004	90
214			Chilko Lake	2001	87
215			Raft River	2001	84
216			Adams River	2002, 2007	187
217			Middle Shuswap River	2002	91
218			Scotch River	2000	91
219			Gates Creek	2009	90
220			Birkenhead River	2007	90
221			Weaver Creek	2001	89
222			Harrison River	2007	95
223			North Thompson	2005	95
224		BC/Washington	Naden River	1995	95
225			QCI - Yakoun Lake	1993	70
226			Kitimat River	2010	93
227			Bloomfield Lake	2005	94

	Reporting	Region	Populations	Year(s) Collected	N
228	***Other (cont.)***	BC/Washington	Tankeeah River03	2003	47
229		(cont.)	Tankeeah River05	2005	47
230			Amback Creek	2004	91
231			Kitlope Lake	2006	95
232			Great Central Lake	2002	95
233			Quatse River	2003	95
234			Mitchell River	2001	94
235			Okanagan River	2002	95
236			Lake Pleasant	1997	89
237			Issaquah Creek	1996	82
238			Lake Wenatchee	1998	95

Table 2. The total number of sockeye salmon harvested from the purse seine fisheries in districts 101, 102, 103 in 2018, the total number of sockeye salmon sampled per statistical week, and the total number genotyped and analyzed for GSI.

District	Statistical Weeks	Harvest	Samples	Genotyped	Analyzed
101	27	259	105	200	198
	28	394	80		
	29	673	147		
	30	2,067	295		
	31	3,889	289		
	32	11,939	340	361	349
	33	3,778	300		
102	25	66	37	153	150
	26	417	202		
	27	1,037	261		
	28	533	193		
	29	3,708	280		
	30	4,691	300	159	188
	31	3,192	40		
	32	3,577	244	200	194
	33	5,470	260		
	36	38	0		
	37	26	0		
103	30	1,120	151	206	196
	31	2,860	320		
	32	4,901	480		
	33	3,137	232	137	195
	34	4,658	57		
	Total	62,430	4,613	1,416	1,470

Table 3. Estimated stock composition (Proportion), upper and lower bounds of the 90% credibility intervals, the number of fish analyzed for each stratum (n), and standard deviations (SD) for District 101 seine fishery samples collected in 2018.

	Statistical Weeks 27-31 (n = 198)				Statistical Weeks 32-33 (n = 349)			
		90% CI				90% CI		
Reporting Group	Proportion	Lower	Upper	SD	Proportion	Lower	Upper	SD
Alaska	0.305	0.246	0.365	0.036	0.072	0.048	0.102	0.016
Nass	0.127	0.088	0.167	0.024	0.070	0.047	0.098	0.015
Skeena	0.260	0.210	0.313	0.031	0.806	0.768	0.840	0.023
Other	0.308	0.248	0.370	0.037	0.052	0.028	0.079	0.016

Table 4. Estimated stock composition (Proportion), upper and lower bounds of the 90% credibility intervals, the number of fish analyzed for each stratum (n), and standard deviations (SD) for District 102 seine fishery samples collected in 2018.

	Statistical Weeks 25-29 (n = 150)				Statistical Weeks 30-31 (n = 188)				Statistical Weeks 32-33 (n = 194)			
		90% CI				90% CI				90% CI		
Reporting Group	Proportion	Lower	Upper	SD	Proportion	Lower	Upper	SD	Proportion	Lower	Upper	SD
Alaska	0.891	0.839	0.936	0.030	0.839	0.792	0.882	0.027	0.664	0.603	0.723	0.036
Nass	0.004	0.000	0.018	0.007	0.042	0.021	0.067	0.014	0.024	0.008	0.046	0.012
Skeena	0.001	0.000	0.010	0.005	0.119	0.082	0.159	0.023	0.280	0.229	0.336	0.033
Other	0.104	0.059	0.156	0.030	0.000	0.000	0.017	0.008	0.033	0.002	0.066	0.019

Table 5. Estimated stock composition (Proportion), upper and lower bounds of the 90% credibility intervals, the number of fish analyzed for each stratum (n), and standard deviations (SD) for District 103 seine fishery samples collected in 2018.

	Statistical Weeks 30-32 (n = 196)				Statistical Weeks 33-34 (n = 195)			
		90% CI				90% CI		
Reporting Group	Proportion	Lower	Upper	SD	Proportion	Lower	Upper	SD
Alaska	0.903	0.868	0.934	0.020	0.783	0.732	0.831	0.030
Nass	0.000	0.000	0.001	0.001	0.005	0.000	0.015	0.005
Skeena	0.092	0.062	0.126	0.020	0.155	0.115	0.199	0.026
Other	0.005	0.000	0.019	0.007	0.058	0.032	0.089	0.017

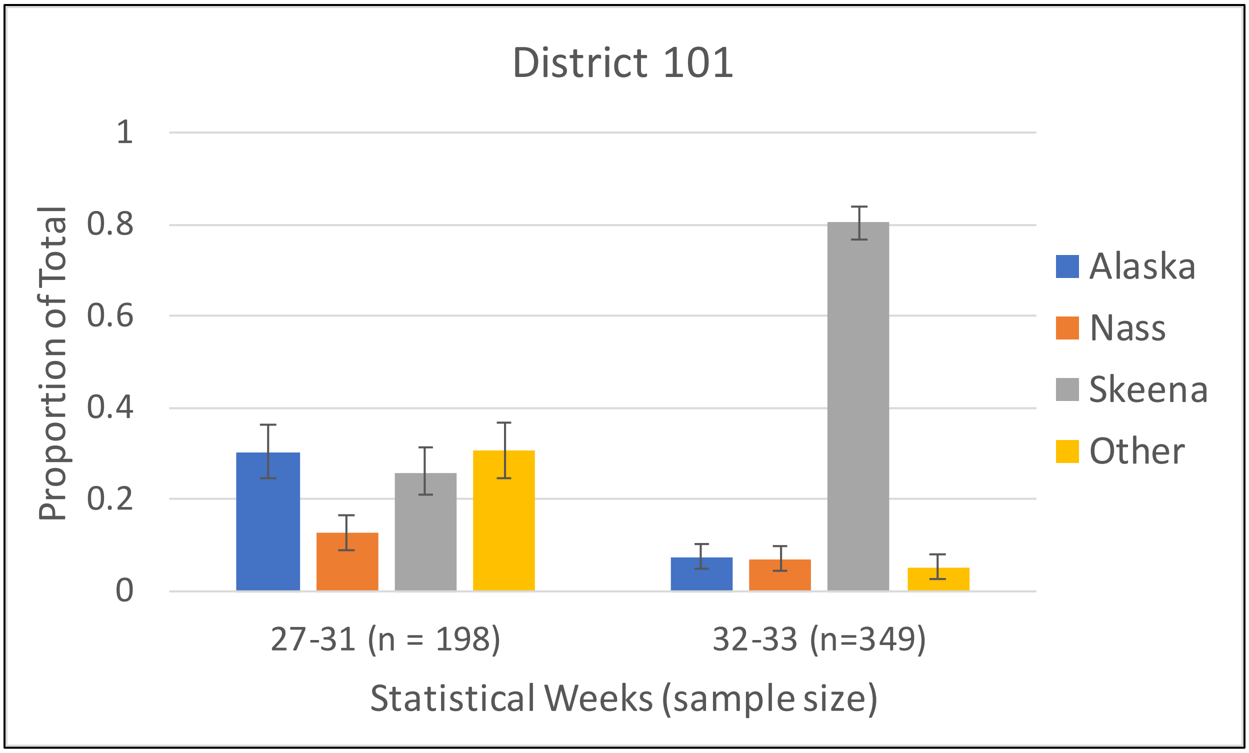

Figure 1. Stock composition estimates of sockeye salmon caught in the District 101 seine fishery in 2018. Error bars are upper and lower bounds of the 90% credibility intervals.

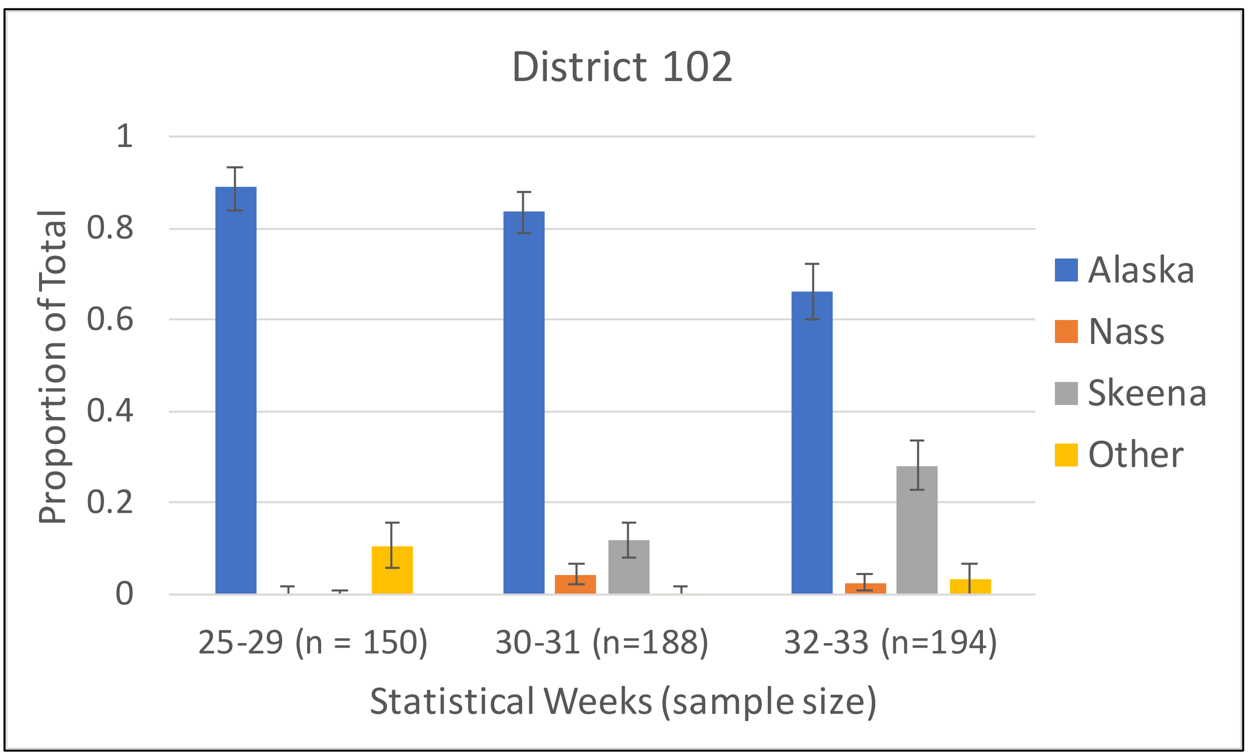

Figure 2. Stock composition estimates of sockeye salmon caught in the District 102 seine fishery in 2018. Error bars are upper and lower bounds of the 90% credibility intervals.

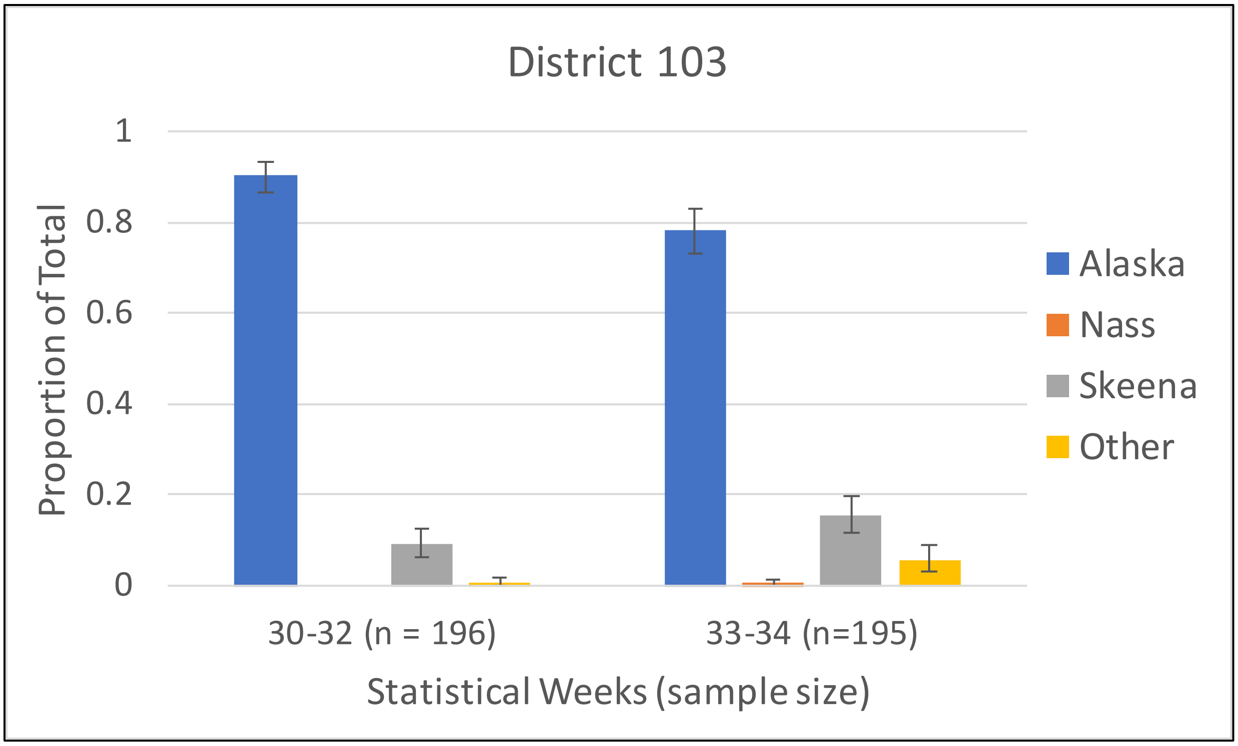

Figure 3. Stock composition estimates of sockeye salmon caught in the District 103 seine fishery in 2018. Error bars are upper and lower bounds of the 90% credibility intervals.