Stock Composition of Area 3 Seine Fishery Encounters of Chinook Salmon in 2004

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ABSTRACT

Tissue samples were collected from 276 chinook salmon (*Oncorhynchus tshawytscha*) encountered in the Area 3 seine fishery in 2004. Encounters were composed primarily of stocks from the Skeena River and the West Coast of Vancouver Island. Encounters of small chinook (<65 cm) were composed primarily of stocks from the East Coast of Vancouver Island, the upper Columbia River and Puget Sound.

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INTRODUCTION

This project was funded for the DNA analysis of tissue samples collected from chinook salmon (*Oncorhynchus tshawytscha*) encountered by the seine fishery operating in Chatham Sound and Portland Canal in 2004. The stock composition of chinook salmon released by seines are of interest because the current fishery is considerably different than in the past, the numbers of chinook encountered can be large, and the mortality rate for chinook released from seines is high.

The seine fishery in the North Coast of British Columbia has changed significantly in recent years. Past fisheries took advantage of salmon abundance wherever they occurred. Recent changes have been designed to move the seine fishery away from mixed stocks and towards stocks with identified surpluses. The Langara Island seine fishery was closed in 1996 to protect chinook stocks from the west coast of Vancouver Island (Peacock et. al. 1996). This area has remained closed in response to concerns for Fraser River sockeye stocks. In 1998 the areas west of Stephens and Dundas Islands were closed to seining to protect upper Skeena River coho and reduce impacts on passing stocks. These changes essentially moved the seine fishery closer to the terminal areas. Area changes were accompanied by restrictions to the species permitted to be retained and by operating requirements designed to enhance the survival of released species. Specifically, the operating requirements included restricting the fishery to daylight fishing only, mandatory brailing and sorting of catch and the use of revival tanks. These species restrictions and operating requirements were referred to as "selective seining."

The seine fishery has been required to release all chinook salmon encountered since 1999. This release requirement has remained in effect to prevent the seine fishery from targeting chinook salmon in fisheries designed to harvest other species.

Historic catches of chinook salmon by seines in Areas 3 and 4 are presented in Figure 1. After 1985, seine landings of chinook salmon were sampled for coded wire tags (cwt) which provided some evidence of stocks encountered, at least for stocks marked with cwt's. However, the movement of the fishery from outer areas to more terminal locations probably had a significant effect on the stock composition. Chinook salmon encountered by seines have not been sampled for cwt's since 1999 because none of the chinook are landed.

A large proportion of the chinook salmon encountered by the seine fishery die after being released. The Pacific Salmon Commission's Chinook Technical Committee (CTC, 1997) recommends using a mortality rate of 72% for releases of chinook from seines where all size classes are combined. When size specific data are available the CTC recommends immediate non-retention mortality estimates of 62.8%, 50.5% and 28% and total non-retention mortality estimates of 85.8%, 73.5% and 51.0% for small, medium and large chinook respectively. Winther (2002) found similar results for chinook released from seines in Areas 3 and 4. Short term (24 hr) mortality was estimated at 71.6%, 48.3% and 21% for small, medium and large chinook respectively. (Here small refers to chinook <53 cm, medium refers to chinook between 53 and 71 cm and large refers to chinook >71 cm measured from the tip of the nose to the fork of the tail.)

Genetic stock identification methods can be used to determine stock composition of fisheries and stock specific catch estimates. Accurate stock identification from mixed stock samples requires complete baselines for estimating relative contribution by each component stock. As the current baselines are still under development the results presented represent analysis relative to the baseline as it existed in 2004.

Preliminary examination of seine stock composition using DNA analysis in 2003 found that the component stocks of chinook salmon encountered by seines in Areas 3 & 4 differed

greatly with size. DNA analysis was completed for tissue collections from 124 large (>65cm) and 66 small (<65 cm) chinook salmon encountered in the seine fishery. Most of the large chinooks were from the Skeena, Nass and Stikine watersheds. However, small chinooks encountered by the seines were predominantly from the Puget Sound, the East Coast of Vancouver Island and the Northern Mainland of British Columbia stock groups. (Appendix 1.)

METHODS

Tissue samples were collected by observers on seine fishing vessels operating in Area 3 (Figure 2).

A common paper punch was used to collect tissue samples from the operculum of the chinook salmon being sampled (Figure 3.). One tissue sample was collected from each chinook. Tissues were preserved in a solution of 95% non-denatured ethanol. Data on the geographic location, date, and sampler accompanied each sample. Samples were forwarded to the Fisheries & Oceans Canada, Molecular Genetics Laboratory at the Pacific Biological Station in Nanaimo.

Chinook salmon collections were compared against genetic baselines from 240 chinook salmon populations from Southeast Alaska south through Canada and the lower United States of America (Appendices 2 & 3). Samples were analyzed for 13 microsatellite loci using methods of DNA extraction, PCR reaction, electrophoresis, and allele scoring described by Candy et. al. (2002) and Nelson et. al. (2000).

The Molecular Genetics Laboratory provided the sample analysis. A new version of the computer program as outlined by Pella and Masuda (2001) was developed and used for the analyses presented here. This program called “c-BAYES” is available upon request from the Fisheries & Oceans Canada, Molecular Genetics Laboratory at the Pacific Biological Station in Nanaimo. The model output presented includes the Bayesian probability estimates for the 5 most probable populations for each sample (J. R. Candy, Fisheries & Oceans Canada, pers. comm.).

A coast-wide microsatellite deoxyribonucleic acid (DNA) baseline is under development by a consortium of American laboratories and Fisheries & Oceans Canada called “Genetic Analysis of Pacific Salmonids (GAPS)” (Moran, et. al., 2004). Chinook tissue samples were collected and may be shared within GAPS according to the practices outlined by the Bilateral Chinook Technical Committee of the Pacific Salmon Commission (CTC, 2004).

RESULTS

The areas open to seine fishing in 2004 extended from Chatham Sound north to the border between Canada and Alaska. Most of the seine fishing occurred in the portions of Area 3 from Finlayson Island near Port Simpson along the eastern part of Chatham Sound and the southern part of Portland Inlet to Truro Island. This area includes the eastern portions of sub-areas 3-2 and 3-3, all of sub-area 3-4 and the southern portion of sub-area 3-7b (Figure 2.)

DNA analysis was completed for a total of 276 chinook tissues sampled from the seine fleet between July 12 and August 13, 2004. All of the collections came from sub-areas 3-4 and 3-7b (Figure 2). The numbers of samples collected by day are compared to hail catch data in Table 1.

Chinook stock compositions are presented by region in Table 2. Size data was collected for 272 of the 276 chinook sampled. Size divisions of large and small separated at 65 cm were included for comparison with the 2003 data (Appendices 1 & 2). The single largest regional

component in the Area 3 seine sample was from the Skeena River. The second largest regional component was from the West Coast of Vancouver Island (WCVI). Separation of chinook into large and small size classes indicates a distinct difference in stock compositions of small chinook which were predominantly from the East Coast of Vancouver Island (ECVI), the upper Columbia River and Puget Sound.

DISCUSSION

A large number of stocks contribute to chinook salmon encounters in the Chatham Sound seine fishery. The Skeena River has been the major contributor to chinook stock compositions in both years 2003 and 2004. Other northern rivers like the Nass and Stikine made smaller contributions to this fishery in 2004 than 2003. In contrast, the WCVI component was much larger in 2004.

Stock composition varied considerably with size both years. Small chinook showed large components of ECVI and Puget Sound stocks in both years and a large component of upper Columbia stocks in 2004. It's probable that size reflects maturity to a large degree in these samples and that the stock differences observed between large and small chinook would be more pronounced if the maturity of the fish had been assessed and comparisons were based on maturity rather than size.

Assessing the impact of the seine fishery on individual stocks would require further analysis of seine encounters. Hail data tends to underestimate the total number of chinook encounters, especially for smaller sized chinook (Winther, 2001, Fisheries & Oceans Canada unpublished data). The difference in stock composition with size combined with the size bias in hails would lead to significant underestimates of impacts on small chinook. Chinook encounters were not assessed by the observers that collected chinook DNA samples in 2003 and 2004.

The majority of the funding for this project was provided for the DNA analysis of tissue samples collected in the seine fishery. Funding was available for the analysis of 1000 chinook tissues but this sampling target could not be met, partially as a result of reduced fishing time in Area 4. Seine fishing opportunities were reduced in area 4 to protect Skeena sockeye. Chinook encounters reported in the hail data of 6,908 and 507 for Areas 3 and 4 respectively reflect the differences in seine fishing opportunity and effort between the areas. The Area 4 stratum was removed from the sampling design because of the difficulty associated with collecting tissues from chinook encounter.

Funding was received too late to initiate new sampling contracts so chinook tissue collections were added as a second priority to an existing sockeye sampling program. Chinook encounters in Area 3 are relatively rare compared to sockeye and pink salmon catches. Hail data indicated average encounters of 10 chinook per vessel operating day (16 hour days) in 2004. Thus approximately 100 vessel days would have to be observed to meet the target of 1000 chinook tissue samples. The design of the sockeye sampling program did not allow for the observation of sufficient numbers seine sets to obtain the target number of chinook tissues for analysis. The sockeye sampling program funded approximately 50 observer days which represents about 25 vessel days of fishing. Sampling reached approximately 25% of the sampling target represented by the funding for analysis.

ACKNOWLEDGEMENTS

Tissue samples were collected by observers funded through the Labour Community Fisheries Habitat Development Centre Society, Prince Rupert. DNA samples were analyzed by the Molecular Genetics Laboratory at the Pacific Biological Station in Nanaimo.

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TABLES

Table 1. Tissue samples collected from chinook salmon in Area 3 compared to 2004 chinook release data from hails.

Date	Samples collected (N=276)	Seines operating in Area 3	Chinook released (hail data)
12-Jul-04	22	28	429
13-Jul-04	19	37	416
15-Jul-04	17	55	901
19-Jul-04	13	32	253
20-Jul-04	13	58	531
22-Jul-04	17	50	626
23-Jul-04	25	59	716
26-Jul-04	19	47	368
27-Jul-04	18	30	313
29-Jul-04	18	24	163
30-Jul-04	15	22	211
2-Aug-04	5	20	121
3-Aug-04	0	22	351
5-Aug-04	6	48	404
6-Aug-04	12	21	341
9-Aug-04	17	41	205
10-Aug-04	5	27	208
12-Aug-04	7	29	157
13-Aug-04	28	21	194

Table 2. Stock composition by region for large (>65 cm) and small (<65 cm) chinook salmon sampled from the Area 3 Seine fishery in 2004.

2004	All chinook	Large chinook (>65 cm)	Small chinook (<65 cm)
Number sampled	272	194	78
Stikine River	2.6%	2.6%	2.6%
Nass River	0.4%	0.5%	0.0%
Skeena River	30.5%	38.7%	10.3%
Northern British Columbia Mainland	8.1%	7.7%	9.0%
West Coast of Vancouver Island	23.5%	30.4%	6.4%
East Coast of Vancouver Island	12.9%	8.8%	23.1%
Southern British Columbia Mainland	0.7%	0.0%	2.6%
Middle Fraser River	0.4%	0.5%	0.0%
Lower Fraser River fall timed	0.4%	0.0%	1.3%
South Thompson River	4.8%	5.2%	3.8%
Puget Sound	7.4%	3.1%	17.9%
Strait of Juan de Fuca	0.4%	0.0%	1.3%
Lower Columbia River	0.4%	0.0%	1.3%
Upper Columbia River summer & fall timed	7.4%	2.6%	19.2%
Snake River fall timed	0.4%	0.0%	1.3%

Note: In addition to the analysis presented in Table 1, 4 chinook of unknown length were collected and analyzed, 2 from the West Coast of Vancouver Island, 1 from the Skeena River and 1 from Coastal Washington to bring the total to 276 chinook sampled.

FIGURES

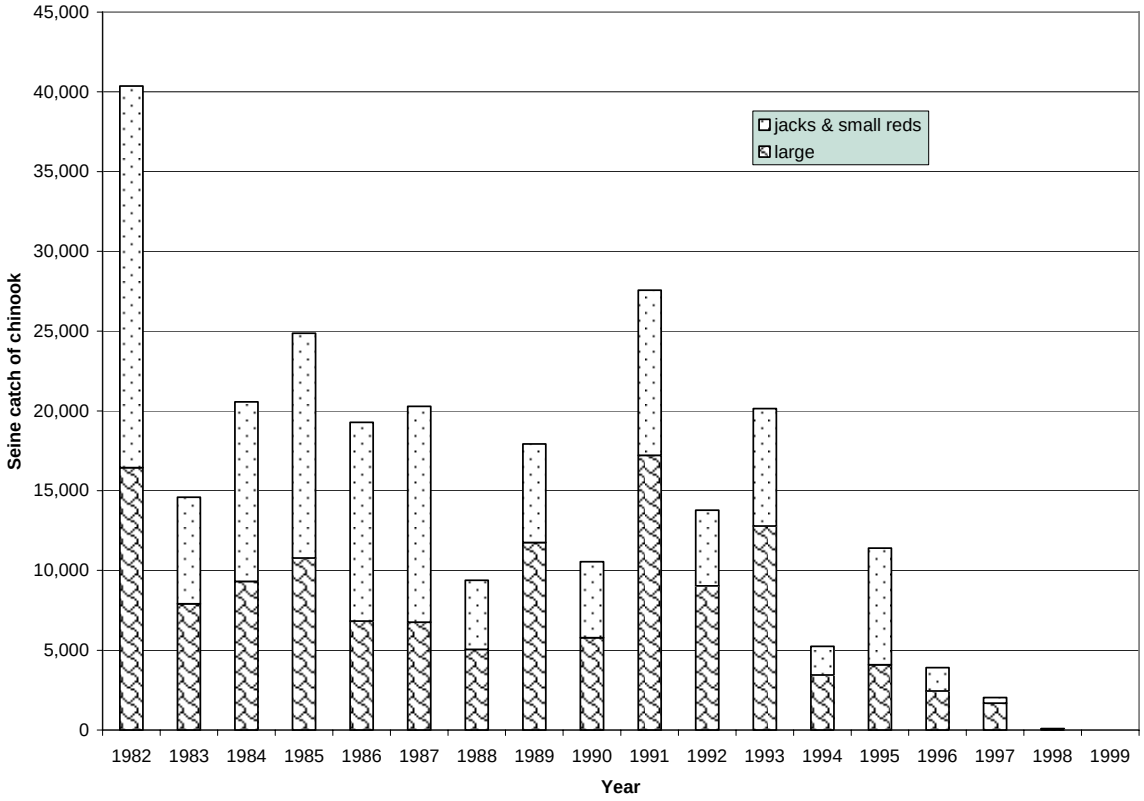

Figure 1. Landed catches of chinook salmon by the seine fishery from Areas 3 and 4 from 1982 to 1999. Catches are separated by grade to show the components of small chinook.

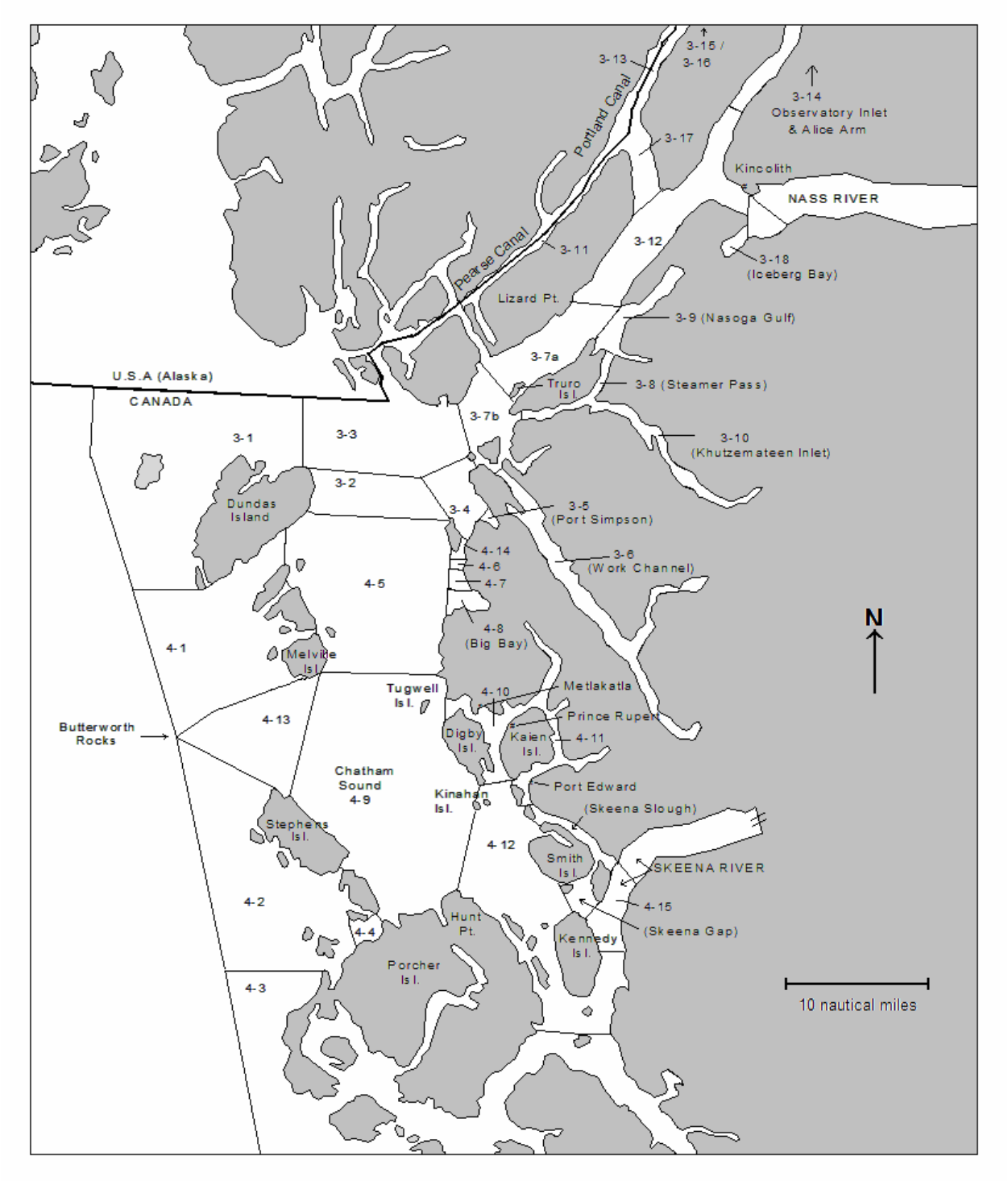

Figure 2. Map of the North Coast of British Columbia showing Pacific Fishery Management Areas 3 and 4.

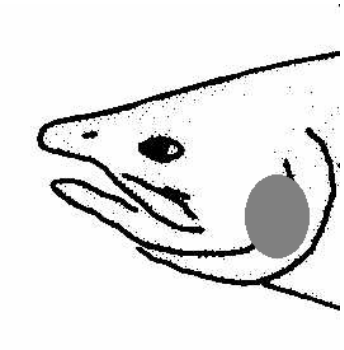

Figure 3. Tissue samples were punched from the opercula of chinook salmon in the location indicated by the shaded area on the diagram.

APPENDICES

Appendix 1. Tissue samples collected from chinook salmon in Area 3 compared to 2003 chinook release data from hails.

Date	Samples Collected (N=190)	Seines operating in Area 3	Chinook released (hail data)
14-Jul-03	25	30	266
15-Jul-03	18	31	150
17-Jul-03	27	15	78
18-Jul-03		17	121
21-Jul-03	20	25	131
22-Jul-03	3	29	280
24-Jul-03	25	13	145
25-Jul-03	8	25	187
28-Jul-03		21	200
29-Jul-03	7	22	219
31-Jul-03	14	7	46
1-Aug-03	10	10	129
4-Aug-03		8	21
5-Aug-03	3	7	91
7-Aug-03	8	4	55
8-Aug-03	2	7	71
11-Aug-03		8	21
12-Aug-03		6	23
14-Aug-03	4	8	19
15-Aug-03	16	5	29
18-Aug-03		10	28
19-Aug-03		11	58
21-Aug-03		7	24
22-Aug-03		2	5

Appendix 2. Stock composition of chinook encountered by the Area 3 seine fishery in 2003 presented by region.

Data presented are for regions contributing to the stock composition. A full list of regions appears in Appendix 3. Baseline consisted of 237 chinook stocks, 3 stocks less than 2004, considering 13 microsatellite loci. Regions remained the same.

Size	Large chinook (>65 cm)	Small chinook (<65 cm)
Number sampled	124	66
Alaska	1.7%	0.7%
Taku River	1.2%	2.3%
Stikine River	14.6%	7.9%
Nass River	17.5%	1.1%
Skeena River	24.0%	9.9%
Yakoun River, Queen Charlotte Islands	0.0%	1.5%
Northern Mainland of British Columbia	9.8%	13.6%
West Coast of Vancouver Island	7.3%	9.0%
East Coast of Vancouver Island	11.4%	19.6%
Southern Mainland of British Columbia	0.8%	3.3%
Lower Fraser River	0.0%	1.9%
South Thompson River	2.8%	0.0%
Lower Thompson River	0.3%	0.0%
Puget Sound	0.9%	17.8%
Juan de Fuca Strait	0.0%	3.3%
Coastal Washington	0.9%	0.0%
Lower Columbia & Willapa Bay	1.5%	2.5%
Upper Columbia summer & fall timed	3.5%	5.6%
Oregon	1.8%	0.0%

Appendix 3: Baseline samples used in the mixture analysis of tissues collected from the 2004 Area 3 seine fishery.

#	Region	Population	N
1	UPFR	Bowron__	176
1	UPFR	Dome____	385
1	UPFR	Fontoniko	63
1	UPFR	Goat____	77
1	UPFR	Holmes___	216
1	UPFR	Horsey___	41
1	UPFR	Indianpoint	47
1	UPFR	James	57
1	UPFR	Kenneth_Cr	78
1	UPFR	MacGregor	126
1	UPFR	Morkill_River	208
1	UPFR	R_Chehalis	127
1	UPFR	R_Chilliwack	163
1	UPFR	Salmon@PG	263
1	UPFR	Slim_____	204
1	UPFR	Swift____	411
1	UPFR	Tete_Jaune	488
1	UPFR	Torpy_River	170
1	UPFR	Walker__	42
1	UPFR	Willow___	85
2	MUFR	Baezeako	82
2	MUFR	Bridge__	425
2	MUFR	Chilako_	45
2	MUFR	Chilcotin_mix	47
2	MUFR	Chilko__	270
2	MUFR	Cottonwood	53
2	MUFR	Elkin____	235
2	MUFR	Endako__	87
2	MUFR	Horsefly	58
2	MUFR	L._Cariboo	33
2	MUFR	L._Chilcoti	232
2	MUFR	Nazko	194
2	MUFR	Nechako_	577
2	MUFR	Portage_	201
2	MUFR	Quesnel_	565
2	MUFR	Stuart__	555
2	MUFR	Taseko__	200
2	MUFR	U._Cariboo	171
2	MUFR	U._Chilcotin	277
2	MUFR	Westroad	39
3	LWFR-F	Chilliwac@Stave	377
3	LWFR-F	Harrison	603
3	LWFR-F	W_Chilliwack	481
4	NOTH	Barriere	55
4	NOTH	Blue_River	52
4	NOTH	Clearwater	262
4	NOTH	Finn____	171
4	NOTH	Lemieux_Creek	98
4	NOTH	N._Thom@Main	115
4	NOTH	Raft____	248
5	SOTH	Bessette	59
5	SOTH	Duteau_Cr	46
5	SOTH	Eagle___	42
5	SOTH	L._Adams_	208
5	SOTH	L._Shuswap	356
5	SOTH	L._Thompson	173
5	SOTH	L_Shus@U_Adams	45
5	SOTH	Little__	158
5	SOTH	M._Shuswap	376
5	SOTH	Salmon@SA	214
5	SOTH	South_Thom	267
6	LWTH	Bonaparte	308
6	LWTH	Coldwater	279
6	LWTH	Deadman__	299
6	LWTH	Louis___	577
6	LWTH	Nicola__	468
6	LWTH	Spius___	136
6	LWTH	U._Coldwat_SP	141
6	LWTH	U._Spius_SP	131
7	ECVI	Big_Qualicum	374
7	ECVI	BigQul@Lang	293
7	ECVI	Chemainus	261
7	ECVI	Cowichan	684
7	ECVI	L._Qualicum	209
7	ECVI	Nanaimo,Upper	118
7	ECVI	Nanaimo_F	546
7	ECVI	Nanaimo_SP	99
7	ECVI	Nanaimo_SU	278
7	ECVI	Nimpkish	57
7	ECVI	Puntled_SU	899
7	ECVI	Puntledge_F	576
7	ECVI	Quatse___	38
7	ECVI	Quinsam_	457
7	ECVI	Woss_Lake	31
8	WCVI	Burman__	273
8	WCVI	Colonial_Cay	40
8	WCVI	Conuma__	456
8	WCVI	Gold_R	93
8	WCVI	Kennedy_	49
8	WCVI	Marble@NVI	507
8	WCVI	Nahmint__	258
8	WCVI	Nitinat_	346
8	WCVI	Rob@Gold	225
8	WCVI	Rob@Muchalat_	33
8	WCVI	Robertson	386
8	WCVI	San_Juan	196
8	WCVI	Sarita__	415
8	WCVI	Stamp___	303
8	WCVI	Tahsis	310
8	WCVI	Thornton_	518
8	WCVI	Tlupana	66
8	WCVI	Toquart_River	87
8	WCVI	Tranquille	342
9	SOMN	Bute____	72
9	SOMN	Capilano	126
9	SOMN	Devereux	329
9	SOMN	Homathko	52
9	SOMN	Klinaklini	448
9	SOMN	Porteau_Cove	357
9	SOMN	Squamish	157
10	NOMN	Ashlulm__	64
10	NOMN	Atnarko_	275
10	NOMN	Chuckwalla	279
10	NOMN	Dean_River	38
10	NOMN	Docee__	50
10	NOMN	Hirsch__	474
10	NOMN	Kilbella	161
10	NOMN	Kildala_	441
10	NOMN	Kitimat_	482
10	NOMN	Kloiya_River	46
10	NOMN	Kwinamass	275
10	NOMN	Neechanze	57
10	NOMN	Nusatsum	43
10	NOMN	Saloompt	96
10	NOMN	U._Atnarko	155
10	NOMN	U._Dean	51
10	NOMN	Wannock_	510
11	NASS	Cranberry	164
11	NASS	Damdochax	257
11	NASS	Kincolith	287

11	NASS	Kwinageese	299
11	NASS	Meziadin	195
#	Region	Population	N
11	NASS	Owegee__	219
11	NASS	Seaskinnish	99
11	NASS	Snowbank_	54
11	NASS	Tseax___	180
12	LWFR-Sp	Big_Silver	111
12	LWFR-Sp	Birkenhead	255
12	LWFR-Sp	Upper_Pitt	88
13	LWFR-Su	Maria_Slough	302
14	QCI	Yakoun__	201
15	Alaska	Chickamin	116
15	Alaska	King_Salmon	57
15	Alaska	Unuk____	193
17	Taku	Little_Tatsam.	204
17	Taku	Little_Trapper	131
18	Stikine	Andrew_Creek	144
18	Stikine	Christina	238
18	Stikine	Craig_River	114
18	Stikine	Little_Tahltan	413
18	Stikine	Shakes_Creek	159
18	Stikine	Verrett	467
19	Skeena Upper	Bear____	177
19	Skeena Upper	Sustut__	416
20	Skeena Babine	Babine__	266
21	Skeena Bulkley	Bulkley	585
21	Skeena Bulkley	Morice__	228
22	Skeena Mid	Kispiox_	105
22	Skeena Mid	Kitwanga	288
23	Skeena Lower	Cedar___	116
23	Skeena Lower	Ecstall_	293
23	Skeena Lower	Gitnadoix	42
23	Skeena Lower	L._Kalum	457
23	Skeena Lower	L._Kalum@AC	190
23	Skeena Lower	Moonlit_Creek	83
24	Alsek	Blanchard	376
24	Alsek	Klukshu_	432
24	Alsek	Takhanne	188
50	Puget Sound	Kendall_Green_F	50
50	Puget Sound	Kendall_Nook_SP	100
50	Puget Sound	LittleCampbell	90
50	Puget Sound	Serpentine	46
50	Puget Sound	Skagit_SU	282
50	Puget Sound	Skykomish_SU	75
50	Puget Sound	Soos_Green_F	100
50	Puget Sound	Stillaguamish	87
50	Puget Sound	White_F_	100
51	Juan de Fuca	Elwha_F_	99
52	Coastal Wash	Hoh_River_SP_SU	59
52	Coastal Wash	Queets__	57
52	Coastal Wash	Quinault_F	64
52	Coastal Wash	Solduc_F	98
53	Low Col	Abernathy_F	100
53	Low Col	Coweeman_	77
53	Low Col	Sandy___	89
54	Up Col-Sp	Chewuch_SP	100
54	Up Col-Sp	Chiwawa_SP	100
54	Up Col-Sp	Entiat__	64
54	Up Col-Sp	Twisp_SP	100
55	Up Col-Su/F	Deschutes-F	100
55	Up Col-Su/F	Hanford_Reach	98
55	Up Col-Su/F	Silmilkameen_SU	100
55	Up Col-Su/F	Wenatchee_SU	100
56	Snake-Sp/Su	Frenchman-SP	61
56	Snake-Sp/Su	Imnaha__	99
56	Snake-Sp/Su	Marsh_Creek	220
56	Snake-Sp/Su	McCall_Hat	41
56	Snake-Sp/Su	McCall_River	32
56	Snake-Sp/Su	Rapid_Sp	80
56	Snake-Sp/Su	Salmon_E.Fork	53
#	Region	Population	N
56	Snake-Sp/Su	Tucannon_SP	100
56	Snake-Sp/Su	Up_Salmon-SP	165
56	Snake-Sp/Su	Upper_Valley	77
56	Snake-Sp/Su	Valley_Creek	43
56	Snake-Sp/Su	Wenaha__	43
57	Snake-F	Lyon's_Ferry_F	123
57	Snake-F	Snake___	62
58	Oregon coastal	Cole_River	49
58	Oregon coastal	Elk_River	70
58	Oregon coastal	Euchre_Creek	57
58	Oregon coastal	Hunter_Creek	96
58	Oregon coastal	Lobster_Creek	49
58	Oregon coastal	Nehalem__	53
58	Oregon coastal	Pistol_River	95
58	Oregon coastal	Siuslaw__	37
58	Oregon coastal	Trask_hat_SP	48
58	Oregon coastal	Trsk_hat_F	98
58	Oregon coastal	Umpqua_Smith	93
59	S.Oregon/Cal coast	Blue_Creek	94
59	S.Oregon/Cal coast	Winchuk__	80
61	Up Klam/Trinity	Trinity_F	100
61	Up Klam/Trinity	Trinity_SP	100
62	Mid Col-Sp	John_Day_main	36
62	Mid Col-Sp	John_Day_middle	40
62	Mid Col-Sp	John_Day_north	40
63	Up Willamette	Clackamas_North	79
63	Up Willamette	North_Santiam	97
64	Cent Val-F	American_River	69
64	Cent Val-F	Battle_Creek	40
64	Cent Val-F	Butte_F	49
64	Cent Val-F	Feather_F	128
64	Cent Val-F	Merced__	200
64	Cent Val-F	Mokelumne	94
64	Cent Val-F	Sacr_F___	136
64	Cent Val-F	Sacr_LF__	96
64	Cent Val-F	Toulume__	34
64	Cent Val-F	Yuba____	50
65	Cent Val-Sp	Butte_Sp	43
65	Cent Val-Sp	Feather_Sp	82
65	Cent Val-Sp	Yuba_Sp__	32

Appendix 4. Abbreviations used to describe regions.

#	Abbreviation	Region
1	UPFR	Upper Fraser River
2	MUFR	Middle Fraser River
3	LWFR-F	Lower Fraser River Fall
4	NOTH	North Thompson River
5	SOTH	South Thompson River
6	LWTH	Lower Thompson River
7	ECVI	East Coast of Vancouver Island
8	WCVI	West Coast of Vancouver Island
9	SOMN	Southern Mainland BC
10	NOMN	Northern Mainland BC
11	NASS	Nass River
12	LWFR-Sp	Lower Fraser River Spring
13	LWFR-Su	Lower Fraser River Summer
14	QCI	Yakoun River
15	Alaska	Alaska
17	Taku	Taku River
18	Stikine	Stikine River
19	Skeena Upper	Skeena Upper
20	Skeena Babine	Skeena Babine
21	Skeena Bulkley	Skeena Bulkley
22	Skeena Mid	Skeena Mid
23	Skeena Lower	Skeena Lower
19-23	Skeena	Skeena regions combined
24	Alsek	Alsek
50	Puget Sound	Puget Sound
51	Juan de Fuca	Juan de Fuca Strait
52	Coastal Wash	Coastal Washington
53	Low Col	Lower Columbia
54	Up Col-Sp	Upper Columbia spring timed
55	Up Col-Su/F	Upper Columbia summer & fall timed
56	Snake-Sp/Su	Snake River spring & summer timed
57	Snake-F	Snake River fall timed
58	Oregon coastal	Oregon coastal
59	S.Oregon/Cal coast	Southern Oregon Coastal and California Coastal
61	Up Klam/Trinity	Upper Klamath & Trinity
62	Mid Col-Sp	Middle Columbia Spring timed
63	Up Willamette	Upper Willamette
64	Cent Val-F	Central Valley fall timed
65	Cent Val-Sp	Central Valley spring timed