

**SOUTHERN STUDY AREA CHUM STOCK DISTRIBUTION
ASSESSMENT IN
WASHINGTON SAN JUAN ISLANDS – PT. ROBERTS
AND IN
BRITISH COLUMBIA SOUTHERN GULF FISHERIES**

**PSC Southern Boundary Restoration & Enhancement Fund
2010**

Final Report

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By

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INTRODUCTION

This is the third year of a southern area Canada and United States trans-boundary chum stock distribution assessment for chum directed fisheries in Washington (Area 7 and 7A) and Canadian fisheries (Area 29 and 18). The 2010 Washington fisheries were sampled during a shortened one week opening due to low run abundance. The fishery was previously sampled in 2007 and 2008 (Kirby 2008, 2009). This project was proposed for three consecutive years but PSC southern endowment fund shortfalls for 2009 delayed the completion of the project by one year. No pre-terminal fisheries were conducted in Canadian water areas 18 and 29 during this time period. It was decided to analyze test fishery archive samples from Area 18 during this same timeframe.

Prior to 1985, genetic stock identification (GSI) analysis had not been conducted in the targeted fisheries. From 1985 to 1995, stock composition data was collected in the Washington San Juan – Point Roberts commercial chum fisheries (Catch Areas 7 & 7A) using a starch-gel electrophoresis methodology (Aebersold et al. 1987) for GSI then run through a maximum likelihood program (MLE) (Millar 1987) to determine fisheries stock composition. The 2010 fisheries collections give fishery managers stock composition information for a third year using the more accurate and accepted DNA analysis technology.

In order to facilitate management responses to Fraser River chum stock strength in accordance with Annex IV, Chapter 6 of the Pacific Salmon Treaty (PST adopted in 2006); it is necessary to quantitatively identify stock contributions to both the Washington (Areas 7 and 7A) and Canadian (Areas 29 and 18) trans-boundary chum fisheries. This joint bilateral project will benefit both the U.S. and Canada, by developing the means toward a more effective in-season management of Southern Area Chum. It will allow the U.S. to effectively implement the current Chum Annex to the PST, to take fishery actions when the Fraser chum run is in a conservation status. The project responds to three objectives for the ‘Inside Southern Chum Fisheries’ to improve stock assessment information for resource managers. 1) The stock aggregate information will help in developing thresholds for Canadian Inside chum run sizes which determine Canadian and U.S. fishing opportunities pursuant to Chapter 6, Annex IV of the Pacific Salmon Treaty. 2) The stock aggregate information will help in shaping fisheries to control the harvest of Fraser chum, when required. 3) An additional benefit will be the assessment of stock component contributions to domestic and intercepting fisheries, enabling the U.S. and Canada to adjust Annex Chapter provisions to better accomplish the goals of the Treaty.

This project responds to five strategies: 1) Refine stock and fishery management objectives by developing, evaluating, and refining trend analysis of stock composition to the fisheries and risk assessment frameworks to address impacts to specific stocks of concern. 2) Develop tools and technologies for fisheries management by supplying a stock composition dataset using the new more widely accepted DNA tissue analysis to address data uncertainties. 3) Improve stock identification techniques by establishing DNA Genetic Stock Identification (GSI) bilateral datasets for southern trans-boundary chum fisheries and enhancing southern chum baseline through multi-agency collaborative effort. 4) Improve selectivity of fishing by applying mixed stock analytical methods based on DNA techniques to shape fisheries to reduce impacts on stocks of concern while creating fishing opportunities on healthy stocks. 5) Improve information sharing between the parties and agencies.

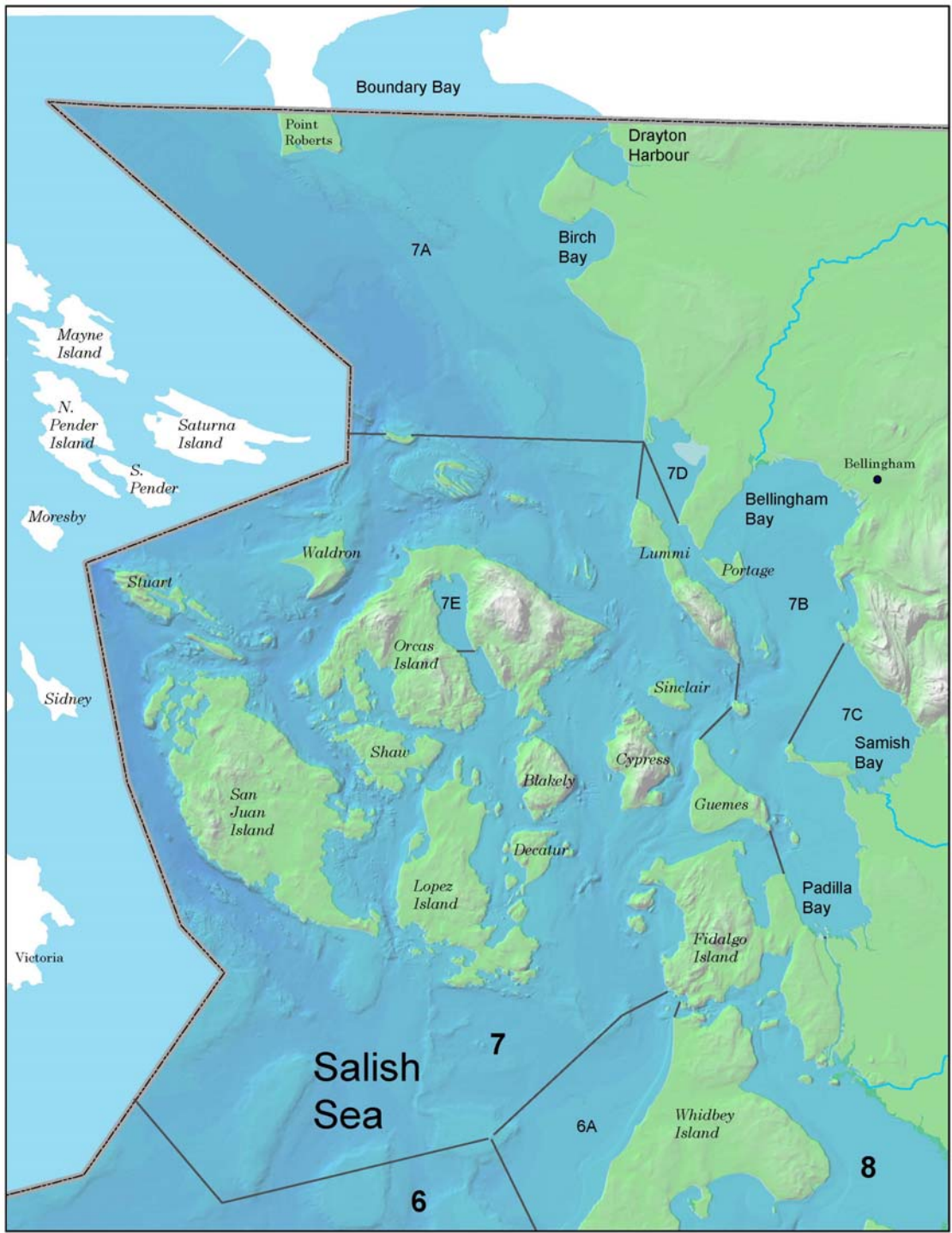


Figure 1. Washington State salmon fisheries catch areas for north Puget Sound (Map developed by Northwest Indian Fisheries Commission).

Project Objectives:

1. Sampling commercial fisheries

Collect samples of operculum tissue from chum salmon in two targeted North Puget Sound and two southern Gulf Georgia Strait commercial fisheries. Tissues will be collected from 200 randomly selected chum salmon in each catch area per week of peak fishing activity.

2. Genetic analysis

Operating under a subcontract, the Canadian Department of Fisheries and Oceans (DFO) Molecular Genetics Lab will complete microsatellite DNA analysis of the tissue samples. The resulting data will be entered into stock assessment program models, which generates statistical estimates of the stock composition of each weekly sample from each fishery.

3. Stock composition of sampled fisheries

Genetic analyses results will be presented for the 2010 U.S. fisheries describing the contribution of three aggregate stock groups: Washington, British Columbia non-Fraser, and Fraser River populations. In addition, genetic analyses of 2007 through 2010 Canadian Area 18 test fishery samples will be presented too.

METHODS

Sampling Protocol

The sampling objective is to collect 200 Chum per week from each fishery. Without an existing North Puget Sound Chum fishery DNA dataset to analyze, the sample size was arrived at from past genetic studies. Simulations from previous Puget Sound chum genetic stock studies in the 1980s and 1990s using less accurate electrophoresis genetic analyses methods demonstrated large increases in precision when sample size increased from 100 to 200 and a small increase in precision for sample size above 200 (TCCHUM 1988).

For the Washington Areas 7/7A commercial chum fisheries, Northwest Indian Fisheries Commission (NWIFC) staff and Washington Department of Fish and Wildlife (WDFW) crews collected tissue samples weekly from the commercial fisheries. To the extent possible, samples were drawn from tenders or processing facilities where catches of many vessels are combined. This insured sample representation from several vessels and when necessary from different gear types. However, lack of sampling opportunities sometimes necessitated sampling from individual fishing vessels. Samplers interviewed fishing vessel operators and checked all fish sales receipts (tickets) to avoid sampling catch of mixed-area origin. For the 2010 Canadian pre-terminal test fishery in Area 18, Canadian Department of Fisheries and Oceans (DFO) collected samples from seine sets. All DNA samples collected by operculum punch and preserved in 95% ethanol.

Management Weeks

In the Puget Sound salmon fisheries, management periods are established for each species and catch area during pre-season planning. These periods correspond to the timing of the target salmon species in the area waters. Fishery managers' offer fishing opportunities during management weeks within the management period after considering conservation concerns.

Management weeks are defined as the period from Sunday to Saturday. If first management week of the year included fewer than four days, i.e. January 1 fell on a Friday, Saturday, or Sunday we redefined the first management week as beginning on the first Sunday in January. This adjustment allows for the comparison among management weeks to better approximate a Julian date comparison, and therefore to reflect the true annual variation in fisheries. Appendix 1 shows management week dates.

Fishery Sampling Summaries

San Juan Islands & Point Roberts commercial chum fisheries (Catch Areas 7 & 7A)

Staff from the Northwest Indian Fisheries Commission (NWIFC) and Washington Department of Fish and Wildlife (WDFW) participated in sampling the landed catch from the San Juan Islands-Point Roberts fishery. The landed commercial catch was sampled from treaty and non-treaty fisheries. Tissue samples were collected from combined gillnets and purse seine catch gear. The sampling objective was to collect 200 fish samples per week per sub-areas for the fisheries.

The fisheries were only open during management week 43 (October 17 – 23). Sample collection objectives were met for both catch areas for the one week. Catch and sampling results are shown in table 1. Landed catch are preliminary numbers taken from soft-data.

Table 1. Commercial chum harvest and sampling summary from Areas 7 and 7A in 2010 For Management Week 43.

Catch Area	Preliminary Landed Catch			DNA Samples
	Treaty	Non-treaty	Total	
7	360	553	913	403
7A	1283	403	1686	203

Note: Catch data queried 5/25/11.

Canadian Southern Gulf Islands Pre-terminal test fishery (Catch Area 18)

Due to the lack of fishery openings in the Canadian targeted areas specified in the study proposal, the study design was modified this year to include 2010 and archived pre-terminal test fishery samples from Area 18 to help meet the objectives of the project. The Canadian Department of Fisheries and Oceans operates salmon test fisheries annually. The 2010 pre-terminal chum seine test fishery in Area 18 collected 59 samples over an extended timeframe (October 30 to November 14). In addition archived test fishery samples totaling 66, 59 and 146 for 2007, 2008 and 2009 respectively; were submitted to the genetics lab for analysis. These archived samples were collected over a similar timeframe.

Laboratory and Stock Composition Analysis

The Canadian Department of Fisheries and Oceans (DFO) Molecular Genetics Laboratory (MGL) at the Pacific Biological Station isolated the genetic DNA from approximately 10-20mg. of tissue per sampled fish using Promega Wizard extraction techniques. MGL assayed samples for genetic variation at 14 microsatellite loci. The loci surveyed are listed and referenced in Appendix 2. Products amplified using polymerase chain reaction were size fractured with the ABI 3730 automated DNA sequencer. A more detailed description of laboratory techniques can be found in Beacham et al. 2006 and Beacham et al. 2001.

The baseline populations were derived from archived tissue samples or DNA specific sample collections usually taken from hatcheries or spawning grounds. The genomic DNA was extracted from operculum punches, fin clips, scales, or liver. To develop baseline stock profiles, genotypic frequencies were determined at each locus in each population. Seven Canadian chum stocks were removed from the 2007 baseline because they fall below the minimum sample size of 30 fish. The Algard population was added now considered part of the British Columbia south coast stock aggregate. Appendix 3 lists DFO's 'southern chum baseline' of 79 populations.

A cBayes statistical analysis software program developed by DFO (Neaves et al. 2005) using Bayesian estimators was used to estimate stock composition of each weekly fisheries sample (Pella and Masuda 2001). The procedure is outlined by Beacham et al. (2005a).

For the purposes of this analysis, we consider the genetic stock identification technique capable of accurately measuring the contributions of regional chum stock aggregates from Washington State (north Puget Sound, south Puget Sound, Hood Canal, Juan de Fuca Strait, Washington Coast), southern British Columbia (south coast British Columbia, east coast Vancouver Island, west coast Vancouver Island), and the Fraser River. A genetic electrophoresis examination of adult chum population collections from 1985 to 1992 found significant allele frequency differences among the Washington chum regional population aggregate groups mentioned above and west coast Vancouver Island, Fraser River, Georgia Strait regional groups from Canada (Phelps et al. 1994). A more recent study using DNA microsatellite techniques further supports the regional population structure of British Columbia (B.C.) stock aggregates in addition to separating the Georgia Strait component into east coast Vancouver Island and south coast B.C. aggregates. Using the available chum stock baseline and the sample sizes specified in the study protocol, contributions of individual stocks or river systems may not be as accurately resolved.

STOCK COMPOSITION ESTIMATES

The cBayes Bayesian estimator model was used to assess stock composition in the 2010 fisheries. In the first year report, the SPAM maximum likelihood model was also used to assess the 2007 fisheries stock composition for comparison. Both models delivered very similar proportion results from the 2007 fishery samples with few exceptions (Kirby 2008). The body of literature suggests greater accuracy with cBayes versus the SPAM model.

San Juan Islands (Area 7) and Point Roberts (Area 7A) Commercial Chum Fishery

The Fraser River aggregate received the largest stock proportion in the one week fishery for both Areas 7 and 7A at 42% and 87%, respectively (Table 2). The East Coast Vancouver Island stock aggregate also contributed substantially in Area 7 at 33% with a minimal contribution in Area 7A of 3%. The North Puget Sound stock aggregate comprising 7% of the sample in Area 7 compared to 1% in Area 7A. The South Coast stock aggregate comprised 19% and 8% for Areas 7 and 7A, respectively.

Table 2. The cBayes model: percent contributions (\pm one standard deviation) of United States and Canadian chum stock aggregates in management week 43 for the 2010 commercial fisheries in San Juan Islands (CA 7) and Point Roberts (CA 7A).

Stock Aggregates	Catch Areas	
	7*	7A*
South Coast	18.6 \pm 4.1	7.9 \pm 2.8
A14-18 ECVI	32.8 \pm 4.2	2.9 \pm 2.7
A19-26 WCVI	0.1 \pm 0.3	1.4 \pm 1.8
Fraser	41.8 \pm 3.5	87.0 \pm 3.5
North Puget Sound	6.6 \pm 1.9	0.7 \pm 1.5
South Puget Sound	0.0 \pm 0.1	0.0 \pm 0.2
Hood Canal	0.1 \pm 0.3	0.0 \pm 0.2
Juan de Fuca Strait	0.0 \pm 0.2	0.1 \pm 0.6
Washington Coast	0.0 \pm 0.1	0.0 \pm 0.2

* Sample sizes were 403 for catch area 7 and 203 for catch area 7A.

Canadian South Gulf Islands (Area 18) Pre-terminal Chum Test Fishery

A decision was made to combine weekly samples and analyze as yearly groupings due to the very small weekly sample sizes. The East Coast Vancouver Island stock aggregate dominated the catch for all 4 years at 63%, 73%, 90%, and 77% for 2007, 2008, 2009, and 2010; respectively (Table 3). The British Columbia South Coast stock aggregate was the other major contributor at 26%, 21%, 6%, and 12% for 2007, 2008, 2009, and 2010; respectively. The Fraser and North Puget Sound stock aggregates comprised a small proportion of the collections. The Fraser contribution ranged from 2% to 7% over the four years. The North Puget Sound stock contributions ranged from 1% to 3%. The West Coast Vancouver Island contributed 1% to 4% over the four years.

Table 3. The cBayes model: percent contributions (\pm one standard deviation) of United States and Canadian chum stock aggregates in Canadian Area 18 pre-terminal test fishery for 2007 - 2010.

Stock Aggregates	Year			
	2007	2008	2009	2010
South Coast	26.3 \pm 9.9	20.8 \pm 11.3	6.3 \pm 6.0	11.9 \pm 10.9
A14-18 ECVI	63.0 \pm 10.7	73.1 \pm 11.9	90.2 \pm 6.6	76.7 \pm 14.2
A19-26 WCVI	3.8 \pm 5.4	0.7 \pm 2.3	0.9 \pm 2.2	1.0 \pm 2.9
Fraser	3.0 \pm 4.1	1.9 \pm 3.5	1.5 \pm 2.6	7.2 \pm 7.6
North Puget Sound	3.1 \pm 5.0	1.6 \pm 3.8	0.6 \pm 1.6	2.6 \pm 4.9
South Puget Sound	0.0 \pm 0.4	1.6 \pm 1.8	0.0 \pm 0.3	0.0 \pm 0.4
Hood Canal	0.0 \pm 0.5	0.0 \pm 0.4	0.3 \pm 0.8	0.0 \pm 0.3
Juan de Fuca Strait	0.7 \pm 1.8	0.1 \pm 1.0	0.0 \pm 0.3	0.3 \pm 1.4
Washington Coast	0.1 \pm 0.6	0.3 \pm 1.2	0.0 \pm 0.2	0.3 \pm 1.1

EVALUATION

The evaluation will address this seasons' work and make an assessment of the accumulative three year project. Annex IV, Chapter 6 of the Pacific Salmon Treaty (PST adopted in 2006) states "U.S. commercial fisheries for chum in Areas 7 and 7A will not occur prior to October 10". When the inside southern chum salmon in-season estimates are less than 1.0 million then the run is considered critical. Such an event curtails directed fisheries.

Sampling

In 2010, the chum run size estimates approached this critical threshold. Consequently, the U.S. Area 7 and 7A fisheries were only open for one week. Therefore only management week 43

contains three years of data. In the previous two years of the study, the largest total catch per week was landed in management week 43 for both areas. This suggests the run peaked in week 43 during the study duration in Areas 7 and 7A. Sampling objectives were typically met when fishing effort was high. For Areas 7 and 7A, fishing effort declines after week 43. Fishers move to other chum commercial fisheries in Puget Sound and Hood Canal. Consequently, it was difficult to obtain sampling objectives for weeks 44 and 45 due to reduced sampling opportunities. Appendix 4 shows samples collected by management week for the three years.

During the three year study no Canadian commercial chum fisheries occurred in pre-terminal sections of areas 18 and 29. In the final year of the study, the sampling design was modified to include Area 18 pre-terminal seine test fishery collections for 2007 through 2010 in the stock composition analysis. Due to low chum abundance at test fishery sites, weekly catches were well below the sampling objectives. Therefore, it was necessary to pool the collections by year to obtain a robust analysis.

Stock Identification Analysis

The Fraser River stock aggregate appears to be the major contributor to the U.S. commercial chum fisheries in Areas 7 and 7A over all weeks of the fisheries. The exception may be in week 45 in the San Juan Islands Area 7 fishery. The north Puget Sound stock aggregate contributions increased dramatically and Fraser River stock presence declined by week 45 though there appears to be no declining trend over the first four weeks as seen in the dataset for 2007 and 2008. The small sample sizes for week 45 combined with just a two year dataset makes it difficult to determine if this is a stock migration timing trend. The data from the Puget Sound terminal area chum stock composition studies in the 1990s appears to indicate a declining trend of Fraser River stock aggregate contribution in Washington waters around week 45 (Kirby 2000). The 2007 Point Roberts Area 7A fishery collection shows an increase for the north Puget Sound stocks in week 45 and a Fraser River stock declining trend. B.C. south coast and east coast Vancouver Island are other major stock aggregate contributors to both fisheries. The same three stock aggregates showed similar dominance from samples collected in the 2007 upper and lower Johnstone Strait fisheries as these populations migrate south (Beacham et al. 2008). Appendices 5a and 5b summarize the stock composition time series of data for the study.

Appendices 6a and 6b contain tables summarizing Area 7 and 7A stock aggregates by Fraser, B.C. non-Fraser, and Washington groupings for the project years. In addition, the electrophoresis data collected from 1985 through 1995 is included for comparison purposes. The overall comparison does indicate a greater presence of Washington stocks throughout both fisheries during the years of electrophoresis analysis. This comparison should be addressed with caution. This project used a Bayesian analytical approach while the electrophoresis collection years used a maximum-likelihood analysis (SPAM). The 2007 sample collections were analyzed using both approaches generating similar stock composition results. The other difference was the baselines used in the analysis. The baseline used for the project was comprised of 18 U.S. stocks and 61 Canadian stocks. During the years of electrophoresis, the baseline consisted of equal proportions of U.S. and Canadian stocks totaling approximately 41 stocks. PSC Chum Technical Committee is addressing this baseline proportion discrepancy for DNA analysis. Additional Washington chum stocks are being collected to be incorporated into the present baseline.

A project objective proposed comparing stock composition by comparable weeks in the U.S. and Canadian targeted commercial chum fisheries. This objective was not met. There were no pre-terminal fisheries in Canadian Areas 18 and 29 during the duration of the project. Test fishery samples were obtained from Area 18 though these samples were pooled by years due to low weekly collection totals. Even comparing the pooled results is difficult since the Area 18 collections were collected during later portion of the Areas 7 and 7A fisheries (weeks 44 – 46) where few to no samples were collected.

Even with the different timeframes a few differences are worth noting. The Canadian Area 18 test fishery samples showed only a small presence of Fraser and Washington stock aggregates in the stock composition analysis. As expected the majority of the catch was East Coast Vancouver Island (ECVI) stocks and a large proportion of these were Cowichan fish. This is not surprising since the pre-terminal sampling area is adjacent to the Cowichan river terminal area. A small proportion of Cowichan stock is present in the San Juan Islands Area 7 fishery. There is little to no presence of this stock in the Point Roberts fishery during the project years.

Benefits from the Project

This report will be submitted to the PSC Chum Technical Committee for their evaluation and recommendation for further dataset expansion. The stock composition information will help in implementing the current Chum Annex to the Pacific Salmon Treaty. The data will provide additional insight to develop fishery options when the Fraser chum run is in a conservation status. The committee has already decided the southern chum baseline needs to be expanded with additions of more Washington stocks.

This study demonstrated Microsatellite DNA techniques can be used to assess stock contributions in the San Juan Islands Area 7 and Point Roberts Area 7A commercial chum fisheries. By running two of the science community accepted genetic stock composition models, baseline confidence was assessed to meet stock aggregate requirements though a fisheries simulation of known population proportion samples would further help assess the baseline resolution. It became apparent during the project that a different strategy needs to be developed to compare stock composition on both sides of the border. The U.S. Areas 7 and 7A fisheries are pre-terminal while southern Canadian chum fisheries are primarily terminal based.

ACKNOWLEDGEMENTS

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APPENDICES

Appendix 1. Management Week Schedule for 2010 Commercial Fisheries.

Mon	Week No.	Calendar Dates		Julian Dates		
		Start	End	Start	End	
Jan	1	1-Jan	2-Jan	1	2	
	2	3-Jan	9-Jan	3	9	
	1	3	10-Jan	16-Jan	10	16
		4	17-Jan	23-Jan	17	23
		5	24-Jan	30-Jan	24	30
Feb	6	31-Jan	6-Feb	31	37	
	7	7-Feb	13-Feb	38	44	
	2	8	14-Feb	20-Feb	45	51
		9	21-Feb	27-Feb	52	58
Mar	10	28-Feb	6-Mar	59	65	
	11	7-Mar	13-Mar	66	72	
	3	12	14-Mar	20-Mar	73	79
		13	21-Mar	27-Mar	80	86
Apr	14	28-Mar	3-Apr	87	93	
	15	4-Apr	10-Apr	94	100	
	4	16	11-Apr	17-Apr	101	107
		17	18-Apr	24-Apr	108	114
		18	25-Apr	1-May	115	121
May	19	2-May	8-May	122	128	
	20	9-May	15-May	129	135	
	5	21	16-May	22-May	136	142
		22	23-May	29-May	143	149
June	23	30-May	5-Jun	150	156	
	24	6-Jun	12-Jun	157	163	
	6	25	13-Jun	19-Jun	164	170
		26	20-Jun	26-Jun	171	177

Mon	Week No.	Calendar Dates		Julian Dates		
		Start	End	Start	End	
Jul	27	27-Jun	3-Jul	178	184	
	28	4-Jul	10-Jul	185	191	
	7	29	11-Jul	17-Jul	192	198
		30	18-Jul	24-Jul	199	205
		31	25-Jul	31-Jul	206	212
Aug	32	1-Aug	7-Aug	213	219	
	33	8-Aug	14-Aug	220	226	
	8	34	15-Aug	21-Aug	227	233
		35	22-Aug	28-Aug	234	240
Sep	36	29-Aug	4-Sep	241	247	
	37	5-Sep	11-Sep	248	254	
	9	38	12-Sep	18-Sep	255	261
		39	19-Sep	25-Sep	262	268
Oct	40	26-Sep	2-Oct	269	275	
	41	3-Oct	9-Oct	276	282	
	10	42	10-Oct	16-Oct	283	289
		43	17-Oct	23-Oct	290	296
		44	24-Oct	30-Oct	297	303
Nov	45	31-Oct	6-Nov	304	310	
	46	7-Nov	13-Nov	311	317	
	11	47	14-Nov	20-Nov	318	324
		48	21-Nov	27-Nov	325	331
Dec	49	28-Nov	4-Dec	332	338	
	50	5-Dec	11-Dec	339	345	
	12	51	12-Dec	18-Dec	346	352
		52	19-Dec	25-Dec	353	359
		53	26-Dec	31-Dec	360	365

Appendix 2. Standard abbreviations of corresponding loci screened in chum salmon DNA microsatellite analysis.

STANDARD LOCI ABBREVIATION

SOURCE REFERENCES

Oke3	Buchholz et al. 2001
Ots3	Banks et al. 1999
OtsG68	Williamson et al. 2002
Ots103	Nelson and Beacham 1999
Oki2	Smith et al. 1998
Omm1070	Rexroad et al. 2001
Oki100	Beacham et al. 2001
Omy1011	Spies et al. 2005
Ssa419	Cairney et al. 2000
One101	Olsen et al. 2000
One102	Olsen et al. 2000
One104	Olsen et al. 2000
One111	Olsen et al. 2000
One114	Olsen et al. 2000

Appendix 3. Baseline chum stocks included in the stock composition analysis of the San Juan Islands and Point Roberts commercial chum fisheries (Catch Areas 7 & 7A).

<u>Region</u>	<u>Stock</u>
South Coast	Algard Cheakamus Heydon Creek Homathko Indian River Kwalate Mamquam Mashiter Creek Orford Phillips Shovelnose Creek Sliammon Southgate Squamish Stawamus Theodosia Tzoonie Wortley Creek
A14-18 East Coast Vancouver Island	Big_Qualicum Campbell River Chemainus Cold Creek Cowichan Goldstream Little Qualicum Nanaimo Puntledge
A19-26 West Coast Vancouver Island	Cayeghle Colonial Demamiel Kootowis Goodspeed River Hathaway Creek Kloutchlimmis Nahmint River Nitinat

Appendix 3 (continued). Baseline chum stocks included in the stock composition analysis of the San Juan Islands and Point Roberts commercial chum fisheries (Catch Areas 7 & 7A).

<u>Region</u>	<u>Stock</u>
	Pegattum Creek
	Smith Creek
	Sugsaw
Fraser River	Alouette
	Alouette North
	Blaney Creek
	Chehalis
	Chilliwack
	Chilqua
	Harrison
	Harrison late
	Hicks Creek
	Hopedale Creek
	Inch
	Kanaka
	Kawakawa
	Lower Lillooet
	NorrishWorth
	Serpentine River
	Silverdale
	Squakum
	Stave
	Vedder
	Wahleach
	Widgeon Slough
	Worth Creek

Appendix 3 (continued). Baseline chum stocks included in the stock composition analysis of the San Juan Islands commercial chum fisheries (Catch Areas 7 & 7A).

<u>Region</u>	<u>Stock</u>
North Puget Sound	Nooksack Skagit County Line Ponds Grant Creek Siberia Creek Tulalip Hatchery Skykomish
South Puget Sound	Green River Kennedy Creek Minter Creek
Hood Canal	Big Quilcene Hoodsport
Strait of Juan de Fuca	Salmon Creek Elwha
Washington Coast	Bitter Creek Ellsworth Creek Quinault Satsop

Appendix 4. GSI Collections by management week for chum commercial fisheries in Areas 7 and 7A from 2007 - 2010.

**AREA
7**

YEAR	OCTOBER																	NOVEMBER																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2007	WEEK 41			WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
	245			184				216					0					30				0																					
2008	WEEK 41			WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
	200			264				200					0					47																									
2010				WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
								403																																			

**AREA
7A**

YEAR	OCTOBER																	NOVEMBER																									
	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2007	WEEK 41			WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
	152			200				200					0					148				0																					
2008	WEEK 41			WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
	0			307				199					145					0																									
2010				WEEK42				WEEK 43					WEEK 44					WEEK 45				WEEK 46																					
								203																																			

Appendix 5a: REGIONAL CHUM FISHERIES STOCK COMPOSITION TIME SERIES

Region	Year	Southern Region Baseline Analyses				
		Management Week				
		41	42	43	44	45
B.C. South Coast	2007	8.3%	15.3%	13.8%		11.3%
	2008	12.2%	7.7%	7.5%		0.7%
	2010			18.6%		
A14-18 ECVI	2007	18.9%	16.2%	30.9%		12.5%
	2008	14.3%	35.9%	39.2%		12.1%
	2010			32.8%		
A19-26 WCVI	2007	4.5%	0.3%	0.6%		1.0%
	2008	0.4%	0.3%	0.8%		0.2%
	2010			0.1%		
Fraser	2007	61.2%	67.6%	54.4%		11.1%
	2008	63.9%	55.1%	49.3%		7.1%
	2010			41.8%		
North Puget Sound	2007	6.1%	0.3%	0.1%		58.5%
	2008	2.0%	0.9%	1.7%		77.2%
	2010			6.6%		
South Puget Sound	2007	0.8%	0.1%	0.0%		3.0%
	2008	0.6%	0.1%	0.5%		0.2%
	2010			0.0%		
Hood Canal	2007	0.1%	0.0%	0.1%		0.0%
	2008	0.0%	0.0%	0.6%		2.4%
	2010			0.1%		
Strait of Juan de Fuca	2007	0.0%	0.1%	0.1%		1.5%
	2008	6.6%	0.0%	0.3%		0.0%
	2010			0.0%		
Washington Coast	2007	0.1%	0.0%	0.0%		0.7%
	2008	0.0%	0.1%	0.1%		0.0%
	2010			0.0%		

Notes: sample size < 100

Appendix 5b: REGIONAL CHUM FISHERIES STOCK COMPOSITION TIME SERIES

1. Area 7A	Southern Region Baseline Analyses					
	Management Week	41	42	43	44	45
Region	Year					
B.C. South Coast	2007	6.1%	8.6%	21.8%		27.0%
	2008		6.3%	32.2%	4.2%	
	2010			7.9%		
A14-18 ECVI	2007	1.4%	1.1%	10.3%		7.8%
	2008		14.7%	12.6%	9.8	
	2010			2.9%		
A19-26 WCVI	2007	0.2%	0.6%	0.3%		0.5%
	2008		1.3%	1.3%	1.7%	
	2010			1.4%		
Fraser	2007	90.9%	87.1%	67.2%		52.6%
	2008		76.4%	53.5%	80.5%	
	2010			87.0%		
North Puget Sound	2007	0.5%	1.7%	0.3%		11.5%
	2008		1.3%	0.3%	0.4%	
	2010			0.7%		
South Puget Sound	2007	0.0%	0.1%	0.2%		0.0%
	2008		0.0%	0.0%	0.0%	
	2010			0.0%		
Hood Canal	2007	0.0%	0.7%	0.0%		0.0%
	2008		0.1%	0.0%	0.0%	
	2010			0.0%		
Strait of Juan de Fuca	2007	0.0%	0.0%	0.1%		0.3%
	2008		0.0%	0.1%	3.4%	
	2010			0.1%		
Washington Coast	2007	0.8%	0.0%	0.0%		0.3%
	2008		0.0%	0.0%	0.0%	
	2010			0.0%		

Appendix 6a:

WASHINGTON COMMERCIAL CHUM FISHERIES AREA 7 STOCK COMPOSITION TIME SERIES BY MANAGEMENT WEEK

YEAR	WEEK 41			WEEK 42			WEEK 43			WEEK 44			WEEK 45		
	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA
2010 _{cBayes}							42	51	7						
2008 _{cBayes}	64	27	9	55	44	1	49	48	3				7	13	80
2007 _{cBayes}	61	32	7	67	32	1	54	45	1				11	25	64
2007 _{SPAM}	57	36	7	63	34	3	52	46	2				11	32	57
1995										28	49	23			
1993													56	38	6
1992							29	58	13						
1991															
1990	40	40	20	40	40	20									
1989										22	44	34	28	32	40
1988	44	48	8	28	60	12	26	53	21						
1987							27	59	14	17	68	15	10	71	19
1986				24	35	41	20	38	42	15	45	40	25	46	29
1985													22	14	64

Notes: 1) The 2008 and 2007 fisheries sample for week 45 is only 47 and 27 fish, respectively.

2) The 1995 to 1985 stock composition numbers are from electrophoresis analysis with a slightly different baseline.

Appendix 6b:

WASHINGTON STATE FISHERIES AREA 7A CHUM STOCK COMPOSITION TIME SERIES BY MANAGEMENT WEEK

YEAR	WEEK 41			WEEK 42			WEEK 43			WEEK 44			WEEK 45		
	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA	Fraser	non-Fr	WA
2010 _{cBayes}							87	12	1						
2008 _{cBayes}				76	22	2	54	46	0	80	16	4			
2007 _{cBayes}	91	8	1	87	10	3	67	32	1				53	35	12
2007 _{SPAM}	85	12	3	82	15	3	66	33	1				52	38	10
1995	62	29	9	62	29	9	62	29	9	56	26	18	56	26	18
1993										57	27	16	30	62	8
1992	52	31	17	52	31	17	29	48	23	57	37	6	57	37	6
1991	43	23	34	53	38	9	68	25	7	55	38	7	55	33	12
1990	63	25	12	72	22	6	57	36	7						
1989	46	33	21	65	23	12	55	45	0	48	39	13			
1988	71	25	4	48	40	12	57	27	16						
1987				52	35	13	27	61	12	24	57	19	47	35	18
1986				39	36	25				46	49	5	31	36	33
1985				72	26	2									

Note: The 1995 to 1985 stock composition numbers are from electrophoresis analysis with a different baseline.