

**Fishery-Sampled Inseason Coho Salmon  
(*Oncorhynchus kisutch*) Stock Identification  
from the Queen Charlotte Islands in 2004.**

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March, 2005

*A project funded by the Northern Boundary and Transboundary Rivers  
Restoration and Enhancement Fund 2004.*

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**ABSTRACT**

Coho salmon (*Oncorhynchus kisutch*) stock compositions were generated for the 2004 Queen Charlotte Islands troll and sport fishery using microsatellite DNA analysis. The stock compositions are an additional tool in the pursuit of inseason stock-specific abundance based management.

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## INTRODUCTION

A goal of North Coast coho (*O. kisutch*) stock assessment is to move towards in-season abundance-based management (ISABM). In theory, ISABM will allow protection of weak coho stocks in years of poor marine survival and increased exploitation in years of good marine survival.

Two recent projects undertaken by DFO North Coast Stock Assessment have made contributions to the goal. 1) Recent analysis of North Coast coho CWT recoveries in Alaska demonstrated total returns to Canadian coho indicator stocks can be predicted inseason. (Cox et al 2003). 2) A significant relationship between CPUE in the Queen Charlotte Island recreational fishery at Langara and total coho returns to the Babine fence has been established (See Figures 1 – 4).

Stock Identification of coho caught in the QCI sport and troll fisheries throughout the fishing season is a further refinement of this goal. Information about the stock composition and abundance in the Area 1 and 2 coho sport and commercial troll fisheries were collected in 2004. Coho DNA samples were taken from the sport caught fish utilizing the existing creel survey performed by the Haida Fisheries Program and the volunteer efforts of participating lodges. Coho DNA samples were taken from the troll fishery by dockside sampling. Both sampling programs were designed to provide stock composition and relative abundance (CPUE) over the fishing season.

The ultimate goal is to couple coho DNA stock identification with sport and troll fishery effort estimates in an attempt to provide similar information to the Alaskan caught CWT – indicator stock data. Should this be possible, management can function at a finer resolution than is currently possible.

Funding for this project was provided by the Northern Boundary and Transboundary Rivers Restoration and Enhancement Fund for the collection and analysis of microsatellite (DNA) coho salmon tissues collected from the Queen Charlotte Islands' (QCI) sport and troll fishery in 2004.

In 2004, the sport fishery consisted of over 14 lodges and a number of charter companies. Lodges include land based operations and floating barge or ship based operations. Lodges were located at Naden Harbour, Langara Island, Port Louis, Nesto Inlet, Kano Inlet, Douglas Inlet and Tasu Sound. A number of charter companies also operated out of Masset, Queen Charlotte City and Rennel Sound. Major sport fishing locations around the QCI are indicated in Figure 1.

A British Columbia tidal water sport fishing licence is required to harvest chinook salmon in the sport fishery. It allows anglers to fish any marine areas on the coast of British Columbia that are open to fishing. The number of sport licences issued is not limited. The number of resident licences issued has fluctuated between 228,000 and 259,000 since 1999. A total of 235,508 resident licences were issued in the 2004/5 season. The total number of nonresident licences issued annually has declined from 86,605 in 1999/2000 to 73,489 in 2004/5. Licences are not area specific so the actual number of licensed anglers that fished the Queen Charlotte Islands is unknown. The licence year begins April 1 each year with "annual" licences expiring the March 31 following the date of issue. Licences for 1 day, 3 days and 5 days are also available. Anglers

were required to purchase a "Salmon conservation stamp" in order to harvest any species of salmon. The cost of an annual licence and stamp was \$30 for residents of Canada and \$115 for non-residents in 2004. Additional information on sport licences is available on the Fisheries & Oceans, Pacific Region, Sport Fishing Homepage ([http://www.pac.dfo-mpo.gc.ca/recfish/Licences/sportLic\\_e.htm](http://www.pac.dfo-mpo.gc.ca/recfish/Licences/sportLic_e.htm)).

The QCI sport fishery is monitored through a creel survey performed by the Haida Fisheries Program. DNA analyses of coho salmon caught in the sport fishery have been completed for samples collected in 2004. In addition, a volunteer collected samples from the "Salmon Seeker" lodge on the west coast of QCI. Due to budget constraints, these samples were not analyzed in 2004 but are archived to allow for future analysis.

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.

## METHODS

Sport caught tissue samples were collected by the Haida Creel Survey program in the vicinity of Langara Island and by West Coast Resorts in the vicinity of Englefield Bay. Samples from the troll fishery were obtained by dock sampling performed by J.O. Thomas. The sampling protocol was to collect tissues and scales from a random sample of a minimum of 25 coho each week.

A common paper punch was used to collect tissue samples from the operculum of the coho salmon being sampled. One tissue sample was collected from each coho. 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.

Coho salmon collections were compared against genetic baselines from 208 coho salmon populations from Southeast Alaska south through Canada and the lower United States of America. Samples were analyzed for 15 loci, 13 microsatellite and 2 MHC, 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.).

## RESULTS

Over 1200 tissue samples were collected from the QCI sport fishery between July 20 and August 28, 2004. Haida Creel Survey program collected 1158 samples at Langara Island and Naden Harbour. West Coast Resorts collected 256 sampled from Englefield Bay. Over 1000 tissue samples were collected from the troll fishery between July 21 and August 23, 2004. DNA analysis was completed for 501 samples from the troll fishery and 397 samples from the sport fishery.

Stock compositions grouped by large geographic areas are presented over time in Figures 6 - 8 for each of the catch sample areas. Stock compositions change considerably over time and space. There are parallels in the patterns of change over time between the Troll and Langara samples, most notably the fishery is dominated by Central Coast stocks early in the season with the QCI stocks showing up in the catch as the season progresses. The major contributors to both sport and troll fisheries are the Central Coast and QCI stock groupings.

The differences in stock composition over space are shown in Figure 9. Since Stat Areas 101-1, 101-3 and 101-7 are positioned relatively close to each other, the differences between Areas could be an indication of sampling error. The most notable difference between Stat Areas is the absence of Central Coast North and an increased presence of Southern Mainland, East and West Coast of Vancouver Island coho in the sample from Area 142-2.

## DISCUSSION

It is encouraging that the coho stocks of concern, Upper Skeena (<1%) and Thompson River (0%) were insignificant in both sport and troll fisheries.

The observations from one season of data should not be considered indicative. Further sampling in subsequent years must be performed to determine if the data from 2004 are representative of the stock composition and abundance of coho salmon harvested off QCI.

## ACKNOWLEDGEMENTS

We thank the Haida Fisheries Program for collecting coho samples as part of their annual Haida Creel Survey. George Cuthbert and the staff of West Coast Resorts for volunteering to collect samples from coho salmon caught near Englefield Bay. DNA samples were analyzed by the Molecular Genetics Laboratory at the Pacific Biological Station in Nanaimo.

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## TABLES

Stat week	74	82	83	84	91	92	93
Stat area	101-1	101-7	101-10	101-10	101-10		
	101-3	101-1	101-7				
	101-7						
	142-2						
						2E	
		3	3-3	3	3	3	3
		6	6			6	

Table 1. : Stat Weeks and Stat Areas sampled for troll caught coho DNA in 2004

Stat Area	Area101-1		Area101-3		Area101-7		Area142-2	
Sampling Date	July 22-23		Jul-23		Jul-21		Jul-23	
Sample Size	111		53		55		46	
1 SE Alaska	0.0	(1.1)	12.0	(6.3)	0.0	(0.8)	2.0	(4.4)
2 WQCI	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.2)
3 EQCI	0.0	(0.2)	0.0	(1.0)	4.9	(3.0)	0.0	(1.9)
4 NQCI	1.1	(1.5)	0.9	(2.1)	3.4	(3.2)	4.6	(3.5)
5 Nass	0.9	(1.2)	0.0	(0.5)	0.0	(1.3)	0.0	(0.6)
6 Upper Skeena	0.0	(0.1)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)
7 Babine	0.0	(1.4)	0.0	(0.3)	5.9	(3.6)	1.6	(2.1)
8 Bulkley/Morice	0.3	(1.0)	0.0	(2.1)	0.0	(1.9)	0.0	(0.3)
9 Mid Skeena	0.0	(0.1)	0.0	(0.4)	0.0	(0.8)	0.0	(0.2)
10 Lower Skeena	16.7	(4.5)	12.2	(5.4)	0.9	(2.9)	9.0	(5.5)
11 Central Coast: No	17.0	(5.1)	31.5	(8.6)	41.2	(12.7)	0.3	(5.8)
12 Central Coast: So	32.5	(5.4)	30.1	(7.8)	4.9	(4.1)	17.4	(7.0)
13 WCVI	3.0	(2.3)	2.5	(2.7)	2.0	(3.3)	16.2	(6.8)
14 ECVI	2.0	(1.7)	0.0	(2.0)	0.0	(1.6)	13.8	(6.0)
15 NCVI	10.1	(3.4)	0.0	(1.6)	34.6	(12.5)	0.2	(2.5)
16 South Main	6.3	(3.1)	3.0	(3.7)	2.1	(2.6)	19.3	(6.7)
17 LWFR	3.7	(2.3)	1.9	(2.7)	0.0	(0.8)	6.7	(4.5)
18 NOTH	0.0	(0.6)	0.0	(0.4)	0.0	(0.4)	0.0	(0.5)
19 SOTH	0.0	(0.2)	0.0	(0.5)	0.0	(0.4)	0.0	(0.5)
20 LWTH	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)	0.0	(0.3)
21 UPFR	0.0	(0.8)	0.0	(0.4)	0.0	(0.2)	0.0	(0.3)
22 Puget	5.0	(2.5)	0.0	(0.4)	0.0	(2.2)	0.0	(2.5)
23 Juan de Fuca	0.0	(0.2)	6.0	(3.5)	0.0	(0.2)	0.0	(0.2)
24 Coastal Wash	1.4	(1.6)	0.0	(1.6)	0.0	(1.1)	9.0	(5.5)
25 Columbia	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.4)
26 California	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)	0.0	(0.4)

Table 2: Percent Stock composition, with standard deviation in brackets, observed in the QCI Troll fishery in July 2004.

Stat Area	Area101-1	Area101-1	Area101-7	Area101-10
Date Sampled	Aug-14	Aug-19	Aug17-24	Aug-23
Sample size	114(1)	52	98(1)	86(4)
1 SE Alaska	0.0 (0.5)	0.0 (0.7)	6.4 (2.6)	4.6 (3.0)
2 WQCI	0.0 (0.1)	0.0 (0.2)	0.0 (0.4)	0.0 (0.1)
3 EQCI	16.3 (3.9)	8.2 (3.8)	0.0 (0.2)	7.7 (3.0)
4 NQCI	36.4 (4.6)	57.6 (7.2)	34.8 (5.0)	17.8 (4.1)
5 Nass	0.7 (1.0)	2.1 (4.4)	2.6 (2.4)	7.4 (3.2)
6 Upper Skeena	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.8)
7 Babine	1.8 (1.5)	0.0 (0.2)	0.0 (0.2)	6.5 (2.7)
8 Bulkley/Morice	3.4 (1.8)	3.6 (2.6)	0.0 (0.6)	0.0 (0.3)
9 Mid Skeena	0.0 (0.2)	0.0 (0.7)	0.0 (1.8)	4.7 (2.8)
10 Lower Skeena	4.4 (2.6)	0.0 (1.9)	14.9 (5.2)	8.1 (4.0)
11 Central Coast: No	16.4 (4.6)	4.5 (5.6)	21.0 (5.1)	26.9 (8.3)
12 Central Coast: So	16.1 (4.0)	7.7 (4.7)	18.9 (4.8)	16.2 (6.1)
13 WCVI	0.0 (0.3)	0.0 (0.7)	0.0 (0.8)	0.0 (1.1)
14 ECVI	2.4 (2.4)	9.4 (4.2)	1.4 (1.6)	0.0 (0.5)
15 NCVI	0.0 (2.2)	0.0 (1.1)	0.0 (0.3)	0.0 (0.4)
16 South Main	0.0 (0.4)	5.7 (3.4)	0.0 (0.5)	0.0 (2.2)
17 LWFR	2.1 (1.6)	1.4 (3.1)	0.0 (0.7)	0.1 (1.2)
18 NOTH	0.0 (0.2)	0.0 (0.5)	0.0 (0.3)	0.0 (0.3)
19 SOTH	0.0 (0.2)	0.0 (0.5)	0.0 (0.2)	0.0 (0.3)
20 LWTH	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.2)
21 UPFR	0.0 (0.1)	0.0 (0.3)	0.0 (0.1)	0.0 (0.2)
22 Puget	0.0 (0.4)	0.0 (1.1)	0.0 (0.3)	0.0 (0.4)
23 Juan de Fuca	0.0 (0.1)	0.0 (1.1)	0.0 (0.1)	0.0 (0.2)
24 Coastal Wash	0.0 (0.1)	0.0 (0.4)	0.0 (0.2)	0.0 (0.3)
25 Columbia	0.0 (0.1)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)
26 California	0.0 (0.2)	0.0 (0.3)	0.0 (0.2)	0.0 (0.2)

Table 3: Percent Stock composition, with standard deviation in brackets, observed in the QCI Troll fishery in August 2004.

	Langara Sport July 20-24 92(4)	Langara Sport Aug 9-11 96(3)	Langara Sport Aug 12-18 85(1)	Langara Sport Aug 19-25 77(3)	Langara Sport Aug 26-28 47(2)
SE Alaska	0.0 (1.3)	7.2 (3.4)	0.0 (1.6)	0.0 (0.9)	0.0 (2.5)
WQCI	2.0 (1.5)	1.4 (1.4)	0.0 (1.4)	0.0 (0.1)	0.0 (0.2)
EQCI	0.0 (0.2)	0.1 (1.5)	0.0 (0.3)	0.9 (1.4)	0.0 (1.2)
NQCI	11.8 (3.9)	22.8 (4.7)	33.3 (5.5)	12.1 (3.9)	12.7 (5.5)
Nass	1.4 (1.8)	4.1 (2.8)	0.0 (2.7)	10.3 (4.4)	10.6 (6.2)
Upper Skeena	0.6 (1.1)	0.0 (0.7)	0.0 (0.2)	0.0 (0.3)	0.0 (0.3)
Babine	0.0 (0.2)	3.5 (2.3)	0.1 (1.9)	0.0 (0.2)	0.0 (0.3)
Bulkley/Morice	1.9 (1.7)	1.8 (1.6)	0.0 (0.4)	1.0 (1.3)	0.0 (0.2)
Mid Skeena	0.0 (0.1)	0.0 (0.7)	0.0 (0.2)	0.0 (0.1)	0.0 (0.3)
Lower Skeena	4.0 (3.8)	10.1 (4.1)	13.6 (4.6)	16.7 (5.7)	6.6 (4.9)
Central Coast: No	50.5 (7.1)	22.5 (5.6)	43.0 (7.7)	24.9 (6.3)	32.5 (8.0)
Central Coast: So	20.8 (5.6)	15.3 (4.7)	7.7 (4.3)	18.2 (6.0)	27.8 (6.8)
WCVI	2.7 (2.4)	3.0 (2.7)	0.1 (2.4)	3.0 (2.7)	0.3 (2.0)

ECVI	0.7	(2.4)	0.6	(1.4)	1.6	(3.2)	0.0	(0.8)	0.0	(0.8)
NCVI	1.3	(1.9)	7.9	(3.6)	0.0	(2.0)	0.0	(1.8)	0.0	(2.8)
South Main	1.6	(2.6)	0.0	(1.9)	0.0	(0.6)	8.7	(4.3)	0.0	(0.6)
LWFR	0.7	(2.3)	0.0	(0.4)	0.0	(0.4)	3.1	(2.5)	0.0	(0.9)
NOTH	0.0	(0.3)	0.0	(0.3)	0.0	(0.3)	0.0	(0.3)	0.0	(0.5)
SOTH	0.0	(0.3)	0.0	(0.2)	0.0	(0.3)	0.0	(0.3)	0.0	(0.5)
LWTH	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
UPFR	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)
Puget	0.0	(0.5)	0.0	(0.5)	0.5	(1.9)	0.0	(0.4)	0.0	(1.0)
Juan de Fuca	0.0	(0.1)	0.0	(0.1)	0.0	(1.9)	0.0	(0.1)	0.0	(1.8)
Coastal Wash	0.0	(0.3)	0.0	(0.3)	0.0	(2.1)	1.1	(1.3)	9.4	(4.2)
Columbia	0.0	(0.1)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(1.8)
California	0.0	(0.2)	0.0	(0.1)	0.0	(0.2)	0.0	(0.2)	0.0	(0.3)

Table 4: Percent Stock composition, with standard deviation in brackets, observed in the QCI Sport fishery from July 20 to August 28 2004.

12  
FIGURES

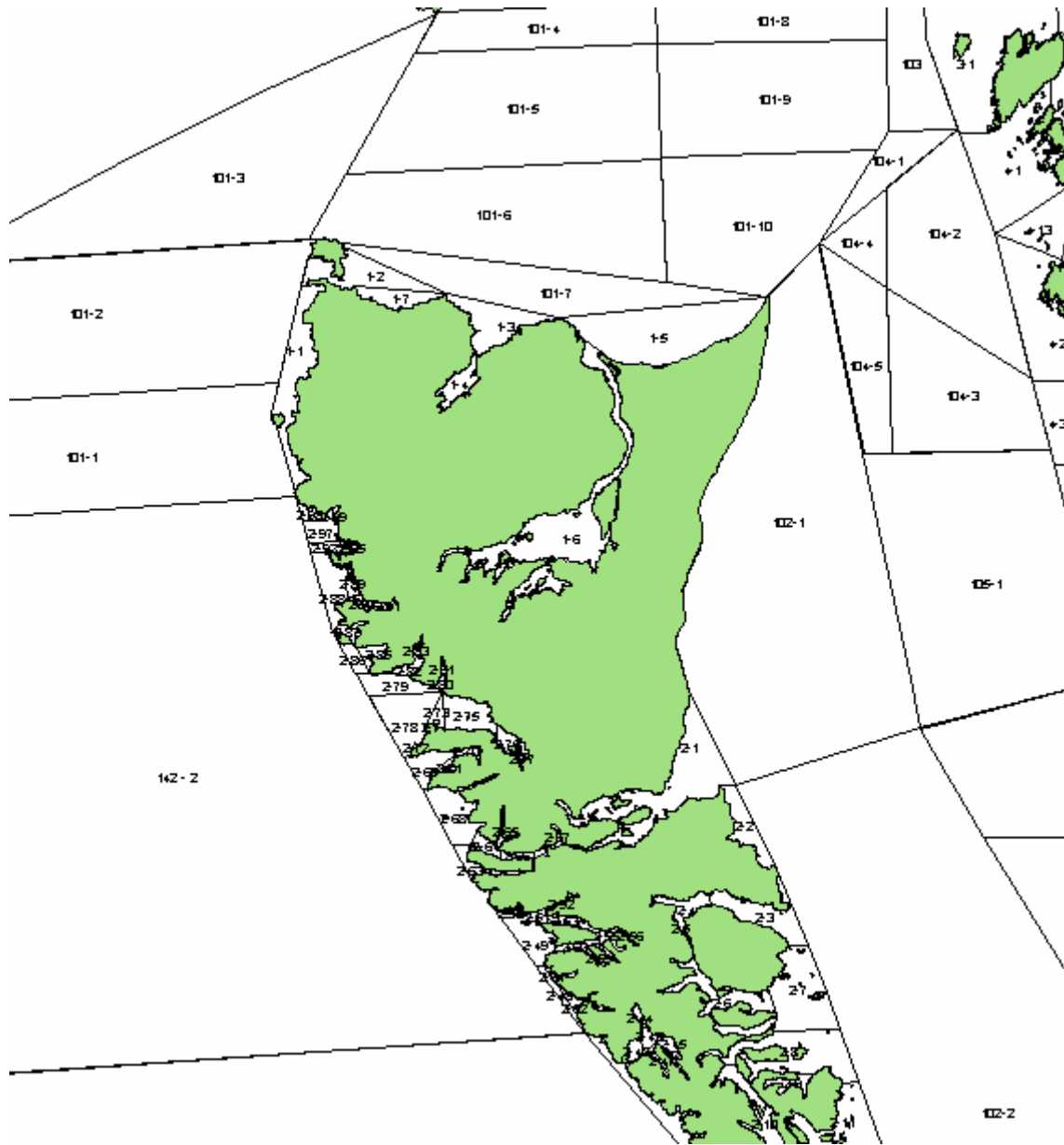


Figure 1. The northern portion of the Queen Charlotte Islands. Fishery Statistical Areas are labeled.

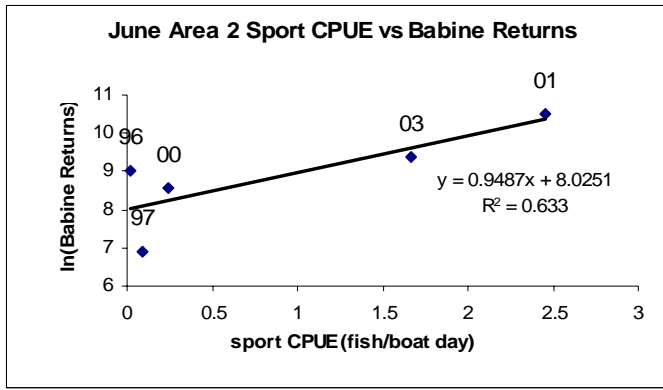


Figure 2: June Stat Area 2 (Langara) Sport CUPE vs. Babine coho returns. Data provided by the Haida Fisheries Program creel survey. Data are for years where there was a minimum of 2 fish harvest limit.

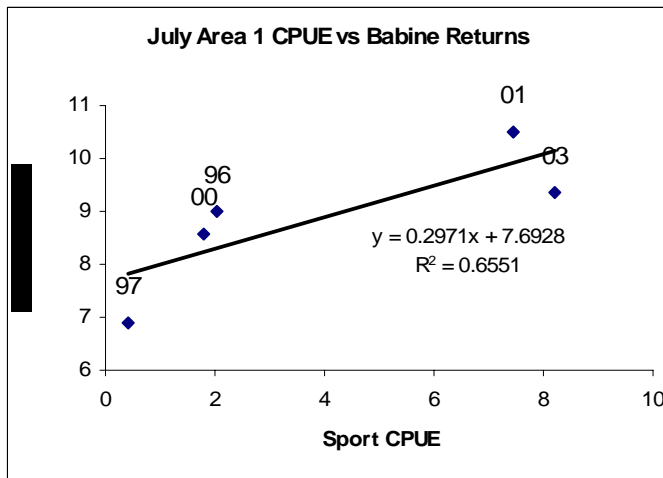


Figure 3: July Stat Area 1 (Langara) Sport CUPE vs. Babine coho returns. Data provided by the Haida Fisheries Program creel survey. Data are for years where there was a minimum of 2 fish harvest limit.

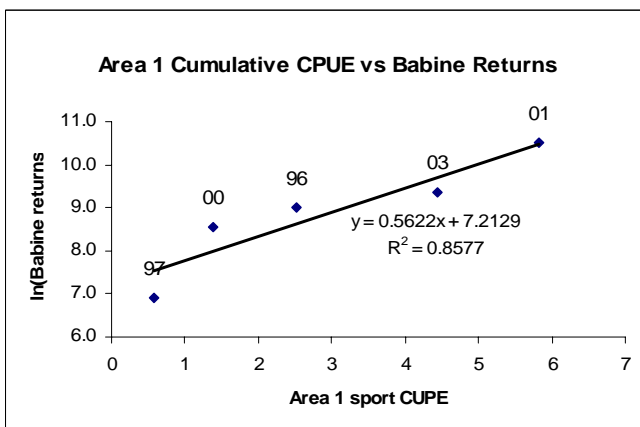


Figure 4: Stat Area 1 (Langara) cumulative sport CUPE vs. Babine coho returns. Data provided by the Haida Fisheries Program creel survey. Data are for years where there was a minimum of 2 fish harvest limit.

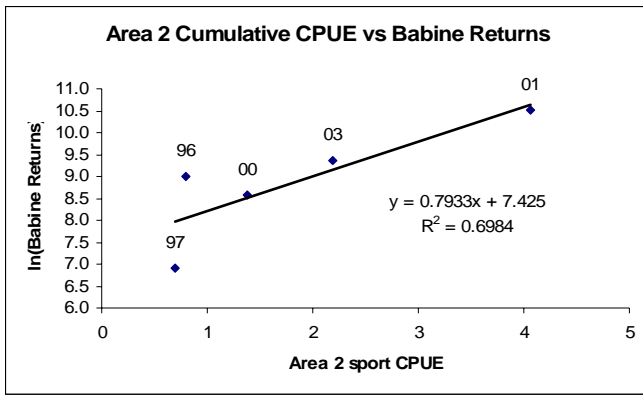


Figure 5: Stat Area 2 (Langara) cumulative sport CUPE vs. Babine coho returns. Data provided by the Haida Fisheries Program creel survey. Data are for years where there was a minimum of 2 fish harvest limit.

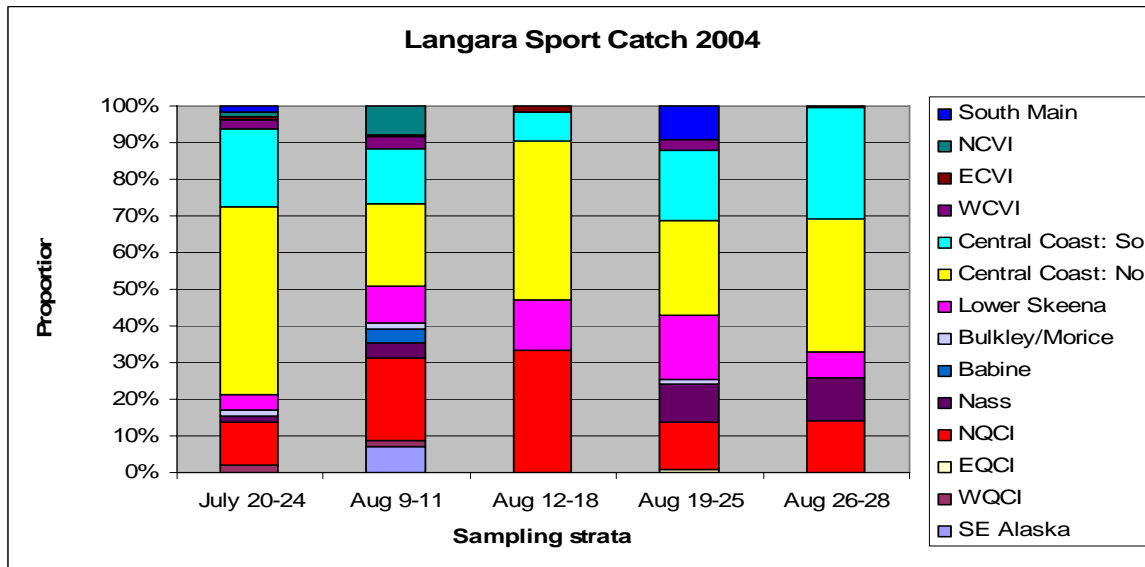


Figure 6: Stock composition of Langara Sport fishery in 2004.

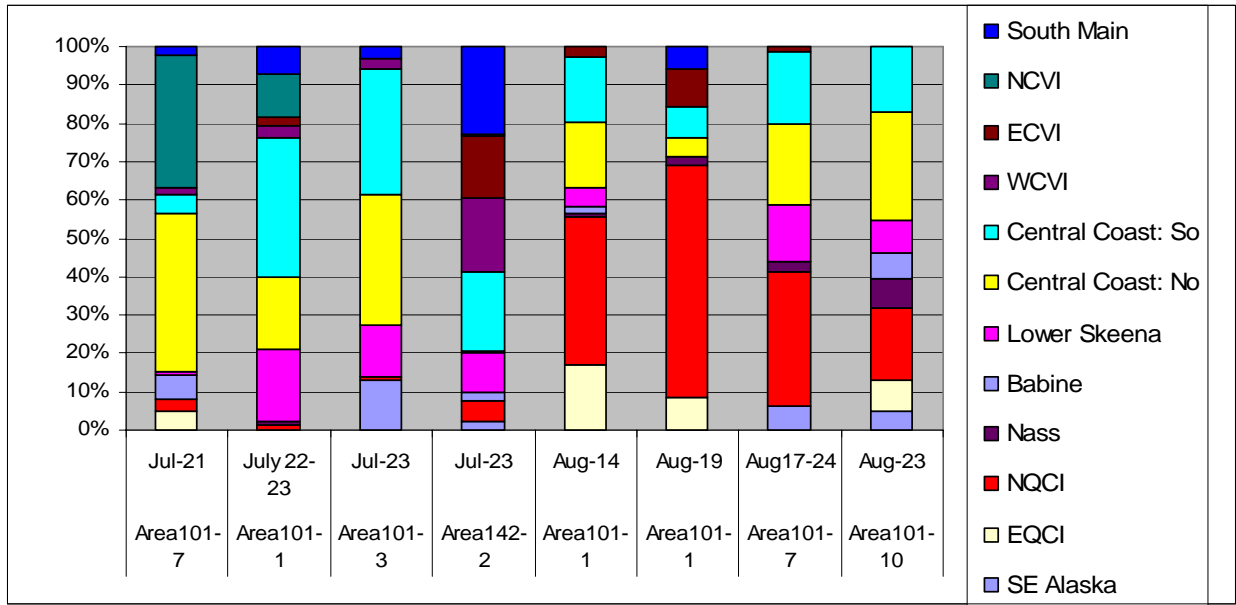


Figure 7: Stock composition of Troll fishery in 2004.

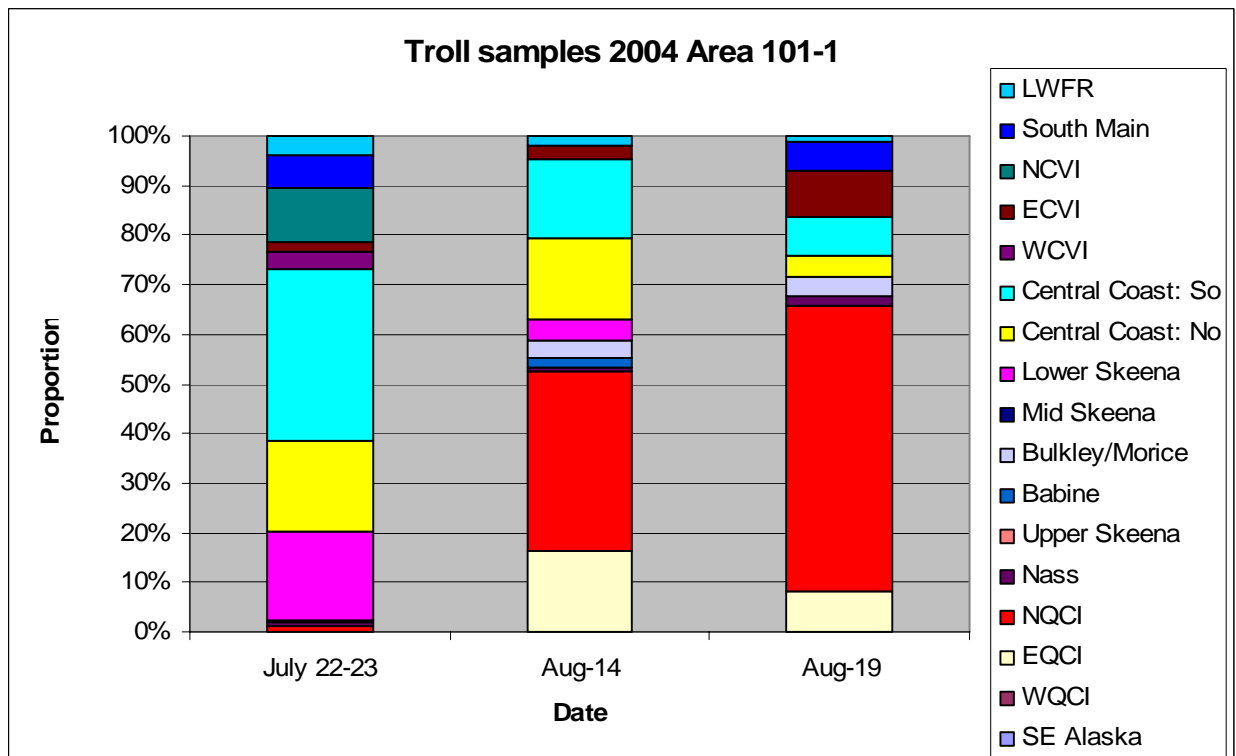


Figure 8: Stock composition over time for Troll fishery in Stat Area 101-1 in 2004.

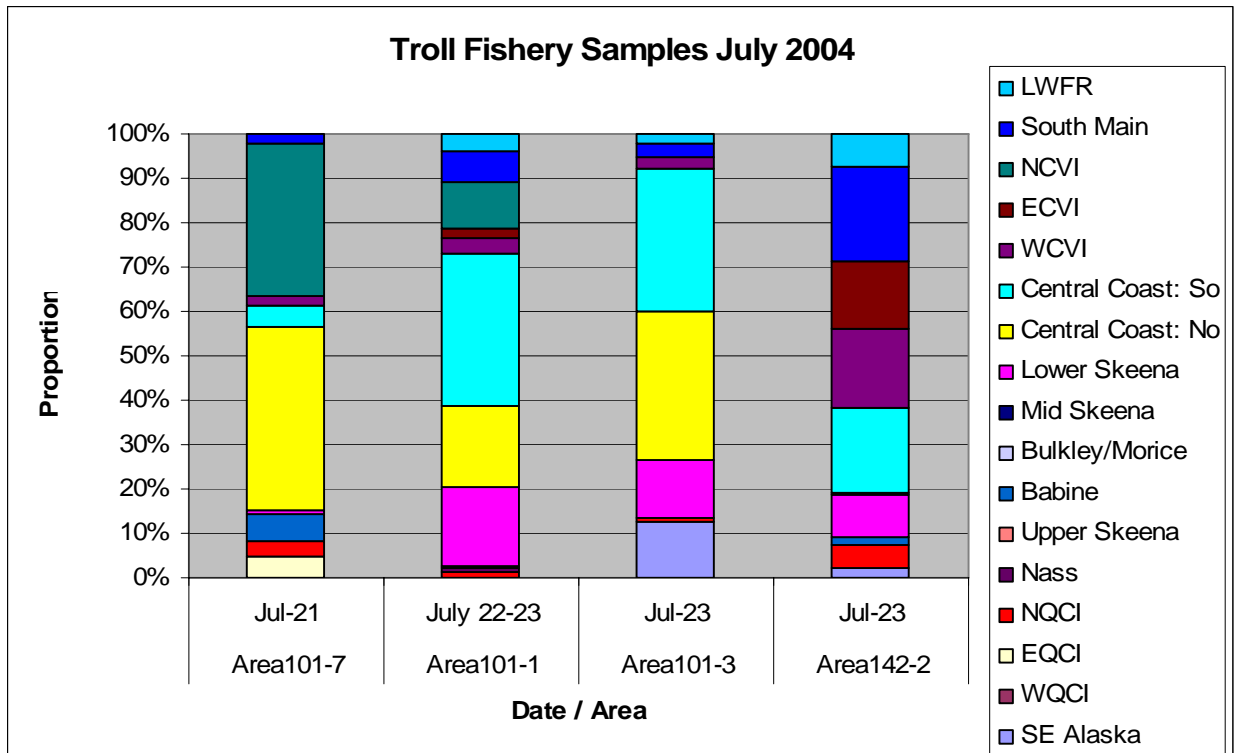


Figure 9: Stock composition across Stat Areas for Troll fishery in July 2004.



## APPENDICES

### Appendix 1. 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
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
1-6, 12 & 13	Fraser	Fraser River and tributaries
19-23	Skeena	Skeena River and tributaries
17, 18 & 24	TRANS	Transboundary Rivers originating in Canada flowing through Southeast Alaska
53-57, 61-63	Columbia	Columbia River and tributaries
58 & 59	Oregon	Oregon coastal
61, 64 & 65	California	California
50-52	Washington	Washington