Pacific Salmon Commission, Northern Fund Final Report

Northern & Transboundary Sockeye Salmon Matched Scale-Tissue Sampling – Final Report for Northern Fund, IHG 09-002; NF-2008-I-12

by

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and

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March 2010

Alaska Department of Fish and Game **Division of Commercial Fisherie**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, Special Publications and the Division of Commercial Fisheries Regional Reports. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

PACIFIC SALMON COMMISSION, NORTHERN FUND FINAL REPORT

NORTHERN & TRANSBOUNDARY SOCKEYE SALMON MATCHED SCALE-TISSUE SAMPLING YEAR 2

(IHG-09-002; NF-2008-I-12)

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ABSTRACT

Matched sockeye salmon scale and tissue samples for stock identification analyses were collected from weekly catches in the 2008 and 2009 Alaska District 101, 106, 108, and 111 drift gillnet, 182 set gillnet, and District 101, 102, 104, 105 and 107 purse seine fisheries.

Key words: sockeye salmon, *Oncorhynchus nerka*, matched biological sampling, scale pattern analysis, Southeast Alaska, Canada, Northern Boundary Area

INTRODUCTION

Provisions of the 1999 Pacific Salmon Treaty specify abundance-based harvest sharing agreements for Canadian Nass and Skeena River and Transboundary Stikine River sockeye salmon in selected U.S. fisheries. In these fisheries the U.S. is allowed to harvest a fixed percentage of the return of Nass, Skeena and Stikine sockeye stocks over the 1999 to 2008 duration of the agreements. Accurate estimates of the catch of Nass, Skeena and Stikine River sockeye salmon in all U.S. and Canadian commercial fisheries targeting these stocks is required, along with escapement estimates, to calculate their total return, and the percentage of that return caught in treaty-limited fisheries.

In the District 101 gillnet fishery the United States is allowed to harvest 13.8% of the Annual Allowable Harvest (AAH) of Nass River sockeye stocks. In the District 104 purse seine fishery, prior to statistical week 31 (late July), the United States is allowed to harvest 2.45% of the combined AAH of Nass and Skeena River sockeye salmon returns.

In the District 106 and 108 gillnet fisheries the U.S. is allowed to harvest 50% of the annual Total Allowable Catch (TAC) of Stikine River wild and enhanced sockeye salmon. Significant numbers of enhanced sockeye propagated under treaty agreement are caught in the District 106 and 108 fisheries and the relative strength of the wild and enhanced returns need to be assessed inseason by inspecting otoliths for thermal marks to avoid over-harvest of wild stocks.

Alaskan McDonald Lake sockeye salmon are not subject to treaty agreement but are the largest stock in southern Southeast Alaska and have been below escapement goals recently; time and area specific catch information is required for conservation efforts. McDonald Lake stocks cannot be identified accurately using scale pattern analysis, due to similarities in freshwater growth patterns shared by numerous other Alaskan stocks, so only genetic stock identification techniques are used for these estimates.

Since 1982 the catch of Canadian Nass and Skeena sockeye salmon in the District 101, 106, and 108 gillnet fisheries and the Districts 101-104 purse seine fisheries has been estimated using scale pattern analysis. Scale pattern analysis has also been used since 1982 to estimate the catch of Transboundary Stikine River sockeye salmon in the District 106 and 108 gillnet fisheries and the catch of Transboundary Taku River sockeye salmon in the District 111 gillnet fishery.

Scale pattern based stock identification analysis of sockeye salmon, based primarily on patterns of freshwater rearing growth, can only identify relatively large groups of stocks; e.g. Alaska, Nass, Skeena, and Stikine. Scale pattern analysis cannot accurately separate McDonald Lake sockeye from the numerous other Southeast Alaskan stocks, nor can the numerous individual sockeye stocks within the Nass, Skeena and Stikine Rivers be separated. Scale analysis is also labor intensive and time consuming and requires annual re-sampling of escapements to form an annual baseline which precludes its use inseason. These and other problems in accurately

estimating stock-specific catches and total returns of sockeye salmon in the early years of the Pacific Salmon Treaty resulted in an extensive investigation by the bilateral Northern Boundary Technical Committee of the run reconstruction modeling process currently used. The Committee concluded that improved stock identification techniques capable of accurately estimating specific groups of stocks are needed to accurately evaluate effectiveness of and improve, if possible, existing run reconstruction methods.

Genetic Stock Identification (GSI) analyses are a powerful emerging technology. Various types of genetic stock identification techniques, including mitochondrial and SNP analysis, have demonstrated accuracy in estimating the contribution of specific sockeye salmon stocks to mixed stock fisheries in Southeast Alaska and northern British Columbia. Fisheries and Oceans Canada (DFO) started using mixed stock analysis (MSA) based on genetic markers as a marine stock identification tool in 2003. This method has been used for stock separation of Canadian Nass and Skeena in-river fisheries since 1996. DFO has a long-term plan to use MSA solely in their analysis.

Matched scale-tissue samples will allow side-by-side comparison of GSI and scale pattern based stock identification estimates in Alaskan fisheries which will be useful in indexing new GSI estimates to the scale pattern estimates which go back to 1982 and which were used in calculating the current sharing agreements. As GSI stock identification techniques are developed this powerful tool will supersede much of the current scale pattern based stock identification work. However, historical baseline interception rate estimates, on which many of the current harvest sharing annexes are based, were based on scale analysis estimates and any differences between these and the new GSI estimates will need to be considered prior to switching analytical techniques.

PROJECT DELIVERABLES

This report covers only matched sampling collection as performed by the Alaska Fish and Game Commercial Fisheries Port Sampling Project. GSI analysis, scale pattern analysis, and otolith analysis are separate projects.

The objective of this project was to representatively collect matched scale-tissue samples weekly from the Districts 101, 106, 108 and 111 gillnet fisheries; the District 182 set gillnet fishery, and the Districts 101, 102, 104, 105, and 107 purse seine fisheries. The District 101, 106, and 108 gillnet and 104 purse seine fisheries are subject to PST harvest sharing agreements for sockeye salmon.

A total of 40,486 matched scale-tissue samples were collected (Tables 1-10). Weekly sampling goals were sometimes not achieved due to low catches or catches from different fisheries being mixed onboard tenders before being delivered to processors. Subdistrict specific purse seine samples in particular are difficult to obtain since numerous areas are open at the same time and seiners move between areas frequently seeking concentrations of fish resulting in mixed-subarea deliveries. Sex was recorded for all fish sampled and mid-eye-to-fork length was recorded for a sub set of all fish sampled. Scales were taken from the preferred area above the lateral line on the left side of the fish on a diagonal downward from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin. Tissue samples consisted of an axial process and/or otoliths.

Table 1.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 101 gillnet fishery July 1, 2008-September 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 5, 2008	27	4,949	520
July 12, 2008	28	6,175	520
July 19, 2008	29	3,361	520
July 26, 2008	30	4,733	520
August 2, 2008	31	1,313	509
August 9, 2008	32	4,394	520
August 16, 2008	33	552	284
August 23, 2008	34	382	130
August 30, 2008	35	273	20
June 27, 2009	26	15,177	220
July 4, 2009	27	9,505	260
July 11, 2009	28	8,494	260
July 18, 2009	29	7,999	260
July 25, 2009	30	7,731	260
August 1, 2009	31	10,113	260
August 8, 2009	32	6,269	260
August 15, 2009	33	2,186	260
August 22, 2009	34	1,141	269
August 29, 2009	35	710	240
September 5, 2009	36	397	187
September 12, 2009	37	121	66
Total		95,975	6,345

Table 2.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 106 gillnet fishery July 1, 2008-September 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 5, 2008	27	7,244	819
July 12, 2008	28	5,219	921
July 19, 2008	29	6,215	1,040
July 26, 2008	30	2,980	930
August 2, 2008	31	1,231	316
August 9, 2008	32	1,629	531
August 16, 2008	33	525	239
August 23, 2008	34	293	86
June 20, 2009	25	17,936	600
June 27, 2009	26	17,529	650
July 4, 2009	27	16,745	1,040
July 11, 2009	28	15,285	923

July 18, 2009	29	10,723	1,039
July 25, 2009	30	4,899	713
August 1, 2009	31	8,134	657
August 8, 2009	32	10,440	1,040
August 15, 2009	33	6,146	1,020
August 22, 2009	34	2,975	308
Total		136,148	12,872

Table 3.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 108 gillnet fishery July 1, 2008-September 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 5, 2008	27	14,654	289
July 12, 2008	28	9,162	518
July 19, 2008	29	5,899	499
July 26, 2008	30	3,300	160
August 2, 2008	31	2,116	40
August 9, 2008	32	869	40
August 16, 2008	33	478	26
August 23, 2008	34	189	7
June 27, 2009	26	7,919	922
July 4, 2009	27	10,280	420
July 11, 2009	28	8,100	260
July 18, 2009	29	2,337	178
July 25, 2009	30	3,454	192
August 1, 2009	31	2,571	220
August 8, 2009	32	876	72
August 15, 2009	33	531	34
August 22, 2009	34	465	41
Total		73,200	3,918

Table 4.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 111 gillnet fishery July 1, 2008-September 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 5, 2008	27	6,414	306
July 12, 2008	28	5,511	414
July 19, 2008	29	20,576	490
July 26, 2008	30	30,152	639
August 2, 2008	31	27,190	518
August 9, 2008	32	12,218	483
August 16, 2008	33	2,819	320
June 27, 2009	26	4,045	214

July 4, 2009	27	3,704	397
July 11, 2009	28	6,704	406
July 18, 2009	29	13,830	627
July 25, 2009	30	11,242	525
August 1, 2009	31	11,036	573
August 8, 2009	32	6,398	481
August 15, 2009	33	2,924	235
Total		167,255	6,628

Table 5.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 101 purse seine fishery July 1, 2008 – August 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 12, 2008	28	110	83
July 19, 2008	29	759	141
July 26, 2008	30	220	88
August 2, 2008	31	598	125
August 9, 2008	32	518	270
August 16, 2008	33	2827	420
August 23, 2008	34	1209	65
July 18, 2009	29	8,994	260
July 25, 2009	30	8,956	260
August 1, 2009	31	7,394	260
August 8, 2009	32	9,098	260
August 15, 2009	33	6,400	260
August 22, 2009	34	2,256	260
August 29, 2009	35	1,953	80
Total		51,292	2,891

Table 6.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 102 purse seine fishery July 1, 2008 – August 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
June 27, 2009	26	1,355	220
July 4, 2009	27	4,780	260
July 11, 2009	28	7,735	260
July 18, 2009	29	4,617	260
July 25, 2009	30	4,115	225
August 1, 2009	31	7,453	285
August 8, 2009	32	4,025	200
August 15, 2009	33	9,119	260
August 22, 2009	34	601	0
August 29, 2009	35	1,289	40
Total		45,089	2,010

Table 7.–Weekly matched scale-tissue samples collected and digitized for scale pattern analysis from Alaska's District 104 purse seine fishery July 1, 2008 – August 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 26, 2008	30	3,355	260
August 2, 2008	31	8,252	519
August 9, 2008	32	10,244	260
August 16, 2008	33	9,721	360
August 23, 2008	34	5,488	305
July 18, 2009	29	3,097	260
July 25, 2009	30	11,960	260
August 1, 2009	31	50,177	260
August 8, 2009	32	7,288	146
August 15, 2009	33	21,766	260
August 22, 2009	34	7,591	244
August 29, 2009	35	6,578	130
Total		145,517	3,564

Table 8.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 105 purse seine fishery 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
August 8, 2009	32	426	8
August 22, 2009	34	196	4
Total		622	12

Table 9.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 107 purse seine fishery July 1, 2008 – August 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 19, 2008	29	292	44
July 26, 2008	30	404	49
August 9, 2008	32	304	143
August 16, 2008	33	735	106
July 11, 2009	28	185	96
July 18, 2009	29	1,996	204
July 25, 2009	30	2,261	260
August 1, 2009	31	1,567	140
August 8, 2009	32	4,905	260
August 15, 2009	33	1,424	80
August 22, 2009	34	848	109
Total		14,921	1,124

Table 10.–Weekly matched scale-tissue samples collected and digitized for scale pattern analysis from Alaska's District 182 set gillnet fishery July 1, 2008 – August 2009.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 12, 2008	28	521	120
July 19, 2008	29	785	175
July 26, 2008	30	107	17
August 16, 2008	33	34	20
June 13, 2009	24	1,091	80
June 20, 2009	25	348	100
June 27, 2009	26	2,210	100
July 4, 2009	27	3,628	160
July 11, 2009	28	2,058	160
July 18, 2009	29	1,041	120
July 25, 2009	30	1,503	20
August 8, 2009	32	134	40
August 15, 2009	33	216	10
Total		13,676	1,122

Table 11.– Age composition of sockeye salmon scale samples collected from the 2008 Southeast Alaska net fisheries.

2008		Age Class												
Gear	District	0.2	0.3	0.4	1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.2	3.3
Seine	101	1	3		10	585	127	8	13	170	27	1	4	
	102	3	44		57	864	545	9	9	366	96	5	1	
	104				20	1201	211	7	7	134	36	1	2	
	107	3	10		8	109	38	2	19	70	10	1		
	112	10	83		3	218	309	1		38	24			
Gillnet	101	4	55		2	870	587	12	1	1863	475	3	10	
	106	1	124		1	2329	1438	40		760	254	13	8	
	108	1	146	1		518	1058	10		110	59	4	1	1
	111	23	548			715	2548	12		58	76	1	1	
Setnet	182	2	3			234	260	12		6	7			

Table 12.– Age composition of sockeye salmon scale samples collected from the 2009 Southeast Alaska net fisheries.

2009		Age Class													
Gear	District	0.2	0.3	0.4	1.1	1.2	1.3	1.4	1.5	2.1	2.2	2.3	2.4	3.2	3.3
Seine	101		2		7	459	480	2		31	227	128		3	
	102	2	7		12	734	473			33	157	142	1		
	104	1	1		5	327	644	1	2	11	116	103	4		
	105						5				3	2			
	107	2	5		9	128	340			64	173	159			1
Gillnet	101	1	19			254	789	3			898	448		2	1
	106		35		1	1114	4217	4		3	504	850		10	3
	108	4	79			240	2252	4		1	201	210		10	
	111	14	374	5		290	2277	7		23	159				
Setnet	182	4	14		1	88	471				4	30			

Analytical results of the matched sample analyses will be correlated using a unique number assigned to each scale sample digitized. This unique number is listed for each digitized scale in the Alexander database which also lists the numbered vial containing the matching tissue sample. Since all scales cannot be digitized this database will be used both to identify which tissues should be analyzed and to compare both individual and pooled stock identification estimates generated by the two techniques.

This project was originally funded for the period July 1, 2008 through June 30, 2008. However, due to staff changes and lower catch levels in 2008 the project was extended into 2009 to collect additional samples. Samples were collected from weekly catches representatively throughout the duration of the fisheries. Prior or subsequent projects provided continuity in sampling over several years.

DISCUSSION

Progress in achieving sampling goals, sample quality control, and the quality of recordkeeping necessary to match stock composition estimates, were monitored on a daily basis by port sampling supervisors in Ketchikan and Petersburg and on a weekly basis by the regional data coordinator and project supervisor in Juneau. Representative sampling of the landed catch was assured by: 1) sampling landings in Petersburg, Wrangell, Ketchikan, Juneau, and Yakutat; 2) collecting no more than 40 samples from individual fishing boat deliveries or 200 from individual tender deliveries; 3) placing samplers onboard vessels purchasing fish on the grounds to obtain unmixed subdistrict specific samples; 4) sampling throughout the duration of each weekly opening; and 5) interviewing vessel personnel and checking fish tickets to assure that all fish onboard were caught in the targeted fishery.

Matched scale-tissue sampling goals were generally met except where low catches and/or mixed deliveries made this impossible. The scales collected have been analyzed to produce stock identification estimates for the 2008 season and analysis is in progress for the 2009 season collection. Delays in completing the genetic analysis baseline, which was not part of this project, have delayed processing of the tissue sample portion of the matched catch samples. Therefore, we are submitting this final report for Alaska Department of Fish and Game's portion of the project and the National Marine Fisheries Service Auke Bay Laboratory will submit results of the genetic analysis when these are complete.

TANGIBLE BENEFITS

Replacement of scale pattern analysis with an accurate, genetically based, stock identification technique will facilitate: 1) reduced sampling costs since the annual baseline escapement samples needed for scale analysis will no longer be needed; 2) much finer resolution of individual stocks allowing stock specific migratory routing and timing studies; 3) inseason stock identification analyses which cannot be done with scale analysis because the baseline samples required cannot be collected until early fall; 4) stock specific spawner-recruit analyses; and 5) providing managers with the ability to shift time and area openings to access surplus stocks or avoid weak stocks.

Inseason examination of otoliths collected in the District 106 and 108 gillnet fisheries provides managers with an estimate of the contribution of enhanced stocks and thus the ability to avoid overharvest of wild stocks.

The negotiated percentage of the annual allowable harvest of Nass and Skeena sockeye that can be taken in Alaska's District 101 gillnet and 104 purse seine fisheries are based on average interception rates in these fisheries estimated by scale pattern analyses between 1985 and 1997. Having matched scale-tissue samples will allow direct comparison of the two techniques which will allow researchers to determine if any apparent changes in interception rates are real or are due to differences in estimates produced by the two techniques.

BUDGET SUMMARY

The budget allocation for this project was as follows:

Salary for ADF&G port sampling personnel: 9 samplers x 7.5/hr/day x 37 days x $26.6024/hr		$148,570
Travel; to/from Juneau, Ketchikan, Petersburg, Wrangell		$1,420
Contractual; pay to tenders for onboard samplers, cell phone charges, shipping, etc.		$22,000
Supplies; vials, forms, tags, gloves, etc.		$6,000
Subtotal Direct	$177,991	
ADF&G Overhead: $137,990 x 14%		$24,919
TOTAL		$202,909

Actual direct expenditures for this project were as follows:

Line 100, salaries and benefits		$154,058
Line 200, travel		$4,082
Line 300 Contractual		$5,271
Line 400 Commodities		$14,308
Subtotal Direct	$177,719	

Total direct project expenditures by Alaska Fish and Game totaled $177,719. All project expenditures by Alaska Fish and Game were for personnel, travel, contractual and commodities related to matched sample collection in Ketchikan, Petersburg and Wrangell as well as project supervision in Juneau. ADF&G personnel coded to this project included: 1); 2) Lezlie Rice, Wrangell port sampling; 3) Jason McGinley, Anna Buettner, Debra Meusel, Brandi Giroux, Andy Leitz, Ketchikan port sampling, 4) Vera Goudima and Troy Wilson, Petersburg port sampling; 4) Ricky Riddle, Tony Florendo, Dylan Rhea-Fournier, Juneau port sampling