Pacific Salmon Commission, Northern Fund Final Report

Northern & Transboundary Sockeye Salmon Matched Scale-Tissue Sampling – Final Report for Northern Fund, NF-2010-I-12; COOP-11-004

by

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July 2011

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 3

(COOP-11-004; NF-2010-I-10)

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ABSTRACT

To fulfill the Pacific Salmon Treaty harvest-sharing agreements, correct estimates of the Nass, Skeena and Stikine River sockeye salmon contribution to catch in the US must be calculated. Matched sockeye salmon scale and tissue samples for stock identification analyses were collected from the weekly catches in the 2010 Alaska District 101, 106, 108, and 111 drift gillnet, 182 set gillnet, and District 101, 102, 103, 104, 105 and 107 purse seine fisheries. A total of 20,210 matched samples were taken from July1-August 2010. These matched samples will be used to facilitate the transition from scale pattern analysis to genetic analysis making processing thousands of samples more accurate and prompt.

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, 103, 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 25,110 matched scale-tissue samples were collected from July 1- June 30, 2011(Tables 1-11). 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, 2010-June 30, 2011.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 3, 2010	27	11,780	60
July 10, 2010	28	8,756	260
July 17, 2010	29	4,051	260
July 24, 2010	30	4,723	260
July 31, 2010	31	7,911	260
August 7, 2010	32	9,373	260
August 14, 2010	33	7,014	260
August 21, 2010	34	2,489	255
August 28, 2010	35	1,280	260
June 25, 2011	26	8,701	260
July 2, 2011	27	20,398	260
Total		86,476	2,655

Table 2.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 106 gillnet fishery July 1, 2010-June 30, 2011.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 3, 2010	27	11,193	120
July 10, 2010	28	17,713	670
July 17, 2010	29	15,348	580
July 24, 2010	30	16,454	920
July 31, 2010	31	16,528	830
August 7, 2010	32	9,105	860
August 14, 2010	33	9,199	990
August 21, 2010	34	5,472	541
June 18, 2011	25	2,050	500
June 25, 2011	26	12,689	900
July 2, 2011	27	32,019	1,040
Total		147,770	7,951

Table 3.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 108 gillnet fishery July 1, 2010-June 30, 2011.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 3, 2010	27	10,888	259
July 10, 2010	28	7,196	517
July 17, 2010	29	4,854	464
July 24, 2010	30	3,013	513
July 31, 2010	31	1,590	300
August 7, 2010	32	691	283
August 14, 2010	33	329	236
August 21, 2010	34	254	61
June 25, 2011	26	5,300	510
July 2, 2011	27	19,517	520
Total		53,632	4,948

Table 4.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 111 gillnet fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 3, 2010	27	3,016	470
July 10, 2010	28	3,725	547
July 17, 2010	29	7,186	520
July 24, 2010	30	14,330	470
July 31, 2010	31	12,672	400
August 7, 2010	32	12,612	240
August 14, 2010	33	2.364	220
June 25, 2011	26	2,143	160
July 2, 2011	27	4,477	410
Total		62,525	3,437

Table 5.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 101 purse seine fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 10, 2010	28	1,653	120
July 17, 2010	29	5,291	260
July 24, 2010	30	5,948	200
July 31, 2010	31	13,035	260
August 7, 2010	32	15,045	260
August 14, 2010	33	7,380	260
August 21, 2010	34	3,239	260
August 28, 2010	35	2,140	218
Total		53,731	1,838

Table 6.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 102 purse seine fishery July 1, 2010 - June 30, 2011.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 10, 2010	28	7,208	260
July 17, 2010	29	2,733	260
July 24, 2010	30	3,441	184
July 31, 2010	31	1,802	40
August 7, 2010	32	5,590	80
August 14, 2010	33	4,957	260
August 21, 2010	34	3,081	160
August 28, 2010	35	2,285	240
June 25, 2011	26	164	40
July 2, 2011	27	3,974	260
Total		31,097	1,484

Table 7.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 103 purse seine fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
August 7, 2010	32	505	40
August 14, 2010	33	1,882	40
Total		2,387	80

Table 8.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 104 purse seine fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 17, 2010	29	2,800	89
July 24, 2010	30	1,491	130
July 31, 2010	31	3,010	380
August 7, 2010	32	3,175	130
August 14, 2010	33	3,417	130
August 21, 2010	34	1,435	80
August 28, 2010	35	1,744	40
Total		17,072	979

Table 9.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 105 purse seine fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
August 14, 2010	33	319	3
Total		319	3

Table 10.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 107 purse seine fishery July 1, 2010-August 2010.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 10, 2010	28	127	35
July 17, 2010	29	873	238
Total		1000	273

Table 11.–Weekly matched scale-tissue samples collected for scale pattern analysis from Alaska's District 182 set gillnet fishery July 1, 2010-June 30, 2011.

Week Ending	Statistical Week	Sockeye Catch	Matched Scale-Tissue Samples
July 10, 2010	28	16,305	300
July 17, 2010	29	14,452	340
July 24, 2010	30	14,780	600
July 31, 2010	31	14,609	40
August 7, 2010	32	7,443	520
August 14, 2010	33	2,316	240
August 21, 2010	34	1,432	20
August 28, 2010	35	863	10
June 11, 2011	24	991	80
June 18, 2011	25	585	80
June 25, 2011	26	495	80
July 2, 2011	27	2,156	100
Total		17,903	1,462

Table 12.–Age composition of sockeye salmon scale samples collected from July 1, 2010- August 2010 in Southeast Alaska net fisheries.

2010		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		14	459	544	1	21	364	65		4	
	102	3	7		14	511	530		20	248	24		6	
	103				1	33	16			13	4		1	
	104	4	2		5	422	185		2	176	25			
	107		1			59	55			93	11			
Gillnet	101		6		2	329	698	2	4	514	222		7	2
	106	1	17			1719	1791	8		1002	268	4	37	3
	108		62	1		292	1129	6		305	86		67	1
	111	23	582	1		509	1298	11		51	55			
Setnet	182	18	241	4	2	507	594	9		171	116		3	

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.

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. All tissue samples from the 2010 season have been forwarded to the respective genetics laboratories. During the 2010 season scale samples and corresponding data were sent weekly to the ADF&G Scale lab. Staff members of the ADF&G Douglas Scale Ageing Laboratory have processed the raw data and are in the process of assigning an age class to all scale samples that can be aged. Once the scale pattern analysis is complete the respective genetics laboratories will compile stock composition estimates using the same samples as were used in the SPA. Results from both methods will be compared and a final report in completion of this project will be available by June 2012.

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 percentages 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:		$154,023
Travel; to/from Juneau, Ketchikan, Petersburg, Wrangell		$1,420
Contractual; pay to tenders for onboard samplers, cell phone charges, shipping, etc.		$10,550
Supplies; vials, forms, tags, gloves, etc.		$12,830
Subtotal Direct	$178,723	
ADF&G Overhead: $178,723 x 14%		$25,021
TOTAL		$203,744

Actual direct expenditures for this project were as follows:

Line 100, salaries and benefits	$145,016
Line 200, travel	$845
Line 300 Contractual	$15,569

Line 400 Commodities		$15,068
Subtotal Direct	$176,498	

Total direct project expenditures by Alaska Fish and Game totaled $176,498. All project expenditures by Alaska Fish and Game were for personnel, travel, contractual and commodities related to matched sample collection in Ketchikan, Petersburg, Wrangell, and Juneau as well as project supervision from Juneau. ADF&G personnel coded to this project included: 1) Ricky Riddle, Jon Livermore, and Antonio Florendo, Juneau port sampling, 2) Lezlie Rice and Marissa Cummings, Wrangell port sampling; 3) Marc Osborne, Debra Meusel, Erika Johnson, Brandi Giroux, Andy Leitz, Ketchikan port sampling, 4) Matt Lenhard, James Spignesi, and Vera Goudima, Petersburg port sampling.