

Special Publication No. 04-16

Approximate Costs That Can Be Associated With The Coded Wire Tag Program In Southeast Alaska

A Summary Prepared for the Future of the CWT Program:

Challenges and Options Workshop

June 7–10, 2004

Seattle, Washington

by

John H. Clark

December 2004

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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, and Special Publications. 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)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mideye-to-fork	MEF
gram	g	all commonly accepted		mideye-to-tail-fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.	Mathematics, statistics	
meter	m			<i>all standard mathematical</i>	
milliliter	mL	at	@	<i>signs, symbols and</i>	
millimeter	mm	compass directions:		<i>abbreviations</i>	
		east	E	alternate hypothesis	H _A
Weights and measures (English)		north	N	base of natural logarithm	<i>e</i>
cubic feet per second	ft ³ /s	south	S	catch per unit effort	CPUE
foot	ft	west	W	coefficient of variation	CV
gallon	gal	copyright	©	common test statistics	(F, t, χ^2 , etc.)
inch	in	corporate suffixes:		confidence interval	CI
mile	mi	Company	Co.	correlation coefficient	
nautical mile	nmi	Corporation	Corp.	(multiple)	R
ounce	oz	Incorporated	Inc.	correlation coefficient	
pound	lb	Limited	Ltd.	(simple)	r
quart	qt	District of Columbia	D.C.	covariance	cov
yard	yd	et alii (and others)	et al.	degree (angular)	°
		et cetera (and so forth)	etc.	degrees of freedom	df
Time and temperature		exempli gratia		expected value	<i>E</i>
day	d	(for example)	e.g.	greater than	>
degrees Celsius	°C	Federal Information		greater than or equal to	≥
degrees Fahrenheit	°F	Code	FIC	harvest per unit effort	HPUE
degrees kelvin	K	id est (that is)	i.e.	less than	<
hour	h	latitude or longitude	lat. or long.	less than or equal to	≤
minute	min	monetary symbols		logarithm (natural)	ln
second	s	(U.S.)	\$, ¢	logarithm (base 10)	log
		months (tables and figures): first three		logarithm (specify base)	log ₂ , etc.
Physics and chemistry		letters	Jan,...,Dec	minute (angular)	'
all atomic symbols		registered trademark	®	not significant	NS
alternating current	AC	trademark	™	null hypothesis	H ₀
ampere	A	United States		percent	%
calorie	cal	(adjective)	U.S.	probability	P
direct current	DC	United States of		probability of a type I error	
hertz	Hz	America (noun)	USA	(rejection of the null hypothesis when true)	α
horsepower	hp	U.S.C.	United States	probability of a type II error	
hydrogen ion activity	pH		Code	(acceptance of the null hypothesis when false)	β
(negative log of)		U.S. state	use two-letter abbreviations	second (angular)	"
parts per million	ppm		(e.g., AK, WA)	standard deviation	SD
parts per thousand	ppt, ‰			standard error	SE
volts	V			variance	
watts	W			population	Var
				sample	var

SPECIAL PUBLICATION NO. 04-16

**APPROXIMATE COSTS THAT CAN BE ASSOCIATED WITH THE
CODED WIRE TAG PROGRAM IN SOUTHEAST ALASKA**

by

John H. Clark
*Chief Anadromous Fisheries Scientist
Commercial Fisheries Division
Alaska Department of Fish and Game
Juneau Alaska*

December 2004

The Division of Sport Fish Special Publications series was established in 1991 for the publication of techniques and procedures manuals, informational pamphlets, special subject reports to decision-making bodies, symposia and workshop proceedings, application software documentation, in-house lectures, and other documents that do not fit in another publication series of the Division of Sport Fish. Since 2004, the Division of Commercial Fisheries has also used the same Special Publication series. Special Publications are intended for fishery and other technical professionals. Special Publications are available through the Alaska State Library and on the Internet: <http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm>. This publication has undergone editorial and peer review.

*John H. Clark
Alaska Department of Fish and Game, Division of Commercial Fisheries
1255 W. 8th Street, PO Box 25526
Juneau Alaska 99802-5526*

This document should be cited as:

Clark, John H. 2004. Approximate costs that can be associated with the coded wire tag program in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 04-16, Anchorage.

The Alaska Department of Fish and Game administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

If you believe you have been discriminated against in any program, activity, or facility, or if you desire further information please write to ADF&G, P.O. Box 25526, Juneau, AK 99802-5526; U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington, VA 22203 or O.E.O., U.S. Department of the Interior, Washington DC 20240.

For information on alternative formats for this and other department publications, please contact the department ADA Coordinator at (voice) 907-465-4120, (TDD) 907-465-3646, or (FAX) 907-465-2440.

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	ii
LIST OF FIGURES.....	ii
LIST OF APPENDICES	ii
ABSTRACT	3
INTRODUCTION.....	3
Coded wire Tag Recovery Program.....	3
Coded wire Tagging Program.....	5
Costs	5
NUMBERS OF CHINOOK AND COHO SALMON RELEASED IN SOUTHEAST ALASKA WITH CODED WIRE-TAGS	6
COSTS OF CODED WIRE TAGGING OF HATCHERY RELEASES OF CHINOOK AND COHO SALMON IN SOUTHEAST ALASKA.....	6
WILD ORIGIN CHINOOK AND COHO SALMON CODED WIRE TAG PROGRAM AND COSTS	8
NUMBERS OF CHINOOK AND COHO SALMON RECOVERED FROM SOUTHEAST ALASKA FISHERIES WITH CODED WIRE TAGS.....	10
COSTS OF THE CODED WIRE TAG RECOVERY PROGRAM IN SOUTHEAST ALASKA	10
COSTS OF THE ADF&G TAG LABORATORY IN JUNEAU ALASKA.....	11
HATCHERY ORIGIN VERSUS WILD STOCK COSTS AND CHINOOK VERSUS COHO COSTS	11
TOTAL COSTS INVOLVED WITH THE CODED WIRE TAG PROGRAM IN SOUTHEAST ALASKA	13
ADDENDUM.....	15
ACKNOWLEDGEMENTS.....	15
APPENDIX A	17

LIST OF TABLES

Table	Page
1. Numbers of juvenile Chinook and coho salmon that were coded wire-tagged in Southeast Alaska from 2000–2002. Also shown are the numbers of total juvenile Chinook and coho salmon released from hatchery facilities and the average percent of released hatchery fish with coded wire tags.	7
2. Approximate costs associated with the coded wire tagging of juvenile Chinook and coho salmon released from hatcheries in Southeast Alaska.	8
3. Projects funded in FY 04 wherein the major effort is involved with the coded wire tagging of juvenile Chinook and coho salmon, Southeast Alaska.	9
4. Numbers of Chinook and coho sampled for the presence of coded wire tags in Southeast Alaska during the period of 1999–2003.	10

LIST OF FIGURES

Figure	Page
1. The percent of troll caught Chinook salmon that were sampled in the Southeast Alaska coded wire tag recovery program that were found to be “no-tags” after delivery to the ADF&G Tag Laboratory from January 2001 through February 2004.	4

LIST OF APPENDICES

Appendix	Page
A1. Genetic stock identification of Chinook salmon harvested in Southeast Alaska fisheries.	18

ABSTRACT

The average annual numbers of Chinook and coho salmon (*Oncorhynchus tshawytscha* and *kisutch*) coded wire tagged in Southeast Alaska in 2000–2002 were about 1.0 million and 1.2 million fish, respectively. The approximate annual costs associated with these activities were about \$400,000 for hatchery fish and about \$850,000 for wild origin fish. The average annual number of Chinook and coho salmon sampled in Southeast Alaska for recovery of coded wire tags in 1999–2003 was about 100,000 and 700,000 fish, respectively. The approximate annual cost associated with these activities was about \$670,000. The Alaska Department of Fish and Game has decoded about 35,000 coded wire tags per year at a cost of about \$650,000. As a result, an approximate annual cost of the Southeast Alaska Chinook and coho salmon coded wire tag program is estimated to total about \$2.6 million. Information available suggests costs on a per fish basis were less for hatchery origin fish than for wild origin fish and that costs for coho salmon were less than costs for Chinook salmon.

Key words: Chinook salmon, *Oncorhynchus tshawytscha* coho salmon, *Oncorhynchus kisutch*, Southeast Alaska, coded wire tags, agency costs.

INTRODUCTION

During the 1970's, various organizations began marking anadromous Chinook and coho salmon with coded wire tags. During the late 1970's, various entities began sampling commercially harvested salmon in Southeast Alaska to recover these tags. The initial recovery efforts were not coordinated and caused disruption to processors. Processors complained about disruptions in their fish processing facilities and entities applying the tags complained because fisheries were not sampled in what they believed to have been an adequate fashion.

CODED WIRE TAG RECOVERY PROGRAM

In the early 1980's, the Commissioner of the Alaska Department of Fish and Game (ADF&G) directed staff of the Commercial Fisheries Division to plan and implement a comprehensive and coordinated recovery program for the commercial fisheries of Southeast Alaska. He similarly directed staff of the Fisheries Rehabilitation, Enhancement, and Development Division to provide a centralized decoding laboratory facility, such that recovery information could be made readily available to those entities that were tagging fish which were recovered in commercial fisheries of Southeast Alaska. Commercial sampling was comprehensive for Chinook and coho salmon in major commercial fisheries of Southeast Alaska from 1982 forward.

Somewhat disjointed and incomplete recovery of coded wire tags from Chinook and coho salmon harvested in the Southeast Alaska sport fishery also took place in the late 1970's. By the early to mid-1980's, a fairly complete creel census of the sport fishery for Chinook and coho salmon in Southeast Alaska was implemented and through that effort, a coordinated and comprehensive sport fishery recovery program for coded wire tags was put in place. From a planning perspective, over the past two decades, overall intent of the ADF&G recovery efforts was to individually examine a minimum of 20% of the harvest of Chinook and coho salmon harvested in commercial and sport fisheries in Southeast Alaska. These sampling efforts have continued on an annual basis.

These coded wire tag recovery sampling efforts rely upon visual examination of harvested Chinook and coho salmon for the presence of a missing adipose fin. Electronic detection systems have not been used except at a few escapement sampling locations where samplers check adipose clipped fish to ensure they have a tag. Once fish with missing adipose fins are identified, heads are removed from these fish, the heads are strap-tagged for later reference to the specific fishery

sample collection, and the heads are sent to the ADF&G Tag Laboratory in Juneau for eventual coded wire tag decoding.

A current issue with the program in place in Southeast Alaska is the increased number of fish sampled with missing adipose fins, but no coded wire tag (“no-tags”). The proportion of “no-tags” has risen substantially over the past few years as agencies south of Alaska have implemented mass marking programs for hatchery origin Chinook and coho salmon. A plot of the proportion of “no-tags” for Chinook salmon sampled from the troll fishery in Southeast Alaska from January 2001 to February 2004 shows how these rates have climbed; from a base level of about 7% at the start of the series, to as high as 60% of the troll caught Chinook salmon sampled in the ADF&G recovery program during some recent temporal strata (Figure 1). This increasing rate of “no-tags” has decreased the effectiveness of the current program, added costs without gaining information, increased the numbers of fish that samplers handle and mutilate causing displeasure to the owners of these fish (the processors), and decreased the value that the processors eventually obtain as they sell these fish to retailers. Costs to agencies and industry as a result of this increasing trend of “no-tags” in Southeast Alaska have not been quantified. Capital and operational costs to implement electronic sampling as an alternative to the current visual program in place as a means to address this concern have also not been completely quantified nor has ADF&G determined where logistically and as a result what portion of the Southeast Alaska harvests could potentially be sampled electronically.

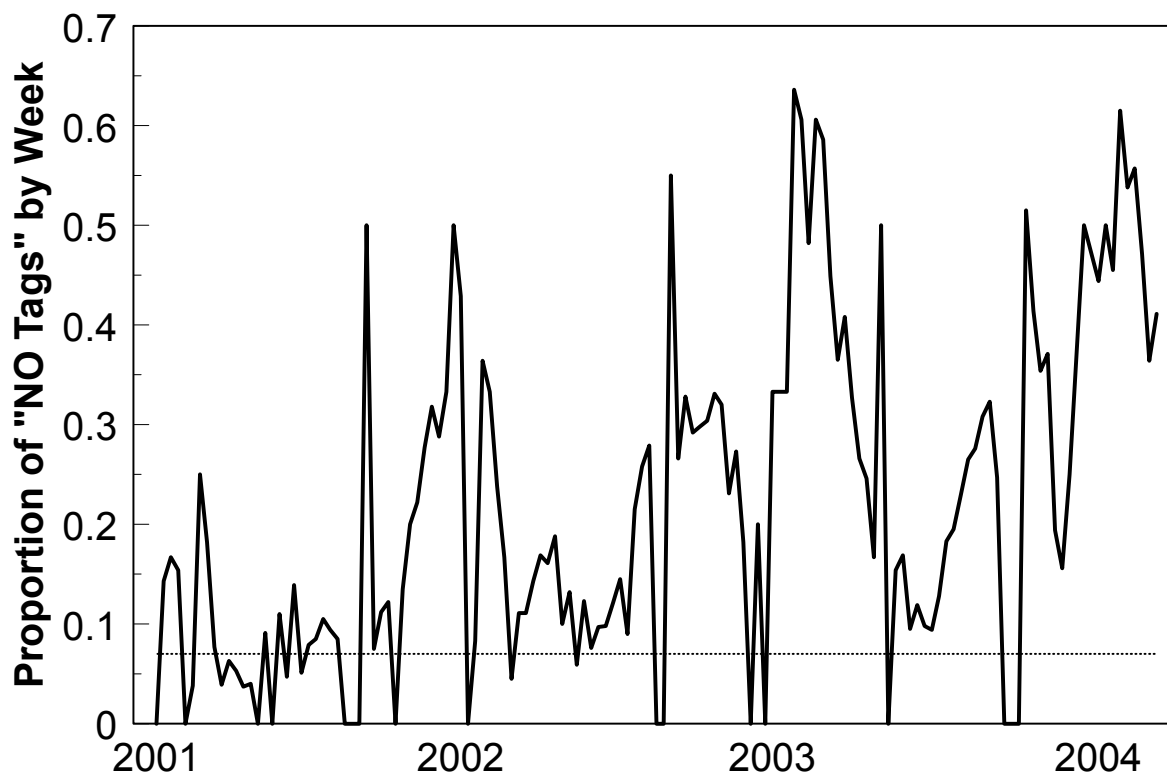


Figure 1.—The percent of troll caught Chinook salmon that were sampled in the Southeast Alaska coded wire tag recovery program that were found to be “no-tags” after delivery to the ADF&G Tag Laboratory from January 2001 through February 2004.

CODED WIRE TAGGING PROGRAM

As the Southeast Alaska coded wire tag recovery program was developed, various hatcheries located in Southeast Alaska coded-wire-tagged a portion of the fish released. The numbers of Chinook and coho salmon released with coded wire tags in Southeast Alaska greatly increased once the fishery recovery program was put in place. Virtually all of the releases of Chinook and coho salmon from hatcheries located in Southeast Alaska are directly represented by a portion of that release that is coded-wire-tagged. Such is not necessarily the case for Chinook and coho salmon released from hatcheries located in British Columbia, Canada nor for hatcheries located in the Pacific Northwest of the United States.

The capture and coded wire tagging of selected wild stocks of Chinook and coho salmon juveniles in Southeast Alaska began in the mid-1970s. These programs are intended to gain better information for stock assessment and fishery management and have been conducted by ADF&G, and at times, other organizations. These wild stock coded wire tag assessment efforts have greatly increased since the early 1990s. This activity also represents a substantial difference from activities south of Alaska where the vast majority of the efforts related to coded wire tagging involve hatchery origin fish as surrogates for wild stocks. For instance, in Southeast Alaska, eleven wild stocks of Chinook salmon are annually monitored for escapement trends for use in Pacific Salmon Commission (PSC) analyses; of those, coded wire tag programs are in place for five stocks (Taku, Stikine, Chilkat, Unuk, and Chickamin) or 45% of the stocks annually monitored for escapement trend information. Additionally, two other of these eleven stocks have historically been coded-wire-tagged (Situk and Alsek). Few such wild stock coded wire tag programs are in place elsewhere.

COSTS

The organizing committee responsible for the June 7–10 workshop concerning the “*Future of the CWT Program: Challenges and Options*” felt that summarizing costs of the existing Southeast Alaska coded wire tag program for Chinook and coho salmon would be helpful to the workshop participants. In this document, recent numbers of Chinook and coho salmon that have been coded-wire-tagged and released is summarized, both for hatchery origin fish and for wild origin fish. Additionally, numbers of Chinook and coho sampled in both commercial and sport fisheries for the presence of coded wire tags is summarized. Approximate costs associated with these activities as well as costs associated with the ADF&G Tag Laboratory is summarized.

Cautionary Note: It should be noted that the costs included in this report are approximations and are likely biased low because: funding identified in this report, for the most part, do not include ancillary costs including (1) all of the monies likely used for permanent hatchery staff that partake in tagging and rack recovery, (2) most monies used for ADF&G permanent staff that supervise field work involved with wild tagging efforts and with recovery programs, and (3) most monies used for ADF&G biometric support for analysis of data, development of operational plans or reporting of results. Costs of training may be borne by funding sources not included in this report. Further, for the most part, the costs reported herein often do not include amortization, depreciation, and replacement allowances for equipment (e.g., tagging machines, boats, and motors) nor costs for facilities (e.g., lease of office space for ADF&G Tag Laboratory). Lastly, costs reported herein do not include agency expenses related to analysis and modeling of the coded wire tag database shared by coast-wide agencies for direct application to fishery management and stock assessments. While these limitations need to be considered, costs

that are relatively easy to identify and that are directly attributable to the Southeast Alaska coded wire tag program are considerable and those costs are reported in this document.

NUMBERS OF CHINOOK AND COHO SALMON RELEASED IN SOUTHEAST ALASKA WITH CODED WIRE TAGS

The numbers of Chinook and coho salmon released in Southeast Alaska with coded wire tags was estimated in an effort to provide the reader with the magnitudes involved. The ADF&G Tag Laboratory provided the information concerning the numbers of fish coded-wire-tagged and released that are summarized in this report. The three most recent years with complete data are 2000–2002; this information was assembled and estimates of the average numbers of fish released in Southeast Alaska were based upon those three years of data (Table 1).

Approximately 900,000 juvenile Chinook salmon and approximately 1,100,000 coho salmon with coded wire tags are released per year in Southeast Alaska (Table 1). These data indicate that approximately 13% of all hatchery releases of Chinook salmon in Southeast Alaska are coded-wire-tagged and that approximately 7% of all hatchery releases of coho salmon in Southeast Alaska are coded-wire-tagged. These data indicate that of the Chinook salmon coded-wire-tagged in Southeast Alaska, on average, about 85% are hatchery origin fish and about 15% are wild origin fish. For coho salmon, the proportions of coded wire tagged fish are about 80% hatchery origin fish and about 20% wild origin fish.

COSTS OF CODED WIRE TAGGING OF HATCHERY RELEASES OF CHINOOK AND COHO SALMON IN SOUTHEAST ALASKA

Several of the hatchery entities in Southeast Alaska were asked to provide information concerning the costs involved with application of coded wire tags. Responses ranged from estimates of \$140 to \$210 per thousand fish tagged (Table 2). These values were used for those entities that provided direct information and the estimated cost of \$200/thousand fish tagged was used for other hatchery releases. Using the average numbers of fish released with coded wire tags in the years 2000–2002 with these cost estimates, it is estimated that current annual costs associated with the application of coded wire tags in the current overall hatchery program in Southeast Alaska totals about \$350,000 (Table 2).

Southern Southeast Regional Aquaculture Association (SSRAA), Northern Southeast Regional Aquaculture Association (NSRAA), and Douglas Island Pink and Chum (DIPAC) provided additional information concerning costs of hatchery rack recovery efforts to sample returning adults at hatchery facilities for estimation of tagged to untagged ratios. SSRAA spends about \$8,000 per year on these activities, while NSRAA and DIPAC spend about \$8,000 and \$2,000, respectively, on these activities. These three private non-profit (PNP) entities together spend about \$18,000 and they account for about 75% of the total PNP heads forwarded to the ADF&G Tag Laboratory, so it may be reasonable to assume that total cost for these activities is about \$24,000. However, these entities have noted that a lot of the rack recoveries are collected by permanent hatchery employees and that those employees also spend time validating coded wire tag release numbers and tag retention by inventorying fish stocks each spring. Considering all of these activities and in an effort to be inclusive, a guess of about \$50,000 to cover these types of coded wire tag related costs with all of the Southeast Alaska hatchery facilities is provided.

Table 1.—Numbers of juvenile Chinook and coho salmon that were coded-wire-tagged in Southeast Alaska from 2000–2002. Also shown are the numbers of total juvenile Chinook and coho salmon released from hatchery facilities and the average percent of released hatchery fish with coded wire tags.

Species	Type	Tagging Agency	Tagged in 2000	Released in 2000	Tagged in 2001	Released in 2001	Tagged in 2001	Released in 2001	2000–2002 Tagged Average	2000–2002 Average Releases	Average % Tagged
Chinook	Hatchery	ADF&G	143,157	1,576,410	0	0	0	0	143,157	1,576,410	9%
Chinook	Hatchery	DIPAC	84,931	523,789	95,924	586,000	84,690	572,447	88,515	560,745	16%
Chinook	Hatchery	KTHC	16,887	90,258	21,589	89,488	20,644	96,026	19,707	91,924	21%
Chinook	Hatchery	MIC	36,160	587,782	43,140	556,937	41,195	840,000	40,165	661,573	6%
Chinook	Hatchery	NMFS	131,459	134,096	105,676	108,826	0	0	118,568	121,461	98%
Chinook	Hatchery	NSRAA	293,179	3,481,444	304,136	3,396,734	250,470	3,099,191	282,595	3,325,790	8%
Chinook	Hatchery	SJ	0	0	5,317	53,170	0	0	5,317	53,170	10%
Chinook	Hatchery	SSRAA	108,387	1,028,448	254,427	2,464,575	226,875	1,965,107	196,563	1,819,377	11%
Chinook	Wild	ADF&G	109,220	-	154,251	-	194,210	-	152,560	-	-
Total		All	923,380	7,422,227	984,460	7,255,730	818,084	6,572,771	1,047,147	8,210,450	13%
Coho	Hatchery	ADF&G	33,763	148,560	0	0	0	0	33,763	148,560	23%
Coho	Hatchery	AKI	50,810	1,358,299	102,071	976,618	93,807	1,468,761	82,229	1,267,893	6%
Coho	Hatchery	BURR	9,854	18,065	0	0	0	0	9,854	18,065	55%
Coho	Hatchery	DIPAC	165,061	896,987	67,008	770,656	172,848	908,958	134,972	858,867	16%
Coho	Hatchery	KAKE	25,664	32,610	0	0	28,567	59,573	27,116	46,092	59%
Coho	Hatchery	KTHC	49,918	156,958	87,508	191,323	54,531	112,369	63,986	153,550	42%
Coho	Hatchery	MIC	41,768	3,403,319	58,510	3,161,810	58,469	2,089,033	52,916	2,884,721	2%
Coho	Hatchery	NMFS	399	399	0	0	0	0	399	399	100%
Coho	Hatchery	NSRAA	117,294	2,216,701	122,576	2,205,154	128,970	3,264,343	122,947	2,562,066	5%
Coho	Hatchery	PWHA	40,748	435,742	101,995	1,596,381	126,367	2,066,162	89,703	1,366,095	7%
Coho	Hatchery	SJ	0	0	13,089	43,514	1,062	1,062	7,076	22,288	32%
Coho	Hatchery	SSRAA	271,443	5,780,852	296,324	5,885,683	257,199	5,164,656	274,989	5,610,397	5%
Coho	Hatchery	USFS	0	0	12,762	18,375	0	0	12,762	18,375	69%
Coho	Wild	ADF&G	259,404	-	258,707	-	202,348	-	240,153	-	-
Coho	Wild	NSRA	-	-	4,616	-	-	-	4,616	-	-
Total		All	1,066,126	14,448,492	1,125,166	14,849,514	1,124,168	15,134,917	1,157,481	14,957,368	7%

Table 2.—Approximate costs associated with the coded wire tagging of juvenile Chinook and coho salmon released from hatcheries in Southeast Alaska.

Species	Agency	Average Number Tagged (2000–2003)	Approximate Cost per 1,000 Juveniles Tagged	Estimated Cost
Chinook	ADF&G	143,157	\$200	\$ 28,631
Chinook	DIPAC	88,515	\$140	\$ 12,392
Chinook	KTHC	19,707	\$200	\$ 3,941
Chinook	MIC	40,165	\$200	\$ 8,033
Chinook	NMFS	118,568	\$180	\$ 21,342
Chinook	NSRAA	282,595	\$210	\$ 59,345
Chinook	SJ	5,317	\$200	\$ 1,063
Chinook	SSRAA	196,563	\$210	\$ 41,278
Chinook	Total	908,641	-	\$ 176,027
Coho	ADF&G	33,763	\$200	\$ 6,753
Coho	AKI	82,229	\$200	\$ 16,446
Coho	BURR	9,854	\$200	\$ 1,971
Coho	DIPAC	134,972	\$140	\$ 18,896
Coho	KAKE	27,116	\$200	\$ 5,423
Coho	KTHC	63,986	\$200	\$ 12,797
Coho	MIC	52,916	\$200	\$ 10,583
Coho	NMFS	399	\$180	\$ 72
Coho	NSRAA	122,947	\$210	\$ 25,819
Coho	PWHA	89,703	\$200	\$ 17,941
Coho	SJ	7,076	\$200	\$ 1,415
Coho	SSRAA	274,989	\$210	\$ 57,748
Coho	USFS	12,762	\$200	\$ 2,552
Coho	Total	1,105,153	-	\$ 178,415
Both	Totals	2,013,795		\$ 354,442

Based upon these data, a reasonable estimate of the total cost of the hatchery program for coded wire tagging in Southeast Alaska is about \$400,000 (\$350,000 for direct tagging and \$50,000 for other related costs) to release about 2,000,000 Chinook and coho salmon per year with coded wire tags. This amounts to a cost per tagged fish of about \$0.20. While these data do not provide exact estimates, they are probably adequate for the purposes intended in this report. The majority of the funding for the coded wire tagging of hatchery Chinook and coho salmon released in Southeast Alaska is private non-profit monies that are derived from the harvest and the sale of a portion of the returning hatchery fish.

WILD ORIGIN CHINOOK AND COHO SALMON CODED WIRE TAG PROGRAM AND COSTS

ADF&G and other agencies have been engaged in the capture and coded wire tagging of wild Chinook and coho salmon in Southeast Alaska for the past three decades. These efforts involve capture in the wild of juveniles, the application of the tags, the sampling of resultant wild escapements for the tagged to untagged ratios by age class and often the estimation of total escapements. A number of these types of projects have been implemented over the past 25 years. Such ADF&G projects with current FY 04 allocations in Southeast Alaska are summarized in Table 3. These data indicate that costs associated with this effort total about \$300,000 for

Chinook salmon in FY 04 and about \$550,000 for coho salmon in FY 04, or a combined cost of about \$850,000. There may be other agencies engaged in such work in Southeast Alaska with current funding allocations, if so the funding involved has not been documented in this report. Table 3 includes funding source; various sources of Federal monies are the primary funding source for these projects with matching monies from the State of Alaska General Fund or the Fish and Game Fund.

Average number of wild Chinook salmon released with coded wire tags from 2000–2002 was about 150,000 fish (Table 1). Cost of the Chinook wild coded wire tag program in FY 04 was about \$300,000 (Table 3). Hence, the approximate cost per coded-wire-tagged Chinook salmon was about \$2.00 per fish. Using the same analytic approach for coho salmon resulted in an approximate current cost estimate of about \$1.70 per wild coho salmon coded-wire-tagged in Southeast Alaska. These cost estimates indicate that the cost involved with wild stock tagging is about 8 to 10 fold the cost involved with tagging of hatchery fish, on a cost per fish basis.

Table 3.—Projects funded in FY 04 wherein the major effort is involved with the coded wire tagging of juvenile Chinook and coho salmon, Southeast Alaska.

Species – CWT Project – Agency	FY04 \$'s	\$ Source
Chinook – Chilkat River – Sport Fish Division	\$60,986	Federal–LOA (PSC)
Chinook – Taku River – Sport Fish Division	\$66,000	Federal Aid–DJ
Chinook – Stikine River – Sport Fish Division	\$61,970	Federal–SSSF
Chinook – Unuk River – Sport Fish Division	\$59,000	Federal Aid – DJ
Chinook – Chickamin River – Sport Fish Division	\$51,000	Federal–SSSF
Chinook Total	\$298,956	Mix
Coho – Chilkat River – Sport Fish Division	\$62,000	Federal–SSSF
Coho – Auke Lake – Sport Fish Division	\$7,000	Federal Aid–DJ
Coho – Taku River – Sport Fish Division	\$66,000	Federal Aid–DJ
Coho – Nakwasina River – Sport Fish Division	\$20,600	Federal Aid–DJ
Coho – Salmon Lake – Sport Fish Division	\$24,000	Federal Subsistence
Coho – Slippery Creek – Sport Fish Division	\$51,000	FederalSSSF
Coho – Warm Chuck – Sport Fish Division	\$65,905	Federal–SSSF
Coho – Unuk River – Sport Fish Division	\$57,000	Federal–DJ & SSSF
Coho – Chickamin River – Sport Fish Division	\$17,000	Federal–SSSF
Coho – Jordan Creek/Duck Creek – Sport Fish Div.	\$30,000	Federal–SSSF
Coho – Berners River – Commercial F. Division	\$34,000	Federal Aid
Coho – Ford Arm Lake – Commercial F. Division	\$45,000	Federal Aid
Coho – Hugh Smith Lake – Commercial F. Division	\$65,000	Federal Aid & PSC
Coho Total	\$544,505	Mix
Total	\$843,461	Mix

Note: The FY 04 allocations listed above, for the most part, do not include ancillary costs including permanent ADF&G staff that supervise the field work, ADF&G biometric support for analysis of data, nor costs associated with operational planning processes or reporting of results. Further, for the most part they do not include capital expenditures made in prior years by ADF&G for the purchase of tagging machines, boats, motors, and other equipment needed in order to implement these field projects.

NUMBERS OF CHINOOK AND COHO SALMON RECOVERED FROM SOUTHEAST ALASKA FISHERIES WITH CODED WIRE TAGS

The numbers of Chinook and coho salmon examined from Southeast Alaska fisheries for the presence of coded wire tags was estimated in an effort to provide the reader with the magnitude involved. The ADF&G Tag Laboratory provided information concerning the numbers of fish sampled from Southeast Alaska fisheries for coded wire tags in the years 1999–2003. These data were used to obtain average estimates of the numbers of Chinook and coho salmon sampled on an annual basis from Southeast Alaska fisheries by gear type. Results indicated that over the five-year period of 1999–2003 in Southeast Alaska, an annual average of almost 100,000 Chinook salmon and over 700,000 coho salmon were sampled for the presence of coded wire tags (Table 4).

This data set was used to estimate the portions of the total harvests that were sampled for the presence of coded wire tags. Average percent of the harvest of Chinook salmon in Southeast Alaska sampled for coded wire tags in the most recent five year period was 27% in the commercial gill net fishery, 10% in the commercial purse seine fishery, 39% in the commercial troll fishery, and 29% in the sport fishery for an overall sampling rate of 36% (Table 4). Similar estimates for coho salmon were: 29% for the commercial gill net fishery, 14% in the commercial purse seine fishery, 34% in the commercial troll fishery, and 32% in the sport fishery for an overall sampling rate of 30% (Table 4).

Table 4.—Numbers of Chinook and coho sampled for the presence of coded wire tags in Southeast Alaska during the period of 1999–2003.

Species	Gear Type	Sum of the Harvest 1999–2003	Sum of the No. of Fish Sampled 1999–2003	Percent Harvest Sampled 1999–2003	Average No. of Fish Sampled per Year 1999–2003
Chinook	Comm. Gillnet	24,065	6,749	27%	1,296
Chinook	Comm. Seine	33,744	3,274	10%	655
Chinook	Comm. Troll	1,085,582	421,848	39%	84,370
Chinook	Sport	208,191	60,738	29%	12,148
Chinook	Total	1,351,582	492,339	36%	98,468
Coho	Comm. Gillnet	1,598,915	464,765	29%	92,953
Coho	Comm. Seine	1,927,513	272,679	14%	54,536
Coho	Comm. Troll	7,751,067	2,614,448	34%	522,890
Coho	Sport	719,020	229,485	32%	45,897
Coho	Total	11,996,515	3,581,377	30%	716,275

COSTS OF THE CODED WIRE TAG RECOVERY PROGRAM IN SOUTHEAST ALASKA

The Commercial Fishery Division of the ADF&G is responsible for the sampling of commercial fisheries in Southeast Alaska for the recovery of coded wire tags from Chinook and coho salmon. The FY 04 allocation for this work totals \$248,000 and funding source is State of Alaska General Funds. The Sport Fish Division of the ADF&G is responsible for the sampling of the sport

fisheries in Southeast Alaska for the recovery of coded wire tags from Chinook and coho salmon. The FY 04 allocation for this work totals \$441,000 and funding source is Federal with matching monies from the State of Alaska Fish and Game Fund. Thus in combination, a total of about \$670,000 is currently used to support activities related to the sampling of Southeast Alaska fisheries and the recovery of coded wire tags from Chinook and coho salmon. Over the last few years, an average of about 35,000 heads with coded wire tags have been obtained through this sampling program and have been subsequently provided to the ADF&G Tag Laboratory for decoding. Thus the current cost per recovered coded wire tag is estimated as approximately \$20 per tag.

COSTS OF THE ADF&G TAG LABORATORY IN JUNEAU ALASKA

The Commercial Fishery Division of the ADF&G supports a laboratory facility located in Juneau, Alaska that has, as its central mission, the physical extraction of coded wire tags from heads of salmon, the decoding of these tags, and the various steps involved in making these results fully available to other agencies and individuals requiring the results of these activities. The FY 04 budget allocation for this program was \$651,000 and funding to support this program comes from a mix of both State of Alaska General Funds and Federal contract monies. Given that the recent average annual number of about 35,000 heads with coded wire tags have been obtained through the sampling program and have been subsequently decoded by employees at this laboratory facility, the decoding costs and the related costs of making these data fully available are currently estimated to average about \$18 per tag.

HATCHERY ORIGIN VERSUS WILD STOCK COSTS AND CHINOOK VERSUS COHO COSTS

Earlier in this document, the approximate costs of the coded wire tagging of hatchery origin Chinook and coho salmon in Southeast Alaska was estimated at about \$0.20 per fish tagged. Costs per fish for the wild stock coded wire tagging of Chinook was estimated at about \$2.00 per fish and the cost for the tagging of coho was estimated at about \$1.70 per fish.

A question that might arise is what is the approximate average cost for one, single, coded-wire-tagged, fish that was tagged and released in Southeast Alaska and that was subsequently recovered in a fishery in Southeast Alaska? Using average recent year data, the ADF&G Tag Laboratory reported that the coded wire tag recovery rates were:

- (1) 0.5% for Southeast Alaska hatchery origin Chinook salmon,
- (2) 1.5% for Southeast Alaska hatchery origin coho salmon,
- (3) 0.3% for Southeast Alaska wild origin Chinook salmon, and
- (4) 1.7% Southeast Alaska wild origin coho salmon.

For Southeast Alaska Chinook of hatchery origin, the recent average recovery rate as listed above was 0.5% or in other words, only about 1 of 200 of the fish that were coded-wire-tagged were eventually recovered. Thus, on average, the tagging cost per recovered fish was $\$0.20 \times 200$, or \$40. Thus, dividing the recent tagging costs by the recent recovery rates is one way of estimating the average cost of each single “piece” of data. The various analyses of fishery and coded wire tag data, of course, require several “pieces” of data or recoveries, and often the need or desire is for more “pieces” of such data. Using this approach, the recent cost per recovered coded-wire-tagged fish in Southeast Alaska or the cost of each “piece” of data was as follows:

- (1) about \$40 for each Southeast Alaska hatchery origin Chinook salmon,
- (2) about \$13 for each Southeast Alaska hatchery origin coho salmon,
- (3) about \$700 for each Southeast Alaska wild origin Chinook salmon, and
- (4) about \$100 for each Southeast Alaska wild origin coho salmon.

These estimated costs per fish relate very much to the recent recovery sampling levels and the recent fishery harvest rates. Hence, these cost estimates are the direct result of specifics associated with the recent trends in the Southeast Alaska sampling program and with the Southeast Alaska fishery management regime. For instance, if the recent harvest rates in the Southeast Alaska fisheries would have been double what they actually were, the cost estimates per fish above would have been about half the levels suggested.

However, these data still provide some general insight. Costs of a coded wire tag program are much less for hatchery origin fish than for wild origin fish and costs for such a program for Chinook are more than is the case for coho. Or said another way, full utilization of the use of coded wire tag methodology for either Chinook or coho would be very expensive if the hatchery fish were not used as surrogates for wild fish. And, the approach is probably more cost effective for coho salmon than for Chinook salmon.

An alternate approach to evaluating the costs of hatchery origin versus wild origin Chinook and coho is to simply add the average tagging costs per fish to the average recovery and decoding costs per fish as identified earlier in this report. For hatchery origin Chinook and coho salmon in Southeast Alaska, costs could be summarized as:

- (1) Tagging cost per fish: \$0.20,
- (2) Recovery cost per fish: \$20.00,
- (3) Decoding related costs: \$18.00, and
- (4) Total costs: about \$38.00.

For wild stock origin Chinook and coho salmon in Southeast Alaska, costs could be summarized as:

- (1) Tagging cost per fish: \$2.00 for Chinook salmon and \$1.70 for coho salmon,
- (2) Recovery cost per fish: \$20.00,
- (3) Decoding related costs: \$18.00, and
- (4) Total costs: about \$40.00.

While this may seem to indicate that the wild origin costs are not much more than the hatchery origin costs, this is simply because the wild origin program was built atop a coded wire tag recovery and decoding program that was put in place due to an extensive hatchery coded wire tag program. And the only difference between the two cost estimates is the approximate 10-fold difference in initial tagging cost. This approach masks the cost differences between Chinook and coho salmon. Further, this approach is a bit misleading. Fish sampled from Southeast Alaska fisheries that were originally tagged other than in Alaska have recently averaged about 68% for Chinook and about 5% for coho salmon. In the earlier cost per fish analysis, the actual associated costs are more complete simply because only a few Chinook and coho that are coded-wire-tagged and released in Southeast Alaska are harvested elsewhere. In these estimates of about \$40

per fish, the costs of initial tagging outside of Alaska and the recovery of these tagged fish in locations outside of Alaska for the non-Alaskan tagged groups of fish are ignored.

In the end, as author of this report, I am unsure how best to calculate the costs of the coded wire tag program on a per fish basis to examine the differences between hatchery origin and wild origin fish or between Chinook and coho. However, I am very confident that cost for the hatchery fish tagging program is substantially less than is the case for the wild stock origin tagging program on a per fish basis and I am reasonably confident that the cost for the coho program is less than is the cost of the Chinook program on a per fish basis.

TOTAL COSTS INVOLVED WITH THE CODED WIRE TAG PROGRAM IN SOUTHEAST ALASKA

Total costs at the current time in Southeast Alaska associated with the coded wire tag program for Chinook and coho salmon are approximated as follows:

- (1) Hatchery tagging costs: about \$400,000,
- (2) Wild stock tagging costs: about \$850,000,
- (3) Fishery sampling costs: about \$670,000,
- (4) ADF&G Tag Laboratory costs: about \$650,000, and
- (5) **Total costs: about \$2.6 million.**

Again, it needs to be pointed out that this total cost estimate is approximate and is based upon information available to the author of this report. These cost estimates are probably not complete and as a result are biased low to some unknown extent. Thus these listed cost estimates should be considered as a minimum estimate of the total costs. However, for the purpose of providing information to the upcoming workshop, these approximations are likely adequate to demonstrate to workshop participants the level of funding imbedded in the coded wire tag program currently in place and used in Southeast Alaska. This level of funding ably demonstrates Alaska's continued fiscal commitment to the coordinated coast-wide coded wire tag program used at the current time to support the existing fishery management program in place for Chinook and coho salmon.

There is a question that could be asked and at least partially answered with information included in this report. If in order to improve management, would it be more cost effective to tag more fish or to sample more fish? In Southeast Alaska, the existing recovery sampling program currently samples about one-third of all Chinook harvested and about 30% of all coho salmon harvested at a cost of about \$670,000. While this sampling could be expanded to some extent, it probably could not be doubled. And if it was doubled, the costs would increase significantly beyond the two-fold level due to logistics of sampling in remote portions of Alaska and due to other factors.

If additional information or more precise information concerning hatchery fish was desired, the doubling of the numbers of hatchery fish released with coded wire tags could be accomplished and the current approximate cost of about \$400,000 might be less than double if the numbers of tagged hatchery fish were doubled. For wild origin Chinook and coho, the answer may be different. Wild origin coded wire tag projects are very expensive. Marginal increases in the numbers of recovered wild origin coded-wire-tagged Chinook and coho may be cost effective

through some expansion of the Southeast Alaska recovery program. However, significant increases in the recoveries of wild origin coded-wire-tagged Chinook and coho could only be accomplished at great expense through additional tagging.

Another issue worth discussion is the concept of marginal costs for additional coded wire tag data given that there already is a large fishery sampling and recovery program and coded wire tag decoding program in place in Southeast Alaska. While recent Laboratory costs have averaged about \$18.00 per fish, as reported earlier, increased numbers of heads could be processed by that laboratory for less. Costs would mostly consist of technician time. For instance, when asked the marginal cost associated with an increase in the laboratory's ability to process 10,000 more heads (about a 30% increase), the laboratory's supervisor indicated a cost of about \$70,000 or roughly \$7.00 per fish, substantially below the recent average cost of \$18.00 per fish. Further, the cost breakdown consists of about \$3.00 per head for fish without a coded wire tag. Thus an estimate of the marginal cost incurred for fish that could have been coded-wire-tagged, but were not is about \$4.00 per fish from the standpoint of the ADF&G Tag Laboratory and while from a fishery sampling perspective, it is already being done and paid for.

To take this example a bit further, Figure 1 shows the great influx of "no-tags" that have been present in the Southeast Alaska troll fishery over the past few years due to mass marking programs. The majority of these fish are hatchery origin Chinook salmon that are adipose clipped, but not coded-wire-tagged (the historic "no-tag" rate is only about 7%). As the "no-tag" fish show up in the Southeast Alaska troll fishery, they are visually identified by staff sampling the commercial fishery, heads are taken, strap tags applied, and the heads and data are sent to the ADF&G Tag Laboratory. Once the laboratory technicians ascertain there is not a coded wire tag present, they enter the "no-tag" category in the data base and no particularly useful information is garnered even though significant expenses associated with these fish have already occurred. In the last two years, this category has averaged about 1,800 extra "no-tags" per year. The marginal cost of obtaining useful information from those 1,800 adipose clipped but not coded-wire-tagged Chinook salmon would have been about \$7,200, a very modest cost to the Southeast Alaska program given that 1,800 additional discrete "pieces" of information would have been provided and made available to agencies up and down the coast that use such information for a diverse number of fishery stock assessment and management functions. If that had been done, more precise information for those stocks represented by the "no-tags" that were harvested in the Southeast Alaska fishery could have been provided. While from the perspective of the Southeast Alaska program those costs would have been fairly minor, the costs to the hatchery programs could have been substantial. Costs incurred at the hatcheries that released the "no-tags" would have already included the costs of producing these fish and clipping their adipose fins. While the author of this report is unsure of the marginal cost of additionally coded wire tagging these fish, at least if done, some useful information could have been garnered that was not collected. The point being made here is that in at least in some cases, better and more precise information from the existing coded wire tag program could currently occur and it seems likely that such changes could be implemented in a reasonably cost effective fashion.

So long as fishery management decision makers are confident that hatchery fish do, in fact, act as "good" surrogates for wild origin fish, improved information and more precise estimates can best be achieved through additional coded wire tagging of hatchery fish. On the other hand, if, decision makers are concerned about this assumption, the utilization of wild origin coded wire tag programs is one methodology by which to address the issue, but it is an expensive

proposition. Further, it is unrealistic to think that agencies can implement a broad scale coded wire tag program for wild fish that allows coast wide fishery management agencies to directly address the surrogate issue without a substantial increase in funding. As a result, verification of the “surrogate assumption” can probably be best addressed from a funding perspective through methodology other than coded wire tag methodology. And, in that vein, documentation of the costs as provided in this report likely provide at least a bit of a measure of the economic bar that should be met through alternate approaches to the problem, given that funding limitations are a fact of life for agencies involved in this issue.

ADDENDUM

A brief summary of the genetics based Chinook salmon stock composition program currently in place in Southeast Alaska with associated funding level is provided in Appendix A. Intent of ADF&G is to continue the genetic-based program as complementary information to the coded wire tag based program for Chinook salmon. ADF&G does not conduct a coho salmon genetic program at the current time. While this information was not specifically requested, it was felt that the *Expert Panel* might be interested in both a brief explanation of and the current cost of the Southeast Alaska Chinook salmon genetic program.

ACKNOWLEDGEMENTS

Thanks to Gary Freitag of SSRAA, David Bedford, Harold Geiger, Michael Jaenicke, Ron Josephson, Andrew McGregor, Scott McPherson, Keith A. Pahlke, James E. Seeb Lisa Seeb, and Leon Shaul of ADF&G, and Gary Morishama of the Quinalt Nation for providing information used in this report and/or for providing useful review comments on an early draft of this report. Thanks to Amy Carroll for formatting and final preparation of this report.

APPENDIX A

Appendix A1.—Genetic stock identification of Chinook salmon harvested in Southeast Alaska fisheries.

The ADF&G has been monitoring the stock composition of the Southeast Alaska Chinook salmon fisheries since 1999 using the extensive Pacific Rim allozyme baseline. Estimates have been provided for 28 regional groupings distinguishable through genetic characters. The project originally monitored the summer troll fishery. The scope of the project was expanded since 1999 to include both legal and sublegal components and temporally expanded to include the early and late winter troll fisheries, the spring troll fisheries, the sport fisheries and the gillnet and seine fisheries.

With the advent of DNA-based technologies during the last decade, a large number of additional marker types beyond allozymes are now available to fisheries researchers. The most common type, DNA microsatellite loci, reveal substantial divergence among runs of Chinook salmon. Unlike allozymes, an almost unlimited number of markers are now available, and analysis costs are decreasing due to automation and high-throughput techniques.

The ADF&G is involved in a collaborative effort funded by the PSC to develop a standardized and transferable DNA baseline for Chinook salmon. Funding for a standardized database was awarded to the consortium subsequently named “Genetic Analysis of Pacific Salmonids (GAPS)”: three NOAA Fisheries Laboratories—Northwest Fisheries Science Center, Auke Bay Laboratory, Southwest Fisheries Science Center; Washington Department of Fish and Wildlife; University of Idaho/Columbia River Intertribal Fisheries Commission/Idaho Department of Fish and Game; Oregon State University; Canadian Department of Fisheries and Oceans, and ADF&G with the NOAA Fisheries Northwest Fisheries Science Center. To date, these laboratories have evaluated over 60 microsatellite markers and 10 single nucleotide polymorphism (SNP) markers in Chinook salmon collections taken from throughout the species’ range and have chosen 25 microsatellite markers which are presently under examination in all laboratories. During the spring of 2004, a final subset of loci will be identified. Funds for Year 2, beginning in July 2004, have been awarded to GAPS to screen approximately 15,000 Chinook salmon to form the foundation of a coastwide baseline. The baseline will be: 1) subject to review by scientists from all interested agencies, 2) freely available to all agencies managing or studying Chinook salmon, and 3) covering the range of Chinook salmon at a geographic scale appropriate to the management objectives of the PSC.

ADF&G decided to terminate ongoing analysis using the Pacific Rim allozyme baseline and instead plans to utilize the DNA baseline being developed with funding from the PSC. ADF&G will begin applying the DNA baseline to mixed stock samples of Chinook salmon harvested in the Southeast Alaska fisheries in 2004. Selected sets of samples collected from mixed stock Southeast Alaska fisheries that were earlier analyzed with the allozyme baseline were archived and those samples will be reanalyzed using the DNA baseline for comparative purposes.

In FY 04, ADF&G anticipates collecting and analyzing genetic data from about 8,500 Chinook salmon harvested in mixed stock Southeast Alaska fisheries. Approximately \$220,000 has been budgeted for this work, or approximately \$26 per fish sampled and analyzed. It is anticipated that this work will complement the existing information being collected through the on-going coded wire tag program.