Regional Operational Plan SF.2A.2015.03

Marking of Hatchery Chinook and Coho Salmon Smolt Released into Cook Inlet, Prince William Sound, and Resurrection Bay, 2015–2017

by

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and

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April 2015

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)

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)

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

REGIONAL OPERATIONAL PLAN SF.2A.2015.03

MARKING OF HATCHERY CHINOOK AND COHO SALMON SMOLT RELEASED INTO COOK INLET, PRINCE WILLIAM SOUND, AND RESURRECTION BAY, 2015–2017

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SIGNATURE PAGE

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Field Dates:	September 2014 through June 2017
Plan Type:	Category II

Approval

Title	Name	Signature	Date
Project leader	Diane Loopstra	Diane P. Loopstra	9/25/15
Biometrician	Patricia Hansen	Pat Hansen	10/9/14
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Chinook Salmon Research Initiative Approval

Title	Name	Signature	Date
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Fisheries Scientist	Eric Volk		4/13/2015

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ABSTRACT

Thermal marking, adipose finclips, and coded wire tags will be applied to hatchery-produced Chinook and coho salmon smolt released at Ninilchik River, Deception Creek, and Crooked Creek. This project will be used to support other projects designed to evaluate the contribution of these hatchery-produced fish to recreational fisheries and spawning escapement. Adipose finclips will also aid in the selection of naturally-produced Chinook salmon for broodstock, which will be used to produce progeny for release at Ninilchik River, Deception Creek, and Crooked Creek. Thermal marks may be used to monitor straying at broodstock collection sites.

Key words: adipose finclip, coded wire tag, thermal mark, straying, otolith, Chinook salmon, coho salmon.

PURPOSE

To meet the demand on the sport fishery resources in Southcentral Alaska, Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SF), stocks hatchery-produced Chinook and coho salmon smolt in numerous locations to improve or create terminal sport fisheries. Smolt marking is a critical element for each Chinook and coho salmon smolt stocking project in Cook Inlet, Prince William Sound, and Resurrection Bay because it enables estimation of the numbers of hatchery-produced fish in harvests, escapements, and returns. All (100%) of the Chinook and coho salmon smolt to be stocked in the 2015–2017 seasons will have a thermal mark that identifies the area of release (Cook Inlet, Prince William Sound, or Resurrection Bay). In addition to the thermal mark, approximately 22% of the estimated 2.24 million Chinook salmon to be stocked annually will be marked with an adipose finclip and coded wire tag (CWT).

One goal of this project is to mark every Chinook salmon in the 2015–2017 Ninilchik River, Deception Creek, and Crooked Creek release groups with an adipose finclip and a CWT (Table 1). A second goal is to mark every fish in all of the 2015–2017 release groups with the assigned thermal mark. Thermal marking entails performing a scheduled series of water temperature changes that results in the deposition of dark protein rings in specific patterns on the otoliths. Marking at William Jack Hernandez Sport Fish Hatchery (WJHSFH) will be standardized for each stocking project to ensure that variability associated with marking technology will not negatively impact the evaluation of each individual project.

Table 1.–Estimated numbers of Cook Inlet Chinook salmon hatchery smolt to be marked with adipose finclips and coded wire tags, and released in 2015–2017.

		Projected numbers	
Tag group	Broodstock	Tagged	Released
Ninilchik River	Ninilchik River	150,000	150,000
Deception Creek	Deception Creek	212,000	212,000
Crooked Creek	Crooked Creek	140,500	140,500

OBJECTIVES

The following objectives will be completed annually from 2015 to 2017:

1) Mark, with an adipose finclip and coded wire tag, 100% of the Chinook salmon in the Ninilchik River, Deception Creek, and Crooked Creek release groups.
2) Estimate the short-term (12–24 hour) tag retention rate of each group of fish marked with CWTs such that the estimate is within 5 percentage points of the true value 95% of the time.
3) Apply the appropriate thermal mark to the otoliths of all hatchery-producedChinook and coho salmon.

Long-term tag retention will also be estimated; see Regional Operational Plan entitled "Size estimation and long term coded wire tag retention of hatchery Chinook salmon, 2015–2017 released into Cook Inlet[1]" for details.

Procedures for evaluating spawning escapements as well as broodstock selection and straying are presented in the following Regional Operational Plans:

1) Ninilchik River Chinook salmon stock assessment and supplementation[2]
2) Assessment of the hatchery and wild components of the Willow and Deception Creek Chinook salmon escapement[3]
3) Crooked Creek Chinook salmon enhancement project[4]

METHODS

SMOLT MARKING PROCEDURES

Coded-wire-tagging

Coded-wire-tagging will occur at William Jack Hernandez Sport Fish Hatchery in Chinook salmon smolt from Ninilchik River, Deception Creek, and Crooked Creek broodstocks. Each release group will be marked with one or more tag codes. All Chinook salmon (100%) released in the Ninilchik River, Deception Creek, and Crooked Creek will be marked with an adipose finclip and CWT.

All fish will be graded into size groups for tagging. Based on data collected from coho and Chinook salmon tagging in 1993, 1994, and 1997, the criteria for grading is listed in Table 2 (Starkey et al. 1999).

[1] Loopstra, D.P. and P.A. Hansen. *In prep*. Size estimation and long-term coded wire tag retention of hatchery Chinook salmon released into Cook Inlet, 2015–2017. Alaska Department of Fish and Game, Division of Sport Fish, Regional Operational Plan, Anchorage.

[2] Booz, M.D. and C.M. Kerkvliet. *In prep*. Ninilchik River Chinook salmon stock assessment and supplementation, 2015. Alaska Department of Fish and Game, Regional Operational Plan, Anchorage.

[3] Oslund, S. *In prep.* Assessment of the hatchery and wild components of the Willow and Deception Creek Chinook salmon escapement, 2015–2017. Alaska Department of Fish and Game. Regional Operational Plan, Anchorage.

[4] Cope, J.L. *In prep* Crooked Creek Chinook salmon enhancement project, 2015. Alaska Department of Fish and Game, Regional Operational Plan, Anchorage.

Table 2.–Size criteria for use of head molds.

Fish size	Head mold size
<65 mm	200 +
65 - 71 mm	200
72 - 80 mm	120
81 - 90 mm	90
91 - 105 mm	65
106 - 120 mm	45
> 120 mm	30

To determine the appropriate sizes of head molds to use, the tagging coordinator will measure a random sample of approximately 100 fish against a board marked with ranges of fish snout to fork lengths (FL) that correspond to specific head mold sizes. The 2 or 3 head mold sizes that cumulatively fit at least 80% of the fish length distribution will be selected for use with tagging, and the fish will be graded accordingly. Changes in head mold sizes to accommodate fish growth will be made at the discretion of the tagging coordinator.

Prior to marking, fish will be anesthetized in an MS-222 (tricaine methanesulfonate) bath at an approximate concentration of 100 mg MS-222 per liter H_2O. The adipose fin will be excised at the base of the fin using surgical scissors. Chinook salmon have highly visible adipose fins, and the only reason for poor finclips would be due to carelessness of the technician. Finclips will be examined on fish checked for overnight tag retention. Fish with poor clips will be clipped again, and the tagging supervisor will take appropriate action to minimize poor finclips.

All fish will be tagged with a standard length coded wire tag (1.1 mm) using a Northwest Marine Technology[5] Mark IV tagging unit fitted with the appropriate head mold size. All injected fish will then be sent through a Quality Control Device (QCD). The QCD detects the magnetized tag and separates the fish with tags from those without tags. All fish without tags will be tagged again. Quality control checks for tag placement will be conducted following initial daily start up, a change in head mold size, or a change in tagging personnel. Additional quality control checks will be performed any time there is reason to believe tag placement needs adjusting. Fish will be dissected to determine tag placement during any tag placement check (Moberly et al. 1977). If the tag is determined to be outside the preferred area of placement (Figure 1), the head mold or needle will be adjusted accordingly. All fish killed to determine tag placement will be subtracted from the daily number tagged. Tagging personnel or the tagging coordinator will also monitor tag placement throughout the tagging shift by examining fish at random for the location of the coded wire tag injection site on the external surface of the fish. If the injection site is determined to be off center, too high, or too low on the head (Figure 1), adjustments will be made to the head mold, needle, or in the positioning of the fish in the head mold.

[5] Product names used in this publication are included for completeness but do not constitute product endorsement.

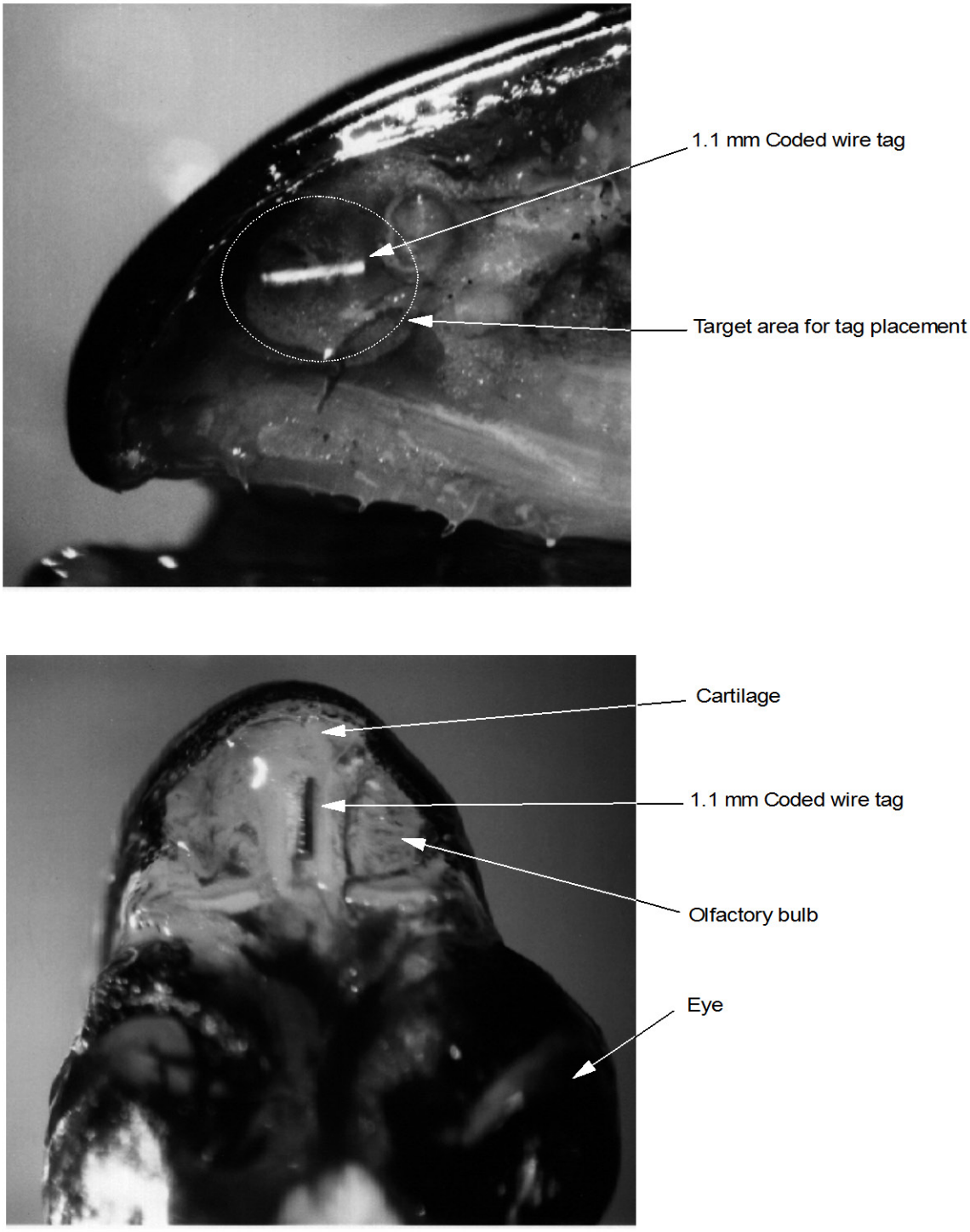

Figure 1.–Proper placement of a coded wire tag implanted in a small fish.

Samples of approximately 100 fish will be collected hourly throughout the day and held in a net pen. At the end of the day, the fish in the net pen will be crowded together and a sample of at least 200 fish will be moved to a second net pen and held overnight to estimate short-term tag retention and finclip rates. All remaining fish from the first net pen will be released into the tagged population for that release group. All overnight mortalities will be counted and recorded. The fish held overnight in the net pen will be passed through the QCD to estimate short-term tag retention. If the actual retention rate is at least 90%, this level of sampling provides an estimate that will be within 5 percentage points of the true retention rate 97.5% of the time (Cochran 1977; Table 3).

Table 3.–Number of coded-wire-tagged fish that need to be sampled to estimate tag retention rates at various precision levels.

Alpha	Retention rate [a]	Precision			
		0.01	0.025	0.05	0.10
0.025	0.70	8,340	1,686	421	105
	0.75	7,617	1,505	376	94
	0.80	6,686	1,285	321	80
	0.85	5,515	1,024	256	64
	0.90	4,058	723	181 [b]	45
0.050	0.70	6,714	1,291	323	81
	0.75	6,104	1,152	288	72
	0.80	5,328	983	246	61
	0.85	4,364	784	196	49
	0.90	3,457	553	138	35

[a] Unknown "true" tag retention rate.

[b] Sample number needed if actual retention rate is at least 90% and estimated rate is within 5 percentage points of the true value 97.5% of the time.

The following information will be recorded daily and given to the marking coordinator:

1) number of fish tagged each day with each head mold
2) number of fish killed while checking tag placement
3) overnight mortality
4) overnight tag retention sample size
5) number of live fish in tag retention sample with valid tags
6) number of fish with acceptable finclips in the overnight retention sample

Hatchery personnel will record the number of mortalities of adipose finclipped fish in each circular tank on the rearing sheet for that tank until the day of release.

Thermal Marking

Thermal marks for release groups of coho and Chinook salmon were assigned by the Mark, Tag, and Age Laboratory operated by ADF&G Division of Commercial Fisheries (CF). The release groups assigned to each thermal mark code are presented in Table 4. All thermal marking will occur at WJHSFH.

Otoliths are developed enough to accept a mark when Chinook salmon have achieved 360 temperature units (TUs), and coho salmon have achieved 310 TUs (Loopstra and Hansen 2005).

At that time, embryos will be exposed to a scheduled series of 4–5°C water temperature changes, with each temperature decrease resulting in the deposit of a dark ring of protein on the developing otolith (Figure 2) (Monk *Unpublished*). Specific patterns of dark protein rings on the otolith will be used to identify area of release (Cook Inlet, Prince William Sound, or Resurrection Bay). Fish culturists will change the incubation water temperature by adjusting the hot and cold water valves that regulate the water flow into the incubator's head box (water supply). Head box water temperature will be monitored using a calibrated digital thermometer during the valve adjustment periods. Water temperature changes in a head box affect 100% of the eggs that receive water from that head box. Temperature changes will occur every 24 hours within a single band of rings. A 72-hour warm water period between bands of rings allows for a distinct separation of the bands.

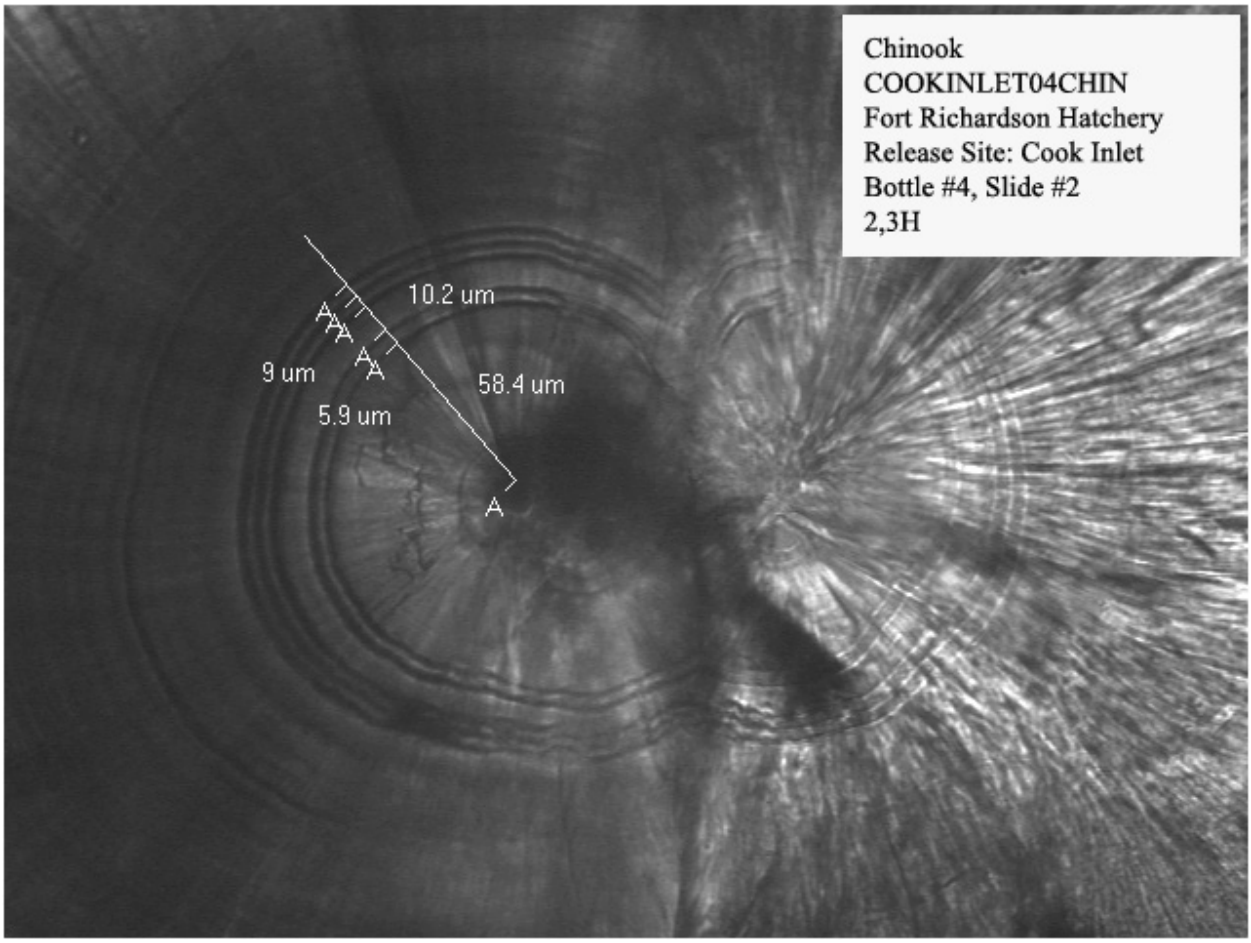

Figure 2.–Image of a thermal mark.

Table 4.–Prehatch graphic, hatch code, and mark schedule for Chinook and coho salmon that will be thermally marked at William Jack Hernandez Sport Fish Hatchery.

Salmon species	Mark group	Release group	Prehatch graphic	Hatch code	Mark schedule
Chinook					
	Cook Inlet		II III	2,3H	2(24H:24C),72H:24C, 2(24H:24C)
		Crooked Creek			
		Deception Creek			
		Eklutna Tailrace			
		Halibut Cove			
		Homer Spit			
		Ninilchik River			
		Seldovia			
		Ship Creek[a]			
	Prince William Sound		II IIII	2,4H	2(24H:24C), 72H:24C, 3(24H:24C)
		Fleming Spit			
		Whittier			
	Resurrection Bay		II IIIII	2,5H	2(24H:24C), 72H:24C, 4(24H:24C)
		Seward Lagoon			
Coho					
	Cook Inlet		I IIIII	1,5H	1(24H:24C), 72H:24C, 4(24H:24C)
		Bird Creek			
		Campbell Creek			
		Eklutna Tailrace			
		Homer Spit			
		Ship Creek			
	Resurrection Bay		II IIII	2,4H	2(24H:24C), 72H:24C, 3(24H:24C)
		Seward Lagoon			

[a] Smolt in the Ship Creek release will also have a posthatch thermal mark that may be used in a smolt size at release study. The 2 posthatch marks applied will vary from year to year in order to identify year classes and smolt size at release.

Samples consisting of approximately 10 eggs will be collected from each egg lot (eggs from individual egg-take events) for each release group the day marking begins. These samples can be used to determine otolith development at the start of marking if there is a problem locating the mark in the voucher samples.

Voucher samples containing approximately 50 fish from each egg lot for each release group will be collected before ponding and submitted to the Mark, Tag, and Age Laboratory for mark verification.

Samples will be preserved in 90% ethyl alcohol and stored in bottles provided by the Mark, Tag, and Age Lab. Labels with the following information will be placed both inside and outside each bottle:

1) sample date
2) species
3) intended thermal mark
4) lot
5) brood year
6) release site(s)
7) beginning CTU (cumulative thermal units)
8) ending CTU

9) ambient temperature
10) heated temperature
11) marking duration (per heating cycle)
12) information regarding transport of fish after marking

During thermal marking, Onset Hobo data loggers will record incubation water temperature every 15 minutes throughout the marking period to generate thermal profiles for each release group (Figure 3). Incubation record sheets will be used to record temperature changes during the thermal marking process.

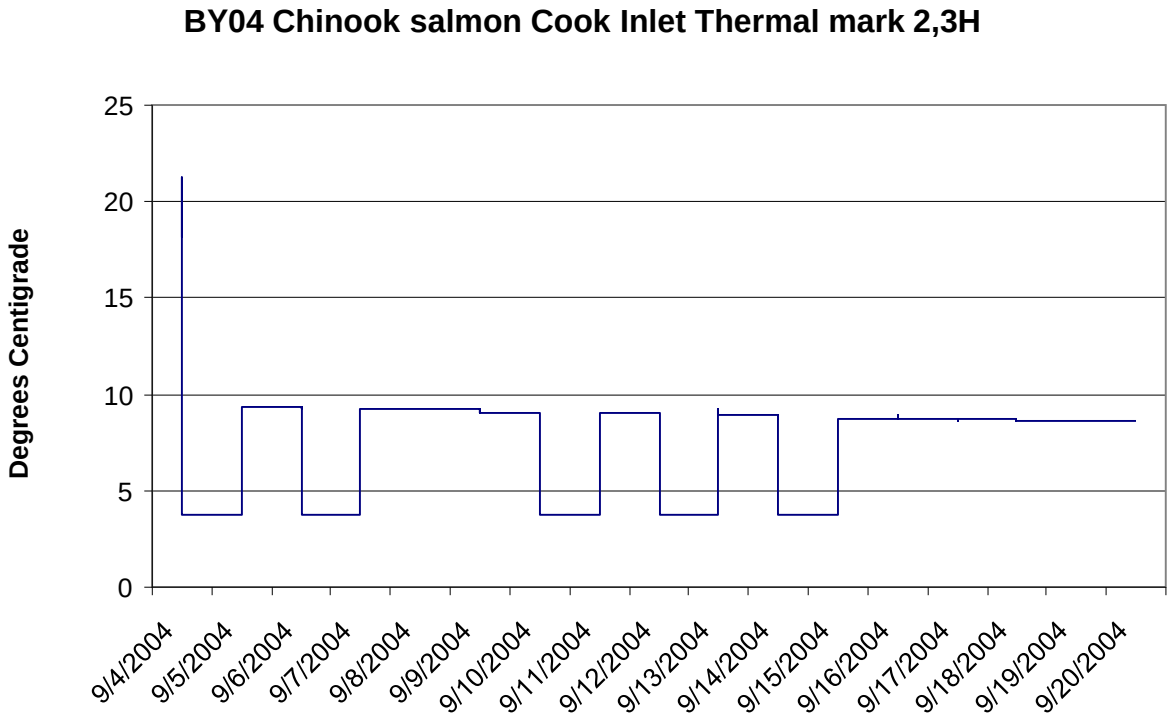

Figure 3.–Thermal marking temperature profile.

DATA REDUCTION

Coded-wire-tagging

Daily tagging data will be transferred from the handwritten data sheet to an Excel workbook. Data for each release group will be recorded on a separate worksheet and stored on the network server. The daily tagging data will also be entered into a CWT Online Release Entry (ORE) form accessed from the ADF&G Division of Commercial Fisheries website (http://tagotoweb.adfg.state.ak.us/CWT/reports/user_login.asp). The ADF&G Mark, Tag, and Age Lab built and maintains the ORE system.

Thermal Marking

When thermal marking is completed, thermal profiles will be downloaded from the Onset Hobo data loggers into an Excel workbook using Onset Hobo software. An Excel file containing the thermal profiles and the Thermal Mark Report Form (provided by the Mark, Tag, and Age Lab)

(Appendix A1) will be submitted to the Mark, Tag, and Age Laboratory along with the voucher samples. Thermally marked releases are also noted on CWT ORE and Non-CWT ORE forms that are submitted to the Mark, Tag, and Age Laboratory.

The raw data will be exported to ASCII files then sent to RTS for archiving on the Division of Sport Fish intranet site ("Docushare") at http:docushare.sf.adfg.state.ak.us/.

DATA ANALYSIS

The CWT retention rate will be estimated daily from a sample of tagged smolt placed in a holding net pen overnight. Daily tag retention rate (D_i) of smolt that were finclipped, tagged, survived, and retained the tag will be estimated as a binomial proportion as follows:

$$\hat{D}_i = \frac{n_i}{n_{ti}} \tag{1}$$

where

n_i = number of live smolt in the sample tagged on day i that retained the tag, and

n_{ti} = total number of live smolt in the sample tagged on day i.

The variance of daily tag retention will be estimated as follows:

$$var\left(\hat{D}_i\right) = \frac{\hat{D}_i\left(1-\hat{D}_i\right)}{n_{ti}-1} \tag{2}$$

SCHEDULE AND DELIVERABLES

Activity	Annual time frame
Thermal marking	
Chinook salmon	September
coho salmon	November
Tagging and adipose finclipping	January–February
Submit voucher samples to Mark, Tag, and Age Lab	Spring
Finalized release data sent to Mark, Tag, and Age Lab	1 August
All data analysis completed	1 September
First draft of report submitted	15 October
First draft of operational plan	1 July

The results of smolt marking, release, and production project components will be combined in an Alaska Department of Fish and Game, Sport Fish Division, Fishery Data Series report. A final edited copy of the data along with a data map will be archived on the Sport Fish network General Docushare (http://docushare.sf.adfg.state.ak.us/dsweb/View/Collection-7445).

RESPONSIBILITIES

Fishery Biologist II (Diane Loopstra)	Project Leader: Coordinates marking activities and insures that the marking plan described in the operational plan is followed. Assimilates all marking and release data. Enters all marking and release data into the Online Release Entry form and submits the final data to the ADF&G Tag Lab. Primary author of annual report and operational plans. Coordinates writing of operational plan with the Project Biometrician.
Biometrician III (Pat Hansen)	Project Biometrician: Provides statistical supervision and shares design and writing of the operational plan with the Project Leader. Assists with data analysis and reviews the annual report.
Fish Culturist III (Andrea Tesch)	Hatchery Manager–WJHSFH: Directs supervision of coho and Chinook salmon smolt production at WJHSFH.
Fish Culturists	Performs or supervises incubation water adjustments for thermal marking coho and Chinook salmon embryos. Monitors and records postclipping mortality.
Fish and Wildlife Technicians	Tag and finclip fingerling at WJHSFH. Monitor and record posttagging mortality.

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Moberly, S.A., R. Miller, K. Crandall, and S. Bates. 1977 Marking tag manual for salmon. Alaska Department of Fish and Game, Division of Fisheries Rehabilitation, Enhancement and Development, Juneau.

Starkey, D., C. Olito, and P. Hansen. 1999. Marking, enumeration, and size estimation for coho and Chinook salmon smolt releases into upper Cook Inlet and Resurrection Bay, Alaska in 1997. Alaska Department of Fish and Game, Fishery Data Series No. 99-1, Anchorage. http://www.adfg.alaska.gov/FedAidPDFs/fds99-01.pdf

Monk, K.M. *Unpublished.* Thermal marking manual: a guideline to the induction of thermal marks in otoliths for the purpose of mass-marketing hatchery stocks. Located at Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Mark, Tag, and Age Laboratory, 10107 Bentwood Place, Juneau, Alaska, 99802-5526.

APPENDIX A: THERMAL MARK REPORT FORM

Appendix A1.–Sample Thermal Mark Report Form.

A.D.F.&G. Thermal Mark Report

FACILITY :	RELEASE SITE :
AGENCY :	STOCK I.D. :
SPECIES :	RBr CODE :
BROOD YEAR :	PROPOSED HATCH CODE :
# MARKED :	APPLIED HATCH CODE :

TEMPERATURE CHANGE °C :	
BEGINNING CTU :	MARKING DURATION :
ENDING CTU:	HEATED TEMPERATURE :
HEAT SOURCE:	CHILLED TEMPERATURE :
COOLING SOURCE:	AMBIENT TEMPERATURE :

Pre Ambient Temp	Pre Change Temp	Pre Total CTU	Post Ambient Temp	Post Change Temp	Post Total CTU

MARK, OR LOT COMMENTS (include explanation for any difference between proposed and applied hatch codes):

_____

_____

_____

Were these fish transported for release? _____

If so, how? _____

Please include this form with your voucher shipment, as well as a temperature profile, if possible.
These can be very helpful to us when trying to identify marks upon return.

Questions?: Please contact Bev Agler at the ADF&G Thermal Mark Lab in Juneau at (907)465-3498 or e-mail bev.agler@alaska.gov.